

# **Application of Modified Data Envelopment Analysis in Evaluating Operational Efficiency and Environmental Impacts**

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## ABSTRACT

Life Cycle Assessment (LCA) is a technique used in evaluation or assessing the environmental impact of a production processes from the extraction of raw material from earth, to production, development, and processing, manufacturing and final disposal. In this study, an integration of the (LCA) and Data Envelopment Analysis (DEA) is used for efficiency evaluation of mussel cultivation rafts operation. The inputs and outputs used for the efficiency evaluation is obtained using the LCA method, and the efficiency is evaluation is performed using the DEA technique. The sites are considered as a Decision-Making Units (DMU).

Standard and modified models are utilized in the efficiency evaluation to give a better analysis of the rafts under evaluation. The modified models identify the weak efficient and highly inefficient rafts. Further analysis of the efficiency results presents interesting findings as to the factors important for the improvement of the mussel rafts operation.

**Keywords:** Life Cycle Assessment; Data Envelopment Analysis; modified models

## ÖZ

Yaşam döngüsü değerlendirmesi yeryüzünden hammaddelerin özütlenmesinden başlayarak üretim, gelişim, işleme, imalat ve nihai tasfiye dahil üretim sürecine tesir eden çevresel etkilerin değerlendirilmesi amacı ile kullanılan bir tekniktir. Bu çalışmada yaşam döngüsü değerlendirilmesi (YDD) ve Veri Geliştirme Analizi (VGA) birleştirilerek yüzer su taşıtlarından biri olan salların yapımında midye yetiştiriciliği işleminin yeterliliğinin değerlendirilmesi için kullanılmıştır. İşlemlerin giriş ve çıkışlarının elde edilmesi ve yeterlilik oranının değerlendirilmesi adına yaşam döngüsü değerlendirme metodu kullanılmıştır. Bu sürecin verimliliği değerlendirmelerin veri geliştirme analizlerinin tekniklerine dayalı olmasıdır. İşlemlerin yapıldığı alanlar karar kabul eden birimler olarak nitelendirilir.

Standart ve değiştirilmiş modeller yeterlilik değerlendirilmesinde değerlendirme aşamasında olan salların yapım işlemlerine kritik çözümlemeler vermek için kullanılmıştır. Değiştirilmiş modeller düşük ve yüksek verimli salları tanımlamaktadır. Verimlilik sonuçlarının geleceğe yönelik analizleri sal yapım sürecinin geliştirilmesinde önemli ve ilginç faktörlerin ortaya çıkmasına neden olmuştur.

**Anahtar kelimeler:** Yaşam Döngüsü değerlendirilmesi, Veri Geliştirme Analizi, değiştirilmiş modeller

To my Parents

Mr & Mrs Patrick Onyechukwu Uzor

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## **LIST OF ABBREVIATIONS**

|     |                            |
|-----|----------------------------|
| DEA | Data Envelopment Analysis  |
| DMU | Decision Making Unit       |
| LCA | Life Cycle Assessment      |
| PPS | Production possibility Set |
| VRS | Variable Return Scale      |

# **Chapter 1**

## **INTRODUCTION**

### **1.1 Preamble**

The concepts of performance evaluation have been gaining a continuous and increasing attention in different organization sector. The idea has been to determine the performance measurement of business firms. In recent years, operational efficiency has gained popularity in terms of the growing competitive nature of the global market. Numerous firms have witnessed a large amount of new product introductions and services that is motivated by increasing consumer taste. Therefore, all business organizations require constant evaluation of processes and operations that has to do with products, marketing, services, etc. to improve on their performance. Performance evaluation is a well-known method that provides best practices needed to improve efficiency and improve productivity, with respect to the use of available resources like machines, energy, materials, labor etc.

As the industrial environment is facing global competition on daily bases every business organization that wants to survive and meet up with standard of product quality, market quality and cost, must continuously evaluate its operation performances in order to identify the strengths and weaknesses of operations and processes or activities, satisfy its customers' requirements, and find innovative ways to improve current operation and processes for better products and services. However, every production process and product produced, transported, used and disposed has a

certain contributions or negative effects on the corresponding environment. Not only must performance evaluation seek to improve the quality of product, market quality and cost to remain competitive in the global market, but must also address the environmental impacts associated with this improvement which may constitute a health hazards to the corresponding environment. This contribution or impact is characterized by the product design and process technology, material, energy utilized or consumed which are the major key determinants of the type of pollutants emitted, solid and hazardous waste generated within the product complete life cycle (Tsoulfas, G. T., & Pappis, C. P. 2006).

Although operational efficiency and environmental impact still remains a debatable issue in numerous studies as regards to the hazardous emissions into the environment, at the of course of producing or offering a high degree of product variety. However, an efficient operation is considered when business firms make the best possible use of inputs or available resources to improve their output without compromising the natural state of surrounding environmental.

Performance evaluation and benchmarking has been in existence for a long time and is recognized and accepted but to an extent limited, as it can only work with a single measurement at a time. This makes it difficult to evaluate the performance of a business organization with multiple sets of data related to operations and environmental impacts especially when the connections among the data sets are complex and increased numbers of entities are needed. Hence the use of Data Envelopment Analysis when combined with Life Cycle Assessment has been proposed as an important technique for performance evaluation and benchmarking in assessment of operational efficiency and environmental impacts of multiple units. According (ISO

14040, 2006), LCA is a good tool that helps in assessment of the environmental performance of products and processes as it takes into account the overall life cycle of a product. Environmental assessment using LCA is done by collecting the inputs and outputs data evaluates the potentials environmental impacts and interpret the results obtained from the inventory analysis (Iribarren, Diego, et al 2010).

Data Envelopment Analysis is a better technique in evaluating the performance of business organizations and has been successfully implemented in different areas because of its accurate assessment of the DMUs. It is effective in comparing the performance of peer units known as DMUs to determine or identify the efficient frontiers that represent the best practice with directions for improvement. DEA has allowed its use in tackling certain cases that are resistant to other approaches because of its ability to evaluate multiple inputs and outputs involved in different activities. DEA been widely applied in so many forms to evaluating the performance of different entities such as schools, hospitals, banks, countries, cities, etc. has helped managers in taking relevant improvement decisions in their various organizations.

## **1.2 Problem Statement**

The increasing demand for environmental solutions regarding operational inefficiencies and corresponding environmental impacts during product productions process has called for the full attention of researches to the joint use of life cycle assessment and data envelopment analysis for performance evaluation in various fields of operation. The use of LCA has shown a great advantage and proven suitable for assessment of environmental impacts associated with aquacultures production such as mussel cultivation in raft used as a case study. On the other hand, DEA as a

performance evaluation method has been extensively used to quantify and compare the productive efficiency of multiple entities known as DMU.

In the case of this study, LCA and DEA were jointly used to determine the operational efficiency and environmental impacts from mussel cultivation in 62 studied rafts. The data were made available from the different mussel cultivation sites. LCA was performed on each raft and their corresponding environmental impact was estimated. Using CCR model of DEA on the inputs and outputs data the efficiency of each mussel raft is computed and appropriate efficiency target are set. The idea of using the CCR Model of DEA in the study proposes that whatever is given to the system is what comes out of it. In other words, the amount of input used is directly proportional to the amount of output produced which in real life is not practical. And from the results of the CCR model of DEA, the efficiency scores show that out of the 62 DMUs, 24 are efficient. But in the case of this current study we tried to use a different model of DEA known as BCC model to evaluate the different 62 entities which contradict the idea of the CCR model. The BCC and ERM model is absolutely different from the CCR model in that it accepts the notion that when there is an increase in the amount of inputs it does not result to proportional increase in outputs all through the operation. Although the same technique is applied in both models, the BCC result is compared with the result of the CCR so that a comprehensive policy and decision could be reached and a perfect and standard benchmark could be set for the improvement of the inefficient DMUs.

The use of DEA as linear programming models for performance evaluation has its drawbacks and researchers have been working tirelessly to improve on these models. For instance, in a situation where by the required number of DMUs are not good enough when compared to the available inputs and outputs amounts, the DEA may not

be able to evaluate efficiently the DMUs which may alter a good decision making. Another important drawback of DEA is the problem of ranking order of the efficiency scores for each DMU.

Considering these drawbacks on DEA a new methodology otherwise known as modified BCC and ERM model of DEA is used also in this study which enhanced the discrimination of efficient frontiers from the inefficient operating points and consequently identifies the hot-spots with the corresponding environmental improvement actions. The modified VRS models strongly investigate the weak line of the efficient frontier and the DMUs that derive their efficiency scores from this weak line is identified while the strong efficient DMUs are unchanged.

### **1.3 Supposition**

The DMUs and their corresponding multiple input and output data are the key requirements needed for running the DEA. The data obtained must not be bias and should satisfy the interest of the observer or analyst. Efficiency evaluation is best when there is increased output and reduced input. The two-basic efficiency evaluation technique adopted in DEA is the input orientation and the output orientation. This research is carried out using the input oriented condition in which the input orientation aims at maximizing the output with same input. The WinQSB linear programming solver was used for the computations and analysis of the data and results obtained are presented in the Appendix.

### **1.4 Organized Structure of the Thesis**

This thesis is organized into five chapters: Chapter one gives an overview of the thesis topic with detailed motivation of the study and introduces the problems to be addressed. Chapter two is made up of the literature review on the key concept of LCA

and DEA in operational efficiency and environmental impact. It also provides background introduction for application of Data Envelopment Analysis to the measurement of efficiency scores in some related topics. Chapter three explains in details the methodology employed, the definition of the units of assessment, framework and application of LCA and BCC model of DEA in the measurement of efficiency in this research study. Chapter four illustrates the use of modified BCC model using facet analysis to reevaluate the efficiency scores obtained in chapter three using normal BCC model of DEA. It also summarizes the results of this study and makes recommendations. And finally, chapter five consists of a summary of discussion, implications, the limitations and recommendation for further research.

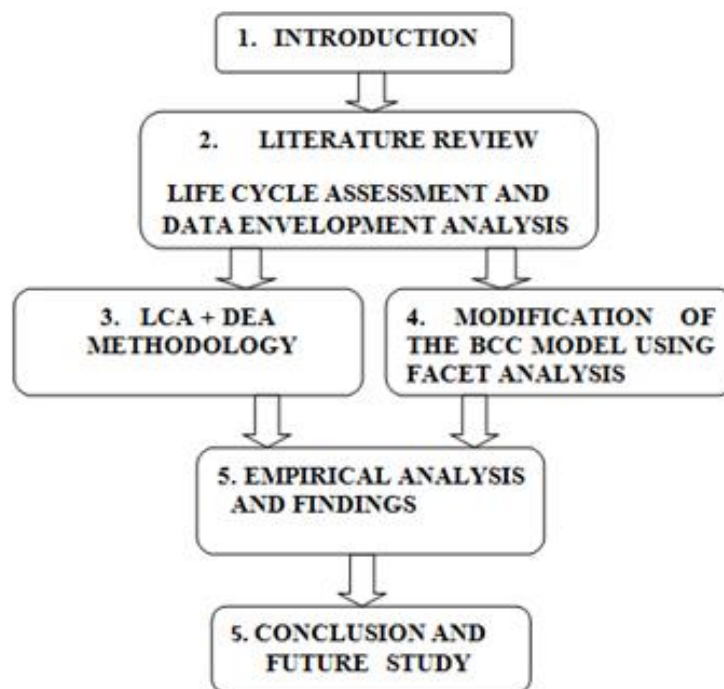


Figure 1: The structure and organization of the Thesis study

## **Chapter 2**

### **LITERATURE REVIEW**

#### **2.1 Life Cycle Assessment and Data Envelopment Analysis**

The idea of LCA came up around 1969s, in which scientists concerned with the rapid breakdown of fossil fuels introduced it as an approach to evaluating the impacts of energy consumption. Its first well known application in environmental study was in Coca Cola Company in 1969, where the study compared beverage containers with environmental impacts to determine which one had the lowest environmental impacts with fewer demands for raw materials and energy (Sarkis, J., & Cordeiro, J. 2001). LCA emerged fully in the late 1980s as an impact assessment tool and has been accepted by increasing numbers of corporations and nonprofit organizations as an aid to understanding of product systems and the associated environmental impacts.

LCA is technique is used to assess and or evaluate the environmental impacts associated with the production of a product from its extraction of raw materials from the earth to product development, processing and manufacturing, use and finally to disposal (ISO 14044, 2006). According to (Barjoveanu, George, et al., 2014), LCA is such evaluation instrument that allows the identification and quantification of environmental impact of a product by considering its entire life span in an exact manner. LCA promotes better understanding of information on the environmental aspects of a product or services from cradle to grave. It gives a clear view on the environmental concerns by: Assembling together inventory data from relevant energy

to environmental emissions. Examining the potential impacts associated with the products via LCIA and interpreting results for improvement on decision. The advantage of using LCA in the operational performance evaluation is that it presents a holistic knowledge of each inventory and the extent to which it contributes negatively into the environment.

Eco-efficiency is normally assessed by using of data envelopment analysis (Cooper et al 2007). Data envelopment analysis was first introduced Charnes, Cooper and Rhodes in 1978 to measure the relative efficiency of business organization unit with multiple inputs and outputs, (Martić, M., Novaković, M., & Baggia, A. 2009, Cooper et al., 2004) It is an established linear programming technique, for non-parametric estimation of relative efficiency of homogeneous units, known as Decision Making Units. (Iribarren, Diego, et al., 2010, Zhu, 2002). It is called a non-parametric method because it does not require an assumption like production function or regression equation. Data Envelopment Analysis from the beginning has shown remarkable credit in performance evaluation resistant to other techniques because of its ability to evaluate multiple inputs and outputs data. It is a well-known approach for assessing the relative performance of business entities as it enables to determine efficiency units and compares it with other units in the analysis. Apart from measuring the relative efficiency; it is capable of finding the sources and the extent of inefficiency from every input and its corresponding outputs. (Martić, M., Novaković, M., & Baggia, A. 2009). DEA is data-oriented because the results of evaluations and other conclusions emanate from the observed data with fewer assumptions. It determines a production possibility set (PPS) that contains the target operating points which are considered feasible. Furthermore, it formulates and solves through linear programming for each DMU and produces an efficiency score with the target operating points which forms the efficient

frontier. (Lozano, Sebastián, et al, 2009). According to (Thanassoulis, 2001). DEA can be said to be one of the evaluation methods in operations research and among many other fields of application.

In the last few decades, the joint use of LCA and DEA has established extensively as a standard technique for operational and environmental performance analysis of similar decision making units (Vazquez-Rowe & Iribarren, 2015). They have been used in many research works to assess many specific systems such as in food production assessment, eco-efficiency assessment of products and processes, operational efficiency and environmental impacts, emission reductions etc. (e.g. Mohammadi, Ali, et al., 2015 Vazquez-Rowe, Ian, et al., 2012, Avadi, Angel., 2014, Iribarren, Diego, et al., 2015). Integrating LCA and DEA as a methodology have been used as standard evaluation for the operational environmental performance of 25 sample wind farms in Spain where it was ascertained that four out of the 25 samples were deemed efficient, while the target input values of both the consumption and environmental impacts were set as standard for those inefficient DMUs (Iribarren, D., Martín-Gamboa, M., & Dufour, J. 2013). LCA & DEA approach has also been used to evaluate the operational performance of thermal power plant in Taiwan (Liu, C. H., Lin, S. J., & Lewis, C. 2010).

LCA + DEA methodology was also applied for production of grape used for vinification in the Rias Baixas appellation (NW Spain) in which the aim of the study was to find out the operational inefficient grapes, determine the standard target input consumption, estimate the economic gains from efficient operational practices, determine the values environmental gains of operational efficiency in growing vine, prove with evidence that inputs used reduces potential environmental impacts and

finally identify the best efficient frontier used as operational and environmental standard for the vineyards (Vázquez-Rowe, Ian, et al., 2012 ). Joint LCA and DEA application have also been used to evaluate the environmental effects for 82 rice paddy production in the summer and winter season using the super- efficiency analysis. According to the LCA results the spring paddy rice has a lower environmental impact compared to the summer rice paddy as a result of global warming, water depletion, eutrophication and acidification etc., while the DEA results shows that the number of efficient fields was lower for summer (21%) when compared with spring (46%) (Mohammadi, Ali, et al. 2015).

## **2.2 DEA Background**

Data Envelopment Analysis (DEA) is an adopted linear programming method that is used for evaluating the relative performance of similar functional entities (DMU). This tool evaluates simultaneously multiple inputs and outputs by measuring the efficiency of the different units as the ratio of weighted sum of outputs to weighted sum of inputs. It tries to compare the available information from each unit or DMU with the aim of identifying the efficient frontiers or best practice frontiers.

DEA originated in 1978 from a postgraduate dissertation that was done by Rhodes under the supervision of Cooper and Charnes (Anadol, B. 2000). Rhodes in his research examined how efficient New York City educational institutions would improve the development of disadvantaged children. The first model used was the CCR model which allows the computation of relative efficiencies on the units being evaluated. The CCR DEA model was a detailed work of Farrell's 1957 which was modified by the introduction of BCC model by Banker 1984. (Anadol, B., 2000). The BCC model contains the convexity constraints that allows the DMUs to be evaluated

on a variable return to scale basis. Recently DEA has been used to study over 70 business organizations such as banks, insurance, credit unions, capital budgeting projects, educational institutions etc. And over 1300 paper research works have been written by academicians under engineering, operations research and management.

### **2.3 How Does DEA Work**

Efficiency is normally evaluated using inputs and output ratio. DEA works in such way that after evaluation of the inputs/outputs data, it forms a best practice frontier that recognizes the performance of some DMUs below optimum levels. Based on that each DMU is optimized against all other DMUs by assigning weights to the variables in such a manner that each of the DMU gives the best it can. The efficiency of DMU is simply the sum of the weights of outputs all over the sum of the weights of inputs. DEA constructs efficiency frontier and measures the efficiency score of each DMU according to its distance from the frontier. These efficiency scores indicate the amount of unit that can increase the outputs without consuming more input, and on the way round the proportion which it can decrease its inputs and still maintain its original level.

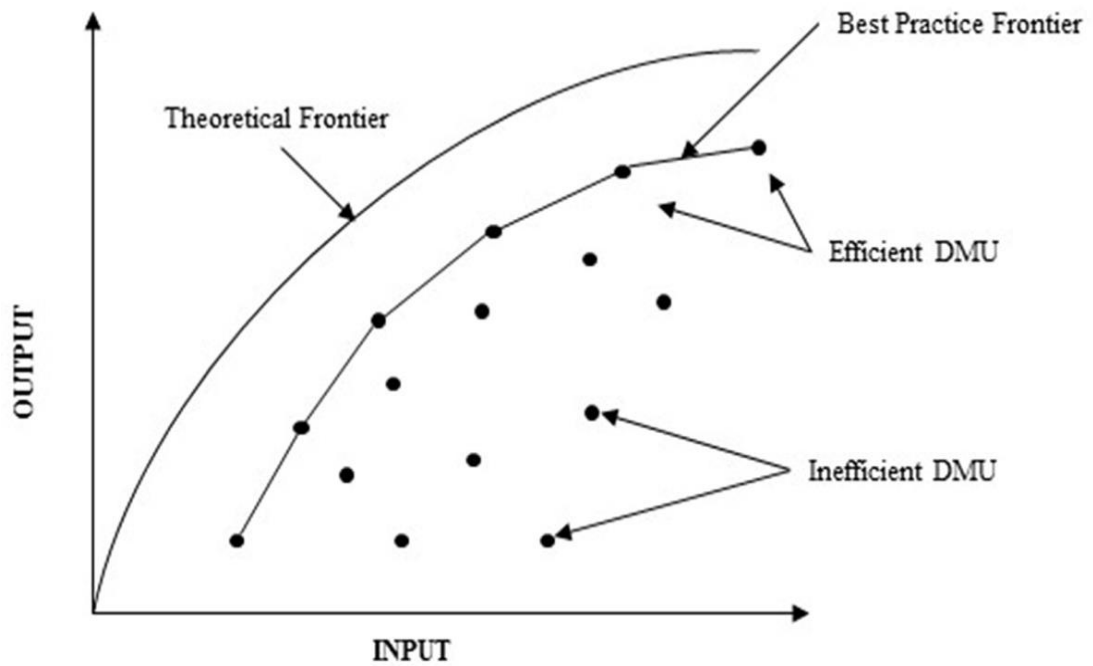


Figure 2: Data Envelopment Analysis Frontier

The figure above shows the graphical representation of efficiency scores in the observed population which identifies the efficient DMUs together with the inefficient ones. The efficiency frontier is made up of the best practice units or DMUs as it is connected to each other while the inefficient DMUs are enveloped within the production possibility set (PPS). The theoretical frontier is above the efficiency frontier in which the human performance effort cannot reach even though there are chances of human improvement. All DMUs that falls below the efficiency frontier are considered inefficient and what the DEA does is to identify the cause and levels of the inefficiency for the inputs when comparing them with the reference units constructed from linear combination of efficient units.

## **2.4 Resource Identification**

DEA is a good tool for finding how effective and ineffective the performance a business organization could be, especially when multiple input and output data variables is involved. In formulating DEA model the first thing is to identify all the relevant or most significant resources that are to be utilized by the decision-making units. The inputs used to produce the outputs are the major resources and the outputs generally represent the proportion of goods and services produced by each DMU. Environmental impacts that are quantifiable and non-quantifiable also influence the model formation and thereby are assigned to a certain proxy and included into the analysis. In general, the idea of DEA formulation for management is to maximize outputs while minimizing inputs used in producing the outputs.

## **2.5. Production Possibility Set**

All the set of inputs and outputs of DMUs such that the inputs can generate an output are known as the production possibility set of DEA. The production frontiers constructed by the linear programming model is the technique used by data envelopment analysis for assessing relative efficiency. When this efficiency envelopment surface is evaluated from the inputs and outputs of the DMUs, the ones that connect the frontier surface are known as the efficient DMUs while the ones lying below it are inefficient. The relative efficiency of the DMUs is clearly evaluated using production possibility set by data envelopment analysis models. The DEA models cannot give the efficient frontiers of production possibility set but it can determine the DMUs efficiency. The set of feasible points of the evaluated input and outputs data are referred to as PPS denoted by ‘‘T’’. One of the component of each of the input and output vector must be positive while all data are assumed nonnegative. Characterizing this mathematically we refer it as semi positive given that the DMU uses input.

$$x_j (x_{ij}, \dots, x_{sj}) \geq 0, x \neq 0 \text{ to produce } y_j (y_{ij} \dots y_{mj}) \geq 0, y \neq 0 \text{ for } i = 1 \dots n$$

**Properties of production possibility set;**

1. The activities observed  $(x_j, y_j)$  ( $j = 1, \dots, n$ ) belong to T
2. If the observed activity  $(\mathbf{x}, \mathbf{y}) \in T$ , then  $(t\mathbf{x}, t\mathbf{y}) \in T$  for any  $t > 0$ , this postulate is known as constant return to scale
3. For any activity  $(\mathbf{x}, \mathbf{y}) \in T$ , any semi positive input and output  $(\bar{\mathbf{x}}, \bar{\mathbf{y}})$  with  $\bar{\mathbf{x}} \geq \mathbf{x}$  and  $\bar{\mathbf{y}} \leq \mathbf{y}$  is included in T
4. Any semi positive mathematical combination of input and output in T belongs to  $T^1$

The data sets is arranged in matrices  $x_j = (x_j)$  and  $y = (y_j)$ ,  $j = 1 \dots n$  and the production possibility set T can be defined by satisfying 1, 2,3, 4 postulates

$$Tc = \left\{ (\mathbf{x}, \mathbf{y}) / x \geq \sum_{j=1}^n \lambda_j x_j, y \leq \sum_{j=1}^n \lambda_j y_j, \lambda_j \geq 0, \forall_j \right\} \quad (2.1)$$

The two major DEA models are the CCR and BCC models. The CCR is known as the constant return to scale (CRS) while the BCC model is referred to as variable returns to scale (VRS). Both models are input and output oriented depending on the objective given by management or organization. The input oriented model exists when the organization has a specific production standard for the DMUs, the ones that are inefficient can be efficient through reducing the utilized inputs and holding the output constant while the output oriented model is established when the organization has required amount of input resources available to the DMUs, the inefficient units can be made efficient by increasing in its outputs while holding input resources constant. The CCR model efficiency frontier starts from the origin while the BCC model does not

have to start from the origin. There are less efficient DMUs in the CCR model with smaller  $\theta$  values and larger  $\phi$  values. The CCR input oriented model is converted to the BCC input oriented model by adding the convexity constraint  $\lambda_j \geq 1$  to the primal model with the  $U_0$  to the dual model. Similarly,  $\lambda_j$  and  $v_0$  is also added to the BCC output oriented model.

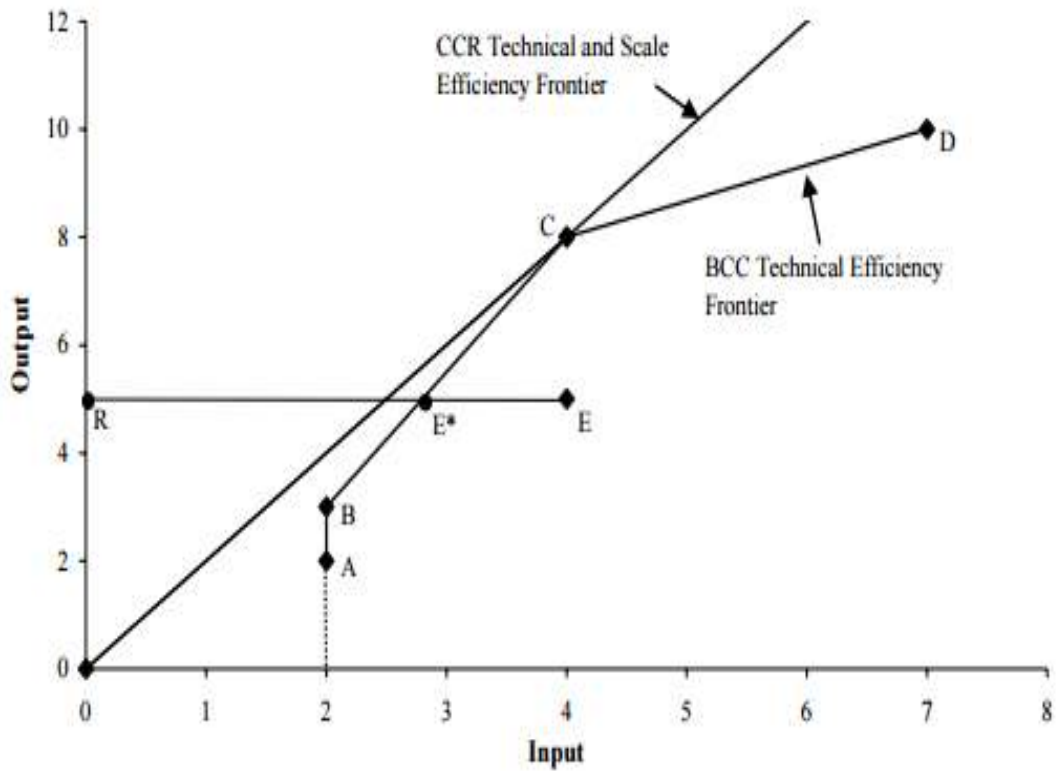


Figure 3: CCR and BCC efficiency Frontier

From the figure above the CCR efficiency frontier is the straight line that passes through point C through the origin. Observing carefully, it is seen that only point C is efficient. However, the efficient frontier of BCC is the line connecting A B E C D.

### 2.5.1 CCR Ratio Model

This ratio mode concentrates on calculating the overall efficiency of the DMUs under study. The efficiency determined is never absolute because it is always measured

relative to the field. It assumes that increasing the input will results to a proportional increase in the output. The CCR model identifies the sources or causes of inefficiency and estimates the potential strategic improvements relevant for the inefficient DMUs. The input and output oriented CCR model are the same in terms of the envelopment surface however different in the way the inefficient DMU is projected. The envelopment surface generated from the CCR model has a convex cone shape. The efficient DMUs fall on top of the frontier, and the inefficient ones are enveloped by the frontier.

From equation (2.1) the envelopment form of CCR model which assumes that the production function exhibits constant return to scale is given as in the equation below;

$$\text{Min } \theta$$

$$s.t \ (\theta \mathbf{x}_0, \mathbf{y}_0) \in T_c$$

The idea is simply, minimizing inputs and maintaining the given output level.

$$\text{Min } \theta$$

$$s.t$$

$$\sum_{j=1}^n \lambda_j x_{ij} \leq \theta x_{i0} \quad i=1 \dots m \quad (2.2)$$

$$\sum_{j=1}^n \lambda_j y_{rj} \geq y_{r0}, \quad r=1 \dots s$$

$$\lambda_j \geq 0, \quad j=1 \dots n$$

Using the duality in linear programming, the equivalent multiplier form of the above model can be formulated as follows;

$$\begin{aligned}
& \text{Max} \sum_{r=1}^s u_r y_{r0} \\
& \text{s.t} \\
& \sum_{i=1}^m v_i x_{i0} = 1 \\
& \sum_{r=1}^s u_r y_{ij} - \sum_{i=1}^m v_i x_{ij} \leq 0 \\
& u_r, v_i \geq 0 \quad r = 1, \dots, s, i = 1, \dots, m
\end{aligned} \tag{2.3}$$

### 2.5.2 BCC Ratio Model

The BCC model was the modification of CCR model done by Banker, Charnes, and Cooper (Banker R. D. & Thrall R. M., 1992). This model has a concave and piecewise linear characteristic which leads to a variable return to scale. The BCC model contradicts the CCR model in that it accepts the notion that when there is an increase in the amount of inputs it does not result to proportional increase in outputs all through the operation. In other words, the addition of the convexity constraints is given by (

$\sum_{j=1}^n \lambda_j = 1$ ). BCC model differentiates between scale and technical inefficiencies through estimating the technical efficiency and identify if it increases, decreases, or constant returns to scale for additional exploitation. It interprets results of the DMU efficiency with an assumption that variable return to scale exists within the observed population. It also allows DMUs of different scale sizes to be compared in the same DEA analysis. BCC input oriented model focuses on reducing the inputs and maximizing the performance of the DMU or increasing the producing output with minimum resources.

The production possibility set (PPS) of the model is written as  $P_B$  in which the postulates are follows;  $x_j (x_{ij} \dots x_{sj}) \geq 0 \quad y_j (y_{ij} \dots y_{mj}) \geq 0$

1. All the input and output observed  $(x_j, y_j) \in P_B \quad j = 1, \dots, n$

2. If the inputs and outputs  $(x_j, y_j) \in P_B$  then the convex combination of these

$$\text{data } \sum_{j=1}^n \lambda_j x_j, \sum_{j=1}^n \lambda_j y_j, \sum_{j=1}^n \lambda_j \geq 0, \quad j = 1, \dots, n \text{ also belongs to } P_B$$

3. Every inputs and outputs  $(x_j, y_j) \in P_B$  and for any combination of input and output  $(\bar{x}, \bar{y})$  with  $\bar{x} \geq x$  and  $\bar{y} \leq y$  belongs to  $P_B$ .

4. All the linear combination of inputs and outputs in  $P_B \in P_B$ .

The published BCC model of PPS is defined by Banker, Charnes & Cooper 1984 is

$$\text{given as } P_B = \left\{ (x, y) \mid x \geq \sum_{j=1}^n \lambda_j x_j, y \leq \sum_{j=1}^n \lambda_j y_j, \sum_{j=1}^n \lambda_j = 1, \lambda_j \geq 0, \forall j \right\} \quad (2.4)$$

The input oriented BCC model evaluates the efficiency of DMU<sub>j</sub> (j = 1, ... n) by solving the linear programming model of the envelopment form. From the above formulation (2.4) can be clearly considered as BCC input oriented envelopment side follows:

$$\text{Min } \theta$$

$$\text{s.t } (\theta \mathbf{x}_0, \mathbf{y}_0) \in T_B$$

From the above formulation, our main objective is finding the value of  $\theta$  such that  $\theta$  is between  $0 \leq \theta \leq 1$  because we want to minimize our input and have same output. Therefore, regarding to the definition of PPS the above problem can be written as follows:

*Min*  $\theta$

*s.t*

$$\sum_{j=1}^n \lambda_j x_{ij} \leq \theta x_{i0} \quad i = 1, \dots, m$$

$$\sum_{j=1}^n \lambda_j y_{rj} \geq y_{r0} \quad r = 1, \dots, s \quad (2.5)$$

$$\sum_{j=1}^n \lambda_j = 1$$

$$\lambda_j \geq 0, j = 1, \dots, n$$

The duality of the multiplier model of the BCC is expressed by

$$\text{Max} \sum_{r=1}^s u_r y_{r0} + u_0$$

*s.t*

$$\sum_{i=1}^m v_i x_{i0} = 1 \quad (2.6)$$

$$\sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} + u_0 \leq 0$$

$$u_r, v_i \geq 0, \quad r = 1 \dots s, i = 1 \dots m$$

$$u_0 \text{ free}$$

## 2.6 Essence of DEA Interpretation

The DEA identifies the target operating points and gives the potential improvement for the inefficient DMUs. The results of the evaluation serve as a guide for policy making or other managerial decision in a business organization. It gives a good understanding of the efficiency and directs the management in creating a perfect benchmark for similar operations. With DEA, DMUs that have poor performance or inefficient are identified among their peers which guides the organization towards an effective management process.

## **Chapter 3**

### **LCA + DEA METHODOLOGY**

#### **3.1 Introduction**

The operational efficiency and environmental impact performance evaluation was established by assessing of multiple input and output data of similar units with the help of combined application of LCA and DEA. This approach has been proven as a most valuable tool that ultimately avoids standard deviation as it provides a comprehensive operational and environmental evaluation of units. (Vázquez-Rowe, Ian, et a 2012, & Iribarren, 2010). It also provides an eco-efficiency technique for operational and environmental benchmarking of DMUs (Iribarren, D., Martín-Gamboa, M., & Dufour, J. 2013). The approach is illustrated using a recent life cycle assessment (LCA) from mussel production raft in which the input and output data were made available from the different mussel cultivation sites (Iribarren et al, Lozano, Sebastián, et al submitted for publication). An evaluation analysis of the units was carried out which aid in identifying the operational inefficiencies and corresponding environmental impacts.

The LCI data are available on similar DMUs; DEA was used to evaluate the efficiency. Where the inefficiencies are found in any of the DMUs, LCIA of their computed target is performed, and the result used to make a comparison with the current DMU. This enables the quantification of the different impact categories and the excess input utilized can be minimized.

### **3.2 Definition of Unit of Assessment**

The mussel cultivation sites are the unit under assessment or DMU. These DMUs under assessment or evaluation was studied, the operational efficiency will give idea of the environmental impact. The LCI data for the 62 mussel cultivation sites were made available with their corresponding quantities of production. The input and output data for the 62 sites are provided in the appendix below. Primary data acquisition was through questionnaires answered by a set of significant boat skippers within the area for mussel cultivation in Galicia. Operational aspects such as oil and diesel consumption, as well as capital goods were also considered. The emissions into the environment resulting from combustion are proportional to the amount of diesel utilized for powering the ship.

When carrying out the LCAs for the 62 sites of mussel cultivation, the system considered different stages from obtaining the mussel seeds through processing it in factories, construction, operation and maintenance of the rafts including the boats used during operation. The LCAs data used was basically original data from mussel cultivation in Galicia rafts and eco invent database was used for background processes as a source of secondary data (Frischknecht et al 2007; Vazquez-Rowe, Ian, et al., 2001). SimaPro 7 was used as the specific software for life cycle inventory computations while CML 2000 was used for the environmental impacts assessment of the 10 impact categories taking into account.

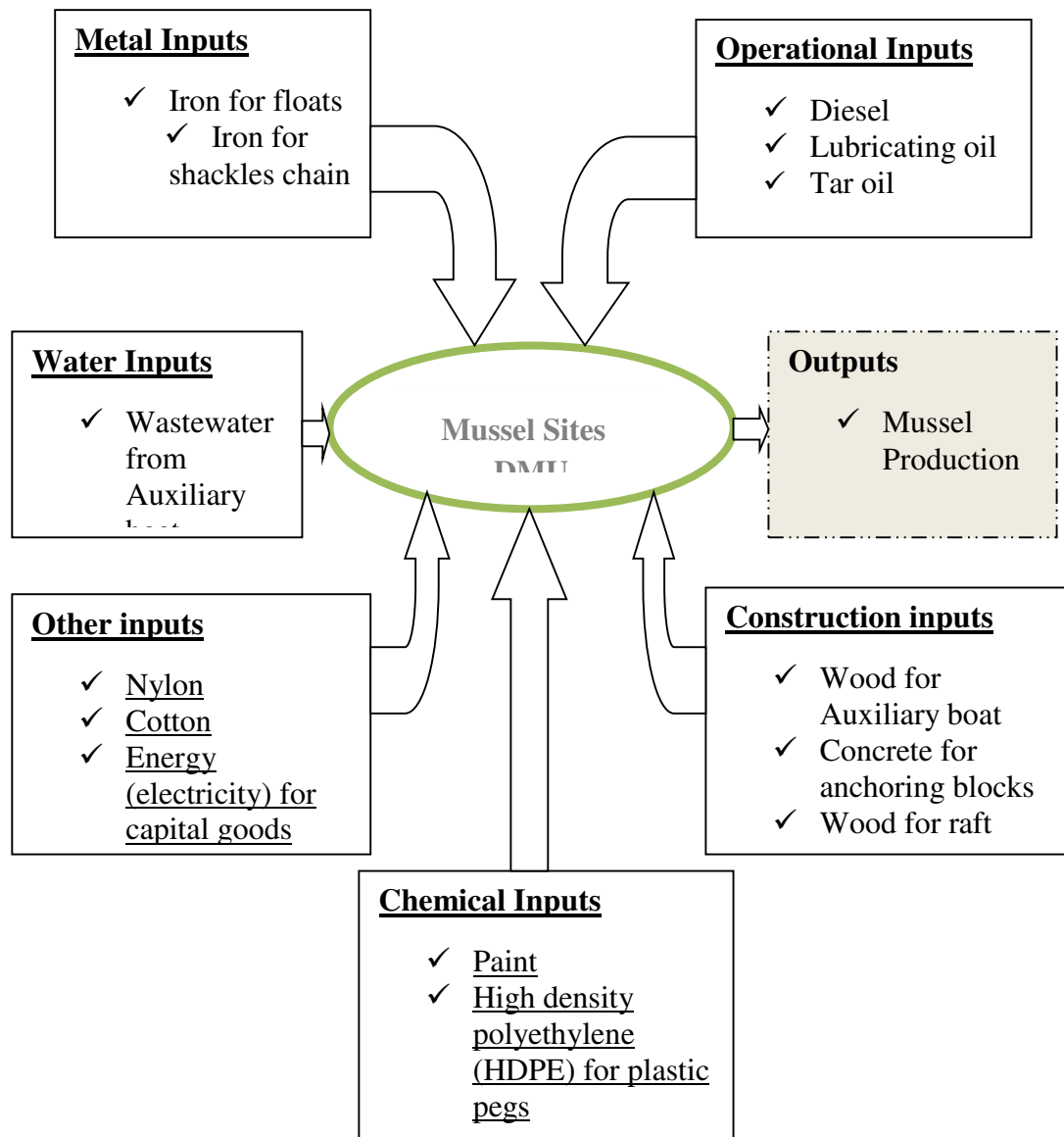


Figure 4: LCA Elements Considered for each Sites

The data from the 62 DMUs to be evaluated using the DEA are the most relevant primary data from the questionnaires. A total of fourteen inputs and one output were considered in the evaluation in which all are related mussel sites activities. In respects to the inputs, the emissions to air due to diesel combustion were not considered as a result of their direct proportion with the amounts of diesel consumed. Following as a result, while minimizing these inputs, we are minimizing the direct emissions from the

DMUs at the same time. The mussel production was considered as the only output data.

| <b>Inputs Consumed</b>                  | <b>Units</b> |
|-----------------------------------------|--------------|
| Diesel                                  | l/year       |
| Wastewater from auxiliary boat          | l/year       |
| Lubricating oil                         | l/year       |
| Wood for auxiliary boat                 | kg/year      |
| Iron for floats                         | kg/year      |
| High density polyethylene (HDPE) for    |              |
| Plastic pegs                            | kg/year      |
| Concrete for anchoring block            | kg/year      |
| Nylon                                   | kg/year      |
| Cotton                                  | kg/year      |
| Paint                                   | l/year       |
| Tar oil                                 | l/year       |
| Iron for shackle chain                  | kg/year      |
| Wood for raft                           | kg/year      |
| Energy (electricity) for capital goods  | GJ/year      |
| <b>Output</b>                           | <b>Units</b> |
| Production of mussel of commercial size | ton/year     |

### **3.3 LCA + DEA Framework**

LCA and DEA were jointly applied for operational efficiency and environmental performance evaluation of mussel rafts. The LCA uses the relevant LCI data in order to carry out a complementary study of the DEA which will lead to efficiency evaluation that will aid to quantify eco efficiency. The LCA and DEA methodology used in operational efficiency and environmental impacts evaluation can be summarized into five steps (Mohammadi et al., 2013; Lozano et al. 2009, 2010).

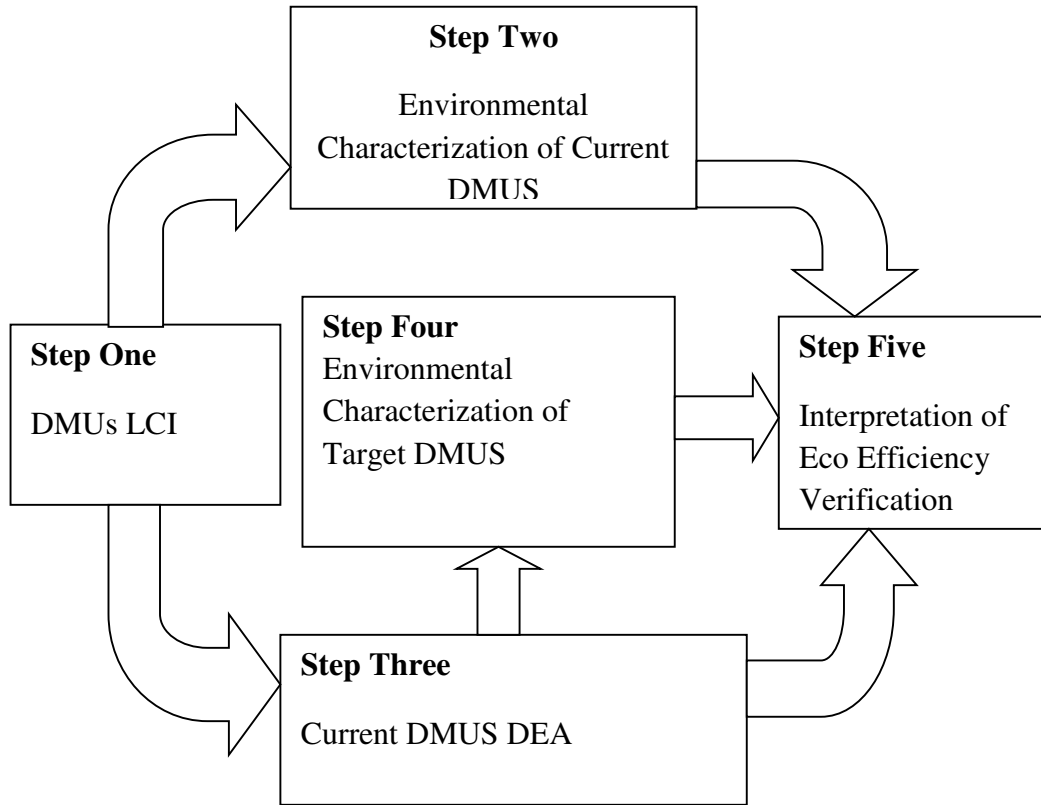


Figure 5: Schematic Representation of LCA + DEA Framework

1. The first step is the preparation of life cycle inventory (LCI) which involves collection of input and output flow of each mussel cultivation site.
2. Performing the LCIA for each of the decision-making units (DMUs) based on the LCI developed in the previous step in order to determine the potential environmental impacts.
3. The DEA is performed in the LCI data collected from the first step with computation of the target DMUs. In this case the target values for the inefficient DMUs refer to virtual units that utilize less input and produce more output, thereby creating an attainable operational benchmark.
4. The performing of LCIA of the target DMUs from the LCI data in the first step and the potential impacts determine from the virtual DMUs.

5. Interpretation of results base on quantifying of the environmental impacts of operational inefficiencies. And then comparing between the potential environmental impact of the current DMUs and virtual DMUs will help to quantify the environmental impacts generated through inappropriate operational practices.

### **3.4 Application of LCA + DEA Methodology**

As described previously joint LCA + DEA approach can be used to evaluate the operational efficiency and environmental impacts of Mussel cultivation rafts. In as much the extraction phase of this mussel production requires greater operational activities in terms of input and output, this methodology is useful and applicable.

#### **3.4.1 LCI Data Acquisition**

Making the data available or a thorough data collection is the key requirements in LCA + DEA studying. The appendix (B.1) shows the inventory data collected for the 62 mussel rafts used for analysis in this study.

#### **3.4.3 BCC Model Application**

When the input and output data are made available for the different DMUs, the immediate approach is DEA application for evaluation and determination of the production possibility set. Although DEA can be said to be a non-parametric approach, convexity and free disposability of inputs and outputs are assumed for the determination of the production possibility set. An input oriented BCC model of DEA with variable returns to scale was used in other to differentiate between the efficient and inefficient Mussel rafts (DMUs). Evaluating the efficiency of the  $DMU_0$  that belongs to the PPS is represented using the input oriented form of the linear programming model.

$$\text{Min } \theta$$

$$s.t \ (\theta \mathbf{x}_0, \mathbf{y}_0) \in T_B$$

From the above formulation, our aim is to find the value of  $\theta$  in which  $\theta$  is between  $0 \leq \theta \leq 1$  because we want to minimize our input and keep the corresponding output constant or have same output. Therefore, regarding to the definition of PPS as discussed in the previous chapter, the above problem can be written as follows:

$$\text{Min } \theta$$

$$s.t$$

$$\sum_{j=1}^n \lambda_j x_{ij} \leq \theta x_{i0} \quad i=1 \dots m \tag{3.1}$$

$$\sum_{j=1}^n \lambda_j y_{rj} \geq y_{r0}, \quad r=1 \dots s$$

$$\sum_{j=1}^n \lambda_j = 1$$

$$\lambda_j \geq 0, \quad j=1 \dots n$$

The dual of the mathematical problem above is given by the following linear programming model known as BCC input oriented multiplier side which is applied in the study.

$$\text{Max } \sum_{r=1}^s u_r y_{r0} + u_0$$

$$s.t$$

$$\sum_{i=1}^m v_i x_{i0} = 1 \tag{3.2}$$

$$\sum_{i=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} + u_0 \leq 0$$

$$u_r, v_i \geq 0, \quad r=1 \dots s, i=1 \dots m$$

$$u_0 \text{ free}$$

The reason behind selecting the input oriented model is because our aim is to achieve an input minimization without altering the mussel production. The BCC model solver was used for running the DEA computation (Saitech, 2011; Vázquez-Rowe, Ian, et al., 2010). The results obtained are presented on the tables 5.1 and 5.2 which is the efficiency scores for mussel production.

#### 3.4.4 ERM – VRS Model Application

The non-radial model otherwise known as Russell Measure was introduced by Fare and Lovell in 1978 identifies DMUs as technically efficient when inputs and outputs do not contain slacks. Based on these (Pastor et al.,1999) extended the initial model and proposed a new measure called Enhanced Russell Measure (ERM) which was also applied in this study with the aim or objective to minimize the ratio of the average input reduction to average output increase for better interpretation about efficiency. It does not neglect the input and output slacks and therefore account for all sources of inefficiency. In addition, ERM consist of desirable properties, such as strong monotonicity of inputs and outputs, unit invariance.  $\phi_0=1$  if only  $DMU_0$  is efficient. The ERM efficiency value is a one figure that shows the ratio of the reduced average inputs to the increased output. The Enhanced Russell Measure (ERM) model is represented as follows;

$$\begin{aligned}
 \phi_0 &= Min \frac{1}{M} \sum_{k=1}^m \theta_{k0} \\
 s.t \quad & \\
 \sum_{j=1}^n \lambda_j x_{k0} &\leq x_{k0} \theta_{k0} \quad \forall i \\
 \sum_{j=1}^n \lambda_j y_{j0} &= 1 \\
 0 &\leq \theta_{k0} \leq 1 \\
 y_{j0} &\geq 0 \quad \forall j
 \end{aligned} \tag{3.3}$$

The dual model of the ERM – VRS Model can be expressed as follows;

$$\begin{aligned}
& \text{Max } u_0 - \sum_{k=1}^m \phi_k \\
& \text{s.t} \\
& \sum_{k=1}^m v_k x_{kj} + u_0 \leq 0 \quad j = 1, \dots, n \\
& \sum_{k=1}^m v_k x_{kj} - \phi_k \leq \frac{1}{M} \quad k = 1, \dots, m \\
& 0 \leq \theta_{k0} \leq 1 \\
& v_k \geq 0 \\
& \phi_k \geq 0 \\
& u_0 \text{ free}
\end{aligned} \tag{3.4}$$

The reason behind using the Enhanced Russell Model is because undesirable outputs, like smoke and waste are normally generated with desirable outputs at the course of mussel production processes. The traditional DEA model is not applicable for performance evaluation of DMUs with undesirable outputs. Base on the explanations above the ERM approach is applied by taking into account the undesirable output which is required to ascertain the environmental efficiency of mussel production.

## Chapter 4

# MODIFICATION OF BCC AND ERM MODEL USING FACET ANALYSIS

### 4.1 Introduction

In this section, the modified BCC is applied on LCA + DEA approach to show an overall operational performance of the mussel production and to identify specific standard and practical target for the underperforming ones in terms of their environment impacts. In BCC model, weak part of the frontier sometimes house DMUs and place them without bias as efficient DMUs. In avoiding the comparison of strong efficient Decision Making Units (DMUs) with DMUs that falls on weak part of efficient frontier of BCC model, as result of the nature of its graphical orientation a non-Archimedean infinitesimal is adopted as a lower bound. These bounds slightly change the weak parts of the frontier and in this situation the weak parts of the DMUs will be observed and it will take a value less than 1 which makes it inefficient.

The variation in  $U_0$  takes the feasibility form of the delineating problem which is the major reason why the DMUs under consideration are inefficient. These bounds are defined in BCC model as  $v_i$  and  $u_r$  which corresponds to the inputs and outputs weights. Similarly, in order to evaluate the real efficiency value of DMUs that fell on the weak parts of frontier we compare with these parts of frontier. According to (Daneshvar S., 2009) the modified DEA model attempt to fix the weak part of the

efficient frontier that gives a bias efficiency score to DMUs that fall on it, thus giving a true efficiency score to the DMUs at the target region.

The modified BCC model applied in this study is presumed to;

- Modify the PPS by restrain within bound the free variable.
- Given the true efficiency score for weak efficient DMUs or DMUs that fall in the weak efficient frontier.
- Give a recommendation to the DMU under evaluation either by increasing input by some units or decreasing output so that efficiency of the DMU can be improved sharply.

#### 4.2 Non-Archimedean Infinitesimal Element

The introduction of non-Archimedean infinitesimal element into data envelopment analysis is to use it to differentiate between positive and non-negative values (charnes et al, 1978). There is a problem when evaluating a weak efficient DMU as an efficient DMU. Therefore (Ali & Seiford, 1993) concluded that the  $\varepsilon$  should be used as the upper bound to make sure feasibility on the multiplier side and bounded for the BCC model envelopment side. Exploring  $\varepsilon$  in the BCC model presents the following model: As noted initially what  $\varepsilon$  does is to change the weak part of the frontier

$$\begin{aligned}
 z_0^* &= \text{Max } UY_0 + u_0 \\
 s.t \quad & \\
 UY_j - VX_j + u_0 &\leq 0 \quad j = 1, \dots, n \\
 VX_0 &= 1 \\
 U &\geq \varepsilon 1 \\
 V &\geq \varepsilon 1 \\
 u_0 &\text{ free}
 \end{aligned} \tag{4.1}$$

### **4.3 Facet Analysis**

Facet analysis was introduced first in DEA by Chug & Guh (Bessent, A., et al 1988) in CCR model. It said to be the analysis of facets defined by hyper plane. When the production function estimates the efficiency, frontier using the input and output, especially in more than two-dimensional space it takes the shape of a diamond edges and facet analysis anchors on the hyper planes of the PPS frontier for DEA classic models. In this case the frontier which is constructed by the hyper plane supports the efficient DMUs in the PPS. (Charnes et al., 1978) developed the facet structure of CCR model, while (Banker et al., 1984) modified the CCR model to BCC model. Similarly, (Daneshvar., 2009) introduced the use of facet analysis in modified VRS through BCC model.

#### **4.3.1 Importance of Facet Analysis**

In evaluating the efficiency of DEA, facet analysis is an important element used to achieve the true evaluated efficiency scores. It gives detailed information about the hyper planes. It gives room for the observer to ascertain areas of improvement base on either to reduce the input and with same amount of output or increase the amount of output and keep the amount of input constant.

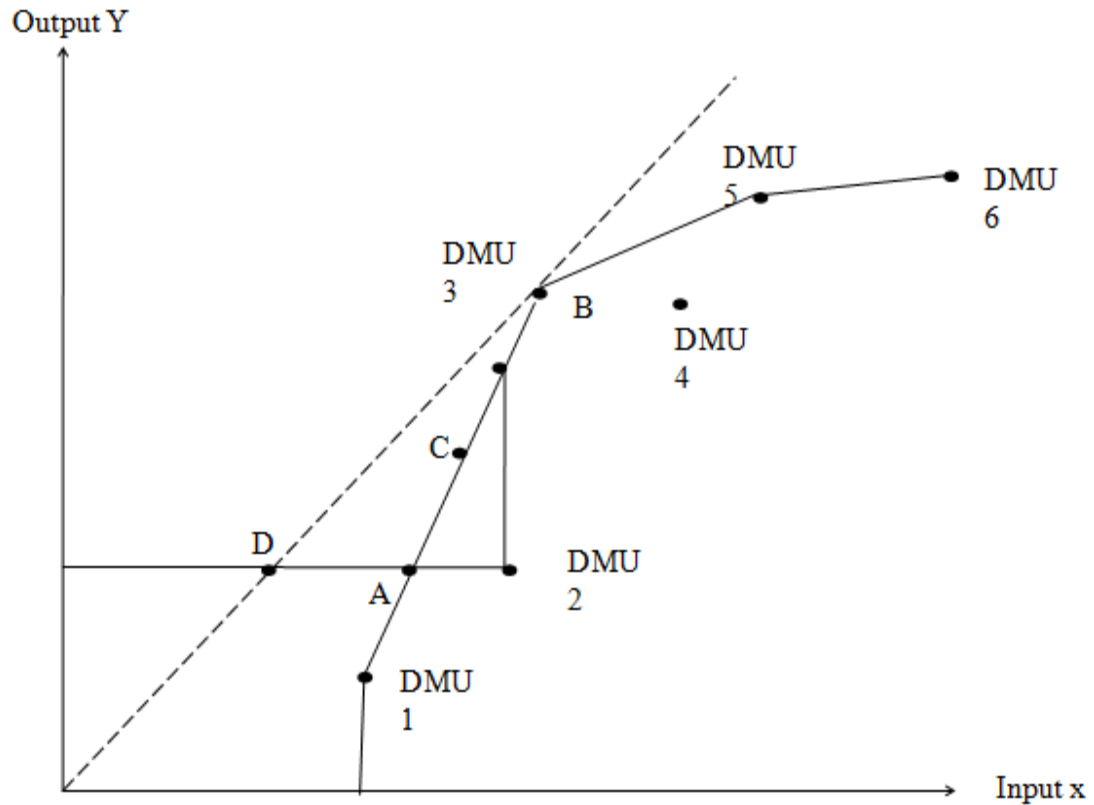


Figure 6: Evaluating the Efficiency Score of DMUs

The facet is an important part of frontier that determines the efficiency scores and therefore managers and analyst rely on it to make decision as illustrated in the figure4.1. For instance, in the figure DMU<sub>2</sub> could be evaluated using facet from DMU<sub>1</sub> to DMU<sub>3</sub> and same is applicable to DMU<sub>3</sub> to DMU<sub>5</sub> which can be used as a benchmark for evaluating DMU<sub>4</sub>. The efficiency of DMU<sub>2</sub> can be improved in these ways, by maintaining the same input and increase the output to point B or reducing the input and keeping the same output at point A. Same operation can also be applicable to DMU<sub>4</sub>

#### 4.3.2 Facet Analysis on Variable Return to Scale

(Charnes et al., 1978) developed the facet structure of CCR model, while (Banker et al., 1984) developed the same for BCC model. Similarly, (Daneshvar., 2009) introduced the use of facet analysis in modified VRS through BCC model. He extended

and generated a stable region for DMUs which are placed on the intersection of efficient and weak efficient frontier.

If we say  $(X_0, Y_0)$  is the efficient DMU to be evaluated, then considering the intersection of the production possibility set and the plane, P is given by ;

$$P = \{(X, Y) / X = \alpha X_0, Y = \beta Y_0, \alpha, \beta \geq 0\} \quad (4.2) \quad \text{we can present this}$$

mathematical formulation as follows;

$$P \cap T = \{(X, Y) / X = \alpha X_0 \geq \sum_{j=1}^n \lambda_j X_j, Y = \beta Y_0 \leq \sum_{j=1}^n \lambda_j Y_j \quad (4.3) \\ \sum_{j=1}^n \lambda_j = 1, \lambda_j \geq 0 \forall (j = 1 \dots n) \forall \alpha, \beta \geq 0\}$$

Considering the new axes  $\alpha$  and  $\beta$  in the plane (P) in figure 4.2 below the equivalent equation is rewritten as follows:

$$\overline{T}(X_0, Y_0) = (\alpha X_0, \beta Y_0) / \alpha X_0 \geq \sum_{j=1}^n \lambda_j X_j, \beta Y_0 \leq \sum_{j=1}^n \lambda_j Y_j, \quad (4.4) \\ \sum_{j=1}^n \lambda_j = 1, \lambda_j \geq 0 \forall (j = 1 \dots n) \forall \alpha, \beta \geq 0$$

If we say  $U^*, V^*$  and  $u_0^*$  is an optimal solution for the BCC model, the efficient point

$\theta^* = 1$  and therefore  $U^{*t} Y_0 + U^{*t} = 1 = V^* X_0$  which is the supporting hyper plane in the input and output spaces passes through  $(X_0, Y_0)$  point.

**Definition 4.1** A hyper plane of PPS is a strongly defined if and only if it is supporting and at least m+s strong efficient DMUs of PPS is lying on it. Its vector gradient components corresponding with output vector are non-negative and components corresponding with input vector are non-positive (Daneshvar S., 2009)

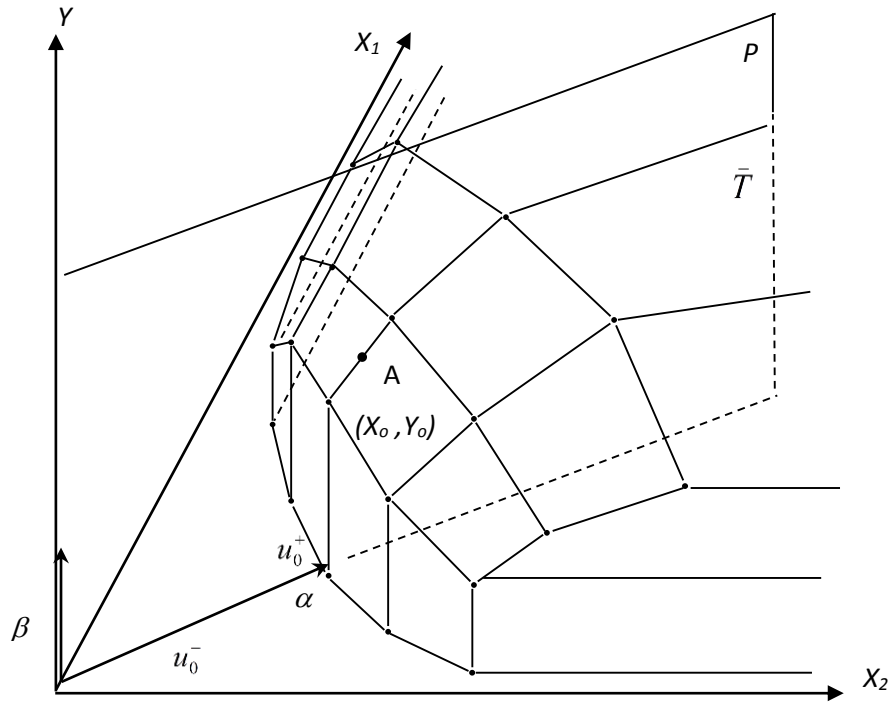


Figure 7: The PPS of two input one output space BCC Model

Banker and Thrall (1988) noted that the production possibility set may have more than one supporting hyper planes at any one of its efficient points. Typical illustration, as seen in Figure 4.1, there are many binding hyper planes in  $A$ . Thus, with respect to normal vectors for these hyper planes the  $u_0^*$  value is not unique at such points. The upper and lower bounds of free variables of all supporting hyper planes that pass through such points in  $\alpha$  and  $\beta$  space can be calculated respectively, as follows

$$\begin{aligned}
 & \text{Max } u_0 \\
 & \text{s.t} \\
 & U'X_0 + u_0 = 1 \\
 & U'Y_j - V^k X_j + u_0 \leq 0 \quad j=1 \dots n \\
 & U \geq 0 \\
 & V \geq 0 \\
 & u_0 \text{ free}
 \end{aligned} \tag{4.5}$$

$$\begin{aligned}
& \text{Min } u_0 \\
& \text{s.t} \\
& U^t X_0 = 1 \\
& U^t Y_j - V^t X_j + u_0 \leq 0 \quad j = 1, \dots, n \\
& U \geq 0 \\
& V \geq 0 \\
& u_0 \text{ free}
\end{aligned} \tag{4.6}$$

We denote  $u_0^-$  and  $u_0^+$ , as the optimal solution for (model 4.5) and (model 4.6) respectively. Observe that,  $u_0^-$  may likely move to  $-\infty$ . Therefore, any optimal solution  $U^*$ ,  $V^*$  and  $u_0^*$  for classical BCC model, the following inequalities hold:

$$u_0^{-*} \leq u_0^* \leq u_0^{+*}$$

**Definition 2** The supporting hyper planes produced by  $u^*$  which satisfy the inequalities  $u_0^{-*} \leq u_0^* \leq u_0^{+*}$  and pass through  $(X_0, Y_0)$ . i.e.  $(U^{*t} Y_0 + U_0^* - v^{*t} X_0 = 0)$  are called admissible supporting hyper planes for  $T_v$ . (Daneshvar S., 2009). By restricting the free variable  $u_0$  the modified variable return to scale model is achieved. This can be illustrated using the input orientation case of the BCC model. (Daneshvar et al., 2014). By using the model equation (4.5) for all the efficient DMUs and obtaining the maximum values excluding one, we assign the values as the upper bound for the free variable in the BCC model. The restriction on this free variable which causes the value of  $u_0$  in optimal solutions to be strictly  $\leq 1$ , can change the weak efficient frontier in PPS. The restriction is defined in such a way that admissible supporting hyper planes are replaced by constructed hyper planes of weak frontier and no changes in other parts

of the frontier. Considering the model (4.6) for all efficient DMUs then  $\varepsilon$  is defined as follows;

$$\varepsilon = \text{Max}\{u^- / u_0^- \neq 0 \text{ for efficient DMUs} \} \quad (4.7)$$

$\varepsilon$  Is considered as the upper bound for free variable of classic BCC model, which is modified as follows:

$$\begin{aligned} & \text{Max} \quad U'Y_0 + u_0 \\ & \text{s.t} \\ & V'X_0 = 1 \\ & U'Y_j - V'X_j + u_0 \leq 0 \quad j=1 \dots n \\ & U \geq 0 \\ & V \geq 0 \\ & u_0 \leq \varepsilon \end{aligned} \quad (4.8)$$

Theorem 4.1 Model (4.4) does not affect the efficiency value of strong efficient DMUs, but rather observed on efficiency value of weak efficient DMUs. See Daneshvar (2009).

#### 4.4 Modified ERM – VRS Model Application

The modification is stands on the supposition that the technical efficient DMUs evaluated by using the regular ERM - VRS model is the DMUs that lie on the weak part of the frontier which get their scores at the weak frontier, however the efficiency score of the strong efficient DMUs remain the same. The production possibility set of the modified BCC and ERM- VRS model is same with the regular BCC model because it is the foundation of the modified BCC method.

The upper bound on free variable used for the modified BCC model is also applied to the ERM – VRS model which also considered the weak part of the frontier by giving the DMUs that falls on it their real efficiency score.

$\varepsilon$  is considered as the upper bound for free variable of ERM – VRS model, which is modified as follows:

$$\begin{aligned}
& \text{Max } u_0 - \sum_{k=1}^m \phi_k \\
& \text{s.t} \\
& \sum_{k=1}^m v_k x_{kj} + u_0 \leq 0 \quad j = 1, \dots, n \\
& \sum_{k=1}^m v_k x_{kj} - \phi_k \leq \frac{1}{M} \quad k = 1 \dots m \\
& 0 \leq \theta_{k0} \leq 1 \\
& v_k \geq 0, \\
& \phi_k \geq 0 \\
& u_0 \leq \varepsilon
\end{aligned} \tag{4.9}$$

The dual model of the modified ERM – VRS model can be written as follows;

$$\begin{aligned}
& \phi_0 = \text{Min } \frac{1}{M} \sum_{k=1}^m \theta_{k0} - \varepsilon \delta \\
& \text{s.t} \\
& \sum_{j=1}^n \lambda_j x_{k0} \leq x_{k0} \cdot \theta_{k0} \quad \forall k \\
& \sum_{j=1}^n \lambda_j = 1 \\
& 0 \leq \theta_{k0} \leq 1 \\
& y_{j0} \geq 0 \quad \forall j
\end{aligned} \tag{4.10}$$

Applying the above ERM – VRS model for all the DMUs would estimate a new efficient value. The new values provide us with the new modified ERM -VRS frontier for efficiency evaluation and with the weakly efficient frontier modified, it would be reflecting the real efficiencies of the DMUs that fall on the frontier.

## Chapter 5

### EMPIRICAL ANALYSIS AND FINDINGS

#### 5.1 Introduction

In this chapter the results of the study from Data Envelopment Analysis is presented. We put forward an empirical analysis, based on the data extracted from the work of (Iozano et al 2008). The approach of the analysis is to evaluate the performance of mussel production raft simply because we are interested in knowing the changes in efficiency score on the prevalent modified DEA efficiency frontier. Here we tried to make a comparison between the model used in the primary article which is the ERM model and the proposed Modified ERM Model. Furthermore, we make comparison between the standard BCC model of Banker et al 1984 and the modified DEA model of Daneshvar (2014). We aimed to see if the ERM model used exaggerate the efficient score of the DMUs and compare it with the exaggeration of the BCC model.

#### 5.2. Findings

The data in appendix (B.1) shows the data set used for the evaluation, 14 inputs and one output is considered. Table 1 presents the results of the BCC model and Modified DEA model in column two and six respectively. Table 2 shows the efficient score of the ERM model and modified ERM model in column two and six respectively.

As can be seen from the table 1, 51 DMUs out of the 62 DMUs are efficient for the BCC model, and 11 are inefficient. However, 29 DMUs are efficient and 22 are inefficient for the modified DEA model. Comparing the number of Efficiency scores among the efficient 51 DMUs in the standard BCC model that changed after applying

the modified DEA model show that 29 DMUs are strongly efficient since there is no change in their efficiency scores. This implies that these 29 DMUs performances are perfectly exaggerated by the standard BCC model. Therefore 21 weak efficient DMUs shows off their real efficiency value or detected using the modified model.

Table 1: Efficiency scores for standard BCC and Modified DEA Model

| <b>DMUs</b> | <b>BCC Eff.<br/>Score</b> | <b>Mod.BCC Eff.<br/>Score</b> | <b>DMUs</b> | <b>BCC Eff.<br/>Score</b> | <b>Mod.BCC<br/>Eff. Score</b> |
|-------------|---------------------------|-------------------------------|-------------|---------------------------|-------------------------------|
| 1           | 100                       | 99.91                         | 32          | 100                       | 99.76                         |
| 2           | 100                       | 99.27                         | 33          | 100                       | 95                            |
| 3           | 100                       | 97.47                         | 34          | 100                       | 100                           |
| 4           | 100                       | 96.81                         | 35          | 100                       | 100                           |
| 5           | 100                       | 97.07                         | 36          | 100                       | 100                           |
| 6           | 100                       | 94.75                         | 37          | 100                       | 100                           |
| 7           | 100                       | 100                           | 38          | 100                       | 99.99                         |
| 8           | 100                       | 100                           | 39          | 100                       | 99.99                         |
| 9           | 100                       | 100                           | 40          | 100                       | 100                           |
| 10          | 100                       | 100                           | 41          | 100                       | 100                           |
| 11          | 100                       | 99.97                         | 42          | 100                       | 100                           |
| 12          | 100                       | 1                             | 43          | 99.95                     | 98.87                         |
| 13          | 100                       | 99.99                         | 44          | 100                       | 100                           |
| 14          | 99.98                     | 99.38                         | 45          | 100                       | 99.92                         |
| 15          | 100                       | 100                           | 46          | 100                       | 99.92                         |
| 16          | 100                       | 100                           | 47          | 100                       | 99.82                         |
| 17          | 100                       | 99.96                         | 48          | 99.95                     | 99.37                         |

|    |       |       |       |        |         |
|----|-------|-------|-------|--------|---------|
| 18 | 100   | 99.95 | 49    | 99.96  | 99.65   |
| 19 | 99.93 | 99.86 | 50    | 100    | 100     |
| 20 | 99.93 | 99.88 | 51    | 100    | 100     |
| 21 | 100   | 99.63 | 52    | 100    | 100     |
| 22 | 100   | 99.67 | 53    | 100    | 100     |
| 23 | 100   | 99.94 | 54    | 100    | 100     |
| 24 | 100   | 99.67 | 55    | 100    | 100     |
| 25 | 100   | 100   | 56    | 100    | 100     |
| 26 | 100   | 100   | 57    | 100    | 99.89   |
| 27 | 100   | 99.82 | 58    | 100    | 100     |
| 28 | 100   | 99.87 | 59    | 100    | 99.36   |
| 29 | 100   | 99.28 | 60    | 100    | 100     |
| 30 | 99.98 | 99.46 | 61    | 100    | 100     |
| 31 | 99.95 | 99.49 | 62    | 100    | 99.98   |
|    |       |       | Total | 6199.5 | 6073.62 |

Total BCC eff. Score = 6199.5      Average = 99.99

Total Mod. BCC eff. Score = 6073.62      Average = 97.96

Looking critically at the changes in the modified BCC model, it could be observed that DMUs 4 and 33 shows significant changes in their efficiency values which indicate that they strongly placed at weak efficiency frontier. These indicates that most of the DMUs that falls in the weak part of the PPS frontier with bias efficiency values are corrected using the modified BCC model. A total BCC efficiency value of 6199.5 is

observed with an average of 99.99% while a total efficiency value of the modified BCC is 6073.62 with an average score of 97.97%.

Table 2: Efficiency scores for ERM-VRS and Modified ERM Model

| <b>DMUs</b> | <b>ERM</b> | <b>Modified<br/>ERM</b> | <b>DMUs</b> | <b>ERM</b> | <b>Modified<br/>ERM</b> |
|-------------|------------|-------------------------|-------------|------------|-------------------------|
| 1           | 67.1       | 51.96                   | 32          | 52.82      | 50.72                   |
| 2           | 75.97      | 74.32                   | 33          | 60.12      | 46.82                   |
| 3           | 53.99      | 50.25                   | 34          | 58.76      | 56.43                   |
| 4           | 55.96      | 55.42                   | 35          | 99.4       | 48.19                   |
| 5           | 50.89      | 50.44                   | 36          | 93.8       | 49.14                   |
| 6           | 53.28      | 53.14                   | 37          | 88.18      | 50.51                   |
| 7           | 65.43      | 65.43                   | 38          | 80.82      | 52.5                    |
| 8           | 68.14      | 68.14                   | 39          | 77.97      | 53.22                   |
| 9           | 70.71      | 70.71                   | 40          | 74.58      | 54.39                   |
| 10          | 99.4       | 67.34                   | 41          | 72.88      | 55.26                   |
| 11          | 100        | 99.4                    | 42          | 71.4       | 55.96                   |
| 12          | 99.4       | 99.4                    | 43          | 53.09      | 39.9                    |
| 13          | 91.86      | 89.26                   | 44          | 64.62      | 35.38                   |
| 14          | 89.15      | 82.81                   | 45          | 63.56      | 47.26                   |
| 15          | 92.3       | 92.3                    | 46          | 61.64      | 51.65                   |
| 16          | 100        | 100                     | 47          | 62.77      | 56.19                   |
| 17          | 65.12      | 59.98                   | 48          | 45.7       | 40.41                   |
| 18          | 63.26      | 59.14                   | 49          | 49.7       | 48.23                   |
| 19          | 53.62      | 50.5                    | 50          | 100        | 68.28                   |

|       |         |         |       |          |           |
|-------|---------|---------|-------|----------|-----------|
| 20    | 54.09   | 51.27   | 51    | 99.4     | 80.81     |
| 21    | 56.5    | 43.21   | 52    | 100      | 100       |
| 22    | 53.96   | 42.96   | 53    | 99.4     | 99.4      |
| 23    | 56.5    | 57.9    | 54    | 92.3     | 92.3      |
| 24    | 50.17   | 49.99   | 55    | 99.4     | 77.48     |
| 25    | 74.3    | 57.64   | 56    | 99.4     | 99.4      |
| 26    | 71.68   | 63.55   | 57    | 72.28    | 65.23     |
| 27    | 69.93   | 65.05   | 58    | 92.3     | 92.3      |
| 28    | 74.97   | 72.29   | 59    | 50.92    | 31.02     |
| 29    | 53.01   | 43.39   | 60    | 99.16    | 51.64     |
| 30    | 50.21   | 46.81   | 61    | 99.4     | 99.4      |
| 31    | 49.06   | 47.01   | 62    | 99.4     | 77.19     |
| Total | 2123.62 | 1987.35 | Total | 2208.524 | 1908.1023 |

Total ERM eff. Score = 4332.144

Average = 69.873

Total Mod. ERM eff. Score = 3895.4523

Average = 62.8298

The efficiency table 5.2 for the ERM model comparisons shows that 4 DMUs are efficient for the ERM model and 2 DMUs are efficient for the modified ERM model. A critical observation show that 47 DMUs though inefficient from the standard ERM – VRS model changed their efficiency score after applying the modified ERM model which indicates that the 47 DMUs are at the weak part of the frontier or are evaluated using the weak part of the efficiency frontier. DMUs 10, 35, 34, 37 and 38 shows a dramatic change in their efficiency values. The rest of remaining 42 indicates slight changes in their efficiency values. Again DMUs 8, 9, 53, 54, 58 and 61 indicates no

change at in the standard ERM model and modified ERM model which ascertain perfect exaggeration of their efficient scores by the two models. A total ERM efficiency value of 4332.15 is observed with an average of 69.87% while a total efficiency value of the modified BCC is 3895.45 with an average score of 62.83%. An efficiency average of 99.99% for the BCC model and 97.96% for the modified DEA model is observed. In addition, an efficiency average of 69.87% and 62.83% is observed for the ERM and modified-ERM model respectively. Based on the efficiency averages and number of DMUs that changed their efficiency scores, it can be concluded that the ERM models, specifically the modified-ERM model is more sensitive than the BCC and modified DEA models.

When we look at the weight distribution average of the variables considered for the efficiency evaluation. Appendix (B) of the weight distribution shows that input 4, input 6, input 9, input 10, which are (wastewater from auxiliary boats, Iron for floats, Nylon and Cotton) contributes the most to the efficiency of the rafts which is believed to be the major source of environmental degradation. However other inputs such as input 1, input 2, input 3, input 5, input 7, input 8, input 11, input 12, input 13 and 14 contributes less to the efficiency of the raft. Therefore, since the input orientation models were considered for the efficiency evaluation, the operators should improve these inputs (4, 6, 9, 10) by reducing their amount in order to improve the rafts performance. To make an analysis into the performances of the 62 rafts considered as DMUs, and provide a recommendation of improvement to the operators. We used the modified ERM model, since it is more sensitive than other models. Finally, despite the performance of the proposed approach, it should be noted that all the systems and processes have some certain differences that cannot be modeled (e.g. local conditions differences). This may require a more detailed approach and process models to understand them better.

## **Chapter 6**

### **CONCLUSION AND FUTURE STUDY**

#### **6.1 Conclusion**

In this thesis research the operational efficiency was determined which ensures the maximum use of production resources while reducing wastes as well as other unproductive inputs. DEA was used in measuring the efficiency and determining the performances of the DMUs. Due to its good sensitive features ERM- VRS DEA model is best proposed approach in this research. Other tools used like the LCA was systematically for assessing the whole life cycle of the inputs consumptions which strongly determine the quality of data used in the analysis. In this case where the number of assessed rafts is high, the interpretation of results using the joint use of LCA and DEA tools has proved helping to improve the discussion and interpretations of results.

Chapter 2 comprehensively presents the review of DEA and LCA and some of the previous research that has been done using these tools. In the chapter 3 the application of DEA was explained in details with its mathematical formulations and robust technique in measuring efficiency. Chapter 4 is the bases of the research in which the concept of facet analysis was introduced and used to ascertain the true efficiency score of the evaluated DMU through reduction of inputs and keeping the same amount output.

It is clear that the four models used (BCC, Modified DEA, ERM and Modified ERM) distinctively shows the performances of the 62 rafts considered. However, this thesis infers that models used in evaluating performances of rafts are also imperative. It can be concluded that the ERM models is more sensitive than the BCC model and modified DEA. However, the modified ERM model tends to be more sensitive and detailed conclusion can be made using the modified ERM model.

## **6.2 Recommendation**

Although DEA has been proved a suitable tool for evaluating efficiency of multiple inputs and outputs DMUs, there are also a number of limitations. Therefore, DEA users should be aware of the specific models capabilities in measuring efficiency of entities because misguided inferences may cause poor DEA model use and greatly influence the results.

A good number of factors may influence the numerical strength of the efficient and efficient DMUs; therefore, sensitivity of the model used should also be investigated. For the ERM model used in this study proved to be more sensitive than standard BCC model and modified DEA model. DEA is data driven that is the amount of data collected has the potential of altering the results positively.

The proposed BCC modification method is input oriented however an output orientation can be considered in the future. Again, the efficiency scores were only evaluated without specific recommendation of the best performing DMUs base on this ranking is also recommended in future as it is a very important aspect of DEA which focuses on helping in improving the performance evaluation.

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## **APPENDICES**

## Appendix A: Optimal Coding Solutions of Modified ERM – VRS Model

Summarized in Table 5.2 (model 4.9)

1

|    | 18:51:24   |                | Thursday  | December        | 08               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.2155           | at bound     | -0.2155            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.1586           | at bound     | -0.1586            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.1822           | at bound     | -0.1822            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.0113           | at bound     | -0.0113            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.2723           | at bound     | -0.2723            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.1819           | at bound     | -0.1819            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.4380           | at bound     | -0.4380            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.2946           | at bound     | -0.2946            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1.1227           | at bound     | -1.1227            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.3462           | at bound     | -0.3462            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.2990           | at bound     | -0.2990            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.5647           | at bound     | -0.5647            | M                  |
| 77 | X78        | 0.5158         | 0.0500    | 0.0258          | 0                | basic        | -0.4505            | 0.1439             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 117.9931         | at bound     | -118.9931          | M                  |
|    | Objective  | Function       | (Min.) =  | -0.4804         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1.7681       | -0.0106            | 0.0002             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0001       | -599.3126          | 0.6875             |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0047       | -4.6013            | 10.3987            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0032       | -4.0898            | 18.4102            |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0010       | -15.2545           | 54.1455            |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0002       | -52.1259           | 254.0741           |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0001       | -650.5919          | 188.1081           |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0009       | -10.5109           | 72.4891            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0001       | -578.4044          | 221.5957           |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0003       | -171.9443          | 49.7557            |
| 11 | X10        | 0.0000         | >=        | 0               | 0                | 0.0022       | -2.8125            | 3.7022             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0006       | -39.9057           | 69.6943            |
| 13 | X12        | 0.0001         | >=        | 0               | 0                | 0.0000       | -1.999,4540        | 414.8458           |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -13.0238           | 13.8762            |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.6527       | -0.0285            | 0.0005             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.4842             | M                  |

2

|    | 18:54:00   |                | Thursday  | December        | 08               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.3044           | at bound     | -0.3044            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.1327           | at bound     | -0.1327            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.1011           | at bound     | -0.1011            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.0758           | at bound     | -0.0758            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.2457           | at bound     | -0.2457            | M                  |
| 70 | DMU56      | 0.4943         | 0         | 0               | 0                | basic        | -0.0476            | 0.0156             |
| 71 | DMU57      | 0              | 0         | 0               | 0.3438           | at bound     | -0.3438            | M                  |
| 72 | DMU58      | 0.0503         | 0         | 0               | 0                | basic        | -0.0302            | 0.0869             |
| 73 | DMU59      | 0              | 0         | 0               | 1.3865           | at bound     | -1.3865            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.4148           | at bound     | -0.4148            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.1980           | at bound     | -0.1980            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.4458           | at bound     | -0.4458            | M                  |
| 77 | X78        | 0.0851         | 0.0500    | 0.0043          | 0                | basic        | -0.0554            | 0.2141             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 195.0934         | at bound     | -196.0934          | M                  |
|    | Objective  | Function       | (Min.) =  | -0.2568         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | -0.0095        | >=        | 0               | 0                | 1.7477       | -0.0066            | 0.0160             |
| 2  | X1         | 0.0476         | >=        | 0               | 0                | 0.0002       | -139.5076          | 39.8116            |
| 3  | X2         | 0.0007         | >=        | 0               | 0                | 0.0028       | -19.7635           | 5.2365             |
| 4  | X3         | -0.0019        | >=        | 0               | 0                | 0.0019       | -9.9523            | 27.5477            |
| 5  | X4         | 0.0035         | >=        | 0               | 0                | 0.0006       | -20.6278           | 94.9722            |
| 6  | X5         | 0.0146         | >=        | 0               | 0                | 0.0001       | -128.3687          | 381.9313           |
| 7  | X6         | -0.1997        | >=        | 0               | 0                | 0.0002       | -36.9405           | 199.1637           |
| 8  | X7         | 0.0198         | >=        | 0               | 0                | 0.0009       | -25.0896           | 57.9104            |
| 9  | X8         | 0.1619         | >=        | 0               | 0                | 0.0001       | -38.3712           | 87.6065            |
| 10 | X9         | 0.0270         | >=        | 0               | 0                | 0.0002       | -330.0052          | 39.4948            |
| 11 | X10        | 0.0028         | >=        | 0               | 0                | 0.0019       | -34.2285           | 4.0715             |
| 12 | X11        | 0.0095         | >=        | 0               | 0                | 0.0006       | -107.5704          | 2.0296             |
| 13 | X12        | 0.6207         | >=        | 0               | 0                | 0.0001       | -87.1176           | 567.2671           |
| 14 | X13        | 0.0051         | >=        | 0               | 0                | 0.0026       | -22.9126           | 3.9874             |
| 15 | X14        | 0.0257         | >=        | 0               | 0                | 0.6439       | -0.0179            | 0.0434             |
| 16 | u0         | 0.9998         | =         | 1.0000          | 0                | 0.0500       | 0.9149             | M                  |

3

|    | 18:58:46   |                | Thursday  | December        | 08               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1699           | at bound     | -0,1699            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1187           | at bound     | -0,1187            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1685           | at bound     | -0,1685            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0319           | at bound     | -0,0319            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2237           | at bound     | -0,2237            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,2035           | at bound     | -0,2035            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4630           | at bound     | -0,4630            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,3778           | at bound     | -0,3778            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,2163           | at bound     | -1,2163            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2776           | at bound     | -0,2776            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,3254           | at bound     | -0,3254            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,6261           | at bound     | -0,6261            | M                  |
| 77 | X78        | 0,1970         | 0,0500    | 0,0098          | 0                | basic        | 0,0259             | 0,0768             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 116,6458         | at bound     | -117,6458          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4958         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,5791       | -0,0245            | 0,0276             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -651,2749          | 98,7251            |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0071       | -6,2930            | 3,7070             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0056       | -4,6267            | 1,6635             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0018       | -20,0871           | 18,4129            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0004       | -75,8060           | 94,2940            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0000       | -191,4987          | 1,526,7010         |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0004       | -74,8924           | 98,0076            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0000       | -855,4866          | 720,3134           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0003       | -204,3902          | 41,0097            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0007       | -19,9666           | 5,6635             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0005       | -33,0205           | 116,9795           |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -2,861,5450        | 2,298,9550         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -21,6014           | 5,2986             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,5831       | -0,0661            | 0,0748             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,8030             | M                  |

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|    | 12:19:56   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 63 | DMU49      | 0              | 0         | 0               | 1,515,3720       | at bound     | -1,515,3720        | M                  |
| 64 | DMU50      | 0,4072         | 0         | 0               | 0                | basic        | -0,0262            | 0,0096             |
| 65 | DMU51      | 0              | 0         | 0               | 0,1667           | at bound     | -0,1667            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1178           | at bound     | -0,1178            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1625           | at bound     | -0,1625            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0434           | at bound     | -0,0434            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2088           | at bound     | -0,2088            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1838           | at bound     | -0,1838            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4228           | at bound     | -0,4228            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,3348           | at bound     | -0,3348            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,1214           | at bound     | -1,1214            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2615           | at bound     | -0,2615            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2970           | at bound     | -0,2970            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,5695           | at bound     | -0,5695            | M                  |
| 77 | X78        | 0,0541         | 0,0500    | 0,0027          | 0                | basic        | 0,0357             | 0,0864             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 118,1540         | at bound     | -119,1540          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4458         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,4425       | -0,0511            | 0,0049             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -807,3315          | 17,6685            |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0062       | -8,7722            | 2,7278             |
| 4  | X3         | 0              | >=        | 0               | 0                | 0,0054       | -1,2592            | 1,0484             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0017       | -23,3485           | 19,0515            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0004       | -91,4966           | 95,6034            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0000       | -199,8237          | 1,518,3760         |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0004       | -99,8119           | 73,0881            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0000       | -1,039,8740        | 535,9257           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0003       | -240,7102          | 31,2898            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0007       | -24,9417           | 2,4569             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0005       | -28,4125           | 121,5875           |
| 13 | X12        | 0,0002         | >=        | 0               | 0                | 0,0000       | -3,164,4490        | 1,996,0510         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -25,4449           | 1,4551             |

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|    | 12:23:51   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1722           | at bound     | -0,1722            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1319           | at bound     | -0,1319            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1481           | at bound     | -0,1481            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0763           | at bound     | -0,0763            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2019           | at bound     | -0,2019            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1775           | at bound     | -0,1775            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3882           | at bound     | -0,3882            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,3116           | at bound     | -0,3116            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,0147           | at bound     | -1,0147            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2457           | at bound     | -0,2457            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2709           | at bound     | -0,2709            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,5048           | at bound     | -0,5048            | M                  |
| 77 | X78        | 0,3327         | 0,0500    | 0,0166          | 0                | basic        | -0,7677            | 0,0582             |
| 78 | g0         | 1,0002         | -1,0000   | -1,0002         | 0                | basic        | -115,2317          | -0,4545            |
|    | Objective  | Function       | (Min.) =  | -0,4956         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 0,0103       | -M                 | 0,0160             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -807,3148          | 167,6853           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0053       | -5,4864            | 8,0136             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0053       | -5,7846            | 7,7154             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0014       | -21,3408           | 28,7592            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -70,6391           | 150,4609           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0000       | -932,7612          | 785,4387           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0004       | -5,6903            | 167,2097           |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0000       | -778,4909          | 797,3091           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -238,7660          | 80,5340            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0007       | -1,5289            | 24,7396            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0005       | -62,5406           | 87,4594            |
| 13 | X12        | 0,0002         | >=        | 0               | 0                | 0,0000       | -2,899,7070        | 2,260,7930         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -17,9493           | 8,9507             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,0024       | -54,3570           | 0,0433             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,6673             | M                  |

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|    | 12:31:03   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1572           | at bound     | -0,1572            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1124           | at bound     | -0,1124            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1467           | at bound     | -0,1467            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0602           | at bound     | -0,0602            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,1844           | at bound     | -0,1844            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1525           | at bound     | -0,1525            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3535           | at bound     | -0,3535            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,2683           | at bound     | -0,2683            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,9526           | at bound     | -0,9526            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2306           | at bound     | -0,2306            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2427           | at bound     | -0,2427            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4600           | at bound     | -0,4600            | M                  |
| 77 | X78        | 0,2560         | 0,0500    | 0,0128          | 0                | basic        | -0,6956            | 0,0554             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 125,1605         | at bound     | -126,1605          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4686         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,2015       | -0,0107            | 0,0371             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -913,8544          | 136,1456           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0049       | -6,7457            | 7,8543             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0049       | -6,3409            | 8,2591             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0013       | -23,5617           | 30,4383            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -79,6439           | 158,4561           |
| 7  | X6         | 0,0001         | >=        | 0               | 0                | 0,0000       | -1,013,4700        | 704,7303           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0004       | -12,8090           | 160,0910           |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0000       | -881,7223          | 694,0778           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -264,9026          | 80,9973            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0007       | -3,4274            | 25,2039            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0005       | -64,1883           | 85,8117            |
| 13 | X12        | -0,0001        | >=        | 0               | 0                | 0,0000       | -3,127,2480        | 2,033,2530         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -20,0132           | 6,8868             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,4436       | -0,0289            | 0,1004             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,7440             | M                  |

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|    | 12:34:15   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2447           | at bound     | -0,2447            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1768           | at bound     | -0,1768            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2176           | at bound     | -0,2176            | M                  |
| 68 | DMU54      | 0,0301         | 0         | 0               | 0                | basic        | -0,1056            | 0,0147             |
| 69 | DMU55      | 0              | 0         | 0               | 0,2859           | at bound     | -0,2859            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,2239           | at bound     | -0,2239            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4876           | at bound     | -0,4876            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,3857           | at bound     | -0,3857            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,2211           | at bound     | -1,2211            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3237           | at bound     | -0,3237            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2732           | at bound     | -0,2732            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,5174           | at bound     | -0,5174            | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 0,0642           | at bound     | -0,0142            | M                  |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 168,4302         | at bound     | -169,4302          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,3457         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,4733       | -0,0100            | 0,0422             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -937,2804          | 743,3196           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0066       | -7,5299            | 3,1701             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0093       | -4,0523            | 3,5477             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0013       | -28,5322           | 27,9678            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -101,6501          | 147,8499           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -706,3734          | 691,5267           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -63,8732           | 74,4268            |
| 9  | X8         | -0,0001        | >=        | 0               | 0                | 0,0001       | -1,092,2430        | 168,4566           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0004       | -22,5351           | 114,8291           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0002       | -7,5445            | 19,4597            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0009       | -61,2469           | 18,7531            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -3,950,3920        | 395,3085           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,5436       | -0,0270            | 0,1141             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | -0,0142      | 0,8167             | 1,0000             |

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|    | 12:43:28   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2288           | at bound     | -0,2288            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1638           | at bound     | -0,1638            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1996           | at bound     | -0,1996            | M                  |
| 68 | DMU54      | 0,0301         | 0         | 0               | 0                | basic        | -0,0983            | 0,0220             |
| 69 | DMU55      | 0              | 0         | 0               | 0,2664           | at bound     | -0,2664            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,2040           | at bound     | -0,2040            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4495           | at bound     | -0,4495            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,3477           | at bound     | -0,3477            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,1400           | at bound     | -1,1400            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3041           | at bound     | -0,3041            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2511           | at bound     | -0,2511            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4744           | at bound     | -0,4744            | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 0,0515           | at bound     | -0,0015            | M                  |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 168,7796         | at bound     | -169,7796          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,3186         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 1,3582       | -0,0115            | 0,0368             |
| 2  | X1         | -0,0001        | >=        | 0               | 0                | 0,0000       | -1,043,6170        | 789,6834           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0061       | -8,1365            | 3,5635             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0086       | -6,0278            | 2,2722             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0012       | -30,0005           | 31,6995            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -105,0963          | 167,0037           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -960,9602          | 436,9398           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -48,9522           | 89,3478            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -1,127,6410        | 133,0586           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0004       | -22,4788           | 73,5453            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0002       | -4,3226            | 25,0829            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0009       | -69,2554           | 10,7446            |
| 13 | X12        | -0,0001        | >=        | 0               | 0                | 0,0000       | -4,050,0850        | 295,6147           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,5011       | -0,0311            | 0,0997             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | -0,0015      | 0,8878             | 1,0000             |

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|    | 12:55:12   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2155           | at bound     | -0,2155            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1528           | at bound     | -0,1528            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1845           | at bound     | -0,1845            | M                  |
| 68 | DMU54      | 0,0299         | 0         | 0               | 0                | basic        | -0,0924            | 0,0428             |
| 69 | DMU55      | 0              | 0         | 0               | 0,2504           | at bound     | -0,2504            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1880           | at bound     | -0,1880            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4185           | at bound     | -0,4185            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,3175           | at bound     | -0,3175            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,0744           | at bound     | -1,0744            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2877           | at bound     | -0,2877            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2328           | at bound     | -0,2328            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4390           | at bound     | -0,4390            | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 0,0407           | at bound     | 0,0093             | M                  |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 169,7038         | at bound     | -170,7038          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,2929         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,2645       | -0,0072            | 0,0162             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -1,150,0120        | 836,0883           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0056       | -8,7429            | 3,8571             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0079       | -8,0002            | 0,9998             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0011       | -31,4657           | 35,3343            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0002       | -108,5263          | 186,2737           |
| 7  | X6         | 0,0001         | >=        | 0               | 0                | 0,0001       | -1,215,5050        | 182,3951           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -33,9970           | 104,3030           |
| 9  | X8         | 0,0001         | >=        | 0               | 0                | 0,0001       | -1,163,0410        | 97,6589            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0003       | -14,8339           | 32,3615            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0002       | -1,0934            | 24,0951            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0009       | -77,2822           | 2,7178             |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -4,149,7460        | 195,9547           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,4665       | -0,0194            | 0,0439             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0093       | 0,9588             | 1,0000             |

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|    | 12:51:02   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,4999           | at bound     | -0,4999            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,5153           | at bound     | -0,5153            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,6443           | at bound     | -0,6443            | M                  |
| 68 | DMU54      | 0,0001         | 0         | 0               | 0                | basic        | -0,6705            | 0,9825             |
| 69 | DMU55      | 0              | 0         | 0               | 0,6274           | at bound     | -0,6274            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,7024           | at bound     | -0,7024            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 1,3842           | at bound     | -1,3842            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 1,3996           | at bound     | -1,3996            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 2,9883           | at bound     | -2,9883            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,6599           | at bound     | -0,6599            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,9335           | at bound     | -0,9335            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 1,8373           | at bound     | -1,8373            | M                  |
| 77 | X78        | 0,5268         | 0,0500    | 0,0263          | 0                | basic        | -0,0215            | 0,2913             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 0                | basic        | -288,0670          | -0,8208            |
|    | Objective  | Function       | (Min.) =  | -0,3266         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 0,0146       | -M                 | 0,0004             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -569,1985          | 2,2015             |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0182       | -3,8746            | 0,0254             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0173       | -4,0425            | 0,0575             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0047       | -15,0888           | 0,0112             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0025       | -0,0603            | 0,1426             |
| 7  | X6         | -0,0001        | >=        | 0               | 0                | 0,0001       | -653,4542          | 744,4458           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -4,5519            | 133,7482           |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -550,9991          | 615,7008           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0013       | -0,0809            | 0,7286             |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0015       | -1,2331            | 17,1115            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -44,0614           | 155,9386           |
| 13 | X12        | -0,0001        | >=        | 0               | 0                | 0,0000       | -2,052,6670        | 2,293,0330         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -12,7280           | 14,1720            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,0014       | -0,3324            | 0,0012             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,4732             | M                  |

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|    | 13:05:51   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,7989           | at bound     | -0,7989            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,7120           | at bound     | -0,7120            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 1,5495           | at bound     | -1,5495            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0                | basic        | -1,5634            | 19,1368            |
| 69 | DMU55      | 0              | 0         | 0               | 4,7406           | at bound     | -4,7406            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 6,6570           | at bound     | -6,6570            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 10,2320          | at bound     | -10,2320           | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 15,3365          | at bound     | -15,3365           | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 21,8013          | at bound     | -21,8013           | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 2,4406           | at bound     | -2,4406            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 4,2369           | at bound     | -4,2369            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 7,7103           | at bound     | -7,7103            | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 0                | basic        | -M                 | 0,2360             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 2,382,3170       | at bound     | -2,383,3170        | M                  |
|    | Objective  | Function       | (Min.) =  | -0,0060         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 27,9732      | -0,0024            | 0                  |
| 2  | X1         | 0              | >=        | 0               | 0                | 0,0001       | -714,3000          | 0                  |
| 3  | X2         | 0              | >=        | 0               | 0                | 0,3185       | 0                  | 0                  |
| 4  | X3         | 0              | >=        | 0               | 0                | 0,0139       | -5,1000            | 0                  |
| 5  | X4         | 0              | >=        | 0               | 0                | 0,0038       | -18,9000           | 0                  |
| 6  | X5         | 0              | >=        | 0               | 0                | 0,0011       | -62,5000           | 0                  |
| 7  | X6         | 0              | >=        | 0               | 0                | 0,0001       | -1,397,9000        | 0                  |
| 8  | X7         | 0              | >=        | 0               | 0                | 0,0005       | -138,3000          | 0                  |
| 9  | X8         | 0              | >=        | 0               | 0                | 0,0001       | -1,166,7000        | 0                  |
| 10 | X9         | 0              | >=        | 0               | 0                | 0,0024       | 0                  | 0                  |
| 11 | X10        | 0              | >=        | 0               | 0                | 0,0115       | 0                  | 0                  |
| 12 | X11        | 0              | >=        | 0               | 0                | 0,0004       | -200,0000          | 0                  |
| 13 | X12        | 0              | >=        | 0               | 0                | 0,0000       | -4,345,7000        | 0                  |
| 14 | X13        | 0              | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0              | >=        | 0               | 0                | 10,3494      | -0,0066            | 0                  |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 1,0000             | M                  |

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|    | 13:10:48   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 251,5531         | at bound     | -251,5531          | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 254,4639         | at bound     | -254,4639          | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 335,2859         | at bound     | -335,2859          | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 495,5529         | at bound     | -495,5529          | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 114,6598         | at bound     | -114,6598          | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 172,3362         | at bound     | -172,3362          | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 374,4773         | at bound     | -374,4773          | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 471,6880         | at bound     | -471,6880          | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,109,5920       | at bound     | -1,109,5920        | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 184,0797         | at bound     | -184,0797          | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 366,8746         | at bound     | -366,8746          | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 671,1049         | at bound     | -671,1049          | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 0                | basic        | -M                 | 0,6612             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 247,5692         | at bound     | -248,5692          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,0060         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 2,4086       | -0,0550            | 0                  |
| 2  | X1         | 0              | >=        | 0               | 0                | 0,0001       | -857,1000          | 0                  |
| 3  | X2         | 0              | >=        | 0               | 0                | 0,0122       | -5,8000            | 0                  |
| 4  | X3         | 0              | >=        | 0               | 0                | 7,8599       | 0                  | 0                  |
| 5  | X4         | 0              | >=        | 0               | 0                | 1,2606       | 0                  | 0                  |
| 6  | X5         | 0              | >=        | 0               | 0                | 2,2837       | 0                  | 0                  |
| 7  | X6         | 0              | >=        | 0               | 0                | 0,0001       | -1,397,9000        | 0                  |
| 8  | X7         | 0              | >=        | 0               | 0                | 0,0005       | -138,3000          | 0                  |
| 9  | X8         | 0              | >=        | 0               | 0                | 0,0001       | -1,166,7000        | 0                  |
| 10 | X9         | 0              | >=        | 0               | 0                | 0,0003       | -254,2000          | 0                  |
| 11 | X10        | 0              | >=        | 0               | 0                | 0,0027       | -26,4000           | 0                  |
| 12 | X11        | 0              | >=        | 0               | 0                | 0,0004       | -200,0000          | 0                  |
| 13 | X12        | 0              | >=        | 0               | 0                | 0,0000       | -4,345,7000        | 0                  |
| 14 | X13        | 0              | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0              | >=        | 0               | 0                | 0,0003       | -278,6000          | 0                  |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 1,0000             | M                  |

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|    | 19:01:50   |                | Thursday  | December        | 08               | 2016         |                    | ▲                  |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 5,0617           | at bound     | -5,0617            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 5,8209           | at bound     | -5,8209            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 7,7544           | at bound     | -7,7544            | M                  |
| 68 | DMU54      | 0,0001         | 0         | 0               | 0                | basic        | -10,2216           | 41,7639            |
| 69 | DMU55      | 0              | 0         | 0               | 3,3277           | at bound     | -3,3277            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 3,5542           | at bound     | -3,5542            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 8,9513           | at bound     | -8,9513            | M                  |
| 72 | DMU58      | 0,0003         | 0         | 0               | 0                | basic        | -13,0467           | 15,6425            |
| 73 | DMU59      | 0              | 0         | 0               | 18,4654          | at bound     | -18,4654           | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 5,6480           | at bound     | -5,6480            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 9,1368           | at bound     | -9,1368            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 18,4549          | at bound     | -18,4549           | M                  |
| 77 | X78        | 0,0428         | 0,0500    | 0,0021          | 0                | basic        | -0,1417            | 0,6590             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 1,065,5470       | at bound     | -1,066,5470        | M                  |
|    | Objective  | Function       | (Min.) =  | -0,1074         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 8,8879       | -0,0053            | 0,0032             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -997,5206          | 2,4794             |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0104       | -6,7799            | 0,0201             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,1815       | -0,0441            | 0,0470             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,1198       | -0,0396            | 0,0726             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0287       | -0,1283            | 0,1614             |
| 7  | X6         | 0,0001         | >=        | 0               | 0                | 0,0001       | -1,331,1030        | 66,7973            |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -50,6183           | 87,6817            |
| 9  | X8         | 0,0001         | >=        | 0               | 0                | 0,0001       | -1,115,7970        | 50,9031            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0143       | -0,0913            | 0,5908             |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0023       | -17,9825           | 12,7175            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -154,5887          | 45,4113            |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -4,156,4090        | 189,2915           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -25,7499           | 1,1501             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 3,2557       | -0,0136            | 0,0084             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,9572             | M                  |

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|    | 19:03:38   |                | Thursday  | December        | 08               | 2016         |                    | ▲                  |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2773           | at bound     | -0,2773            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2742           | at bound     | -0,2742            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,3173           | at bound     | -0,3173            | M                  |
| 68 | DMU54      | 0,0000         | 0         | 0               | 0                | basic        | -0,2964            | 0,2480             |
| 69 | DMU55      | 0              | 0         | 0               | 0,3465           | at bound     | -0,3465            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,3412           | at bound     | -0,3412            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,6725           | at bound     | -0,6725            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,5915           | at bound     | -0,5915            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,4423           | at bound     | -1,4423            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3594           | at bound     | -0,3594            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,4199           | at bound     | -0,4199            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,8178           | at bound     | -0,8178            | M                  |
| 77 | X78        | 0,0581         | 0,0500    | 0,0029          | 0                | basic        | -0,0644            | 0,0683             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 0                | basic        | -282,2651          | -0,8868            |
|    | Objective  | Function       | (Min.) =  | -0,1985         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | -0,0001        | >=        | 0               | 0                | 0,0073       | -M                 | 0                  |
| 2  | X1         | 0,0026         | >=        | 0               | 0                | 0,0001       | -1,139,5370        | 3,3629             |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0091       | -7,7443            | 0,0557             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0087       | -8,1659            | 0,0341             |
| 5  | X4         | 0,0001         | >=        | 0               | 0                | 0,0024       | -30,1242           | 0,0758             |
| 6  | X5         | 0,0004         | >=        | 0               | 0                | 0,0007       | -99,7141           | 0,2859             |
| 7  | X6         | 0,0011         | >=        | 0               | 0                | 0,0001       | -1,316,6270        | 81,2733            |
| 8  | X7         | -0,0001        | >=        | 0               | 0                | 0,0005       | -8,0418            | 130,2582           |
| 9  | X8         | 0,0011         | >=        | 0               | 0                | 0,0001       | -1,098,8670        | 67,8325            |
| 10 | X9         | 0,0003         | >=        | 0               | 0                | 0,0006       | -0,0256            | 1,1604             |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0014       | -2,1608            | 32,3810            |
| 12 | X11        | 0,0001         | >=        | 0               | 0                | 0,0004       | -88,2729           | 111,7271           |
| 13 | X12        | 0,0035         | >=        | 0               | 0                | 0,0000       | -4,093,0430        | 252,6572           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -25,3360           | 1,5640             |
| 15 | X14        | 0,0026         | >=        | 0               | 0                | 0,0005       | -0,6663            | 0                  |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,9419             | M                  |

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|    |            |                |           |                 |                  |              |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
|    | 13:37:11   |                | Wednesday | December        | 07               | 2016         |                    |                    |
| 65 | DMU51      | 0              | 0         | 0               | 5,3978           | at bound     | -5,3978            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 2,1989           | at bound     | -2,1989            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 1,3538           | at bound     | -1,3538            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 1,1787           | at bound     | -1,1787            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 5,4130           | at bound     | -5,4130            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 2,5942           | at bound     | -2,5942            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 4,2909           | at bound     | -4,2909            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0                | basic        | -0,2005            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 8,6575           | at bound     | -8,6575            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 7,5606           | at bound     | -7,5606            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 4,1009           | at bound     | -4,1009            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 4,4075           | at bound     | -4,4075            | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 10,7747          | at bound     | -10,7247           | M                  |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 10,7109          | at bound     | -11,7109           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,0770         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 0,0757       | 0                  | 0                  |
| 2  | X1         | 0              | >=        | 0               | 0                | 0,0001       | -1,285,7000        | 0                  |
| 3  | X2         | 0              | >=        | 0               | 0                | 0,0082       | -8,7000            | 0                  |
| 4  | X3         | 0              | >=        | 0               | 0                | 0,0077       | -9,2000            | 0                  |
| 5  | X4         | 0              | >=        | 0               | 0                | 0,0021       | -34,0000           | 0                  |
| 6  | X5         | 0              | >=        | 0               | 0                | 0,0006       | -112,5000          | 0                  |
| 7  | X6         | 0              | >=        | 0               | 0                | 0,0001       | -1,397,9000        | 0                  |
| 8  | X7         | 138,3000       | >=        | 0               | 138,3000         | 0            | -M                 | 138,3000           |
| 9  | X8         | 0              | >=        | 0               | 0                | 0,0001       | 0                  | 0                  |
| 10 | X9         | 0              | >=        | 0               | 0                | 0,0002       | -381,4000          | 0                  |
| 11 | X10        | 0              | >=        | 0               | 0                | 0,0018       | -39,6000           | 0                  |
| 12 | X11        | 0              | >=        | 0               | 0                | 0,0004       | -200,0000          | 0                  |
| 13 | X12        | 0              | >=        | 0               | 0                | 0,0000       | -4,345,7000        | 0                  |
| 14 | X13        | 0              | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0              | >=        | 0               | 0                | 0,0002       | -418,0000          | 0                  |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | -10,7247     | 1,0000             | 1,0000             |

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| Infeasible             | solution!!! | Make any of | the following   | RHS changes  | and solve the             | problem again.        |
|------------------------|-------------|-------------|-----------------|--------------|---------------------------|-----------------------|
| 12-07-2016<br>13:47:00 | Constraint  | Direction   | Right Hand Side | Shadow Price | Add More Than This To RHS | Add Up To This To RHS |
| 1                      | Y1          | >=          | 0               | 0            | -M                        | -16,6715              |
| 2                      | X1          | >=          | 0               | 0,0000       | -129,1111                 | 1,299,4890            |
| 3                      | X2          | >=          | 0               | -0,0012      | 1,5239                    | 1,5239                |
| 4                      | X3          | >=          | 0               | 0,0070       | -0,6038                   | 9,5962                |
| 5                      | X4          | >=          | 0               | 0,0019       | Not                       | Bound                 |
| 6                      | X5          | >=          | 0               | 0,0006       | Not                       | Bound                 |
| 7                      | X6          | >=          | 0               | 0,0001       | Not                       | Bound                 |
| 8                      | X7          | >=          | 0               | 0            | Not                       | Bound                 |
| 9                      | X8          | >=          | 0               | 0,0000       | Not                       | Bound                 |
| 10                     | X9          | >=          | 0               | 0,0002       | Not                       | Bound                 |
| 11                     | X10         | >=          | 0               | 0,0016       | Not                       | Bound                 |
| 12                     | X11         | >=          | 0               | 0,0004       | Not                       | Bound                 |
| 13                     | X12         | >=          | 0               | 0,0000       | -33,5711                  | 4,312,1290            |
| 14                     | X13         | >=          | 0               | 0,0026       | 0                         | 26,9000               |
| 15                     | X14         | >=          | 0               | 0,0002       | Not                       | Bound                 |
| 16                     | u0          | =           | 1,0000          | 0,7161       | 0                         | 0                     |

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|    | 13:51:04   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.2413           | at bound     | -0.2413            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.2148           | at bound     | -0.2148            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.2567           | at bound     | -0.2567            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.1072           | at bound     | -0.1072            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.2328           | at bound     | -0.2328            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.1704           | at bound     | -0.1704            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.3970           | at bound     | -0.3970            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.1844           | at bound     | -0.1844            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0.9622           | at bound     | -0.9622            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.2967           | at bound     | -0.2967            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.2856           | at bound     | -0.2856            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.5425           | at bound     | -0.5425            | M                  |
| 77 | X78        | 0.2476         | 0.0500    | 0.0124          | 0                | basic        | -0.4147            | 0.1270             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 111.8005         | at bound     | -112.8005          | M                  |
|    | Objective  | Function       | (Min.) =  | -0.4002         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1.4574       | -0.0731            | 0.0001             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0001       | -815.7018          | 324.8981           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0031       | -13.0514           | 9.7485             |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0059       | -0.0290            | 0.8708             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0021       | -28.8248           | 5.3752             |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0003       | -116.6113          | 89.6887            |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0001       | -767.9978          | 396.9022           |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0006       | -77.4625           | 37.8375            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0001       | -867.0269          | 105.1731           |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0003       | -228.2676          | 0.0324             |
| 11 | X10        | 0.0000         | >=        | 0               | 0                | 0.0019       | -20.6940           | 1.2801             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0004       | -42.6640           | 157.3360           |
| 13 | X12        | 0.0001         | >=        | 0               | 0                | 0.0000       | -2.228.3320        | 1.393.0680         |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0032       | -11.7968           | 10.6032            |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.5379       | -0.1974            | 0.0002             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.7524             | M                  |

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|    | 13:57:00   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.2352           | at bound     | -0.2352            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.2088           | at bound     | -0.2088            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.2471           | at bound     | -0.2471            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.1079           | at bound     | -0.1079            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.2266           | at bound     | -0.2266            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.1629           | at bound     | -0.1629            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.3790           | at bound     | -0.3790            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.1720           | at bound     | -0.1720            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0.9193           | at bound     | -0.9193            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.2882           | at bound     | -0.2882            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.2712           | at bound     | -0.2712            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.5124           | at bound     | -0.5124            | M                  |
| 77 | X78        | 0.2301         | 0.0500    | 0.0115          | 0                | basic        | -0.3866            | 0.1351             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 114.6041         | at bound     | -115.6041          | M                  |
|    | Objective  | Function       | (Min.) =  | -0.4082         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1.4013       | -0.0624            | 0.0154             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0001       | -814.8016          | 403.9984           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0029       | -12.6861           | 11.7139            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0055       | -5.3652            | 2.5730             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0019       | -29.9043           | 6.6957             |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0003       | -118.9846          | 101.4153           |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0001       | -814.3358          | 350.5642           |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0006       | -72.3890           | 42.9110            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0001       | -869.1382          | 103.0618           |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0003       | -234.4185          | 8.8815             |
| 11 | X10        | 0.0000         | >=        | 0               | 0                | 0.0019       | -19.3386           | 3.7825             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0004       | -50.2781           | 149.7219           |
| 13 | X12        | 0.0000         | >=        | 0               | 0                | 0.0000       | -2.395.6570        | 1.225.7430         |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0032       | -11.8883           | 10.5117            |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.5172       | -0.1686            | 0.0418             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.7699             | M                  |

|    | 13:59:54   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2472           | at bound     | -0,2472            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2290           | at bound     | -0,2290            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2457           | at bound     | -0,2457            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,1822           | at bound     | -0,1822            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2234           | at bound     | -0,2234            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1714           | at bound     | -0,1714            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3770           | at bound     | -0,3770            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,1987           | at bound     | -0,1987            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,9284           | at bound     | -0,9284            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2757           | at bound     | -0,2757            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2684           | at bound     | -0,2684            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4945           | at bound     | -0,4945            | M                  |
| 77 | X78        | 0,3132         | 0,0500    | 0,0157          | 0                | basic        | -0,1585            | 0,1032             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 0                | basic        | -115,2905          | -0,4550            |
|    | Objective  | Function       | (Min.) =  | -0,4950         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 0,0113       | -M                 | 0                  |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -637,3309          | 659,5692           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0027       | -8,3074            | 17,5926            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0062       | 0                  | 6,0653             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0018       | -28,5065           | 10,3935            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -104,5860          | 129,9140           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -854,1688          | 310,7312           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0006       | -33,6616           | 81,6384            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -693,9557          | 278,2443           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -212,8334          | 94,6666            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0019       | -9,0311            | 14,5387            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -74,5923           | 125,4077           |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -2,655,4040        | 965,9960           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -9,7802            | 17,1198            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,0026       | -86,8348           | 0                  |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,6868             | M                  |

|    | 14:11:17   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2440           | at bound     | -0,2440            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2258           | at bound     | -0,2258            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2412           | at bound     | -0,2412            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,1816           | at bound     | -0,1816            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2202           | at bound     | -0,2202            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1674           | at bound     | -0,1674            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3680           | at bound     | -0,3680            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,1919           | at bound     | -0,1919            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,9071           | at bound     | -0,9071            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2715           | at bound     | -0,2715            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2613           | at bound     | -0,2613            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4799           | at bound     | -0,4799            | M                  |
| 77 | X78        | 0,2867         | 0,0500    | 0,0143          | 0                | basic        | -0,1108            | 0,1071             |
| 78 | g0         | 1,0001         | -1,0000   | -1,0001         | 0                | basic        | -117,2703          | -0,4627            |
|    | Objective  | Function       | (Min.) =  | -0,4873         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | -0,0001        | >=        | 0               | 0                | 0,0109       | -M                 | 0,0072             |
| 2  | X1         | 0,0009         | >=        | 0               | 0                | 0,0001       | -661,8953          | 681,9047           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0026       | -8,6276            | 18,2724            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0060       | -5,4795            | 6,2411             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0018       | -29,6052           | 10,6948            |
| 6  | X5         | 0,0001         | >=        | 0               | 0                | 0,0003       | -108,6171          | 134,3829           |
| 7  | X6         | 0,0061         | >=        | 0               | 0                | 0,0001       | -887,0958          | 277,8042           |
| 8  | X7         | 0,0001         | >=        | 0               | 0                | 0,0006       | -34,9591           | 80,3409            |
| 9  | X8         | 0,0005         | >=        | 0               | 0                | 0,0001       | -720,7023          | 251,4977           |
| 10 | X9         | 0,0001         | >=        | 0               | 0                | 0,0002       | -221,0365          | 98,2635            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0019       | -9,3792            | 15,0990            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -77,4672           | 122,5328           |
| 13 | X12        | 0,0019         | >=        | 0               | 0                | 0,0000       | -2,757,7490        | 863,6509           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -10,1571           | 16,7429            |
| 15 | X14        | 0,0002         | >=        | 0               | 0                | 0,0025       | -77,6332           | 0,0193             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,7133             | M                  |

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|    | 14:14:25   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.2608           | at bound     | -0.2608            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.2115           | at bound     | -0.2115            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.2690           | at bound     | -0.2690            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.1092           | at bound     | -0.1092            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.2811           | at bound     | -0.2811            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.2426           | at bound     | -0.2426            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.5025           | at bound     | -0.5025            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.3384           | at bound     | -0.3384            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1.3240           | at bound     | -1.3240            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.3622           | at bound     | -0.3622            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.3906           | at bound     | -0.3906            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.6898           | at bound     | -0.6898            | M                  |
| 77 | X78        | 0.3650         | 0.0500    | 0.0182          | 0                | basic        | -0.1286            | 0.1612             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 76.3394          | at bound     | -77.3394           | M                  |
|    | Objective  | Function       | (Min.) =  | -0.5679         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0.0000         | >=        | 0               | 0                | 1.2826       | -0.0087            | 0.0400             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0001       | -487.9953          | 845.3047           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0043       | -4.2686            | 12.4314            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0090       | -3.6833            | 1.4623             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0023       | -15.7747           | 15.0253            |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0007       | -57.9633           | 44.7367            |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0000       | -174.9134          | 1.437.9870         |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0004       | -76.6604           | 82.9396            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0000       | -662.5154          | 1.260.5850         |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0004       | -158.8760          | 39.2240            |
| 11 | X10        | 6.3876         | >=        | 0               | 6.3876           | 0            | -M                 | 6.3876             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0014       | -14.3850           | 35.6150            |
| 13 | X12        | -0.0001        | >=        | 0               | 0                | 0.0000       | -2.366.9790        | 2.647.2220         |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -17.0828           | 9.8172             |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.4731       | -0.0236            | 0.1079             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.6350             | M                  |

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|    | 14:20:28   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.2705           | at bound     | -0.2705            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.2281           | at bound     | -0.2281            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.2625           | at bound     | -0.2625            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.1421           | at bound     | -0.1421            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.2848           | at bound     | -0.2848            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.2504           | at bound     | -0.2504            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.4967           | at bound     | -0.4967            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.3508           | at bound     | -0.3508            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1.2892           | at bound     | -1.2892            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.3571           | at bound     | -0.3571            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.3837           | at bound     | -0.3837            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.6637           | at bound     | -0.6637            | M                  |
| 77 | X78        | 0.3366         | 0.0500    | 0.0168          | 0                | basic        | -0.1106            | 0.1877             |
| 78 | g0         | 1.0001         | -1.0000   | -1.0001         | 0                | basic        | -78.0384           | -0.3797            |
|    | Objective  | Function       | (Min.) =  | -0.5704         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0.0000         | >=        | 0               | 0                | 0.0154       | -M                 | 0.0094             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0000       | -491.3195          | 953.0805           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0039       | -3.8893            | 14.2107            |
| 4  | X3         | 0              | >=        | 0               | 0                | 0.0093       | -3.8601            | 1.6352             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0021       | -16.5377           | 16.8623            |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0006       | -59.4060           | 51.8940            |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0000       | -196.1823          | 1.416.7180         |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0004       | -81.4368           | 78.1632            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0000       | -679.3324          | 1.243.7680         |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0003       | -165.2523          | 47.6477            |
| 11 | X10        | 8.3640         | >=        | 0               | 8.3640           | 0            | -M                 | 8.3640             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0014       | -14.8719           | 35.1281            |
| 13 | X12        | 0.0000         | >=        | 0               | 0                | 0.0000       | -2.558.2320        | 2.455.9680         |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -17.8456           | 9.0544             |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.0040       | -50.4582           | 0.0254             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.6634             | M                  |

|    | 14:25:10   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 64 | DMU50      | 0,0602         | 0         | 0               | 0                | basic        | -0,1263            | 0,1003             |
| 65 | DMU51      | 0              | 0         | 0               | 0,3031           | at bound     | -0,3031            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2321           | at bound     | -0,2321            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2711           | at bound     | -0,2711            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,2315           | at bound     | -0,2315            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2765           | at bound     | -0,2765            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,2085           | at bound     | -0,2085            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4180           | at bound     | -0,4180            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,2876           | at bound     | -0,2876            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,1609           | at bound     | -1,1609            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3446           | at bound     | -0,3446            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2918           | at bound     | -0,2918            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4750           | at bound     | -0,4750            | M                  |
| 77 | g0         | 1,0000         | -1,0000   | -1,0000         | 110,2016         | at bound     | -111,2016          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4210         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 0,9653       | -0,0247            | 0,0045             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -923,5290          | 1,632,0710         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0022       | -12,3647           | 19,5353            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0117       | -4,7744            | 0,1358             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0012       | -37,6272           | 21,4728            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0004       | -141,4847          | 55,4153            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0000       | -1,063,2800        | 549,6200           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0004       | -119,7213          | 39,8787            |
| 9  | X8         | 0,0001         | >=        | 0               | 0                | 0,0000       | -1,051,4610        | 871,6393           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -293,3681          | 85,0319            |
| 11 | X10        | 14,6138        | >=        | 0               | 14,6138          | 0            | -M                 | 14,6138            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0014       | -48,8850           | 1,1150             |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -3,644,3520        | 1,369,8490         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -16,5520           | 10,3480            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,3558       | -0,0668            | 0,0121             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | -0,0360      | 0,9878             | 1,1436             |

|    | 19:08:20   |                | Thursday  | December        | 08               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1756           | at bound     | -0,1756            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1570           | at bound     | -0,1570            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1855           | at bound     | -0,1855            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,1128           | at bound     | -0,1128            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,1639           | at bound     | -0,1639            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1256           | at bound     | -0,1256            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2753           | at bound     | -0,2753            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,1643           | at bound     | -0,1643            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,6910           | at bound     | -0,6910            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,1984           | at bound     | -0,1984            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,1887           | at bound     | -0,1887            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,3508           | at bound     | -0,3508            | M                  |
| 77 | X78        | 0,0571         | 0,0500    | 0,0029          | 0                | basic        | -0,3173            | 0,0823             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 102,9051         | at bound     | -103,9051          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,5001         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 0,8680       | -0,0063            | 0,0275             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -885,0648          | 1,781,6350         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0021       | -11,7437           | 21,5563            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0045       | -7,2031            | 4,0258             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0012       | -38,9310           | 22,7690            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -143,7619          | 61,7381            |
| 7  | X6         | 0,0001         | >=        | 0               | 0                | 0,0000       | -1,158,3290        | 454,5709           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0004       | -49,6911           | 109,9089           |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0000       | -961,8885          | 961,2115           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -291,7825          | 101,4175           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0011       | -13,2749           | 18,6354            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -99,0634           | 100,9366           |
| 13 | X12        | -0,0002        | >=        | 0               | 0                | 0,0000       | -3,587,3280        | 1,426,8720         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -13,5201           | 13,3799            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,3203       | -0,0169            | 0,0746             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,9429             | M                  |

|    | 14:39:35   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,3003           | at bound     | -0,3003            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2659           | at bound     | -0,2659            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2891           | at bound     | -0,2891            | M                  |
| 68 | DMU54      | 0,0400         | 0         | 0               | 0                | basic        | -0,0488            | 0,5430             |
| 69 | DMU55      | 0              | 0         | 0               | 0,3067           | at bound     | -0,3067            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1688           | at bound     | -0,1688            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4333           | at bound     | -0,4333            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,1750           | at bound     | -0,1750            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,9105           | at bound     | -0,9105            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3717           | at bound     | -0,3717            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2326           | at bound     | -0,2326            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4472           | at bound     | -0,4472            | M                  |
| 77 | X78        | 0,4112         | 0,0500    | 0,0206          | 0                | basic        | -0,3061            | 0,1186             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 172,1065         | at bound     | -173,1065          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4236         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 2,1638       | -0,0079            | 0,0143             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -706,9127          | 1,293,0870         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0036       | -5,6738            | 14,3262            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0036       | -5,6614            | 14,3386            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0012       | -19,5257           | 40,4743            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -67,7483           | 178,8517           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -810,1409          | 28,5591            |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0009       | -28,2508           | 54,7492            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0002       | -73,3042           | 64,1177            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0005       | -29,7976           | 133,4704           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0033       | -7,1178            | 8,8302             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -41,7750           | 158,2250           |
| 13 | X12        | -0,0001        | >=        | 0               | 0                | 0,0000       | -2,501,2850        | 106,1144           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0037       | -15,8383           | 3,1617             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,7989       | -0,0213            | 0,0388             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,5888             | M                  |

|    | 14:47:39   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,3609           | at bound     | -0,3609            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2699           | at bound     | -0,2699            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2622           | at bound     | -0,2622            | M                  |
| 68 | DMU54      | 0,0519         | 0         | 0               | 0                | basic        | -0,0841            | 0,0318             |
| 69 | DMU55      | 0              | 0         | 0               | 0,3025           | at bound     | -0,3025            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0654           | at bound     | -0,0654            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4015           | at bound     | -0,4015            | M                  |
| 72 | DMU58      | 0,0739         | 0         | 0               | 0                | basic        | -0,0728            | 0,0117             |
| 73 | DMU59      | 0              | 0         | 0               | 1,0192           | at bound     | -1,0192            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3924           | at bound     | -0,3924            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,1244           | at bound     | -0,1244            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,3192           | at bound     | -0,3192            | M                  |
| 77 | X78        | 0,3628         | 0,0500    | 0,0181          | 0                | basic        | -0,5402            | 0,0555             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 200,7495         | at bound     | -201,7495          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,3645         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0183         | >=        | 0               | 0                | 2,2417       | -0,0075            | 0,0016             |
| 2  | X1         | -0,2689        | >=        | 0               | 0                | 0,0000       | -831,7919          | 1,418,2080         |
| 3  | X2         | -0,0017        | >=        | 0               | 0                | 0,0032       | -9,6915            | 12,8085            |
| 4  | X3         | -0,0012        | >=        | 0               | 0                | 0,0032       | -7,8118            | 14,6882            |
| 5  | X4         | -0,0090        | >=        | 0               | 0                | 0,0011       | -15,7662           | 51,7338            |
| 6  | X5         | -0,0399        | >=        | 0               | 0                | 0,0003       | -90,9242           | 186,4758           |
| 7  | X6         | -1,8929        | >=        | 0               | 0                | 0,0001       | -837,6140          | 1,0860             |
| 8  | X7         | -0,0187        | >=        | 0               | 0                | 0,0008       | -69,2120           | 26,1123            |
| 9  | X8         | -0,1707        | >=        | 0               | 0                | 0,0003       | -33,3978           | 109,9060           |
| 10 | X9         | -0,0432        | >=        | 0               | 0                | 0,0005       | -39,0285           | 60,3486            |
| 11 | X10        | -0,0045        | >=        | 0               | 0                | 0,0036       | -14,0995           | 5,4005             |
| 12 | X11        | -0,0108        | >=        | 0               | 0                | 0,0004       | -72,6038           | 127,3962           |
| 13 | X12        | -0,5884        | >=        | 0               | 0                | 0,0001       | -3,1224            | 282,3172           |
| 14 | X13        | -0,0036        | >=        | 0               | 0                | 0,0037       | -17,1396           | 1,8604             |
| 15 | X14        | -0,0494        | >=        | 0               | 0                | 0,8269       | -0,0202            | 0,0044             |
| 16 | u0         | 1,0001         | =         | 1,0000          | 0                | 0,0500       | 0,6372             | M                  |

|    | 14:51:31   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2512           | at bound     | -0,2512            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1668           | at bound     | -0,1668            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1580           | at bound     | -0,1580            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0674           | at bound     | -0,0674            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,1941           | at bound     | -0,1941            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0253           | at bound     | -0,0253            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2677           | at bound     | -0,2677            | M                  |
| 72 | DMU58      | 0,3055         | 0         | 0               | 0                | basic        | -0,1287            | 0,0302             |
| 73 | DMU59      | 0              | 0         | 0               | 0,8262           | at bound     | -0,8262            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2700           | at bound     | -0,2700            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,0807           | at bound     | -0,0807            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,2076           | at bound     | -0,2076            | M                  |
| 77 | X78        | 0,2685         | 0,0500    | 0,0134          | 0                | basic        | -0,0527            | 0,0945             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 158,8878         | at bound     | -159,8878          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,3495         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,4943       | -0,0056            | 0,0160             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -1,098,4360        | 1,568,2640         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0027       | -21,5437           | 5,1563             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0027       | -10,7657           | 15,9343            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0006       | -5,5154            | 2,2734             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0002       | -148,2799          | 180,5201           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -823,7142          | 14,9858            |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -81,3907           | 16,7241            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0002       | -80,7179           | 52,7189            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -291,7108          | 24,5892            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0022       | -27,3218           | 5,4782             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -99,2936           | 100,7064           |
| 13 | X12        | -0,0002        | >=        | 0               | 0                | 0,0001       | -43,3019           | 89,5498            |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -17,9275           | 8,9725             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,5511       | -0,0150            | 0,0436             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,7315             | M                  |

|    | 14:57:13   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,3684           | at bound     | -0,3684            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2501           | at bound     | -0,2501            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2215           | at bound     | -0,2215            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,1751           | at bound     | -0,1751            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2544           | at bound     | -0,2544            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0199           | at bound     | -0,0199            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3059           | at bound     | -0,3059            | M                  |
| 72 | DMU58      | 0,4830         | 0         | 0               | 0                | basic        | -M                 | 0,0225             |
| 73 | DMU59      | 0              | 0         | 0               | 1,0239           | at bound     | -1,0239            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3446           | at bound     | -0,3446            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,0577           | at bound     | -0,0577            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,1426           | at bound     | -0,1426            | M                  |
| 77 | X78        | 0,1820         | 0,0500    | 0,0091          | 0                | basic        | -0,3218            | 0,1235             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 227,5612         | at bound     | -228,5612          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,2771         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,8582       | -0,0034            | 0,0071             |
| 2  | X1         | -0,0001        | >=        | 0               | 0                | 0,0000       | -1,350,6860        | 1,732,6140         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0031       | -1,1791            | 1,0625             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0023       | -17,9191           | 12,8809            |
| 5  | X4         | 7,8326         | >=        | 0               | 7,8326           | 0            | -M                 | 7,8326             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0002       | -211,1036          | 168,9964           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0002       | -43,8049           | 22,4912            |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0009       | -18,0978           | 64,9022            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0003       | -41,6119           | 46,0679            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -349,6169          | 13,9831            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0019       | -36,2860           | 1,4140             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -103,9974          | 96,0026            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0001       | -81,8666           | 146,9077           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -21,9495           | 4,9505             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,6853       | -0,0092            | 0,0193             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,8180             | M                  |

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|    | 15:05:11   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2152           | at bound     | -0,2152            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2099           | at bound     | -0,2099            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2417           | at bound     | -0,2417            | M                  |
| 68 | DMU54      | 0,2134         | 0         | 0               | 0                | basic        | -0,1408            | 0,1093             |
| 69 | DMU55      | 0              | 0         | 0               | 0,2785           | at bound     | -0,2785            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,2284           | at bound     | -0,2284            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4105           | at bound     | -0,4105            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,3224           | at bound     | -0,3224            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,8040           | at bound     | -0,8040            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3032           | at bound     | -0,3032            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2739           | at bound     | -0,2739            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4750           | at bound     | -0,4750            | M                  |
| 77 | X78        | 0,4450         | 0,0500    | 0,0223          | 0                | basic        | -1,3559            | 0,1991             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 98,4748          | at bound     | -99,4748           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,5661         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,3645       | -0,0153            | 0,0752             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -576,8157          | 1,318,9840         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0033       | -5,8666            | 15,8334            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0033       | -9,0864            | 12,6136            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0008       | -21,9827           | 67,4173            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0004       | -85,1842           | 106,2158           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0000       | -736,8715          | 760,8285           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -74,1877           | 74,0123            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -660,5168          | 410,8833           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0004       | -31,2309           | 153,8691           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0019       | -3,1114            | 15,3291            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0007       | -11,1901           | 88,8099            |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -2,256,4540        | 2,399,6460         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0035       | -14,9295           | 5,2705             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,5039       | -0,0412            | 0,2032             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,5550             | M                  |

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|    | 15:11:33   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1675           | at bound     | -0,1675            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1361           | at bound     | -0,1361            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1519           | at bound     | -0,1519            | M                  |
| 68 | DMU54      | 0,2874         | 0         | 0               | 0                | basic        | -0,1122            | 0,0456             |
| 69 | DMU55      | 0              | 0         | 0               | 0,2021           | at bound     | -0,2021            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1403           | at bound     | -0,1403            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2932           | at bound     | -0,2932            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,1906           | at bound     | -0,1906            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,6855           | at bound     | -0,6855            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2417           | at bound     | -0,2417            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,1918           | at bound     | -0,1918            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,3359           | at bound     | -0,3359            | M                  |
| 77 | X78        | 0,2999         | 0,0500    | 0,0150          | 0                | basic        | -0,5359            | 0,1560             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 94,7633          | at bound     | -95,7633           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,5319         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,0231       | -0,0127            | 0,0705             |
| 2  | X1         | -0,0001        | >=        | 0               | 0                | 0,0000       | -709,2827          | 1,711,5180         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0026       | -7,0410            | 20,6590            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0026       | -11,9099           | 15,7901            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0006       | -28,2684           | 85,8316            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -109,0603          | 135,4397           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0000       | -946,1523          | 551,5477           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -94,6818           | 53,5182            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -824,0786          | 247,3215           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0003       | -26,0710           | 246,4290           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0010       | -2,5973            | 21,3857            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0007       | -14,7817           | 85,2183            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -2,912,6750        | 1,743,4260         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0030       | -18,8337           | 4,6663             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,3776       | -0,0344            | 0,1909             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,7001             | M                  |

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|    |            |                |           |                 |                  |              |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
|    | 15:14:21   |                | Wednesday | December        | 07               | 2016         |                    |                    |
| 65 | DMU51      | 0              | 0         | 0               | 0,1433           | at bound     | -0,1433            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,0977           | at bound     | -0,0977            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,0908           | at bound     | -0,0908            | M                  |
| 68 | DMU54      | 0,3455         | 0         | 0               | 0                | basic        | -0,1479            | 0,0063             |
| 69 | DMU55      | 0              | 0         | 0               | 0,1610           | at bound     | -0,1610            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0955           | at bound     | -0,0955            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2354           | at bound     | -0,2354            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,1286           | at bound     | -0,1286            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,6391           | at bound     | -0,6391            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2088           | at bound     | -0,2088            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,1527           | at bound     | -0,1527            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,2698           | at bound     | -0,2698            | M                  |
| 77 | X78        | 0,2514         | 0,0500    | 0,0126          | 0                | basic        | -0,0103            | 0,1233             |
| 78 | g0         | 1,0001         | -1,0000   | -1,0001         | 0                | basic        | -85,6936           | -0,4201            |
|    | Objective  | Function       | (Min.) =  | -0,5299         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 0,0097       | -M                 | 0,0125             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -719,8195          | 1,963,4810         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0023       | -6,7718            | 23,9282            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0023       | -13,6700           | 17,0300            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0006       | -31,3482           | 95,1518            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -119,9448          | 151,0552           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0000       | -1,046,4230        | 451,2767           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -103,4826          | 44,7174            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -861,8150          | 209,5850           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -255,0061          | 0,1225             |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0004       | -27,8056           | 0,0127             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0007       | -17,2259           | 82,7741            |
| 13 | X12        | -0,0002        | >=        | 0               | 0                | 0,0000       | -3,253,0520        | 1,403,0480         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -20,1365           | 6,7635             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,0023       | -67,9717           | 0,0339             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,7486             | M                  |

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|    |            |                |           |                 |                  |              |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
|    | 15:22:12   |                | Wednesday | December        | 07               | 2016         |                    |                    |
| 65 | DMU51      | 0              | 0         | 0               | 0,2097           | at bound     | -0,2097            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1838           | at bound     | -0,1838            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1915           | at bound     | -0,1915            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0320           | at bound     | -0,0320            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2155           | at bound     | -0,2155            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1179           | at bound     | -0,1179            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2786           | at bound     | -0,2786            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,0542           | at bound     | -0,0542            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,6480           | at bound     | -0,6480            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2726           | at bound     | -0,2726            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,1914           | at bound     | -0,1914            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,3578           | at bound     | -0,3578            | M                  |
| 77 | X78        | 0,2862         | 0,0500    | 0,0143          | 0                | basic        | -0,1223            | 0,0980             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 95,6202          | at bound     | -96,6202           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4928         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 1,0736       | -0,0086            | 0,0376             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -762,6085          | 1,237,3920         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0014       | -5,8204            | 44,1796            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0014       | -3,9601            | 46,0399            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0012       | -21,0269           | 38,9731            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0002       | -72,7017           | 256,0983           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -169,7883          | 128,2469           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -28,2938           | 75,5062            |
| 9  | X8         | -0,0001        | >=        | 0               | 0                | 0,0000       | -807,9332          | 692,0668           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0003       | -228,8693          | 22,0307            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0023       | -7,1185            | 15,9051            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -52,9941           | 147,0059           |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -2,893,2790        | 160,7209           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0032       | -19,2013           | 3,1987             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,3960       | -0,0233            | 0,1019             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,7138             | M                  |

|    | 15:26:32   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2536           | at bound     | -0,2536            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1792           | at bound     | -0,1792            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1844           | at bound     | -0,1844            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0809           | at bound     | -0,0809            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,3019           | at bound     | -0,3019            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,2300           | at bound     | -0,2300            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4769           | at bound     | -0,4769            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,3824           | at bound     | -0,3824            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,3071           | at bound     | -1,3071            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3574           | at bound     | -0,3574            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2960           | at bound     | -0,2960            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,5027           | at bound     | -0,5027            | M                  |
| 77 | X78        | 0,5134         | 0,0500    | 0,0257          | 0                | basic        | 0,0171             | 0,1066             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 0                | basic        | -87,1663           | -0,4182            |
|    | Objective  | Function       | (Min.) =  | -0,5318         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 0,0151       | -M                 | 0,0002             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -554,4177          | 695,5823           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0057       | -3,7872            | 8,7128             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0086       | -3,9549            | 4,3451             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0009       | -14,6730           | 62,4270            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0002       | -48,6162           | 291,5838           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -675,4922          | 399,8079           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -67,2315           | 39,1685            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -567,1161          | 330,2839           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0003       | -163,6100          | 81,7900            |
| 11 | X10        | 16,9351        | >=        | 0               | 16,9351          | 0            | -M                 | 16,9351            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0016       | -15,2373           | 0,0971             |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -2,112,5630        | 1,230,2370         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -13,0899           | 13,8101            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,0036       | -89,6336           | 0,0006             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,4866             | M                  |

|    | 15:31:55   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2060           | at bound     | -0,2060            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1249           | at bound     | -0,1249            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1358           | at bound     | -0,1358            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0539           | at bound     | -0,0539            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2365           | at bound     | -0,2365            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1482           | at bound     | -0,1482            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3478           | at bound     | -0,3478            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,2246           | at bound     | -0,2246            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,0433           | at bound     | -1,0433            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2993           | at bound     | -0,2993            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2100           | at bound     | -0,2100            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,3544           | at bound     | -0,3544            | M                  |
| 77 | X78        | 0,2855         | 0,0500    | 0,0143          | 0                | basic        | -0,8646            | 0,0717             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 95,1756          | at bound     | -96,1756           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4357         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 1,0275       | -0,0138            | 0,0134             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -850,8689          | 899,1311           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0041       | -6,6997            | 10,8003            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0061       | -5,7883            | 5,9117             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0007       | -21,5430           | 86,3570            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0001       | -74,2143           | 402,0857           |
| 7  | X6         | -0,0001        | >=        | 0               | 0                | 0,0001       | -954,1819          | 121,1181           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -95,8288           | 10,5712            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -854,5522          | 42,8478            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -240,8706          | 105,0294           |
| 11 | X10        | 21,2135        | >=        | 0               | 21,2135          | 0            | -M                 | 21,2135            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0015       | -0,5133            | 50,7419            |
| 13 | X12        | -0,0001        | >=        | 0               | 0                | 0,0000       | -2,928,2410        | 414,5593           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -19,2213           | 7,6787             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,3788       | -0,0374            | 0,0363             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,7145             | M                  |

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|    | 15:35:15   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.6019           | at bound     | -0.6019            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.4638           | at bound     | -0.4638            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.5157           | at bound     | -0.5157            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.5143           | at bound     | -0.5143            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.5841           | at bound     | -0.5841            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.4230           | at bound     | -0.4230            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.8388           | at bound     | -0.8388            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.3781           | at bound     | -0.3781            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 2.5173           | at bound     | -2.5173            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.7612           | at bound     | -0.7612            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.6626           | at bound     | -0.6626            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 1.0383           | at bound     | -1.0383            | M                  |
| 77 | X78        | 0.6799         | 0.0500    | 0.0340          | 0                | basic        | -0.9353            | 0.1151             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 53.2529          | at bound     | -54.2529           | M                  |
|    | Objective  | Function       | (Min.) =  | -0.5181         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1.3563       | -0.0038            | 0.0552             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0001       | -397.3554          | 802.6446           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0036       | -3.2675            | 16.7325            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0178       | -2.6044            | 1.3956             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0038       | -10.2321           | 8.2679             |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0007       | -35.1928           | 62.8072            |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0001       | -440.3829          | 118.7171           |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0009       | -43.8830           | 39.1170            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0000       | -400.1642          | 1.199.8360         |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0003       | -103.1136          | 133.3864           |
| 11 | X10        | 7.7287         | >=        | 0               | 7.7287           | 0            | -M                 | 7.7287             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0044       | -1.9761            | 12.4091            |
| 13 | X12        | 0.0000         | >=        | 0               | 0                | 0.0001       | -259.6864          | 958.8995           |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -6.6744            | 20.2256            |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.4989       | -0.0103            | 0.1491             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.3201             | M                  |

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|    | 15:41:10   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.5754           | at bound     | -0.5754            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.4396           | at bound     | -0.4396            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.4873           | at bound     | -0.4873            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.4877           | at bound     | -0.4877            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.5536           | at bound     | -0.5536            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.3940           | at bound     | -0.3940            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.7937           | at bound     | -0.7937            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.3452           | at bound     | -0.3452            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 2.4033           | at bound     | -2.4033            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.7254           | at bound     | -0.7254            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.6240           | at bound     | -0.6240            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.9817           | at bound     | -0.9817            | M                  |
| 77 | X78        | 0.6601         | 0.0500    | 0.0330          | 0                | basic        | -0.8498            | 0.1041             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 53.6189          | at bound     | -54.6189           | M                  |
|    | Objective  | Function       | (Min.) =  | -0.5086         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1.3004       | -0.0039            | 0.0555             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0001       | -426.1580          | 833.8420           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0034       | -3.5566            | 17.4434            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0169       | -2.7665            | 1.4335             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0037       | -10.9733           | 8.4267             |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0007       | -37.8299           | 65.0701            |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0001       | -468.5926          | 90.5074            |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0009       | -46.6822           | 36.3178            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0000       | -428.8481          | 1.171.1520         |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0003       | -108.6620          | 139.6380           |
| 11 | X10        | 7.7613         | >=        | 0               | 7.7613           | 0            | -M                 | 7.7613             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0041       | -2.4348            | 12.7458            |
| 13 | X12        | 0.0000         | >=        | 0               | 0                | 0.0001       | -322.6722          | 731.0448           |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -6.7400            | 20.1600            |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.4783       | -0.0106            | 0.1498             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.3399             | M                  |

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|    | 15:44:56   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.5398           | at bound     | -0.5398            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.4071           | at bound     | -0.4071            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.4491           | at bound     | -0.4491            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.4521           | at bound     | -0.4521            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.5127           | at bound     | -0.5127            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.3552           | at bound     | -0.3552            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.7334           | at bound     | -0.7334            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.3022           | at bound     | -0.3022            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 2.2505           | at bound     | -2.2505            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.6772           | at bound     | -0.6772            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.5720           | at bound     | -0.5720            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.9054           | at bound     | -0.9054            | M                  |
| 77 | X78        | 0.6302         | 0.0500    | 0.0315          | 0                | basic        | -0.7375            | 0.0658             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 54.1525          | at bound     | -55.1525           | M                  |
|    | Objective  | Function       | (Min.) =  | -0.4949         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0.0000         | >=        | 0               | 0                | 1.2256       | -0.0041            | 0.0558             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0001       | -469.3668          | 880.6332           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0032       | -3.9903            | 18.5097            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0158       | -3.0097            | 1.4903             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0034       | -12.0851           | 8.7149             |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0006       | -41.7860           | 68.4140            |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0001       | -510.9064          | 48.1936            |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0009       | -50.8810           | 32.1190            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0000       | -471.8780          | 1.128.1220         |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0003       | -116.9854          | 149.1146           |
| 11 | X10        | 7.8099         | >=        | 0               | 7.8099           | 0            | -M                 | 7.8099             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0038       | -3.1229            | 13.2508            |
| 13 | X12        | -0.0001        | >=        | 0               | 0                | 0.0001       | -417.1472          | 389.2680           |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -6.8386            | 20.0614            |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.4508       | -0.0110            | 0.1507             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.3698             | M                  |

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|    | 15:50:27   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.5099           | at bound     | -0.5099            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.3808           | at bound     | -0.3808            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.4131           | at bound     | -0.4131            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.4239           | at bound     | -0.4239            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.4728           | at bound     | -0.4728            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.3093           | at bound     | -0.3093            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.6648           | at bound     | -0.6648            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.2438           | at bound     | -0.2438            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 2.0778           | at bound     | -2.0778            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.6286           | at bound     | -0.6286            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.5065           | at bound     | -0.5065            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.8099           | at bound     | -0.8099            | M                  |
| 77 | X78        | 0.4828         | 0.0500    | 0.0241          | 0                | basic        | 0.0266             | 0.2163             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 56.6020          | at bound     | -57.6020           | M                  |
|    | Objective  | Function       | (Min.) =  | -0.4750         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1.1520       | -0.0023            | 0.0552             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0000       | -688.6888          | 811.3112           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0028       | -6.8869            | 18.1131            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0142       | -3.3893            | 1.6107             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0031       | -18.7386           | 4.3614             |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0006       | -68.0942           | 54.4058            |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0001       | -123.3302          | 199.5019           |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0009       | -69.2523           | 13.7477            |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0000       | -685.2921          | 914.7079           |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0002       | -138.3302          | 157.2698           |
| 11 | X10        | 0.0000         | >=        | 0               | 0                | 0.0003       | -4.3871            | 7.0967             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0034       | -18.9060           | 13.1152            |
| 13 | X12        | 0.0000         | >=        | 0               | 0                | 0.0001       | -382.0257          | 617.9743           |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -4.3516            | 22.5484            |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.4236       | -0.0063            | 0.1484             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.5172             | M                  |

|    | 15:52:23   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,5054           | at bound     | -0,5054            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,3813           | at bound     | -0,3813            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,4115           | at bound     | -0,4115            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,4246           | at bound     | -0,4246            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,4688           | at bound     | -0,4688            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,3056           | at bound     | -0,3056            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,6527           | at bound     | -0,6527            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,2399           | at bound     | -0,2399            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 2,0277           | at bound     | -2,0277            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,6188           | at bound     | -0,6188            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,4937           | at bound     | -0,4937            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,7880           | at bound     | -0,7880            | M                  |
| 77 | X78        | 0,4606         | 0,0500    | 0,0230          | 0                | basic        | 0,0089             | 0,1915             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 58,4745          | at bound     | -59,4745           | M                  |
|    | Objective  | Function       | (Min.) =  |                 | -0,4678          |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,1437       | -0,0025            | 0,0495             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -708,9979          | 851,0021           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0027       | -7,0747            | 18,9253            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0137       | -3,4220            | 1,7780             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0029       | -19,4438           | 4,6562             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0006       | -70,8389           | 56,5611            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0002       | -150,6352          | 172,1969           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0009       | -71,7271           | 11,2729            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0000       | -705,4880          | 894,5120           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -143,6846          | 163,8154           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0005       | -5,3584            | 6,1254             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0033       | -16,5743           | 14,4769            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0001       | -466,6054          | 533,3946           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -4,9897            | 21,9103            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,4206       | -0,0066            | 0,1343             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,5394             | M                  |

|    | 15:58:46   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,4990           | at bound     | -0,4990            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,3815           | at bound     | -0,3815            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,4087           | at bound     | -0,4087            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,4252           | at bound     | -0,4252            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,4627           | at bound     | -0,4627            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,3000           | at bound     | -0,3000            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,6358           | at bound     | -0,6358            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,2316           | at bound     | -0,2316            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,9607           | at bound     | -1,9607            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,6057           | at bound     | -0,6057            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,4767           | at bound     | -0,4767            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,7591           | at bound     | -0,7591            | M                  |
| 77 | X78        | 0,4272         | 0,0500    | 0,0214          | 0                | basic        | -0,0140            | 0,1589             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 61,2293          | at bound     | -62,2293           | M                  |
|    | Objective  | Function       | (Min.) =  |                 | -0,4561          |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,1314       | -0,0026            | 0,0378             |
| 2  | X1         | -0,0001        | >=        | 0               | 0                | 0,0000       | -739,4564          | 910,5436           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0026       | -7,3562            | 20,1438            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0129       | -3,4711            | 2,0289             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0028       | -20,5017           | 4,8983             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0005       | -74,9563           | 59,7437            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0002       | -191,5732          | 131,2589           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0009       | -75,4403           | 7,5597             |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0000       | -735,7806          | 864,2194           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -151,7138          | 173,4862           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0008       | -5,1127            | 4,6691             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0032       | -11,1149           | 16,5200            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0001       | -593,4143          | 406,5857           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -5,9462            | 20,9538            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,4161       | -0,0071            | 0,1023             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,5728             | M                  |

|    |            |                |           |                 |                  |              |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
|    | 16:09:55   |                | Wednesday | December        | 07               | 2016         |                    |                    |
| 65 | DMU51      | 0              | 0         | 0               | 0.4953           | at bound     | -0.4953            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.3819           | at bound     | -0.3819            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.4074           | at bound     | -0.4074            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.4258           | at bound     | -0.4258            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.4594           | at bound     | -0.4594            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.2970           | at bound     | -0.2970            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.6258           | at bound     | -0.6258            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.2283           | at bound     | -0.2283            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1.9191           | at bound     | -1.9191            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.5976           | at bound     | -0.5976            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.4661           | at bound     | -0.4661            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.7409           | at bound     | -0.7409            | M                  |
| 77 | X78        | 0.4051         | 0.0500    | 0.0203          | 0                | basic        | -0.0286            | 0.1378             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 63.1017          | at bound     | -64.1017           | M                  |
|    | Objective  | Function       | (Min.) =  | -0.4474         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | -0.0001        | >=        | 0               | 0                | 1.1246       | -0.0037            | 0.0290             |
| 2  | X1         | 0.0025         | >=        | 0               | 0                | 0.0000       | -760.6247          | 949.3753           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0025       | -7.5745            | 20.9255            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0125       | -3.5131            | 2.1869             |
| 5  | X4         | 0.0001         | >=        | 0               | 0                | 0.0027       | -21.1669           | 5.2331             |
| 6  | X5         | 0.0004         | >=        | 0               | 0                | 0.0005       | -77.6523           | 61.9477            |
| 7  | X6         | 0.0012         | >=        | 0               | 0                | 0.0002       | -222.0116          | 100.8205           |
| 8  | X7         | -0.0001        | >=        | 0               | 0                | 0.0009       | -77.7652           | 5.2348             |
| 9  | X8         | 0.0010         | >=        | 0               | 0                | 0.0000       | -756.1977          | 843.8023           |
| 10 | X9         | 0.0003         | >=        | 0               | 0                | 0.0002       | -157.4628          | 179.5372           |
| 11 | X10        | 0.0000         | >=        | 0               | 0                | 0.0010       | -3.5404            | 3.5864             |
| 12 | X11        | 0.0001         | >=        | 0               | 0                | 0.0031       | -7.6967            | 17.8064            |
| 13 | X12        | 0.0036         | >=        | 0               | 0                | 0.0001       | -687.6998          | 312.3001           |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -6.6803            | 20.2197            |
| 15 | X14        | 0.0026         | >=        | 0               | 0                | 0.4136       | -0.0099            | 0.0786             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.5949             | M                  |

|    |            |                |           |                 |                  |              |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
|    | 16:14:29   |                | Wednesday | December        | 07               | 2016         |                    |                    |
| 65 | DMU51      | 0              | 0         | 0               | 0.4917           | at bound     | -0.4917            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0.3821           | at bound     | -0.3821            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0.4059           | at bound     | -0.4059            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0.4261           | at bound     | -0.4261            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.4561           | at bound     | -0.4561            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.2938           | at bound     | -0.2938            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.6162           | at bound     | -0.6162            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.2241           | at bound     | -0.2241            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1.8808           | at bound     | -1.8808            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.5901           | at bound     | -0.5901            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.4564           | at bound     | -0.4564            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0.7243           | at bound     | -0.7243            | M                  |
| 77 | X78        | 0.3827         | 0.0500    | 0.0191          | 0                | basic        | -0.0418            | 0.1174             |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 64.9481          | at bound     | -65.9481           | M                  |
|    | Objective  | Function       | (Min.) =  | -0.4404         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1.1178       | -0.0029            | 0.0221             |
| 2  | X1         | 0.0000         | >=        | 0               | 0                | 0.0000       | -780.0693          | 989.9307           |
| 3  | X2         | 0.0000         | >=        | 0               | 0                | 0.0024       | -7.7315            | 21.7685            |
| 4  | X3         | 0.0000         | >=        | 0               | 0                | 0.0120       | -3.5365            | 2.3635             |
| 5  | X4         | 0.0000         | >=        | 0               | 0                | 0.0026       | -21.9123           | 5.3877             |
| 6  | X5         | 0.0000         | >=        | 0               | 0                | 0.0005       | -80.4461           | 64.0539            |
| 7  | X6         | 0.0000         | >=        | 0               | 0                | 0.0002       | -197.8813          | 76.6684            |
| 8  | X7         | 0.0000         | >=        | 0               | 0                | 0.0009       | -80.3909           | 2.6091             |
| 9  | X8         | 0.0000         | >=        | 0               | 0                | 0.0000       | -776.1711          | 823.8289           |
| 10 | X9         | 0.0000         | >=        | 0               | 0                | 0.0002       | -162.4202          | 186.3798           |
| 11 | X10        | 0.0000         | >=        | 0               | 0                | 0.0011       | -1.7645            | 2.7272             |
| 12 | X11        | 0.0000         | >=        | 0               | 0                | 0.0030       | -3.8361            | 14.4452            |
| 13 | X12        | 0.0000         | >=        | 0               | 0                | 0.0001       | -762.5131          | 237.4869           |
| 14 | X13        | 0.0000         | >=        | 0               | 0                | 0.0026       | -7.2218            | 19.6782            |
| 15 | X14        | 0.0000         | >=        | 0               | 0                | 0.4111       | -0.0077            | 0.0598             |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | 0.0500       | 0.6173             | M                  |

|    | 16:20:06   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1494           | at bound     | -0,1494            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,0861           | at bound     | -0,0861            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,0884           | at bound     | -0,0884            | M                  |
| 68 | DMU54      | 0,2006         | 0         | 0               | 0                | basic        | -0,1642            | 0,0835             |
| 69 | DMU55      | 0              | 0         | 0               | 0,1843           | at bound     | -0,1843            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1219           | at bound     | -0,1219            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3373           | at bound     | -0,3373            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,2189           | at bound     | -0,2189            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,9668           | at bound     | -0,9668            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2886           | at bound     | -0,2886            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,3029           | at bound     | -0,3029            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,5621           | at bound     | -0,5621            | M                  |
| 77 | x78        | 0,5652         | 0,0500    | 0,0283          | 0                | basic        | 0,0267             | 0,1154             |
| 78 | g0         | 1,0018         | -1,0000   | -1,0018         | 0                | basic        | -86,8353           | -0,3502            |
|    | Objective  | Function       | (Min.) =  | -0,6010         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 0,0167       | -M                 | 0,1076             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0002       | -417,8904          | 48,8096            |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0024       | -3,9355            | 25,1645            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0036       | -7,9326            | 12,0674            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0012       | -18,2119           | 43,4881            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -69,6880           | 202,4120           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -607,6392          | 766,9608           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -60,1162           | 78,1838            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -500,4222          | 760,2777           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -76,2782           | 0,0711             |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0009       | -11,0211           | 0,0074             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0006       | -10,0208           | 99,5792            |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -1,888,9890        | 2,134,8110         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -11,6864           | 15,2136            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,0044       | -18,9566           | 0,2907             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,4348             | M                  |

|    | 16:25:43   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2565           | at bound     | -0,2565            | M                  |
| 66 | DMU52      | 0,2141         | 0         | 0               | 0                | basic        | -0,0093            | 0,0074             |
| 67 | DMU53      | 0,0093         | 0         | 0               | 0                | basic        | -0,0082            | 0,0085             |
| 68 | DMU54      | 0,4665         | 0         | 0               | 0                | basic        | -0,0416            | 0,1033             |
| 69 | DMU55      | 0              | 0         | 0               | 0,3248           | at bound     | -0,3248            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1252           | at bound     | -0,1252            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,4433           | at bound     | -0,4433            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,2009           | at bound     | -0,2009            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,4630           | at bound     | -1,4630            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,6102           | at bound     | -0,6102            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,5263           | at bound     | -0,5263            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,8765           | at bound     | -0,8765            | M                  |
| 77 | x78        | 0              | 0,0500    | 0               | 0,4335           | at bound     | -0,3835            | M                  |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 316,1547         | at bound     | -317,1547          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,3538         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 2,6562       | -0,0003            | 0,0074             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0003       | -5,4309            | 55,7132            |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0012       | -13,1407           | 45,0593            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0018       | -20,5287           | 19,4713            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0006       | -42,8092           | 80,4908            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0001       | -181,2768          | 363,0232           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -1,189,0580        | 185,5417           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -123,3354          | 14,9646            |
| 9  | X8         | 0,0001         | >=        | 0               | 0                | 0,0001       | -1,202,7840        | 57,9157            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0001       | -210,5729          | 4,1502             |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0017       | -30,7220           | 10,0780            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0006       | -37,0352           | 72,5648            |
| 13 | X12        | 0,0002         | >=        | 0               | 0                | 0,0000       | -3,545,0510        | 478,7489           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,9806       | -0,0007            | 0,0200             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | -0,3835      | 0,9865             | 1,0000             |

|    | 16:36:32   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2014           | at bound     | -0,2014            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1371           | at bound     | -0,1371            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1605           | at bound     | -0,1605            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0113           | at bound     | -0,0113            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,1954           | at bound     | -0,1954            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0913           | at bound     | -0,0913            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3179           | at bound     | -0,3179            | M                  |
| 72 | DMU58      | 0,1663         | 0         | 0               | 0                | basic        | -0,0404            | 0,0510             |
| 73 | DMU59      | 0              | 0         | 0               | 0,9150           | at bound     | -0,9150            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3272           | at bound     | -0,3272            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2946           | at bound     | -0,2946            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,5488           | at bound     | -0,5488            | M                  |
| 77 | X78        | 0,5548         | 0,0500    | 0,0277          | 0                | basic        | -0,8466            | 0,1841             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 92,7175          | at bound     | -93,7175           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,5274         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,4643       | -0,0040            | 0,0043             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -645,3422          | 154,6578           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0015       | -11,5278           | 36,4722            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0022       | -6,8246            | 25,1754            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0024       | -14,3613           | 0,7976             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0004       | -79,7627           | 83,5373            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -519,3893          | 529,0107           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -48,8847           | 54,9153            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -450,2573          | 199,7427           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0003       | -173,1071          | 63,3929            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0014       | -13,0486           | 0,8057             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0007       | -18,7776           | 81,2224            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -1,637,9410        | 1,681,6590         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -11,9759           | 14,9241            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,5403       | -0,0109            | 0,0116             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,4452             | M                  |

|    | 16:38:52   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1908           | at bound     | -0,1908            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1294           | at bound     | -0,1294            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1434           | at bound     | -0,1434            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0290           | at bound     | -0,0290            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,1835           | at bound     | -0,1835            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0790           | at bound     | -0,0790            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2752           | at bound     | -0,2752            | M                  |
| 72 | DMU58      | 0,2079         | 0         | 0               | 0                | basic        | -0,1036            | 0,0509             |
| 73 | DMU59      | 0              | 0         | 0               | 0,8051           | at bound     | -0,8051            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2970           | at bound     | -0,2970            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2422           | at bound     | -0,2422            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4428           | at bound     | -0,4428            | M                  |
| 77 | X78        | 0,4435         | 0,0500    | 0,0222          | 0                | basic        | -0,5091            | 0,1845             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 102,1296         | at bound     | -103,1296          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4835         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,2891       | -0,0051            | 0,0054             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -806,6833          | 193,3167           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0012       | -14,4099           | 45,5901            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0018       | -8,5308            | 31,4692            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0018       | -14,3621           | 0,9967             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -99,7040           | 104,3960           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -649,2366          | 399,1634           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -61,1069           | 42,6931            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -562,8264          | 87,1737            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -216,3847          | 79,2153            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0014       | -16,3110           | 1,0069             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0007       | -23,4714           | 76,5286            |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -2,047,4230        | 1,272,1770         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -14,9699           | 11,9301            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,4756       | -0,0136            | 0,0145             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,5565             | M                  |

|    | 16:47:00   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1924           | at bound     | -0,1924            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1223           | at bound     | -0,1223            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1263           | at bound     | -0,1263            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,0344           | at bound     | -0,0344            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,1759           | at bound     | -0,1759            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0520           | at bound     | -0,0520            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2409           | at bound     | -0,2409            | M                  |
| 72 | DMU58      | 0,2518         | 0         | 0               | 0                | basic        | -0,0920            | 0,0869             |
| 73 | DMU59      | 0              | 0         | 0               | 0,7367           | at bound     | -0,7367            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2851           | at bound     | -0,2851            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,1840           | at bound     | -0,1840            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,3315           | at bound     | -0,3315            | M                  |
| 77 | X78        | 0,3261         | 0,0500    | 0,0163          | 0                | basic        | -0,1581            | 0,2001             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 130,9656         | at bound     | -131,9656          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4381         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,3746       | -0,0061            | 0,0023             |
| 2  | X1         | -0,0001        | >=        | 0               | 0                | 0,0001       | -978,8026          | 221,1975           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0010       | -17,5486           | 54,4514            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0015       | -10,2669           | 37,7331            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0010       | -22,8294           | 0,6969             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0003       | -120,7575          | 124,1425           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -788,3564          | 260,0436           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -76,3783           | 27,4217            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0002       | -25,3766           | 25,2449            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -260,4153          | 94,3847            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0015       | -12,6465           | 0,5754             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0007       | -27,3691           | 72,6309            |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -2,486,0700        | 833,5298           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -18,1273           | 8,7727             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,5073       | -0,0164            | 0,0061             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,6739             | M                  |

|    | 16:49:40   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1717           | at bound     | -0,1717            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1628           | at bound     | -0,1628            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1796           | at bound     | -0,1796            | M                  |
| 68 | DMU54      | 0,2678         | 0         | 0               | 0                | basic        | -0,0825            | 0,0737             |
| 69 | DMU55      | 0              | 0         | 0               | 0,2113           | at bound     | -0,2113            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1525           | at bound     | -0,1525            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2900           | at bound     | -0,2900            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,1507           | at bound     | -0,1507            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,5934           | at bound     | -0,5934            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2478           | at bound     | -0,2478            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2073           | at bound     | -0,2073            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,3576           | at bound     | -0,3576            | M                  |
| 77 | X78        | 0,3911         | 0,0500    | 0,0196          | 0                | basic        | -0,8975            | 0,1742             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 82,8861          | at bound     | -83,8861           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,5959         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,0107       | -0,0047            | 0,1153             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -598,9579          | 1,578,1420         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0017       | -5,7728            | 35,9272            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0017       | -10,7943           | 30,9057            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0009       | -25,1089           | 51,9911            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0002       | -96,4106           | 243,7894           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -839,0464          | 558,8536           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -83,4119           | 54,8881            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -707,7725          | 552,9274           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0003       | -9,6820            | 235,7180           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0017       | -0,9646            | 19,9234            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0006       | -13,5045           | 96,0955            |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -2,597,6660        | 1,748,0340         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -16,3800           | 10,5200            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,3731       | -0,0128            | 0,3112             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,6089             | M                  |

|    | 16:55:55   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,1433           | at bound     | -0,1433            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1161           | at bound     | -0,1161            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,1206           | at bound     | -0,1206            | M                  |
| 68 | DMU54      | 0,3774         | 0         | 0               | 0                | basic        | -0,0649            | 0,0318             |
| 69 | DMU55      | 0              | 0         | 0               | 0,1652           | at bound     | -0,1652            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0965           | at bound     | -0,0965            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,2114           | at bound     | -0,2114            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,0719           | at bound     | -0,0719            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,5028           | at bound     | -0,5028            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2078           | at bound     | -0,2078            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,1463           | at bound     | -0,1463            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,2501           | at bound     | -0,2501            | M                  |
| 77 | X78        | 0,1416         | 0,0500    | 0,0071          | 0                | basic        | -0,3586            | 0,1543             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 89,9484          | at bound     | -90,9484           | M                  |
|    | Objective  | Function       | {Min.} =  | -0,5177         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 0,7773       | -0,0067            | 0,0750             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -844,3391          | 2.203,5610         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0012       | -8,1380            | 50,1620            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0012       | -15,2158           | 43,0842            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0007       | -35,3945           | 72,5055            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0001       | -135,9044          | 340,3956           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -1.182,7520        | 215,1480           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -117,5811          | 20,7189            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -997,7225          | 262,9775           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -13,6592           | 332,2408           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0011       | -1,3608            | 28,0841            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0006       | -19,0361           | 90,5639            |
| 13 | X12        | -0,0001        | >=        | 0               | 0                | 0,0000       | -3.661,7580        | 683,9425           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -23,0902           | 3,8098             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,2868       | -0,0180            | 0,2030             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,8584             | M                  |

|    | 16:58:33   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2176           | at bound     | -0,2176            | M                  |
| 66 | DMU52      | 0,1738         | 0         | 0               | 0                | basic        | -0,0128            | 0,0792             |
| 67 | DMU53      | 0              | 0         | 0               | 0,1810           | at bound     | -0,1810            | M                  |
| 68 | DMU54      | 0,1775         | 0         | 0               | 0                | basic        | -0,3779            | 0,0102             |
| 69 | DMU55      | 0              | 0         | 0               | 0,6369           | at bound     | -0,6369            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,6743           | at bound     | -0,6743            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 1,5513           | at bound     | -1,5513            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 1,7147           | at bound     | -1,7147            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 4,3490           | at bound     | -4,3490            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 1,0146           | at bound     | -1,0146            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 1,5362           | at bound     | -1,5362            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 2,8279           | at bound     | -2,8279            | M                  |
| 77 | X78        | 0,6230         | 0,0500    | 0,0312          | 0                | basic        | -2,8894            | 0,0919             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 333,0162         | at bound     | -334,0162          | M                  |
|    | Objective  | Function       | {Min.} =  | -0,3172         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 6,6803       | -0,0004            | 0,0028             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0009       | -107,1153          | 16,0363            |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0203       | -3,3032            | 0,1968             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0071       | -9,0085            | 0,9915             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0038       | -17,0529           | 1,4471             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0009       | -70,2362           | 6,5638             |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -497,4662          | 550,9338           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -49,2596           | 54,5404            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -405,3898          | 444,6102           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0005       | -137,6843          | 66,0713            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0048       | -12,7621           | 1,9379             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0014       | -17,5726           | 32,4274            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -1.545,6990        | 1.713,6010         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -10,1405           | 16,7595            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 2,4689       | -0,0011            | 0,0076             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,3770             | M                  |

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|    |            |                |           |                 |                  |              |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
|    | 17:06:03   |                | Wednesday | December        | 07               | 2016         |                    |                    |
| 65 | DMU51      | 0              | 0         | 0               | 0,1859           | at bound     | -0,1859            | M                  |
| 66 | DMU52      | 0,3655         | 0         | 0               | 0                | basic        | -0,0706            | 0,0814             |
| 67 | DMU53      | 0              | 0         | 0               | 0,1608           | at bound     | -0,1608            | M                  |
| 68 | DMU54      | 0,1747         | 0         | 0               | 0                | basic        | -0,1398            | 0,0565             |
| 69 | DMU55      | 0              | 0         | 0               | 0,5992           | at bound     | -0,5992            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,6086           | at bound     | -0,6086            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 1,3899           | at bound     | -1,3899            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 1,5876           | at bound     | -1,5876            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 3,8424           | at bound     | -3,8424            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 1,0128           | at bound     | -1,0128            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 1,5187           | at bound     | -1,5187            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 2,7499           | at bound     | -2,7499            | M                  |
| 77 | X78        | 0,3859         | 0,0500    | 0,0193          | 0                | basic        | -M                 | 0,1483             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 518,3515         | at bound     | -519,3515          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,1919         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 6,4919       | -0,0010            | 0,0043             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0010       | -20,3961           | 21,5406            |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0127       | -5,0340            | 0,5660             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0044       | -13,1479           | 2,8521             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0024       | -25,4372           | 4,1628             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0006       | -103,9516          | 18,9484            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -795,6475          | 252,7525           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -78,8310           | 24,9690            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -651,0363          | 198,9637           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0004       | -84,8202           | 89,5798            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0066       | -2,3194            | 2,4495             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0014       | -27,0331           | 22,9669            |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -2,471,1680        | 788,1321           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -16,5185           | 10,3815            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 2,3995       | -0,0028            | 0,0115             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,6141             | M                  |

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| Infeasible             | solution!!! | Make any of | the following   | RHS changes  | and solve the             | problem again.        |
|------------------------|-------------|-------------|-----------------|--------------|---------------------------|-----------------------|
| 12-07-2016<br>17:10:36 | Constraint  | Direction   | Right Hand Side | Shadow Price | Add More Than This To RHS | Add Up To This To RHS |
| 1                      | Y1          | >=          | 0               | 0            | -M                        | 0,0000                |
| 2                      | X1          | >=          | 0               | 0,0000       | Not                       | Bound                 |
| 3                      | X2          | >=          | 0               | -0,0103      | 0                         | 0                     |
| 4                      | X3          | >=          | 0               | 0,0036       | 0                         | 20,0000               |
| 5                      | X4          | >=          | 0               | -0,0041      | Not                       | Bound                 |
| 6                      | X5          | >=          | 0               | 0,0005       | Not                       | Bound                 |
| 7                      | X6          | >=          | 0               | 0,0001       | Not                       | Bound                 |
| 8                      | X7          | >=          | 0               | 0,0006       | Not                       | Bound                 |
| 9                      | X8          | >=          | 0               | -0,0001      | Not                       | Bound                 |
| 10                     | X9          | >=          | 0               | 0,0002       | Not                       | Bound                 |
| 11                     | X10         | >=          | 0               | 0,0019       | 0                         | 36,5000               |
| 12                     | X11         | >=          | 0               | 0,0014       | 0                         | 50,0000               |
| 13                     | X12         | >=          | 0               | 0,0000       | Not                       | Bound                 |
| 14                     | X13         | >=          | 0               | 0,0026       | Not                       | Bound                 |
| 15                     | X14         | >=          | 0               | 0,0002       | Not                       | Bound                 |
| 16                     | u0          | =           | 1,0000          | 0,3828       | 0                         | 0                     |

|    | 17:16:02   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0.1895           | at bound     | -0.1895            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0                | basic        | -0.0961            | 0.0095             |
| 67 | DMU53      | 1.0000         | 0         | 0               | 0                | basic        | -0.0095            | 0.0210             |
| 68 | DMU54      | 0              | 0         | 0               | 0.0205           | at bound     | -0.0205            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0.3946           | at bound     | -0.3946            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0.3327           | at bound     | -0.3327            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0.7975           | at bound     | -0.7975            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0.7821           | at bound     | -0.7821            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 2.3879           | at bound     | -2.3879            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0.6647           | at bound     | -0.6647            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0.8427           | at bound     | -0.8427            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 1.4719           | at bound     | -1.4719            | M                  |
| 77 | X78        | 0              | 0.0500    | 0               | 0.1035           | at bound     | -0.0535            | M                  |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 0.2793           | at bound     | -1.2793            | M                  |
|    | Objective  | Function       | (Min.) =  | -0.0060         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 0.0093       | 0                  | 0                  |
| 2  | X1         | 0              | >=        | 0               | 0                | 0.0005       | 0                  | 0                  |
| 3  | X2         | 0              | >=        | 0               | 0                | 0.0085       | -8.4000            | 0                  |
| 4  | X3         | 0              | >=        | 0               | 0                | 0.0030       | -24.0000           | 0                  |
| 5  | X4         | 0              | >=        | 0               | 0                | 0.0016       | -44.4000           | 0                  |
| 6  | X5         | 0              | >=        | 0               | 0                | 0.0004       | -184.4000          | 0                  |
| 7  | X6         | 0              | >=        | 0               | 0                | 0.0001       | -1.233.4000        | 0                  |
| 8  | X7         | 0              | >=        | 0               | 0                | 0.0006       | -122.1000          | 0                  |
| 9  | X8         | 0              | >=        | 0               | 0                | 0.0001       | -1.000.0000        | 0                  |
| 10 | X9         | 0              | >=        | 0               | 0                | 0.0002       | -384.3000          | 0                  |
| 11 | X10        | 0              | >=        | 0               | 0                | 0.0018       | -39.9000           | 0                  |
| 12 | X11        | 0              | >=        | 0               | 0                | 0.0014       | -50.0000           | 0                  |
| 13 | X12        | 0              | >=        | 0               | 0                | 0.0000       | -3.834.4000        | 0                  |
| 14 | X13        | 0              | >=        | 0               | 0                | 0.0026       | -26.9000           | 0                  |
| 15 | X14        | 0              | >=        | 0               | 0                | 0.0002       | -371.3000          | 0                  |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | -0.0535      | 1.0000             | 1.0000             |

|    | 17:21:30   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 6.1967           | at bound     | -6.1967            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 1.2700           | at bound     | -1.2700            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0                | basic        | -M                 | 0.0542             |
| 68 | DMU54      | 1.0000         | 0         | 0               | 0                | basic        | -0.0490            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 7.0078           | at bound     | -7.0078            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 2.9356           | at bound     | -2.9356            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 5.7754           | at bound     | -5.7754            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0                | basic        | -M                 | 0.3760             |
| 73 | DMU59      | 0              | 0         | 0               | 14.5661          | at bound     | -14.5661           | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 10.5950          | at bound     | -10.5950           | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 5.9799           | at bound     | -5.9799            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 7.0970           | at bound     | -7.0970            | M                  |
| 77 | X78        | 0              | 0.0500    | 0               | 13.9302          | at bound     | -13.8802           | M                  |
| 78 | g0         | 1.0000         | -1.0000   | -1.0000         | 15.1556          | at bound     | -16.1556           | M                  |
|    | Objective  | Function       | (Min.) =  | -0.0770         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 0.1154       | -0.4474            | 0                  |
| 2  | X1         | 0              | >=        | 0               | 0                | 0.0010       | -71.7627           | 0                  |
| 3  | X2         | 0              | >=        | 0               | 0                | 0.0192       | 0                  | 0                  |
| 4  | X3         | 0              | >=        | 0               | 0                | 0.0024       | -30.0000           | 0                  |
| 5  | X4         | 0              | >=        | 0               | 0                | 0.0013       | -55.5000           | 0                  |
| 6  | X5         | 0              | >=        | 0               | 0                | 0.0003       | -230.5000          | 0                  |
| 7  | X6         | 0              | >=        | 0               | 0                | 0.0001       | -1.397.9000        | 0                  |
| 8  | X7         | 0              | >=        | 0               | 0                | 0.0005       | -138.3000          | 0                  |
| 9  | X8         | 0              | >=        | 0               | 0                | 0.0002       | 0                  | 0                  |
| 10 | X9         | 393.2000       | >=        | 0               | 393.2000         | 0            | -M                 | 393.2000           |
| 11 | X10        | 0              | >=        | 0               | 0                | 0.0017       | -40.8000           | 0                  |
| 12 | X11        | 0              | >=        | 0               | 0                | 0.0095       | 0                  | 0                  |
| 13 | X12        | 0              | >=        | 0               | 0                | 0.0000       | -4.345.7000        | 0                  |
| 14 | X13        | 0              | >=        | 0               | 0                | 0.0026       | -26.9000           | 0                  |
| 15 | X14        | 0              | >=        | 0               | 0                | 0.0002       | -378.0000          | 0                  |
| 16 | u0         | 1.0000         | =         | 1.0000          | 0                | -13.8802     | 1.0000             | 1.0000             |

|    | 17:25:15   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2766           | at bound     | -0,2766            | M                  |
| 66 | DMU52      | 0,1882         | 0         | 0               | 0                | basic        | -0,0413            | 0,1218             |
| 67 | DMU53      | 0              | 0         | 0               | 0,0963           | at bound     | -0,0963            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,1424           | at bound     | -0,1424            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2068           | at bound     | -0,2068            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0070           | at bound     | -0,0070            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,6851           | at bound     | -0,6851            | M                  |
| 72 | DMU58      | 0,0611         | 0         | 0               | 0                | basic        | -0,1856            | 0,0154             |
| 73 | DMU59      | 0              | 0         | 0               | 2,7414           | at bound     | -2,7414            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,7225           | at bound     | -0,7225            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,8814           | at bound     | -0,8814            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 1,7194           | at bound     | -1,7194            | M                  |
| 77 | X78        | 0,4250         | 0,0500    | 0,0212          | 0                | basic        | -0,0670            | 0,1617             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 375,9802         | at bound     | -376,9802          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,2252         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 4,7123       | -0,0051            | 0,0024             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0006       | -85,0707           | 19,2072            |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0042       | -8,1463            | 8,9537             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0084       | -7,3740            | 1,1260             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0068       | -2,6417            | 1,2650             |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0007       | -89,5521           | 6,7479             |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -710,7833          | 127,9168           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -21,3404           | 8,6137             |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0004       | -14,4697           | 11,5578            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -211,8083          | 95,6917            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0022       | -20,1039           | 11,7961            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0007       | -73,0155           | 26,9845            |
| 13 | X12        | 0,0001         | >=        | 0               | 0                | 0,0000       | -2,212,1700        | 187,8301           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -14,0360           | 12,8640            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 1,7401       | -0,0136            | 0,0066             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,5750             | M                  |

|    | 17:30:38   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 1,0998           | at bound     | -1,0998            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,6468           | at bound     | -0,6468            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,5558           | at bound     | -0,5558            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,8861           | at bound     | -0,8861            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,5859           | at bound     | -0,5859            | M                  |
| 70 | DMU56      | 1,0000         | 0         | 0               | 0                | basic        | -0,0161            | 0,1076             |
| 71 | DMU57      | 0              | 0         | 0               | 0,9308           | at bound     | -0,9308            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0                | basic        | -8,7111            | 0,1098             |
| 73 | DMU59      | 0              | 0         | 0               | 3,5257           | at bound     | -3,5257            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 1,0582           | at bound     | -1,0582            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,5682           | at bound     | -0,5682            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 1,1179           | at bound     | -1,1179            | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 0,3265           | at bound     | -0,2765            | M                  |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 1,7424           | at bound     | -2,7424            | M                  |
|    | Objective  | Function       | (Min.) =  | -0,0060         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 0,0229       | 0                  | 0                  |
| 2  | X1         | 0              | >=        | 0               | 0                | 0,0001       | -897,4000          | 0                  |
| 3  | X2         | 0              | >=        | 0               | 0                | 0,0028       | -25,6000           | 0                  |
| 4  | X3         | 0              | >=        | 0               | 0                | 0,0055       | -12,8000           | 0                  |
| 5  | X4         | 0              | >=        | 0               | 0                | 0,0030       | -23,7000           | 0                  |
| 6  | X5         | 0              | >=        | 0               | 0                | 0,0039       | 0                  | 0                  |
| 7  | X6         | 0              | >=        | 0               | 0                | 0,0001       | 0                  | 0                  |
| 8  | X7         | 0              | >=        | 0               | 0                | 0,0009       | -83,0000           | 0                  |
| 9  | X8         | 0              | >=        | 0               | 0                | 0,0007       | 0                  | 0                  |
| 10 | X9         | 0              | >=        | 0               | 0                | 0,0002       | -369,5000          | 0                  |
| 11 | X10        | 0              | >=        | 0               | 0                | 0,0019       | -38,3000           | 0                  |
| 12 | X11        | 0              | >=        | 0               | 0                | 0,0007       | -100,0000          | 0                  |
| 13 | X12        | 0              | >=        | 0               | 0                | 0,0003       | 0                  | 0                  |
| 14 | X13        | 0              | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0              | >=        | 0               | 0                | 0,0002       | -324,0000          | 0                  |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | -0,2765      | 1,0000             | 1,0000             |

|    | 17:33:24   |                | Wednesday | December        | 07               | 2016         |                    | ▲                  |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2622           | at bound     | -0,2622            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,1877           | at bound     | -0,1877            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2093           | at bound     | -0,2093            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,1654           | at bound     | -0,1654            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,2123           | at bound     | -0,2123            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,0899           | at bound     | -0,0899            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3323           | at bound     | -0,3323            | M                  |
| 72 | DMU58      | 0,1719         | 0         | 0               | 0                | basic        | -0,0489            | 0,0210             |
| 73 | DMU59      | 0              | 0         | 0               | 1,0265           | at bound     | -1,0265            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,3379           | at bound     | -0,3379            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2609           | at bound     | -0,2609            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,4756           | at bound     | -0,4756            | M                  |
| 77 | X78        | 0,3250         | 0,0500    | 0,0162          | 0                | basic        | -0,2507            | 0,1215             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 157,7449         | at bound     | -158,7449          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,3477         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0,0000         | >=        | 0               | 0                | 1,5874       | -0,0024            | 0,0195             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -958,9244          | 237,6756           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0021       | -14,0400           | 20,1600            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0042       | -9,0812            | 8,0188             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0022       | -7,5482            | 24,0518            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0004       | -107,8941          | 84,8059            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -829,4933          | 9,2067             |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0007       | -68,6237           | 35,5626            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0002       | -8,1293            | 57,3795            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -264,1252          | 120,1748           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0018       | -14,6258           | 25,2742            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0007       | -77,1929           | 22,8071            |
| 13 | X12        | -0,0001        | >=        | 0               | 0                | 0,0000       | -2,596,0070        | 203,9926           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -18,1575           | 8,7425             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,5858       | -0,0066            | 0,0528             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,6750             | M                  |

|    | 17:39:14   |                | Wednesday | December        | 07               | 2016         |                    | ▲                  |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 5,2510           | at bound     | -5,2510            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 2,5068           | at bound     | -2,5068            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 1,8077           | at bound     | -1,8077            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 2,6205           | at bound     | -2,6205            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 4,2485           | at bound     | -4,2485            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 1,4252           | at bound     | -1,4252            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 3,7254           | at bound     | -3,7254            | M                  |
| 72 | DMU58      | 1,0000         | 0         | 0               | 0                | basic        | -4,2325            | 1,9816             |
| 73 | DMU59      | 0              | 0         | 0               | 12,0604          | at bound     | -12,0604           | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 6,7207           | at bound     | -6,7207            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 3,6648           | at bound     | -3,6648            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 4,8771           | at bound     | -4,8771            | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 6,6736           | at bound     | -6,6236            | M                  |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 12,7120          | at bound     | -13,7120           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,0770         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 0,0857       | 0                  | 0                  |
| 2  | X1         | 0              | >=        | 0               | 0                | 0,0000       | -1,914,5000        | 0                  |
| 3  | X2         | 0              | >=        | 0               | 0                | 0,0013       | -54,7000           | 0                  |
| 4  | X3         | 0              | >=        | 0               | 0                | 0,0026       | -27,4000           | 0                  |
| 5  | X4         | 50,6000        | >=        | 0               | 50,6000          | 0            | -M                 | 50,6000            |
| 6  | X5         | 0              | >=        | 0               | 0                | 0,0111       | 0                  | 0                  |
| 7  | X6         | 0              | >=        | 0               | 0                | 0,0034       | 0                  | 0                  |
| 8  | X7         | 0              | >=        | 0               | 0                | 0,0009       | -83,0000           | 0                  |
| 9  | X8         | 0              | >=        | 0               | 0                | 0,0001       | -720,0000          | 0                  |
| 10 | X9         | 0              | >=        | 0               | 0                | 0,0002       | -473,0000          | 0                  |
| 11 | X10        | 0              | >=        | 0               | 0                | 0,0014       | -49,1000           | 0                  |
| 12 | X11        | 0              | >=        | 0               | 0                | 0,0007       | -100,0000          | 0                  |
| 13 | X12        | 0              | >=        | 0               | 0                | 0,0000       | -2,800,0000        | 0                  |
| 14 | X13        | 0              | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0              | >=        | 0               | 0                | 0,0002       | -432,0000          | 0                  |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | -6,6236      | 1,0000             | 1,0000             |

|    | 17:42:56   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,2019           | at bound     | -0,2019            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,2153           | at bound     | -0,2153            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,2383           | at bound     | -0,2383            | M                  |
| 68 | DMU54      | 0,1613         | 0         | 0               | 0                | basic        | -0,0726            | 0,0753             |
| 69 | DMU55      | 0              | 0         | 0               | 0,2257           | at bound     | -0,2257            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,1582           | at bound     | -0,1582            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,3063           | at bound     | -0,3063            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,1288           | at bound     | -0,1288            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 0,5224           | at bound     | -0,5224            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,2571           | at bound     | -0,2571            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,2063           | at bound     | -0,2063            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,3720           | at bound     | -0,3720            | M                  |
| 77 | X78        | 0,6332         | 0,0500    | 0,0317          | 0                | basic        | -0,8621            | 0,2036             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 60,8216          | at bound     | -61,8216           | M                  |
|    | Objective  | Function       | (Min.) =  | -0,6898         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 1,2364       | -0,0029            | 0,0823             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0000       | -360,8243          | 2,032,3760         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0010       | -3,4777            | 64,9223            |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0021       | -6,5025            | 27,6975            |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0011       | -15,1258           | 48,0742            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0002       | -58,0788           | 327,3212           |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -505,4496          | 847,3505           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0005       | -50,2483           | 83,6517            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -426,3737          | 347,8263           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0004       | -5,8353            | 186,3647           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0026       | -0,5813            | 12,0019            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0004       | -8,1351            | 191,8649           |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -1,564,8560        | 2,306,1440         |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -9,8676            | 17,0324            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,4565       | -0,0077            | 0,2219             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,3668             | M                  |

|    | 17:47:43   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,4571           | at bound     | -0,4571            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,4173           | at bound     | -0,4173            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,5054           | at bound     | -0,5054            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,4157           | at bound     | -0,4157            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,4218           | at bound     | -0,4218            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0,3621           | at bound     | -0,3621            | M                  |
| 71 | DMU57      | 0              | 0         | 0               | 0,7805           | at bound     | -0,7805            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0,6445           | at bound     | -0,6445            | M                  |
| 73 | DMU59      | 0              | 0         | 0               | 1,9938           | at bound     | -1,9938            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,4610           | at bound     | -0,4610            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,4577           | at bound     | -0,4577            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,8799           | at bound     | -0,8799            | M                  |
| 77 | X78        | 0,5580         | 0,0500    | 0,0279          | 0                | basic        | 0,0439             | 0,1759             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 119,2171         | at bound     | -120,2171          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,4836         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 2,4043       | -0,0041            | 0,0425             |
| 2  | X1         | 0,0000         | >=        | 0               | 0                | 0,0001       | -382,1758          | 451,1241           |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0086       | -4,3374            | 3,9626             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0155       | -1,7889            | 4,6884             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0024       | -14,9833           | 15,0167            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0007       | -55,1850           | 46,9150            |
| 7  | X6         | 0,0000         | >=        | 0               | 0                | 0,0001       | -345,4330          | 469,9671           |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0010       | -29,6339           | 39,5661            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0001       | -454,7490          | 175,5510           |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0004       | -125,5839          | 72,5161            |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0031       | -8,6867            | 7,0536             |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0006       | -35,1441           | 74,4559            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0000       | -258,0693          | 170,2827           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -8,8982            | 18,0018            |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 0,8875       | -0,0111            | 0,1146             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,4420             | M                  |

|    | 17:50:16   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 1,4047           | at bound     | -1,4047            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,9136           | at bound     | -0,9136            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,6591           | at bound     | -0,6591            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0                | basic        | -2,5005            | 0,1147             |
| 69 | DMU55      | 0              | 0         | 0               | 1,0442           | at bound     | -1,0442            | M                  |
| 70 | DMU56      | 0              | 0         | 0               | 0                | basic        | -M                 | 0,0040             |
| 71 | DMU57      | 0              | 0         | 0               | 1,4184           | at bound     | -1,4184            | M                  |
| 72 | DMU58      | 0              | 0         | 0               | 0                | basic        | -0,0113            | 1,0205             |
| 73 | DMU59      | 0              | 0         | 0               | 4,4554           | at bound     | -4,4554            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 1,3523           | at bound     | -1,3523            | M                  |
| 75 | DMU61      | 1,0000         | 0         | 0               | 0                | basic        | -0,0172            | 0,0028             |
| 76 | DMU62      | 0              | 0         | 0               | 0,5725           | at bound     | -0,5725            | M                  |
| 77 | X78        | 0              | 0,0500    | 0               | 0                | basic        | -0,0846            | 0,0601             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 2,8845           | at bound     | -3,8845            | M                  |
|    | Objective  | Function       | (Min.) =  | -0,0060         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 0,0388       | 0                  | 0                  |
| 2  | X1         | 0              | >=        | 0               | 0                | 0,0000       | -1,666,7000        | 0                  |
| 3  | X2         | 0              | >=        | 0               | 0                | 0,0220       | 0                  | 0                  |
| 4  | X3         | 0              | >=        | 0               | 0                | 0,0191       | 0                  | 0                  |
| 5  | X4         | 0              | >=        | 0               | 0                | 0,0012       | -60,0000           | 0                  |
| 6  | X5         | 0              | >=        | 0               | 0                | 0,0003       | -204,1000          | 0                  |
| 7  | X6         | 0              | >=        | 0               | 0                | 0,0009       | 0                  | 0                  |
| 8  | X7         | 0              | >=        | 0               | 0                | 0,0013       | 0                  | 0                  |
| 9  | X8         | 0              | >=        | 0               | 0                | 0,0012       | 0                  | 0                  |
| 10 | X9         | 0              | >=        | 0               | 0                | 0,0017       | 0                  | 0                  |
| 11 | X10        | 0              | >=        | 0               | 0                | 0,0108       | 0                  | 0                  |
| 12 | X11        | 0              | >=        | 0               | 0                | 0,0006       | -109,6000          | 0                  |
| 13 | X12        | 0              | >=        | 0               | 0                | 0,0004       | 0                  | 0                  |
| 14 | X13        | 0              | >=        | 0               | 0                | 0,0026       | -26,9000           | 0                  |
| 15 | X14        | 0              | >=        | 0               | 0                | 0,0003       | -270,0000          | 0                  |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 1,0000             | M                  |

|    | 17:55:03   |                | Wednesday | December        | 07               | 2016         |                    |                    |
|----|------------|----------------|-----------|-----------------|------------------|--------------|--------------------|--------------------|
| 65 | DMU51      | 0              | 0         | 0               | 0,6217           | at bound     | -0,6217            | M                  |
| 66 | DMU52      | 0              | 0         | 0               | 0,3851           | at bound     | -0,3851            | M                  |
| 67 | DMU53      | 0              | 0         | 0               | 0,3479           | at bound     | -0,3479            | M                  |
| 68 | DMU54      | 0              | 0         | 0               | 0,4250           | at bound     | -0,4250            | M                  |
| 69 | DMU55      | 0              | 0         | 0               | 0,3752           | at bound     | -0,3752            | M                  |
| 70 | DMU56      | 0,2013         | 0         | 0               | 0                | basic        | -0,0384            | 0,0653             |
| 71 | DMU57      | 0              | 0         | 0               | 0,5249           | at bound     | -0,5249            | M                  |
| 72 | DMU58      | 0,2733         | 0         | 0               | 0                | basic        | -0,3074            | 0,0758             |
| 73 | DMU59      | 0              | 0         | 0               | 2,0203           | at bound     | -2,0203            | M                  |
| 74 | DMU60      | 0              | 0         | 0               | 0,5261           | at bound     | -0,5261            | M                  |
| 75 | DMU61      | 0              | 0         | 0               | 0,0646           | at bound     | -0,0646            | M                  |
| 76 | DMU62      | 0              | 0         | 0               | 0,2221           | at bound     | -0,2221            | M                  |
| 77 | X78        | 0,2228         | 0,0500    | 0,0111          | 0                | basic        | -M                 | 0,2097             |
| 78 | g0         | 1,0000         | -1,0000   | -1,0000         | 282,9842         | at bound     | -283,9842          | M                  |
|    | Objective  | Function       | (Min.) =  | -0,2281         |                  |              |                    |                    |
|    | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1  | Y1         | 0              | >=        | 0               | 0                | 2,8398       | -0,0016            | 0,0108             |
| 2  | X1         | -0,0001        | >=        | 0               | 0                | 0,0000       | -1,118,8740        | 1,381,1260         |
| 3  | X2         | 0,0000         | >=        | 0               | 0                | 0,0077       | -1,5871            | 2,1391             |
| 4  | X3         | 0,0000         | >=        | 0               | 0                | 0,0094       | -1,4807            | 2,7738             |
| 5  | X4         | 0,0000         | >=        | 0               | 0                | 0,0008       | -7,6637            | 82,3363            |
| 6  | X5         | 0,0000         | >=        | 0               | 0                | 0,0002       | -161,1668          | 145,0332           |
| 7  | X6         | -0,0001        | >=        | 0               | 0                | 0,0003       | -49,9371           | 70,9358            |
| 8  | X7         | 0,0000         | >=        | 0               | 0                | 0,0010       | -47,5560           | 21,6440            |
| 9  | X8         | 0,0000         | >=        | 0               | 0                | 0,0005       | -47,6403           | 54,5068            |
| 10 | X9         | 0,0000         | >=        | 0               | 0                | 0,0002       | -285,5729          | 107,6271           |
| 11 | X10        | 0,0000         | >=        | 0               | 0                | 0,0017       | -29,5453           | 11,2547            |
| 12 | X11        | 0,0000         | >=        | 0               | 0                | 0,0006       | -90,8945           | 18,7055            |
| 13 | X12        | 0,0000         | >=        | 0               | 0                | 0,0002       | -157,0648          | 172,4993           |
| 14 | X13        | 0,0000         | >=        | 0               | 0                | 0,0026       | -18,5227           | 8,3773             |
| 15 | X14        | 0,0000         | >=        | 0               | 0                | 1,0469       | -0,0042            | 0,0292             |
| 16 | u0         | 1,0000         | =         | 1,0000          | 0                | 0,0500       | 0,7772             | M                  |

## Appendix B: Optimal weights of the Modified ERM-VRS Model

| DMUs | Y1      | X1     | X2     | X3     | X4     | X5     | X6      | X7      | X8      | X9      | X10    | X11     | X12     | X13    | X14    |
|------|---------|--------|--------|--------|--------|--------|---------|---------|---------|---------|--------|---------|---------|--------|--------|
| 1    | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       | 0.0001  | 0      | 0      |
| 2    | 0.0095  | 0.0476 | 0.0007 | -0.002 | 0.0035 | 0.0146 | -0.1997 | 0.0198  | 0.1619  | 0.027   | 0.0028 | 0.0095  | 0.06207 | 0.0051 | 0.0257 |
| 3    | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       | 0.0001  | 0      | 0      |
| 4    | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       | 0.0002  | 0      | 0      |
| 5    | 0       | 0      | 0      | 0      | 0      | 0      | 0.0001  | 0       | 0       | 0       | 0      | 0       | 0.0002  | 0      | 0      |
| 6    | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       | -0.0001 | 0      | 0      |
| 7    | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | -0.0001 | 0       | 0      | 0       |         | 0      | 0      |
| 8    | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       |         | 0       | 0      | 0       | -0.0001 | 0      | 0      |
| 9    | 0       | 0      | 0      | 0      | 0      | 0      | 0.0001  | 0       | 0.0001  | 0       | 0      | 0       |         | 0      | 0      |
| 10   | 0       | 0      | 0      | 0      | 0      | 0      | -0.0001 | 0       | 0       | 0       | 0      | 0       | -0.0001 | 0      | 0      |
| 11   | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       |         | 0      | 0      |
| 12   | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       |         | 0      | 0      |
| 13   | 0       | 0      | 0      | 0      | 0      | 0      | 0.0001  | 0       | 0.0011  | 0       | 0      | 0       | 0.0001  | 0      | 0      |
| 14   | -0.0001 | 0.0026 | 0      | 0      | 0.0001 | 0      | 0.0011  | -0.0001 | 0       | -0.0003 | 0      | -0.0001 | 0.0035  | 0      | 0.0026 |
| 15   | 0       | 0      | 0      | 0      | 0      | 0      | 1383000 | 0       | 0       | 0       | 0      | 0       |         | 0      | 0      |
| 16   | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       | 0.0001  | 0      | 0      |
| 17   | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       | 0       | 0      | 0      |
| 18   | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       | 0       | 0      | 0      |
| 19   | 0       | 0      | 0      | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0      | 0       | 0       | 0      | 0      |

|    |             |             |             |            |        |        |         |             |             |        |         |             |         |        |        |
|----|-------------|-------------|-------------|------------|--------|--------|---------|-------------|-------------|--------|---------|-------------|---------|--------|--------|
| 20 | -<br>0.0001 | -<br>0.0009 | 0           | 0          | 0      | 0.0001 | 0.0061  | 0.0001      | 0.0005      | 0.0001 | 0       | 0           | 0.0019  | 0      | 0.0002 |
| 21 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           |        | 6.3876  | 0           | 0.0001  | 0      | 0      |
| 22 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           |        | 8.364   | 0           |         | 0      | 0      |
| 23 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0.0001 | 146138  | 0           | 0.0001  | 0      | 0      |
| 24 | 0           | 0           | 0           | 0          | 0      | 0      | 0.0001  | 0           | 0           | 0      | 0       | 0           | -0.0002 | 0      | 0      |
| 25 | 0           | 0           | 0           | 0          | 0      | 0      |         | 0           | 0           | 0      | 0       | 0           | -0.0001 | 0      | 0      |
| 26 | 0.0183      | 0.2689      | -<br>0.0017 | -<br>0.001 | -0.009 | -0.04  | -1.8929 | -<br>0.0187 | -<br>0.1707 | -0.032 | -0.0045 | -<br>0.0108 | -0.5884 | 0.0036 | 0.0494 |
| 27 | 0           | 0           | 0           | 0          |        | 0      | 0       | 0           | 0           | 0      | 0       | 0           | -0.0002 | 0      | 0      |
| 28 | -<br>0.0001 | 0           | 0           | 0          | 7.8326 | 0      | 0       | 0           | 0           | 0      | 0       | 0           |         | 0      | 0      |
| 29 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 0       | 0           | 0.0001  | 0      | 0      |
| 30 | -<br>0.0001 | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 0       | 0           |         | 0      | 0      |
| 31 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 0       | 0           | -0.0002 | 0      | 0      |
| 32 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | -<br>0.0001 | 0      | 0       | 0           | 0       | 0      | 0      |
| 33 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 169,350 | 0           | 0       | 0      | 0      |
| 34 | 0           | 0           | 0           | 0          | 0      | 0      | -0.0001 | 0           | 0           | 0      | 0       | 0           | 0       | 0      | 0      |
| 35 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 0       | 0           | 0       | 0      | 0      |
| 36 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 0       | 0           | 0       | 0      | 0      |
| 37 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 0       | 0           | 0       | 0      | 0      |
| 38 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 0       | 0           | 0       | 0      | 0      |
| 39 | 0           | 0           | 0           | 0          | 0      | 0      | 0       | 0           | 0           | 0      | 0       | 0           | 0       | 0      | 0      |
| 40 | -<br>0.0001 | 0           | 0           | 0          | 0      | 0      | 0       |             | 0           |        | 0       | 0           | 0       | 0      | 0      |
| 41 | -<br>0.0001 | 0           | 0           | 0          | 0.0001 | 0      | 0.0012  | -<br>0.0001 | 0.01        | 0.0003 | 0       | 0.0001      | 0.0036  | 0      | 0.0026 |

|    |             |   |   |   |        |   |         |   |        |         |   |   |         |   |   |
|----|-------------|---|---|---|--------|---|---------|---|--------|---------|---|---|---------|---|---|
| 42 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 |        | 0       | 0 | 0 | 0       | 0 | 0 |
| 43 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 |        | 0       | 0 | 0 | 0.0001  | 0 | 0 |
| 44 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0.0001 | 0       | 0 | 0 | 0.0002  | 0 | 0 |
| 45 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 |         | 0 | 0 |
| 46 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0.0001  | 0 | 0 |
| 47 | -<br>0.0001 | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0.0001  | 0 | 0 |
| 48 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0.0001  | 0 | 0 |
| 49 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | -0.0001 | 0 | 0 |
| 50 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 |         | 0 | 0 |
| 51 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | -0.0001 | 0 | 0 |
| 52 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0       | 0 | 0 |
| 53 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0       | 0 | 0 |
| 54 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 3932000 | 0 | 0 | 0       | 0 | 0 |
| 55 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0       | 0 | 0 |
| 56 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 |         | 0 | 0 |
| 57 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | -0.0001 | 0 | 0 |
| 58 | 0           | 0 | 0 | 0 | 506000 | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0       | 0 | 0 |
| 59 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0       | 0 | 0 |
| 60 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0       | 0 | 0 |
| 61 | 0           | 0 | 0 | 0 | 0      | 0 | 0       | 0 | 0      | 0       | 0 | 0 | 0       | 0 | 0 |
| 62 | -<br>0.0001 | 0 | 0 | 0 | 0      | 0 | -0.0001 | 0 | 0      | 0       |   | 0 | 0       | 0 | 0 |

|       |       |        |        |       |        |        |         |       |        |         |        |        |         |        |        |
|-------|-------|--------|--------|-------|--------|--------|---------|-------|--------|---------|--------|--------|---------|--------|--------|
| Total | 0.027 | 0.3182 | -0.001 | 0.003 | 506008 | -0.025 | 1382998 | 0.001 | 0.0028 | 3932000 | 315503 | 0.0013 | -0.5169 | 0.0087 | 0.0805 |
|-------|-------|--------|--------|-------|--------|--------|---------|-------|--------|---------|--------|--------|---------|--------|--------|

### Appendix C: The evaluated fourteen input and one output data

| DMU | 0     | 1      | 2    | 3    | 4     | 5     | 6      | 7     | 8      | 9     | 10   | 11    | 12     | 13   | 14    |
|-----|-------|--------|------|------|-------|-------|--------|-------|--------|-------|------|-------|--------|------|-------|
| 1   | 67.3  | 600    | 15   | 22.5 | 69.4  | 306.2 | 838.7  | 83    | 800    | 221.7 | 23   | 109.6 | 2414.3 | 26.9 | 181.7 |
| 2   | 112.2 | 1000   | 25   | 37.5 | 115.6 | 510.3 | 838.7  | 83    | 800    | 369.5 | 38.3 | 109.6 | 2414.3 | 26.9 | 302.9 |
| 3   | 74.5  | 750    | 10.4 | 10.4 | 38.5  | 170.1 | 1718.2 | 172.9 | 1575.8 | 245.4 | 25.5 | 150   | 5160.5 | 26.9 | 201.1 |
| 4   | 82.6  | 825    | 11.5 | 11.5 | 42.4  | 187.1 | 1718.2 | 172.9 | 1575.8 | 272   | 28.2 | 150   | 5160.5 | 26.9 | 222.9 |
| 5   | 96.9  | 975    | 13.5 | 13.5 | 50.1  | 221.1 | 1718.2 | 172.9 | 1575.8 | 319.3 | 33.1 | 150   | 5160.5 | 26.9 | 261.7 |
| 6   | 105   | 1050   | 14.6 | 14.6 | 54    | 238.1 | 1718.2 | 172.9 | 1575.8 | 345.9 | 35.9 | 150   | 5160.5 | 26.9 | 283.5 |
| 7   | 115   | 1680.6 | 10.7 | 7.6  | 56.5  | 249.5 | 1397.9 | 138.3 | 1260.7 | 272   | 28.2 | 80    | 4345.7 | 26.9 | 310.5 |
| 8   | 125   | 1833.3 | 11.7 | 8.3  | 61.7  | 272.1 | 1397.9 | 138.3 | 1260.7 | 295.6 | 30.7 | 80    | 4345.7 | 26.9 | 337.5 |
| 9   | 135   | 1986.1 | 12.6 | 9    | 66.8  | 294.8 | 1397.9 | 138.3 | 1260.7 | 319.3 | 33.1 | 80    | 4345.7 | 26.9 | 364.5 |
| 10  | 68.4  | 571.4  | 3.9  | 4.1  | 15.1  | 50    | 1397.9 | 138.3 | 1166.7 | 168.5 | 17.5 | 200   | 4345.7 | 26.9 | 184.7 |
| 11  | 85.2  | 714.3  | 4.8  | 5.1  | 18.9  | 62.5  | 1397.9 | 138.3 | 1166.7 | 209.9 | 21.8 | 200   | 4345.7 | 26.9 | 230   |
| 12  | 103.2 | 857.1  | 5.8  | 6.1  | 22.7  | 75    | 1397.9 | 138.3 | 1166.7 | 254.2 | 26.4 | 200   | 4345.7 | 26.9 | 278.6 |
| 13  | 120   | 1000   | 6.8  | 7.1  | 26.4  | 87.5  | 1397.9 | 138.3 | 1166.7 | 295.6 | 30.7 | 200   | 4345.7 | 26.9 | 324   |
| 14  | 136.8 | 1142.9 | 7.8  | 8.2  | 30.2  | 100   | 1397.9 | 138.3 | 1166.7 | 337   | 35   | 200   | 4345.7 | 26.9 | 369.4 |
| 15  | 154.8 | 1285.7 | 8.7  | 9.2  | 34    | 112.5 | 1397.9 | 138.3 | 1166.7 | 381.4 | 39.6 | 200   | 4345.7 | 26.9 | 418   |
| 16  | 171.6 | 1428.6 | 9.7  | 10.2 | 37.8  | 125   | 1397.9 | 138.3 | 1166.7 | 422.8 | 43.8 | 200   | 4345.7 | 26.9 | 463.3 |
| 17  | 77.4  | 1140.6 | 22.8 | 5.7  | 34.2  | 206.3 | 1164.9 | 115.3 | 972.2  | 228.3 | 23.3 | 200   | 3621.4 | 22.4 | 208.8 |
| 18  | 82.5  | 1218.8 | 24.4 | 6.1  | 36.6  | 220.4 | 1164.9 | 115.3 | 972.2  | 243.3 | 24.8 | 200   | 3621.4 | 22.4 | 222.6 |
| 19  | 88.4  | 1296.9 | 25.9 | 6.5  | 38.9  | 234.5 | 1164.9 | 115.3 | 972.2  | 307.5 | 31.9 | 200   | 3621.4 | 26.9 | 238.7 |
| 20  | 91.8  | 1343.8 | 26.9 | 6.7  | 40.3  | 243   | 1164.9 | 115.3 | 972.2  | 319.3 | 33.1 | 200   | 3621.4 | 26.9 | 247.9 |
| 21  | 60.3  | 1333.3 | 16.7 | 2.5  | 30.8  | 102.7 | 1164.9 | 159.6 | 1923.1 | 198.1 | 20.5 | 50    | 5014.2 | 26.9 | 162.8 |
| 22  | 64.8  | 1444.4 | 18.1 | 2.7  | 33.4  | 111.3 | 1164.9 | 159.6 | 1923.1 | 212.9 | 22.1 | 50    | 5014.2 | 26.9 | 175   |
| 23  | 115.2 | 2555.6 | 31.9 | 4.8  | 59.1  | 196.9 | 1164.9 | 159.6 | 1923.1 | 378.4 | 39.2 | 50    | 5014.2 | 26.9 | 311   |
| 24  | 119.7 | 2666.7 | 33.3 | 5    | 61.7  | 205.5 | 1164.9 | 159.6 | 1923.1 | 393.2 | 40.8 | 200   | 5014.2 | 26.9 | 323.2 |
| 25  | 80    | 2000   | 20   | 20   | 60    | 246.6 | 838.7  | 83    | 600    | 173.8 | 17.4 | 200   | 2607.4 | 19   | 216   |
| 26  | 90    | 2250   | 22.5 | 22.5 | 67.5  | 277.4 | 838.7  | 83    | 600    | 195.6 | 19.5 | 200   | 2607.4 | 19   | 243   |
| 27  | 107   | 2666.7 | 26.7 | 26.7 | 80    | 328.8 | 838.7  | 83    | 600    | 316.3 | 32.8 | 200   | 2607.4 | 26.9 | 288.9 |
| 28  | 123   | 3083.3 | 30.8 | 30.8 | 92.5  | 380.1 | 838.7  | 83    | 600    | 363.6 | 37.7 | 200   | 2607.4 | 26.9 | 332.1 |
| 29  | 72.9  | 1895.8 | 21.7 | 21.7 | 89.4  | 191.4 | 1497.7 | 148.2 | 1071.4 | 185.1 | 18.6 | 100   | 4656.1 | 20.2 | 196.8 |
| 30  | 93.6  | 2420.8 | 27.7 | 27.7 | 114.1 | 244.5 | 1497.7 | 148.2 | 1071.4 | 272.5 | 27.9 | 100   | 4656.1 | 23.5 | 252.7 |
| 31  | 103.5 | 2683.3 | 30.7 | 30.7 | 126.5 | 271   | 1497.7 | 148.2 | 1071.4 | 340   | 35.3 | 100   | 4656.1 | 26.9 | 279.5 |
| 32  | 90    | 2000   | 50   | 50   | 60    | 328.8 | 698.9  | 103.8 | 1500   | 250   | 25.6 | 200   | 3054.1 | 22.4 | 243   |
| 33  | 66.4  | 1250   | 12.5 | 8.3  | 77.1  | 340.2 | 1075.3 | 106.4 | 897.4  | 245.4 | 25.5 | 20    | 3342.8 | 26.9 | 179.3 |
| 34  | 93.6  | 1750   | 17.5 | 11.7 | 107.9 | 476.3 | 1075.3 | 106.4 | 897.4  | 345.9 | 35.9 | 20    | 3342.8 | 26.9 | 252.7 |

|       |       |        |      |      |       |       |        |       |        |       |       |       |         |      |        |
|-------|-------|--------|------|------|-------|-------|--------|-------|--------|-------|-------|-------|---------|------|--------|
| 35    | 40    | 1200   | 20   | 4    | 18.5  | 98    | 559.1  | 83    | 1600   | 236.5 | 24.5  | 12.5  | 1000    | 26.9 | 108    |
| 36    | 42    | 1260   | 21   | 4.2  | 19.4  | 102.9 | 559.1  | 83    | 1600   | 248.3 | 25.8  | 12.5  | 1000    | 26.9 | 113.4  |
| 37    | 45    | 1350   | 22.5 | 4.5  | 20.8  | 110.2 | 559.1  | 83    | 1600   | 266.1 | 27.6  | 12.5  | 1000    | 26.9 | 121.5  |
| 38    | 50    | 1500   | 25   | 5    | 23.1  | 122.5 | 559.1  | 83    | 1600   | 295.6 | 30.7  | 12.5  | 1000    | 26.9 | 135    |
| 39    | 52    | 1560   | 26   | 5.2  | 24.1  | 127.4 | 559.1  | 83    | 1600   | 307.5 | 31.9  | 12.5  | 1000    | 26.9 | 140.4  |
| 40    | 55    | 1650   | 27.5 | 5.5  | 25.4  | 134.7 | 559.1  | 83    | 1600   | 325.2 | 33.7  | 12.5  | 1000    | 26.9 | 148.5  |
| 41    | 57    | 1710   | 28.5 | 5.7  | 26.4  | 139.6 | 559.1  | 83    | 1600   | 337   | 35    | 12.5  | 1000    | 26.9 | 153.9  |
| 42    | 59    | 1770   | 29.5 | 5.9  | 27.3  | 144.5 | 559.1  | 83    | 1600   | 348.8 | 36.2  | 12.5  | 1000    | 26.9 | 159.3  |
| 43    | 60.1  | 466.7  | 29.1 | 20   | 61.7  | 272.1 | 1374.6 | 138.3 | 1260.7 | 198.1 | 20.5  | 109.6 | 4023.8  | 26.9 | 162.3  |
| 44    | 119.4 | 933.3  | 58.2 | 40   | 123.3 | 544.3 | 1374.6 | 138.3 | 1260.7 | 393.2 | 40.8  | 109.6 | 4023.8  | 26.9 | 322.2  |
| 45    | 64    | 800    | 48   | 32   | 24    | 163.3 | 1048.4 | 103.8 | 650    | 236.5 | 24.5  | 100   | 3319.6  | 26.9 | 172.8  |
| 46    | 80    | 1000   | 60   | 40   | 30    | 204.1 | 1048.4 | 103.8 | 650    | 295.6 | 30.7  | 100   | 3319.6  | 26.9 | 216    |
| 47    | 96    | 1200   | 72   | 48   | 36    | 244.9 | 1048.4 | 103.8 | 650    | 354.8 | 36.8  | 100   | 3319.6  | 26.9 | 259.2  |
| 48    | 83    | 2177.1 | 41.7 | 41.7 | 77.1  | 340.2 | 1397.9 | 138.3 | 1260.7 | 245.4 | 25.5  | 109.6 | 4345.7  | 26.9 | 224.1  |
| 49    | 117   | 3047.9 | 58.3 | 58.3 | 107.9 | 476.3 | 1397.9 | 138.3 | 1260.7 | 345.9 | 35.9  | 109.6 | 4345.7  | 26.9 | 315.9  |
| 50    | 50    | 250    | 3.5  | 10   | 18.5  | 76.8  | 1048.4 | 103.8 | 850    | 141.9 | 14.7  | 50    | 3259.3  | 26.9 | 135    |
| 51    | 80    | 400    | 5.6  | 16   | 29.6  | 122.9 | 1048.4 | 103.8 | 850    | 174.4 | 18.1  | 50    | 3259.3  | 26.9 | 216    |
| 52    | 125   | 500    | 7    | 20   | 37    | 153.7 | 1233.4 | 122.1 | 1000   | 351.8 | 36.5  | 50    | 3834.4  | 26.9 | 337.5  |
| 53    | 137.5 | 600    | 8.4  | 24   | 44.4  | 184.4 | 1233.4 | 122.1 | 1000   | 384.3 | 39.9  | 50    | 3834.4  | 26.9 | 371.3  |
| 54    | 140   | 750    | 10.5 | 30   | 55.5  | 230.5 | 1397.9 | 138.3 | 1133.3 | 393.2 | 49.8  | 50    | 4345.7  | 26.9 | 378    |
| 55    | 80    | 598.3  | 17.1 | 8.5  | 15.8  | 96.3  | 838.7  | 83    | 600    | 307.5 | 31.9  | 100   | 2400    | 26.9 | 216    |
| 56    | 120   | 897.4  | 25.6 | 12.8 | 23.7  | 144.5 | 838.7  | 83    | 600    | 369.5 | 38.3  | 100   | 2400    | 26.9 | 324    |
| 57    | 100   | 1196.6 | 34.2 | 17.1 | 31.6  | 192.7 | 838.7  | 83    | 720    | 384.3 | 39.9  | 100   | 2800    | 26.9 | 270    |
| 58    | 160   | 1914.5 | 54.7 | 27.4 | 50.6  | 308.3 | 838.7  | 83    | 720    | 473   | 49.1  | 100   | 2800    | 26.9 | 432    |
| 59    | 50    | 2393.2 | 68.4 | 34.2 | 63.2  | 385.4 | 1352.8 | 133.9 | 774.2  | 192.2 | 19.9  | 200   | 3871    | 26.9 | 135    |
| 60    | 50    | 833.3  | 8.3  | 4.2  | 30    | 102.1 | 815.4  | 69.2  | 630.3  | 198.1 | 20.5  | 109.6 | 1666.7  | 26.9 | 135    |
| 61    | 100   | 1666.7 | 16.7 | 8.3  | 60    | 204.1 | 815.4  | 69.2  | 630.3  | 263.1 | 27.3  | 109.6 | 1666.7  | 26.9 | 270    |
| 62    | 100   | 2500   | 25   | 123  | 90    | 306.6 | 815.4  | 69.2  | 500    | 393.2 | 40.8  | 109.6 | 1666.7  | 26.9 | 270    |
| TOTAL | 5685  | 88,825 | 1485 | 1020 | 3145  | 13400 | 70,616 | 7226  | 70,143 | 18161 | 1,880 | 6966  | 210,109 | 1628 | 15,351 |