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

Uzor Darlington Chibuzor

Submitted to the
Institute of Graduate Studies and Research
in partial fulfilment of the requirements for the degree of

Master of Science
in
Industrial Engineering

Eastern Mediterranean University
January 2017
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

Prof. Dr. Mustafa Tümer
Director

I certify that this thesis satisfies the requirements as a thesis for the degree of Master of Science in Industrial Engineering.

Assoc. Prof. Dr. Gökhan Izbirak
Chair, Department of Industrial Engineering

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Industrial Engineering.

Asst. Prof. Dr. Sahand Daneshvar
Supervisor

Examining Committee

1. Prof. Dr. Bela Vizvari
2. Assoc. Prof. Dr. Adham Mackieh
3. Asst. Prof. Dr. Sahand Daneshvar

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 teknikdir. 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 ilginc faktörlerin ortaya çıkmasına neden olmuştur.

Anahtar kelimler: Yaşam Döngüsü değerlendirilmesi, Veri Geliştirme Analizi, değiştirilmiş modeller

To my Parents

Mr & Mrs Patrick Onyechukwu Uzor

ACKNOWLEDGMENT

I sincerely appreciate my Supervisors, Asst. Prof. Dr. Sahand Daneshvar for his supervision and supports during the period of this study. I thank Assoc. Prof. Dr. Emine Atasoylu for her candid advice at the beginning of this research. Thanks Assoc. Prof. Dr. Gökhan İzbriak and Assoc. Prof. Dr. Adham Mackieh for your excellent leadership in Industrial Engineering Department.

This thesis has been a long journey for me. There have been times when I thought I would never be able to see this endeavor through. My friend and brother, Mustapha Daruwana Ibrahim stood by my side and was a source of inspiration and support for me throughout this process.

My sincere gratitude goes to my best friend Akwaugo Tina Esinna who has been much more than a friend. She has been a motivator, my prayer partner, who believed in this study and encouraged me on at all times. Special thanks also go to my Boss, a philanthropist, Hon. Francis Eleto (JP) for his financial support all through the period of this program. Thank you so much Amb. Pastor promise Ekejiuba for bringing up the idea of this tough and challenging journey, but achievable and successful task.

Finally, I am grateful to my parents, without their sacrifices I would not have accomplished as much as I have. They served as constant reminders of my unfinished task, pushing me to forge ahead.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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.

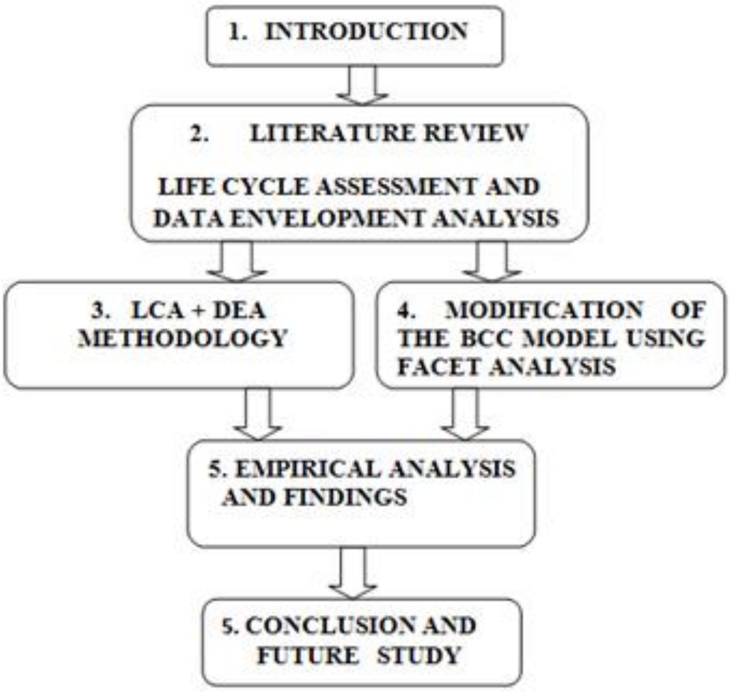

Figure 1: The structure and organization of the Thesis study

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 vilification in the Rias Baixs 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.

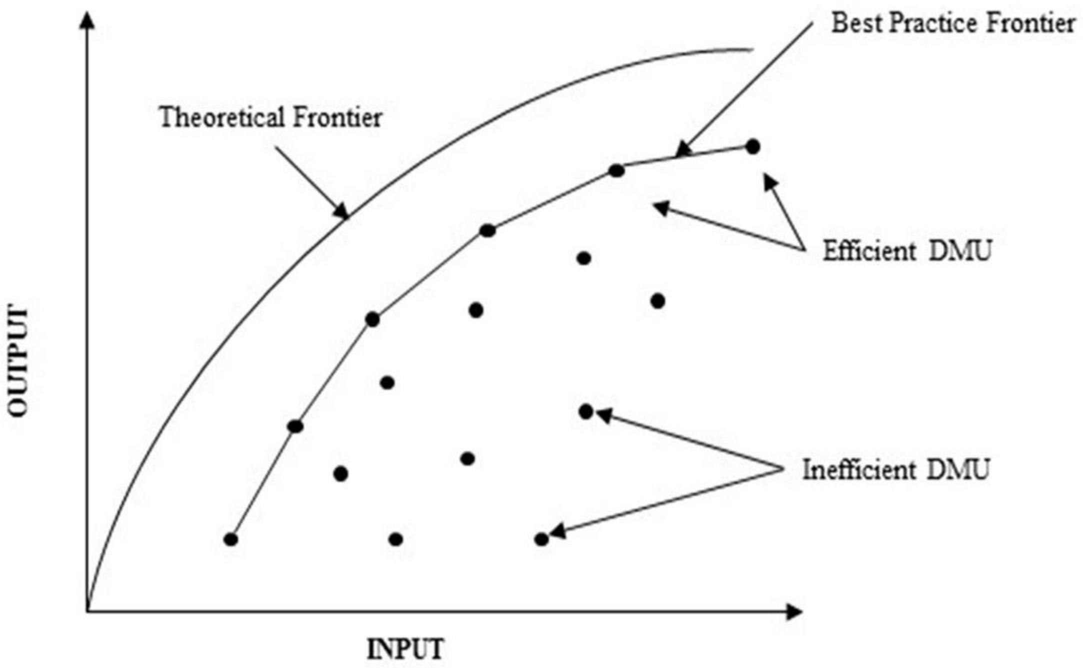

Figure 2: Data Envelopment Analysis Frontier

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.

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

Properties of production possibility set;

1. The activities observed (x_j , y_j) (*j* = 1, …., n) belong to T
2. If the observed activity $(\mathbf{x},\mathbf{y}) \in T$, then (tx, ty) $\in$ 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 $\bar{\mathbf{x}} \geq x$ and $\bar{\mathbf{y}} \leq y$ 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… n and the production possibility set T can be defined by satisfying 1, 2,3, 4 postulates

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

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 θ values and larger ϕ 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, λ_j and v_0 is also added to the BCC output oriented model.

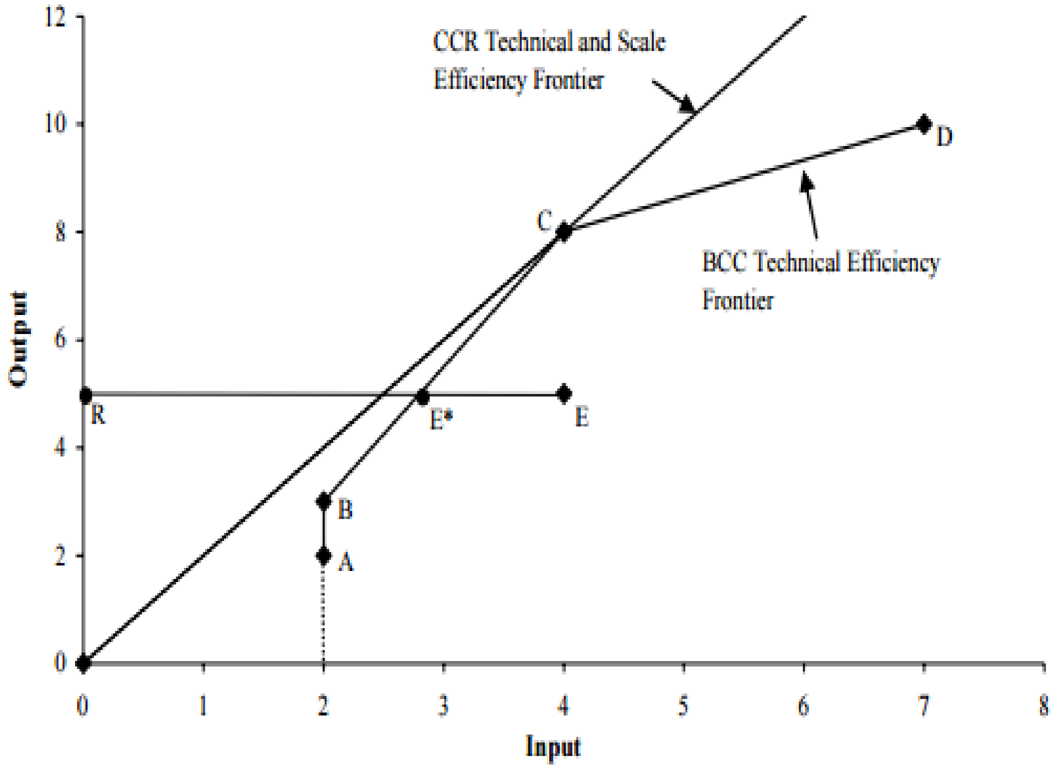

Figure 3: CCR and BCC efficiency Frontier

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;

$$\begin{aligned} & Min\,\theta \\ & s.t\ (\theta \mathbf{x}_0, \mathbf{y}_0) \in T_C \end{aligned}$$

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

$$\begin{aligned} & Min\,\theta \\ & s.t \\ & \sum_{j=1}^{n} \lambda_j x_{ij} \le \theta x_{io} \quad i = 1 \ldots m \\ & \sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{ro}, \quad r = 1 \ldots s \\ & \lambda_j \ge 0,\ j = 1 \ldots n \end{aligned} \tag{2.2}$$

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

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

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; $x_j\,(x_{ij} \ldots x_{sj}) \geq 0 \;\; y_j\;(y_{ij} \ldots y_{mj}) \geq 0$

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

2. If the inputs and outputs $(x_j, y_j) \in$ P_B then the convex combination of these data $\sum_{j=1}^{n}\lambda_j x_j, \sum_{j=1}^{n}\lambda_j y_j, \sum_{j=1}^{n}\lambda_j \geq 0, \quad j = 1, \ldots n$ 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 $(\bar{\mathbf{x}}, \bar{\mathbf{y}})$ with $\bar{\mathbf{x}}, \geq x$ and $\bar{\mathbf{y}} \leq y$ 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 given as $P_B = \{(x, y) \mid x \geq \sum_{j=1}^{n}\lambda_j x_j, \, y \leq \sum_{j=1}^{n}\lambda_j y_j, \sum_{j=1}^{n}\lambda_j = 1, \lambda_j \geq 0, \forall j\}$ (2.4)

The input oriented BCC model evaluates the efficiency of DMU_j (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:

$$Min\,\theta$$
$$s.t\ (\theta\mathbf{x_0}, \mathbf{y_0}) \in T_B$$

From the above formulation, our main objective is finding the value of θ such that θ 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:

$$
\begin{aligned}
&Min\,\theta \\
&s.t \\
&\sum_{j=1}^{n}\lambda_j x_{ij} \le \theta x_{i0} \quad i=1,\ldots m \\
&\sum_{j=1}^{n}\lambda_j y_{ij} \ge y_{r0} \quad r=1,\ldots s \\
&\sum_{j=1}^{n}\lambda_j = 1 \\
&\lambda_j \ge 0,\ j=1,\ldots n
\end{aligned}
\tag{2.5}
$$

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

$$
\begin{aligned}
&Max\sum_{r=1}^{s}u_r y_{r0} + u_0 \\
&s.t \\
&\sum_{i=1}^{m}v_i x_{i0} = 1 \\
&\sum_{r-1}^{s}u_r y_{rj} - \sum_{i=1}^{m}v_i x_{ij} + u_0 \le 0 \\
&u_r, v_i \ge 0, \quad r=1\ldots s, i=1\ldots m \\
&u_0\ free
\end{aligned}
\tag{2.6}
$$

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 (Frischknechtet 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.

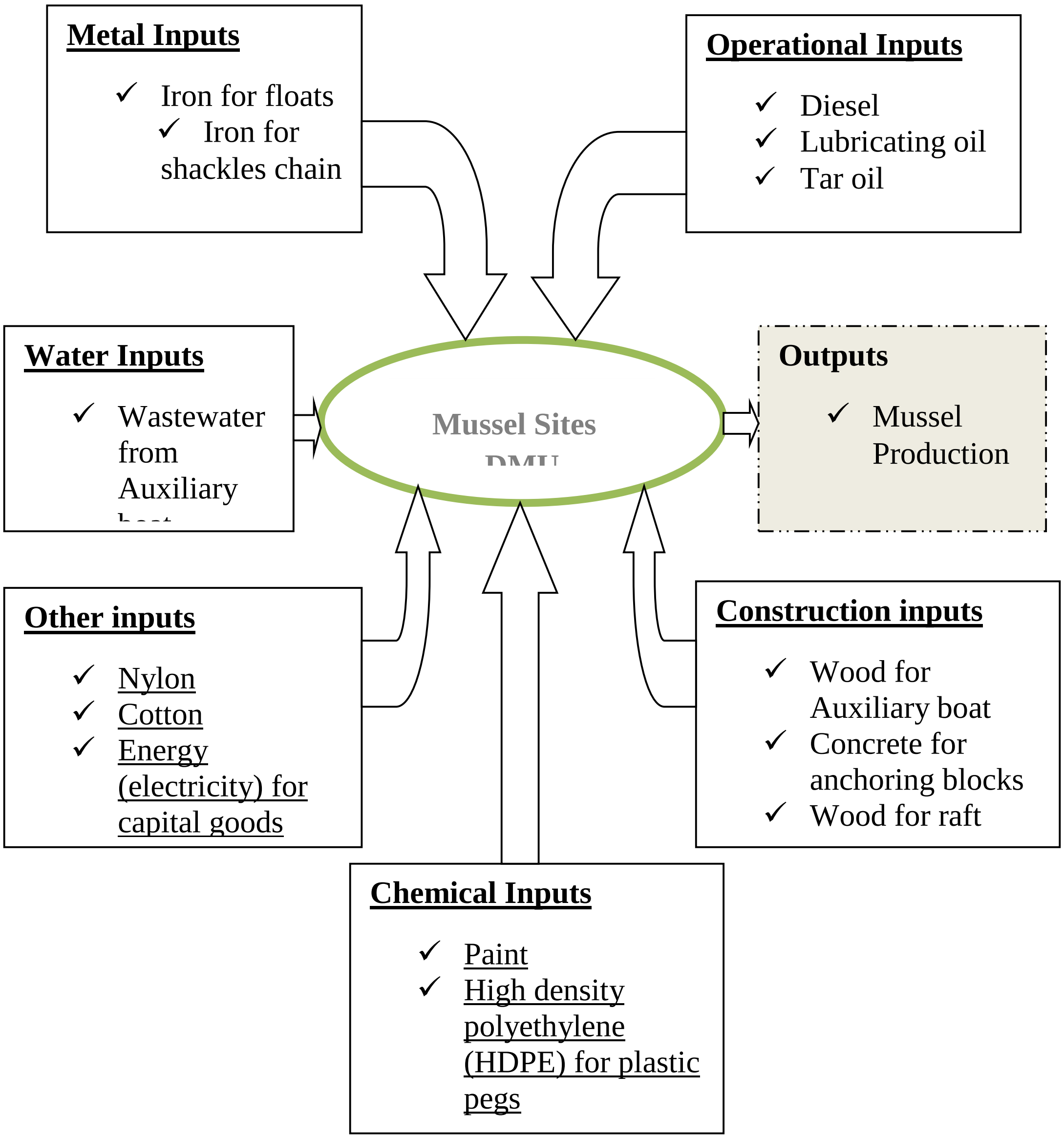

Figure 4: LCA Elements Considered for each Sites

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.

Inputs Consumed	Units
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
Output	**Units**
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).

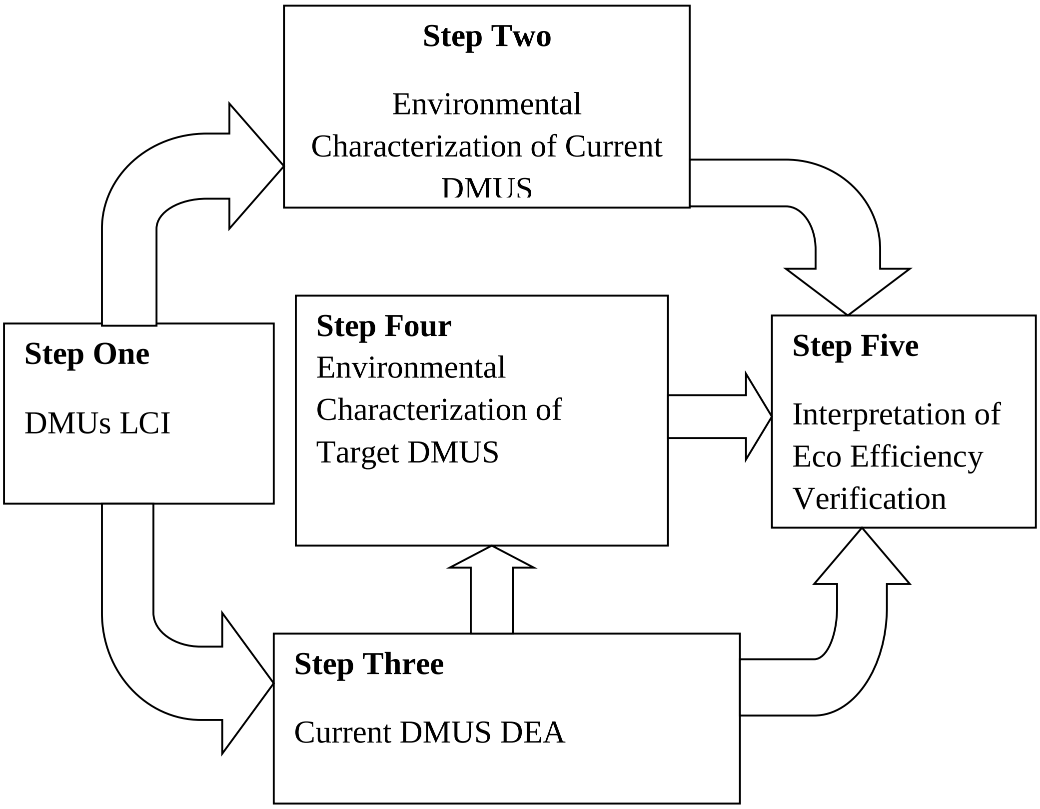

Figure 5: Schematic Representation of LCA + DEA Framework

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 other 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.

$$
\begin{aligned}
&Min\,\theta \\
&s.t\ (\theta \mathbf{x_0}, \mathbf{y_0}) \in T_B
\end{aligned}
$$

From the above formulation, our aim is to find the value of θ in which θ is between $0 \le \theta \le 1$ 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:

$$
\begin{aligned}
&Min\,\theta \\
&s.t \\
&\sum_{j=1}^{n} \lambda_j x_{ij} \le \theta x_{io} \quad i=1\ldots m \\
&\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{ro}, \quad r=1\ldots s \\
&\sum_{j=1}^{n} \lambda_j = 1 \\
&\lambda_j \ge 0,\ j=1\ldots n
\end{aligned}
\tag{3.1}
$$

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.

$$
\begin{aligned}
&Max \sum_{r=1}^{s} u_r y_{r0} + u_0 \\
&s.t \\
&\sum_{i=1}^{m} v_i x_{i0} = 1 \\
&\sum_{i=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} + u_0 \le 0 \\
&u_r, v_i \ge 0, \quad r=1\ldots s, i=1\ldots m \\
&u_0\ free
\end{aligned}
\tag{3.2}
$$

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. ϕ_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;

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

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

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

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 other 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 Infinistimal 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 ε should be used as the upper bound to make sure feasibility on the multiplier side and bounded for the BCC model envelopment side. Exploring ε in the BCC model presents the following model: As noted initially what ε does is to change the weak part of the frontier

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

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., 1884) 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.

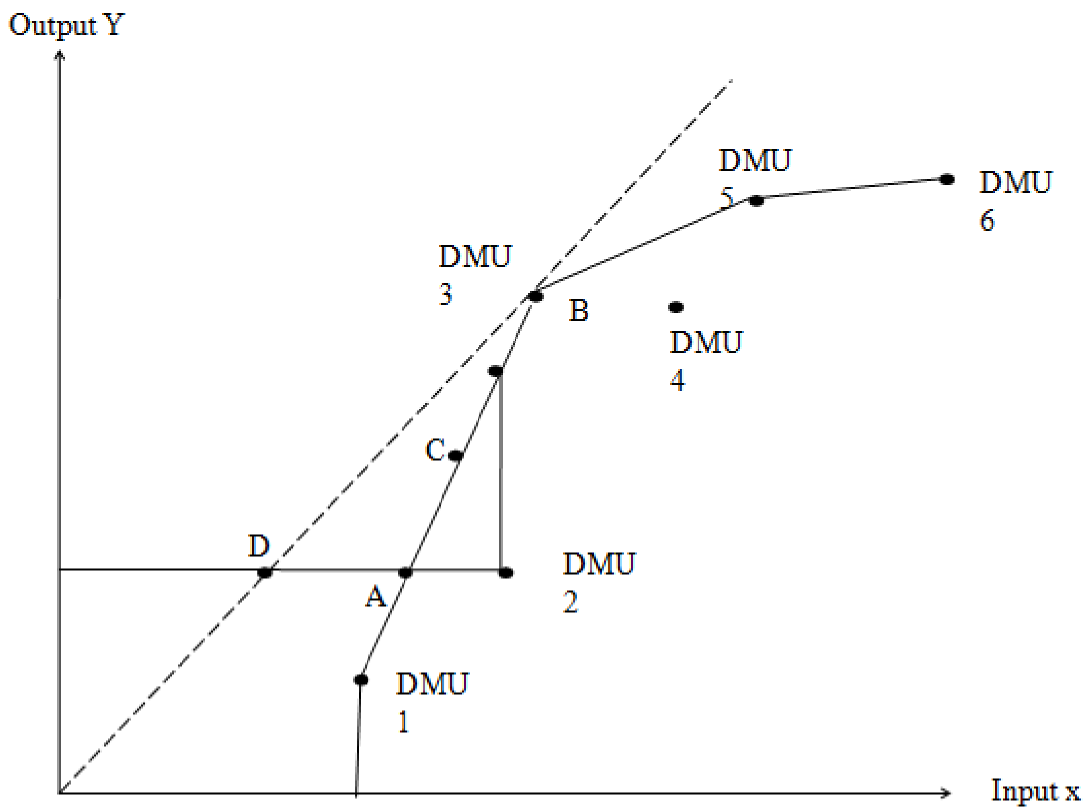

Figure 6: Evaluating the Efficiency Score of DMUs

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 DMU2could be evaluated using facet from DMU_1 to DMU_3 and same is applicable to DMU_3 to DMU_5 which can be used as a benchmark for evaluating DMU_4. The efficiency of DMU2 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_4

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., 1884) 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 ;

$P = \{(X,Y) / = \alpha X_0, Y = \beta Y_0, \alpha, \beta \geq 0 \}$ (4.2) we can present this mathematical formulation as follows;

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

Considering the new axes α and β in the plane (P) in figure 4.2 below the equivalent equation is rewritten as follows:

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

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)

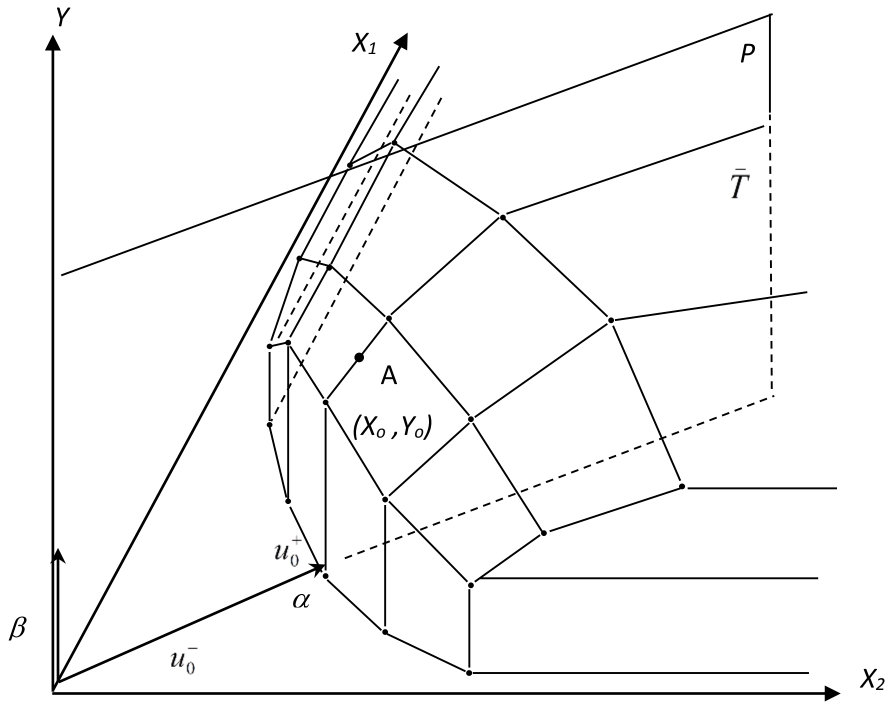

Figure 7: The PPS of two input one output space BCC Model

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 Figure4.1, 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 α and β space can be calculated respectively, as follows

$$
\begin{aligned}
& Max \quad u_0 \\
& s.t \\
& U^t X_0 + u_0 = 1 \\
& U^t Y_j - V^k X_j + u_0 \le 0 \quad j = 1 \ldots n \\
& U \ge 0 \\
& V \ge 0 \\
& u_0 \ free
\end{aligned}
\tag{4.5}
$$

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

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

Definition 2 The supporting hyper planes produced by u^* which satisfy the inequalities $u^{-*} \leq u_0^* \leq u_0^{t*}$ 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 ≤ 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 ε is defined as follows;

$$\varepsilon = Max\{u^- / u_0^- \neq 0 \ for\ efficient\, DMUs\ \} \tag{4.7}$$

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

$$\begin{aligned}
&Max \quad U^tY_0 + u_0 \\
&s.t \\
&V^tX_0 = 1 \\
&U^tY_j - V^tX_j + u_0 \leq 0 \quad j = 1 \ldots n \\
&U \geq 0 \\
&V \geq 0 \\
&u_0 \leq \varepsilon
\end{aligned} \tag{4.8}$$

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.

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

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

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

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

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 (lozano 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

DMUs	**BCC Eff. Score**	**Mod.BCC Eff. Score**	**DMUs**	**BCC Eff. Score**	**Mod.BCC Eff. Score**
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

DMUs	ERM	Modified ERM	DMUs	ERM	Modified ERM
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 and38 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, input7, 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.

REFERENCES

Akçay, A. E., Ertek, G., & Büyüközkan, G. (2012). Analyzing the solutions of DEA through information visualization and data mining techniques: *Smart DEA framework. Expert systems with applications*, 39(9), 7763-7775.

Ali, A. I., & Seiford, L. M. (1993). Computational accuracy and infinitesimals in data envelopment analysis. INFOR: *Information Systems and Operational Research*, 31(4), 290-297.

Anadol, B. (2000). Valuing private companies: *A DEA approach* (Doctoral dissertation, University of Toronto).

Avadí, Á.,Vázquez-Rowe, I., & Fréon, P. (2014). Eco-efficiency assessment of the Peruvian anchoveta steel and wooden fleets using the LCA+ DEA framework. *Journal of Cleaner Production*, 70, 118-131.

Banker, R. D., & Thrall, R. M. (1992). Estimation of returns to scale using data envelopment analysis. *European Journal of Operational Research*, 62(1), 74-84.

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management science*, 30(9), 1078-1092.

Bessent, A., Bessent, W., Elam, J., & Clark, T. (1988). Efficiency frontier determination by constrained facet analysis. *Operations Research,* 36(5), 785-796.

Iribarren, D., Martín-Gamboa, M., & Dufour, J. (2013). Environmental benchmarking of wind farms according to their operational performance. *Energy policy,* 61, 589-597.

Iribarren, D., Vázquez-Rowe, I., Moreira, M. T., & Feijoo, G. (2010). Further potentials in the joint implementation of life cycle assessment and data envelopment analysis. *Science of the Total Environment*, 408(22), 5265-5272.

Liu, C. H., Lin, S. J., & Lewis, C. (2010). Evaluation of thermal power plant operational performance in Taiwan by data envelopment analysis. *Energy policy*, 38(2), 1049-1058.

Lozano, S., Iribarren, D., Moreira, M. T., & Feijoo, G. (2010). Environmental impact efficiency in mussel cultivation. *Resources, Conservation and Recycling*, 54(12), 1269-1277.

Lozano, S., Iribarren, D., Moreira, M. T., & Feijoo, G. (2009). The link between operational efficiency and environmental impacts: a joint application of life cycle assessment and data envelopment analysis. *Science of the Total Environment,* 407(5), 1744-1754.

Martić, M., Novaković, M., & Baggia, A. (2009). Data envelopment analysis-basic models and their Utilization. *Organizacija*, 42(2), 37-43.

Mohammadi, A., Rafiee, S., Jafari, A., Keyhani, A., Dalgaard, T., Knudsen, M. T., .& Hermansen, J. E. (2015).Joint Life Cycle Assessment and Data Envelopment Analysis for the benchmarking of environmental impacts in rice paddy production. *Journal of Cleaner Production*, 106, 521-532.

Thanassoulis, E. (2001). *Introduction to the theory and application of data envelopment analysis*: a foundation text with Integrated Software. Boston: Kluwer Academic Publisher.

Tsoulfas, G. T., & Pappis, C. P. (2006). Environmental principles applicable to supply chains design and operation. *Journal of Cleaner Production*, 14(18), 1593-1602

Vázquez-Rowe, I., Villanueva-Rey, P., Iribarren, D., Moreira, M. T., & Feijoo, G. (2012). Joint life cycle assessment and data envelopment analysis of grape production for vinification in the Rías Baixas appellation (NW Spain). *Journal of Cleaner Production*, 27, 92-102.

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

4

	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

5

	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

6

	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

7

	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

8

	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

9

	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

10

	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

11

	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

12

	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

13

	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

14

	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

15

	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

16

Infeasible	solution!!!	Make any of	the following	RHS changes	and solve the	problem again.
12-07-2016 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

17

	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

18

	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

19

	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

20

	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

21

	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

22

	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

23

	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

24

	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

25

	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

26

	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

27

	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

28

	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

29

	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

30

	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

31

	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

32

	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

33

	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

34

	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

35

	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

36

	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

37

	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

38

	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

39

	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

40

	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

41

	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

42

	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

43

	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

44

	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

45

	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

46

	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

47

	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

48

	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

49

	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

50

	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

51

	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

52

Infeasible	solution!!!	Make any of	the following	RHS changes	and solve the	problem again.
12-07-2016 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

53

	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

54

	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

55

	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

56

	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

57

	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

58

	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

59

	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

60

	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

61

	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

62

	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	-0.0001	-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	-0.0017	-0.001	-0.009	-0.04	-1.8929	-0.0187	-0.1707	-0.032	-0.0045	-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	-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	-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	-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	-0.0001	0	0	0	0	0	0		0		0	0	0	0	0
41	-0.0001	0	0	0	0.0001	0	0.0012	-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	-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	-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