AN EVALUATION OF HOSPITALITY INDUSTRY'S EFFICIENCY USING DATA ENVELOPMENT ANALYSIS (DEA)

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of Bachelor of Industrial Technology Management (Hons).

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I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurently submitted for award of other degree.

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This thesis is a symbol of appreciation for my most beloved mother, father and brothers.

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ABSTRACT

This survey was conducted to identify the efficiency variable's influencing hospitality industry by using Data Envelopment Analysis and to evaluate of efficiency of hotel using Data Envelopment Analysis. The sample is constituted by 9 of five star hotel (Grand Hyatt Hotel, Traders Hotel, Berjaya TS Hotel, Shangri-La Hotel, JW Marriott Hotel, Sama Sama Hotel, Hilton PJ Hotel, Majestic Hotel, and Royale Chulan Hotel) that operating in Malaysia. The efficiency for the selected hotels is estimated through the data envelopment analysis methodology. The efficiency ranking can be explained by interaction between variables. Then, the hotel inefficiency mainly causes of the input and output configuration. A direction for future research can be easy to make of input and output. Furthermore, the inefficiency causes was identify and suggestion for the manager or hotel owners are made to increase hotel efficiency. This is one of the a few research of study measuring hotel efficiency in Malaysia. Moreover, it identify the inefficiency causes of hotel and offer suggestion to fixing the lacks that be found in hotel management.

ABSTRAK

Kajian ini dijalankan untuk mengenalpasti kecekapan pembolehubah yang mempengaruhi industri hospitaliti dengan menggunakan Data Envelopment Analysis dan menilai kecekapan hotel menggunakan Data Envelopment Analysis. Sampel data yang digunakan adalah daripada 9 buah hotel iaitu hotel lima bintang (Grand Hyatt Hotel, Traders Hotel, Berjaya TS Hotel, Shangri-La Hotel, JW Marriott Hotel, Sama Sama Hotel, Hilton Hotel PJ, Majestic Hotel, dan Royale Chulan Hotel) yang beroperasi di Malaysia. Kecekapan untuk hotel-hotel yang terpilih dianggar melalui kaedah Data Envelopment Analysis. Kecekapan antara hotel boleh diterangkan oleh interaksi antara pembolehubah. Kemudian, ketidakcekapan hotel kebanyakan disebabkan oleh penyusunan input dan output. Satu arahan bagi penyelidikan masa depan akan memudahkan untuk kemasukan input dan output. Tambahan pula, sebab-sebab ketidakcekapan boleh dikenalpasti dan cadangan untuk pengurus atau pemilik hotel dibuat bagi meningkatkan kecekapan hotel. Ini ialah salah satu antara beberapa penyelidikan kajian untuk mengukur kecekapan hotel di Malaysia. Tambahan pula, ia mengenalpastikan sebab-sebab ketidakcekapan hotel dan menawarkan cadangan untuk memperbetulkan kelemahan boleh ditemui dalam pengurusan hotel.

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LIST OF ABBREVIATIONS

DEA	Data Envelopment Analysis
AHP	Analytic Hierarchy Process
QFD	Quality Function Deployment
DMU	Decision Making Unit
TFP	Total Factor Productivity
CRS	Return-to-scale
VRS	Variable returns-to-scale
HNDEA	Hyperbolic Network DEA
CCR	Charnes, Cooper, Rhodes
BCC	Banker, Charnes, Cooper
VBA	Visual Basic for Application

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter forms and include about introduction of the finding and it have the overview and general explanation for the entire research process. The research analyse and mainly focuses about the efficiency of the hotel that are calculate from the variable to choose the best and most efficiency five stars hotel in Malaysia. This chapter discusses about the background of study, problem statement, research objectives, research questions, scope of study, significance of study, operational definition, expected results, and for the summary of this first chapter and this research focus and only refer to the hotel that around in Malaysia.

1.2 BACKGROUND OF STUDY

Guest and host, or practice of being friendly have relate with hospitality. It also called as the demonstration of generously providing care and benefit to whoever is in necessity. Hospitality also means 'the friendly reception and treatment of guests or strangers' based to Dictionary.com. The Latin word of hospitality is '*hospitalitem'* which means, "Friendliness to guests". Furthermore hospitality are attitude that to make others feel comfortable and also to make satisfaction to other and getting their needs. Then, we

move to “hospitality industry” which are refer to the organisations or companies that involve to provide drink and food or accommodation to people that are far away from their home.

Hospitality industry is a wide category of field within service industry which is related closely within the tourism industry that includes lodging, transportation, theme parks, event planning, cruise line and etc. The hospitality industry which depends on the availability of free time and disposable time of multi-billion dollar industry. In addition, hospitality process very vast market. The things that can be placed at under hospitality market is all those that had stayed in hotels or any other lodging establishment. The hospitality market also will be travellers including tourism visitors, businessman, pilgrims, company’s executive and etc.

Because the one of Asia’s most famous tourist destination, the Malaysia’s tourism industry has been identified which are have potential to increase its contribution to the service sector in particular and the economy in general. This are included in the Ninth Malaysia Plan. Surely, under the Third Industrial Master Plan (IMP3) (2006-2020), tourism administrations have been recognized as one of the eight administration sub-segments to be centred for further advancement amid the IMP3 period. With the plan to upgrade Malaysia as one of the worldwide tourism destinations, the hotels sector, being one of the areas in the tourism business, assumes an imperative part to keep up and enhance its execution to add to the acknowledgment of the arrangements.

In spite of the fact that hotels stay prevailing in the travel settlement part in Malaysia, representing 85% (RM10, 738.4 million) of aggregate travel convenience value sales in the year 2006, hotel sales did not develop in coupled with the increment in entries and residential treks. Hotel sales just became by 4% when contrasted with the sales in year 2005 (RM10, 311.9 million) (Euromonitor, 2007). Oversupply of rooms and solid rivalry among hotels have driven down room rates (via promotion and discount). Meanwhile, a few visitors decide on option convenience, for example, campgrounds, motels, cooking toward oneself flats, chalets, guesthouses, hostels, private settlement and others. As the consequence of oversupply of rooms, commitment from the lodging area was extremely influenced. Hence, there is a need to enhance the efficiency of hotels.

Data Envelopment Analysis (DEA) is a new data-oriented approach for evaluating efficiency of a set of Decision Making Units (DMU's) which convert multiple number of inputs into multiple number of outputs. It is a nonparametric method in operations research and economics for the estimation of production frontiers. By using this method which is DEA to measure the efficiency among the hotels.

Even with an exceedingly focused environment and the fast development of hotels emerging from business interest and the changing monetary atmosphere, it is essential for hotels to define advertising rivalry systems, reinforce corporate operations and redesign the nature of administrations. In detailing rivalry methods, one must first measure the near execution of the whole business, before one may comprehend one's qualities and shortcomings. Execution assessment serves as a critical reference for arranging and development strategies. Consequently, to survive and be supportable in the division, it is imperative for top administration of hotels to discover approaches to enhance their efficiency.

1.3 PROBLEM STATEMENT

Sufficient number of employees to treat the customer is significance in providing the service to the customer. To provide service properly is one of the role in hotel industry. The efficiency will not be achieved without the best quality of service. The problem will occur when hotels receive too many customer at the same time and management cannot provided enough employee to serve their customer. Hence this problem will relate with another case of customer dissatisfaction. Less employee in charge for many job will result in low performance to customer because they are already tired in serving many customer.

Furthermore, the number of room available following too many customer in once time which is normally happen when holiday are coming. The different packages will result the number of rooms occupied give dissatisfaction to the guest because some of the room that guest like are not available for that time. But, the oversupply of room also influence of the decreasing rate and performance of the hotel management because it waste the cost to build many room but the guest only a few.

1.4 RESEARCH OBJECTIVES

The purpose of this research is to analyse and to measuring the efficiency of hospitality industry in hotel by using Data Envelopment Analysis. The objective of this study need to be achieved at the end of the study. The specific objective of the study is:

- To identify the efficiency variable's influencing hospitality industry by using Data Envelopment Analysis.
- To evaluate of efficiency of hotel using Data Envelopment Analysis.

1.5 RESEARCH QUESTION

The research question for this study are:

- What are the efficiency variable's influencing hospitality industry by using Data Envelopment Analysis?
- How are the efficiency of hotel using Data Envelopment Analysis?

1.6 SCOPE OF STUDY

The main focus of this research is to measure the efficiency of hospitalities industry: hotel in Malaysia using DEA method and to recommend the better performance target. This research is be selected only five star hotels ranking in Malaysia and a comparison is conducted between the DEA model results and the hotel's performance ratios and benchmarks, validating the use of the proposed DEA models for efficiency analysis in the hospitality industry.

Furthermore, this research only focus to hotels that located in Malaysia. This scope also not include all hotels in Malaysia but only a few hotel in five star ranking that

are selected. There are have 106 five star hotel in the Malaysia but only the selected are chosen in this research because of the few problem and the limited of the data. Besides that, the particular study additionally focusing to the hotels this may be selected randomly categories at the great time were compared throughout respect towards goal. In the terms through hotels this particular study will certain focus to how efficiency there are only because the personnel of hotels are should give more commitment that to achieve performance that could make their for being selected to get the best ranking. The organization that this study choose for the research is more related to the characteristics that they have to make sure its compatible with the research title.

1.7 SIGNIFICANCE OF STUDY

This research is actually will revealed the suitable way to select the efficiency of hotels that will be benchmarking for the others. This study will evaluate the measurement criteria available and also to promote the efficiency scale from 0.98 to 1.0 by using the Data Envelopment Analysis (DEA) method. Through this method, it will able to know the criteria that should hotel have to make their efficiency is the best ranking and also can help the hotels to create their efficiency and can compete to other hotels. Even though, it is not just among their service that they provide to customer, but also among their criteria such as, number of employees, number of room and etc. that they have qualifications for being a good and benchmark hotels.

In terms of that, this research also can help to measure the efficiency of hotels which involve nine hotels that located in Malaysia of being the best ranking that which are based on the number of employees, number of room, assets and number of guest in hotels by using the DEA method as the guide for the best ranking or selection. It also important to hotels management because they can formulate the strategy's competition, and known what are strengths and weakness that they have. Proposed DEA models have been integrated with the existing planning tools utilized in the hotels and make the management going easy to use.

Last but not least, multiplication of difference input and output is the main advantages of the DEA method. It is very helpful scale and powerful method in

calculating efficiency of the hotels and based on output levels and size, the concept of increase or decrease in efficiency was allowed. It is actually can bring more benefits to the research which is related to the objective of this study that is about how to measure efficiency of hotels by using data envelopment analysis in other word it will review the process to select the best ranking to be benchmarking.

1.8 OPERATIONAL DEFINITION

Hospitalities Industry – a broad category of fields within the service industry that includes lodging, theme parks, event planning, cruise line, transportation, and additional fields within the tourism industry**.**

Efficiency – the extent to which effort, time, or cost is well-used for the intended task or function. It often comprises specifically the capability of a specific application of effort to produce a specific outcome effectively with a quantity of waste or minimum amount, expense, or pointless exertion.

Data Envelopment Analysis (DEA) – a nonparametric technique in operations exploration and financial matters for the estimation of creation wildernesses [clarification needed]. It is utilized to exactly gauge profitable productivity of choice making units (or DMUs). In spite of the fact that DEA has a solid connection to creation hypothesis in financial aspects, the device is additionally utilized for benchmarking as a part of operations administration, where an arrangement of measures is chosen to benchmark the execution of assembling and administration operations.

Decision Making Unit (DMU) - a gathering or group of people who take part in a purchaser choice procedure. By and large DMU identifies with business or hierarchical purchasing choices instead of to those of a family for instance.

CCR – is presumably the most broadly utilized and best known of DEA model. CCR comes from the name of Charnes, Cooper and Rhodes who're present this model.

BCC – is the DEA model utilized as a part of Frontier Analyst when a variable comes back proportional relationship is expected in the middle of inputs and outputs. BCC comes from the name Banker, Charnes and Cooper.

1.9 EXPECTED RESULTS

1. To identify the efficiency variable's influencing hospitality industry using Data Envelopment Analysis.

This model is composed of three input (number of employees, number of rooms, assets) and one output (number of guest) to run by using Data Envelopment Analysis. This study is target to do productivity analysis in the service provided to customer by measuring most important variables that will give high impact on Hotel's performance through past research and interviewing the expertise.

2. To evaluate the efficiency of hotel using Data Envelopment Analysis.

This study are going to run by using Data Envelopment Analysis (DEA) Solver in order to evaluate the efficiency of hotels in Malaysia which are Grand Hyatt Hotel, Traders Hotel, Berjaya Time Square Hotel, Shangri-La Hotel, JW Marriott Hotel, Sama Sama Hotel, Hilton Petaling Jaya Hotel, Majestic Hotel and Royale Chulan Hotel. At the end of this study, the outcome which hotel is most efficient can be traced using Data Envelopment Analysis (DEA).

1.10 SUMMARY

In the hospitality industry, there are a few problem should be improving in their service to make it more quality. This occur because they do not have their strategic planning in their organization of management are not compatible in their industry. They also are do not know which is their management are achieve the benchmark or not and also the systematic ways to overcome it. So, this chapter are generally explained about how this study will be conducted. The purpose of this study is to identify the ranking to be benchmark to other hotel's management and select the best ranking by using the DEA methods.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, it is review and related of the article and the past literatures that related to the proposed study that has been published by accredited scholar and researcher were are summarized. This chapter covered the literature review of the data development analysis (DEA), decision making units (DMUs), measurement of efficiency, DEA-Based studies in hotel industry, DEA condition and the advantages and disadvantages of the DEA method.

2.2 DATA ENVELOPMENT ANALYSIS (DEA)

Agreeing of a couple specialist, DEA are utilized to gauge productivity. DEA is valuable non-parametric venture for accomplishment of benchmarking. It utilizes direct programming system to focus relative efficiencies of an arrangement of homogeneous and equivalent units with the accompanying benefits: DEA requires neither a priori determination of a production function nor information on prices, it is helpful in distinguishing the best entertainer and in addition in giving noteworthy measures to enhancing the execution, and this type of efficiency evaluation can be regarded as

benchmarking. In 2009, Yu and Lee proposed a hyperbolic network DEA (HNDEA) model to assess administration adequacy, profitable proficiency, and gainful viability for global vacationer lodgings. Furthermore, in 2010, Chiou et al. further developed two integrated DEA (IDEA) models to measure technical effectiveness, service effectiveness and technical efficiency for transport industry that produces non-storable (perishable) commodities. Charnes, Cooper and Rhodes (1978) are the first who introduced the DEA to describe the mathematical programming approach to the construction of production frontiers and the measurement of efficiency of developed frontiers.

There are two basic DEA models which are CCR model discovered by Charnes et al. in 1978 and BCC model by Banker et al. in 1984. The CCR model that had an information and assumed constant return-to-scale (CRS). Then for the BCC was introduced the assumption of variable returns-to-scale (VRS). Furthermore, there are five other basic DEA models besides of CCR and BCC which is less common in the literature: the multiplicative, the additive, the cone-ratio DEA model, the assurance region DEA model, and the super-efficiency model. The additive model are functions to determine the input excesses and output shortfalls simultaneously. The cone-ratio, the assurance region models and a priori information such as opportunity costs, opinion of expert, rate of transformation or rate of substitution, in order to restrict the result for the single best performing in decision making unit, DMU. In addition, eliminating the data on the DMU which can be evaluated from the solution set causes the super-efficiency model providing efficiency score.

The other developments of DEA include the disentangling of Malmquist TFP index as well as technical and allocative efficiency. Anderson, Fok & Scott defined allocative inefficiency as deviations from the efficient frontier that result from the failure of managers to use the optimal input mix in the production process. Failure to fully utilise input, which given their allocation can represented by technical in efficiency that act as the product of the pure technical inefficiency and scale efficiency in the pure technical. All significant input and output can be consider by obtaining an output-to-input ratio value where productivity can be measure by TFP. The TFP approach can be useful theoretically and empirically.

Efficiency quantitatively which are the economy. In any case, both routines have their focal points and disadvantages. Besides, since it is evaluated with a nonparametric

technique (DEA), there is no compelling reason to force any useful structure on the information, or to make distributional suppositions for the wastefulness term metric frontier and DEA. DEA can be analyse by using the two scientific methods.

Both techniques accept that the creation capacity of the completely effective choice unit is known. Practically speaking, this is not the case and the effective isoquant must be evaluated from the specimen information. Along these lines, the boondocks is with respect to the example considered in the examination. DEA is connected to unit appraisal of homogeneous units, for example, banks, healing facilities and accommodations. The unit of appraisal is regularly alluded to as a DMU which changes over inputs into outputs. The ID of DMUs, inputs and outputs in an appraisal is as troublesome as it is essential (Barros, 2005).

The DEA methodology speaks to a system by which non-similar various inputs and outputs of a substance can be joined dispassionately onto a general measure of authoritative productivity. DEA is likewise a benchmarking system that evaluates the relative effectiveness of DMUs. Analysts keen on administration industry execution have connected DEA to a few segments like managing an account, nursing and protection.

2.3 DECISION MAKING UNIT (DMU)

The organization or company that was used under study in Data Envelopment Analysis is called Decision Making Unit (DMU). The DMU is means rather lose to allow flexibility in its use over a wide range of conceivable application. Generically, DMU is viewed as the element in charge for converting of the inputs into outputs and whose performance are to be assessed. In administrative application, DMUs may include in many types of field's activities such as education, hospitality, warehouse, supplier selection and etc. For the purpose of securing the relative correlations, a cluster of DMU is used to assess one another which each DMU are having a certain level of administrative opportunity in decision making. Suppose there are n DMUs: DMU_1, $DMU_{2...}$ and DMUn. Some common input and output items for each of these j = l... n DMUs are selected as follows:

- Numerical data are available for each input and output, with the data assumed to be positive[1] for all DMUs.
- The items (inputs, outputs and choice of DMUs) should reflect an analyst's or a manager's interest in the components that will enter into the relative efficiency evaluations of the DMUs.
- In principle, smaller input amounts are preferable and larger output amounts are preferable so the efficiency scores should reflect these principles.
- The measurement units of the different inputs and outputs need not be congruent. Some may involve number of persons, or areas of floor space, money expended, etc.

Boussofiane et.al (1991) stipulate that to get good discriminatory power out of the CCR or BBC models the lower bound on the number of DMUs should be the multiple of the number of inputs and number of outputs. In this study, 3 input should be multiply with 1 outputs which brings out of 3 Decision Making Unit (DMUs) or 3 of five stars hotel. So, the minimum of the DMU should use is 3 but if get more than 3 is quite good for the research.

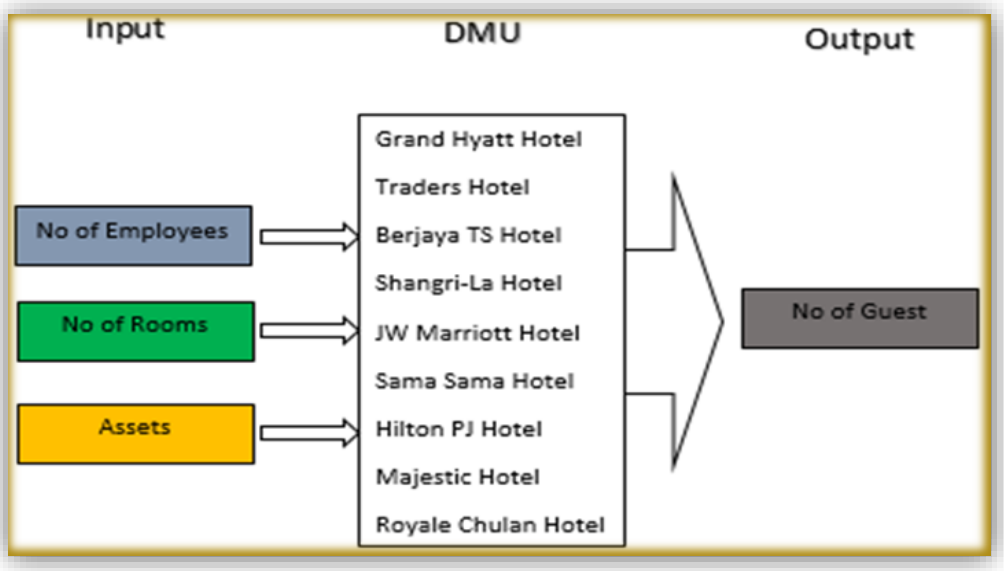

Figure 1: The flows of how to get the number of DMU

2.4 MEASUREMENT OF EFFICIENCY

Efficiency measurement is an indispensable piece of administration control. It can be utilized as a kind of perspective in choice making, as well as the premise for upgrades. Accordingly, estimation of proficiency has turns into a critical and expansive degree subject. Administrators, economists and different scientists have endeavoured to precisely quantify the effectiveness of the lodging business for a long time utilizing different methodologies.

There are different approaches utilized in effectiveness estimation. A portion of the scientists concentrate on execution markers, for example, cost-volume-benefit examination, the cabin's business receipt data, hotel list, an income execution marker, and an effectiveness pointer. Fetched volume-benefit investigation was acquainted as a system with give data on the productivity of a firm in connection to volume. It is helpful in the business arranging stage and also in testing or assessing conjecture and in breakeven examination. Plus, it can be connected to examine an individual association's execution and utilized at a territorial level to think about different sorts of firms. In spite of the fact that this strategy is valuable in evaluating hotel execution in total, it gives no firm particular measures of execution

Then again, Wassenaar & Stafford had recommended the utilization of a cabin list pointer for the lodging/motel industry since 1991. The creators characterized cabin record as the normal income acknowledged from every room, empty or involved, inside an area or city amid a given time period. The list is especially compelling for neighbourhood travel destinations where normal inhabitancies and room rates are not accessible. The list joins normal inhabitancies and room rates into a solitary pointer however this system does not look at how productively firms are controlling expenses.

These execution markers give imperative and valuable data to benchmarking in light of bookkeeping and money related execution regarding straightforward degrees, yet there are actually numerous variables with respect to lodging execution, and clearly these pointers have not considered the blend and nature of administrations gave. As recommended by Anderson et al., measuring the relative productivity of a lodging obliges

techniques that are more delicate than bookkeeping and budgetary proportion measures and that can unequivocally consider different inputs and outputs of the hotels.

2.5 DEA-BASED STUDIES IN HOTEL INDUSTRY

In the tourism writing, the examination of proficiency is constrained to a little number of studies, which concentrates on the investigation on micro-units (e.g., inns, corporate travel divisions, and so on.). Among the most punctual, Morey & Dittman had utilized information envelopment investigation to assess the general-director execution of 54 hotels of an American tourism chain for the year 1993.

DEA was likewise utilized by a few different analysts as a part of inns. Sanjeev was assessed the effectiveness of 68 lodging and eatery organizations working in India utilizing the DEA procedure. The study found that the normal score for all the organizations as a gathering stands at 0.73 and therefore, the friendliness business is seen as doing admirably.

Hwang & Chang also utilized information envelopment examination and the Malmquist TFP to assess the administrative execution of 45 lodgings and the effectiveness change of 45 hotels from 1994 to 1998. The creators found that there was a critical distinction in effectiveness change because of a distinction in wellsprings of clients and administration styles. In year 2005, Barros & Mascarenhas again utilizing information envelopment investigation, measured the specialized and allocative productivity of 43 hotels in Portugal for the year 2001. Though Anderson et al. was utilized the DEA-stochastic outskirts way to deal with appraisal normal and firm-particular productivity level in 48 lodgings.

Then a few studies utilized DEA with other imaginative measures to assess effectiveness. Sun (2004) deliberate the lodging execution of 47 worldwide vacationer inns in Taiwan for the time of four years on different measurements. The analyst utilized a generation way to deal with outline three execution models, which are administrative execution, room division execution and providing food office execution. A comprehensive study coupled with DEA has been finished by Barros to assess the proficiency of individual inns having a place with the Portuguese state-possessed chain,

Pousadas de Portugal. The creator found that this strategy can be utilized for the examination of intra chain near hotels productivity and also to inspect the intensity of the chain overall.

2.6 DEA CONDITION

DEA calculation had many ways to use and it's depend on the condition which are related with the number of input and output and also the number of DMU.

A few DEA conditions such as:

1. Isotinicity property
   -Means that an increasing of the any input result will also increase the output result and not decreasing the output.

2. Positive property
   -In DEA formulation, the input and output should be positive.

3. Number of Decision Making Units (DMUs)
   - A general rule of thumb which is multiple of variable which is input and output. Boussofiane et.al (1991) stipulate that to get good discriminatory power out of the CCR or BBC models the lower bound on the number of DMUs should be the multiple of the number of inputs and number of outputs. In this study , a 3 input shoud be multiply with 1 outputs which brings out of 3 Decision Making Unit (DMUs) or 3 of five stars hotel. Golany and Roll (1989) establish a rule of thumb that the number of units should be at least twice the number of inputs and outputs considered. Bowlin (1998) mentions that need to have three times the number of DMUs as there are inputs and output variables. Dyson et.al (2001) recommend a total of two times the product of the number of input and output variables. In this study, 3 inputs with 2 outputs model Gollany and Roll recommend using 8 DMUs, while Bowlin recommends 15 DMUs and Dyson et.al recommend 12.

4. Homogeneity of DMUs

   -DEA requires a relatively homogeneous set of entities. That is all the entities involved in evaluation set should be have the same inputs and outputs of the positive number.

2.7 ADVANTAGES OF DEA

DEA method have several strength that will shows it different from others tool.

Strengths:

- Easy to use
- Allows multiple inputs and multiple outputs
- Does not require specification of functional form for the frontier
- Does not require a priori specification of weights for inputs and outputs
- Inputs and outputs can be expressed in different measurement units
- No need to explicitly specify a mathematical form for the production function
- Proven to be useful in uncovering relationships that remain hidden for other methodologies
- Capable of handling multiple inputs and outputs
- Capable of being used with any input-output measurement
- The sources of inefficiency can be analysed and quantified for every evaluated unit

2.8 SUMMARY

As a conclusion, this part could be possible in light of the readings and survey of the past specialist paper, online diaries and article. The readings and survey give the analyst seeing about the hospitalities industry and data envelopment analysis method (DEA) topic. Other than that, the researcher can show signs of improvement view and viewpoint on the significance of DEA. All the terms that included in hospitalities industry and DEA can be distinguish. The through perusing and audit of the chose materials give another information and thought for the analyst to lead the study.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This specific chapter is actually consisting of the window analysis model, CCR model, selection of input and output, performance analysis and last but not least summary of this chapter. In general, the basic methodology of this study is to measure the efficiency of hospitality industry in Malaysia by using a method. In the previous study, they had use many method such as analytic hierarchy process (AHP), simulation, quality function deployment (QFD) and etc.

AHP is a method to break a situation that complex not structure inside some components in arrangement that hierarchy, by giving subjective value on importance of each variable relatively, and fix which variable own highest priority that use influence result in the situation. AHP scatters multi problem factor or multi criteria that complex be one hierarchy. But AHP method only mathematics method without testing statistically until do not have belief limit from model truth that formed. Next is simulation method. Simulation means the impersonation of the operation of a genuine process of framework over time. The demonstration of simulating something first obliges that a model be produced; this model speaks to the key qualities or practices/elements of the chose physical or conceptual framework or procedure.

The model speaks to the framework itself, while the recreation speaks to the operation of the framework over the long run. Then, for the QFD is strategy wily to change subjective client requests into quantitative parameters, to convey the capacities shaping quality, and to send systems for accomplishing the configuration quality into subsystems and segment parts, and eventually to particular components of the assembling procedure.

3.2 RESEARCH DESIGN

Research design is a process to make the frameworks and show the flow of the research from beginning steps until end which are detailed. The Figure 1 shows seven step of the research design.

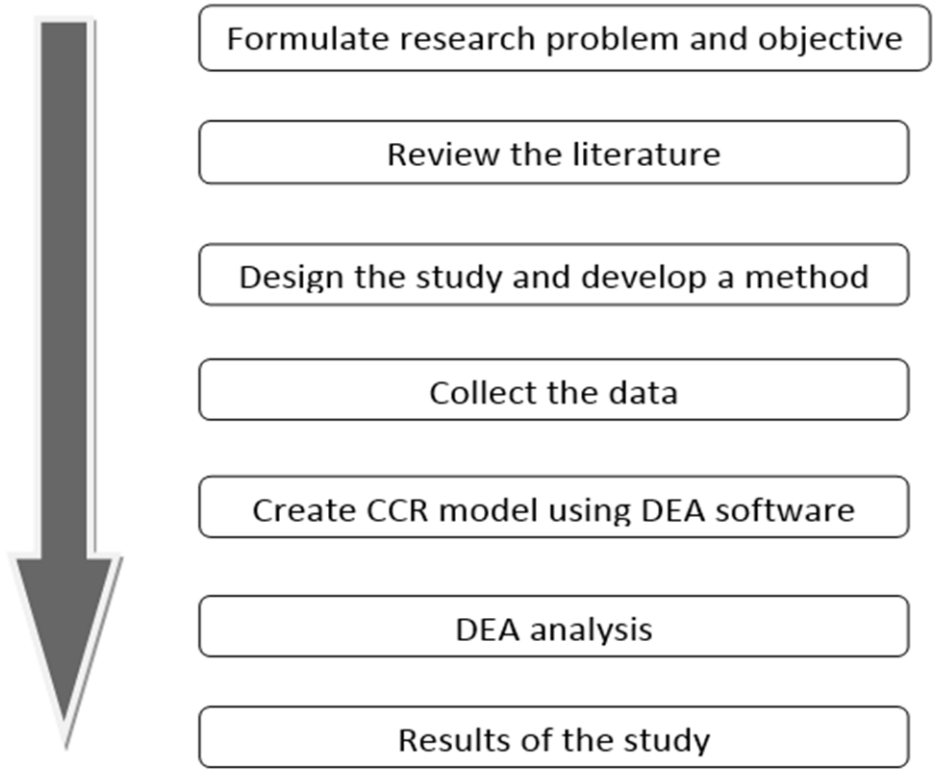

Figure 2: The research design flow

Step 1 is the formulate research problem and research objective. In this step is research about the hospitality industry which is cover of the many field such as service. The field that was chosen for this study is hotel sector. The research problem was identified based on the organization faced which is affect the efficiency of the management. From problem occurred in the organization, research objective can be developing in research design to find the solution of that problem.

Step 2 is review the literature. For this step, it is process of the review from the previous research which is related to this study. The previous research will guide and help to write the research smoothly. The literature can be book, articles, journals, newspaper or any things that are give information and guide to do the research. But for the literature that can support the research is the current or latest because the old literature are not up to date and not strong enough to using.

Step 3 is design the study and develop the method. This step are will conducted after the above step are completely done. After reviewing the literature and understand the problem, objective for this study, the method are develop to find the solution for the problem. Choosing for the suitable method are important for this research because wrong method will give wrong answer for the problem and cannot get the accuracy answer to the research objective. So the most suitable method for this research is DEA method.

Step 4 is collect the data. There have many way to collect the data such as interview, questionnaire, historical data, survey, observation and others. Data is one of the important thing that used to put in the method. Data that use in this study is type of variable which is input and output. The collected data will use and run it using DEA software. In DEA method, the relevant of input will produce the relevant output.

Step 5 is create CCR model using DEA software. When the information and data of the research was recorded, it will able to run the data to get the result using DEA software. The correct variable which is input and output will influence for the good or bad result either efficiency or inefficiency. The running process model need to validate by using the data that has been collected.

Step 6 is DEA analysis. DEA analysis is to analyse the model to be more efficiency of the management in the hotel sector. Furthermore, it also to evaluate the slack that produce for the inefficiency DMU and find the problem that occur at that hotels.

Step 7 is results of the study. After the DEA analysis and what if analysis approach, the result of all DMUs that created using DEA software need to calculate their efficiency. From the result, the DMUs that give efficiency score equal to 1 will be chosen.

Besides that, this study are focus and use the DEA method to run the data that are collected. It is because this method is a very powerful managerial tools among the rest for measuring performance. The main advantage of DEA method is ability to suit a variety of inputs and outputs. It is likewise valuable on the grounds that it contemplates comes back proportional in computing effectiveness, considering the idea of decreasing or increasing efficiency based on size and output levels. Moreover, it also easy to use for comparable among organization to produce the best one and make it as a benchmark among the rest.

3.3 DEA SOLVER

DEA Solver-Pro

- Software title : DEA-Solver-Pro, Version 4.0
- System requirement : Microsoft Windows, Microsoft Excel 97 or newer
- Available from : SAITECH, Inc; demonstration version included with Cooper, Seiford and Tone (2000)

This study are using DEA-Solver software that is training version which is to encourage the utilization of this material a "DEA-Solver" circle is supplied with going hand in hand with guidelines which are presented ahead of schedule in the content. This Solver was created utilizing VBA (Visual Basicfor Application) and Excel Macros in Microsoft Office 97 (a trademark of Microsoft Corporation) and is totally good with Excel information sheets. It can read straightforwardly from an Excel worksheet and returns the consequences of processing to an Excel workbook. The code takes a shot at Excel 2000 too. The outcomes give both primal (envelopment form) and double (multiplier form) arrangements and additionally slacks, projections onto proficient outskirts, diagrams, and so on.

The straight programming code was initially planned and actualized for DEA, exploiting uncommon highlights of DEA plans. Reader are urged to utilize this Solver for taking care of cases and issues in this content and for developing their comprehension of the models and their answers. In spite of the fact that the appended Solver is principally for learning purposes and can bargain just with moderately little measured issues inside a set number of models, a more propelled "Proficient adaptation" can be found at the site http://www.saitech-inc.com.

3.4 CCR MODEL

In this model introduced an efficiency measure to respectively making decision unit (DMU) that is maximum ratio between weights of output and input. Respective weight value that used in ratio that determine with ratio that limitation that same to every DMU should possess value that less from or equal to one. Thereby will reduction inputs multiple and outputs multiple into one "virtual" input and virtual" output without require preliminary determination weight value. Because of the efficiency measure is a weight value function from virtual combination input and virtual.

Measuring efficiency DMU output enumerable by settling mathematical programming problem following:

$$\max_{u,v} h0(u,v).\frac{\sum_{r=1}^{s} u, y,_o}{\sum_{i=l} V_i X_{io}} \; subject\ to \frac{\sum_{r=1}^{s} u, y,_o}{\sum_{r=1}^{m} u, y,_o} \le 1, j = 1,2,3..., jo,..., n$$

$$u_r \le 0, r = 1,2,...,s; v_i \le 0, i = 1,2,...,m$$

with x_{ij} is input value perceived with tip to-i from DMU to-j and $x_{ij} > 0$ for $i = 1,2,3,\ldots,m$ and $j = 1,2,\ldots, n$. Likewise with y_{rj} is output value perceived with tip to-i from DMU to-j

and $y_{rj} > 0$ for $i = 1,2,\ldots,m$ and $j = 1,2,\ldots,n$. The variable of u_r and v_i is weight value to determine programming problem that has been mentioned. However this problem own solution that unlimited because if u * and v*it is optimal, thus to every $\alpha > 0$, $\alpha u^*$and αv^*also optimal. By following Charnes-Cooper's transformation, so solution (u,v) that we can choose is solution that representative with condition:

$$\sum v_i x_{i0} = 1$$

Until gained linear programming that equivalent with problem linear programming fractional. Division in efficiency measure above made equal to one and linear problem that have transformation can be written by:

$$\max_{z0} = \sum u_r y_{r0} \; ; subject\ to \sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij}$$

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

$$u_r \geq 0, r = 1,2,\ldots,s; v_i \geq 0,1,2,\ldots,m$$

Linear programming problem above often mentioned CCR model also with input-output oriented. Maximum carried out by choosing "virtual" multiple (such as weight values) *u* and *v* which produces speed largest "virtual" output over "virtual" input. The problem can be written to every DMU_0 as:

$$\min_{\lambda} = \theta_{o}\,; subject\ to \sum_{j=1}^{n} \lambda_j y_{rj} \geq 0, i = 1,2,...,m$$

$$\theta_o x_{i0} - \sum_{j=1}^{n} \lambda_j x_{rj} \geq 0, i = 1,2,... m$$

$$\lambda_j \geq 0,\ j = 1,2,... n$$

Linear programming problems from above acquire optimal solution Θ_0*, that is efficiency value, mentioned too efficiency technique value or CCR efficiency, for certain DMU_0. Meanwhile, to get efficiency value to whole DMU achieved by repeating process above to every DMU_j, j =1, 2… n. The value of Θ always smaller or more similar one. For DMU who obtained Θ_0 * =1 mentioned efficient relative, of which combination "virtual" input-output rests with efficient frontier.

3.5 SELECTION INPUT AND OUTPUT

For the successful utilization of DEA, cautious ID of inputs and outputs is significance. Although that assets utilized by DMU can be incorporated as input, just three inputs will be picked for this study. Inputs distinguished are number of room, number of employees and assets. One outputs will be selected, including number of guests. The quantity of perceptions and the variables utilized will need to stick to the DEA tradition that the base number of choice making units is more noteworthy than three times the total number of inputs and outputs.

Keeping in mind the end goal to keep up the homogeneity of the hotels for even-handed examinations, nine of the hotels enrolled with the Malaysian Association of Hotels 5-star taking into account the Star-Rating hotel grouping plans and working for the year 2013 will be picked for this study. These hotels are topographically scattered over Peninsular Malaysia and East Malaysia. Board information covering the perceptions on the data and output variables for all choice setting aside a few minutes period will be acquired from the Companies Commission of Malaysia. The hotels information in the

report are ordinarily esteemed substantial and dependable. Nonetheless, a few hotels whose information was distracted from the Companies Commission of Malaysia report will be inferred through web-hunt and meeting with the hoteliers. The board information will be utilized as a part of this study to focus the Malmquist gainfulness list of the hotels in Malaysia. The TFP lists of inns will be processed utilizing the DEA program. Figure 2 demonstrates the proposed system for the Source of Hotel Statistical Data.

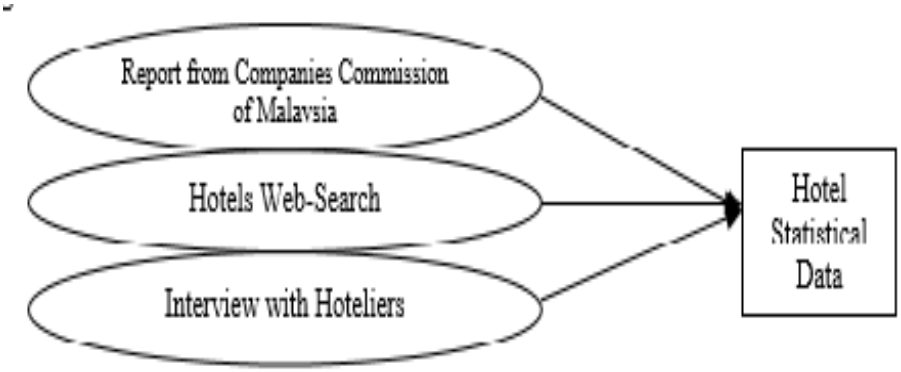

Figure 3: Source of Hotel Statistical Data

3.6 SUMMARY

Based on the study, the data from the hotel is collected and will observed and calculated. Then the results of the study and comparing between hotels to make as a benchmark suing data envelopment analysis (DEA) method. If by using the DEA method, its can help the organization to find the factor that involved to improve the efficiency at hotels.

CHAPTER 4

DATA ANALYSIS

4.1 INTRODUCTION

This chapter will discuss about the finding and result of the study. Those result was gained from analysis data that had conducted by interviewed and questionnaire to determined or searching about performance and efficiency which is plan to improve the efficiency of hotel by using Data Envelopment Analysis (DEA). DEA functions is to identify the best performing unit be benchmarked for the other unit which is inefficient unit to improve their performance. Hence, for the inefficient unit, the problem of the slack can be traced and be implement to overcome that problems. The collection of data will be used by key in data to Microsoft Excel to do the calculation by using DEA Solver software. The result of the data will be interpret of this chapter.

4.2 DATA FINDINGS

The efficiency of the hotel performance depends on what they are practice. In this study, DMU's was choose nine hotels and randomly from the five star hotel because it's international hotel that also have tourist from overseas. The sample variable had selected based on the previous research which are an input were number of employees, number of rooms and assets while for an output is number of guest. The hotel's data was collected

based on their annual report on year 2013. Table 4.1 shows the hotel's data finding of input and output in the efficiency analysis. In required of production activity, input is a main factors. How many the number of employees can treat the number of guest well. If hotel have less employees, it is not necessarily efficiency to they served their customer. Sufficient the number of employees will improve the time taken for the waiting customer line. Furthermore, the number of rooms also have correlation with the number of guest. It is because to enhance the number of guest especially during holiday, the number of guest will arise and the number of room provided will not enough.

Lastly, the assets will improve the efficiency due to conducive of assets, high technology and sufficient the number of asset to support the number of customer for example is facilities. When the hotels provided the pretty much of facilities, it will give more satisfaction to the customer or guest.

Table 4.1: Data of each hotel in the sample

	(I) Number of Employees	(I) Number of Rooms	(I) Assets	(O) Number of guest
Grand Hyatt Hotel	150	412	RM10556740	70050
Traders Hotel	195	571	RM9415770	79150
Berjaya TS Hotel	357	650	RM12266840	95556
Shangri-La Hotel	450	662	RM12890000	88815
JW Marriott Hotel	219	491	RM10796000	65500
Sama Sama Hotel	259	442	RM9132890	66320
Hilton PJ Hotel	432	546	RM12110150	77780
Majestic Hotel	167	300	RM8890560	51120
Royale Chulan Hotel	219	402	RM10511750	56632

Table 4.2: The Descriptive of Statistics on input and output data use in the study

	Number of Employees	Number of Rooms	Assets	Number of guest
Maximum	450	662	RM12890000	95556
Minimum	150	300	RM8890560	51120
Average	272	479.3333	RM10730078	972324.78
SD	106.528	113.8371	RM1361200.4	13628.71

4.3 MODEL DEVELOPMENT

Late years have seen a great several of application of Data Envelopment Analysis (DEA) for use in an evaluation the performances of many different exercise or activities in many samples in many different countries. One reasons of the DEA has introduced which is potential outcomes for use in cases that have been hurdle to approaches because of the complex nature and have correlation between the multiple inputs and output that involved in pretty much of activities. DEA used to measure efficiency among hotels which is who are the best and have efficiency to make it as a benchmarking to the others. In DEA method have three different model to measure the activities which are Window Analysis, CCR and BCC but in this study only using CCR model. Each of the model already have their rule and condition to using.

In CCR model, implemented to evaluate the relative operational efficiencies of the hotel performance from the production perspective. CCR model also introduced an efficiency measure of the ratio between weights of output and input to respectively making decision unit (DMU) that is maximum. The significant efficiency calculations

have been completed using DEA-solver software package which is learning version 3.0. This software are very ease to used and its only depend on the Microsoft excel to completed the data results. The below figure are shown the a few steps of using of DEA-solver software and what will come up when the software are run. The data result will be outward when it not have error shown on the how the data was keep in the Microsoft excel.

Step 1:

Open the DEA-Solver software by using "open with WinRAR" and starting like figure 3 will come out.

Figure 4: Learning Version for DEA Solver

Step 2:

Then the CCR-I model selection was chosen in this study. Then click the OK to continue the process.

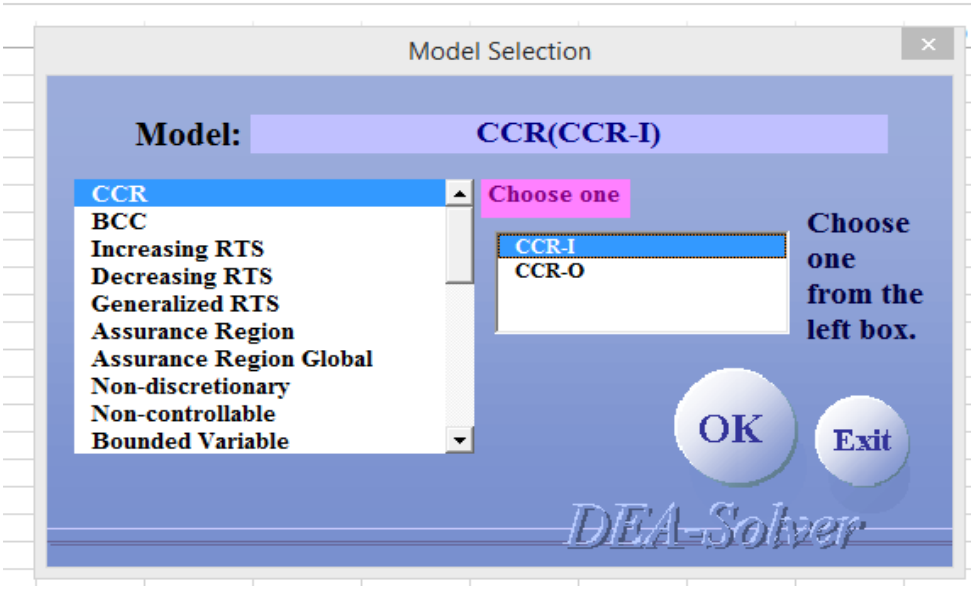

Figure 5: Model Selection of DEA Solver

Step 3:

After the sheet of data was choose, just click of OK to proceed the process but if want to change the sheet data, just click BACK to return back for changing.

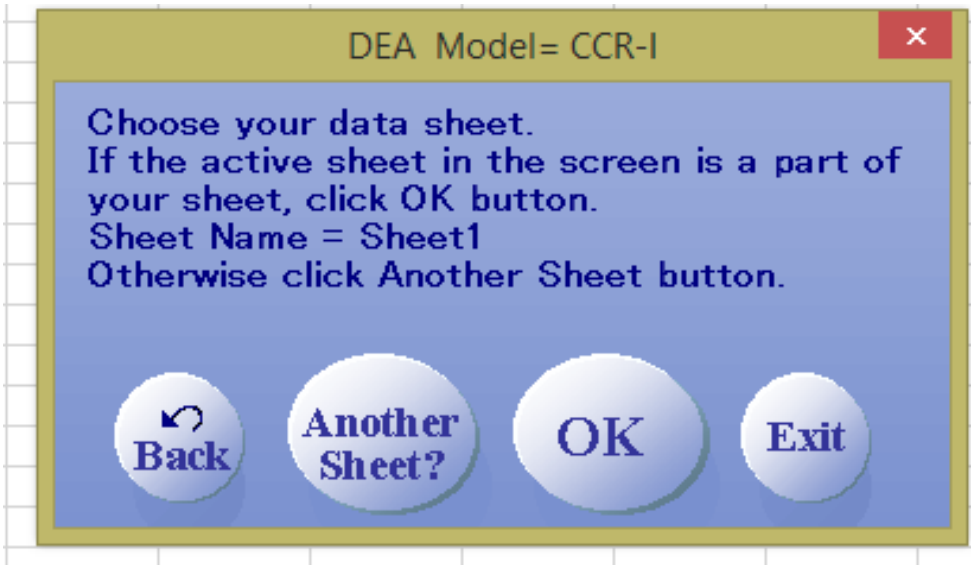

Figure 6: DEA Model (CCR-Input)

Step 4:

After that, proceed the process by click the button RUN and the result will be come out in excel.

Figure 7: Run of DEA data

Table 4.3: Correlation reading for the efficiency measured

+.70 or higher	: Very Strong positive relationship
+.40 to +.69	: Strong positive relationship
+.30 to +.39	: Moderate positive relationship
+.20 to +.29	: Weak positive relationship
+.01 to +.19	: No or negligible relationship

4.4 ANALYSIS OF DEA RESULT

After the data are run by DEA solver, the main results will be displayed in the Worksheets. The worksheet summary includes statistics on data such as standard deviation of each input and output, average, and correlation coefficient between the observations of the variables. It also report DMUs with inappropriate data for evaluation and summarizes the results. The summarizing of data result are shown in the table below:

Table 4.4: Worksheet containing main results

Worksheet name	**Contents**
Summary	Summary on data and result
Score	The efficiency score Θ, the reference set (ƛ), ranking, etc.
Rank	The descending order ranking of efficiency scores
Weight	The optimal (dual) multipliers
Weighted Data	The weighted data
Slack	The input excess and the output shortfall
Projection	Projection on to efficiency frontier
Graph 1	The bar chart of CCR scores
Graph 2	The bar chart of scores in ascending order

Efficiency Result

The relevant efficiency calculation have been conduct by using learning version of the DEA-solver software. The technical, scale efficiency score, ranking number, lambda and the reference set for each hotel in the sample are represent in the Table 4.3.

The third column in the table are illustrates the technical efficiency (CCR) index results. This index are measures the firm's productivity due to the input and output

variables. This index are possibility focus on the reducing the inputs to produce the equivalent output level as explained earlier. This study achieve the four efficiency score which are Grand Hyatt Hotel, Traders Hotel, Berjaya TS Hotel and Majestic Hotel, and five more hotel are achieve inefficiency which are their score are less than one.

Table 4.5: Efficiency score of the DMUs

No.	DMU	Score	Rank	Reference set (lambda)	
1	Grand Hyatt Hotel	1	1	Grand Hyatt Hotel	1
2	Traders Hotel	1	1	Traders Hotel	1
3	Berjaya TS Hotel	1	1	Berjaya TS Hotel	1
4	Shangri-La Hotel	0.900099	6	Grand Hyatt Hotel	0.128374
5	JW Marriott Hotel	0.846383	8	Grand Hyatt Hotel	0.488655
6	Sama Sama Hotel	0.979961	5	Grand Hyatt Hotel	0.27884
7	Hilton PJ Hotel	0.899983	7	Grand Hyatt Hotel	0.584362
8	Majestic Hotel	1	1	Majestic Hotel	1
9	Royale Chulan Hotel	0.828322	9	Grand Hyatt Hotel	0.702361

For the inefficiency result which are Shangri-La Hotel 0.9001<1, JW Marriott Hotel 0.8464<1, Sama Sama Hotel 0.9800<1, Hilton PJ Hotel 0.9000<1 and Royale Chulan Hotel 0.8283<1 but all of them have very strong positive relationship for the efficiency measured. Besides that, the fourth column illustrate the ranking of the efficiency the hotels. In the ranking of each hotel, four hotels show the same efficiency which is equal to 1 and followed by next ranking are Sama Sama Hotel (5), Shangri-La Hotel (6), Hilton PJ Hotel (7), JW Marriott Hotel (8) and lastly is Royale Chulan Hotel (9). Therefore, the main source that contribute of the hotel's inefficiency is the problem

input and output variables in terms how they are organizing input in the production process.

Furthermore, the fifth column shows the reference set of the inefficiency hotel that should follow or be as benchmark to achieve the efficiency scale. For this study, the result shows that the Grand Hyatt Hotel should be followed by all of the inefficiency hotels and make to improve their respective transformation process of inputs to outputs. What is more, the Royale Chulan hotel should also prioritize the optimization of their score. Figure 7 shows the sequence of the ranking from efficiency to inefficiency hotels.

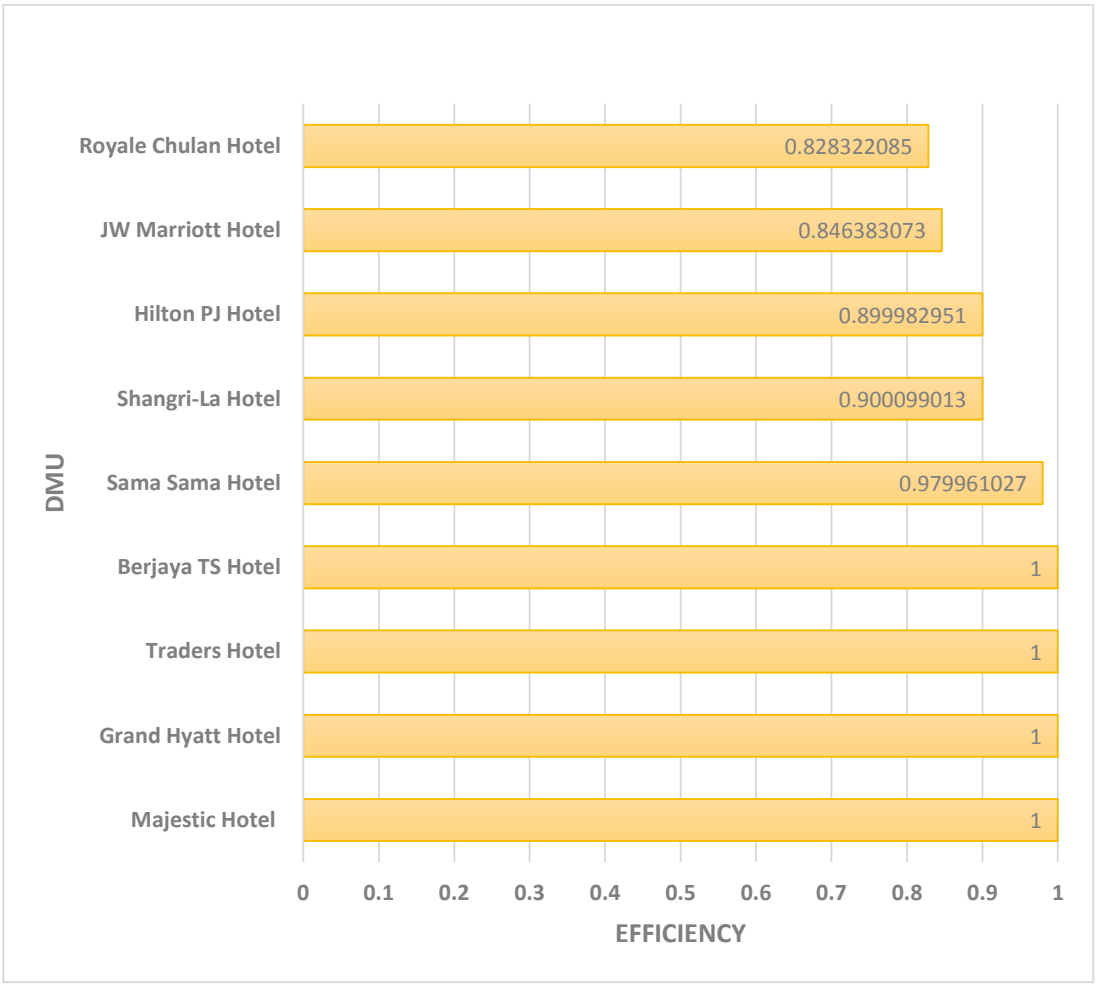

Figure 8: Graph of the hotel's ranking following their efficiency

Slack Analysis

One of the most useful insight provided by the DEA is the set of target values for the DMU's improvement through specific recommendations. "Adjustments for the inefficient hotels can be identified for inputs and outputs in order for them to join the efficient frontier", Barros words. In technical inefficiency, input and output slacks are identified only for the hotels characterized. In the respect, to hotel owners and managers, the slack analysis provide valuable information about their respective hotel's efficiency decision making process.

In Table 4.6 indicates the check-up of input and output slacks which is provides the input and output slacks obtained from the CCR, for the hotels in the sample.

Table 4.6: DEA input and output slacks of the DMUs

No.	**DMU**	**Score**	**Excess No of Employees** S-(1)	**Excess No of Rooms** S-(2)	**Excess Assets** S-(3)	**Shortage No of Guest** S+(1)
1	Grand Hyatt Hotel	1	0	0	0	0
2	Traders Hotel	1	0	0	0	0
3	Berjaya TS Hotel	1	0	0	0	0
4	Shangri-La Hotel	0.900099	87.5696	0	0	0
5	JW Marriott Hotel	0.846383	56.9132	0	0	0
6	Sama Sama Hotel	0.979961	37.18533	0	0	0
7	Hilton PJ Hotel	0.899983	163.4827	0	0	0

8	Majestic Hotel	1	0	0	0	0
9	Royale Chulan Hotel	0.828322	51.77064	0	0	0

To interpreting the contents in the table, all of the hotel's slack are cause from the surplus number of employees. The lack of efficiency occur which means excess the number of employees in performance necessary to serve the guest and do the job tasking. So, if hotel have too much the employee, it will give some effect to the management to manage their performance such as in terms of their job and tasking.

First case is Shangri-La Hotel, which should make one adjustment which is of their input. Thus, it would have to reduce operational capacity by 87 employees which is from 450 to 363 (19.33 percent). Second is JW Marriott Hotel. This hotel have surplus as much as 56 employees and should reduce 25. 57 percent from 219 to 163. Third is Sama Sama Hotel that should reduce 37 employees which is from 259 to 222 (14.29 percent). Next, Hilton PJ Hotel which have excess number of employees 163, so they should reduce them from 432 to 269 (37.73 percent).

Lastly, Royale Chulan Hotel which is the lowest efficient among all of have excess in terms the number of employees. They would have reduce as much as 51 employees which is from 219 to 168 (23.29 percent). Furthermore, as far as employees are concerned, this piece of evidence suggest that this five hotels are relatively overstaffed, so they could produce the same level of outputs with less staff on average, as compared to an efficient hotels which is have achieve the score =1.

The above analysis indicates that five from nine hotels should make adjustments in their lacks of the variables which is input. They should more focus in terms to reduce the number of their employees. Insufficient employees, long time taken for customer waiting line, geographical area, low technologies used and etc. are the multiple problems that occur that may lead to inefficiency of hotel's management in Malaysia.

Correlation

Table 4.7: Correlation of the input and output

	No of Employee	**No of Rooms**	**Assets**	**No of Guest**
No of Employee	1	0.7480	0.8277	0.6913
No of Rooms	0.7480	1	0.7509	0.9511
Assets	0.8277	0.7509	1	0.7298
No of Guest	0.6913	0.9511	0.7298	1

The table above shows the result correlation of the input and output after the sample data had run by the DEA software. The correlation of the number of employee between numbers of room is 0.7480. So, it is very strong positive relationship. Likewise for the correlation of the number of employees between assets which is 0.8277. It also very strong positive relationship. But, correlation for the number of employees between numbers of guest is only strong positive relationship which is 0.6913.

Besides that, the correlation for the numbers of room between assets is very strong positive relationship which is 0.7509. Hence, correlation between the number of rooms and the numbers of guest have higher value than other which is 0.9511, very strong positive relationship. Lastly, the correlation for the assets between the numbers of guest also is very strong positive relationship which is have value 0.7298.

Projection

The projection result shows that the number of each variables (input and output) that each DMUs should possess in order to achieve the efficiency. Thus, the result also shows the difference and percentage between the outcome of score data and projection.

Table 4.8: Projection DEA result for the efficient hotel

No.	DMU I/O	Score Data	Projection	Difference	%
1	Grand Hyatt Hotel	1			
	No of Employees	150	150	0	0.00%
	No of Rooms	412	412	0	0.00%
	Assets	10556740	10556740	0	0.00%
	No of Guest	70050	70050	0	0.00%
2	Traders Hotel	1			
	No of Employees	195	195	0	0.00%
	No of Rooms	571	571	0	0.00%
	Assets	9415770	9415770	0	0.00%
	No of Guest	79150	79150	0	0.00%
3	Berjaya TS Hotel	1			
	No of Employees	357	357	0	0.00%
	No of Rooms	650	650	0	0.00%
	Assets	12266840	12266840	0	0.00%
	No of Guest	95556	95556	0	0.00%

The above result shows of an efficiency hotel that had achieve efficiency score = 1. Those hotels that achieve efficiency score = 1 are Grand Hyatt Hotel, Traders Hotel and Berjaya TS Hotel. Based on their result, the number of employees, number of rooms and total assets are sufficient to produce the numerous the number of guest. Its shows there is no excess or shortage the number of input that need to be fix and make adjustment.

Table 4.9: Projection DEA result for the inefficient hotel

No.	DMU I/O	Score Data	Projection	Difference	%
4	Shangri-La Hotel	0.900099			
	No of Employees	450	317.47495	-132.525	-29.45%
	No of Rooms	662	595.86555	-66.13445	-9.99%
	Assets	12890000	11602276	-1287724	-9.99%
	No of Guest	88815	88815	0	0.00%
5	JW Marriott Hotel	0.8463831			
	No of Employees	219	185.35789	-33.64211	-15.36%
	No of Rooms	491	415.57409	-75.42591	-15.36%
	Assets	10796000	9137551.7	-1658448	-15.36%
	No of Guest	65500	65500	0	0.00%
6	Sama Sama Hotel	0.979961			
	No of Employees	259	216.62458	-42.37542	-16.36%
	No of Rooms	442	433.14277	-8.857226	-2.00%
	Assets	9132890	8949876.3	-183013.7	-2.00%
	No of Guest	66320	66320	0	0.00%
7	Hilton PJ Hotel	0.899983			
	No of Employees	432	225.30998	-206.69	-47.84%
	No of Rooms	546	491.39069	-54.60931	-10.00%
	Assets	12110150	10898929	-1211221	-10.00%
	No of Guest	77780	77780	0	0.00%

The above result shows of an inefficient hotel that had achieve efficiency score less than 1. For Shangri-La Hotel, they have surpass the amount number of employees that have been required. To achieve the efficiency score =1, the projected should be 317

from 450 of overall. Other than that, Shangri-La Hotel faced the surplus 42 employee, they will tend to skip the job, so it will lead the bad impression from the guest. Shangri-La Hotel must reduce as much as 29.45 percent the number of employee to attract more guest. For the number of rooms, the projected should be 596 from 662. Shangri-La Hotel also faced the excess of 66 rooms, so they should reduce 9.99 percent the number of rooms to achieve efficiency. Then, for the total assets, the projected should be RM11602276 from RM12890000 that are required. Shangri-La Hotel have surplus RM1287724 and they must reduce 9.99 percent of the total assets or make improving for the other factor whether internal or external factor to support the operation or service of each of the hotel's asset.

Secondly is JW Marriott Hotel. As mentioned of other inefficiency's hotel, JW Marriott Hotel also run into same situation. In this study, JW Marriott Hotel is the second lowest of the efficiency score among DMUs which is efficiency score = 0.8463831. In term the number of employees, the projected should be 185 from 219 to achieve efficiency score=1. JW Marriott Hotel faced excess as much as 34 employees and must reduce 15.36 percent. Furthermore, for the number of rooms, the projected should be 416 from 491 of overall. Thus, the JW Marriott Hotel have excess 75 rooms. In this situation, they must reduce 15.36 percent of the overall the number of rooms. For the total assets, the projected should have RM9137551.7 from RM10796000. So, they have excess RM1658448 the total assets that should reduce of 15.36 percent from overall. Hotels management should manage their total assets because to avoid the wasted of assets.

Next is Sama Sama Hotel. The projected data number of employee for Sama Sama Hotel should be 217 from 259. The differences of 42 shows of the Sama Sama Hotel faced on excessive of employees and required to reduce 16.36 percent of employees to attain efficiency. For the number of rooms, the projected should be 433 from 442. Sama Sama Hotel must reduce of 9 rooms which is should reduce only 2.00 percent for the number of rooms in overall. For the number of total assets, projected should be RM8949876.3 from RM9132890. To achieve the efficiency score, Sama Sama Hotel must reduce 2.00 percent of the assets in term of their asset's excessing of RM183013.7.

For the lastly in above table is about projection of Hilton PJ Hotel. From the analysis, the projected data number of employee for the Hilton PJ Hotel should be 225 from 432. Hilton PJ Hotel faced a large of the excessive number of employees among the other DMUs which is have surplus 207 employees. So, they must reduce 47.84 percent of employees to retain the efficiency. In term of the number of rooms, the projected should be 491 from 546 which is have difference 55 of rooms. Then, they must reduce 10.00 percent to make its efficiency as same for the other DMUs. For the total assets, the projected should be RM10898929 from RM12110150. So Hilton PJ Hotel must reduce of 10.00 percent of the asset to make it sufficient for the guest. It is because they have surplus RM1211221 in term of their assets.

Table 4.10: Projection DEA result for the Majestic Hotel

No.	**DMU**	**Score**			
	I/O	**Data**	**Projection**	**Difference**	**%**
8	Majestic Hotel	1			
	No of Employees	167	167	0	0.00%
	No of Rooms	300	300	0	0.00%
	Assets	8890560	8890560	0	0.00%
	No of Guest	51120	51120	0	0.00%

Based on the above result, the Majestic Hotel had achieve the efficiency score which is equal 1. It is because they do not have the excessive or shortage required among their input which is number of employee, number of rooms and assets. So that, they also have the balance input to produce the output.

Table 4.11: Projection DEA result for the Royale Chulan Hotel

No.	DMU I/O	Score Data	Projection	Difference	%
9	Royale Chulan Hotel	0.8283221			
	No of Employees	219	129.6319	-89.3681	-40.81%
	No of Rooms	402	332.98548	-69.01452	-17.17%
	Assets	10511750	8707114.7	-1804635	-17.17%
	No of Guest	56632	56632	0	0.00%

Lastly, Royale Chulan Hotel is the lowest efficiency among the other hotel in this study which is have efficiency score = 0.8283221. For the number of employees, the projected is 130 rather than 219. Royale Chulan Hotel have surplus 89 employees and need to reduce 40.81 percent of the employees. Besides that, for the number of rooms, the protected is 333 rather than 402. So, they have surplus 69 rooms and have to reduce 17.17 percent of the number of room. Furthermore, for the assets, Royale Chulan Hotel' projected is RM8707114.7 rather than RM 10511750. Thus, their surplus for the assets is RM1804635 and have to reduce 17.17 percent for the value of the assets.

4.5 DATA VERIFICATION AND VALIDATION

Data verification and validation process had determine to complete and verify the data. It is important process to make the real data or result are accurate and fulfil the rule that have been required. The CCR model's result was verified to check the technical correctness. It is valid for the CCR model to check the performance of this study and apply it for the real situations.

The variables of the DMU which is input and output of this study subjected to verification. The technical correctness which is reviewing of the results and compare with previous study result are checked. If the result of DMU is inefficient, the input and output are checked if the slack happen or what are difference from others to ensure that they are

indeed were inefficient. The examination then led to selection of a recommended hotels to be the benchmark for other inefficient hotels.

The recommended models for each organization were then subjected to validation. The validation's results are check through reviews with the decision makers from the respective organizations. Historical data for periods with major drops in efficiency were considered to ensure that the company management team would identify those periods as poor performers independent of the DEA results. Some of the periods considered were already known as having achieved poor performance and this contributed to an initial level of comfort with DEA results. Other periods were not identified previously as poor performers, but with a comprehensive consideration of the input and output factors the decision makers agreed with DEA results. Similarly, there were periods that were not considered previously as good performers, but were redeemed after the second look prompted by the DEA results. It was realized that these periods achieved their performances under extenuating circumstances that reduced one or more of the input resources. Peer group information was very useful in assessment of both good and poor performers.

4.6 SUMMARY

This kind of research is experimented with study the application of the data envelopment analysis with variables collection from nine DMUs which is five star hotels at Malaysia. In addition, this research studies also to know the efficiency of the DMUs and what of the problem occur if that DMU not achieve the efficiency for example is lack of the variables. It is determined that the process of the application of data envelopment analysis model has been review in this chapter. So, the best overall of the selection efficiency based on their input to produce the outputs.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter conclude the overall of findings to the study. The result was getting from the other four chapters. The finding this research have specific implication on the data envelopment analysis which related toward a process of calculation in Data Envelopment Analysis. This chapter will determine the conclusion of the findings which is research summary, limitation to this study, future research and recommendation and lastly will conclude the overall of this study.

5.2 RESEARCH SUMMARY

This study was based on the exploring the management in the hotel sector by using data envelopment analysis (DEA): in case to select the efficiency hotel. DEA function to calculate the efficiency between hotels from the variable that are collected, as well as to examination the relevant inefficiency causes and provide the suggestions the manager or the hotel's owner to increase their management or hotel efficiency. DEA also as powerful method compare the other. For this research, the data are collected by using an interview with hotelier and hotel web-search that covering an international hotel. In order to achieve the objective, there are many information can get from the previous stud of DEA model.

Using DEA method, this study are conducted a sample of nine hotels that operating in Malaysia. One key finding is that hotel operating under five star ranking are most efficient among the rest. Furthermore, in terms of variables in CCR model, there are three input and one output was used in this study to calculate an inefficiency of the DMUs. For the input, this study use number of employees, number of rooms and assets while for the outputs are the number of guest. In the descriptive criteria analysis, there is a relating between the numbers of input that affect the number of the guest. The relating was aim to identify the criteria that effect on the selections of the variables. Hotel management always required the criteria that can be increase their performance and efficiency that was related to the project. All of that variables data was keep in Excel before it run of the process to get the results.

The verification and validation are important things to make the information that have collected are valid to ensure it's accurate. After DEA was running, the slack for the inefficiency DMUs was detected to make some improvement of that lacking. In this research, the surplus of number of employee are detected for the all inefficiency DMUs.

Last but not least, why DEA technique are call as the powerful method? It is because this method can help the hotel performance to solve their efficiency problem and use it as benchmark for the other hotels. So, the owner of the hotel will know their problem and where that lacking occur in their management then improve it by using the DEA results. It also can save the time and cost to finding of the problem.

5.3 LIMITATION

There have some limitation towards this study in order to calculate the efficiency of hotel using data envelopment analysis.

- Lack of Previous Research Reference

There are very limited, if not none, previous researches on hotel energy performance by DEA method creates extreme difficulties in comparing and verifying the end results of the analysis.

- Total Number of Input / Output

The major constraint of his study is the total number of input and output variables. The rule of thumb is that the number of DMU should be at least twice the total number of input and output amounts. Three times would be more secure.

- Other Factors (Not Able to Be Considered)

There are factors not able to be considered, such as change of equipment, change of management staff, change of staff behaviour, change of guest mix, hotel's image, customer satisfaction, service qualities, scale factors, etc.

5.4 RECOMMENDATION FOR FUTURE RESEARCH

In this section are discussed about the recommendation for the future research. It was discussed due to the problem that have been facing in this research. First, the number of input should be improved which is increasing the number of input more than three input. It is because to know, other than number of employee, rooms and asset, what the other input that influence of inefficiency of the hotels. Besides that, this study used only 4 variable and it is not enough to calculate the efficiency since they have many other input and output that should be tested.

The second recommendation are about the decision making unit (DMUs) which is hotels. To make sure it will get accurate efficiency, the comparison between hotels should be rise and the ranking of that hotels should be variety such as one star hotel, two star hotel, three star hotel and four star hotel. If only the five star hotel involve, it is not enough to find the efficiency.

Lastly is by using both qualitative and quantitative techniques should add further value to the study. Because efficiency analysis cannot identify the external or internal variables causing inefficiency, econometric models are also necessary, and will be conducted in the future.

5.5 SUMMARY

As the conclusion, this research also have their limitation and recommendation as same as the other research to make improvement for the future. In this chapter also already state the summary for all chapter and what actually this research about.

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APPENDICES

APPENDIX 1 : GANTT CHART

A WORK PROGRESS OF UNDERGRADUATED RESEARCH PROJECT 1

PROGRESS/ RESEARCH ACTIVITY	**WEEK**													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Identify Research Issues														
Preparation of Research Proposal														
CHAPTER 1 : Introduction														
Problem Statement & Objectives														
Method of Analysis														
Significance of The Study														
Scope of Study														
Expected Result														
CHAPTER 2 : Literature Review														
CHAPTER 3 : Research Methodology														
Submit Draft Proposal														
Presentation														
Submit Report FYP 1														

A WORK PROGRESS OF UNDERGRADUATED RESEARCH PROJECT 2

PROGRESS/ RESEARCH ACTIVITY	**WEEK**													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Data Collected During July & August 2015														
CHAPTER 4 : Finding and Analysis														
Data Finding														
Model Development														
Analysis of Data														
Data Verification & Validation														
CHAPTER 5 : Conclusion and Recommendation														
Submit Draft Thesis														
Mock Presentation														
Turn it in & submit														
Submit Poster (in pdf)														
Presentation (Poster)														
Submit the Corrected Report														

APPENDIX 2 : THE DATA'S RESULT

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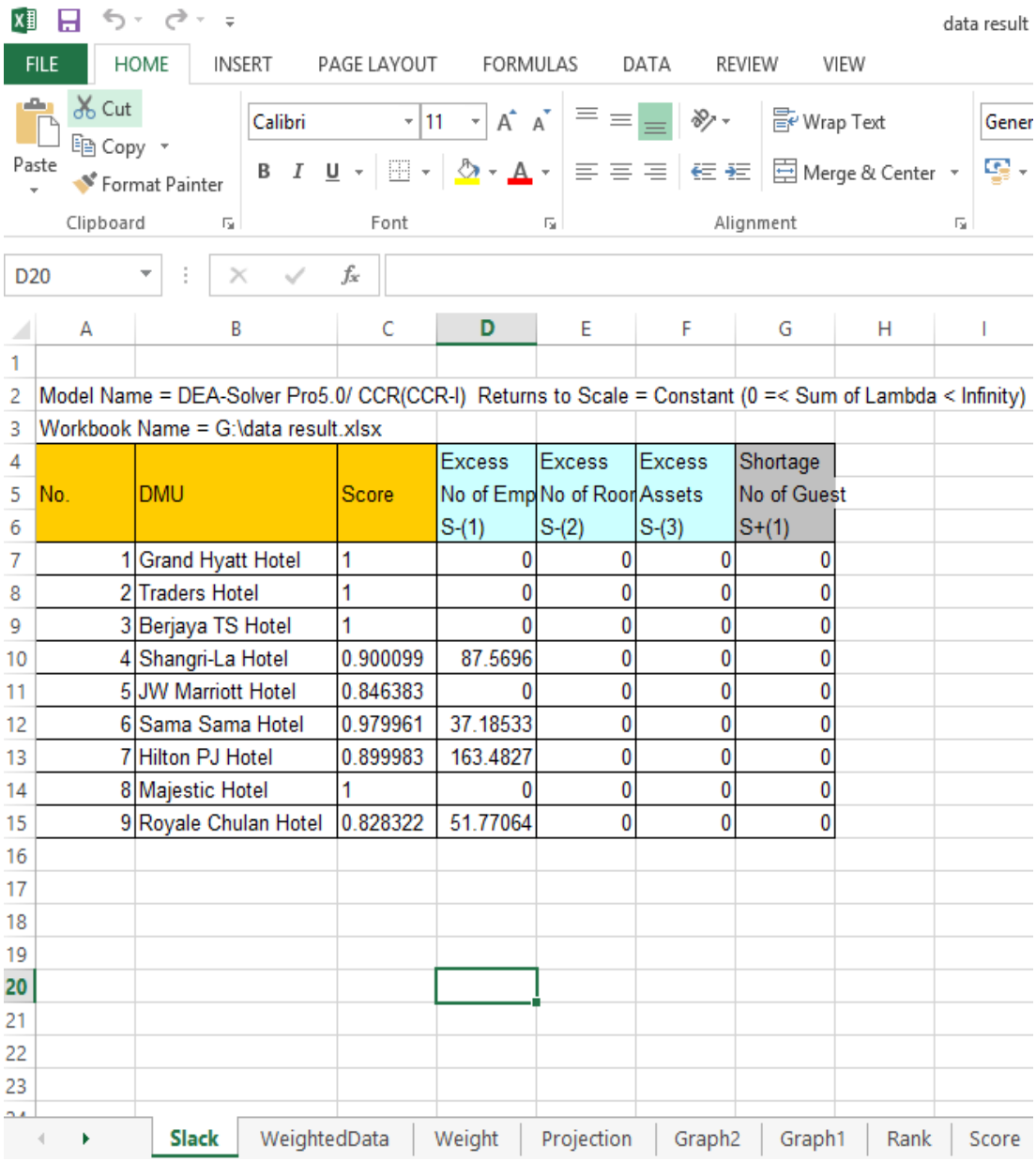

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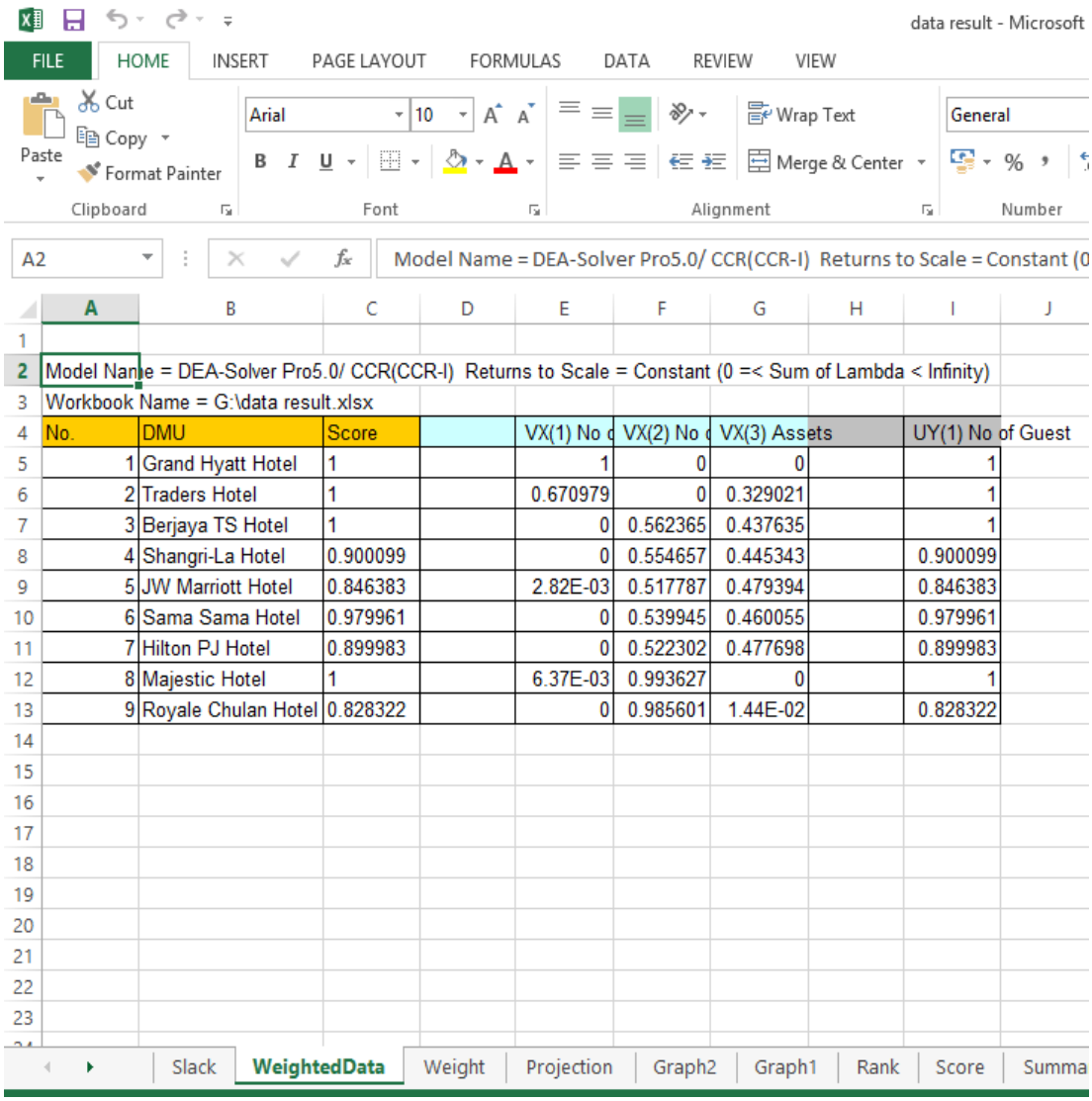
No.	DMU	Score	Excess No of Emp S-(1)	Excess No of Roor S-(2)	Excess Assets S-(3)	Shortage No of Guest S+(1)
1	Grand Hyatt Hotel	1	0	0	0	0
2	Traders Hotel	1	0	0	0	0
3	Berjaya TS Hotel	1	0	0	0	0
4	Shangri-La Hotel	0.900099	87.5696	0	0	0
5	JW Marriott Hotel	0.846383	0	0	0	0
6	Sama Sama Hotel	0.979961	37.18533	0	0	0
7	Hilton PJ Hotel	0.899983	163.4827	0	0	0
8	Majestic Hotel	1	0	0	0	0
9	Royale Chulan Hotel	0.828322	51.77064	0	0	0

Slack WeightedData Weight Projection Graph2 Graph1 Rank Score

WEIGHTED DATA (FROM EXCEL)



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3	Workbook Name = G:\data result.xlsx									
4	No.	DMU	Score		VX(1) No c	VX(2) No c	VX(3) Assets		UY(1) No of Guest	
5	1	Grand Hyatt Hotel	1		1	0	0		1	
6	2	Traders Hotel	1		0.670979	0	0.329021		1	
7	3	Berjaya TS Hotel	1		0	0.562365	0.437635		1	
8	4	Shangri-La Hotel	0.900099		0	0.554657	0.445343		0.900099	
9	5	JW Marriott Hotel	0.846383		2.82E-03	0.517787	0.479394		0.846383	
10	6	Sama Sama Hotel	0.979961		0	0.539945	0.460055		0.979961	
11	7	Hilton PJ Hotel	0.899983		0	0.522302	0.477698		0.899983	
12	8	Majestic Hotel	1		6.37E-03	0.993627	0		1	
13	9	Royale Chulan Hotel	0.828322		0	0.985601	1.44E-02		0.828322	
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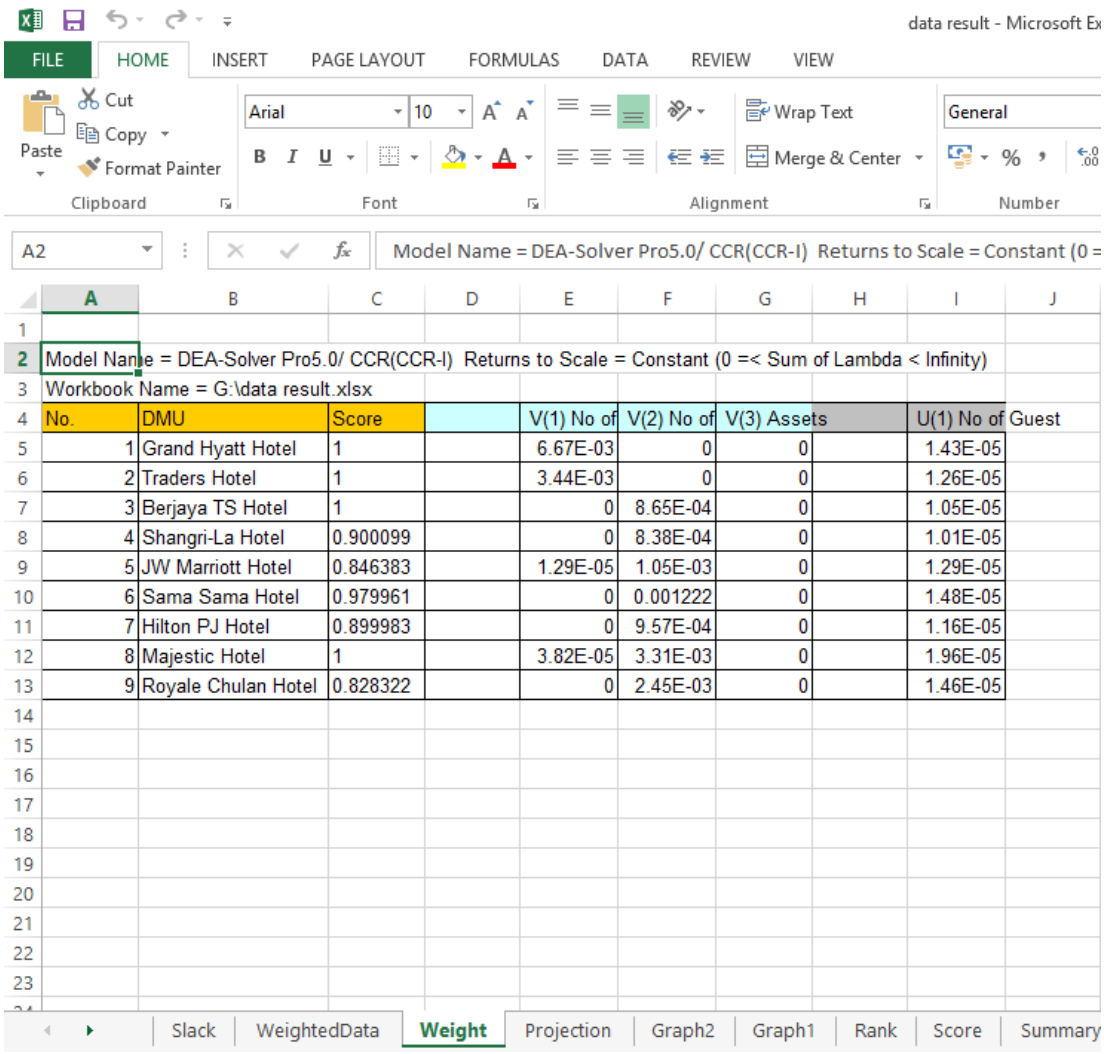
WEIGHT (FROM EXCEL)



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4	No.	DMU	Score		V(1) No of	V(2) No of	V(3) Assets		U(1) No of Guest	
5	1	Grand Hyatt Hotel	1		6.67E-03	0	0		1.43E-05	
6	2	Traders Hotel	1		3.44E-03	0	0		1.26E-05	
7	3	Berjaya TS Hotel	1		0	8.65E-04	0		1.05E-05	
8	4	Shangri-La Hotel	0.900099		0	8.38E-04	0		1.01E-05	
9	5	JW Marriott Hotel	0.846383		1.29E-05	1.05E-03	0		1.29E-05	
10	6	Sama Sama Hotel	0.979961		0	0.001222	0		1.48E-05	
11	7	Hilton PJ Hotel	0.899983		0	9.57E-04	0		1.16E-05	
12	8	Majestic Hotel	1		3.82E-05	3.31E-03	0		1.96E-05	
13	9	Royale Chulan Hotel	0.828322		0	2.45E-03	0		1.46E-05	
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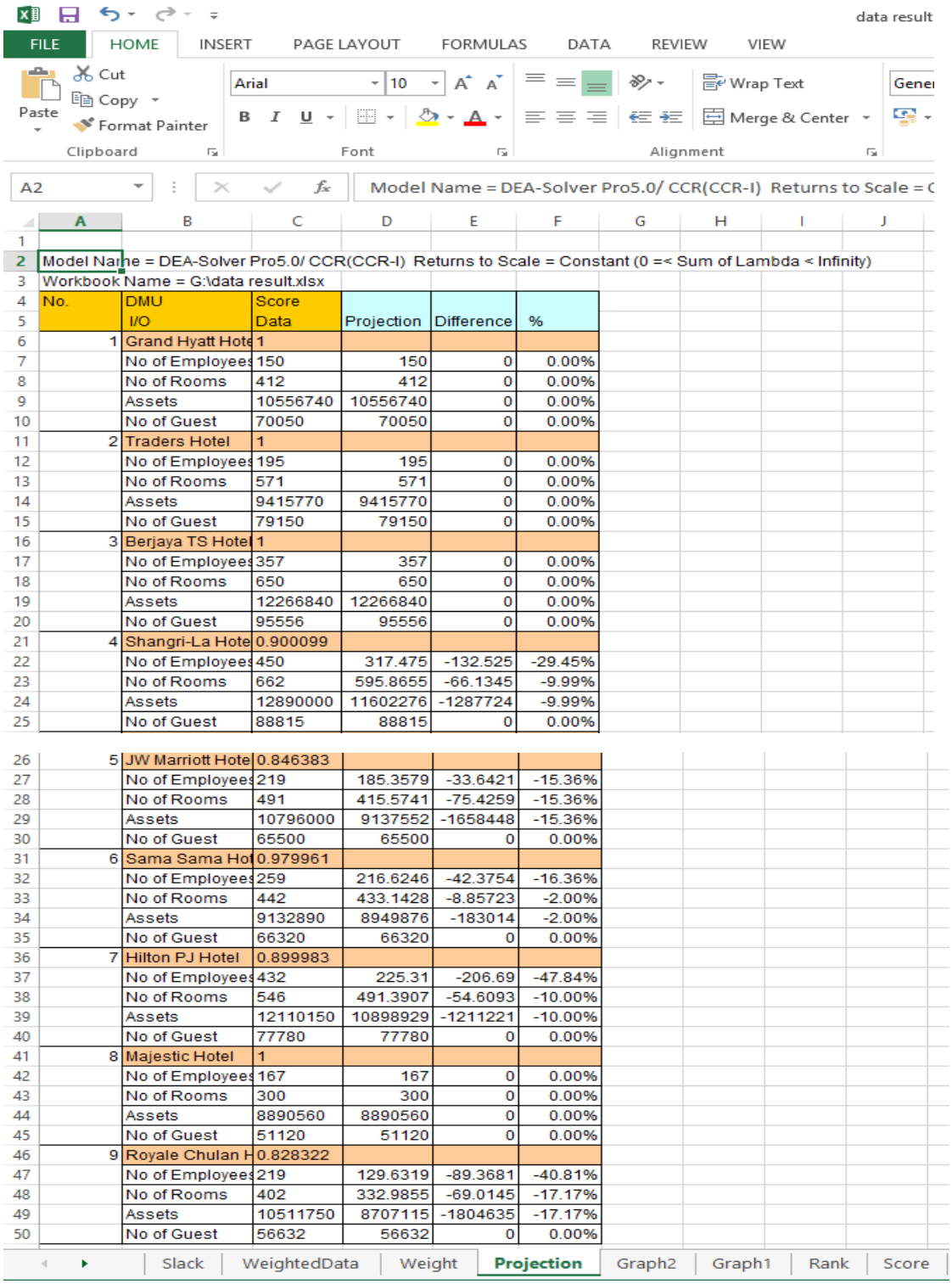

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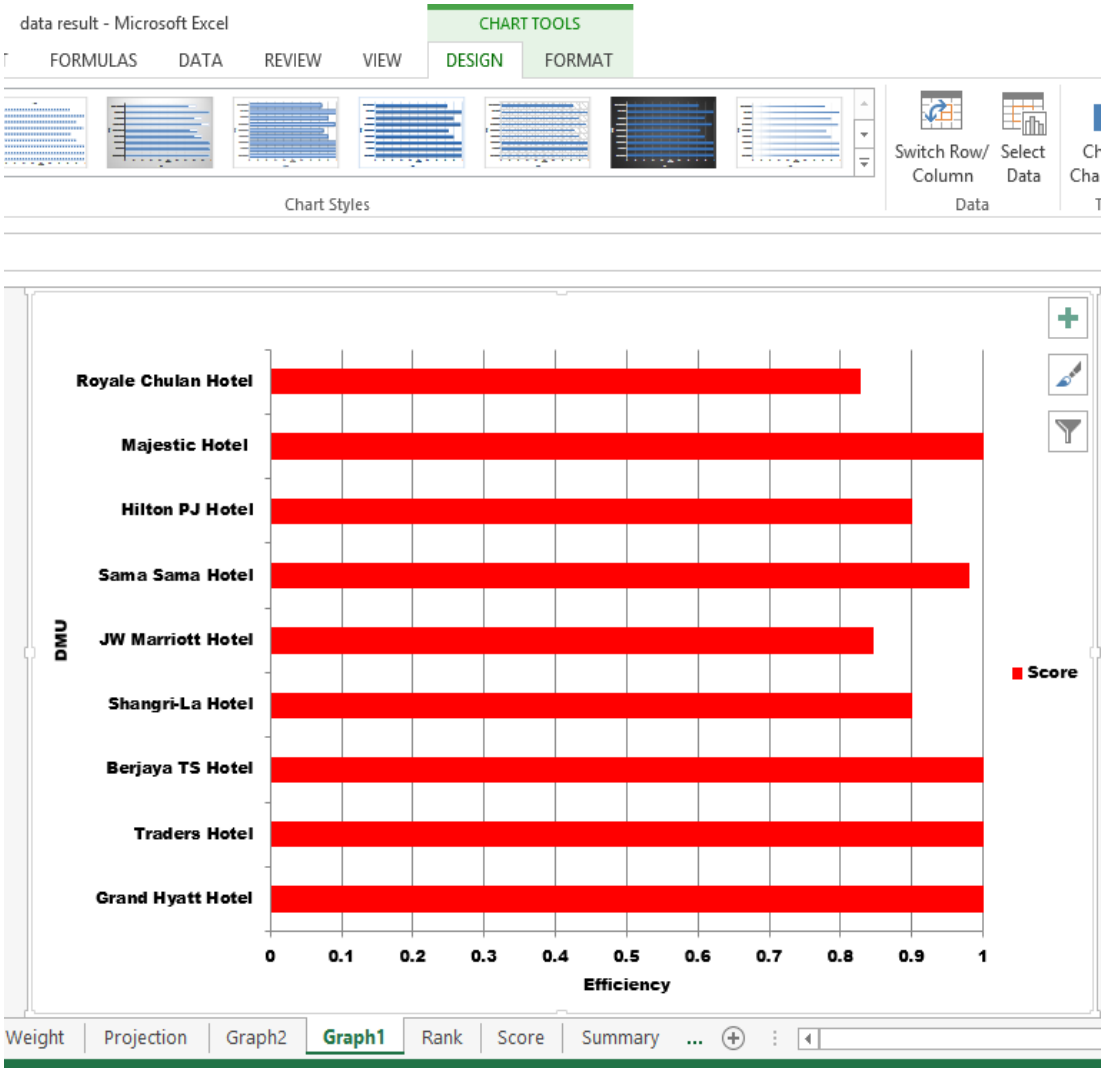
4	No.	DMU	Score							
5		I/O	Data	Projection	Difference	%				
6	1	Grand Hyatt Hote	1							
7		No of Employees	150	150	0	0.00%				
8		No of Rooms	412	412	0	0.00%				
9		Assets	10556740	10556740	0	0.00%				
10		No of Guest	70050	70050	0	0.00%				
11	2	Traders Hotel	1							
12		No of Employees	195	195	0	0.00%				
13		No of Rooms	571	571	0	0.00%				
14		Assets	9415770	9415770	0	0.00%				
15		No of Guest	79150	79150	0	0.00%				
16	3	Berjaya TS Hotel	1							
17		No of Employees	357	357	0	0.00%				
18		No of Rooms	650	650	0	0.00%				
19		Assets	12266840	12266840	0	0.00%				
20		No of Guest	95556	95556	0	0.00%				
21	4	Shangri-La Hote	0.900099							
22		No of Employees	450	317.475	-132.525	-29.45%				
23		No of Rooms	662	595.8655	-66.1345	-9.99%				
24		Assets	12890000	11602276	-1287724	-9.99%				
25		No of Guest	88815	88815	0	0.00%				
26	5	JW Marriott Hote	0.846383							
27		No of Employees	219	185.3579	-33.6421	-15.36%				
28		No of Rooms	491	415.5741	-75.4259	-15.36%				
29		Assets	10796000	9137552	-1658448	-15.36%				
30		No of Guest	65500	65500	0	0.00%				
31	6	Sama Sama Hot	0.979961							
32		No of Employees	259	216.6246	-42.3754	-16.36%				
33		No of Rooms	442	433.1428	-8.85723	-2.00%				
34		Assets	9132890	8949876	-183014	-2.00%				
35		No of Guest	66320	66320	0	0.00%				
36	7	Hilton PJ Hotel	0.899983							
37		No of Employees	432	225.31	-206.69	-47.84%				
38		No of Rooms	546	491.3907	-54.6093	-10.00%				
39		Assets	12110150	10898929	-1211221	-10.00%				
40		No of Guest	77780	77780	0	0.00%				
41	8	Majestic Hotel	1							
42		No of Employees	167	167	0	0.00%				
43		No of Rooms	300	300	0	0.00%				
44		Assets	8890560	8890560	0	0.00%				
45		No of Guest	51120	51120	0	0.00%				
46	9	Royale Chulan H	0.828322							
47		No of Employees	219	129.6319	-89.3681	-40.81%				
48		No of Rooms	402	332.9855	-69.0145	-17.17%				
49		Assets	10511750	8707115	-1804635	-17.17%				
50		No of Guest	56632	56632	0	0.00%				

Slack | WeightedData | Weight | Projection | Graph2 | Graph1 | Rank | Score

GRAPH (FROM EXCEL)



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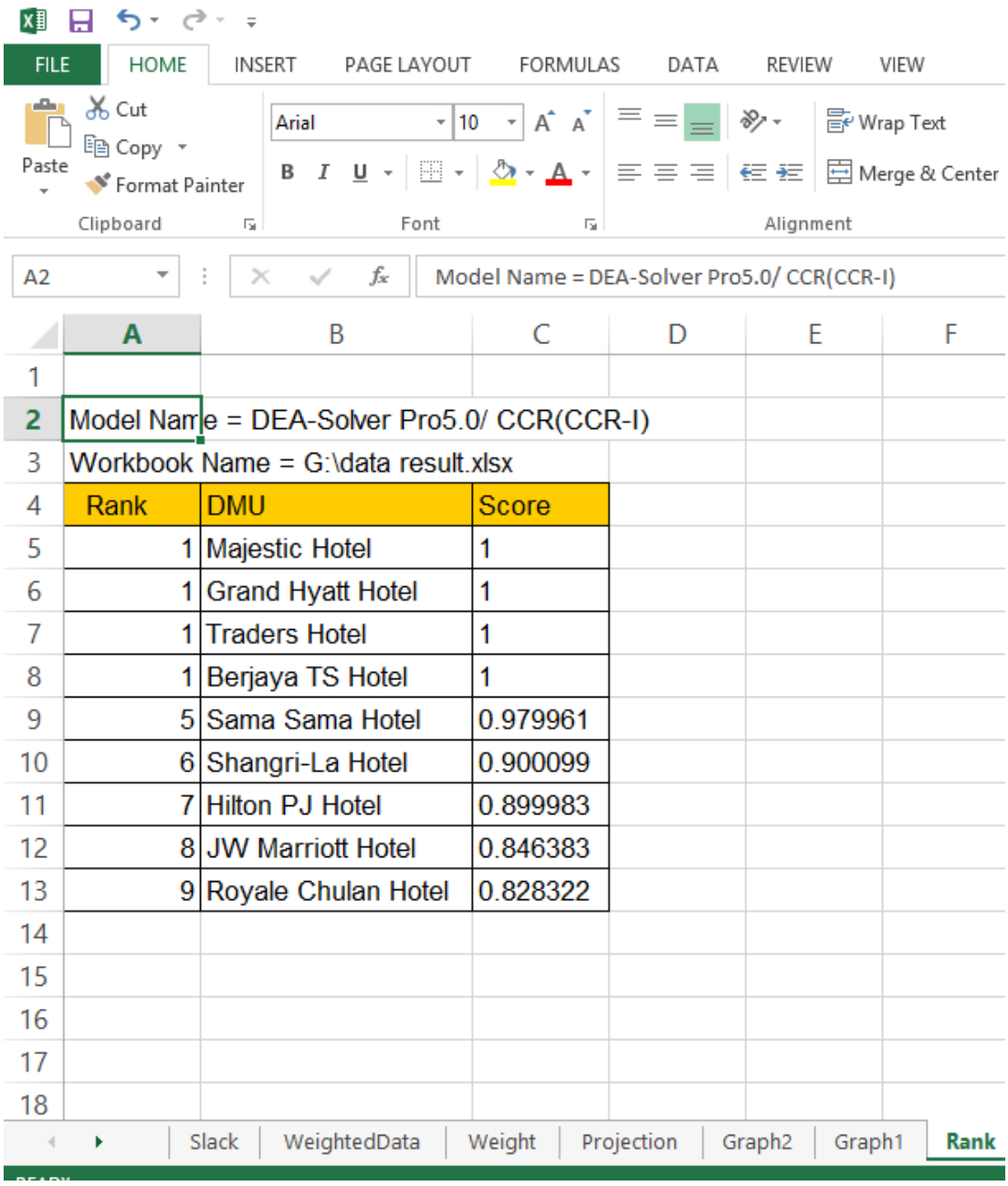

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2	Model Name = DEA-Solver Pro5.0/ CCR(CCR-I)					
3	Workbook Name = G:\data result.xlsx					
4	Rank	DMU	Score			
5	1	Majestic Hotel	1			
6	1	Grand Hyatt Hotel	1			
7	1	Traders Hotel	1			
8	1	Berjaya TS Hotel	1			
9	5	Sama Sama Hotel	0.979961			
10	6	Shangri-La Hotel	0.900099			
11	7	Hilton PJ Hotel	0.899983			
12	8	JW Marriott Hotel	0.846383			
13	9	Royale Chulan Hotel	0.828322			
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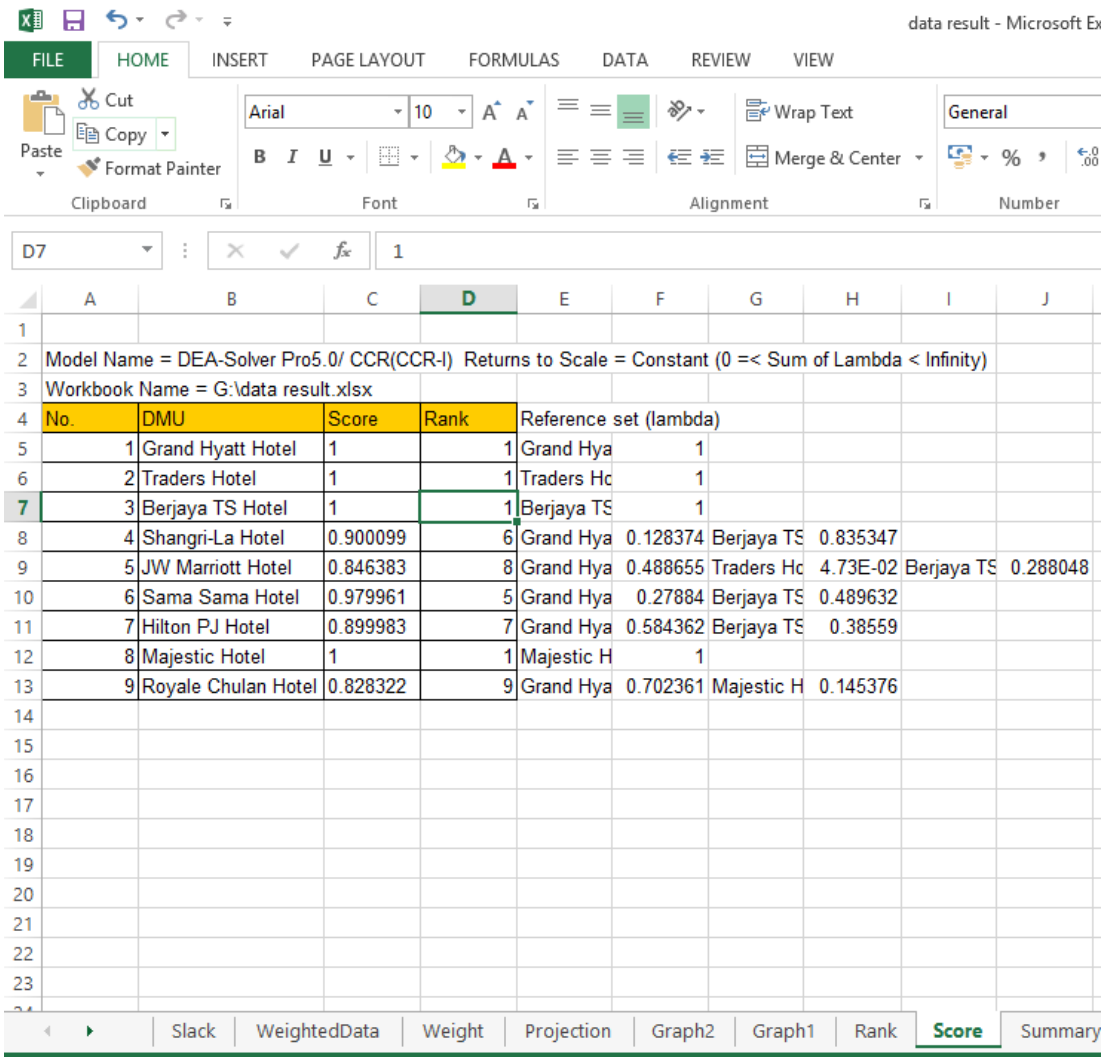
Slack | WeightedData | Weight | Projection | Graph2 | Graph1 | Rank

SCORE (FROM EXCEL)



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3	Workbook Name = G:\data result.xlsx									
4	No.	DMU	Score	Rank	Reference set (lambda)					
5	1	Grand Hyatt Hotel	1	1	Grand Hya	1				
6	2	Traders Hotel	1	1	Traders Hc	1				
7	3	Berjaya TS Hotel	1	1	Berjaya TS	1				
8	4	Shangri-La Hotel	0.900099	6	Grand Hya	0.128374	Berjaya TS	0.835347		
9	5	JW Marriott Hotel	0.846383	8	Grand Hya	0.488655	Traders Hc	4.73E-02	Berjaya TS	0.288048
10	6	Sama Sama Hotel	0.979961	5	Grand Hya	0.27884	Berjaya TS	0.489632		
11	7	Hilton PJ Hotel	0.899983	7	Grand Hya	0.584362	Berjaya TS	0.38559		
12	8	Majestic Hotel	1	1	Majestic H	1				
13	9	Royale Chulan Hotel	0.828322	9	Grand Hya	0.702361	Majestic H	0.145376		
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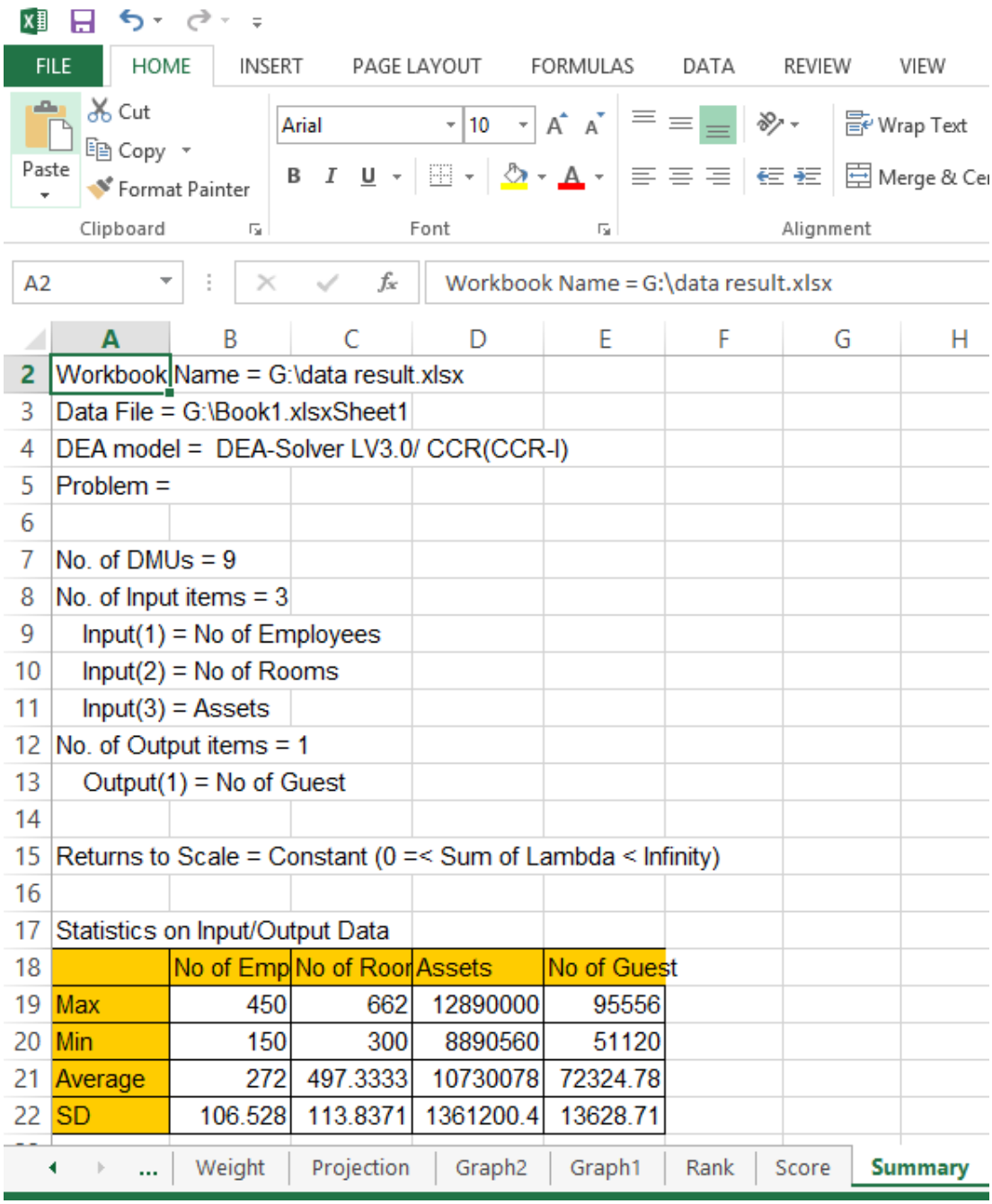
Slack | WeightedData | Weight | Projection | Graph2 | Graph1 | Rank | Score | Summary

SUMMARY 1 (FROM EXCEL)



FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

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Arial 10 Font

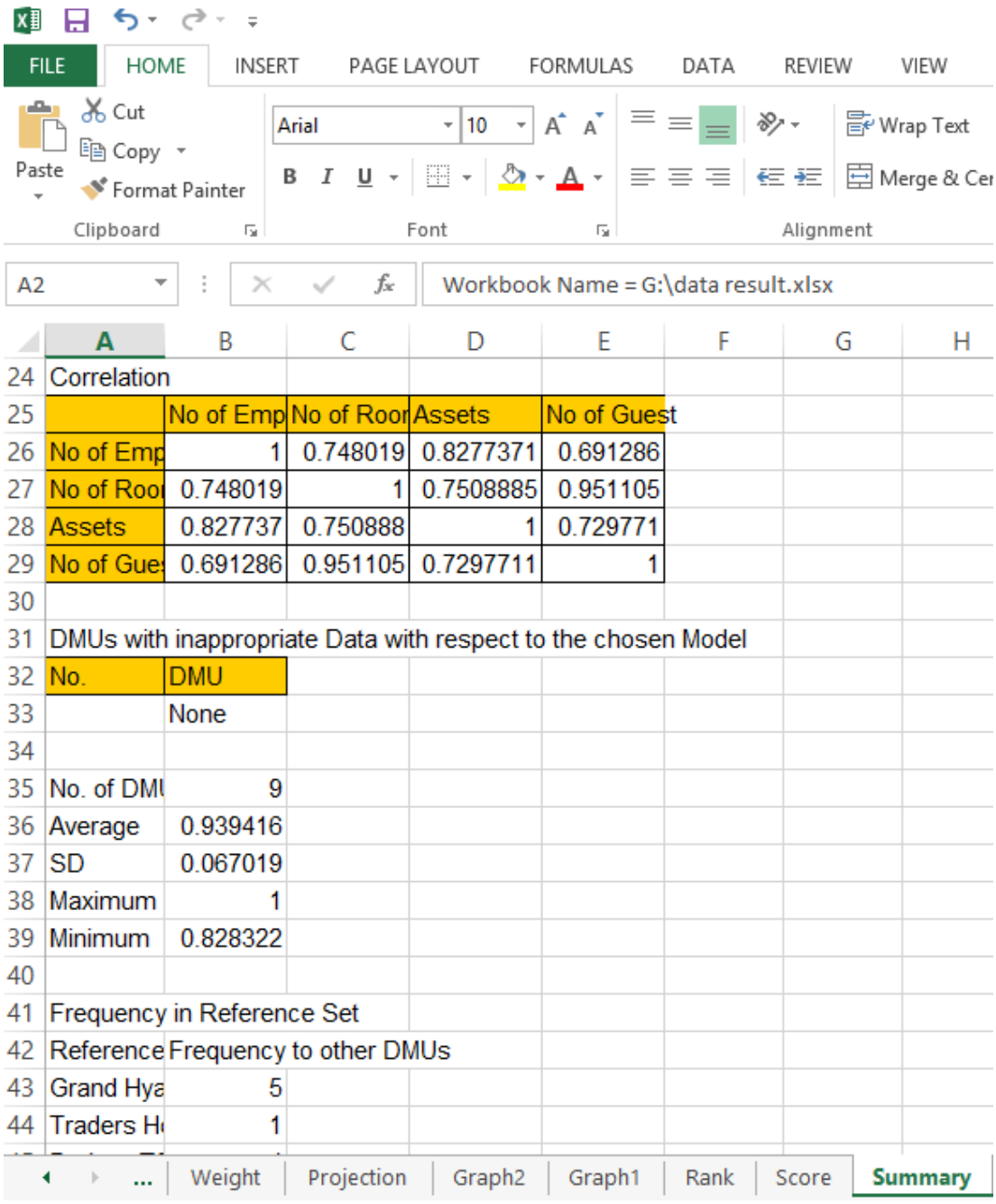
Wrap Text Merge & Ce Alignment

A2 Workbook Name = G:\data result.xlsx

	A	B	C	D	E	F	G	H
2	Workbook Name = G:\data result.xlsx							
3	Data File = G:\Book1.xlsxSheet1							
4	DEA model = DEA-Solver LV3.0/ CCR(CCR-I)							
5	Problem =							
6								
7	No. of DMUs = 9							
8	No. of Input items = 3							
9	Input(1) = No of Employees							
10	Input(2) = No of Rooms							
11	Input(3) = Assets							
12	No. of Output items = 1							
13	Output(1) = No of Guest							
14								
15	Returns to Scale = Constant (0 =< Sum of Lambda < Infinity)							
16								
17	Statistics on Input/Output Data							
18		No of Emp	No of Roor	Assets	No of Guest			
19	Max	450	662	12890000	95556			
20	Min	150	300	8890560	51120			
21	Average	272	497.3333	10730078	72324.78			
22	SD	106.528	113.8371	1361200.4	13628.71			

... Weight Projection Graph2 Graph1 Rank Score Summary

SUMMARY 2 (FROM EXCEL)



FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

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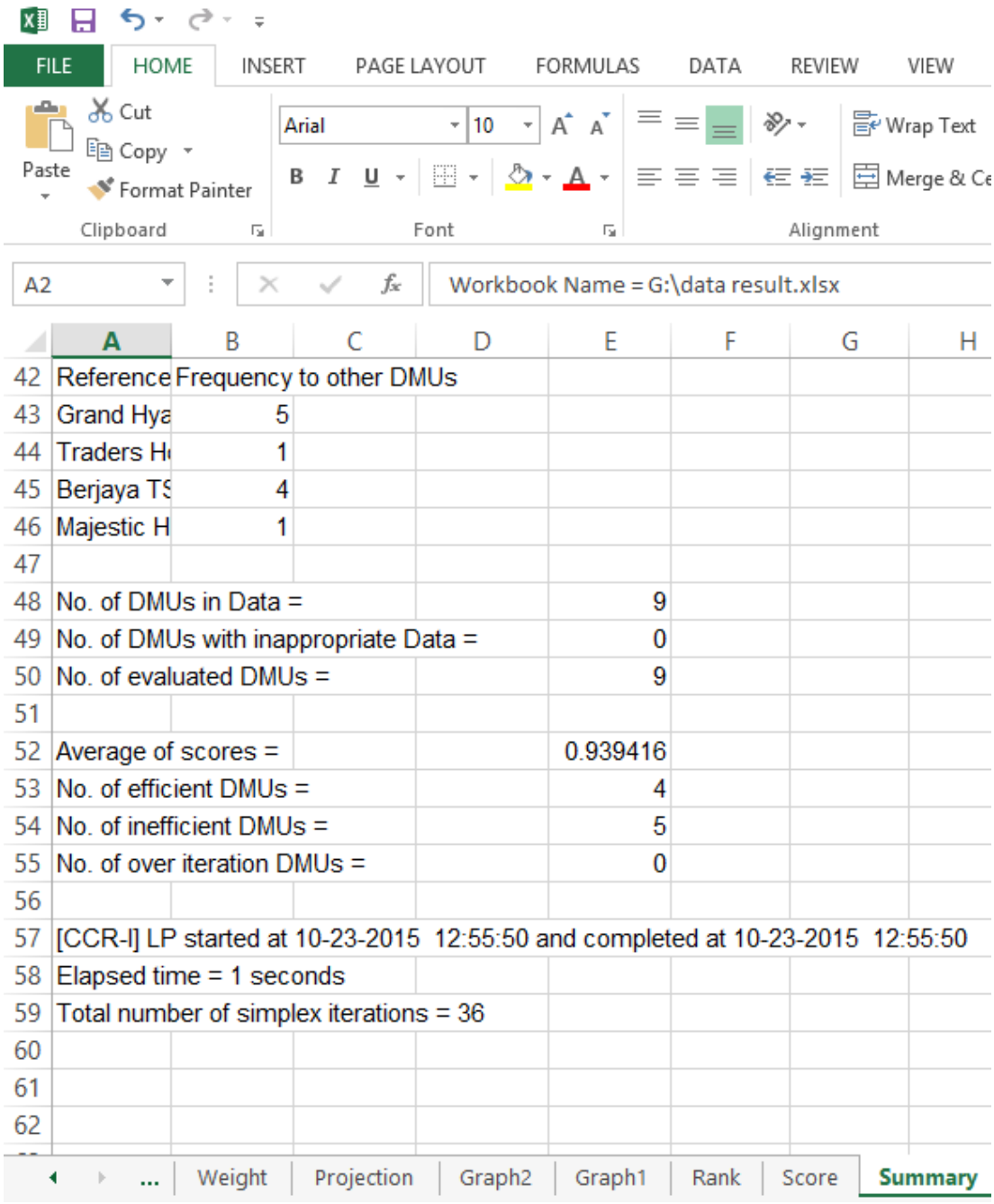
Wrap Text Merge & Ce Alignment

A2 Workbook Name = G:\data result.xlsx

	A	B	C	D	E	F	G	H
24	Correlation							
25		No of Emp	No of Roor	Assets	No of Guest			
26	No of Emp	1	0.748019	0.8277371	0.691286			
27	No of Roo	0.748019	1	0.7508885	0.951105			
28	Assets	0.827737	0.750888	1	0.729771			
29	No of Gue	0.691286	0.951105	0.7297711	1			
30								
31	DMUs with inappropriate Data with respect to the chosen Model							
32	No.	DMU						
33		None						
34								
35	No. of DMI	9						
36	Average	0.939416						
37	SD	0.067019						
38	Maximum	1						
39	Minimum	0.828322						
40								
41	Frequency in Reference Set							
42	Reference	Frequency to other DMUs						
43	Grand Hya	5						
44	Traders H	1						

... Weight Projection Graph2 Graph1 Rank Score Summary

SUMMARY 3 (FROM EXCEL)



	A	B	C	D	E	F	G	H
42	Reference	Frequency to other DMUs						
43	Grand Hya	5						
44	Traders H	1						
45	Berjaya TS	4						
46	Majestic H	1						
47								
48	No. of DMUs in Data =				9			
49	No. of DMUs with inappropriate Data =				0			
50	No. of evaluated DMUs =				9			
51								
52	Average of scores =				0.939416			
53	No. of efficient DMUs =				4			
54	No. of inefficient DMUs =				5			
55	No. of over iteration DMUs =				0			
56								
57	[CCR-I] LP started at 10-23-2015 12:55:50 and completed at 10-23-2015 12:55:50							
58	Elapsed time = 1 seconds							
59	Total number of simplex iterations = 36							
60								
61								
62								