Data Mining and Service Customization in Leisure and Hospitality

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Abstract*— This study provides insights into the relationship between data mining activities and the customization of the packages offered to tourists by hotels. Data mining provides a method of understanding the needs and habits of the tourists so that hotels can provide targeted value propositions to tourists from different geographies. For the study, ten prominent hotels around the country were selected and three employees from each hotel with information were interviewed to collect information about the data mining activities they perform. The study identifies that hotels give a high level of attention to data mining. Many of the hotels have suitable systems to capture the data of the guests, and have suitable staff to operate them. This indicates that data mining capabilities are either being built or are already in place in many of the hotels. It is also seen that hotels actively seek to customize the packages they offer to customers. All these eventually result in increased levels of long term customer loyalty. The regression analysis indicated a very strong relationship between data mining and the customization of service packages. The also study indicates that there is a significant correlation between the data mining activities of the hotels and the customized value and service offerings. This indicates that the hotels of the country are using data mining to develop customized service offerings. This is likely to benefit the hotels as well as Sri Lanka as a whole due to increased repeat visits by the tourists.

Index Terms— ***Customized service packages, Data mining, , Hotels, Tourism.***

I. INTRODUCTION

Sri Lanka is seen as a developing destination for tourism. The country is positioned in a prominent location between the East and West. Furthermore, the natural beauty of the country, the ability to experience different climates within a short travelling distance, and value for money makes the country one of the top recommendations for travelling.

In 2012, the leading travel magazine in Britain, Conde Nast Traveller, nominated Sri Lanka as 'one of the top five destinations to watch'. In addition, one of the most respected global tour information providers, The Lonely Planet, has recently announced Sri Lanka to be "the number one destination in the world to visit in the year 2013". All these aspects indicate that tourism in Sri Lanka is set for growth. Tourist arrivals were over a million in 2012, up 17% year over year and reaching just over 1 million visitors. This is expected to increase up to 2.5 million in 2016. Fig 1 shows the tourist arrivals by month for the 2010, 2011 and 2012 periods.

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II. PROCEDURE FOR PAPER SUBMISSION

A. *Review Stage*

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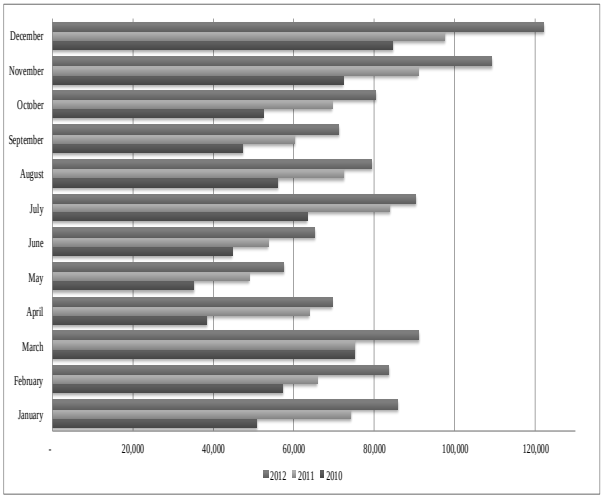

Fig 1: Arrival of tourists in Sri Lanka in the last three years (Sri Lankan Tourism Development Authority (b), 2013)

While sector growth in the future is very likely, there is considerable competition from other countries in the region. Many of these countries have better tourism infrastructure in place compared to Sri Lanka. Thus Sri Lanka has to ensure that it has the ability to provide value- for-money services. This will contribute to the growth of the tourism industry over the long run. If the country fails to provide the required levels of services to tourists, it is likely that they will opt for other destinations, and Sri Lanka will not enjoy higher levels of tourist arrivals. Another challenge that the industry has to face is the diversity of the tourists arriving. Different tourists will have different expectations and all these expectations will have to be met in order to improve any repeat visitations of the tourists. Fig 2 indicates the arrival destinations of tourists during the 2011 period.

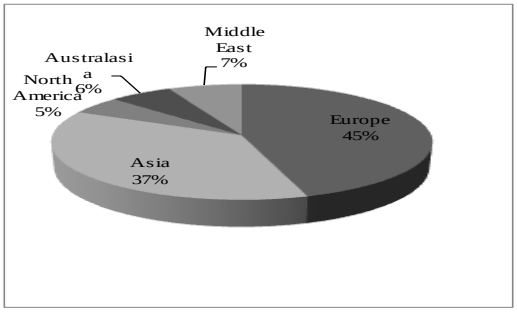

Fig 2: The regional contribution to Sri Lankan tourism in 2011 (Sri Lanka Tourism

Development Authority (a), 2013)

While there are no statistics to indicate the percentage of repeat visits, it is likely to be low at the moment. However, with the tourists building loyalty to the destination, it is likely that there will be a higher level of repeat visitations. The other competing destination such as Thailand is enjoying higher levels of repeat visitations. TTG (2013) estimates that roughly 70% of visitors are repeat tourists in Thailand.

This indicates a very high level of destination loyalty. Sri Lanka should also target building a loyal repeat tourist base as this will contribute towards sustainable growth in the tourism industry. Therefore all the current hotels and tourism service providers will have to build an understanding of the needs of the customers and provide services exactly in line with those needs.

Providing such a customized service to tourists from different geographies in a manner that they build destination loyalty remains the challenge that tourism establishments need to identify. On the other hand, the sector is seeing increased levels of investment by various local and foreign investors. This will increase competition between the hotels over the long term as well. Thus the overall tourism industry is set to see increased competition over the long run and building loyalty is a must for the hospitality service providers. This will ensure that individual growth of these establishments can be achieved through this approach. The discussion indicates that the hotels will have to work to build tourist loyalty over the long run.

Data mining will provide the required levels of information combining capabilities for the hotels. It is evident that there are establishments which use data mining to create customer loyalty. In this light, it is important to identify the role of data mining in the tourism industry.

II. RELATED WORK

Data mining and customer loyalty is an area which has received a considerable level of attention in literature. Increased customer loyalty indicates that data mining will contribute towards attracting customers to the companies. Once customers identify that the company provides them with the services they seek, they will stay with the company. This is the basis of customer loyalty [7]. Data mining will be able to indicate the needs of the customers. This will ensure that the companies know exactly what the customers need. When the companies know the needs of the customers, it is likely that they will be able to provide these needs [8]. Thus data mining contributes towards increased levels of customer loyalty.

The nature of the industry is what justifies the investment in data mining activities. This is due to the fact that data mining requires the companies to have a considerable amount of resources [9]. For instance, the hotels will require computer systems which are dedicated to collecting and storing data. There also needs to be extensive storage facilities. Furthermore, dedicated staff will have to be in place for data mining activities. Only such people who have an understanding of the needs can provide meaningful results through data mining [10]. All these indicate that data mining is a very technical area and the hotels will have to invest in it in a meaningful manner.

However, it is also likely that not all the companies and industries will need to invest in data mining activities in order to identify the needs of the customers [11]. In simple industries, it is likely that they will be able to serve the basic needs of the customers. The long term outcome will be that the markets will receive the exact value proposition that they require. Thus the customers will be able to enjoy products better fitting to their needs [8]. When the customers receive the values that they seek, it is likely that their loyalty will increase. There is a strong relationship between data mining and the tourism industry. This is due to the fact that the tourism industry involves people with different needs. The hotels will seek to serve these guests with the values they need [10]. In order to identify these values, there could be several factors that they will take into consideration [14].

One of the main aspects would be the lifestyle factors associated with the region. It can be assumed that tourists visit a particular destination expecting to get engaged in a certain set of activities [12]. Thus if the hotels could identify the patterns of activities preferred by the tourists with the geographical area they are from, it is likely that they could create suitable packages for tourists from the given regions. Furthermore, the tourists may have their preferences due to the demographics they have in place. It is likely that there could be other customer specific and lifestyle related aspects as well; for instance, higher-end tourists are likely to have unique lifestyle related factors and they will only visit the same destination provided these needs are fulfilled [9]. This indicates that data mining is a must in cases where the hotels are interested in repeat tourist arrivals.

Thus, due to the complex nature of the variables associated with the industry, data mining could provide suitable methods of identifying customer needs and providing value propositions based on these needs [17]. It is further apparent that data mining will allow the hotels to be innovative. This is due to the fact that the hotels will be able to identify the changing trends and adjust accordingly. In case those tourists from a given region spend less, the hotels will be able to provide them with value packages.

Thus the hotels will be able to identify the changes in the patterns and develop services to cater to these changing patterns. Over the long run, the tourists seeking these new value propositions will arrive at destinations that they believe will provide the said set of values [15]. It is also clear that the companies will not obtain results if they only have data mining systems in place. They also have to effectively incorporate these data into the decision making structures they have in place [18]. This ensures that the hotels not only have the data but also use the necessary data for the purpose of decision making. Thus the role of data mining becomes a part of the practical decision making scenario of the company [6]. This is what results in producing the values and service packages in line with the needs of the customers over the long term. This is likely to benefit the customers as they receive exactly what they are looking for [5]. On the other hand, the companies will benefit as customer loyalty is built due to offering services to the customers in line with their needs.

Thus the discussion indicates that data mining is a necessary exercise for a complex industry such as tourism. There are several

information areas such as the demographics, lifestyle factors and the regional details that need to be analyzed, and this facilitates such complex analysis [4]. The long term outcome of the exercise is that data mining becomes a part of creating customer loyalty in the tourism industry. This will provide considerable benefits and will eventually result in the sustainable growth of the industry over the long term. Data mining provides the details of the customer associations [23]. For instance, it is possible that a customer from Europe would like to get engaged in activities which are based on the beach [16]. While this is a general rule, it might not be the case in all instances. The second preference they have might be for another activity. If the company has the ability to mine into past data, it will be able to dig out any patterns available on customer behavior. This will allow the hotels to have extensive insights into the area of discussion [3]. While all the positives are apparent, there could be a number of negatives as well. This could actually result in distancing the customers rather than attracting them to the services provided.

There could be over-generalization of the activities and the eventual result would be customers who are offered packages which are not in line with their needs [1]. Thus the hotels will have to structure these activities in an effective manner and ensure that they do not get into the danger of over-generalizing the aspects. If the companies are in a position to achieve the benefits without over-generalization, the discussed results will be achieved and the benefits will be shared by the customer and the organization [22].

III. METHODOLOGY

The selected methodology is quantitative in nature as the relationship between the customization of the packages and the data mining has to be evaluated. For the discussion, ten prominent tourist hotels from different parts of the country were selected. From each of the selected hotels, three employees with knowledge on the data mining activities were interviewed. The selection of the hotels and employees was based on contacts. Thus the sample selection approach is convenient sampling by nature. The discussions with them were held based on a structured questionnaire. The questionnaire consisted of two sets of Lickert scale attributes, one representing data mining aspects and the other representing the customized value creation aspect. This is likely to indicate if there is a relationship between the data mining activities and the creation of customized packages by the hotels.

IV. RESULTS

The discussion of results begins with the identification of the role that data mining plays within the hotels. Subsequently, this will provide insights into the level of customization that the hotels will offer. Thus, it can be identified if there is a clear relationship between the data mining approach and the customization of the values in line with the needs of the guests. Fig 3 shows the data mining tendencies indicated by the hotels.

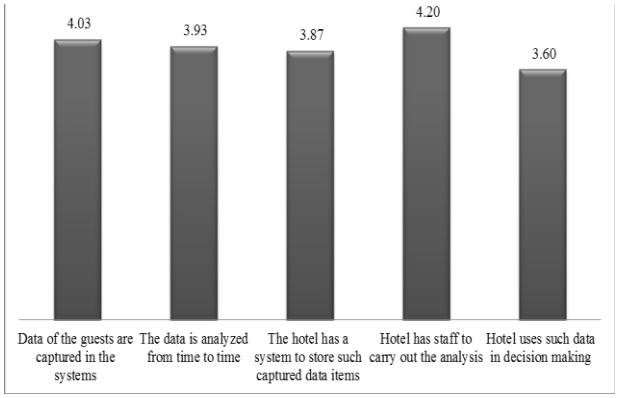

Fig 3: Data mining tendencies of the hotels (research data)

The above chart indicates that the overall score obtained by the parties is 3.93 and this shows that the hotels have a high level of concern regarding data mining related activities. When observing the charts, the highest score has been achieved by the statement of having dedicated staff. This indicates that data mining is a key area of the hotels and they have allocated a certain number of people to ensure that required data is captured, stored, and used in different forms when such data is required for the purpose of decision making.

It is also clear that the data about the guests and various aspects of the requirements and preferences are being captured. Thus the hotels will be able to ensure that the personal preferences of the guests are captured and stored in the systems. This will allow them to offer the customers exactly what is required by them in case they visit the hotel again. The attributes of analyzing the data from time to time and the ability to store the data were also identified. While the score is still high, it is interesting that the lowest scoring attribute of the set was for incorporating the data in decision making.

This indicates that while the hotels have the ability to capture the required data, the full utilization of the data in the case of decision making might not be taking place. This is one of the areas of future concern. The companies are willing to invest in such aspects as they know that they will be able to identify the needs of the customers. However, whether they actually customize the packages in line with the needs of the customers is yet to be discovered. Thus the above chart indicates that the concept of data mining is well known to the companies, and is being applied popularly in the hotel sector. Thus it is clear that the hotels have data mining functions in place and they are placed in a position to customize the packages in line with customer needs.

The customization can take place with or without data mining activities. The focus of the hotels on customization can be identified through the study as well. Fig 4 indicates the details.

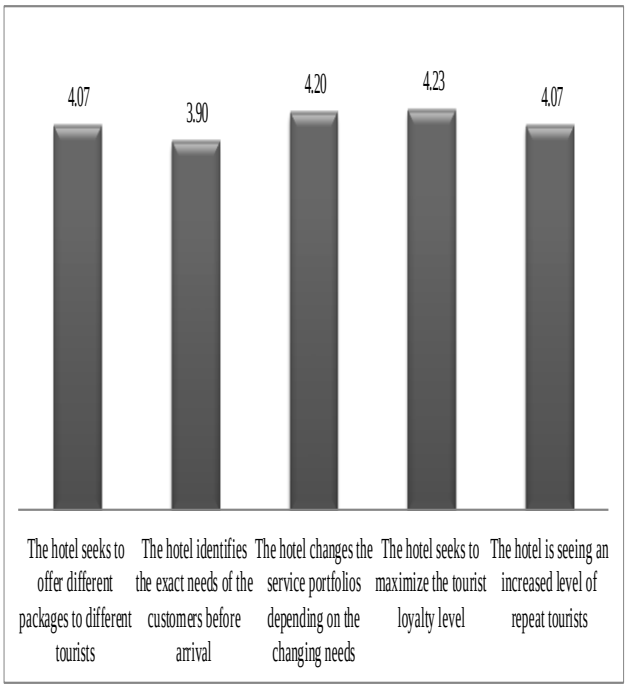

Fig 4: Customization of the packages at hotels (research data)

The overall score of 4.09 indicates that the hotels seek to customize the value and the packages in line with the needs. The highest scoring attributes in the service package customization front indicate that the hotels are working to maximize the values they offer customers. This further indicates that the hotels customize the values and services they offer with the vision of customization of these packages. This approach ensures that the customers receive the best quality services in line with their needs.

This creates loyalty, and if they plan to visit again, it is likely that they will select the same hotel. The outcome will be positive for the hotels over the long term as customer loyalty is constructed. Service differentiation based on customer attributes is evident.

The hotels have been attempting to offer the tourists different packages based on various attributes. This also indicates that the hotels have been attempting to match the services and the customer needs. It is also interesting to note that the hotels have actually seen the beneficial results of changing the packages and offering them in line with the customer needs. Many of the respondents believed that the hotels have seen the beneficial results due to increasing repeat customers over the past few years.

This is likely to increase further if the hotels continue to focus on creating customer loyalty. Another area of interest to the study would be to identify the areas that the hotels capture through the data mining exercises. This indicates the sophistication of the data mining operations affiliated with the hotel sector. If the operations are highly comprehensive, it is likely that most of the information about the tourists would be covered in detail. Fig 5 indicates the level of sophistication associated with the data mining exercises.

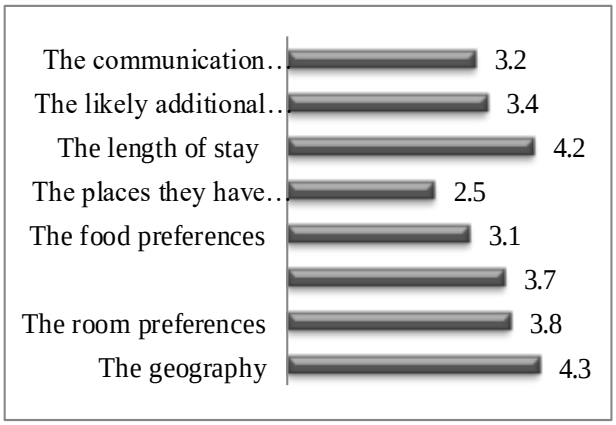

Fig 5: The areas that have been captured through the data capturing system

It is clear that the systems do not capture all the data areas alike; the length of stay is one of the common attributes captured. The other is the location. These are actually the easiest of the data items to capture. However, they do not provide the required behavioral insights into the tourist requirements, although it is important to note that there are systems in place to capture the behavioral attributes as well. The issue is that they are not as prominent as the capture of the non-behavioral traits and attributes.

The preferences within the hotel were also captured to a certain degree. However, there is room for improvement in this regard as the scores are lower. For instance, capturing of the communication capabilities of the visitors is taking place, yet the score is only slightly above the midpoint of the scale. This indicates that the communication capabilities have to be captured in detail, which in turn will improve the contribution towards understanding the nature of tourists' needs. Another important area which is in need of improvement would be the food preferences of the tourists. While there are systems to capture this, due to the buffet style offerings of the hotels, the food preferences might not be easily captured either.

Another of the most difficult areas to capture was the places that the tourists would visit. The hotels have seen lower capabilities of capturing information of this nature. However, capturing this information will allow the hotels to develop tour packages in line with the needs they have. Thus the places that the tourists prefer to visit should be another important area which requires attention and needs to be captured in detail. The discussion on the areas of information capturing indicates that while there are systems in place, capturing of the information is not perfect.

Thus, there need to be considerable improvements made to data capturing in order for the hotels to develop sophisticated data mining operations. This will further enhance the success of the data mining related operations of the hotels. Furthermore, the hotels are seeking to maximize the values they provide to customers in line with their needs. They also ensure that the customer loyalty levels are maximized. Thus the findings indicate that hotels seek to employ data mining capabilities as well as customization of the packages offered to customers in line with their needs.

A regression analysis has been carried out on data mining and customization of the packages. The discussion

indicates that the correlation score between the two variables is 0.979, indicating an almost perfectly positive relationship. This indicates that with the increase of data mining considerations, the value customization has also been positive for the hotels. There is a strong relationship indicated between data mining and the customization of services.

In order to evaluate the significance of the relationship, the predictors were evaluated. The constant score was 0.832 and the gradient was 0.831. This indicates that the relationship between the variables remains very strong. In other words, with an increase of the data mining score by one, the service customization approach increases by 0.831. Thus, due to the significant nature of the relationships between the variables, it can be said that there is a statistically proven significant relationship existing between the variables.

V.DISCUSSION

The above data analysis indicates that there is a significant relationship in existence between the data mining activities and the hotels providing customized values. This is in line with the discussion in the literature review where the evidence indicates that the companies that seek to offer customers products and services in line with their needs are those which have the capability to identify these needs through data mining activities. Thus, it is very likely that the hotels that have suitable data mining systems will be able to capture the information about the guests and ensure that they customize and proactively offer the customers the values they seek. The hotels in Sri Lanka should increase the sophistication of their data mining capabilities. There is a significant relationship to ensure that when the data mining capabilities are constructed, the customization of the service packages will take place.

With increased investment in such packages, the hotels will be able to provide the customers with a surprise factor as the customers do not have to ask for what they require. The hotel will know from the moment of arrival that the customers would be looking for a certain set of values. The hotel has the capability and the confidence as they have identified through data mining activities the nature of these preferences.

The data capturing areas will also have to be expanded. Details such as the number of days that the customers have stayed at the hotel, food preferences, travelling modes, the activities they needed in the hotel, and a number of other such aspects will have to be taken into consideration over the long run. This will ensure that the capturing of the data is complete in nature and the packages can be offered in line with the customer needs. This is likely to enhance the image of the country as the visitors will feel that they were well taken care of and received the values that they were seeking. This will in turn provide the push to increase tourism in the country through service quality improvements.

While the study provides a general understanding of the relationship between data mining and service customization, it is likely that the methods in use could change at each of the hotels. Thus hotels should carry out their own research to identify to what extent they carry out data mining activities and how they should improve the utilization of the data. It is important that the hotels build the relationship between data mining and decision making. When the relationship is improved, the outcome will be beneficial to the hotels. Thus, having data mining systems and using the mined data for decision making are two important areas to obtain the anticipated results.

The role of data mining is of high importance to the hotel sector in the country. The industry is such that the information cannot be easily captured due to the variety of the customers and the different nature of the requirements. However, data mining will assist the managers in the hotels as it will unearth the patterns of operations and allow the Management of the hotels to develop service packages and values exactly in line with the needs of the customers. Thus the customer loyalty levels are likely to increase and repeat visitations by the guests could take place in line with expectations.

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REFERENCES

[1] Byrd, E.T., and Gustke, L., (2011). *Using decision trees to identify tourism stakeholders*. *Journal of Place Management and Development*. Vol. 4 Iss: 2, pp.148 – 168.

[2] Carvão, S., (2010). *Embracing user generated content within destination management organizations to gain a competitive insight into visitors' profiles*. Worldwide Hospitality and Tourism Themes. Vol. 2 Iss: 4, pp.376 – 3.

[3] France, T., Yen, D., Wang, J., and Chang, C.M., (2002*). Integrating search engines with data mining for customer-oriented information search*. Information Management & Computer Security. Vol. 10 Iss: 5, pp.242 – 254.

[4] Golmohammadi, A., Ghareneh, N.S., Keramati, A., and Jahandideh, B., (2011*). Importance analysis of travel attributes using a rough set-based neural network: The case of Iranian tourism industry*. Journal of Hospitality and Tourism Technology. Vol. 2 Iss: 2, pp.155 – 171.

[5] Jayawardena, C., and Ramajeesingh, D., (2002). Performance of tourism analysis: a Caribbean perspective. International Journal of Contemporary Hospitality Management. Vol. 15 Iss: 3, pp.176 – 179.

[6] Jayawardena, C., and Sinclair, D., (2010). Tourism in the Amazon: *conclusions and solutions*. Worldwide Hospitality and Tourism Themes. Vol. 2 Iss: 2, pp.201 – 210.

[7] Koh, H.C., and Low, C.K., (2004). Going concern prediction using data mining techniques. Managerial Auditing Journal. Vol. 19 Iss: 3, pp.462 – 476.

[8] Lejeune, M., (2001). Measuring the impact of data mining on churn management. Internet Research. Vol. 11 Iss: 5, pp.375 – 387.

[9] Low, B., (2005). The evolution of China's telecommunications equipment market: a contextual, analytical framework. Journal of Business & Industrial Marketing, Vol. 20 Iss: 2, pp.99 – 108.

[10] Min, H., Min, H., and Emam, A., (2002). A data mining approach to developing the profiles of hotel customers. International Journal of Contemporary Hospitality Management. Vol. 14 Iss: 6, pp.274 – 285.

[11] Miori, V.M., (2009). Econometric count data forecasting and data mining (cluster analysis) applied to stochastic demand in truckload routing.

[12] Patrick, X., and Ypsilanti, D., (2008). Switching costs and consumer behaviour: implications for telecommunications regulation. info, Vol. 10 Iss: 4, pp.13 – 29.

[13] Rafalski, E., (2002). Using data mining/data repository methods to identify marketing opportunities in health care. Journal of Consumer Marketing. Vol. 19 Iss: 7, pp.607 – 613.

[14] Ranjan, J., and Malik, K., (2007). Effective educational process: a data-mining approach. VINE. Vol. 37 Iss: 4, pp.502 – 515.
[15] Reyes, M.V., (2010). Tourism strategies for "advantaging" the Amazon rainforest region: The Ecuador model . Worldwide Hospitality and Tourism Themes. Vol. 2 Iss: 2, pp.163 – 172.
[16] Ritchie, J.R., Tung, V., and Ritchie, R., (2011). Tourism experience management research: Emergence, evolution and future directions. International Journal of Contemporary Hospitality Management. Vol. 23 Iss: 4, pp.419 – 438.
[17] Segall, R.S., (2004). Incorporating data mining and computer graphics for modeling of neural networks. Kybernetes. Vol. 33 Iss: 8, pp.1258 – 1276.
[18] Shannon, T., and Zwick, M., (2004). Directed extended dependency analysis for data mining. Kybernetes. Vol. 33 Iss: 5/6, pp.973 – 983.
[19] Sri Lanka Tourism Development Authority (a), (2013). Arrival of Tourists by Country, Available: http://www.sltda.gov.lk/sites/default/files/Page_2_Dec_2011.pdf.
[20] Sri Lankan Tourism Development Authority (b), (2013). Statistic. Available: http://www.sltda.gov.lk/statistics
[21] TTG Digital, (2013). Q&A: Is it still safe to sell Thailand?, Available: http://www.ttgdigital.com/news/qa-is-it-still-safe-to-sell-thailand/4686270.article
[22] Uzama, (2009). Marketing Japan's travel and tourism industry to international tourists. International Journal of Contemporary Hospitality Management. Vol. 21 Iss: 3, pp.356 – 365.
[23] Wang, T., (2012). An efficient algorithm for mining condensed sequential pattern bases. Kybernetes. Vol. 41 Iss: 9, pp.1289 – 1296.
[24] Data mining. Available: http://www.laits.utexas.edu/~anorman/BUS.FOR/course.mat/Alex/
[25] Data Mining in Tourism Demand Analysis: Available: http://link.springer.com/chapter/10.1007%2F978-3-540-73871-8_47#page-1
[26] Data Mining Example: Tourism. Available: http://www.easydatamining.com/index.php?option=com_content&view=article&id=59&Itemid=79&lang=en
[27] Wei Z., (2008), Data mining procedures in generalized Cox regressions
[28] Viktor, H.L., and Arndt, H., (2000). Combining data mining and human expertise for making decisions, sense and policies, Journal of Systems and Information Technology, Vol. 4 Iss: 2, pp.33 – 56
[29] Pendharkar, P.C., and Rodger, J.A., (2000) .Data mining using client/server systems, Journal of Systems and Information Technology, Vol. 4 Iss: 2, pp.72 – 82
[30] Data Mining in Tourism Demand Analysis: A Retrospective Analysis. Available: http://dl.acm.org/citation.cfm?id=1421221
[31] The Application of Data Mining in Tourism Information. Available: http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5199787&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D5199787
[32] S.Daskslaki,I.Kopanas,M.Goudara,N.Avouris.Data Ming for decision support on customer insolvency in telecommunications business. European Journal of Operational Research,2003,145:239-255
[33] Data mining using SAS/EM:A Case Study Approach,SAS,Institute Inc.2003.4
[34] Jiawei Han and Micheline Kamber Data Mining Concepts and Techniques BeiJing Higher Education Press, 2001:279-299.
[35] Elder J F & Abbott D W , A Comparison of Leading Data Mining Tools, KDD-98.
[36] Jiawei Han, Michelin Kamber;Fan Ming, Meng Xiaofeng(interpret),Data Mining: Concepts and Technologies [M] ,Beijing Machinery Industry Press,2001,8
[37] Xin Haitao, Analysis of Mining Technology of Web Data and Application in Tourism E-Commerce, Journal of Harbin University of Commerce (Natural Sciences Edition). Aug. 2010, No. 4
[38] Ren Mingshu, Study on Web Mining and Electronic Commerce, Shandong University of Science and Technology.2002.

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