Journal of Sustainability Science and Management
Volume 14 *Number* 4, August 2019: 93-104
eISSN: 2672-7226

DEVELOPING A COMPREHENSIVE TOUR PACKAGE USING AN IMPROVED GREEDY ALGORITHM WITH TOURIST PREFERENCES

AIDA MAUZIAH BENJAMIN*[1], AIMI SARAH ABDULLAH[2], SYARIZA ABDUL-RAHMAN[1], ENGKU M. NAZRI[1] AND HARLI ZAKRY YAHAYA[3]

[1]Institute of Strategic Industrial Decision Modeling (ISIDM), School of Quantitative Sciences, [2]School of Quantitative Sciences, Universiti Utara Malaysia, Sintok, Malaysia. [3]DRYM Valley Langkawi, Kampung Kuala Temonyong, Langkawi, Malaysia.

**Corresponding author: mauziah@uum.edu.my*

Abstract: This study sought to improve three heuristic algorithms derived from prior studies and applied on tour packages based on six tourist preferences. The tour packages were then tested in a real-case study in Langkawi, Malaysia. At present, holiday packages in the island are drawn up individually by tour agents. If these packages fail to satisfy tourists, the agents would face problems in offering their services, including spending more time to plan new packages. Hence, it is hoped that the improved algorithms would make it easy for tour agents to devise packages that best fit the preferences of tourists. Three tour packages with different objectives — maximum places to visit (package 1), maximum popularity weight (package 2) and minimum cost (package 3) — were formulated. If a tourist wants to visit as many places as possible in one day with a budget of RM100, they may visit six places at RM59 (package 1), four places at RM90 (package 2), or five places at RM40 (package 3). These packages, nonetheless, were not compared to determine the best. They are presented as alternatives that may be proposed by tour agents.

Keywords: Heuristics, tourist, tourist trip design problem, Langkawi, tour package.

Introduction

In many countries, tourism happens to be one of the largest economic activity. It is an important source of income and generates employment for citizens (Singh *et al.,* 2011). Through tourism itself, many services are provided to ensure that visitors have a comfortable travel and stay. The services mainly come in the form of tour packages. A tour package is a combination of transport services, accommodation arrangements, guided site visits and other facilities (Middleton *et al.,* 2009). It is also defined as the offering of various services for tourists to enjoy an experience that has been advertised in brochures, billboards, radio, television and other media. A tour package involves a stay of more than 24 hours at the host country (Page & Connell, 2006).

A substantial number of studies has proven the benefits of offering tour packages. A simple survey of 37 tourists in Istanbul, Turkey, found that they preferred to subscribe to all-inclusive package tours, which included arrangements to go to attraction sites, hotel stays and airlines bookings. (Cetinsoz & Artuger, 2014).

In Malaysia, selection of a tour package is strongly driven by cost (Abang Josmani, 2007). The price of a tour is likely to be rated as the most important criteria by local tourists. Apart from that, other factors include safety, service quality, availability of escorts, experience of tour guides, comfortable transport and meal provisions (Abang Josmani, 2007). The use of a tourism advisory system (TAS) may help in devising travel plans through a fuzzy logic approach combined with multi-criteria decision-making (MCDM) tools (Mohamad Noor *et al.,* 2010).

In India, a web-based mapping system based on Geographic Information System (GIS) has been developed for visitors to Sivasagar, a tourism district in Assam State. The webpage contained information regarding tourist destinations, hotels, historical places and maps with satellite and street views (Sharma, 2016).

Langkawi also has its own web-based GIS and Global Positioning System (GPS) tools, which were designed to facilitate tourism on the island (Ahmad *et al.,* 2011). Another system is a GIS-based spatial decision support system (SDSS), which was developed to aid visitors in planning their itinerary in Langkawi (Ayob *et al.,* 2015). Information on all the amazing places that one must visit can be obtained online along with the criteria and reviews which may be accessed through the web. The criteria have been mainly discussed in prior studies (Abdul-Rahman *et al.,* 2014; Benjamin *et al.,* 2013a; 2013b). The points of interest (POI) range from jungle trekking to island-hopping and adventure, beach and waterfall relaxation, historical site visits, shopping and recreation. These six POI are frequently considered by tourists in determining the places that they wish to visit in Langkawi (Abdul-Rahman *et al.,* 2014).

Interviews with Langkawi tour agents revealed that the packages they offered are manually prepared. If the packages receive negative feedback from tourists, the agents would be forced to spend additional time in devising new packages. Besides, not many Langkawi tour packages seem to focus on tourist preferences (Abdul-Rahman *et al.,* 2014; Benjamin *et al.,* 2013a; 2013b). Prior studies have discussed more on GIS and a decision support system that offered information pertaining to Langkawi attractions and maps (Ahmad *et al.,* 2011; Mohd Ayob *et al.,* 2015).

With that highlighted, this study proposes three heuristic algorithms improved from prior studies (Abdul-Rahman *et al.,* 2014; Benjamin *et al.,* 2013a; 2013b), which are then used to construct personalised tour packages. Six preferences are identified through a questionnaire survey among 60 respondents (nine tour agents and 51 local tourists). The preferences comprised budget, duration of stay, types of places to visit, tour packages, touring time and starting locations. The improved algorithms should be able to aid agents in proposing the best places to visit based on what their clients preferred. Instances of tour packages based on these preferences were generated and tested in a real case study in Langkawi.

Materials and Methods

Tourist Trip Design Problem

Trip planning could be considered the main effort of a tourist's journey. Each journey required detailed planning to fulfil a desired outcome, usually to cover as many places as possible within a limited time. Most tourists faced difficulties in selecting and planning their POI. In order to choose one location after another, detailed evaluations were required to get the best deals. Such planning dilemma was called the "tourist trip design problem" (TTDP).

TTDP had been researched extensively by those involved in promoting tourism. The term might vary depending on the constraints investigated. Different authors might use a different term, such as tourist trip planning or tourist trip problem. But in the end, all seemed to focus on the basic model, which was TTDP.

TTDP referred to a route-planning problem faced by tourists who were interested in visiting multiple POI, in which constraints had to be resolved based on preferences (Gavalas *et al.,* 2014). The constraints could be in the form of a time budget, which referred to the time available for touring each POI and the distance to travel between them (Vansteenwegen & Van Oudheusden, 2007).

In addition, TTDP could be modelled as an orienteering problem (OP). A pioneer in TTDP research defined OP as the number of nodes one could visit within a given time when facing certain constraints, such as budget and travel time to each node (Tsiligirides, 1984). The definition of OP had been expanded, as Gavalas *et al.,* (2014) concluded that it had similarities with TTDP, wherein the location was linked with POI in scoring (i.e. user satisfaction), with the objective being to maximise the scores accumulated within a stipulated time (i.e. time for sightseeing per day).

The following subsections discussed the techniques used in this study to solve TTDP and OP in the tourism context.

Techniques for Solving TTDP

Many approaches had been proposed to solve TTDP, such as the exact method and heuristic and meta-heuristic techniques. In a Chinese study of day trips that excluded the opening and closing times for each POI, TTDP offered the shortest routes for tourists to plan their trips via the exact method (Fu & Li, 2012). The researchers used a mathematical model of a time-aggregated graph to come up with their solutions. Similarly, a mathematical modelling using taboo search was also implemented to detect *m* tours that included as many POI as possible within a limited budget (Sylejmani & Dika, 2011). The researchers considered satisfaction factor and travel time for each journey in their study.

As discussed in the previous section, the simplest form of TTDP could be modelled as an OP. Several researchers had applied the exact method to solve OP with a small number of nodes. Since OP was an NP-hard problem (Golden *et al.,* 1987), it could only be solved in cases or studies that applied smaller nodes or data. An instance of an OP that was solved using the exact method was performed by Fischetti *et al.,* (1998). The researchers used the branch-and-bound technique according to Fischetti and Toth (1988). Although the exact method resulted in satisfactory outcomes, it appeared to be inadequate for large volumes of data due to the exceeding time taken to yield the outcome.

Zhu *et al.,* (2012) examined tour planning problems by developing a mathematical model and solving them via the exact method. The problems were formulated as a mixed integer linear programming (MILP) problem. The study assessed 30 sites. Unfortunately, common constraints, namely budget and time, were omitted in the research. The MILP model was applied using CPLEX software. The reason for using CPLEX was due to the small data size. The results indicated that the error was less than 1 %.

The most common method used by researchers was the heuristic technique, which required minimal observations to gain near optimal results. Fu and Li (2012) asserted that TTDP offered the shortest routes for tourists to plan their trips via label-correcting algorithm (LCA), which was a heuristic method. Their findings produced better solutions to enhance tourist satisfaction.

Souffriau and Vansteenwegen (2010) attempted to solve TTDP using a guided local search (GLS) tool and applying meta-heuristics. Fischetti *et al.* (1998) utilised heuristics to analyse the variances that stemmed from his study results. The heuristic method was applied to solve problems at hand in two stages. The method appeared to be like that applied by Ramesh and Brown (1991), which included vertex insertion, cost improvement, vertex deletion and maximal insertions. Comparisons were made and the outcome showed that the heuristic method was able to solve up to 500 nodes.

Tackling the same subject with a different method, Zhu *et al.,* (2012) assessed a tour planning problem-solving method via a heuristic approach. The study proposed a method based on the idea of a local search with a sample of 59 sites and 26 hotels. However, they excluded common constraints, which were budget and time, but included accommodation as the main selection. The reason for using the heuristic method was to cater to large volumes of data, as well as to prove that the method could rapidly generate results compared with others.

Lim (2016) implemented variants of OP to resolve tour recommendations at individual, group and global levels. The researcher developed an algorithm based on user preferences that were gleaned from details and geo-tagged photos uploaded by tourists on Flickr. The researcher integrated the diverse sets of interests among tourists, such as travelling time, visiting time and time window at each POI. The results appeared to be outstanding compared with other metrics in several vital aspects, such as precision, recall, F1-scores, user interest scores and POI popularity.

Although studies on solving TTDP had been carried out in many nations, it was not applied much in Malaysia. Only several researchers seemed interested in the subject. To date, only Abdul-Rahman *et al.,* (2014) and Benjamin *et al.,* (2013a; 2013b) had investigated TTDP within the local context. Both groups based their studies in Langkawi using a number of approaches.

Abdul-Rahman *et al.* (2014) probed into the economy and high-end tour packages offered to tourists by implementing the problem as TTDP via heuristic algorithm. In fact, they managed to cover more than 30 tourist sites in Langkawi by considering various parameters, such as distance between the sites, time taken to reach POI, time window for visiting each POI, entry fees and conditions during the trip. The main criterion in choosing the POI in their itinerary was the lowest entry fee. The results showed that the objectives were achieved after implementing the heuristic method in a local search using the C++ software.

Benjamin *et al.* (2013a) improved the methodology by maximising the number of interesting POI in Langkawi. All constraints applied by the authors were similar to the prior study, except the limited budget was determined for each day of the trip. Their results were similar to each other, except that the limited budget subjects chose POI with a low entrance fee compared to those with unlimited budget.

Apart from exact and heuristic methods, some researchers had implemented the meta-heuristic method to obtain optimal solutions. For instance, Souffriau (2010) proposed an algorithm that maximised satisfaction of tourist trips by choosing the most interesting visits after considering all constraints. This study pictured their results in web-based tourist decision support system (DSS) to users and implemented the meta-heuristics Greedy Randomised Adaptive Search Procedure (GRASP). Regardless of the success that the study achieved, it only catered for a day trip, thus demanding future enhancements to be included in the tour packages.

Maervoet *et al.,* (2008) revealed that solving planning problems was a difficult combinatorial optimisation issue. Although the literature vastly depicted the exact method, it was impossible to do so as it required a considerable amount of time. Hence, the study opted to use the meta-heuristic method to plan customised trips by considering the available time for POI and the maximum trips tourists could undertake. The authors modelled their TTDP as an OP with Time Windows (OPTW) (Tsiligirides, 1984).

The Langkawi studies happened to dismiss TTDP. Most only offered information pertaining to POI,but omitted the implementation of a heuristic algorithm. Prior studies contained detailed discussions on GIS, DSS and graphical user interface (GUI). Only a few included TTDP, although TTDP had been proven to aid researchers in obtaining optimal outcomes. The use of a heuristic algorithm in TTDP offered the shortest distance in trips with a budget to consider (Sylejmani & Dika, 2011; Fu & Li, 2012; Souffriau & Vansteenwegen, 2010; Zhu *et al.,* 2012).

Previous Heuristic Algorithms

This section depicts three heuristic algorithms for a tour package problem derived from past studies (Benjamin *et al.,* 2013a and 2013b; Abdul-Rahman *et al.,* 2014), which have been enhanced by considering additional tourist preferences. Figure 1 illustrated the problem flow of TTDP, including those derived from Benjamin *et al.* (2013a and 2013b) and Abdul-Rahman *et al.* (2014).

Three locations were embedded in the problem (a set of POI, restaurants and hotel). Figure 1 portrayed an example of a two-day tour package, where the itinerary of each day was presented in blue and yellow arrows. The itinerary contained a sequence of POI to be visited on each day, beginning and ending at the hotel and was inclusive of stopovers at restaurants for lunch and dinner. The POI

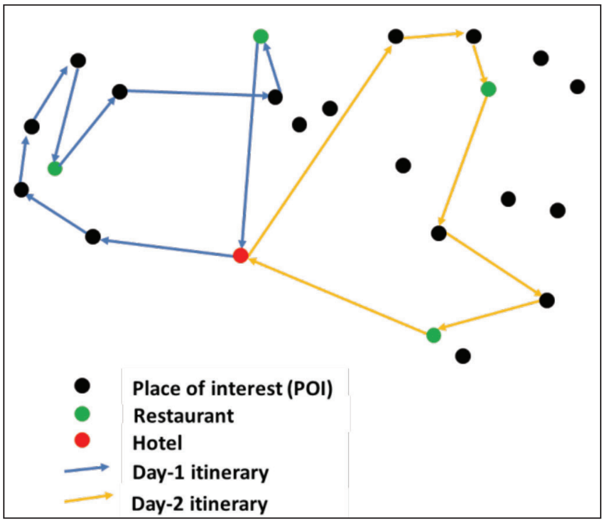

Figure 1: Problem flow of TTDP

Table 1: Tour packages from previous studies

References	Package objective	POI criteria
Benjamin *et al.,* (2013a)	Maximize the number of POI to be visited	Distance between POI and time spent at each place
Benjamin *et al.,* (2013b)	Maximize the total popularity weight	Popularity weight of each POI
Abdul-Rahman *et al.,* (2014)	Minimize the total cost of the tour	Entrance fee of each POI

selection depended on the objectives of the tour packages.

Previous studies had developed three tour packages as presented in Table 1 and the selected POI in the itineraries were based on criteria in the right column of Table 1. For instance, the objective of the algorithm developed by Abdul-Rahman *et al.,* (2014) was to devise a package that minimised the cost of tour. Hence, the criteria of selecting the POI were based on the cheapest entry fee.

The heuristic algorithms derived from the tabulated studies, nonetheless, considered only two preferences in developing the tour packages, which were total budget and number of days. Hence, this study incorporated additional tourist preferences to improve the packages. A survey found four additional preferences to be embedded into the tour packages — types of places to visit, types of tour packages, touring time and starting location.

Improved heuristic algorithm

The heuristic algorithm, particularly the greedy algorithm applied in this study, began with six inputs of tourist preferences in Figure 2. The inputs were total budget of tour, tour days, types of POI, types of packages, touring time and initial starting location.

Tourists could select the start location (i.e. hotel area), their budget, number of days, touring time, types of POI (i.e. jungle-trekking, island-hopping adventure, beaches and waterfall, history and culture, shopping and recreation). After setting the preferences, the improved greedy algorithm was run to conjure a complete package based on the preferences setting. The flow chart of the algorithm is presented in Figure 3.

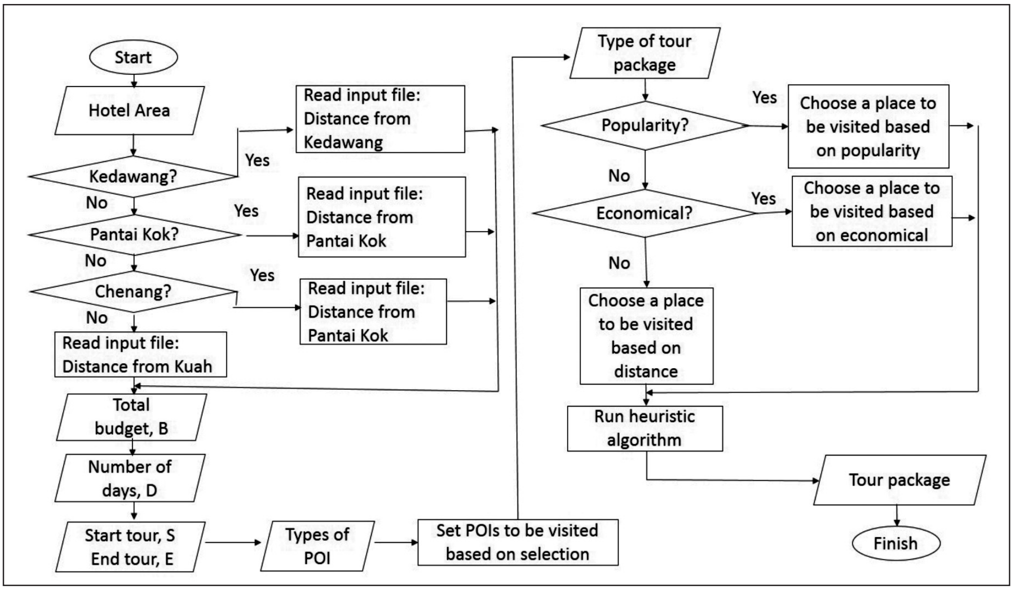

Figure 2: A flow chart of six tourist preferences incorporated into the greedy algorithm

Figure 3 was similar to the algorithm employed in past studies (Benjamin *et al.,* 2013a and 2013b; Abdul-Rahman *et al.,* 2014). However, the process of determining POI (written in red font) differed since more preferences had been incorporated into the package. The objective function of the algorithm depended on the three tour packages selected by the tourists (second column in Table 1). Type 1 was to maximise the number of POI to visit, type 2 was to maximise the popularity weight and type 3 was to minimise cost.

In addition, six constraints were addressed by the algorithm proposed in this study. In the first constraint, the algorithm must ascertain that the number of itineraries was equivalent to the number of tour days. In precise, the itinerary for each day was constructed. The second constraint referred to the total cost of the tour that must not exceed the budget set by the tourists. In the third constraint, the selected POI included in the itineraries must meet the type of place that the tourists wanted to see (i.e. beaches, shopping mall, etc.) and the opening hours of the POI. As for the fourth constraint, suitable restaurant(s) for having lunch and dinner must be integrated in the itineraries. In the fifth constraint, the tour must finish at the same place where it began, which was the hotel. Lastly, the sixth constraint referred to the tour that must start and end based on the time proposed by the tourists.

The process of the greedy algorithm is depicted in Figure 3. It started with a feasibility check of the tour package. If the feasibility criteria were fulfilled, then the tour route would start at *S*, (i.e. start time preferred by the tourist). Next, the algorithm determined the availability of budget *B* to be spent for another visit. Upon availability of a budget ($B > 0$), the algorithm would select the next POI to be visited, *P*. The criteria for the selection was based on the types of tour package chosen by the tourist (see right column in Table 1). *P* was included in the itinerary if all constraints of *P* (i.e. operation hours and ticket price) were fulfilled.

In the next step, the algorithm determined the feasibility of including lunch/dinner time. If the current time could accommodate the lunch/ dinner time windows, the algorithm would find the nearest available restaurant, *R*, to be embedded into in the itinerary. Otherwise, the algorithm would find next *P* to be visited. The process was repeated until the current time met

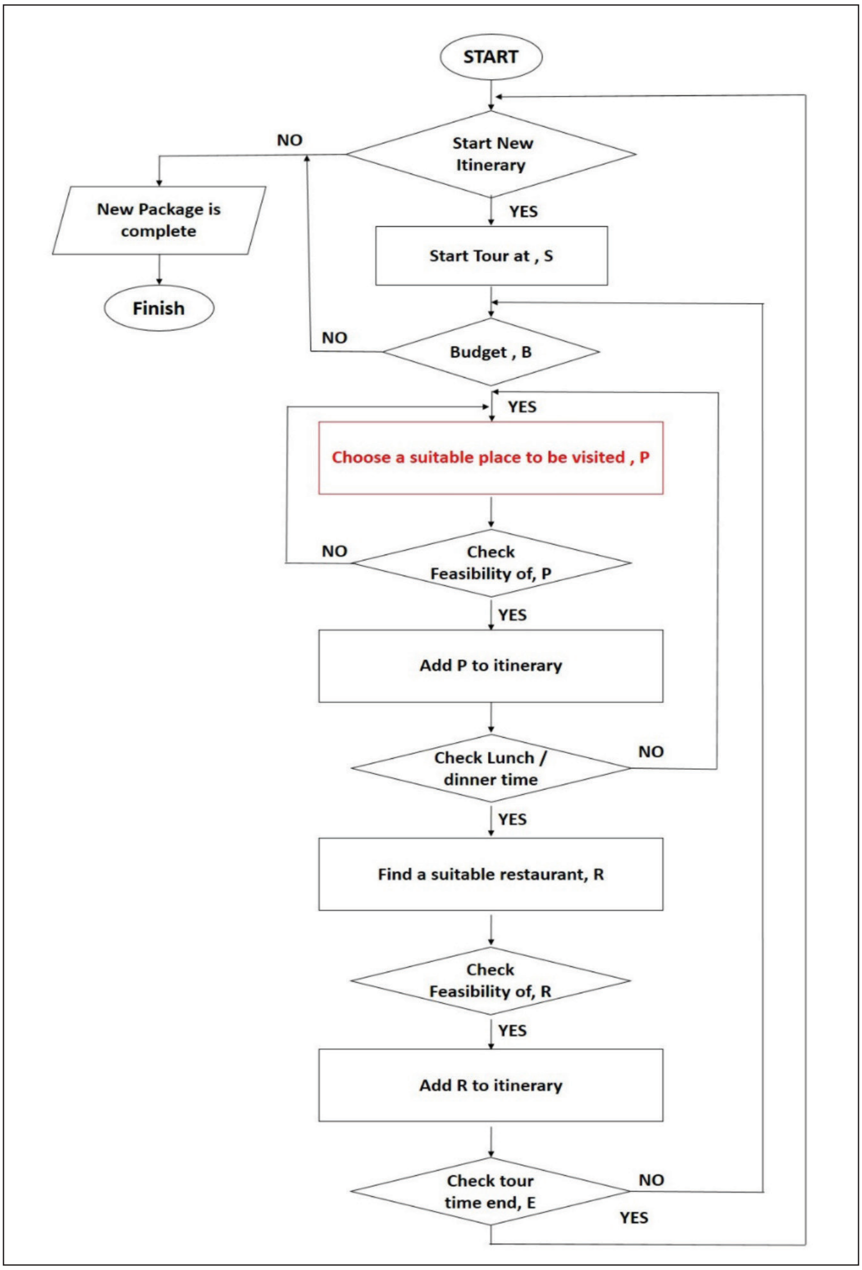

Figure 3: A flow chart of the improvised greedy algorithm

E, (i.e. end time of the tour preferred by the tourist) and hence, the itinerary was completed.

The process of developing the next itinerary was repeated until all itineraries had been developed based on the number of tour days. Finally, a complete tour package was developed and the algorithm would be terminated. The greedy algorithm was run on a Pentium® Dual-Core CPU T4300 @ 2.10GHz with 3.00 GB memory using C++. Different tour packages, which had been generated using the improved algorithm, were compared in terms of total cost and the number of places to visit. The algorithm was applied on a real case study in Langkawi, Malaysia.

The case study

Langkawi is a well-known international resort island in Malaysia. Administered by the Langkawi Development Authority (Lada), it is located off the coast of Kedah and is close to Thailand. It has a total area of 478.48 sq km, including surrounding islands. Tourist arrivals had increased annually (Mansor & Ishak, 2015) and the statistics were available at Lada (2019).

Jetties of Kuala Kedah, Kuala Perlis and Penang served as local entry points while the international jetty was in Satun, Thailand. International and domestic flights would land at an airport on the island. Langkawi offers a vast range of activities and tourist sites for backpackers and luxury travellers. In this paper, 35 POI on the island were considered to generate the tour packages. These POI were categorised into six types as stated in Table 2.

Table 2: POI categories in Langkawi considered in this study

No.	Type	POI
1.	Forests	Gunung Mat Cincang
2.	Island Adventure	Pulau Payar Marine Park
		Island hopping
		Day cruise
		Mangrove tour (Geopark)
3.	Beaches and Waterfalls	Pantai Pasir Hitam
		Tanjung Rhu
		Pantai Tengah
		Teluk Datai
		Pantai Cenang
		The Langkawi Waterfall
		Telaga Tujuh Waterfall
		Temurun Waterfall
		Pasir Tengkorak Beach
		Pantai Kok
4.	History and culture	Langkawi Craft Cultural Complex
		ATMA Alam Batik Art Village
		Kota Mahsuri
		Laman Padi
		Ayer Hangat Village
		Beras Terbakar
		Galeria Perdana
		Ibrahim Hussein Museum and Cultural Foundation

5.	Shopping	Langkawi Fair shopping mall
		Langkawi night market
		Cenang Mall
		Jetty Point
		Zone duty-free shop
6.	Fun	Underwater World
		Langkawi wildlife park
		Langkawi cable car & oriental village
		Dataran Lang
		Langkawi crocodile farm
		Herbwalk in Langkawi
		Mardi Agropark

Other variables included the entry fee at each POI, touring time, popularity weight, 11 potential restaurants for lunch and dinner, operating hours, as well as traveling time and distance between POI and restaurants.

Other variables included the entry fee at each POI, touring time, popularity weight, 11 potential restaurants for lunch and dinner, operating hours, as well as traveling time and distance between POI and restaurants.

Results and Discussion

The instances of tour packages generated by the improved algorithm are presented in this section. Table 3 shows a comparison of the packages. in terms of the total POI to be visited and the total cost.

The left column in Table 3 presents the six types of POI (i.e. forests, island adventure, beaches and waterfalls, history and culture, shopping and fun). For these tour packages, it was assumed that the tourists did not have any specific preference for the types of places to visit. The second and third columns displayed the number of days and budget for each day, respectively. The remaining columns in Table 3 present the three types of packages (tour packages with maximum number of POI to visit, the most popular POI to visit and minimum cost to visit POI). All packages were compared in terms of number of POI to visit and total cost. These tour packages were suitable for tourists who did not have specific preference on the types of POI to visit.

Table 3: Comparison between different types of tour packages

Types of POIs	Number of Days	Total budget per person (RM)	Maximum POI (tour package 1)		Popularity (tour package 2)		Economic (tour package 3)	
			Total POI	Total cost (RM)	Total POI	Total cost (RM)	Total POI	Total cost (RM)
Choose all POI	1	100	**6**	**59**	**4**	**90**	**5**	**40**
	2	200	9	179	7	182	8	160
	3	300	14	233	11	260	13	160

Table 4: Comparison between different types of POI

Types of POI	Number of days	Total budget per person (RM)	Maximum number of POI	
			Total POIs	Total cost (RM)
i. island adventures ii. beaches and waterfalls iii. history and culture	1 2 **3**	100 200 **300**	5 11 **13**	26 52 **181**
i. beaches and waterfalls ii. history and culture iii. shopping malls	1 2 **3**	100 200 **300**	6 11 **16**	16 21 **31**

Table 4 shows some examples from tour package 1 with various types of POI. The tour packages were suitable for tourists who desired to visit specific types of POI.

For example, if the tourist chose island adventure, beaches and waterfalls and history and culture for a three-day package, he/she would be able to visit 13 POI for RM181. This package could be considered costly when compared to other packages in Table 4 because of the ticket prices of tourist sites under island adventure. The tickets for Pulau Payar Marine Park, island hopping, day cruise and mangrove tour (Geopark) were priced between RM35 and RM320.

However, if the tourist preferred POI with less cost like beaches and waterfalls, history and culture, as well as shopping malls for a three-day tour package, he/she could visit 16 POI with RM31 only. All the tour packages presented in Tables 3 and 4 were not compared to determine the best package. They only displayed the vast alternatives that could be proposed through the use of the greedy algorithm to meet tourist preferences.

Conclusion

In this paper, three heuristic algorithms derived from previous studies had been improved after embedding tourist preferences, such as budget, tour days, types of POI to visit, types of tour packages, touring time and start location. These preferences were identified from questionnaires distributed to 60 respondents. Instances of tour packages with varied preferences setting were presented and discussed. All the generated tour packages were compared in terms of the total POI to visit and the cost of each package. It is hoped that by considering all these preferences in the algorithm, the tour agents can easily customise tour packages for tourists that ensures satisfaction.

Acknowledgements

We would like to extend our gratitude to Universiti Utara Malaysia for providing us the research funding under Leadership Development Schemes Grant (Code: 12414) to carry out this research work.

References

Abang Josmani, D. S. (2007). *Study on The Selection Criteria for Choosing Domestic Package Tours In Malaysia.* Master's thesis, Universiti Teknologi Malaysia, 23 pp.

Abdul-Rahman, S., Benjamin, A., & Engku Abu Bakar, E. (2014). Economic tour package model using heuristic. *AIP Conference Proceedings*, 1605(1), pp. 1160-1165.

Ahmad, A., Masron, T., Osman, M., Mohammed, B., & Marzuki, A. (2011). Initial Studies on Web Based Tourism Decision Support System (WBTDSS) Case Study: Langkawi Island,Kedah. *Proceedings of 2nd Regional Conference on Tourism Research*, pp. 344-359.

Benjamin, A., Abdul Rahman, S., & Engku Abu Bakar, E. (2013a). Heuristic technique for tour package. In: P*roceedings of the 2013 International Conference on Information, Operations Management and Statistics,* Malaysia, (on CDROM) pp. 1-8.

Benjamin, A., Abdul-Rahman, S., & Engku Abu Bakar, E. (2013b). Langkawi tour package models using heuristics. *Presented at Statistics and Operational Research International Conference 2013 (SORIC2013)*. Kuching. [Unpublished].

Cetinsoz, B.C., & Artuger, S. (2014). International tourists' selection criteria for choosing all-inclusive package tours: An application in Istanbul. *International Journal of Academic Research in Business and Social Sciences*, *4*(9), 369-384.

Fischetti, M., & Toth, P. (1988). An additive approach for the optimal solution of the prize collecting traveling salesman problem. *Vehicle Routing: Methods and Studies*, 319-343.

Fischetti, M., Toth, P., & Gonzalez, J. (1998). Solving the orienteering problem through Branch-and-Cut. *INFORMS Journal on Computing*, 133-148.

Fu, P., & Li, J. (2012). A label correcting algorithm for dynamic tourist trip planning. *Journal of Software*, *7*, 2889-2905.

Gavalas, D., Konstantopoulos, C., Mastakas, K., & Pantziou, G. (2014). A survey on algorithmic approaches for solving tourist trip design problems. *Journal Heuristics*, *20*(3), 291-328.

Golden, B., Levy, L., & Vohra, R. (1987). The orienteering problem. *Naval Research Logistics*, *34*(3), 307-318.

Lada (2019). *Tourist arrival statistics.* Retrieved from https://www.lada.gov.my/index.php/en/information/statistics/tourist-arrival-statistics.

Lim, K. H. (2016). Recommending and planning trip itineraries for individual travellers and group of tourists. Retrieved from *https://people.eng.unimelb.edu.au/limk2/2016-ICAPS-tourRecDC.pdf*,

Maervoet, J., Souffriau, W., Vansteenwegen, P., Vanden Berghe, G., & Van Oudheusden, D. (2008). Tourist decision support for mobile navigation systems: A demonstration. *Applied Artificial Intelligence*, *22*, 964-985.

Mansor, K., & Ishak, W. (2015). Forecasting Tourist Arrivals to Langkawi Island Malaysia. *Cross-Cultural Management Journal, 17*(1), 69-76.

Middleton, V.T.C., Fyall, A., Morgan, M., Morgan, M., & Middleton, A.R. (2009*). Marketing in Travel and Tourism. 4th Edition*. Butterworth-Heinemann: Elsevier Publishers, Oxford, UK, 502 pp.

Mohamad Noor, N., Ahmad, I., Haji Ali, N., & Ismail, F. (2010). Intelligent decision support system for tourism destination choice: A preliminary study. *IEEE Xplore*, pp. 1357-1361.

Mohd Ayob, N., Masron, T., Idris, A., & Seifi, M. (2015). Web-based tourism decision support system (WBTDSS): Architecture and application for Langkawi Island, Malaysia. *Advances in Environment Biology*, *9*(4), 62-65.

Page, S.J., & Connell, J. (2006). *Tourism: A Modern Synthesis. 2nd Edition*. Thomson Learning Publishers, Bedford Row, London, UK, 546 pp.

Ramesh, R., & Brown, K. (1991). An efficient four-phase heuristic for the generalized orienteering problem. *Computers & Operations Research*, *18*(2), 151-165.

Singh, S. P., Sharma, J., & Singh, P. 2011. A web-based tourist decision support system for Agra city. *International Journal of Instrumentation, Control & Automation*, *1*(1), 51-54.

Souffriau, W. (2010). *Automated Tourist Decision Support*. Ph.D. Dissertation. Katholieke Universiteit Leuven, Belgium, 196 pp.

Souffriau W., & Vansteenwegen P. (2010). Tourist Trip Planning Functionalities: State-of-the-Art and Future. In: Daniel F., Facca F.M. (Eds) *Current Trends in Web Engineering. ICWE 2010. Lecture Notes in Computer Science*, vol 6385. Springer, Berlin, Heidelberg: Publishers.

Sylejmani, K., & Dika, A. 2011. Solving touristic trip planning problem by using taboo search approah. *IJCSI International Journal of Computer Science Issues*, *8*(5), 139-149.

Tsiligirides, T. 1984. Heuristic methods applied to orienteering. *Journal of the Operational Research Society*, *35*(9), 797-809.

Vansteenwegen, P., & Van Oudheusden, D. 2007. The mobile tourist guide: An OR opportunity. *OR Insight*, *20*(3), 21-27.

Zhu, C., Hu, J., Wang, F., Xu, Y., & Cao, R. 2012. On the tour planning problem. *Annals of Operations Research*, *192*(1), 67-86.