CREATING ITINERARIES USING DECISION ANALYSIS

BY

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THESIS

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Abstract

With the age of technology and information, tourists today are more informed. The dynamic nature of the ever growing tourism industry, the ever changing demands and the drive towards customization coupled with the availability of offline, online and mobile commerce has led to products and services being developed to plan and organize travel. Websites like TripHobo, TripIt, TripAdvisor etc. have simplified the reservation systems involved in planning for trips. They may give the customers recommendations based on the rankings and ratings of other people, and probably in the near future, may recommend places to visit within the city based on history. But until now, there has not been a solution which suggests the destinations to be visited and no system accounts for one of the best measures of personal requirements, i.e. the ‘utility’.

This thesis describes a new method for recommending a complete itinerary to tourists (especially individual travelers). It proposes a model which uses decision theory and data available online to customize, choose and build an itinerary for a tourist. The objective of the model is to find the combination of tourist destinations along with the number of days that the tourist should spend at each destination and the recommended activities. The combination is chosen in a way that maximizes the utility of the trip: in lay terms, the itinerary should maximize the satisfaction that the tourist derives from the trip.
Acknowledgements

I would like to extend my sincere gratitude to my advisor, Professor Deborah Thurston for giving me the opportunity to work on a topic which is in the field of my passion and for guiding me through the research with her expertise and valuable inputs during the course of the project as well as in writing this thesis. I would like to thank my family for support to me while earning this Master’s degree.
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1. Introduction

Travelers today are searching for altered and customized choices to visit spots and vacation destinations of their preferring. A travel management company Peak DMC wrote the following in a 2014 report “Seemingly every company today operating in the hospitality and tourism sector is marketing itself as an experience versus a product, based on rising demand from consumers for more authentic and engaging travel experiences,” [2]. According to TripAdvisor which is the world’s largest travel review website, it has over 160 new contributions every minute from someone of its 375 million unique monthly visitors. Furthermore, of these users, almost 50 percent get to the site through tablets and cell phones, a rate the organization hopes to continue developing. Tnooz, which provides editorial and business administration to the travel and hospitality industry wrote “The big daddy of online reviews, TripAdvisor, is becoming terrifyingly important in a traveler’s decision-making process. In fact, more than half of travelers are not willing to book a hotel until they read reviews about the property” [2].

The internet is filled with content about different destinations, but is cluttered and vast. It is therefore natural that people (tourists and travel agents) look for tools to narrow their search through a logical approach to choose itineraries which best fit the travelers’ expectations. In other words, the tools which help in choosing the itinerary which will provide the best value (utility) shall be in great demand.
Figure 1 shows how people are planning their travel. Over three fourths of the people are now using mobile phones for planning their travel as compared to travel agents and traditional offline channels.

As shown in figure 2, a study commissioned by Google and carried out by IPSOS media CT, which is an independent market research company, in 2014 found that the internet is the single largest source for planning travel. Figure 3 shows that most people use search engines or aids like applications on the internet and figure 4 shows that almost all travelers had planned their trips through an online travel agent (internet), among which three fourths do so for better deals (value for money) and one in three travelers select an OTA (Online Travel Agency) for better tools and options [4].
Figure 2: Travel Planning Sources [4]

Figure 3: Online travel planning sources [4]
Figure 4: Reasons for booking on specific online travel agency sites or apps [4]

Figure 5: Inspirations for traveling [4]

Figure 5 shows indicates that travel sites and apps contribute 42% of the online inspiration to travel [4]. The opportunity for good tools in this market is therefore huge, as they provide the next logical step in planning travel.
There are multiple offerings, websites and applications available online which help in organizing the nuances of travel like which airline to choose, which hotel to book, adding attractions within the destination to the list of things to do. However, an intelligent recommendation system based on personal preferences and utility of travel are not available yet, (to the best of the author’s knowledge). This creates an opportunity for a recommendation system to cater to personal preferences to optimize the total utility of the itinerary.

1.1 Definitions

1.1.1 Tourism: According to the UNWTO (United Nations World Tourism Organization) [5], “Tourism comprises the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an actively remunerated from within the place visited.”

1.1.2 Itinerary: Itinerary is defined as a detailed plan or route of a journey by the Cambridge English dictionary [6].

1.1.3 Itinerary planning: Itinerary planning or planning an itinerary, for the purpose of this thesis refers to the process of choosing the destinations and things to do.

1.1.4 Itinerary organizing: Itinerary organizing or organizing an itinerary, for the purpose of this thesis, refers to the actions and process of micromanaging the details of the trip. For example, booking, reservations, payments, sorting the things to do and implementing travel plans are parts of the organizing tasks.
1.1.5 Tourist attraction: A tourist attraction is a place of interest where tourists visit, typically for its inherent or exhibited natural or cultural value, historical significance, natural or built beauty, offering leisure, adventure and amusement [7].

1.1.6 Online travel agency or OTA: Websites offering comprehensive travel shopping and Reservations Solutions to consumers. Examples include Expedia, Orbitz, Travelocity, Priceline, and many local and regional sites [8].

1.2 Motivation

To create a method that aids the process of choosing an itinerary, which is the first step in a travel plan, gathering a large amount of data is required, followed by filtering the relevant information and processing it to create customized recommendations. The thesis provides a method to do all these things based on the already available data on the internet and a few small pieces of information from other direct or indirect sources. A tool utilizing this method may be used by the travelers themselves or by agents (online or offline) who want to help in planning itineraries for their customers.

The methodology/ tool shall

• Reduce or nearly eliminate the time and cost involved in choosing an itinerary.

• Increase the efficiency of travel planning by using real-time and relevant information using heuristics

• Provide greater insight into customers’ behavior and utilities over time that can be used for better predictions (through machine learning and better predictive models) with the accumulation of data and feedback form users.
• Provide greater scope for innovation in the design and marketing of travel products synchronized with different services that go with it.
• Improve quality and utility of (satisfaction derived from) travel.
• Provide a rational and directed approach rather than arbitrary search
• Reduce or eliminate the stress and effort involved in a wide search

1.3 Drivers
There are several drivers that might lead a tourist, travel agents or tour operators to start using this method for planning and pricing itineraries. This trend of a demand for higher level of customized attention and service online is also corroborated by a Forrester Consulting study commissioned by a company named Fusion. The research demonstrated that businesses will find much greater success in online ancillary sales if they create a unique and dynamic experience for the customer [9].

• Customization bridges the gap between tourist knowledge and satisfaction: Lee, et al. noted that customization leads to greater satisfaction in tourism [10] and hence which means that the utility of a customized trip is greater than a generic one.
• Technology enables communication and more: This era of travelers is more tech-savvy. They are most comfortable with seamless connectivity, speed and comfort that technology and online purchases offer [11].
2. Literature Review

Due to the significance of the decision-making process for selecting travel destinations, a variety of theories have been hypothesized and analyzed. All of them have the commonality that making the decision and the final purchase is a multi-stage process [12].

Woodside and Lysonski provided a model to summarize the destination choice process for travelers [13].

Multiple theories have been put forward to explain the decision-making of travelers and consumers. The ‘Classical Theories’ describe the consumer as a risk reducer, a problem solver or an information processor [14].

According to the information-processing rationale, it is presumed that travelers constantly search and process information for improving the quality of their choices. This logic follows the approach of bounded rationality since it states that travelers have limited resources to process information [14]. However, with the advent of the internet, this assumption can be rebutted considering the fact that there is now almost an unlimited access to resources since the internet is an ever growing database and hence, there is now a need to structuring and filtering the information in order for it to be effective.

A recent theory trying to explain decision making in the current scenario is the garbage can model [15] paradigm which is derived from organizational behavior and explains the indecisiveness and excessive information available. The decision maker is faced with overflowing information highlighted by the internet which leads to lack of decisiveness. This also provides basis for the fact that many travelers make spontaneous decisions considering the availability and ease of transportation coupled with the flexibility of time.
Much of the research postulates that when there are fewer options available, decision makers often use the entire set of information and process it to available to compare and contrast. They generally go on to define the trade-offs between relevant attributes. However, when the decision maker are faced with a large number of options, they often resort to heuristic strategies which filter out information. Moreover, in these cases, it decision makers fail to specifically determine the willingness to tradeoff between different parameters. The strategy may be termed as elimination by aspects [16].

With reference to itineraries, the most common problem addressed is the traveling salesman or route optimization problem or Itinerary planning problem, i.e., determination of the itinerary that lexicographically optimizes a set of criteria (i.e., total travel time, number of transfers, and total walking and waiting time) while departing from the origin and arriving at the destination within specified time windows.

Almost no research is available on the use of the vast data available to come up with recommended itineraries for tourists based on the utility of the trip.

Some attempts were made to create system which would plan a schedule around the already chosen places to visit using inputs from the traveler. The system would require the user to manually input the destinations, dates and times and the system would calculate a basic route by searching various data bases and the time allocated previously in a time storage section [17].

While others give detailed tools to organize and plan the details of the travel within the chosen destination [18].

A few patents in the 1990s attempted to make the process of planning an itinerary easier by providing tools and products which helped in visualizing the trips. Others just aided in scheduling and organizing an already planned itinerary [19].
In this regard, some research papers like Automatic Travel Itinerary Planning System for Domestic Areas [20] as well as new online tools, products and websites like Tripit, Triphobo Skiplagged help in micromanaging the holiday with booking tools and organizing tools.

An attempt to capture utility was made in an iterative approach used by Basu et al. where the process needs user feedback on POIs selected by the system [21]. Itineraries are recommended considering the previous feedback and finally a new set of options with optimal utility are chosen in order to get feedback. This iterative process stops when the user is satisfied with the recommended itinerary. The paper shows that the problem of computing an itinerary is NP-complete. Hence, in order to find an optimal or near optimal itinerary, heuristics would have to be used in case of a large set of options. The problem with this is that the method stops searching if the user finds an itinerary which he or she perceives as satisfactory and hence, the optimal or near optimal itinerary is almost never achieved.

Dunstall et al. suggested a framework [22] for an electronic travel planner. They claimed that a large dataset of user travel related preferences can be expressed in a mathematical approach to create an automated framework to planning an itinerary. They did touch upon the concept of utility, but restricted it to the utility of and used only preferences to iterate, which is a lengthier and localized optimality search approach.
There has been some research over how to evaluate Group recommendations. The two main strategies used are to increase the average of the alternatives relevance (in our case, it would be the total utility) and to maximize the minimum individual relevance for the itineraries [23]. A patent filed by Kevin Brown aimed to solve the itinerary problem using the internet and the database available through it [24].

![Architecture of ETP electronic travel planner][22]

**Figure 6: Architecture of ETP electronic travel planner [22]**

![Kevin Browns framework for an itinerary planner][24]

**Figure 7: Kevin Browns framework for an itinerary planner [24]**
3. Methodology

This chapter describes the new methodology to evaluate and choose different itineraries for a tourist. The current system of travel recommendations is highly inefficient.

A global survey of over 15,000 tourists done in 2011 found the reasons for which people traveled. The observations were as follows [25]:

![Chart showing reasons for choosing a travel destination](image)

*Figure 8: Reasons for choosing a travel destination [25]*

A cursory analysis of the influencing factors shows that this might not be the optimum way of choosing the destinations. The use of a customized quick decision aid would help in increase the utility of a trip. Especially for 30% of the people who relied on the internet and travel agents.
A 6 step methodology was used for the purpose of this thesis

3.1 Problem Formulation

The problem that the proposed tool aims to solve is to provide personalized recommendations to travelers to plan their holidays based on their personal preferences with minimal questions asked.

3.2 Framework creation

To provide recommendations to the traveler, the tool needed to estimate the utility of itineraries. To total utility of the itinerary is assumed to rely on the combined utility of 3 major parameters

- Cost of the trip: This is the $ amount of all the expenses incurred during the trip. It includes cost of transportation, food, lodging and sightseeing expenses.
- Distance travelled: This includes all the traveling involved from the first destination to the last.

- Tourist attractions and activities visited during the trip.

The utility of these three parameters were to be estimated by estimating the utility function and considering rating patterns to estimate the utilities of the components.

3.3 Data Collection

3.3.1 Indirect information (data taken from online sources)

The following data was collected from sources like TripAdvisor, backpacker’s index:

- Ratings given by the subject

![Figure 10: Subject’s Ratings](image)

- Average ratings of the places rated by the subject
Figure 11: Average Ratings

- Type or classification of tourist attraction (classified into major categories based on information available)

![Bayshore Boulevard](image)

Figure 12: Classification of tourist attraction

- City of location of the attraction

![Bayshore Boulevard Location](image)

Figure 13: Location of tourist attractions
• Distances between cities

![Distance between two cities](image)

*Figure 14: Distances between tourist destinations*

• Average cost of living in the cities as per backpackers, 3 star and 5 star ratings

• List of top cities in the world

As a sample set, the list of the 56 most visited cities in Europe (2015) was taken.

• List of attractions/top things to do in the cities (restricted to top 30 per city)

3.3.2 Direct sources

Lottery Questions would be asked to ascertain the

• Utility of money graph/expression
Figure 15: Subjects’ utility of money

- Utility graph/expression of ratings

Figure 16: Subjects’ utility of experience at tourist attractions

Utility graph/expression of travel distance

Figure 17: Subjects’ utility of experience at tourist attractions
• Scaling and normalization constants (k_i and K)

<table>
<thead>
<tr>
<th></th>
<th>Experience (Rating)</th>
<th>Total Cost</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value corresponding to Utility = 0</td>
<td>1</td>
<td>$2,200</td>
<td>1300 miles</td>
</tr>
<tr>
<td>Value corresponding to Utility = 1</td>
<td>5</td>
<td>$500</td>
<td>100 miles</td>
</tr>
<tr>
<td>k (tradeoff coefficient)</td>
<td>0.90</td>
<td>0.70</td>
<td>0.67</td>
</tr>
</tbody>
</table>

*Table 1: Tradeoff coefficients*

3.4 Assumptions and Estimations

Almost all of the data used in the analysis was taken from reasonable online sources and indices. The cost of travel is assumed from published indices and travel cost data is taken from average bus, train and air fares booked in advance. Other costs are taken from back-packers’ index [26] and 3-star travel indexes, for the purpose of the demonstration, assuming that the traveler in this case is in that category of travelers.

The utility functions and tradeoff coefficients were assumed for general audiences. There is scope for alternative methods to be incorporated in determining the utility functions and the validation can be done when there is access to non-anonymous subjects.

The ratings for each tourist attraction considered are estimated based on the subjects rating history. Any such method used to find patterns leaves room for inaccuracy, which is minimized as the amount of data keeps increasing over time. A heuristic method of using average multipliers for each category of tourist attraction is used in this demonstration.

In recommending the activities, to make the itinerary realistically feasible it was assumed that the subject would not want to visit more than 6 destinations in the same category, for the purpose of demonstration. This number may vary from person to person and may also be different for
different categories. Similarly, it was assumed that the itinerary would be a multicity trip with
the first destination not being the last destination of the trip. However, this need not necessarily
be the case, and the data for itineraries otherwise is also available.

3.5 Data Analysis

Based on the information available, the first objective was to select the cities to visit.

3.5.1 Plotting the subject’s rating history versus average rating of places in each category of
place, the user’s rating pattern was estimated for the respective type of attraction. Based
on this pattern, the rating that the subject would give to each of the attractions in the
search range (Top 30 attractions in the top 136 cities of the world) is estimated.

![Figure 18: Subject’s rating pattern in a particular category of attractions vs. average rating
given by other people to the same attractions](image)

- All the feasible combinations of cities based on the traveler’s specifications within the
given duration, region are listed.
- The composition of each combination is noted and the different utilities for distance
  travelled, cost of trip and composition of attractions is noted.
It was assumed that the ratings are consistent, which meant that a rating of 3 given for a national park was equivalent in utility to a rating of 3 given for a museum and so on.

The average rating of the places that the subject can visit within the combination of destinations was taken as the average attractions’ rating of the place (This is an approximation). The utility of the chosen places was calculated from the utility graph/ expression of ratings.

Based on the lottery questions the scaling constants $k_i$ (tradeoff coefficients) are determined.

$$k_i = U(\text{Best}_i, \text{Worst}, \text{Worst}) = p U(\text{Best}_i, \text{Best}, \text{Best}) + (1-p) U(\text{Least}_i, \text{Least}, \text{Least})$$

The total utility of the itinerary is calculated using the multiplicative formula.

$$U(x) = \frac{1}{K} \left[ \prod_{i=1}^{n} [Kk_i U_i(x_i)+1] - 1 \right]$$
K (normalization constant) = -0.99

### 3.6 Recommendation

<table>
<thead>
<tr>
<th>City combo</th>
<th>Experience (rating)</th>
<th>One way distance</th>
<th>Total cost</th>
<th>Total Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bratislava-Krakow-Vienna</td>
<td>4.5</td>
<td>330</td>
<td>$1,032</td>
<td>0.975</td>
</tr>
<tr>
<td>Bratislava-Munich-Vienna</td>
<td>4.6</td>
<td>332</td>
<td>$1,139</td>
<td>0.974</td>
</tr>
<tr>
<td>Bratislava-Prague-Vienna</td>
<td>4.4</td>
<td>253</td>
<td>$1,074</td>
<td>0.973</td>
</tr>
<tr>
<td>Bratislava-Salzburg-Vienna</td>
<td>4.5</td>
<td>241</td>
<td>$1,149</td>
<td>0.972</td>
</tr>
<tr>
<td>Bratislava-Munich-Salzburg</td>
<td>4.5</td>
<td>328</td>
<td>$1,137</td>
<td>0.971</td>
</tr>
<tr>
<td>Munich-Salzburg-Vienna</td>
<td>4.6</td>
<td>283</td>
<td>$1,226</td>
<td>0.971</td>
</tr>
<tr>
<td>Krakow-Vienna-Warsaw</td>
<td>4.5</td>
<td>469</td>
<td>$1,023</td>
<td>0.971</td>
</tr>
<tr>
<td>Bratislava-Munich-Prague</td>
<td>4.5</td>
<td>444</td>
<td>$1,064</td>
<td>0.970</td>
</tr>
<tr>
<td>Munich-Prague-Salzburg</td>
<td>4.5</td>
<td>323</td>
<td>$1,150</td>
<td>0.970</td>
</tr>
<tr>
<td>Bratislava-Vienna-Warsaw</td>
<td>4.5</td>
<td>466</td>
<td>$1,068</td>
<td>0.970</td>
</tr>
<tr>
<td>Bratislava-Krakow-Warsaw</td>
<td>4.3</td>
<td>464</td>
<td>$1,047</td>
<td>0.970</td>
</tr>
<tr>
<td>Munich-Prague-Vienna</td>
<td>4.6</td>
<td>446</td>
<td>$1,154</td>
<td>0.970</td>
</tr>
<tr>
<td>Berlin-Bratislava-Prague</td>
<td>4.3</td>
<td>422</td>
<td>$1,049</td>
<td>0.969</td>
</tr>
<tr>
<td>Krakow-Prague-Vienna</td>
<td>4.4</td>
<td>492</td>
<td>$1,047</td>
<td>0.959</td>
</tr>
<tr>
<td>Berlin-Prague-Vienna</td>
<td>4.5</td>
<td>424</td>
<td>$1,138</td>
<td>0.958</td>
</tr>
<tr>
<td>Berlin-Munich-Prague</td>
<td>4.5</td>
<td>458</td>
<td>$1,126</td>
<td>0.958</td>
</tr>
<tr>
<td>Berlin-Hamburg-Prague</td>
<td>4.4</td>
<td>396</td>
<td>$1,123</td>
<td>0.958</td>
</tr>
<tr>
<td>Berlin-Bratislava-Vienna</td>
<td>4.5</td>
<td>472</td>
<td>$1,141</td>
<td>0.958</td>
</tr>
<tr>
<td>Prague-Salzburg-Vienna</td>
<td>4.4</td>
<td>398</td>
<td>$1,164</td>
<td>0.957</td>
</tr>
<tr>
<td>Krakow-Salzburg-Vienna</td>
<td>4.5</td>
<td>478</td>
<td>$1,122</td>
<td>0.957</td>
</tr>
<tr>
<td>Krakow-Munich-Vienna</td>
<td>4.6</td>
<td>569</td>
<td>$1,111</td>
<td>0.957</td>
</tr>
<tr>
<td>Bratislava-Prague-Salzburg</td>
<td>4.3</td>
<td>436</td>
<td>$1,074</td>
<td>0.957</td>
</tr>
<tr>
<td>Berlin-Krakow-Warsaw</td>
<td>4.4</td>
<td>540</td>
<td>$1,013</td>
<td>0.956</td>
</tr>
<tr>
<td>Bratislava-Krakow-Salzburg</td>
<td>4.4</td>
<td>518</td>
<td>$1,032</td>
<td>0.956</td>
</tr>
</tbody>
</table>

*Table 4: Recommendations for destinations to the traveler*

### 3.6.1 Choosing the destinations

Based on the total utility values of various combinations, the top values are listed as recommendations along with the near top combinations which are distinct from the previously
listed ones. In each option, the average cost, distance travelled and the top 5 things to do from each category of attractions are also listed.

This marks the end of the first part of the recommendation. The subject/user may pick one or a few feasible and interesting combinations out of these.

3.6.2 Planning the specific attractions to visit and things to do

The second part of the objective is to recommend a list of things to do within those cities/destinations and how many days and nights should be spent at each destination.

This is done by arranging the things to do in a descending order and removing the attractions which are ranked within their category of attractions as over 5, 6 or a limit as set by the subject. Based on the time required to travel and to be spent at each attraction, the itinerary is cut off at the total time of trip as specified by the subject/user.

<table>
<thead>
<tr>
<th>City</th>
<th># of things do</th>
<th>Days to spend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bratislava</td>
<td>6.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Krakow</td>
<td>10.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Vienna</td>
<td>13.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Total</td>
<td>29.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Table 5: Recommendations for days to spend at each destination

3.7 Validation

Although it was not possible to contact the subjects whose data was used online, due to anonymity and privacy laws, a future step in the research would be to choose non-anonymous subjects for validating the results.
4. Comparative Advantages

4.1 Ad hoc versus rational decision making

For most travelers today, the traditional ways of choosing itineraries is ad hoc and random. The first shortcoming is that the decision is not based on extensive data or research. Decisions are made on the basis of whatever data is available and the data that is available may be insufficient as well as biased.

4.2 Biased versus rational decision making

If the itinerary is chosen from the recommendation of travel agents, it is based on the agents’ perspective, biased information and the suggestions are based on experiences of other people. This by its nature is usually not total customization or optimal use of information, but a strategy to classify people with similar interests together and offering them pre-packaged deals. The proposed tool goes a step further and critically analyzes the individual’s interests, and instead of grouping them with others, recommends personalized itineraries and in turn assuring more or even total customization.

If the inspiration of the itinerary is from listening to experiences family friends, the decision making still becomes biased since it is some other person’s experience, moreover the other person’s utility of the various factors like cost, perceived experience rating (which itself varies from person to person) and travel distance would be different for different people and would therefore lead to different results.
4.3 Overcoming indecisiveness from lack of information or information overload

Frost and Shows [27] noted that indecisive individuals take longer and report more difficulty when making decisions. Indecisive people need more information before making decisions [28] and judgements [29]. Indecisive individuals making decisions in cognitively demanding situations report more anxiety and less confidence in their choices than decisive individuals [30].

On the other hand, too much information which is also available on the internet or in books may lead to information overload which has been associated with various psychological problems like continuous partial attention [31], stress and attention deficit trait [32]. Using this tool would help users overcome both the issues of less or restricted information which avoids loss of opportunity as well as too much information which may lead to information overload since it gives the users an objective quantification and analysis of what they like and guides them to defining what they want.

4.4 Visual representation of rational decision making

The graphically represented and data-backed recommendations as well as utility functions and the estimated values let the users see, (modify if required) and think about the tradeoffs between cost, distance and quality and quantity of the attractions seen in a visual and objective way. It also gives an opportunity to filter out already visited places, unimportant locations as well as unwanted information easily which in turn leads to a structured approach. Figure 19 shows a prototype of what the user would be able to see and/ or edit (inputs).
4.5 Reassurance and the availability of quantifiable data for reasoning

The confirmation (and positive reinforcement) from the tool that the decision is rational may lead to satisfaction from the search. It would also give a solid basis for communicating and explaining to themselves as well as to others that the chosen itinerary is a good option. In other words, the user would have the numbers to back their decision.
5. Applications

As part of the Visa Global Travel Intentions Study [33] which was carried out in 25 countries, the market research company Millward Brown noted that the number of solo or individual travelers is increasing rapidly. As per the report, 24 percent of the people traveled alone on their most recent overseas leisure vacation in 2015 in contrast with 15 percent in 2013. The trend also shows that more first time travelers chose to travel solo. The number of first time travelers who traveled alone was 37 percent as compared to 16 percent in 2013.

This category of customers is an appropriate target audience to use a tool for planning holidays. It is easier and more accurate to define preferences and estimate utility for individuals rather than groups due to more availability of personalized data and the research that has been done in machine learning, clustering algorithms and recommendation systems.

The demonstration done in section 3 of this thesis was based on a user profile chosen appropriately from a website called tripadvisor.com which anonymizes its users by giving them an option to pick their usernames. A hypothetical trip was planned this user based on his/her preferences, rating data and a few assumptions as described in the methodology. It remains to be seen whether this individual would find the tool useful.
6. Future Case Studies

6.1 Online and offline Travel Agents

Since the travel industry is constantly changing, there is a push from the industry to innovate new methods to attract travelers. An itinerary builder tool may help them accurately assess their customers and provide customized offers based on rational inputs and analyses. Since the tool also considers cost as a variable, the agents can use it to create pricing strategies for their customers.

6.2 Destination Development organizations and tourism boards

If the concept of optimal traveling is structured and has a considerable impact on travel patterns, destination developers, tourism councils and boards could and would need to learn from the effects to facilitate the changes in creating experience for tourists which increase the utility of the trip, i.e., the quality of the travel experience can potentially be enhanced by designing the services and products offered. Similarly, the availability of such data can assist tourism related businesses to design and manage their products and services optimally.
7. Challenges

7.1 Consent to gathering data

One of the major challenges in executing this framework is to get consent from the users or customers to accessing their travel, booking, and rating information at all times. Debates in the United States regarding the National Security Agency as to tracking telephone calls and messages in the U.S. have prompted wariness amongst residents around an individual's security. Just in 2016, there was a lawsuit between Apple and F.B.I regarding privacy over accessing a terrorist private cell phone data. As most of the online interaction between travelers and the tool might be on the cell phones, privacy shall remain to be a concern. The author recognizes the importance of privacy of data and strongly supports legislation protecting personal information. Moreover, in most cases, the data collected is from public sources where the users themselves have rated attractions online. This simply reflects the quality of the places they’ve visited and how much they liked them in comparison with the rest of the world. Another aspect of it is that the data can be anonymized since the only individual data for a user is his/ her own and the decision to use the tool can be kept optional, in which case, the data of that individual can be used for a particular search which will be compared to the anonymized bulk data and then the search can then be deleted. This is possible since the algorithm is a small one and calculations by the computers are done extremely fast. It remains crucial that tool providers seek consent and inform the users.

7.2 Data processing and warehousing costs

Gathering large sets of data on a daily basis from millions of users will require data management techniques. Raw data, such as that of the utility functions or individual behavior can be
processed either at the user’s end or on the cloud, to reduce the number of data points to more a more actionable level. This would reduce the total data needed to be stored. The costs of analyzing and defining an accurate model for each product and the cost of data management must be considered.

7.3 Resistance to the new idea

The proposed method requires one to firstly disclose their personal behavior to the program or programmers and relies on a non-human entity or logic to provide recommendations. This idea of replacing people by computers and algorithms may find resistance in the present practitioners and lobbies of travel agents as well as individual reluctance to remove the human touch. Given the fact that a major chunk of people choose their destinations based on the recommendations of their friends, relatives or travel agents, it would be a tough sell to prove to them that an algorithm which is not biased by these factors is actually a better way of planning itineraries.
8. Future Research

Apart from the validation from non-anonymous subjects, these few areas of research are recommended for future work on the topic.

8.1 Using decision theory in group travels and group decision making approaches in travel planning

Most of leisure travel isn’t solo or individual travel and hence the tool may give different recommendations to different people traveling together.

Several logics of optimizing utility are used in group decision making as discussed in the literature review section of the thesis. Some of them might be applicable in this context and there is scope to consider group dynamic factors in this area of research.

8.2 Use of the tool in travel pricing and promotions

Since the methodology utilizes the utility of money in generating the recommendations, it is possible to utilize it in pricing strategies wherein the total utility is still above a threshold and a perceptibly good deal for the travelers.

8.3 Use of the available knowledge to re-package and develop tourist attractions or form strategic partnerships

There could be research on further analyzing traveling patterns and preferred combination of tourism attractions, tourism destinations or partnership between tourism organizations to create offers which will try to suit the traveler requirements and also improve the experiences they offer through a rational and utility-based approach.
8.4 Finding reasonable utility curves without asking questions directly

The model discussed in the thesis is a heuristic one rather than an accurate one. There shall probably never be an accurate input data of the sort which is used, especially in the lottery questions to find utility curves. However, the method used still needed to ask the travelers direct questions in order to ascertain utility curves and trade-off coefficients. There is scope for research to find ways to determine utility functions and trade-off coefficients through other past behaviors, especially trough studies of past actions and purchases in a preferential or quantitative manner.
9. Conclusion

This paper presented a method for using direct and indirect data gathered by different online and offline products, in the form of answers, previous history and ratings from tourists for the purpose of trip planning. The objective of is to aid rational and informed decision making in choosing the optimum/ near optimum itinerary based on heuristics and decision theory rather than rules of thumb, long search processes and consultation periods. The limitation of this paper is that the distributions of the user ratings data is not known, and is only assumed to be accurate or consistent. Moreover, not enough data is available for all users as of now, and we assume that as more data is generated, the more accurately we would be able to provide personalized itinerary recommendations. Future work includes the gathering of more relevant data, developing strategies to estimate the utility functions and scaling coefficients (constants) for individuals), validation of results in comparison with currently used methods and extending the research to group travel.

For tourism companies, this model can help them reduce costs, improve profitability, increase the quality of offerings and so on. For tourists, this will help them derive most value out of their time and for the tourism corporations, organizations and bureaus this would be an entry into the future of the personalized tourism industry and development of tourist attractions. There are a few conceivable challenges in implementing such a system. The first being privacy protection which makes it critical to have the customer’s consent for gathering data and protecting this data as well as deciding what level of privacy is to be in place for a sustainable, accurate and non-intrusive use of technology. This can also be an opportunity for third party companies to use this data and create a hub for stakeholders of the tourism industry to study it
and utilize in designing and managing tourism products. The other challenges are to do with the
cost and profitability of offering a tool as well as resistance of the current stakeholders to change.
As we move to an even more connected world with the exponential growth of relevant and
irrelevant data and the number of connected products and services in an individual’s life keeps
increasing, this tool can enable fit right into the system making travel experiences more efficient
and meaningful.
References

[1] UNWTO Annual Report 2015. [cited on June 22\textsuperscript{nd} 2016]

[2] Michelle Toh, How personalized travel is reshaping the tourism industry, October 8\textsuperscript{th} 2015 [cited on June 22\textsuperscript{nd} 2016], The Christian Science Monitor,

[3] Travel planning methods of Millennials in the U.S. as of July 2015 [cited on June 22\textsuperscript{nd} 2016]

[4] The 2014 Traveler’s Road to Decision [cited on June 22\textsuperscript{nd} 2016]


[6] Cambridge Dictionaries Online [cited on June 22\textsuperscript{nd} 2016]
    http://dictionary.cambridge.org/dictionary/english/itinerary
    https://en.wikipedia.org/wiki/Tourist_attraction

[8] Travelclick, Online Travel Agencies (OTA) [cited on June 24th 2016]
    http://www.travelclick.com/industry-insights/glossary/O

[9] Optimize Your Path To Purchase Understanding The Opportunity Of Ancillary Products In
    Digital Channels, Forrester Consulting, Commissioned By Fusion, November 2014
    https://gallery.mailchimp.com/7670c9a1b4da8ccc8b7f7a982/files/Optimize_Your_Path_To
    _Purchase__November_2014.pdf

    Bridges the Gap Between Tourist Knowledge and Satisfaction, Volume 20, Number 5,
    pp. 475-485(11)

    Traveler [cited on 22 June, 2016]
    https://skift.com/2014/06/19/3-must-know-trends-to-understand-the-millennial-traveler

[12] Hanlan, J, Fuller, D & Wilde, SJ (2005), Destination decision making and consumer
    demands: identifying critical factors, Center for Enterprise Development and Research
    Occasional paper, no. 2


[20] Hsien-Tsung Chang et al., Yi-Ming Chang, and Meng-Tze Tsai’s, 2016, ATIPS: Automatic Travel Itinerary Planning System for Domestic Areas, Computational Intelligence and Neuroscience, Volume 2016, Article ID 1281379


https://aboutourism.wordpress.com/2011/10/03/top-factors-influencing-destination-choice/


[33] Milward Brown (Co.), 2015, Visa Global Travel Intentions Study [cited on 22 June, 2016]
http://www.inboundreport.com/2015/10/14/the-visa-global-travel-intentions-study-answers-the-question-are-travelers-spending-more-or-less