



Employing a recommendation expert system based on mental accounting and artificial neural networks into mining business intelligence for study abroad's P/S recommendations

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ABSTRACT

Successfully designing and positioning product/service will lead most enterprises to have the chance to keep the competitive advantages, and consumers also will have clear and strong preferences for product/service (P/S) during competitive environment. At Taiwan, study abroad service which being provided by travel agencies can be viewed as a new market during the recent years. Most travel agencies intend to develop the novel techniques and mine the useful business intelligence (BI) for improving their quality of P/S or adjusting their strategies of marketing. In this article, a recommendation expert system (ES) based on mental accounting and artificial neural networks (ANNs) is proposed to address the issue of BI mining. The travel agencies can obtain BI relating to consumers' decision-making, consumers' responses for different mental accounting and the recommended features for P/S by inputting referenced information into such recommendation ES. Finally, we also take an illustrative example owing to a local travel agency at Taiwan to demonstrate the feasibility and rationality of the proposed architecture.

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1. Introduction

The managerial significance of behavioral decision theory, [Simonson \(1993\)](#) concludes as "In some situations, consumers do have clear and strong preferences for particular product or service characteristics. In such cases, none of the (behavioral science) manipulations are expected to affect purchase decisions. However, most enterprises can increase their sales significantly by supplementing the voice of the customer with a better understanding of the various "irrational" influences on purchase decisions and translating that knowledge into specific sales, positioning, pricing, and communications tactics." If the enterprise can successfully design and position their product/service (P/S), consumers will have clear and strong preferences for their P/S during the competitive environment, then the enterprise can have the chance to win most of the battle.

Reviewing the relating tourism studies, many scholars studying the effect of previous trip experience on choice behavior have found that past trip experience may impact an individual's choice decision-making ([Kando & Summers, 1971](#); [Mazursky, 1989](#); [Schreyer, Lime, & Williams, 1984](#)). [Schreyer et al. \(1984\)](#) developed the Experience Use History (EUH) theory that suggests previous participation in recreational activities may be utilized as an

indicator of the amounts and types of information a person can draw on to make decisions with regards to leisure behavior. They further asserted that EUH may serve as an indicator of motivations for visiting. [Beaulieu and Schreyer \(1984\)](#) expressed the significance of users' experience on choice behavior more directly. They stated that one of the most important factors affecting choice behavior should be the amount and type of experience a person has with an activity. The transnational sightseeing traveling is day by day vigorous arises along with globalization development or tourism trend. In order to improve the quality of life, the majority people will travel regard as the free time or achieve one of the life style leisure goals. The traveling expectations may be affected with respect to the different personnel characteristics, environment and economy.

College students at Taiwan had recognized the trend and the chance for the issue of globalization development, many students choose "study abroad" to enhance their globalization perspectives. Restated, study abroad had gradually led to a new market in Taiwan during the recent years. At the same time, many travel agencies had focused on providing such new service. According to the comments from [Shaw and Williams \(1994\)](#), to have the income, the idle time and a person which may control freely to the traveling expectations can be regarded as three primary factors for individual traveling. As we known, the conceptual and emotion of each personnel may denote the different effects on the different considerations even though addressing the traveling behaviors. [Thaler \(1985\)](#) pointed out when people face different source of

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income, income disbursement and account calculation frequency, in their heart will be able to establish the different mental accounting and then will have the policy-making behavior and the responses. In other words; the consumer establishes two sources of income the mental account is “which gains laboriously” and “unexpected fortune” respectively. As we known, how to hold the useful business intelligence (BI) via the customers’ transaction records or customers’ behavior is an important issue and it can be achieved by using the relating data mining techniques (Hsieh, 2007). Hence, the travel agencies at Taiwan will seek for suitable techniques to resolve the problem. From above discussion, how to analyze the decision-making with the consideration of mental accounting for the study abroad in advance and adjust the corresponding strategies to achieve the competitive advantages will be an important issue to be studied for those traveling agencies.

2. Literature review

2.1. Concept of mental accounting and decision-making behavior

The easiest way to define mental accounting is to compare it with the conventionally financial and managerial accounting as practiced by organizations. Accounting can be viewed as a system of recording and summarizing business and financial transactions in books, and analyzing, verifying, and reporting the results. Of course, individuals and households also need to record, summarize, analyze, and report the results of transactions and other financial events. They do so for reasons similar to those which motivate organizations to use managerial accounting: to keep trace of where their money is going, and to keep spending under control. Mental accounting is a description of the ways they do these things (Thaler, 1985, 1990). Three components of mental accounting receive the most attention. The first component captures how outcomes are perceived and experienced, and how decisions are made and subsequently evaluated. The accounting system provides the inputs to do both *ex ante* and *ex post* cost-benefit analyses. This component is illustrated by the anecdote above involving the purchase of the quilt. A second component of mental accounting involves the assignment of activities to specific accounts. Both the sources and uses of funds are labeled in real as well as in mental accounting systems. Expenditures are grouped into categories (housing, food, etc.) and spending is sometimes constrained by implicit or explicit budgets. Funds to spend are also labeled, both as flows (regular income versus windfalls) and as stocks (cash on hand, home equity, pension wealth, etc.). The third component of mental accounting concerns the frequency with which accounts are evaluated and what Read and Rabin (1998) had labeled ‘choice bracketing’. Accounts can be balanced daily, weekly, yearly, and so on, and can be defined narrowly or broadly. A wellknown song implores poker players to ‘never count your money while you’re sitting at the table’. An analysis of dynamic mental accounting shows why this is excellent advice, in poker as well as in other situations involving decision making under uncertainty (Thaler, 1990).

The primary reason for studying mental accounting is to enhance our understanding of the psychology of choice or decision-making behaviors. In general, understanding mental accounting processes helps us understand choice because mental accounting rules are not neutral.

2.2. BPNN in AI

A neural network can model the non-linear relationship between the system’s input and system’s output, and it had been employed into many applications (Barletta, Gisario, & Guarino, 2007; Chen, Lee, Deng, & Liu, 2007; Hsieh, 2009, 2010; Sanjay,

Neema, & Chin, 2005). The ability of neural networks to discover nonlinear relationships in input data makes them ideal for modeling nonlinear dynamic systems such as the stock market. Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A neural network method can enhance an investor’s forecasting ability. Neural networks are also gaining popularity in forecasting market variables. A trained neural network can be thought of as an expert in the category of information it has been given to analyze. This expert can then be used to provide projections given new situations of interest and answer “what if” questions. Traditionally forecasting research and practice had been dominated by statistical methods but results were insufficient in prediction accuracy. Khan, Bandopadhyaya, and Sharma (2008) used the back propagation neural networks with different number of hidden layers to analyze the prediction of the buy/sell. Neural networks using back propagation algorithms having one hidden layer give more accurate results in comparison to two, three, four and five layers. Basically, a BPNN consists of three or more layers, including an input layer, one or more hidden layers, and an output layer. The backpropagation learning algorithm employs a gradient- or steepest-heuristic (Rumelhart, Hinton, & Williams, 1986) that enables a network to self organize in such ways that improve its performance over time. This forward pass through the BPNN begins as the input layer receiving the input data pattern and passes it to the hidden layer. Each PE calculates an activation function in first summing the weighted inputs. This sum is then used by an activation function in each node to determine the activity level of the processing node. In training this type of network, an input pattern is presented and the network adjusts the set of weights in all the connecting links such that the desired output is obtained at the output node. The output generated by the network is compared to the known target value. If there is no difference, no learning takes place. If a difference exists, the resulting error term is propagated back through the network, using a gradient- or steepest-descent heuristic to minimize the error term by adjusting the connection weights. In training this type of network, an input pattern is presented and the network adjusts the set of weights in all the connecting links such that the desired output is obtained at the output node. On accomplishing the adjustment, the next pair of input and output target value is presented and the network learns that association. The overall training process for the network using the gradient descent technique can be referred to the relating literatures (NeuralWare, 1990; Rumelhart et al., 1986).

3. Proposed recommendation expert system

The conceptual diagram for the proposed recommendation expert system will be graphically depicted in Fig. 1. As for the architecture of the BPNN models in recommendation ES, the conceptual diagrams are also given in Figs. 2–4. For traveling agencies which providing study abroad service, they can use this web-based platform to collect the necessary information including the motivations, option (here, we define it as the sources of fee), type (here, we define it as the way of study abroad), responses of mental accounting via on-line questionnaires or from the historical records. Then, three BPNN models can be constructed well. And, the traveling agencies can re-modeled them according to the real requirements after receive the new data records.

In Fig. 1, the purpose of BPNN-A is to model the correlation among those motivations and responses of mental accounting, and the purpose of BPNN-B is to model the correlation among motivations, option, type, the responses of mental accounting and the decision-making of study abroad, and the purpose of

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