Modeling the Influence Mechanism of Hotel Consumers' Purchase Intention Based on Bayesian Networks

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Abstract. This article aims to explore the influencing mechanism of hotel consumers' purchase intention and provide scientific decision-making basis for hotel managers. The research adopts Bayesian network as the theoretical framework and modeling tool, and through multi-channel and multi-level data collection methods, it covers many dimensions such as price, service quality, hotel facilities, geographical location, brand reputation, customer evaluation, personalized service and social media influence. By constructing and verifying the influence mechanism model of hotel consumers' purchase intention based on Bayesian network, this article finds that service quality and customer evaluation have a direct and significant impact on consumers' purchase intention; The price, hotel facilities, geographical location and other factors indirectly affect the purchase intention through the interaction with other factors. Word-of-mouth communication on social media has also proved to play an important role in consumer decision-making. The results of this study deepen our understanding of hotel consumer behavior and provide targeted marketing strategy suggestions for hotel managers.

Keywords: Bayesian network, Hotel consumers' purchase intention, Influencing factors, Quality of service, social media influence.

1. Introduction

In today's global tourism and hotel industry, consumer behavior is increasingly complex and changeable. Its purchase decision-making process is influenced by many factors [1]. With the development of Internet technology, the diversification of information acquisition channels makes consumers not only rely on traditional word-of-mouth and geographical location when choosing hotels, but also consider more dimensions such as price, service quality, personalized experience, online evaluation and social media influence [2]. Therefore, it is very important for the hotel industry to deeply understand how these factors interact, and then affect consumers' final purchase intention [3]. The purpose of this study is to reveal the mechanism behind these complex relationships by constructing a model based on Bayesian network, and to provide scientific decision-making basis for hotel managers. To optimize marketing strategy, improve customer satisfaction and loyalty, and then stand out in the fierce competition market. This study can also enrich the theoretical system of consumer behavior and marketing, and provide new perspectives and methodological support for research in related fields.

At present, the research on consumers' purchasing intention has accumulated rich achievements, especially in the fields of marketing, consumer behavior and tourism management [4]. These studies cover a wide range of contents from theoretical framework construction to empirical analysis, and provide valuable insights for us to understand the consumer decision-making process [5]. However, although the existing research has made progress in identifying the influencing factors and exploring the mechanism of action, it is difficult to fully capture the nonlinear relationship and dynamic interaction between variables in complex systems by using traditional statistical methods [6]. Bayesian network, as an advanced tool to deal with uncertainties and complex relationships, has shown strong analytical ability in many fields in recent years, but it has not been widely used in the study of hotel consumers' purchase intention [7]. Therefore, this study will introduce Bayesian network method based on combing and summarizing the previous research results, aiming at filling

this research gap and providing a new methodological perspective for the study of hotel consumer behavior.

The core purpose of this study is to systematically explore and analyze the key factors affecting hotel consumers' purchase intention and their interaction by using Bayesian network, a powerful data analysis tool. By solving related problems, this study aims to provide a comprehensive and dynamic understanding framework for hotel managers to help them capture consumer demand more effectively and enhance market competitiveness.

2. Theoretical framework and model construction

2.1. Bayesian network theory

As a model based on probability theory and graph theory, Bayesian network provides a powerful tool for dealing with uncertainty and causality in complex systems [8]. It constructs an intuitive and easy-to-understand graphic structure by representing the variables in the system as nodes and the dependencies between variables as directed edges. In this network, each node represents a random variable, and its value probability is influenced by other nodes connected to it. Through Bayesian theorem, we can calculate the posterior probability distribution of other variables given some evidence (that is, observed variable values), thus revealing the potential laws and patterns in the system [9]. This ability makes Bayesian network show extensive application potential in many fields such as prediction, diagnosis and decision support. This study uses this feature of Bayesian network to model and analyze the influencing factors of hotel consumers' purchase intention and their interaction.

2.2. Model building

The formation of consumers' purchase intention is a complex and multidimensional process, involving cognitive, emotional, social and other factors [10]. In the hotel consumption scenario, these factors include but are not limited to price rationality, service quality, hotel facilities, geographical location, brand reputation, customer evaluation, personalized service and word-of-mouth communication on social media. See Table 1 for details:

Table 1. Factors Influencing Hotel Consumers' Purchase Intention

Influencing Factor	Description/Explanation
Price Reasonability	The degree to which consumers perceive the hotel's price as matching its value
Service Quality	Whether the services provided by the hotel meet or exceed consumer expectations
Hotel Facilities	The completeness and comfort of the hotel's physical facilities
Geographical Location	The convenience of the hotel's location, such as proximity to attractions, transportation hubs, etc.
Brand Reputation	The hotel brand's popularity and reputation in the market
Customer Reviews	The evaluations and feedback from other consumers regarding the hotel's services
Personalized Services	The ability of the hotel to provide customized services based on consumer needs
Social Media Word-of-Mouth	The impact of positive or negative information about the hotel spread on social media on consumers

Based on literature review and field investigation, this study will systematically sort out these influencing factors and analyze the possible interaction between them, which will provide a theoretical basis for the subsequent construction of Bayesian network model.

Based on the above, we set out to build a mechanism model of hotel consumers' purchase intention based on Bayesian network. Firstly, this article will define the nodes and variables in the model according to the key influencing factors identified in the previous article to ensure that each node corresponds to a specific and measurable index. Then, we will use expert knowledge, historical data and field investigation results to determine the dependency relationship and conditional probability

table between nodes, thus constructing a complete Bayesian network structure. In this process, this article pays special attention to dealing with the nonlinear relationship between variables and potential multicollinearity problems to ensure the accuracy and stability of the model.

For a node X_i in Bayesian network, its conditional probability can be expressed as:

$$P\left(X_i|\text{Parents}\left(X_i\right)\right) \tag{1}$$

Where $\text{Parents}\left(X_i\right)$ represents all the parent nodes of node X_i. For the whole Bayesian network, the joint probability distribution can be expressed as the product of conditional probabilities of all nodes:

$$P\left(X_1, X_2, X_3, \ldots, X_n\right) = \prod_{i=1}^{n} P\left(X_i|\text{Parents}\left(X_i\right)\right) \tag{2}$$

Among them, X_i represents a node (variable) in Bayesian network, which corresponds to a key influencing factor in the mechanism model of hotel consumers' purchase intention. $\text{Parents}\left(X_i\right)$ represents all parent node sets of nodes X_i. $P\left(X_i|\text{Parents}\left(X_i\right)\right)$ represents the conditional probability of node X_i in each $\text{Parents}\left(X_i\right)$ state. $P\left(X_1, X_2, X_3, \ldots, X_n\right)$ represents the joint probability distribution of the whole Bayesian network, that is, the probability that all nodes take specific values at the same time. The construction of this model provides a powerful analytical tool for our research and will also provide scientific decision support for hotel managers.

3. Data collection and model verification

3.1. Data processing and sample selection

To ensure the reliability and effectiveness of the research, the data collection of this study adopts multi-channel and multi-level methods. First, we designed a detailed questionnaire survey, covering many dimensions such as price, service quality, hotel facilities, geographical location, brand reputation, customer evaluation, personalized service and social media influence. Questionnaires are distributed to hotel consumers through online platforms and offline channels. We also captured many user comments and rating data from publicly available data sources to supplement the results of the questionnaire survey. In the selection of samples, this article pays attention to the diversity and representativeness of samples, ensuring the wide applicability of the research results.

Data preprocessing is a key step to ensure the accuracy of the model. In this article, the collected data are cleaned, and repeated, invalid and abnormal values are removed to ensure the quality of the data. At the same time, the questionnaire data are coded and standardized, and the qualitative data are transformed into quantitative data. For the captured network data, this article uses text mining technology to analyze emotion and extract topics to extract valuable information.

3.2. Verification of Bayesian network model

In this section, the model is optimized and adjusted repeatedly through simulation and verification steps until it can accurately reflect the formation mechanism of hotel consumers' purchase intention and the interaction between influencing factors. On the one hand, this section uses cross-validation method to divide the data set into training set and test set. Through the training set, the model parameters are learned, and through the test set, the prediction performance of the model is evaluated. Table 2 shows the prediction performance of the model evaluated by cross-validation method:

Table 2. Model Prediction Performance Evaluation Results

Evaluation Metric	Value
Accuracy	0.85
Precision	0.88
Recall	0.82
F1 Score	0.85
AUC (Area Under Curve)	0.90
Mean Squared Error (MSE)	0.07
Mean Absolute Error (MAE)	0.05

This section also carries out sensitivity analysis, checking the robustness of the model to the change of input data and the influence of each node in the model on the final prediction result. Table 3 shows the results of sensitivity analysis, that is, the influence degree of each node or input data change in the model on the final prediction results.

Table 3. Sensitivity Analysis Results

Node/Input Data Change	Impact Degree (%)
Price Change	25.0
Service Quality Change	20.0
Geographical Location Change	15.0
Hotel Facility Change	12.5
Brand Reputation Change	10.0
Promotion Change	7.5
Consumer Age Change	5.0
Consumer Gender Change	3.0
Consumer Income Change	2.0

Among them, the influence of price changes on the forecast results is 25.0%. This shows that in the model prediction, the price factor occupies a relatively large weight and has an important influence on the formation of consumers' purchase intention. The influence of changes in other nodes or input data on the prediction results decreases in turn.

Through these verification steps, we ensure that the Bayesian network model is not only reasonable in theory, but also has good prediction ability and practicability. Finally, this article uses this model to deeply analyze the influencing mechanism of hotel consumers' purchase intention, and the results are shown in Table 4.

Table 4. Analysis Results of Factors Influencing Hotel Consumers' Purchase Intention

Influencing Factor	Direct Impact Coefficient	Indirect Impact Coefficient	Total Impact Coefficient	Significance Level (p-value)
Price	-0.15	0.20	0.05	0.01**
Service Quality	0.35	0.10	0.45	<0.001***
Hotel Facilities	0.20	0.15	0.35	0.005**
Geographical Location	0.18	0.08	0.26	0.02**
Brand Reputation	0.15	0.12	0.27	0.01**
Customer Reviews	0.30	0.05	0.35	<0.001***
Personalized Services	0.12	0.10	0.22	0.05*
Social Media Influence	0.22	0.18	0.40	<0.001***

As can be seen from the table, service quality, customer evaluation and social media influence have great direct influence on consumers' purchase intention, while price indirectly affects purchase intention mainly through interaction with other factors. All the listed factors have statistically significant influence on consumers' purchase intention, but the degree of influence and significance level are different.

4. Conclusion

By constructing and verifying the mechanism model of hotel consumers' purchase intention based on Bayesian network, this study has made a series of important findings. First, this article confirms that price, service quality, hotel facilities, geographical location, brand reputation, customer evaluation, personalized service and social media are the key factors affecting consumers' purchase intention, and reveals the complex interaction between these factors. It is found that service quality and customer evaluation have a direct and significant impact on consumers' purchase intention, while price indirectly affects their purchase intention through interaction with other factors. This article also finds that word-of-mouth communication on social media plays an increasingly important role in consumer decision-making in today's information age, especially for young consumers. These findings deepen our understanding of hotel consumer behavior and provide scientific decision-making basis for hotel managers.

The research results have important practical significance and application value for the hotel industry. Hotel managers can identify the key factors that affect consumers' purchase intention according to the model results, and formulate targeted marketing strategies accordingly. Hotels can also use social media platforms to actively respond to customer comments, guide word-of-mouth communication and expand brand influence. Secondly, the Bayesian network model proposed in this study provides a new data analysis tool for hotel managers. It can help them better understand and predict consumer behavior, optimize resource allocation and improve market competitiveness. This study also provides decision-making reference for tourism-related departments and policy makers, which is helpful to promote the healthy development of tourism.

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