

Marketing Stratification and Path Research based on User Behavior Scenarios and Cluster Analysis in the Background of Big Data

Zhen Yu ^{1, 2, *}, Zhenni Wu ^{1, 2}

¹ China Automotive Technology and Research Center Co., Ltd. Tianjin, China

² China Auto Information Technology (Tianjin) Co., Ltd. Tianjin, China

* Corresponding author: Zhen Yu (Email: yuzhen@catarc.ac.cn)

Abstract: With the rapid development of Internet and digital technology, user behavior trajectory has become an important basis for enterprises to analyze market dynamics, optimize products and formulate precise marketing strategies. The purpose of this paper is to discuss the analysis method of automobile user behavior trajectory and its application in marketing path. Through the in-depth analysis of user behavior data, enterprises can understand the consumer psychology, purchasing habits and preferences of users, so as to formulate personalized marketing strategies, improve marketing effects and reduce costs. This paper first outlines the concept and importance of the car user behavior track, and then elaborates the whole process of data processing, density-based cluster analysis and the application of the car user portrait, and displays the specific application effect of the user behavior track in the marketing path combined with the simulation data.

Keywords: User Behavior Trajectory; Marketing Path; Density Clustering; User Profiling.

1. Introduction

With the increasingly fierce market competition, automobile enterprises pay more and more attention to the application of precision marketing in the promotion of automobile products. Relying on deep data mining and personalized strategies, precision marketing can accurately identify target customer groups, thus significantly improving marketing efficiency and reducing resource waste. At the same time, by meeting the individual needs of consumers, precision marketing optimizes the customer experience and enhances brand loyalty. In addition, while reducing marketing costs, precision marketing helps enterprises quickly capture market dynamics, flexibly adjust marketing strategies, and improve market response speed. Based on customer feedback and market insight, precision marketing can also promote product innovation and iteration, optimize customer relationship management, and extend customer life cycle value. The synergistic effect of these advantages not only enhances the market competitiveness of automobile brands, but also promotes the healthy and sustainable development of the automobile market, injecting new growth momentum into the industry.

At present, many scholars have carried out in-depth research on the implementation path of precision marketing from different fields. For example, based on the perspective of 4R theory, the literature [1] discusses the optimization path of marketing strategy of pure electric vehicles in view of their inherent advantages in energy saving, emission reduction and cost control. The research shows that if pure electric vehicle enterprises want to achieve the ideal marketing effect, they need to continuously improve the marketing level and quality from the aspects of new technology research and development, personalized brand strategy, whole industry chain collaboration and partnership user relationship construction. The literature [2] focuses on the content optimization strategy of e-commerce platform in the era of digital marketing, in-

depth analysis of the positive role of digital marketing models such as precision marketing, real-time monitoring and strategy adjustment, brand image enhancement and customer service experience optimization on e-commerce platforms. The research further points out that technological innovation and data-driven decision-making mechanism are the key factors to improve the efficiency of content optimization. These studies provide important theoretical support and practical guidance for the practice of precision marketing in different fields. Although many scholars have studied a variety of precision marketing paths based on the product itself, many scholars still need to pay attention to the path of automotive precision marketing based on the user behavior scenario from the perspective of big data.

With the rapid development of intelligent connected vehicles, enterprises are paying more and more attention to formulate precision marketing strategies through user behavior data analysis to improve market competitiveness. As an important source of data reflecting users' consumption psychology, purchasing habits and preferences, user behavior trajectory constitutes multi-source heterogeneous big data and has become an important basis for enterprises' marketing decisions. Through the in-depth analysis of user behavior trajectory, enterprises can understand the user's browsing, searching, clicking, purchasing and other behavioral data in different platforms or applications, so as to formulate personalized marketing strategies, improve marketing effects and reduce costs.

To sum up, this paper proposes a method of "Marketing path research based on user behavior scenarios and cluster analysis under the background of big data". This method will systematically discuss the concept definition of user behavior trajectory, data acquisition and preprocessing, construction of cluster analysis model and its application in marketing path optimization, etc., aiming to deeply explore the characteristics of user behavior through the data-driven analysis framework of user behavior trajectory, and provide theoretical basis and

practical guidance for the formulation of automotive precision marketing strategy.

2. Research Methods

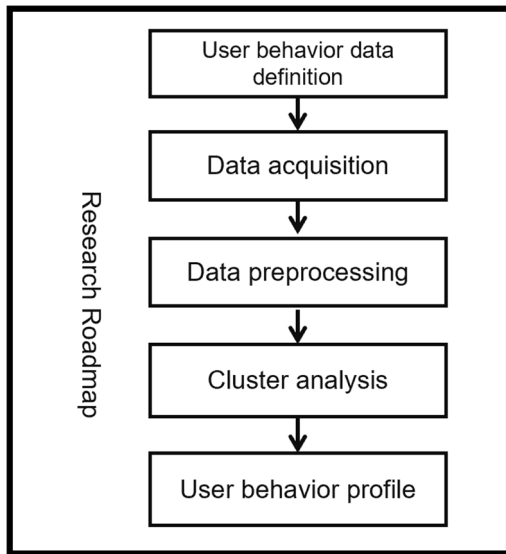


Figure 1. Research roadmap of this paper

The research route of this paper is composed of five parts: defining user behavior data, data acquisition and preprocessing, cluster analysis and user behavior profile. Among them, defining user behavior data mainly describes the composition of user behavior track and the importance of user behavior track. Data acquisition includes simulation data

and data based on website analysis. Data preprocessing includes missing value, outlier value, data classification and labeling, data integration and other details processing. Cluster analysis adopts density-based clustering which has obvious advantages. The final user behavior profile stone is based on the results of density clustering to describe the user behavior portrait of the car user, which is convenient for the automobile enterprise to better implement the precision marketing of the product. The research roadmap of this paper is shown in Figure 1.

2.1. Overview and Composition of User Behavior Trajectory

Car user behavior trajectory consists of two parts. The first refers to a series of behavioral data of users on a specific platform or during driving, such as browsing, searching, clicking, purchasing, etc. The second is the user's daily driving track, driving mode and other behaviors. These data reflect the user's behavior habits, interest points and consumer psychology, which is an important basis for enterprises to carry out market analysis, product optimization and precision marketing [3].

(1) Composition of user behavior trajectory

Car user behavior trajectory is usually composed of key data such as access source, visit duration, visit frequency, click path, conversion rate, etc. These data can help enterprises understand where users come from, where they are going, as well as their behavior habits and consumer psychology. The components and explanations of user behavior tracks are shown in Table 1 below.

Table 1. Composition fields of user behavior trajectory

fields	Data interpretation
Access to sources	Reflect the user's access to the platform or app, such as search engines, social media, advertising, etc.
Duration of visit	Reflects the amount of attention and time spent on the platform or app
Frequency of visits	Reflects how dependent and active users are on the platform or app
Click Path	Reflect the user's browsing habits and interest points in the platform or app
Running track	Refers to the driving trajectory, can calculate the user's car purchase purpose
Driving mode	This field can calculate the user's driving habits and ways

(2) The importance of user behavior trajectory

Automobile user behavior trajectory analysis provides multi-dimensional decision support for enterprises, which is mainly reflected in the following three aspects:

1) In terms of automobile user demand insight, through the in-depth mining of automobile user behavior trajectory data, enterprises can build a complete user portrait, accurately grasp the psychological characteristics, behavior patterns and preferences of consumers, which helps enterprises develop differentiated marketing strategies and achieve accurate reach.

2) At the level of automobile product optimization, the data of automobile user behavior trajectory can reveal the bottleneck of user experience in the process of product use. Through thermal map analysis and transformation funnel model, enterprises can identify interface design defects, functional use obstacles and other key issues, to provide data support for product iteration. The user behavior-oriented product optimization method has significantly improved the market adaptability of products and user satisfaction.

3) In the formulation of automobile marketing strategy,

user segmentation based on behavior trajectory enables enterprises to effectively identify high-value user groups and potential converted users. By building a predictive model, enterprises can realize the accurate allocation of marketing resources, improve the marketing conversion rate, and optimize the marketing input-output ratio.

2.2. Data Acquisition

Data acquisition includes two ways, the first is to generate simulation data with random numbers, the second is to use the website or application data analysis tools such as Google Analytics, Baidu statistics, etc., to collect user registration forms, service request forms, trade orders and other background data. By embedding points in APP, applets, H5 and other front-end pages, recording users' browsing, clicking and other embedding points record behavior data. Through the feedback information of sales, customer service, after-sales and other business personnel, collect the user's purchase intention, use feedback and other business personnel feedback data.

2.3. Data Preprocessing

Data preprocessing includes missing value processing, outlier processing, data classification and labeling, and data integration. Missing values may be caused by machine and equipment failure or human problems. The mean filling method is used to solve this problem. Outliers may be caused by human input errors, using the 3σ principle processing method, you can delete the outliers as missing values to deal with, and then use the method of dealing with missing values. Data classification and labeling: Through the user portrait technology, the user behavior data is classified and labeled, such as age, gender, occupation, interest, etc., for subsequent analysis. Data integration: Data from different sources and in different formats are integrated to form a unified data set, which is convenient for subsequent analysis.

2.4. Cluster Analysis

Density-based clustering method is an important clustering algorithm. Its core idea is to cluster by analyzing the local density of data points. Compared with other clustering methods, density-based clustering methods have many advantages, such as the ability to find arbitrary shapes of clusters, strong robustness to noise and outliers, no need to specify the number of clusters in advance, and the ability to deal with data with uneven density. These advantages make them particularly effective in dealing with complex data sets [4-5]. The steps of density-based clustering are as follows:

Assume that the input sample set $D = (x_1, x_2, \dots, x_m)$, neighborhood parameters $(\varepsilon, MinPts)$, sample distance measurement, the output result is cluster partition C .

(1) Initialize the core object set $\Omega = \emptyset$, initialize the cluster number $k=0$, and initialize the unvisited sample set $\Gamma = D$ cluster partition $C = \emptyset$.

(2) For $j=1, 2, \dots, m$, follow the steps below to find all the

core objects:

a) by the distance metric, find the sample x_j ε -neighborhood subsample set $N_\varepsilon(x_j)$;

b) If the number of subsample sets is sufficient $|N_\varepsilon(x_j)| \geq MinPts$, add the samples x_j to the core object sample set $\Omega = \Omega \cup \{x_j\}$;

(3) If the core object set $\Omega = \emptyset$, the algorithm ends; otherwise, go to step 4;

(4) In the core object set Ω , randomly select a core object o , initialize the current cluster core object queue $\Omega_{cur} = \{o\}$, initialize the category sequence number $k=k+1$, initialize the current cluster sample set $C_k = \{o\}$, and update the unvisited sample set $\Gamma = \Gamma - \{o\}$.

(5) If the current cluster core object queue $\Omega_{cur} = \emptyset$, then the current cluster C_k is completed, update the cluster division $C = \{C_1, C_2, \dots, C_k\}$, update the core object set $\Omega = \Omega - C_k$, and go to step (3).

(6) Take out a core object o' in the current cluster core object queue Ω_{cur} , find out all the ε -neighborhood subsample sets $N_\varepsilon(o')$ through the neighborhood distance threshold ε , and $\Delta = N_\varepsilon(o') \cap \Gamma$ update the current cluster sample set $C_k = C_k \cup \Delta$, update the unvisited sample set $\Gamma = \Gamma - \Delta$, and update $\Omega_{cur} = \Omega_{cur} \cup (N_\varepsilon(o') \cap \Omega)$ [6].

2.5. User Behavior Profile

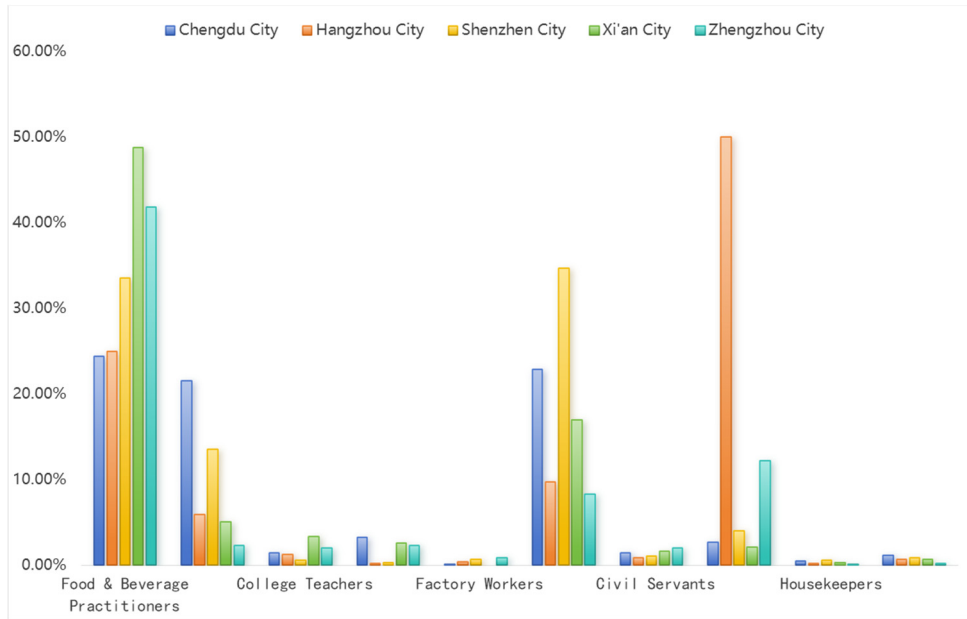


Figure 2. shows the analysis result of user behavior portrait

User portrait is based on the analysis results after the clustering of the data of the user's behavior trajectory. Through the collection of the user's attribute data, behavior data, transaction data, etc., the complete image of the user is built. User portrait can help enterprises deeply understand the

consumer psychology, purchasing habits and preferences of users, and provide strong support for the formulation of precision marketing strategies.

According to the frequency of car travel and daily residence area of the owner, AOI and information can be

deeply combined, and the scope of activity and travel habits of the owner can be accurately depicted. At the same time, by making full use of the user's daily operation behavior data when using the car machine and mobile APP, more detailed and in-depth analysis and statistics can be carried out, aiming at obtaining and verifying the real identity information data distribution of the user. This kind of analysis is not only limited to the user's geographical location and activity pattern, but also can go deep into the user's consumption habits, social circles, interests and preferences and other levels, comprehensive analysis to obtain analysis and statistics of the user's real identity information data distribution, so as to build

a more three-dimensional and comprehensive user portrait. The analysis results of user behavior portrait are shown in Figure 2.

According to the behavior data of the car owner, the long-term residence area of the user is analyzed, and the housing price data of the community is obtained. At the same time, the consumption power of the user is judged according to the daily travel consumption area and the daily APP usage data. The economic level of the user is comprehensively analyzed, and the section in which the user is located is judged. The economic level analysis of car users is shown in Figure 3 below.

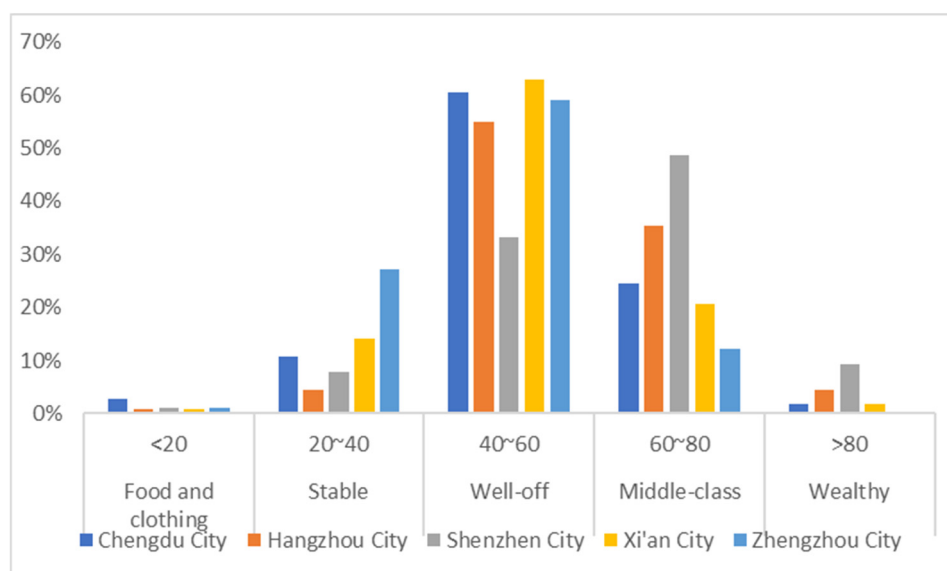


Figure 3. economic level analysis diagram of car users

2.6. Application of User Behavior Trajectory in Marketing Path

(1) Personalized recommendation: By analyzing user behavior trajectory, enterprises can understand users' interest points and purchasing habits, so as to formulate personalized recommendation strategies. For example, e-commerce platforms can recommend related products to users according to their browsing history and purchase records; Social media platforms can recommend relevant content and friends to users based on their interests and social behavior.

(2) Precision marketing: By analyzing user behavior trajectories, enterprises can identify high-value users and potential users and formulate targeted marketing strategies. For example, for high-value users, enterprises can provide exclusive offers, customized services, etc.; For potential users, enterprises can guide the transformation through advertising, push and other ways.

(3) Optimize product design: By analyzing user behavior trajectories, enterprises can find existing problems in products, such as unreasonable page layout and imperfect functions, and then optimize and improve them. For example, through path analysis and heat map analysis, enterprises can find the difficulties and bottlenecks encountered by users when using products, and then optimize and adjust the page layout and functions.

(4) Improve the user experience: By analyzing the user behavior trajectory, enterprises can understand the user's behavior and needs in different links, and then provide personalized services and experience. For example, through conversion rate analysis and path analysis, enterprises can

find the obstacles and dissatisfaction points encountered by users when using products, and then carry out targeted optimization and improvement to improve user experience and satisfaction.

3. Analysis and Outlook

3.1. Analysis

Through the in-depth analysis of the car user behavior trajectory, this paper discusses its application and effect in the marketing path. The research finds that by analyzing the behavior track of automobile users, automobile enterprises can deeply understand the consumer psychology, purchasing habits and preferences of users, so as to formulate personalized marketing strategies; At the same time, automobile enterprises can also find the problems and optimization space of automobile products, and then carry out targeted optimization and improvement. Finally, through vehicle user behavior trajectory analysis, enterprises can improve marketing effect, reduce costs and enhance market competitiveness.

3.2. Future Outlook

In the future, with the continuous development of big data and artificial intelligence technology, vehicle user behavior trajectory analysis will be more intelligent and automated. Enterprises can use advanced algorithms and models to conduct in-depth mining and predictive analysis of automobile user behavior data, and further accurately grasp user needs and market dynamics.

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