

Consumer Preferences Research of Smartphone Online Shopping based on Online Views

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Abstract

With the booming of the era of Big Data, the whole world and most of industries are gradually realizing the great value hidden in Big Data. The E-commerce industry has a unique user behavior data resource because of its high dependence on Internet information technology. Taking online reviews as an example, many companies are beginning to pay attention to the real feelings left by users after experiencing products or services, so as to develop effective product strategies. This paper focuses on the online shopping behavior of smart phones, designs and distributes an online questionnaire to explore the relationship between consumers' online consumption preferences and online commentary tendencies. This paper also collects the online views of six smart phones of H brand in Jingdong Mall, extracts high-frequency words and concludes feature factors of effective views. In order to identify the individualized demand of consumers for smart phones, this paper also research on the importance of different characteristic factors by Discrete choice models.

Keywords

Online Views; E-commerce; Consumer Preferences; Smartphone; Discrete Choice Model.

1. Introduction

Big Data is proposed by McKinsey Research Institute in the report Big Data: the next frontier of innovation, competition and productivity. From the technical level of data mining and information analysis, Big Data means the technical ability to collect and analyze larger scale, higher speed and more diversified data. E-commerce carries out business activities based on information network technology and commodity exchange, and has extremely large and rich Big Data resources. Among them, online comment is the original content independently edited by consumers who have purchased goods online according to their own experience of goods or services. It can be understood as the Internet form of traditional word-of-mouth, which truly and directly reflects consumers' satisfaction with purchased goods. Transforming unstructured online comment information with significant individual differences into analyzable data, identifying user characteristics, extracting user consumption preferences, establishing user portraits, and providing users with goods more in line with their real needs quickly and accurately is the only way for the development of the platform, which make many B2C platforms attach great importance to its development[1].

2. Relevant Research

2.1. Online Reviews

Chatterjee [2] first introduced the concept of "online reviews" when he studied whether consumers' purchase decisions involved reviews of purchased goods, and later, with the development of web technology, more and more scholars began to pay attention to this concept. Bickart[3] argues that the sources of online reviews may include product websites, personal homepages, and merchandising websites. Stephen[4] considers online reviews as a web-

mediated exchange of information between consumers about a good or service . Both Cui[5] and Park[6] have suggested that online commentary is a new form of traditional word-of-mouth on the Internet. The current online review systems commonly found on E-commerce platforms cover three forms: intuitive star-rated quantitative ratings, text-based ratings that include photos, videos, and the user's own experience and additional reviews after completing the product experience, and interactive ratings in which potential customers randomly ask questions to customers who have already purchased. The content of the reviews often includes product features, quality, appearance and other attributes, as well as price, logistics, customer service and other merchant service ratings.

Online feedback helps customers to understand product information and provides an important reference when making purchase decisions. Researches about how online reviews impact product sales are steadily increasing. For example, Liu[7] analyzed Yahoo movies review data and found that the number of online reviews promoted box office. Luan and Neslin[8] showed that the number of online reviews is positively related to the acceptance of new games in new product research. These studies highlight the impact of online review volume on product sales[9] and services[10]. The commonly used research variables include online reviews, the length of the review, and the percentage of negative reviews, among others[11, 12].

In summary, most of the current research on users' online reviews focuses on the characteristic factors and influence mechanisms of reviews, and further research is still needed on the consumer preferences projected by the review content and the consumer psychology reflected by the reviews. The section headings are in boldface capital and lowercase letters. Second level headings are typed as part of the succeeding paragraph (like the subsection heading of this paragraph). All manuscripts must be in English, also the table and figure texts, otherwise we cannot publish your paper. Please keep a second copy of your manuscript in your office. When receiving the paper, we assume that the corresponding authors grant us the copyright to use the paper for the book or journal in question. When receiving the paper, we assume that the corresponding authors grant us the copyright to use the paper for the book or journal in question. When receiving the paper, we assume that the corresponding authors grant us the copyright to use.

2.2. Consumer Preferences

Consumption preference refers to the personalized preference of consumers' preferences for different products and services. the development of research on users' consumption preference so far mainly includes three types of research approaches. The early research on customer consumption preference originated from the market segmentation theory in marketing, and the research tends to take a qualitative analysis approach. Hoffman and Novak argued that users would compare product information with their own evaluation criteria when shopping for goods. Some scholars also adopt questionnaire method and in-depth interview method to conduct survey and statistical research. Pahnla et al.[13] analyzed the influence of online shopping habits and motivations on consumer behavior with the help of online questionnaires. After the concept of "Big Data" was proposed, more and more scholars began to use data mining technology to collect data related to users' consumption preferences and conduct modeling analysis to conduct research. Currently, the mining of user consumption preference data on E-commerce platforms is divided into the mining of explicit data such as user registration information and ratings of purchased products, and the mining of implicit data such as time spent on web pages, frequency of web page visits, and search and filtering operations of products. Prasad et al.[14] use K-means and expectation-maximization two clustering methods to analyze E-commerce user registration data and historical consumption data and establish customer segmentation model.

In summary, research on user consumption preferences has slowly shifted from qualitative to quantitative analysis, and the use of Big Data to analyze consumer behavior and preferences and to predict and recommend their future shopping intentions is increasingly important in E-commerce-related research today.

3. Research Method

In this paper, a discrete choice analysis model is chosen to model and analyze the characteristic factors and their ratings extracted from product evaluation information, to explore the correlation between each factor and customers' consumption preferences, and to rank the importance of each factor to provide reference for merchants to create products and services that better meet consumers' needs.

The Fishbein Model, also known as the multi-attribute model, was proposed by the American scholar Fishbein in 1963. He believed that consumer behavior is influenced by both consumer self-perception and herd mentality, i.e., actors tend to combine their own attitudes toward goods and the attitudes of others toward goods to make decisions before their behavior occurs. Fishbein established a formula for the quantitative description of this model, as shown in Equation (1).

$$A_0 = \sum_{i=1}^n b_i e_i \quad (1)$$

Where,

A_0 - the overall attitude of consumers towards the product;

b_i - the consumer's attitude towards the i th attribute of the product;

e_i - consumer's evaluation of the i th attribute of this product;

n - the number of attributes of this product

4. Research Process and Results

In order to identify online consumers' demand and preference for smartphones, two methods are used to study consumers' online shopping behavior preferences. The first is a questionnaire survey method, taking smartphones as an example, to study the factors respondents pay attention to in online smartphone shopping, the importance they attach to online reviews, and the content tendency of writing online reviews, and to explore the correlation between each respondent's online smartphone shopping preference and online review tendency by the correlation between each respondent's online smartphone preference and online review tendency was investigated by the degree of overlap between the two. The second is the model analysis method, based on the Fishbein consumer behavior model, which attributes consumers' evaluation of products to the sum of their utility of various aspects of product characteristics, and collects some online reviews of smartphones on B2C E-commerce platforms to obtain users' real evaluation of various attributes of smartphone products. The descriptive words that appear frequently in the review samples are summarized and analyzed by introducing a discrete choice model, and the final result is the degree of attention to cell phone features when consumers purchase smartphones online, as reflected by the content of online reviews.

4.1. Questionnaire Investigation

4.1.1. Research Process

The content design of the questionnaire is divided into three parts: basic information survey, basic online shopping behavior survey, and online reviews and online shopping behavior correlation survey. Among them, the first part is a survey of respondents' basic personal information, and the survey results are compared with the statistical report of the survey on

the characteristics of China's online shopping consumer group released by the authority to observe the difference between them, and if the difference between them exceeds a certain range, the questionnaire will continue to be distributed to expand the survey sample and reduce the error level. The second part is to ask the respondents about their daily online shopping, respectively, the average monthly online shopping frequency of online shoppers and the average monthly consumption expenditure level on online shopping, and to invalidate the questionnaires with too low online shopping frequency and too low online shopping expenditure. The third part is a survey on the preference of online smartphone shopping and the situation related to online reviews. Simulating the online shopping process, consumers were first asked about their attitudes toward online smartphone shopping, and then rated the brand, price, phone performance, and design of smartphones in a hypothetical online smartphone shopping scenario in the form of matrix scale questions to explore consumers' preferences for online smartphone shopping. The questionnaire also investigated online shoppers' attention to online reviews, the degree of influence of online reviews on purchase decisions, and the usefulness of different types of online reviews. Finally, to investigate the relationship between online shopping users' consumption preferences and the tendency to write online reviews, a virtual situation was set up for respondents who had already purchased a smartphone online and evaluated it online after experiencing it. In terms of the tendency to evaluate the content, the same indicators of brand, price, phone performance, and appearance design were given, and five items were selected.

4.1.2. Results

The survey questionnaire was open from March 10, 2021 to March 25, 2021, and the distribution channel was online questionnaire. Excluding 67 invalid questionnaires, and finally 420 valid questionnaires were obtained.

The result shows that users are more evenly concerned about various aspects of the phone. Among the 11 factors, the highest average score is storage space, followed by after-sales service, battery life, price, phone performance, charging speed, operating system, design, camera function, and screen size. According to the questionnaire investigation, nearly 90% of consumers pay attention to online reviews of products before purchasing a smartphone, of which 40% said they frequently browse online reviews. For the different types of reviews featured in B2C E-commerce platforms, the most concerned consumers include picture video reviews, additional reviews, and poor reviews, followed by long text effective reviews, latest reviews, and reviews from high-ranking users. Consumers were asked about their tendency to review smartphone products under the assumption that they had already purchased a smartphone, and the results showed that consumers were more likely to evaluate the phone's performance, price, brand, design, battery life, and charging speed.

In order to investigate the relationship between the content of online reviews written by consumers and their own consumer preferences for the product, this questionnaire set up two questions to compare the similarity between consumers' attention to various factors when purchasing smartphones online and the factors consumers tend to mention when writing online reviews. Taking each respondent as the research object, their ratings on the factors of smartphone aspects were ranked in descending order according to the results of consumer preference, and X_{ij} was recorded as 1 when the i respondent's rating on the j factor ranked less than 6 among all factor ratings, otherwise it was recorded as 0. Then, according to the results of online reviews preference, the five preferred review contents selected by that filler were recorded, and if the factor is selected, then Y_{ij} (the 0-1 variable of whether the i respondent selects the j factor) is recorded as 1, otherwise it is recorded as 0. As shown in equation below, the overlap degree A_i is calculated.

$$A_i = \frac{\sum_{j=1}^{420} X_{ij} Y_{ij}}{5}, i=1,2,\dots,420, j=1,2,\dots,11 \tag{2}$$

The average value of A_i was calculated to be 0.96, which indicates that for the same product, consumers' tendency to review it online overlaps with their consumption preference for that product. It turns out that to some extent when reviewing a purchased product online, the content of the review can reflect the reviewer's consumption preference for that product, and the two are correlated.

4.2. Discrete Choice Models

4.2.1. Research Process

Table 1. Examples of online comment data

Product Name	Star Rating	Cnontent	Create Time	...
M**0	5	First, the screen is good, very clear, also has the eye protection function, but there is a gap with a star phone; second, the photo is very high, very far away license plate can see; third, the phone has too many various settings. Overall, it's still good!	2021-03-01 16:38	...
...
M**X	5	Very fast delivery, good service, original and genuine, beautiful and generous, the phone is very fast, large screen, no lag, long standby time, especially like, five stars!	2021-01-27 22:55	...
...
P3**	4	The screen looks very comfortable, the camera takes good pictures, the speed of electricity is okay, the screen fingerprint unlock is not very good.	2021-04-13 18:51	...
...
P2**	5	The phone performs well, face recognition is fast, good pixels! The response is also relatively fast, the original factory also paste the film, phone case these, details determine success, support it!	2021-02-28 10:33	...
...
N**3	4	Pretty good and runs fast.	2021-03-09 17:34	...
...
N**4	5	The screen is large, feel good, great camera experience, always use H, very good!	2021-04-03 11:59	...
...

Data collection

This experiment will collect online reviews of a total of six smartphone products under the H brand toward the high-end, terminal, and low-end markets on the Jingdong platform. In view of the characteristics of the review system and the specific situation of the review content in Jingdong Mall, the content and format of the collected reviews are determined, and the data crawling task is established by using the web data collection tool. The collected review information covers multiple dimensions, including the rating star, the review content, the time

of publishing the review, the purchase model, the content of the follow-up review, and so on. The collection starts from April 30, 2021 and goes forward.

A total of 8813 raw data of online reviews were finally collected, and the results were exported to an excel database and organized as shown in [Table 1](#).

Data processing

1) Online comment information pre-processing

Online reviews of products on E-commerce platforms have low threshold nature, individual variability, false evaluations, and swiping. To avoid the influence of such evaluations on the research results, the collected online review information needs to be pre-processed to delete invalid evaluations. It mainly includes in duplicate reviews, system default positive reviews, reviews with missing information, and garbled codes. After data pre-processing, a total of 1895 invalid reviews were deleted, and the results of the collected online review information after processing are shown in [Table 2](#).

Table 2. Online Reviews Quantity

Phone	Original quantity	Invalid reviews quantity	Valid reviews quantity
M**0	969	152	817
M**X	769	139	630
P2**	1313	242	1071
P3**	1242	212	1030
N**3	1829	568	1261
N**4	2691	582	2109
Total	8813	1895	6918

2) High-frequency word extractions

First, we need to remove the descriptive words of degree, such as "very", "very", "somewhat", etc., and keep the part that describes the characteristics of the product. Because of the differences in individual reviews, each user's wording and expressions are different, so when conducting the frequency statistics of high-frequency words, we need to include words with similar meanings to the high-frequency words in the database for searching, and then finally do the aggregation process. Finally, a total of 74 keywords were identified, and the frequency of keywords in the evaluation of different cell phone products is shown in [Table 3](#).

Table 3. Six Smartphone Product Review Keyword Frequency

Keywords	M**0	M**X	P3**	P2**	N**3	N**4	total
Domestics	39	22	26	39	25	40	191
Huawei	332	175	250	311	349	453	1870
Price	21	14	43	31	38	75	222
brand	15	4	8	21	28	30	106
trust	16	7	17	17	24	37	118
Price	24	13	30	27	76	90	260
Preferential	3	4	4	17	12	12	52
value	112	54	96	125	178	255	820
expensive	14	4	6	12	14	15	65
cheap	8	6	20	18	27	34	113
performance	28	9	15	38	66	65	221
...
delivery	11	0	10	5	12	11	49

According to the keyword frequency statistics, "H*", "photo", "smooth", "beautiful", "value", "good" and "good" appeared more frequently, followed by "running", "running" and "good". "The frequency of "value" and "good" is high, 1870, 1116, 861, 853, 820 and 814 respectively. "logistics", "screen", "feel", "good-looking", "function". Functionality". This indicates that users pay more attention to cell phone brand, camera function, cell phone performance, appearance design, and cell phone price when they make online reviews after purchasing smartphones online.

Characteristic factor induction and scoring

As shown in [Table 4](#). Smartphone products can be divided into brand, price, system, hardware, software and functions, appearance and body, service seven categories, each category also contains a number of sub-categories, basically covers the six smartphone reviews extracted keywords.

Table 4. Smartphone Features

Level 1 classification	Secondary classification	Three-level classification	Four-level classification	
brand	Brand loyalty	Domestics		
		Huawei		
	Brand impact	spokesman		
		Publicity and promotion		
Brand honor				
Price	Price			
	Offer			
system	Fluency			
	UI convenience			
	Response speed			
hardware	Core hardware	Run memory		
		Storage space		
		processor		
	screen	Material		
		resolution		
		Screen occupant ratio		
		size		
		resolution		
		Touch		
		battery	Battery capacity	
	Charging speed			
	Duration			
	The battery is hot			
	Battery life			

	Camera	Rear camera	quantity	
			pixel	
		Front camera	quantity	
			pixel	
	fittings	earphone		
		Charging cable		
Protective shell				
		Protective film		
		...		
Software and features	The basic function	communication		
		Internet		
		Bluetooth		
		GPS positioning		
	Entertainment features	audio and video playback		
		Video		
		Game		
		Mobile app		
			...	
	Additional features	Biometrics	Fingerprint identification	
			Face recognition	
			Double card double stay	
appearance and fuselage	color			
	size			
	weight			
	Material	feel		
		Anti-fall		
		scratches		
		discoloration		
appearance				
serve	Pre-sales consultation			
	Logistics delivery	Delivery speed		
		wrap		
	After-sales service			
	Value-added services	Gifts		
insurance				

The characteristic factors of H-phone online reviews can be summarized into six aspects, which are brand, price, performance, function, screen, battery, camera, appearance, and service. Each factor contains a series of keywords, and the frequency of the keywords they contain is summed up and counted. Due to the different popularity of different models of smartphones in the market, different sales volume, different number of product reviews, different number of collected reviews, etc., it is also necessary to conduct comparable caliber processing of the feature factors. The relative frequency of keyword occurrences. By calculation, the feature factor scores of the six cell phone products are shown in [Table 5](#).

Table 5. The Frequency of Keywords of Each Characteristic Factor

	M**0	M**X	P3**	P2**	N**3	N**4
Brand	0.49	0.33	0.28	0.38	0.34	0.27
Price	0.24	0.16	0.19	0.23	0.28	0.23
Performance	0.75	0.43	0.43	0.64	0.69	0.62
Function	0.34	0.14	0.25	0.28	0.23	0.16
Screen	0.22	0.33	0.06	0.11	0.14	0.12
Battery	0.29	0.14	0.07	0.17	0.14	0.08
Services	0.42	0.43	0.5	0.46	0.42	0.54

Model building

The model adopted in this paper is the discrete choice analysis model, also known as the choice-based conjunction analysis model, which is a complex advanced multivariate statistical analysis technique dealing with discrete, nonlinear qualitative data. The model is based on random utility theory, which proposes that a decision maker choosing between n available options will associate the utility U_j that the jth option brings to him with the probability of choosing the jth option. In this paper, the following hypothesis is established: the decision maker needs to choose one of the six cell phone models of brand H. Six characteristic factors are introduced as six attributes of cell phone products, and the relative frequencies of brand, price, performance, features, screen, battery, and service appearing in the online review text content are set as $x_1, x_2, x_3, x_4, x_5,$ and x_6 , respectively, and the relative importance of the above six characteristic factors in the decision maker's mind is set as $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5,$ and β_6 according to the application of random utility theory in the discrete choice analysis model, the utility brought by product j to the decision maker is calculated as shown in Equation (3) and Equation (4).

$$U_j = V_j + \epsilon_j \tag{3}$$

$$V_j = \sum_{i=1}^6 x_i \beta_i \tag{4}$$

V_j is a deterministic score based on the attribute rank of the optional option, and ϵ_j is a random unobservable error term. According to the multinomial logit model, the formula for calculating the probability of the decision maker to choose option j is shown in Equation (5).

$$\text{Prob}(Choosing j) = \frac{e^{V_j}}{\sum_{i=1}^n e^{V_i}} \tag{5}$$

The multinomial logit model provides a reasonable method for converting consumers' ratings of each product into a reasonable assessment of probabilities. After knowing the probability of the decision maker choosing option j, a maximum likelihood evaluation technique is needed to obtain the possible values of the unknown parameters (i.e., the relative importance of the characteristic factors) after the decision maker has made a choice among the n options. The maximum likelihood evaluation method adopted in this paper is shown in Equation (6).

$$\ln(p_1 p_2 \dots p_n) = \ln p_1 + \ln p_2 + \dots + \ln p_n \tag{6}$$

Considering the result of the sample of decision makers for n options, assume that y_j is the number of decision makers in the sample who choose option j. Then Equation (7) can be used to represent the likelihood of observed choices.

$$\ln(p_1^{y_1} p_2^{y_2} \dots p_n^{y_n}) = y_1 \ln p_1 + y_2 \ln p_2 + \dots + y_n \ln p_n \tag{7}$$

In summary, the main idea of the modeling analysis in this paper is: V_j is obtained by scoring six characteristic factors for each cell phone product j. The utility value U_j obtained by the decision maker when choosing product j is calculated by V_j. The probability of the decision maker choosing product j is calculated by referring to the multinomial winning logit model, and the actual number of choices of each product by the sample of decision makers is introduced, and the maximum value of likelihood is found by applying the maximum likelihood technique. The parameters that are closest to the actual choices of the decision maker sample are derived.

4.2.2. Results

The feature factor scores extracted from the online reviews were analyzed by a discrete choice analysis model. The specific steps are as follows.

In the first step, the parameter table of the six feature factors is set as shown in Table 5.5. The larger the parameter value, the higher the relative importance of the feature factor. To ensure the existence of a unique solution, the trial value of any of the independent variables is set to 0. Here, the initial value of the attribute "brand" is set to 0, and the initial values of the other attributes are all 1. In the second step, a discrete choice analysis model is developed as shown in Table 6. Where, score is the utility U_j of each product for the decision maker, prob is the probability of the decision maker choosing the product, number choosing is the number of people choosing the product, and likelihood is the likelihood. The likelihood is solved nonlinearly using the Excel add-in tool, Planning Solver, with the planning objective of likelihood maximization.

Table 6. Multinomial Logit Model

products	score	exp(score)	prob	number choosing	ln(prob)
M**0	2.26	9.58	0.25	817	-1.38358
M**X	1.63	5.10	0.13	630	-2.01358
P3**	1.5	4.48	0.12	1071	-2.14358
P2**	1.89	6.62	0.17	1030	-1.75358
N**3	1.9	6.69	0.17	1261	-1.74358
N**4	1.75	5.75	0.15	2109	-1.89358
				Likelihood	-10.9315

The final planning results are shown in Table 7. Among the six product attributes involved in the analysis, service has the highest relative importance, followed by price, function,

performance, screen, and battery, and the brand of the phone is not sensitive to consumers, which may be due to the fact that all the characteristic factors in this model analysis are from the same brand.

Table 7. Results of Planning Solution

property	brand	price	performance	function	screen	battery	service
value	-4.31326	3.657529	1.898729	2.09018	1.729602	-0.81963	5.499115

5. Conclusion and Discussion

This paper combs the related theory and research literature of online reviews and consumer preferences and designs a web-based questionnaire to study the relationship between consumer's tendency to write online reviews and online shopping behavior preferences. The results show that for the same commodity, consumer's online reviews tend to coincide with their consumer preferences for this kind of commodity. When reviewing purchased goods online, the content of the review can reflect the reviewer's consumer preferences to some extent, which provides a basis for studying reviewers' consumer preferences through online reviews. This paper also collects online comments of six smartphones under H Brand of Jingdong Platform. The unstructured information such as online comments is transformed into structured information by high frequency word extraction, feature factor induction and feature factor scoring. Finally, the results of the scattered selection model show that for consumers, the related services provided by mobile phone brand providers are the most important, followed by price, function, performance, screen, battery and brand. The high-frequency term extraction and modeling analysis of online reviews can identify the different needs of users and the degree of attention to different attributes of products, and develop effective product iteration for enterprises.

This paper is based on the online review system of B2C E-commerce platform, through the analysis of large unstructured data such as online review, to analyze the consumer behavior and preferences of smartphones' online purchase behavior. However, since all the mobile phones selected in this study are of the same brand, this element of brand could not be included in the influencing factors of consumers' purchase decisions. In addition, subsequent studies can incorporate both the polarity and timeliness of comments into the model.

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