Research Article

The role of online consumer reviews in shaping the sales of traditional Chinese costumes

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Abstract

Online consumer reviews is often considered to be one of the most important factors in e-commerce marketing as it is closely related to the online sales of the products. Although a few examples of analyzing the impact of online consumer reviews consumer reviews on the online sales have been reported so far, the specific attributes of online consumer reviews were barely considered in the traditional Chinese costumes domain. Therefore, this study applied the data of online consumer reviews and online sales of Chinese costumes products from Tmall as samples, using multiple linear regression model and random forest model to analyze the impact and predict effect of online consumer reviews attributes as description score, logistics score, service score, price, the number of reviews, the number of pictures in reviews, the number of Q&A and the number of follow-up reviews, on the online sales. The results indicate that the price, the number of reviews and the number of pictures in reviews post a significant impact and well predict effect on the online sales. Then, suggestions of management measures to increase online sales for e-commerce merchants were presented accordingly, so as to promote the economic performance and cultural inheritance of Chinese costumes.

Keywords: online consumer reviews, Chinese traditional costumes, online sales, random forest model, multiple linear regression model

Introduction

Online consumer reviews refers to the text or multimedia comment information that consumers share with other netizens about products or services on the internet.[1,2] In recent years, the development of internet interaction technology facilitates the construction of online marketing platforms for various products and services along with a large number of users and comprehensive feedback information, which further increases the online consumption by drawing consumers to rely on online consumer reviews to make purchase decisions. In the face this emerging marketing environment, the ability to extract and process big data derived from online marketing platforms grasping the inclination of online consumer reviews have become the key to product online sales.[3]

In the current literature, to the best of our knowledge, there are no measurement-related works regarding the online consumer reviews of traditional Chinses costumes, so as the relationship between online sales. However, quite a few studies have focused on the communication characteristics of online consumer reviews:

1) Conduct research on the generation of online consumer reviews, clarify the rise, construction forms and internal driving factors of online consumer reviews.[1,4]

2) Conduct research on the dissemination and acceptance of online consumer reviews, sort out the impact of the dissemination ways of online consumer reviews on consumers and the corresponding psychological response to determine the model of online consumer reviews information dissemination finding that online consumer reviews will form a spiral upward circular opinion flow in continuous iteration.[5–8]

In addition, measurements in other domains have been conducted; in particular, the online consumer reviews is commonly related to online sales. For instance, Elvira et al. proposed a map of online consumer reviews factors that affect consumers' purchase intention, mainly including the quantity, quality, validity, usefulness, credibility,

etc. of online consumer reviews attributes;[9] Zeng believed that the attributes of online consumer reviews , persuasive effect contribute a lot to consumer purchase intention;[10] Gong pointed out the inherent impact of relative differences in online consumer reviews on forest product sales, and came up with strategies to overcome the endogeneity between online consumer reviews and forest product sales.[11] From the above literature review, it can be seen that more and more scholars are realizing the importance of understanding and mastering online consumer reviews and have conducted in-depth exploration of its communication characteristics in various stages. Online consumer reviews has increasingly played an important role in the sales process of products and services, and post great impact on consumers' purchasing intentions and product sales.

Traditional Chinese costumes are impressive products that witnessed the evolution and development of Chinese history, and important carriers of culture in different eras that record people's lifestyles, aesthetic tastes and psychological states in different periods through their external characteristics such as color, style and shape. With the continuous promotion and development of traditional culture in recent years, traditional Chinese costumes tend to attract the attention of many consumers, and the traditional cultural connotations, elements and aesthetics contained have become high-quality IP in the market, promoting the product online consumer reviews and sales.[3] Previous research has focused on the internal culture and recreate design of traditional Chinese costumes, nevertheless, there is currently a lack of attention to both the online consumer reviews data and online sales data of traditional Chinese costumes, which have significant potential research value in improving the online sales volume of these products. Therefore, this study aims to explore the impact of online consumer reviews on the online sales of traditional Chinese costumes to propose suggestions for relevant e-commerce merchants. Firstly, this study applied web crawler software to obtain online sales data of traditional Chinese costumes. Then, the stepwise multiple regression method was carried out to explore the relationship between various attributes of online consumer reviews and online sales, and the optimal model

was obtained. In addition, by constructing a random forest model, this study further comprehensively explored the importance of various online consumer reviews attributes and their predictive effect on the online sales. Finally, management suggestions have been given to increase sales to relevant e-commerce merchants.

Hypothesis

This study is based on the theory of online consumer reviews communication and consumer purchase decision theory, combined with existing market research on online consumer reviews communication media, and divides online consumer reviews into three major types: the number of online consumer reviews, the direction of online consumer reviews and the interest of online consumer reviews.[12–14] In addition, according to the theory of price regulation, price plays a certain moderating role in the impact of online consumer reviews on consumer behavior decision-making.[15] Therefore, this article also includes price in the preliminary consideration scope and proposes the following assumptions.

The number of online consumer reviews refers to the size of a product's consumer reviews online, which directly affects consumers' purchasing intention and thus affects online sales.[12] The number of online consumer reviews for products usually involves two types of data: the number of reviews and the number of follow-up reviews, and previous studies have shown that the attributes of the online consumer reviews have significant correlation with product sales. Therefore, it is necessary to consider the impact of the two on online sales. Based on the herd effect, consumers tend to refer to the decisions made by the majority to make their own purchasing decisions. Therefore, the more data of online consumer reviews there is, the more likely consumers are to make purchase and increase online sales.[12] In addition, online consumer reviews has the function of information role, and the more times a product have been reviewed, the greater its popularity, thereby promoting the exposure of the product and affecting sales.[12] Besides, due to the fact that follow-up reviews are supplementary evaluation of products by consumers after a period of complete experience of using them, which make them usually rather authentic to affect consumers' purchasing intention and sales.[16] In addition, relevant research has already found a significant correlation between the number of reviews and the number of follow-up reviews on product sales.[17] Therefore, it is assumed that:

H1: The number of reviews of traditional Chinese costumes is positively correlated with their online sales.

H2: The number of follow-up reviews for traditional Chinese costumes is positively correlated with their online sales.

The direction of online consumer reviews refers to the attitude of consumers towards a product, indicating their satisfaction with the product and providing reference for potential consumers, thereby affecting their purchase intention and sales.[12] The direction of online consumer reviews is usually expressed in the form of product ratings, which not only conveys consumers' attitudes about the product, but also reflects the reputation of merchants. Previous studies have shown that description scores, logistics scores and service scores all contribute to product sales.[3,18,19] Besides, for consumers, product ratings directly affect their impression on the product, which in turn affects purchasing decisions and product sales. Therefore, it is assumed that:

H3: The description score of traditional Chinese costumes is positively correlated with their online sales.

H4: The logistics score of traditional Chinese costumes is positively correlated with their online sales.

H5: The service score of traditional Chinese costumes is positively correlated with their online sales.

The interest of online consumer reviews refers to the pleasure experienced by online consumer reviews recipients when browsing product feedback information.[20] Interesting online consumer reviews enhances the positive emotions and attitudes of consumers and affects their purchasing intention, ultimately the sales. For instance, the pictures in the reviews play a similar information dissemination function as print advertisements, allowing consumers to have a more intuitive feeling and understanding of the product, which in turn affects their purchasing decisions and product sales.[21] Besides, the Q&A between potential consumers and past consumers can increase the fun of the purchasing process through interaction, and the Q&A content can affect other potential consumers' attitudes and purchase intentions towards the product, thereby affecting sales. Moreover, relevant research has confirmed that the number of pictures in the reviews and Q&A have positive effect on online sales.[22] Therefore, it is assumed that:

H6: The number of pictures in the reviews of traditional Chinese costumes is positively correlated with their online sales.

H7: The number of Q&A on traditional Chinese costumes is positively correlated with their online sales.

Price refers to the hanging tag price of products sold by online stores, which has a dual impact on consumers.[23] On the one hand, low prices are considered to be important motivation for consumption, on the other hand, prices are also considered a reflection of product quality, and high-priced products are considered to have better quality that can promote consumers' desire to consume. However, both too low and too high prices carry certain consumption risks to reduce consumers' willingness of purchase. When risk is higher, consumers are more likely to rely on information obtained from online consumer reviews to assist decision-making, so price has a certain moderating effect on consumer reviews effects.[15] Besides, relevant research has validated the impact of prices on the sales.[15,24] Therefore, it is assumed that:

H8: The price of traditional Chinese costumes is positively correlated with their online sales.

Methods

Data collection and organization

Previous studies have shown that products or services with higher reputation have a larger target customer base. Based on relevant theories of communication and acceptance motivation, reputation is positively correlated with the growth rate of online consumer reviews.[25] Therefore, apparel and accessories with higher reputation technically have an advantage in terms of the number of online consumer reviews. In order to select representative traditional Chinese costumes as the research objects, this study' selects 23 categories as the research objects from the ranking list of the international reputation of Chinese traditional costumes as shown in Table 1.[26]

Considering that the independence and inclusivity of online marketing platforms can greatly affect the credibility of online consumer reviews data, this study selected Tmall platform, which has a high number of merchants and enterprises and a relatively high credibility, as the data source, using network crawler excavated the

data of online consumer reviews and sales of traditional Chinese costumes in October 2022. Through sorting and screening, items with the sale volume of 0 were eliminated and a total of 496 items of traditional Chinese costumes were finally obtained, including cloud collar, embroidered shoes, jade hairpin, jade pendant, phoenix crown, Mongolian robe, cheongsam and dragon robe. Each item involves 9 types of data, including sales volume, description score, logistics score, service score, price, the number of reviews, the number of pictures in the reviews, the number of follow-up reviews and the number of Q&A, totaling 4464 sample data were shown in Table 2.

Table 1 Ranking list of the reputation of Chinese traditional costumes

No.	Categories	No.	Categories
1	Cheongsam	13	Phoenix crown
2	Dragon robe	14	Mongolian robe
3	Embroidered shoes	15	Mongolian boots
4	Chinese jacket	16	Lenin suit
5	Jade belt	17	Manchu shoes
6	Cloud collar	18	Manchu clothes
7	Jade hairpin	19	Runqun
8	Samfoo	20	Xiapei
9	Tibetan robe	21	Hakka hat
10	Jade pendant	22	Pomegranate skirt
11	Tibetan boots	23	Chaofu
12	Lotus shoes		

Table 2 Data collection of Chinese traditional costumes

No.	Store	Item	Sale volume	Description score	Logistic score	Service score	Price	Reviews	Pictures	Follow-up reviews	Q&A
1	Shisanyu flagship store	Cloud collar	70	4.8	4.9	4.9	179	78	23	5	6
2	Suyuhuashang flagship store	Cloud collar	21	4.8	4.8	4.8	168	40	20	5	5
…	…	…	…	…	…	…	…				
496	Meilimao flagship store	Embroidered shoes	65	4.7	4.8	4.8	39	100	7	2	4

Model development

Multiple linear regression model

A multiple linear regression model is used to explain the linear relationship between the explained variable and multiple other explanatory variables. Multiple linear regression uses multiple predictive variables X_i to predict the response variable Y, where Y and X_i represent the following functional relationship in Equation (1):

$$Y = \alpha_0 + \alpha_1 X_1 + \ldots + \alpha_p X_p + e_i \qquad (1)$$

In Equation (1), α_0 is the intercept; α_i The regression coefficient of X_i, where $I=1, 2..., p$, p is the number of predicted variables, e_i is the residual term, which is usually assumed to satisfy a normal distribution.[27]

Based on the above theoretical basis, this study proposes eight research hypotheses to explore the impact of eight independent variables, including description score, logistics score, service score, price, the number of reviews, the number of pictures in reviews, the number of follow-up reviews and the number of Q&A, on the online sales of traditional Chinese costumes. Due to the selection of 8 attributes of online consumer reviews, there may be multicollinearity issues between each variable, which may cause errors, this study adopted a stepwise multiple regression method to analyze the impact of online consumer reviews on the online sales of traditional Chinese costumes. The following model is established based on Equation (2)

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + e_i$$

$$(2)$$

In equation (2), where α_0 is the intercept; α_i is the regression coefficient of X_i, e_i is the error term, $X_1 \sim X_8$ represent the description score, logistics score, service score, price, the number of reviews, the number of pictures in the reviews, the number of follow-up reviews and the number of Q&A of traditional Chinese costumes. MATLAB was applied for multiple regression analysis, and $X_1 \sim X_8$ were gradually added to the Equation (2)

Random forest model development

The random forest model is a multifunctional machine learning algorithm based on decision trees and has been commonly used in the field of machine learning as a combinatorial classification model proposed by Breiman in 2001.[28] It has two purposes: to measure the importance of independent variables in classifier construction and to perform category prediction on the dependent variable.[29] The application method of random forest algorithm is as follows:

1) Select sample set D as input according to Equation (3):

$$D = \{(x_1, y_i), (x_2, y_2), x_3, y_3), \ldots, (x_m, y_m)\} \qquad (3)$$

The number of iterations of the weak learner is T.

2) Randomly sample the data set with random sampling times $t=1, 2, 3..., T$, and randomly select m samples each time to obtain sample D_t.

3) Train sample D_t in the CART decision tree model $G_t(x)$, that is, learn in the t-th weak learner;

4) Output the final strong learner $f(x)$.[30]

The fitting effect of random forest model is usually measured by the mean square error (MSE), mean absolute error (MAE), and root mean square error (RMSE) of the model. Among them, MSE is an indicator that measures prediction error by calculating the average square of the difference between the predicted value and the observed value. The smaller the MSE value, the more accurate the prediction result is. MAE is an indicator that measures prediction error by calculating the average absolute value of the difference between the predicted value and the observed value. The smaller the value of MAE, the more accurate the prediction result is. RMSE is the square root of MSE, which represents the square root of the average difference between the predicted value and the observed value. A smaller RMSE value indicates a more accurate prediction result.

Due to the fact that multiple regression analysis provides explanations and statistical inferences for linear relationships, while random forest regression analysis can capture nonlinear relationships, resulting in more comprehensive research results to increase the robustness of model analysis.[33] Therefore, based on 4464 sample data, this study constructed a random forest regression model with all attributes of the online consumer reviews as independent variables and sale volume as dependent variable, rating the importance of the independent variables. In addition, the independent variable of online consumer reviews is used to predict the dependent variable data, and the MSE, MAE, and RMSE of the analysis model are calculated.[32,33]

Results

Descriptive analysis

Due to the significant numerical difference between the 9 groups of variables, this study normalized them to the range of [0,1]. The main statistical data of the variables are shown in Table 3.

Table 3 Descriptive statistics of variables

Variables	Mean	S.D.
Sale volume	0.019372519	0.040507216
Description scores	0.044891882	0.000920864
Logistic scores	0.044897451	0.000589828
Service scores	0.044895953	0.000694566
Price	0.024376423	0.037708342
Reviews	0.014547278	0.042479474
Pictures	0.017304589	0.04143284
Follow-up reviews	0.014823628	0.04238383
Q&A	0.016531482	0.041747325

Multiple linear regression model analysis

This study used MATLAB for stepwise multiple regression analysis, 8 independent variables were added to the model regression, and the regression results are shown in Table 4.

Table 4 Quantitative regression results

Variables	Regression (1)	Regression (2)	Regression (3)	Regression (5)	Regression (6)	Regression (7)	Regression (8)
Description score	1.3000 (0.657)	-1.427 (-0.404)	0.456 (0.114)	1.453 (0.465)	1.674 (0.545)	1.749 (0.567)	1.484 (0.481)
Logistic score	-	5.140 (0.932)	9.297 (1.350)	5.299 (1.003)	6.974 (1.340)	6.961 (1.336)	6.394 (1.227)
Service score	-	-	-6.347 (-1.008)	-4.205 (-0.869)	-5.802 (-1.217)	-5.890 (-1.232)	-5.213 (-1.088)
Price	-	-	-	-0.127** (-3.245)	-0.140*** (-3.634)	-0.141*** (-3.642)	-0.142*** (-3.677)
Reviews	-	-	-	0.600*** (18.199)	0.365*** (5.752)	0.359*** (5.393)	0.350*** (5.261)
Pictures	-	-	-	-	0.280*** (4.320)	0.263** (3.033)	0.306*** (3.384)
Follow-up reviews	-	-	-	-	-	0.024 (0.297)	0.0364 (0.4490)
Q&A	-	-	-	-	-	-	-0.072 (-1.651)
Constant	-0.039 (-0.439)	-0.147 (-1.007)	-0.134 (-0.909)	-0.101 (-0.881)	-0.115 (-1.025)	-0.114 (-1.013)	-0.107 (-0.948)
Sample	469	469	496	496	496	496	496
F	0.43	0.65	0.77	70.40	63.90	54.70	48.30
R^2	0.0009	0.0026	0.0047	0.4180	0.4390	0.4400	0.4430

Note: ***, **, * denote the levels of significance test at 1%, 5% and 10%, respectively. The statistical value of T is shown in parentheses.

As shown in Table 4, as the explanatory variables gradually increase, the R^2 of the regression results also gradually increases. In the final regression (8), the R^2 reached 44.3%, indicating a good fit of the model ($R^2 > 0.4$) and a reasonable model construction. The final standardized model can be expressed as Equation (4):

$$Y = -0.107 - 0.142X_4 + 0.350X_5 + 0.306X_6 \qquad (4)$$

Through multiple stepwise regression, it can be seen that the impact of description scores, logistics scores, service scores, the number of follow-up reviews and the number of Q&A on online sales of traditional Chinese costumes are not significant. However, the impact of price, the number of reviews and the number of pictures in reviews on online sales of traditional Chinese costumes are significant at the 1% level. For each unit increase in price by consumers, online sales are expected to decrease by 1.14179 units. For each unit increase in the number of reviews, online sales are expected to increase by 0.35035 units. For each unit increase in the number of pictures in reviews, online sales are expected to increase by 0.30589 units. That is to say, for traditional Chinese costumes products on Tmall, the impact of price, the number of reviews and the number of pictures in reviews contribute a lot to their online sales.

Random forest model analysis

The importance rating results of the online consumer reviews attributes to the online sales presented by random forest model are shown in Figure 1. It can be seemed that the most important attributes affecting the online sales of traditional Chinese costumes are the number of reviews, the number of pictures in reviews and the price, which are consistent with the multiple linear regression model. The importance score of 33.8% for the number of reviews indicates that the number of reviews plays the most important role in influencing the online sales. A higher number of reviews may mean greater

attention and satisfaction toward product and increasing the number of reviews may positively impact the online sales. The importance score of 25% for the number of pictures in reviews indicates that the number of pictures in the reviews has a significant impact on the online sales. Pictures can provide rather intuitive information and help potential buyers better understand the product. Therefore, increasing the number of pictures in reviews may help increase the online sales, too. The importance score of 18% for price indicates that price has a relatively high impact on the online sales. Lower prices usually attract more buyers. The importance score of 14.2% for the number of follow-up reviews ranks fourth, which means that a high number of reviews may indicate factors such as good product quality and high buyer satisfaction, thereby having a positive impact on sales. The importance score of 4.7% for the number of Q&A is relatively low in the model, indicating that the number of Q&A has a small impact on the consumers' decisions and online sales. The importance score of 3% for the description scores indicates that the importance of the description score in influencing online sales is relatively low. The importance score of 0.9% for the service score is very low in the model, indicating that the impact of the services score provided by the consumers on the purchase decision of potential consumers and online sales is minimal. The importance score of 0.5% for logistics score has the lowest importance in the model, which means that logistics service has a very limited impact on purchasing decisions and sales.

Figure 1 Importance score of the online consumer reviews attributes influencing online sale.

Figure 2 presented the predicted results of various attributes of online consumer reviews on online sales, which shows that the observed and predicted values of online sales are very close, indicating that the attributes of online consumer reviews can effectively predict the online sales. Table 5 shows the error of the model, where an MSE of 0.0005 means that the overall difference between the predicted value and the observed value is small. A MAE of 0.0100 indicates a small average difference between the predicted value and the observed value; A RMSE of 0.0223 indicates that the overall difference between the predicted value and the observed value is relatively small. In summary, the fitting results of the random forest model are good, which has a good effect on exploring the importance of various attributes of online consumer reviews and their predictive ability for online sales of traditional Chinese costumes.

Table 5 Model error results

MSE	MAE	RMSE
0.0005	0.01	0.0223

With the improvement of people's living standards and the online, consumers pay more attention to the quality of traditional Chinese costumes when purchasing online. On the one hand, due to the unique nature of e-commerce platforms, consumers can have a more intuitive understanding of the products they want to purchase through the reviews and pictures contained and then make a decision on whether

to purchase. Therefore, in the online sales process, the number of reviews and the number of pictures in reviews play essential important role in the online sales of traditional Chinese costumes. On the other hand, price is also very important and has a negative impact on the online sales, indicating that the pricing strategy for online sales of traditional Chinese costumes also has a significant impact on its online sales. In summary, the increase in the number of reviews and the number of pictures in reviews can help potential consumers obtain more information about traditional Chinese costumes, thereby increasing their willingness to purchase. In addition, price has a certain impact on consumers' purchasing behavior, which requires e-commerce merchants to adopt appropriate pricing strategies. In this case, merchants can adopt corresponding marketing strategies, such as increasing the number of reviews and pictures in reviews by returning positive reviews in the above picture, and inviting friends to help collect coupons, in order to attract the attention of potential consumers and ultimately increase online sales.
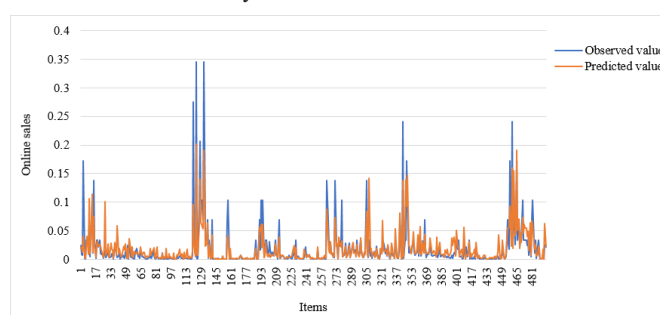

Figure 2 Observed online sales and predicted online sales.

Conclusion

This study explored the impact of online consumer reviews on the online sales of traditional Chinese costumes from eight attributes: description score, logistics score, service score, price, the number of reviews, the number of pictures in reviews, the number of follow-up reviews and the number of Q&A by conducting multiple linear regression model and random forest model. Based on the above research, the following conclusions can be drawn:

1) By developing multiple stepwise regression model, it is found that the description score, logistics score, service score, the number of follow-up reviews and Q&A of traditional Chinese women's apparel do not have a significant impact on online sales. However, the price, the number of reviews and the number of pictures in reviews of traditional Chinese costumes post a significant impact on online sales.

2) By constructing a random forest model, it indicates that the price, the number of reviews and the number of pictures in reviews of the traditional Chinese costumes are the most important attributes affecting the online sales, while other attributes have lower importance. In addition, the online consumer reviews attributes have a good predictive effect on the online sales, and their prediction results present good accuracy and effectiveness.

3) Based on the comprehensive analysis of the online data of traditional Chinese costumes on Tmall, suggestions are proposed to improve online sales: firstly, pay less attention on the online ratings. Secondly, using strategies such as positive feedback in the above pictures and inviting friends to help obtain coupons can increase the number of reviews and pictures contained to attract potential consumers. Then, improve product quality; finally, e-commerce merchants need to conduct thorough research to

determine the psychological expected prices that consumers can accept and adopt certain pricing strategies.

Conflicts of interest

The author declares that there is no conflict of interest.

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