Evaluation of fresh food logistics service quality using online customer reviews

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Abstract: Fresh food places high requirements on logistics because of its perishable nature. Improving the quality of cold chain logistics services is a great challenge for fresh food e-commerce companies. Traditionally, the evaluation of logistics service quality has been carried out mainly through questionnaire surveys and expert groups, which are time consuming and laborious, and their reliability and validity have been questioned. Unlike previous studies, in this study we used a latent Dirichlet allocation model to explore logistics services using customer reviews on the 'fresh food' category of JD.com, one of China's most popular e-commerce websites. By revising the evaluation index system for logistics service quality based on a review of the literature, we put forward an evaluation system that covers six dimensions: reliability, security, timeliness, economy, pleasantness and convenience. We then incorporated sentiment analysis technology and the TF-IDF (Term Frequency-Inverse Document Frequency) algorithm to obtain a total score for the service quality of JD's fresh food logistics. The results show that customers are more satisfied with the dimensions of timeliness and pleasantness, are but less satisfied with the dimensions of security and economy. JD.com should therefore focus on reducing logistics costs to make its services more cost-effective, providing professional packaging, improving its insurance compensation mechanism, and giving customers accurate and timely logistics information feedback to improve its fresh food logistics services. This study extends and refines the application of the logistics service evaluation system, and thus provides a reference for other B2C fresh e-commerce enterprises on the implementation of logistics service quality evaluation and management.

Keywords: logistics service quality; fresh food e-commerce; evaluation system; online reviews; text mining

1. Introduction

Given the fierce competition in the fresh food e-commerce industry, logistics service quality has become the key to the survival and development of enterprises and to the improvement of their competitiveness. According to the 'China E-commerce User Experience and Complaint Monitoring Report' (2018), e-commerce complaints increased by 38.36% from 2017 to 2018, and 14.9% of these complaints were related to logistics issues such as delivery, returns, and exchanges.. In the fresh food e-commerce field, which has higher immediacy requirements, logistics and distribution have become consumers' second core concern after product quality. Consumers are more concerned about freshness of product with the improvement of living standards (Yang and Tang, 2019), and traditional transport methods can easily affect the quality of fresh food. Miroslav (2006) proposed that in the fresh food e-commerce transaction process, the quality of logistics service has a primary effect on the quality of fresh products. How to conveniently and effectively evaluate the logistics service quality of fresh food e-commerce has thus become a major concern of e-commerce platforms and scholars.

Research on the evaluation of logistics service quality has mainly focused on the establishment of scale models and the construction of consumer evaluation sets using questionnaire surveys (Han and Xie, 2019) and expert groups. The most representative models are the SERVQUAL model proposed by the US service management research group PZB in 1988, and the logistics service

quality (LSQ) model proposed by the research group of Professor Mentzer from the University of Tennessee. To avoid subjectivity in the evaluation of service quality, some scholars have used fuzzy theory and multi-criteria decision-making methods to modify the SERVQUAL and LSQ models, and have developed new measurement methods. For example, Liao et al. (2014) proposed a new LSQ evaluation method that integrated fuzzy theory, quality function deployment and multi-stage goal planning. Büyüközkan and Çifçi (2012) combined the fuzzy analytic hierarchy process and the fuzzy approximate ideal solution ranking method to redesign the calculation method for indicator weights to meet the individual needs of different companies. However, these methods do not consider the high cost and information effectiveness of collections of consumer reviews, and often involve high research costs.

A large number of studies on service quality evaluation have pointed out that online reviews are extremely valuable. By making full use of the large amount of consumer evaluation data on a fresh food e-commerce platform through text mining and other methods, an effective consumer logistics service quality evaluation set can be obtained at a lower cost. Text mining technology has been used effectively to analyse the services of hotels, restaurants and travel agencies. For example, Lucini et al. (2020) used the LDA model to analyse 55,000 online reviews covering more than 400 airlines from 170 countries. He then derived the factors that influence aviation service satisfaction, which airlines can use to improve their competitiveness. The LDA topic model can extract the core topic and the related vocabulary of each topic from a large amount of text, from which we can know the meaning of each topic, the frequency of occurrence and the relevance of each topic. Topic modelling based on LDA has been applied to different types of text data, including email, scientific abstracts, newspaper archives, twitter, online reviews，consumer complaints and so on(Bastani et al.,2019; Cao et al.,2017; Wan et al.,2020; Wang and Xu, 2018).However, text mining has not been used to evaluate the logistics service quality of fresh food e-commerce platforms.

This study considered the characteristics of fresh food e-commerce and constructed a fresh food logistics service quality evaluation system based on the SERVQUAL scale and the LSQ model. The TextRank function was used to obtain word frequency statistics on the crawled consumer evaluation data through text mining to identify the main concerns of consumers regarding the quality of fresh logistics service. We then updated the index system based on the main concerns identified, and developed a consumer-oriented, scientific and comprehensive logistics service quality evaluation system for fresh products. We also used sentiment analysis technology to determine consumers' emotional attitudes towards each logistics service quality evaluation index, and identified where consumers' attention is concentrated based on the fresh food logistics service quality and satisfaction with each index. We provide some management approaches to improve the service level of fresh food logistics suggestions.

2. Literature review

The American service management research group PZB (Parasuraman et al., 1988) put forward the SERVQUAL model in 1988 as an important tool for measuring service quality after using it in investigating and analysing the telephone repair, retail banking and insurance industries, and it has been widely accepted by managers and scholars. SERVQUAL is an abbreviation of 'service quality', which includes five dimensions: reliability, tangibility, responsiveness, security and empathy. From 1990 to 2000, studies on logistics service quality gradually shifted toward measurement research. The most representative theory is the logistics service quality (LSQ) model proposed by the research

team of Professor Mentzer from the University of Tennessee. LSQ scales have been formulated through the research of companies in various industries and countries (Kilibarda et al., 2016; Murfield et al., 2017; Thai, 2013). A logistics service quality evaluation system that includes time quality, personnel communication level, order completion level, error handling ability, goods delivery efficiency, flexibility and convenience dimensions was used to evaluate companies in China (Sohn, 2017). However, customers' evaluations of service quality are subjective and usually fuzzy. As the traditional SERVQUAL and LSQ scales are not very suitable for dealing with these problems, scholars have developed new measurement methods using fuzzy theories and multi-criteria decision-making methods. For example, the grey relational analysis method has been applied to LSQ evaluation , and an LSQ evaluation method that integrates fuzzy theory, quality function deployment, and multi-stage goal planning has been proposed (Liao and Kao, 2014). The fuzzy analytic hierarchy process and fuzzy approximate ideal solution sorting have been combined, and the method of calculating the index weight has been redesigned to meet the individual needs of various enterprises (Büyüközkan and Çifçi, 2012).

With the rise of e-commerce, service quality has a new mechanism, as service interaction behaviour mainly occurs through the Internet. Cross-regional marketing has become extremely common, and evaluation and management characteristics have been neglected. Research on the construction of e-commerce logistics service quality evaluation models and scales has increased (Parasuraman et al., 2005; Zeithaml, 2000). The dimensions of electronic service quality generally recognised by scholars include website design, information content and availability, security and privacy, customer service, order fulfilment and delivery, convenience and flexibility, after-sales service and reverse logistics (Colla and Lapoule, 2012; Ha and Stoel, 2009; Roca et al., 2009; Udo et al., 2010).

Fresh produce is the foods of plant origin with perishability, quality variation, and seasonality(Meena et al.,2019). Siddh et al.(2017) delivered a structure of review on agri-fresh food supply chain quality showed that the current studies mainly focuses on designing a sustainable agri-fresh food supply chain(Gokarn and Kuthambalayan, 2019; Patidar et al., 2018; Yang et al., 2020), the logistics of fresh food(Dwivedi et al., 2020) and the quality of fresh food. Logistics service quality is the main factor affecting the quality of products in fresh food e-commerce transactions (Verbic, 2006). Research on fresh food e-commerce logistics service quality evaluation systems have mainly focused on procurement, loading and unloading, distribution, warehousing and information processing, as is further development of the SERVQUAL and LSQ models.

Most related studies obtained research data through enterprise surveys and questionnaire surveys, with few using online reviews as a data source. In online reviews, customers publish product evaluation information through e-commerce and other social media to provide references for other customers. Online reviews are typically high in number, provide a great deal of information, and are anonymous (Mudambi and Schuff, 2010). Research on online reviews can be classified into four main groups. The first is studies on the motivation for online reviews, which have provided references for optimising the customer review systems of e-commerce platforms (Li et al., 2019; Munzel and Kunz, 2014). The second is research on the usefulness of online reviews, which has mainly focused on the individual characteristics of the reviewer and the review content. The characteristics of the reviewer include reputation, professionalism, and credibility, and those of the review content include review length, additional reviews, expression methods, emotional polarity and review quality (Pan and Zhang, 2011). The third is research on the influence of online reviews,

which can help customers optimise purchasing decisions and help merchants predict sales volume, formulate product marketing plans, control the influence of online reviews and improve their competitive advantage (Filieri et al., 2018; Kumar and Benbasat, 2006; Xiao et al., 2016;). The fourth is research on the content mining of online comments, which has mainly used natural language processing and mining algorithms to analyse text content to identify opinions and attitudes. Topic extraction, opinion holder identification, text classification and sentiment analysis has been shown to have good business research value (Bao and Chau, 2015), and this approach has been frequently used in the exploration of customer satisfaction and concerns and the identification of products' competitive advantages to help companies improve service quality (Rajendran, 2020), update products and optimise performance, product pricing and market forecasts (Filipe et al., 2019; Li et al., 2019; Yao et al., 2019).

Although previous studies on social media data have used large-scale empirical data from online social networking platforms such as Facebook and Twitter (Choi, 2018; Ma et al., 2019; Matthias et al., 2017), recent studies have argued that companies still require more accurate analysis to evaluate customers' opinions (Sheng et al., 2017) and handle dynamic data. Researchers need new statistical methods, such as topic modelling, sentiment analysis and simulation models, to fully evaluate the change. This study addresses this challenge by integrating multiple big data analytics techniques to measure various aspects of social media data. We used online reviews under the 'fresh food' category of JD.com as the research data source to establish a fresh food logistics service quality evaluation system based on customer perception, and then evaluated the current situation of JD's fresh food logistics service quality to provide targeted management suggestions for improving JD's logistics.

3. Method

3.1 Evaluation index

Following the literatures which research on logistics service quality (like Awasthi et al.,2018; Chen et al.,2020; Mentzer et al.,2001; So et.al,2006), we adjusted the dimensions of the SERVQUAL scale and the LSQ model by combining the SERVQUAL scale and the LSQ model and considering the characteristics of JD's self-operated fresh food logistics service model. We then developed self-operated fresh food logistics service quality evaluation system that included six dimensions: reliability, security, timeliness, economy, pleasantness and convenience, as shown in Figure 1. The collation of literature indexes can facilitate the mapping and verification of the results of the LDA model using online reviews.

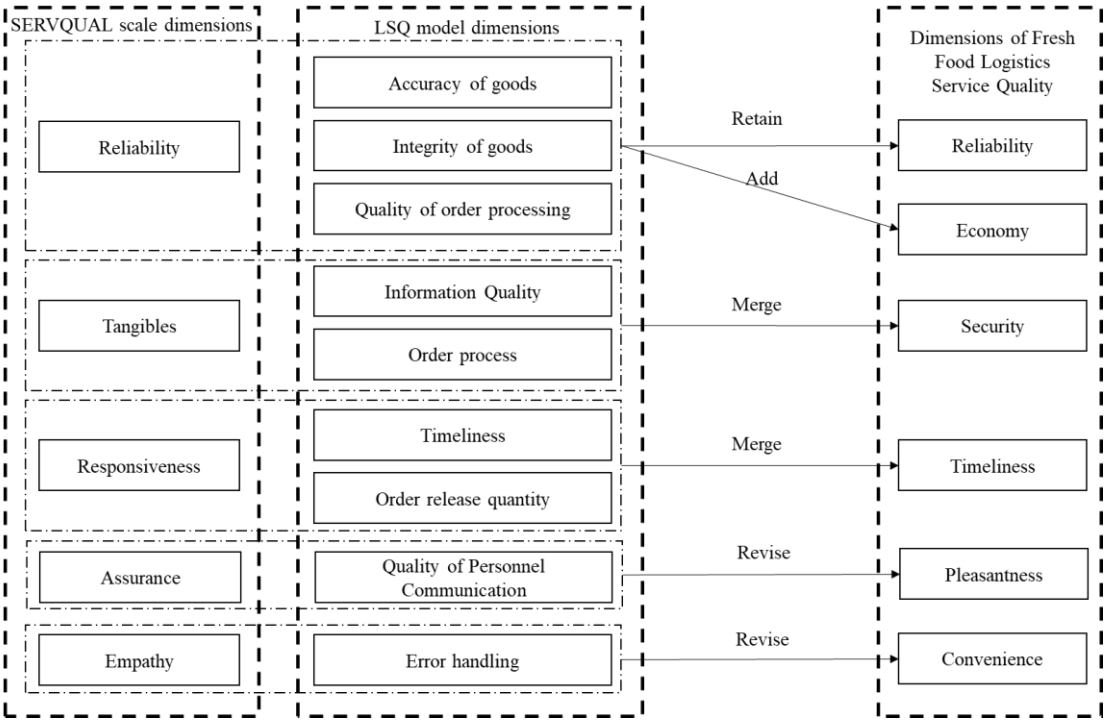

Fig. 1. Dimension adjustment process based on SERVQUAL scale and LSQ model

Firstly, providing reliable services is fundamental to sustainable business operation and it is widely recognized among scholars (Awasthi et al.,2018), so we retain this dimension and incorporates "accuracy of goods", "completeness of goods" and "order processing quality" from the LSQ model (Mentzer et al.,2001, Liao et al. ,2014) into the "reliability" dimension.

Secondly, in the e-commerce environment, consumers are more concerned about the security of services and their rights and interests, especially in fresh produce e-commerce. The "tangibility" refers to the entity in the service, which provides guarantee for the freshness and quality of fresh products. The "quality of information" provides a guarantee for the orderly execution of the service (Kilibarda et al., 2016; Murfield et al., 2017; Thai, 2013). The "ordering process" guarantees the success rate of the service. Therefore, we combine "tangibility", "information quality" and "ordering process" into "assurance".

Thirdly, fresh products have higher requirements for the timeliness of delivery (Yang and Tang, 2019), while the speed of customer service response also largely affects the service experience of consumers. Therefore, we combines "responsiveness", "timeliness" and "order release quality" into "timeliness" (Sohn，2017).

Fourthly, the logistics cost, as an additional cost in online shopping, will affect consumers' purchasing decision to a certain extent, especially for fresh products with low unit price and high logistics cost, so the dimension of "economy" is added.

Fifthly, the word "assurance" in the SERVQUAL scale refers to the comfort that the service personnel bring to the consumers (Parasuraman et al., 1988), which is different from the literal meaning of assurance. Therefore, in this paper, "assurance" and "communication quality" are revised to "pleasant".

Finally, the essence of "empathy" is to provide convenience for consumers (Chen et al.,2020). In online shopping, the return of goods due to various errors brings great inconvenience to

consumers, so the quality of the platform's "error handling" is also a manifestation of "convenience". Therefore, in this paper, "empathy" and "error handling" are revised to "convenience".

3.2 Data pre-processing

We selected the top 10 products sold in each of the categories of fresh fruits, seafood and aquatic products, selected meats, cold drinks and frozen foods, vegetables and eggs under JD's self-operated fresh food channel, a total of 50 products, and crawled customers' online reviews to collect the evaluation star ratings, evaluation content, evaluation time, and page title for these products. In pre-processing, 5,791 duplicate values were excluded. The number of pre-processed reviews was 80,851, of which 46,323 were positive reviews, 18,241 were moderate reviews and 16,287 were negative reviews. The review period was January 2017 to January 2020.

Online reviews generally include information that has nothing to do with logistics service reviews. These noisy data will interfere with the results of text mining, so filtering is necessary. We used a dictionary-based method to screen for reviews mentioning logistics services. To facilitate the development of a logistics dictionary for reviews, we used the Jieba toolkit with the TextRank function to extract keywords in the reviews.

The keyword extraction steps based on TextRank algorithm are as follows.

Algorithm 1: TextRank algorithm

1. Segment each sentence and tag words by their parts of speech, and filter out stopwords (those without actual meaning and value, such as 'of', 'is', 'are', 'because' and 'but' and other auxiliary words, function words, conjunctions, punctuation marks, etc.) and words fewer than two characters in length. Only words with the specified part of speech are retained to generate candidate keywords.
2. Use the generated candidate keywords as the node set, and use the co-occurrence relationship to construct the edge between any two points within the set window range to construct the candidate keyword graph.
3. According to the formula of TextRank, use an iterative calculation until convergence.
4. Sort the weight value of each node in reverse order, and filter out the required top keywords.

We added the national standard logistics terminology (GB/T 18354-2006) jointly issued by China Federation of Logistics and Purchasing, the China Logistics Technology Association and the China Study Numbering Center (2015), and 'Express Service Part 1: Basic Terminology' (GB/T 27917.1-2011) jointly issued by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and the National Standardization Administration of China (2011) as supplements to the word segmentation dictionary. For the stopword dictionary, the Harbin Institute of Technology Stopwords Database, Sichuan University Machine Learning Intelligence Laboratory Stopwords Database, Baidu Stop Words List and other dictionaries were integrated.

Most logistics keywords are nouns, verbs and adjectives, so the qualifiers fall into the above

three categories, and the co-occurrence window defaults to 5. A total of 1,101 keywords with frequencies greater than 50 were extracted and sorted in descending order. To avoid the omission of logistics keywords, we invited another researcher in a related field to screen the keywords. We comprehensively compared the results, and 230 logistics keywords were chosen. We selected the top 100 verbs, nouns, and adjectives in descending order of word frequency and used the micro word cloud tool to draw a word cloud diagram, as shown in Figure 2.

Fig. 2. Top 100 nouns, verbs and adjectives related to reviews on JD's self-operated fresh food logistics services

Analysis of the word cloud diagram of the top 100 nouns and verbs related to JD's self-operated fresh food logistics services reveals that customers' attention to fresh food logistics services was mainly on product packaging, logistics service personnel, last-mile delivery and the integrity of goods. The top 100 adjectives, most of which were positive words, indicate that customers were generally satisfied with JD's self-operated fresh food logistics services and were mainly focused on the speed of delivery and logistics convenience.

Using the logistics service keyword dictionary constructed based on customer reviews, we wrote a Python program to screen the reviews related to JD's self-operated fresh logistics service including the above logistics keywords. Because each review includes multiple types of information, to filter the reviews accurately and avoid introducing too many impurities, the reviews were segmented according to the symbols of '.', '!', '?' and '...'. We ultimately identified 5,377 negative reviews, 4,447 moderate reviews, and 37,724 favourable reviews.

3.3 Index system based on the LDA topic model

According to the review of the existing logistics service quality index system, the index numbers are between 10 and 35. This study calculates the perplexity for the number of topics from 5 to 50 and graphs it, as shown in Figure 3.

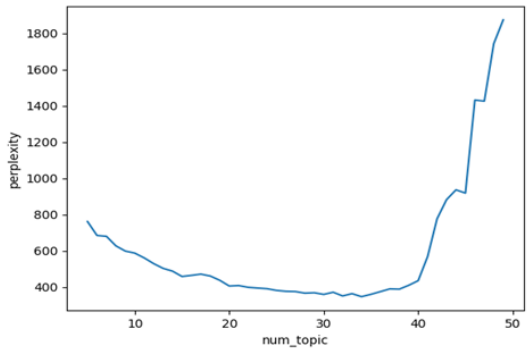

Fig. 3. Determination of the optimal number of topics in the LDA topic model

As shown in the figure, with 25 to 30 topics, the degree of confusion tends to be stable, and with 34, the degree of confusion is the smallest. However, to avoid over-fitting and considering previous studies, the initial quality index system contains 27 indexes. Combining these with new perspectives from the reviews, ultimately 30 topics were selected. The usual empirical values of the hyperparameters α and β are $\alpha = 50/K$ and $\beta = 0.01$. Therefore, given the 30 topics in this study, α should be 1.67. Finally, using the Gensim module in Python, the number of iterations was set to 100, the number of keywords was set to 10, and the LDA topic model was established for the reviews related to JD's self-operated fresh logistics service. Subsequently, each index was named according to the words under each topic and the initial fresh logistics service quality index system. To avoid the subjectivity of manual naming, another scholar in a relevant field was invited to participate in the naming. The naming results were adjusted through comparison, and the index names corresponding to each topic are shown in Table 1.

Table 1 The probability distribution of words under each topic and the corresponding index name of each topic

Topic Number	Keywords	Probability	Scholar A	Scholar B	Final index
1	JD.com Express delivery Shopping Experience Reliable Support Trust Service Impression Product quality	0.2772 0.1273 0.0979 0.0922 0.0662 0.0629 0.041 0.037 0.0278 0.0252	Overall impression of the company	Overall impression of the company	Overall impression of the company
2	Send Complete Intact Description Bad fruit Damaged Bump Image Receive Physicals	0.1543 0.1252 0.0706 0.068 0.0615 0.0363 0.0349 0.0337 0.0274 0.0194	Integrity of goods	Integrity of goods	Integrity of goods
3	Quickly Delivery Speed Logistics Timely Awesome Time Express delivery Distribution Receive	0.3203 0.1692 0.0636 0.0502 0.046 0.0259 0.0254 0.0251 0.0239 0.0182	Delivery speed	Delivery speed	Delivery speed
4	Keep fresh Freezing Free delivery Cheap Catch up Activity Transport Affordable Fresh goods	0.1214 0.113 0.0886 0.0661 0.0567 0.0369 0.0312 0.0213 0.0206	Logistics price	Reasonable product packaging	Logistics price

	Price	0.0193			
5	Specification Expect Management Self-supporting Process Purchase Procedure Service Work Undertake	0.1039 0.0885 0.0855 0.0651 0.0614 0.0611 0.0574 0.03 0.0268 0.0253	Overall impression of the company	Overall impression of the company	Overall impression of the company
6	Cost performance Quality Merchandise Cost-effective Service Purchase Character Supermarket Speed Price	0.3484 0.0646 0.0568 0.0514 0.0404 0.0389 0.0356 0.0289 0.0244 0.0231	Service cost performance	Service cost performance	Service cost performance
7	Delivery Guarantee Go upstairs Remote Solid Many Convenient Home delivery Home Good	0.1134 0.1105 0.0768 0.0714 0.0594 0.0463 0.0449 0.0393 0.0334 0.029	Coverage of outlets	"Door to door" transportation	"Door to door" transportation
8	Ice bag Foam Cold chain Package Heat preservation Dry ice Open Damaged E-commerce Send	0.1877 0.1066 0.1001 0.0568 0.0464 0.0345 0.0333 0.0275 0.0254 0.023	Reasonable product packaging	Reasonable product packaging	Reasonable product packaging

9	Product Get Intact Frozen Save Package Unboxing Crushed Quality Measures	0.153 0.1413 0.1129 0.0591 0.0441 0.0408 0.0394 0.0283 0.0264 0.0258	Integrity of goods	Integrity of goods	Integrity of goods
10	Send High speed Delivery Express delivery In advance Expect Tertian Logistics Especially Service	0.2194 0.1612 0.0582 0.0416 0.04 0.0375 0.0317 0.0307 0.0253 0.0214	Delivery speed	Delivery speed	Delivery speed
11	Self-supporting Compared to SF-Express Logistics Supermarket Relieved Good Merchandise Speed Quality	0.1835 0.0578 0.0513 0.0465 0.0396 0.0319 0.0272 0.0251 0.0237 0.0224	The superiority of the platform	Platform brand effect	The superiority of the platform
12	Receive Merchant Call Return Package Safety Personnel Can only Hide Append	0.3599 0.0837 0.0378 0.0297 0.0254 0.0239 0.0233 0.0201 0.0187 0.0175	Confidential customer personal information	Confidential customer personal information	Confidential customer personal information

13	Logistics Hard Send Express delivery Station Very near Logistics outlets Range Convenient Rural area	0.4307 0.1538 0.0442 0.0322 0.0273 0.0254 0.019 0.0186 0.018 0.0175	Coverage of outlets	Coverage of outlets	Coverage of outlets
14	Incubator Parcel Carton Overall Good Present Fast enough Dissolved Keep fresh Practical	0.1834 0.132 0.0713 0.0569 0.0364 0.0316 0.031 0.0275 0.0248 0.0212	Reasonable product packaging	Reasonable product packaging	Reasonable product packaging
15	Arrival of goods Get Box Open Outward appearance Picture All Case Disappointed Smell	0.1234 0.122 0.0836 0.0831 0.0731 0.0699 0.0646 0.0618 0.0369 0.0213	Integrity of goods	Reasonable product packaging	Integrity of goods
16	Intact Ice cube Simple Environmental Find Waste Throwaway Unboxing Gift box Package	0.2156 0.1642 0.1214 0.0499 0.0426 0.0359 0.0294 0.0242 0.0222 0.0162	Reasonable product packaging	Environmental logistics	Environmental logistics

17	Package Arrival of goods Crushed Parcel Carefully Deformed Protection Open Tight Carton	0.3134 0.1508 0.0827 0.0725 0.0654 0.0429 0.0429 0.0238 0.017 0.0162	Reasonable product packaging	Reasonable product packaging	Reasonable product packaging
18	Order Distribution Marvelously quick Goods Send Logistics Rapid Receive Delivery Praise	0.1673 0.1459 0.0531 0.0522 0.0491 0.0468 0.0365 0.0351 0.0345 0.0253	Delivery speed	Delivery speed	Delivery speed
19	Receiving Clean Full Order Error Address Logistics Acceptance Staff Consistent	0.1461 0.1127 0.058 0.0465 0.0428 0.0384 0.0317 0.0315 0.0284 0.0272	Delivery accuracy	Delivery accuracy	Delivery accuracy
20	Satisfied Dispatch Solve Immediately Seller Complaint Return Receive Reflect Customer service	0.2227 0.1519 0.0905 0.0687 0.0635 0.044 0.0328 0.0287 0.0234 0.0227	Logistics error processing speed	Return and exchange processing speed	Logistics error processing speed

21	Service attitude Favorable comment Delivery man Delivery Express delivery Hard Worker Thanks Conscientious Goods	0.1901 0.141 0.047 0.0442 0.0402 0.0371 0.0336 0.0315 0.0312 0.0274	Attitudes of logistics service personnel	Attitudes of logistics service personnel	Attitudes of logistics service personnel
22	Distribution Last time Repurchase Arrogant No Specially Again Before Package Same	0.1045 0.0875 0.0547 0.0462 0.0401 0.0384 0.0373 0.033 0.0312 0.0299	Service stability	Product brand effect	Service stability
23	Delivery Receive Professional Special Inquire Quickly SMS Delivery goods Phone Inform	0.2512 0.071 0.0686 0.0426 0.0414 0.0405 0.03 0.0299 0.0292 0.0275	Accurate logistics information feedback	Accurate logistics information feedback	Accurate logistics information feedback
24	Express delivery Relieved Take delivery Reserve Time Custody Merchant Put Hive box Expect	0.187 0.1335 0.1067 0.0706 0.048 0.0306 0.0276 0.0257 0.0237 0.0208	Flexible pickup form	Flexible logistics service	Flexible logistics service

25	Shopping Money off Cost-effective Activity Member Discount Parcel insurance Promotion effort Come to hand Send back	0.1424 0.1126 0.0749 0.0605 0.0479 0.0415 0.0415 0.0305 0.0275 0.0197	Perfect insured compensation mechanism	Perfect insured compensation mechanism	Perfect insured compensation mechanism
26	Fresh food Guarantee Exchange Full marks Good Reply Convenience Application Price differences Quickly	0.2298 0.1371 0.1116 0.0367 0.0319 0.0288 0.0277 0.0226 0.0223 0.0192	Convenient service recovery	Return and exchange processing speed	Convenient service recovery
27	Speed Express delivery Service Delivery Information Logistics Display Status Goods Inform	0.2336 0.1591 0.1228 0.078 0.0546 0.0401 0.0328 0.0264 0.0203 0.0197	Accurate logistics information feedback	Accurate logistics information feedback	Accurate logistics information feedback
28	Cold chain Need not Delivery Distribution Home Delivery Logistics Specified Community Transport Examine goods	0.2401 0.1341 0.0494 0.0493 0.0319 0.02 0.0262 0.0257 0.0221 0.0213	Provide personalized service	Flexible logistics service	Flexible logistics service

29	Evaluation Responsible Commitment Enthusiasm Trust Convenience Customer service Quality Timely Reply	0.1256 0.0892 0.0637 0.0486 0.0483 0.0409 0.0392 0.0343 0.0313 0.0296	Customer service response speed	Convenient return and exchange	Customer service response speed
30	Attitude After sale Store Customer Service Customer No other than Service Offer Good Satisfied	0.2367 0.0979 0.0643 0.0547 0.0356 0.027 0.025 0.0247 0.0247 0.0221	Customer service attitude	Customer service attitude	Customer service attitude

Modelling the theme of customer online reviews reveals that customers frequently compare their service experience with previous experience or with other shopping platform services. The consistency of the various services enjoyed and the advantages compared to other platforms were used as the criteria for service evaluation, so the two indexes of 'service stability' and 'platform superiority' were added. With increased environmental awareness, customers have become more concerned about whether packaging materials are green, biodegradable, recyclable or over-packed. Therefore, 'environmental friendliness of packaging' is included in the index system. Because online fresh food purchases are usually packed in boxes, they are heavier, so customers had a higher demand for the convenience of home delivery and door-to-door delivery, so a 'door-to-door transportation' index was added. Ultimately, the fresh logistics service quality evaluation system had 21 indexes in 6 dimensions.

4 Results

4.1 Index classification of review content based on index feature keywords

To calculate the sentiment score and weight of each index, it is necessary to obtain reviews on the relevant logistics service quality under each index. Before the reviews corresponding to each index can be extracted, they must be segmented. We filtered out the logistics keywords based on the

keywords under each topic in the LDA topic model of JD's self-operated fresh food logistics service reviews and the keyword frequency statistics. We then determined the characteristic keywords corresponding to each index. Subsequently, according to the index feature keywords determined in previous studies, this study retained reviews containing the relevant index feature keywords and assigned the corresponding indexes and dimensions, thereby classifying the review content in the evaluation index.

In terms of the number of feature reviews under each index, 'reasonable product packaging', 'service stability' and 'delivery speed' had the most, exceeding 10,000, which is consistent with the characteristics of fresh food logistics. The number of reviews in the new 'environmental friendliness of packaging' index exceeded those of the 'logistics price', 'perfect insured compensation mechanism' and 'flexible logistics service' indexes, which shows that customers' environmental awareness is high. However, because of the large differences in the numbers of reviews in each index, it was not feasible to select the percentage of reviews as the weight for each index, so the TF-IDF method was used.

4.2 Calculation of the service quality index score

After obtaining the feature reviews under each index, the average value of the sentiment tendency score of the feature review data under each index was used to obtain customers' evaluations of the service quality of JD's self-operated fresh food logistics. Sentiment dictionary-based methods and machine learning-based methods are currently the mainstream technologies for sentiment analysis. Because machine learning-based methods rely on training sets, manual data annotation is required, and it is difficult to apply such methods to large-scale, multi-domain practical applications. Here, the sentiments of customers' online reviews of JD's self-operated fresh food logistics service quality was therefore analysed using the sentiment dictionary. The accuracy and completeness of the sentiment dictionary have important effects on the final result. Therefore, using the Hownet Sentiment Dictionary as a reference, this study combined the high-frequency words in the reviews, logistics keywords and index feature words to supplement the custom dictionary.

The sentiment score calculation process based on the sentiment dictionary is as follows.

Algorithm 2: Sentiment scoring algorithm

1. Read the review data and perform word segmentation processing.
2. Find and locate sentiment words, and record their sentiment scores according to the sentiment word dictionary.
3. Search for the degree word before the sentiment word, and stop when you find it. According to the degree word dictionary, multiply the sentiment word score by the word's weight.
4. Identify all of the negative words in front of the sentiment word. Count the number of negative words, denoted by t, and multiply the sentiment score by -1 to the power of t because the sentiment polarity will change according to the odd and even conditions of the negative words, such as double negatives.
5. Look for an exclamation mark at the end of the review. If there is an exclamation point, add two points to the sentiment score.
6. Check whether there is a question mark at the end of the review. If so, multiply the sentiment score by -1 because most of the questions in reviews are rhetorical questions.
7. Repeat the above steps until all of the sentiment words in the review are

identified. Then, the sentiment score S is output.

The sentiment score can be expressed as

$$S(i) = [\sum_{j}^{n} (-1)^{t} * \deg ree(k) * senti(j)] + 2 * e - 1 * q \quad (1)$$

where $S(i)$ is the sentiment score of the review, t is the number of negative words, $\deg ree(k)$ is the weight of the degree word, $senti(j)$ is the sentiment value of the sentiment word, e and q both take a value of 0 or 1, which indicates whether there is an exclamation mark or a question mark in the review.

To prevent the outliers in the sentiment scores from affecting the overall score of each index, the score interval of reviews were set to [-6,6]. After segmentation, the reviews were generally short, with 95% concentrated in the range of [-6,6]. In the remaining 5%, customers did not use punctuation or repeated words, such as 'good, good, good, good', which can lead to extreme scores that would affect the overall sentiment score. These were regarded as outliers and the overall sentiment score interval was set to [-6,6], All reviews with scores of greater than 6 were classified as having 6 points, and similarly, reviews with scores of less than -6 were all classified as having -6 points. Then, the sentiment scores of the feature reviews under each index were averaged to obtain the average sentiment scores of each index. The calculation results are shown in Table 2.

4.3 Determining the weight of the service quality index based on TF-IDF

In the field of text mining, commonly used weight calculation methods include Boolean weights, frequency weights and TF-IDF weights. This study used TF-IDF, which can take into account word frequency and discriminate index feature keywords, to determine the weight of the JD self-operated fresh food logistics service quality evaluation index. We normalised the TF-IDF value of each evaluation index, and the final weights of the indexes are shown in Table 2. The reliability and security index has a higher weight, and the economy and convenience index has a lower weight.

4.4 Analysis of the Results of the JD fresh logistics service quality evaluation

The total score of JD self-operated fresh food logistics service quality evaluation can be expressed as

$$LSQ = \sum_{i=1}^{21} (x_i * Weight(Index_i)) \quad (2)$$

where LSQ represents the total score of JD's self-operated fresh food logistics service quality, x_i represents the sentiment score of the index, and *Weight* $Index_i$ represents the weight of the index.

The final score for JD's self-operated fresh food logistics service quality is 1.088. The evaluation scores of various indexes and dimensions are shown in Table 2.

Table2 The evaluation score of each dimension and index

Dimension	Evaluation index	Weight

		Sentiment score		Evaluation score	Dimension score
reliability	Delivery accuracy	0.561	0.011	0.006	0.373
	Integrity of good	0.676	0.056	0.038	
	Service stability	0.746	0.13	0.097	
	The superiority of the platform	1.078	0.094	0.101	
	Overall impression of the company	1.438	0.091	0.131	
Security	Professional packaging	1.135	0.156	0.177	0.181
	Perfect insured compensation mechanism	0.156	0.012	0.002	
	Accurate logistics information feedback	0.044	0.025	0.001	
	Confidential customer personal information	0.6	0.001	0.0006	
Timeliness	Delivery speed	1.4	0.13	0.182	0.219
	Logistics error processing speed	1.184	0.027	0.032	
	Customer service response speed	0.97	0.005	0.005	
Economy	Logistics price	0.58	0.012	0.007	0.028
	Service cost performance	0.629	0.033	0.021	
Agreeableness	Quality of logistics service personnel	1.554	0.084	0.131	0.196
	Customer service attitude	1.804	0.037	0.067	
	Environmental packaging	-0.127	0.012	-0.002	
Convenience	Flexible logistics service	0.732	0.006	0.004	0.092

Convenient service recovery	0.773	0.03	0.023
"Door to door" transportation	1.416	0.044	0.062
Coverage of outlets	0.407	0.005	0.002

As shown, only the score for ‘environmental friendliness of packaging’, the main problem reported by customers, was negative. Adding a great deal of anti-collision fillers or ice bags to the packaging results in large amounts of disposable plastic waste, and sometimes over-packing occurs, which results in extensive wasted resources. The scores for ‘accurate logistics information feedback’, ‘perfect insured compensation mechanism’ and ‘coverage of outlets’ were all less than 0.5 points, showing that their performance needs to be improved. The scores for ‘customer service attitude’ and ‘quality of logistics service personnel’ were both greater than 1.5 points, indicating that JD.com performed well in personnel management and training. The highest satisfaction levels were for ‘timeliness’ and ‘agreeableness’, with scores greater than 1 point. As can be seen, JD’s self-operated logistics had good customer perceptions in terms of timeliness and service attitude. However, JD’s self-operated logistics performed poorly in terms of ‘insurance’, which shows that it still needs to improve its internal mechanisms to provide customers with more secure services.

The weighted ‘professional packaging’, ‘delivery speed’ and ‘service stability’ indexes ranked very high. Customers were most concerned about the freshness of food and the timeliness of distribution. Maintaining stable and consistent service capabilities is essential for retaining customers. The ‘superiority of the platform’, ‘overall impression of the company’, ‘literacy of logistics service personnel’ and ‘integrity of goods’ indexes were also highly weighted, which shows that the platform and the company’s overall reputation had strong effects on customer perception. Finally, customers were less concerned about ‘flexible logistics service’, ‘customer service response speed’, ‘coverage of outlets’ and ‘confidential customer personal information’, perhaps because only a small proportion of customers had experienced personal information leakage, been outside the scope of delivery, and required special logistics services. In terms of evaluation dimensions, the weight of ‘reliability’ was highest, which shows that customers were strongly concerned about the fundamentals of the company and logistics services. Because each platform has a relatively open and unified delivery price for fresh food and JD.com provides ‘excellent fresh compensation’ and free shipping benefits for members, customers were least concerned about ‘economic efficiency’.

4.5 Construction of four-part graph model for fresh food logistics service quality

The four-part graph model is a diagnostic model commonly used by enterprises. According to customers’ scoring of the importance and satisfaction of the various indexes of the enterprise, the evaluation indexes are divided into four categories: advantage area, repair area, opportunity area and maintenance area. Companies can refer to the classification results to make targeted management measures for different types of indexes. The weights and sentiment scores of JD’s self-operated fresh food logistics service quality evaluation indexes are ranked, and the four-point chart drawn is shown in Figure 3.

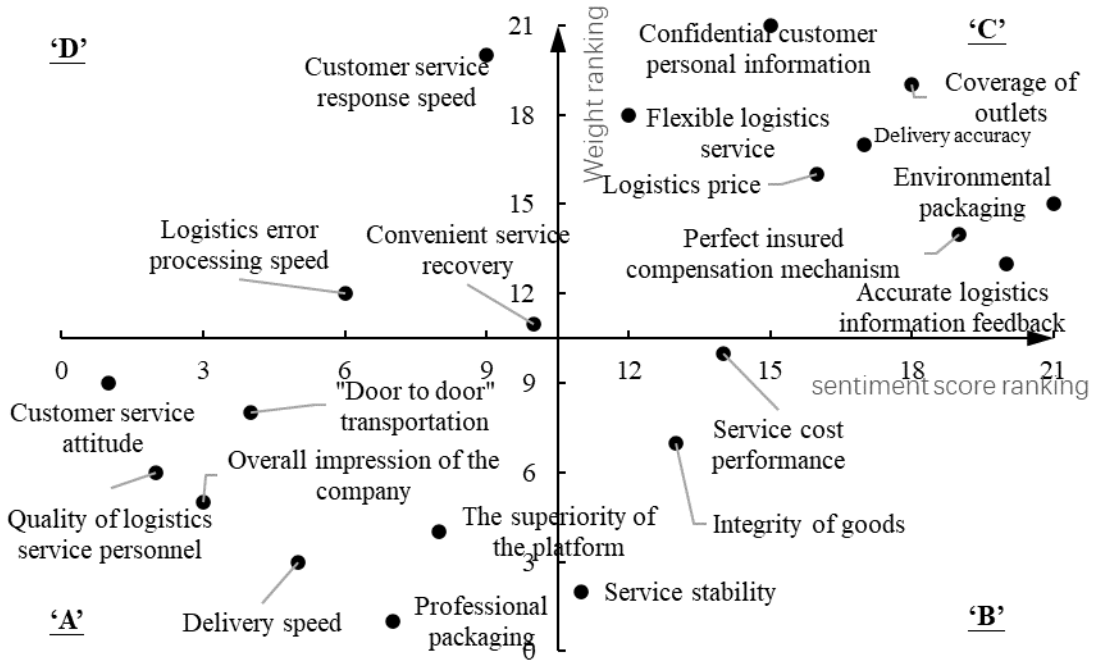

Fig.3. Four-point chart of JD's self-operated fresh food logistics service quality

Area 'A' includes seven indexes, all of which have high sentiment scores and weights: 'customer service attitude', 'quality of logistics service personnel', 'door-to-door transportation', 'overall impression of the company', 'delivery speed', 'professional packaging' and 'superiority of the platform'. Thus, these are strengths of the JD logistics service, and should be maintained and promoted. Indexes belonging to area 'D' include 'logistics error processing speed', 'convenient service recovery', and 'customer service response speed'. These had higher sentiment score rankings but lower weight rankings. There is little room for improvement, but the effect on the improvement of company's overall logistics service quality would be relatively insignificant.

The sentiment scores for areas 'B' and 'C' were both lower than the median value. Especially in area 'B', the repair area, customers were less satisfied with the 'service stability', 'integrity of goods' and 'service cost performance' indexes, but they were very concerned about them. It is essential for JD.com to focus on and improve indexes in this area. First, JD.com should standardise the logistics operation process and implement standardised management to eliminate the phenomenon of rough sorting and ensure the integrity of the goods. It should also pay more attention to the connection of various links of cold chain logistics, strengthen control before, during and after cold chain logistics, and improve the stability of services. It should also promote six sigma management to improve the accuracy of distribution, use service blueprints to analyse the whole process from front-end service to back-end service, and identify the contact points and key control points with customers. Finally, it should pay attention to the public praise effect while managing customer psychological expectations. Customers' perceptions of service depend on the difference between their expectations and actual feelings. Therefore, JD.com should introduce the real logistics service attributes to customers and guide them to form reasonable quality expectations. It should also conduct an in-depth study of customers and the market to accurately understand and grasp the true expectations of customers in terms of the quality of logistics services. JD.com should also operate with integrity, build a good reputation and corporate image, and enhance customers' perceptions of service cost performance.

4.6 Suggestions for improving the service quality of JD's fresh food logistics

Firstly, at present, the fresh food logistics of JD.com still has such problems as violent sorting, poorly connected logistics links and unstable service levels. JD.com should continuously innovate the content and form of its logistics services to improve convenience. JD.com should establish a

complete customer database based on the historical records of customer transactions, to comprehensively understand the habits and preferences of various customers for logistics services and to achieve the automatic selection of the logistics delivery method and delivery time to which customers are accustomed.

Secondly, the current logistics visualization and personal information protection mechanisms of JD.com still fail to meet the needs of consumers, which leads to a certain number of complaints and grievances. JD.com should provide visibility into the service process and enhance the security of logistics services. To eliminate customers' concerns about the intangibility, non-storability and process uncertainty of logistics services, JD.com should improve its logistics service guarantee mechanism and provide accurate real-time logistics information dynamics. It should ensure the safety of customers' personal information, thus eliminating customer concerns in this area.

Thirdly, currently JD.com does not provide logistics and delivery services for fresh products to customers in third and fourth tier cities and most rural areas. JD.com should cooperate with third-party logistics companies and convenience stores to improve delivery flexibility. JD.com can cooperate with convenience stores to improve the coverage of these outlets.

Finally, although JD.com has already launched the corresponding environmentally friendly recycling packaging, but the coverage of such measures is not high and the application is not widespread. JD.com should update its logistics equipment in a timely manner, adopt biodegradable or recyclable packaging materials, improve the environmental friendliness of packaging, and shift to green logistics.

5. Discussion

5.1 Theoretical contributions

This study has several practical and theoretical contributions. First, contrary to the traditional questionnaire survey method, which is often expensive but cannot ensure the validity of the data obtained, we processed consumer review data using data mining and developed a logistics service evaluation system. This approach enriches the theory and methods of logistics service quality evaluation research and broadens the application scope of text mining technology. Second, we use consumers' online evaluation data to construct an LDA topic model and extract the logistics service elements that customers care about from real customer review data. we then identified the most valuable indicators to update the existing evaluation system. Third, previous studies have mostly focused on the quality of logistics services but have not considered the field of fresh food e-commerce. In this study, we used consumer review data as the entry point to establish a logistics service quality evaluation system for fresh food, thus extending and refining the application of logistics service evaluation systems.

5.2 Managerial implications

In this paper, by investigating the current situation of logistics service quality management of JD.com and combining the final evaluation results of the service quality of JD's self-operated fresh food logistics, a quadratic chart based on the ranking of the sentiment score and the weight ranking of each index is drawn. This paper points out that JD.com needs to focus on improving the service quality of three indicators: "service stability", "cargo integrity" and "service cost effectiveness", as well as eight indicators such as opportunity areas that need attention, and puts forward some management suggestions in a targeted manner. Here are some implications for fresh food e-commerce platforms, especially self-operated logistics e-commerce platforms.

Firstly, improve the service facilities and technical level to achieve intelligent management. fresh food e-commerce platforms should also strengthen the analysis and application of the big data of online reviews by platform customers to obtain feedback from customers on logistics services in a timely manner, and improve services to gain a competitive advantage.

Secondly, Apply the concept of total quality management to build a complete quality management system. Fresh food e-commerce platforms should integrate the idea of customer-centricity, full participation, continuous improvement, etc. into the management of logistics service quality, and use target management methods to establish internal performance evaluation indicators based on consumer satisfaction.

Finally, JD.com needs to pay attention to the company's word-of-mouth effect, and at the same time carry out consumer psychological expectation management. When JD.com promotes fresh food logistics services, it should guide customers to form reasonable quality expectations, conduct in-depth research on customers and the market, accurately understand and grasp the true expectations of customers on the quality of fresh food logistics services, build a good reputation and corporate image, and enhances consumers' perception of service cost performance.

5.3 Limitation and future work

The limitations and future research directions of this study should be highlighted. First, we only studied the consumer reviews from JD's self-operated fresh food category. In future research, we can expand the categories or compare the quality of logistics services under different models and platforms. Second, we didn't classify the online reviews, so the conclusions are relatively limited. In future research, we could explore the differences in review content in different review types or carry out classification research according to the level of consumer membership to develop service management methods for different types of consumers. Third, the TextRank algorithm used only considers the relationships between words, and cannot consider context or semantics. In future research, we could use the semantic-based keyword extraction method SKE or the TextRank method weighted by word position. Fourth, the LDA topic model used is based on the word bag model, which has high dimensionality and high time complexity. When the data scale is large and the number of iterations is high, efficiency is low. In future research, we could use the BTM topic model, which directly models double words in the corpus and effectively avoids text sparsity and is therefore more suitable for the topic clustering of short texts. Finally, the analysis method based on the sentiment dictionary used is highly dependent on the dictionary, and does not consider grammatical structure. Therefore, in future research, we can build a more complete sentiment dictionary or use dependent syntax and semantic sentiment analysis methods.

6. Conclusion

Improving the quality of logistics services is essential for an enterprise to establish a brand image and enhance its competitiveness. A traditional way for companies to collect customer opinions is the questionnaire survey method, which is costly, inefficient and likely to miss the true concerns of customers. This study established a fresh food logistics service quality evaluation system based on online reviews and used text mining methods to explore customer satisfaction, disputes, sentiment distribution and perceptions of JD logistics service quality. Finally, a fresh food logistics service quality evaluation system with 21 indexes including reliability, security, timeliness, economy, pleasantness and convenience was established.

Using the evaluation results for JD's self-operated fresh food logistics service quality, a four-

point chart was constructed based on the sentiment score ranking and weight ranking of each index and determined that JD should focus on improving ‘service stability’, ‘integrity of goods’ and ‘service cost performance’. The eight indexes in the area ‘C’ also require attention. Some management suggestions are given of important practical significance to help JD.com to effectively improve its level of logistics service and customer satisfaction.

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Appendix

Table2 Abbreviation table

Abbreviation	Full Name
TF-IDF	Term Frequency-Inverse Document Frequency
B2C	Business to customer
LSQ	the logistics service quality
SERVQUAL	Service Quality
LDA	Latent Dirichlet Allocation
BTM	Biterm Topic Model