Key Drivers of E-Commerce Platform Customer Service Satisfaction: A Big-Data Analytics Approach

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Abstract. This study investigates the key determinants of Customer Satisfaction (CSAT) within an e-commerce customer service context. Using over 85,000 customer interaction records, we applied descriptive statistics and multiple linear regression to quantify how operational, managerial, and product-related factors influence customer satisfaction. Results show that issue category and product price are the most influential predictors, while variables such as agent shift, and response lag have limited impact. The findings offer insights for optimizing customer service scheduling, product communication strategies, and pricing perceptions.

Keywords: CSAT, e-commerce, regression analysis, customer service, price sensitivity

1 Introduction

Customer Satisfaction (CSAT) is a critical indicator for evaluating the performance of online customer service operations [1]. CSAT is a key metric for measuring how customers perceive a product, service, interaction, or any other customer experience. It's about whether a particular product or service meets customer expectations, thereby generating personalized recommendations and a willingness to repurchase [2]. With increasing competition among e-commerce platforms, understanding the drivers of CSAT has become central to improving user retention and reducing churn. However, CSAT outcomes are often influenced by multiple overlapping dimensions, including operational efficiency product category and managerial factors, which make it difficult to identify actionable insights.

Consumer perceptions of service quality has been a crucial point in marketing study areas. Early study conducted by Parasuraman, Zeithaml and Berry (1988) established the SERVQUAL framework, indicating that the service reliability, responsiveness and empathy are primary satisfaction drivers [3]. Oliver (1993) further illustrated that satisfaction of consumer is affected by the gap between actual performance received and expectations. This study result connects multiple dimensions related, including emotional experience, disconfirmation perceptions, and attribute satisfaction and dissatisfaction judgments [4].

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Based on this evidence, recent studies advanced by focusing e-commerce's consumer perception and quantifying CSAT determinants using regression-based models. For instance, Majka (2023) analysed large-scale service datasets and found that operational variables such as response time and communication channel explain only a small proportion of satisfaction variance, suggesting the influence of unobservable emotional factors [5]. Ling et al. found that customer satisfaction is affected by a variety of factors, including delivery time, product status, logistics, price, diversified services and platform image [6]. Zhu et al. found that the overall convenience of the platform and the security of products and shopping information have a positive impact on customer satisfaction [7].

Building on this literature, this study applied descriptive statistics and multiple linear regression incorporating both quantitative (response lag, price) and categorical variables (agent shift, channel, manager, category, tenure, and reported time) under real customer service data. This research aims to quantify the effect of operational factors (agent shift, response time), valuate management and team performance (manager, tenure) as well, examine customer and product-related factors (price, category, channel) and finally, provide managerial insights.

2 Data and Methodology

2.1 Dataset

The dataset consists of 85,907 customer service interactions from an e-commerce platform-Shopzilla between January–December. Variables include dependent variable CSAT Score (1–5 scale) and independent variables, including Agent Shift, Channel, Manager, Category, Response Lag, Price, Tenure Bucket, Reported Hour. Specific variables are shown in Table 1.

Table 1. Key Variables

Variable Name	Definition
CSAT	Customer satisfaction rating (1=very dissatisfied, 5=very satisfied)
Agent Shift	Customer service shift
Manager	Team manager
Category	Product category
Product_category	Product sub-category
price_bin	Product price segments (Low, Medium, High)
issue_responded_period	Time period when the issue was resolved
issue_reported_at_period	Time period when the issue was reported
handling_time	Time taken from issue reporting to response (hours)
channel_name	Communication channel type (e.g., Inbound, Outcall, Email)
Tenure Bucket	Customer tenure segments (e.g., 0-30 days, 31-60 days)

2.2 Data Preprocessing

The data cleaning and preprocessing was achieved. Firstly, removing columns with excessive missing values (e.g., connected_handling_time, >99% missing). Secondly, standardize categorical formats (case, spacing). Thirdly, missing remarks was replaced with "No Remarks"; Fourthly, text fields were normalized. Then, removing negative values in Item_price and Response lag. Additionally, Response Duration was imposed through the formula "Issue_responded – Issue_reported"for operational efficiency analysis.

2.3 The Research Methods

This paper adopts research methods such as Descriptive Statistics, Visualization and Inferential Analysis. Descriptive Statistics is completed based on calculated mean, std, and standard error by grouping factors. Visualization uses Boxplots and bar charts (with SEM) for categorical comparison. The Regression Analysis assessed combined influence and explained variance (R^2).

3 Data Visualization and Descriptive Insights

From a global perspective, the distribution of CSAT scores for all service evaluations during this period is shown in Figure 1. The majority received a satisfaction rating with a full score of 5 (5 scores), but at the same time, the lowest score of 1 score accounted for the second largest proportion (13.1%), while the middle score (2-3 scores) accounted for a relatively small proportion. It accounts for 4.5% in total. The CSAT scores of courseware are highly polarized.

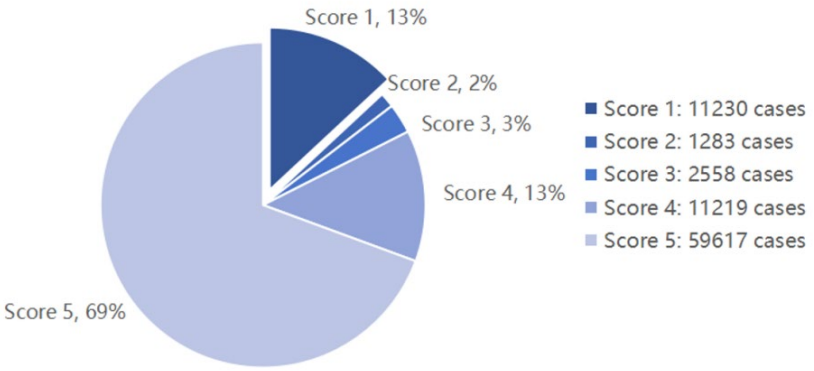

Fig. 1. CSAT Scores Percentage

From the perspective of e-commerce customer service, various agents, managers, and response times all influence satisfaction, with service being one of the key factors

that differentiate satisfaction levels. As the bar chart(Upper of Figure 2) showing CSAT Score mean by agent shift Mean CSAT across shifts ranges from 4.19 (morning) to 4.43 (split). Small variation suggests low practical difference. Upper right of Figure 2 shows that outcall and inbound calls score slightly higher (≈4.27) than email (≈3.90), confirming preference for live interactions. Lower left of Figure 2 shows that scores range from 4.11–4.38, minor managerial differences but potential for performance benchmarking. Lower of Figure 3 shows a clear negative trend that as response time increases, the average CSAT declines, indicating that customers are highly sensitive to delayed responses.

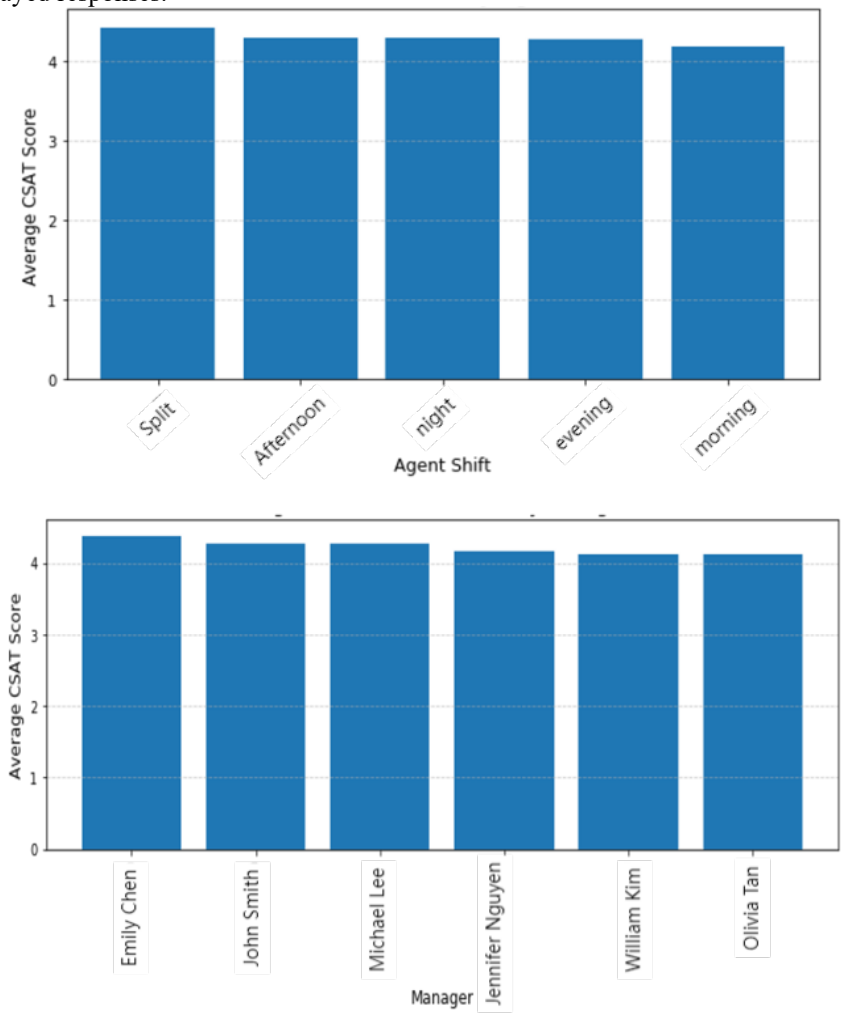

Fig. 2. CSAT Score mean by Agent Shift/Manager

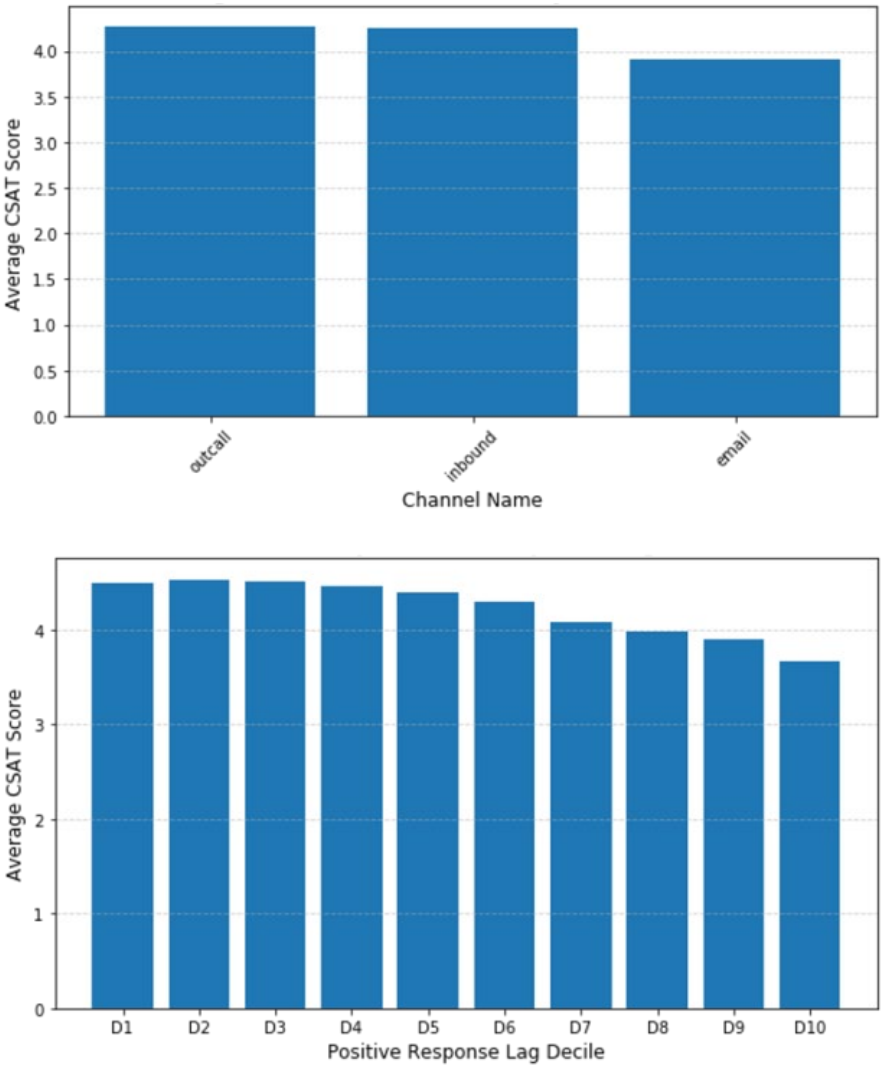

Fig. 3. CSAT Score mean by Channel_name/Positive Response Lag Decile

Upper of Figure 4 illustrates observed variation —cancellation categories scored lowest (≈4.0), while app/website and payment issues scored higher (>4.3). Lower of Figure 4 implies higher-priced orders slightly reduce satisfaction.

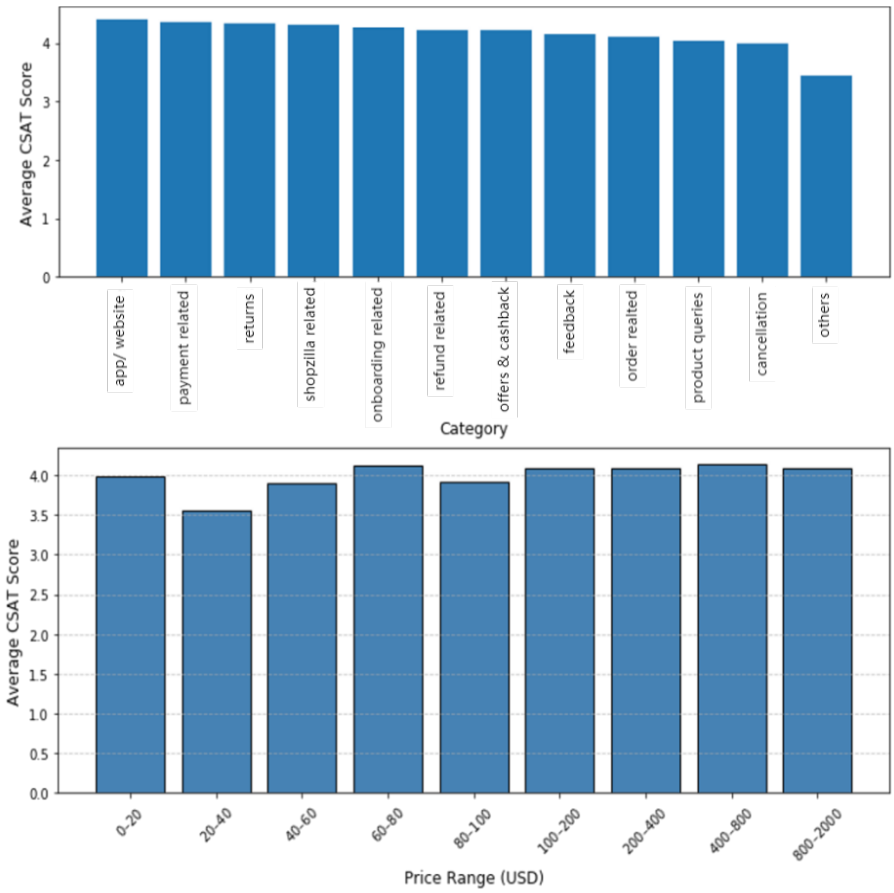

Fig. 4. CSAT Score mean by Category/Price Range(USD)

4 Regression Analysis

This study was analyzed using ordinary least squares (OLS). Based on the panel data of customer orders, this paper constructs the following linear regression formula to analyze the driving factors of CSAT scores:

$$\text{CSAT score} = \alpha + \sum_{i=1}^{n} \beta_i \times x_i$$

The CSAT score is the explained variable, a continuous variable with a value range of 1 to 5. All other possible influencing factors are x, which is the explained variable. The categorical variable is converted into a single hot code and enters the regression model.

Table 2. The overview of the regression results

Model:	OLS	R-squared:	0.048
Method:	Least Squares	Adj. R-squared:	0.047
F-statistic:	58.82	Prob (F-statistic):	0
No. Observations:	85907	Log-Likelihood:	-147400
Df Residuals:	85833	AIC:	2.949e+05
Df Model:	73	BIC:	2.956e+05
Covariance Type:	nonrobust		
	coef	std err	P>|t|
const	4.3073	0.215	0
Item_price	-0.00001149	9.47e-07	0
connected_handling_time	0.0004	0	0.315
response_time_minutes	-0.0003	8.01e-06	0
channel_name_inbound	0.2668	0.025	0
channel_name_outcall	0.3044	0.027	0
Manager_Jennifer Nguyen	-0.1981	0.056	0
Manager_John Smith	-0.0877	0.02	0
Manager_Michael Lee	-0.1356	0.023	0
Manager_Olivia Tan	-0.2229	0.03	0
Manager_William Kim	-0.1452	0.058	0.013
Tenure Bucket_31-60	0.0815	0.026	0.002
Tenure Bucket_61-90	0.0235	0.028	0.396
Tenure Bucket_>90	0.0492	0.024	0.036
Tenure Bucket_On Job Training	-0.0082	0.056	0.884
Agent Shift_evening	0.0066	0.022	0.768
Agent Shift_morning	-0.062	0.022	0.004
Agent Shift_night	-0.0065	0.045	0.884
Agent Shift_split	0.0338	0.031	0.28
category	Controlled		
Product_category	Controlled		
Supervisor	Controlled		

The overview of regression model insights is shown in Table 2.

For the Service Efficiency, customers are more sensitive to *how long they wait for a response* than to *how long it takes to resolve the issue.* A quick initial reply significantly enhances perceived responsiveness and builds customer trust.

For communication channel, proactive communication is one of the most effective ways to improve satisfaction. Customers often perceive *outbound contact* as a sign of responsibility and respect from the company.

As can be seen in Table 2, the price of the subject goods affects service satisfaction,which is significantly negatively correlated, indicating that the higher the value of the goods, the more likely it is to lead to a low satisfaction score at the customer service stage. This may suggest that customers with higher-priced orders tend to be more critical and have elevated expectations, meaning even minor service gaps can be amplified into dissatisfaction.

From the perspective of customer service, more experienced agents tend to achieve higher satisfaction scores, indicating that familiarity with internal processes and effective communication skills are crucial for improving customer experience. Also,

there are significant differences in satisfaction across supervisor teams, with some consistently underperforming. This may stem from variations in communication tone, emotional management, or customer allocation mechanisms.

It is evident that in the Agent_shift variable, the coefficient for Morning is -0.062 (p=0.004). Consequently, the early shift frequently results in a decline in service satisfaction. Therefore, the efficiency of customer service during peak hours is relatively low, which may be related to the lower complexity of customer issues or the higher attention paid to customer service. We further analyze using statistical charts (Figure 5) and find that Split is more conducive to improving customer satisfaction.

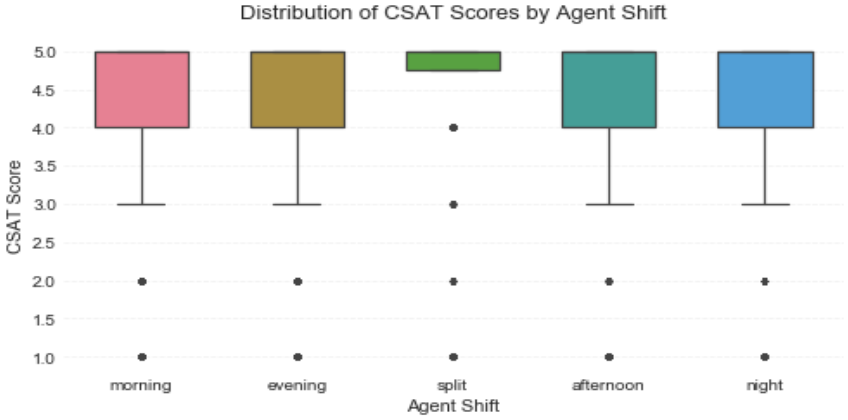

Fig. 5. Distribution of CSAT Scores by agent shift

Table 3. The detaild results of the regression results about Issue Category

Variable	Coef	p-value	Interpretation
category_cancellation	-0.297	0.047	Cancellations cause frustration and perceived loss, lowering satisfaction.
category_product_queries	-0.352	0.018	Product query cases often reflect unclear or insufficient information.
category_others	-0.874	0	These are usually complaint-type or unresolved cases, driving dissatisfaction.

Regarding the issue category, the primary sources of dissatisfaction are concentrated in three areas: order cancellations, product-related inquiries, and miscellaneous or unresolved issues. As shown in Table 3, these have a relatively greater impact on service satisfaction. Consequently, customer service representatives handling orders in these categories should pay attention and consider special handling methods.

5 Managerial Insights

The regression results illustrate several actionable managerial implications for improving customer satisfaction, providing better service to customers.

First, response lag is the most critical service factors. The results suggest that customers care more about how quickly they receive a reply than about how long it takes to resolve the issue. Therefore, there is the need to establish strict service level agreements

(SLAs) for first response time and to implement automated routing or AI-based triage systems to minimize waiting time.

Second, proactive communication plays an important role in driving satisfaction. Outbound or follow-up contact is emphasised by customers, suggesting that companies should expand their outreach and follow-up mechanisms.

Third, the major sources of dissatisfaction include order cancellations, product inquiries, and miscellaneous unresolved issues. These indicate information gaps. To solve these problems, streamlining the cancellation process and enhancing FAQ systems on digital platform can help.

Fourth, price sensitivity shows that customer buying high-price items are more likely to be sensitive about satisfaction. This suggest that implying the e-commerce should premium service experiences for high-price transactions.

Fifth, significant differences in satisfaction across supervisor teams highlight the need for building leadership standards. These differences may come from various working style in different team, like communication tone or workload allocation. Regular team performance reviews, coaching programs, and balanced case assignments can help reduce variability.

Finally, employee experience has a clear positive impact on CSAT. This may be due to more experienced agents can deliver better interactions. Therefore, management should invest in continuous training for the new staff. And incentives based on tenure can also help retain skilled staff.

In summary, improving customer satisfaction requires a dual focus on service process efficiency and human factor consistence. E-commerce should speed up responses while enhance teams' management.

6 Conclusion

This study analysed 85,907 e-commerce customer service records to identify the key operational and managerial drivers of customer satisfaction (CSAT). The multiple regression results reveal that although the model explains a modest 4.8% of the variance, several statistically significant factors are effective. Based on these evidence, meaningful managerial insights can be provided.

Among all predictors, response time is viewed as the most critical determinant. Customers attach more importance to the response efficiency than long handling time. Moreover, proactive communication through outbound or follow-up contact substantially increases satisfaction, suggesting that responsiveness and perceived care should be emphasized [8].

In contrast, dissatisfaction is concentrated in specific issue categories, particularly order cancellations and product inquiries. Price sensitivity also plays an important role. Customers handling higher-priced transactions tend to exhibit stricter expectations and lower tolerance for service disadvantages.

Furthermore, significant variation across supervisors and managers indicates that leadership consistency strongly affects perceived service quality. Teams under certain supervisors consistently underperformed, implying that communication style, emo-

tional management, and workload allocation should be standardized. Finally, employee experience positively correlates with CSAT.The results suggest that agents with longer tenure perform better. Therefore, e-commerce should apply structured training, continuous learning, and retention programs[9].

From the perspective of the customer, there is a consistent expectation for service enhancements, the introduction of novel features, improved performance, and dependable service provision, all at a price deemed reasonable[10]. Presently, e-commerce platforms facilitate the shopping and checkout processes by incorporating interbank transfer applications or instant payment services, thereby enabling users to circumvent the expenditure of superfluous time and effort[11].

Overall, this research finds that enhancing customer satisfaction in e-commerce service environments requires a dual focus on service efficiency and human factors. Organizations can create a more reliable customer service ecosystem by improving response speed and employee development.

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