Article

Expectation Disconfirmation, Ideal Point and Kano Models of Customer Satisfaction: A Comparison

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Abstract

This article compares three customer satisfaction models: expectation disconfirmation, ideal point, and Kano. It depicts the details of the three types of satisfaction stochastic models. A beauty shop's e-commerce database is used as empirical data for parameter estimates and model comparisons. The model calibration uses both root-mean-square deviation (RMSD) and the Chi-square test. The results demonstrate that the expectation disconfirmation model has the maximum fitness in the RMSD index, but the lowest goodness of fit in the Chi-square test. In contrast, the ideal point model produces opposite findings on the RMSD index and the Chi-square test. The expectation model, which has a larger number of parameters than the other two models, can be used for elastic changes to explain varied situational elements of pleasure, but it also requires more data to be stable. However, the ideal point model has a simpler structure than the other two models. There is only one parameter to estimate, which makes it easy to apply. However, it is less accurate than the other two models when measuring dynamic satisfaction.

Key Words

Satisfaction, expectation disconfirmation model, ideal point model and Kano model

Introduction

Customer satisfaction is always an important topic in management. In marketing, it can positively influence the communication of word of mouth and customers' repeat purchases which have a direct impact on the primary

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source of future revenue streams for most companies (Adegoke et al. 2022, Carraher-Wolverton and Hirschheim 2023, Gunawan 2022, Huang 2021a). In the industry area, it can accelerate upstream manufacturing to improve the product quality to satisfy its downstream' s needs. Thus, finding a suitable satisfaction model which can help a company to accurately predict the real satisfaction of customers and link their repurchase behaviour is a curtail issue in marketing research.

Highlighting customer satisfaction as a strategic tool to enhance business outcomes is a prevalent business approach. Yet, over slightly more than 25 years, academic inquiries have yielded at times contradictory evidence. Consequently, enhanced academic lucidity and managerial comprehension could stem from a comprehensive analysis of the correlation between customer satisfaction and business performance. To achieve this, Otto et al.(2020) examine 251 correlations across 96 studies spanning from 1991 to 2017 to validate the relationship between customer satisfaction and company performance. This topic explored in the academic sphere for numerous years, often yields contradictory findings across different studies. Otto et al.(2020) find that the satisfaction-performance correlation is positive and statistically significant more profound insights arise when considering moderating and mediating connections. Notably, satisfaction appears to mediate the influence of chosen marketing strategies on firm performance, especially under optimal conditions, yielding a reasonably strong correlation.

Dam and Dam's (2021) research empirically investigates the connections among service quality, brand image, customer satisfaction, and customer loyalty. Data was gathered from 299 shoppers in Ho Chi Minh City, Vietnam. The results indicate that service quality significantly influences brand image, customer satisfaction, and customer loyalty. Similarly, the study confirms the positive influence of brand image on both customer satisfaction and loyalty. Furthermore, the findings reveal a favourable association between customer satisfaction and customer loyalty.

Customer satisfaction is a measurement that determines how happy customers are with a company's products, services, and capabilities (American Society for Quality 2023). Thus, it is important to construct a measurable model to specifically calculate consumer satisfaction. Furthermore, it can contribute to a certain extent to satisfaction research to compare the satisfaction models (Huang, 2015, 2017, 2018a,2018b, 2021) that have been proposed in the past, and test the effectiveness of the models. Thus, this study makes a total comparison of Huang's (2015, 2017, 2018a,2018b, 2021) satisfaction model which is rooted in the theoretical basis of ideal point theory, expectancy disconfirmation theory and Kanon model. Therefore, this study will introduce the disconfirmation expectation theory, the ideal point theory and the Kano Model to portray the contours of consumer satisfaction seen from different perspectives.

The Expectation Disconfirmation Theory

Building on Oliver's work (1977, 1980), research on satisfaction has primarily centred on the expectation disconfirmation paradigm. Oliver (1980) suggested that expectations, as an adjusted standard, establish a basis for buyers' assessment judgments (Anderson and Sullivan 1993). From the point of view of the Expectation disconfirmation theory, satisfaction can be broadly considered as an assessment of product performance after purchase, considering initial purchase anticipations (Adegoke et al. 2022, Carraher-Wolverton and Hirschheim 2023). Customer anticipations stem from details presented in product advertisements and the exposure an individual has to product trials, with the person functioning as a passive yet imperfect information integrator (Ha et al. 2021). Preceding expectations might impact the perceived actual post-purchase performance (Sinha et al. 2020). Consequently, this model views satisfaction as a function encompassing the disparity between observed product quality and prior assumptions about the product's quality (Adegoke et al. 2022).

In the study of satisfaction models, Huang (2015, 2017) utilized a disconfirmation theory to investigate the variance between pre-purchase expectations and post-purchase perceived performance. The research delved into the satisfaction formation process, highlighting how new information impacts satisfaction judgments through the anchoring effect (Huang 2017). Huang conceptualized pre-purchase expectations and post-purchase performance as random variables conforming to normal distributions, each with its own joint density. Subsequently, probabilities were presented wherein pre-purchase expectations are greater (or lesser) than post-purchase performance, under a constant pre-purchase experimental condition.

The Ideal Point Theory

The concept of the ideal point is a facet of customer satisfaction, signifying the utmost level of product performance a consumer envisions. It embodies an aspirational performance level (Einhorn and Gonedes 1971).

This perception can arise from prior product encounters, assimilation of advertisements, and word-of-mouth exchanges (Tse and Wilton 1988). The idea of optimal product performance is among the methods for outlining a pre-experience benchmark, as outlined in the content on satisfaction. Consequently, models centred around the ideal point empower managers to assess the proximity of each product to a consumer's optimal expectation (Chernev 2003).

Over the last five decades, multiple models rooted in the concept of an ideal point have been introduced in the fields of psychology and marketing. For example, Fornell et al. (1996) adopt the psychological gap between product performance and the customer's ideal point to gauge overall customer satisfaction. Additionally, the assessment of the ideal standard in service quality research is akin to appraising SERVQUAL expectations —a service quality questionnaire commonly employed in the service industry— concerning customer satisfaction or dissatisfaction (Carter and Dalal 2010, Lin and Liang 2011, Tse and Wilton 1988).

In Huang's work (2018a, 2018b), satisfaction is conceptualized as a function, gauged by the variance between a product attribute's ideal position and customers' perceived position. This study redefines satisfaction and repeats purchase intention as an input-output procedure, employing stochastic principles to construct the model. Within this framework, satisfaction is treated as a random variable conforming to an exponential distribution.

The Kano Model

In the realm of production and operations management, Kano (1984) categorized customer needs or product qualities into three groups: must-be, one-dimensional and attractive which also corresponds to three concepts respectively: performance attributes, threshold attributes and excitement attributes. These divisions are determined by the extent to which customer satisfaction is met based on fulfilling their requirements (Kano et al. 2001).

For performance attributes, customer satisfaction originates from performance traits, which are competitive verbal qualities. Satisfaction emerges upon fulfilment, yet unfulfilled aspects breed discontent. The connection between functionality and satisfaction is depicted as a profound azure line. Threshold attributes cover assumed customer expectations. Meeting them yields neutral responses, but failure causes dissatisfaction. Kano terms these as “Must-be” crucial for market viability. The functional-satisfaction connection is illustrated as a green line. In excitement attributes, customers seldom expect thrilling features. These pleasantly surprising quality aspects quietly delight them and, once experienced, result in full satisfaction. Not meeting these aspects doesn’t always cause dissatisfaction. Improved functionality amplifies the excitement factors, aligning with higher customer satisfaction.

Different from disconfirmation theory and ideal point, Huang (2021b) employs Kano’s perspective as a theoretical framework, not a stochastic model. The resulting satisfaction model is simpler and more practical than the stochastic approach.

Expectation Disconfirmation Model: Pre-Purchase Expectation and Post-Purchase Evaluation

Huang (2015; 2017), based on the expectation disconfirmation theory, proposes a customer satisfaction model. She considers the customer’s pre-purchase expectation as a random variable x which follows the normal distribution with its probability density function (p.d.f.) f_x and its parameters μ_x, σ_x. The post-purchase product(service) performance of the customer is a random variable y which also follows the normal distribution with its p.d.f. g_y and its parameters μ_y, σ_y.

Since both the pre-purchase consumer expectation and the post-purchase product performance perception are related to the same product or service, pre-purchase expectation and post-purchase product (service) performance have joint distribution as k_{xy} with parametersμ_x, σ_x, μ_y, σ_y and ρ which is the correlation of x and y.

According to expectation disconfirmation theory, when a customer feels satisfied, it means he or she perceives that post-purchase product (service) performance is larger than pre-purchase expectation. Then, the probability of customer satisfaction is demonstrated as

$$\mathrm{P}(Y > x_0|X = x_0) = 1 - \int_0^{x_0} k_y(y|x_0)dy$$

in which $k_y(y|x_0)$ is $\frac{e^{\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{(x-\mu_x)^2}{\sigma_x^2}+\frac{\rho^2(y-\mu_y)^2}{\sigma_y^2}-\frac{2\rho^2(x-\mu_x)(y-\mu_y)}{\sigma_x\sigma_y}\right]\right\}}}{\sqrt{2\pi\sigma_x^2(1-\rho^2)}}$, $\rho = \frac{cov(x,y)}{\sigma_x\sigma_y}$ and $x>0$, $y>0$, $\sigma_x>0$, $\sigma_y>0$.

Thus, the probability of customer satisfaction can be presented as

$$\mathrm{P}(Y > x_0|X = x_0) = 1 - \int_0^{x_0} \frac{e^{\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{(x-\mu_x)^2}{\sigma_x^2}+\frac{\rho^2(y-\mu_y)^2}{\sigma_y^2}-\frac{2\rho^2(x-\mu_x)(y-\mu_y)}{\sigma_x\sigma_y}\right]\right\}}}{\sqrt{2\pi\sigma_x^2(1-\rho^2)}}dy$$

Customer dissatisfaction can be demonstrated as

$$\mathrm{P}(Y < x_0|X = x_0) = \int_0^{x_0} \frac{e^{\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{(x-\mu_x)^2}{\sigma_x^2}+\frac{\rho^2(y-\mu_y)^2}{\sigma_y^2}-\frac{2\rho^2(x-\mu_x)(y-\mu_y)}{\sigma_x\sigma_y}\right]\right\}}}{\sqrt{2\pi\sigma_x^2(1-\rho^2)}}dy$$

which means that the customer perceives post-purchase product(service) performance as larger than pre-purchase expectation.

Ideal Point Model

Customer satisfaction stems from the variance between their ideal expectations and actual experiences. When reality aligns closely with their ideals, satisfaction increases. Therefore, this study relies on the ideal point theory, measuring the gap between customer expectations and real encounters (Carter and Dalal 2010). Therefore, based on the literature review, drawn from consumer preference and choice models, customer satisfaction is assessed by deviations from their ideal preferences. Thus, in line with the ideal point theory, Huang (2018a; 2018b) views that satisfaction is gauged through the difference between a customer's perceived product attribute position (*p*) and their ideal preference (*i*). This discrepancy is represented as a random variable (*d*), calculated as . As the variance in attribute deviation grows, satisfaction decreases linearly. Initial deviations from one's ideal position result in a more substantial satisfaction drop compared to subsequent deviations. Thus, to consider the function discrepancy *d* between the ideal positions of satisfaction is a random variable which follows an exponential distribution and λ is its parameter which indicates the weight of the importance of the attribute that the customer perceives.

Kano Model

Kano's (1984) framework classified customer requirements or product attributes into performance attributes, threshold attributes and excitement attributes. Huang (2021b) through Kano's view of point builds the satisfaction model. Heightened functionality enhances excitement attributes, correlating with increased customer satisfaction. Hence, the product's attribute functionality can be represented as the random variable q. Thus, the satisfaction function, *l(q)* is followed as.

$$l(q) = \theta^{-1} exp\left[\frac{-(q+\beta)^2}{\theta}\right].$$

Direct customer satisfaction stems from performance characteristics. These are competitive spoken attributes. Satisfaction arises when these are met, but unmet ones lead to dissatisfaction. The link between functionality and satisfaction is shown as a deep blue line. If product attribute functionality is u, the satisfaction function is *z(u)* which is a linear equation with parameter α and constant ε.

Threshold attributes encompass customer expectations taken for granted. Satisfactory execution results in neutral reactions. However, poor performance leads to discontent. Kano labelled these "Must-be's" vital for market presence. The functional-satisfaction link in these attributes is depicted as a green line. If attribute functionality is variable *n,* satisfaction is represented by function $h(n) = \pm\left(\sqrt{-\theta\log\ \theta n}\right) - \beta$, $n<0$.

The Empirical Data

In this study, the empirical data was collected from a beauty shop e-commerce database. There are a total of 9798 data collected from January 1 to August 31 in 2023. Then, a survey was conducted to ensure that all consumers in the sample had more than one consumption record. The number of valid questionnaires is 924. The measurement includes the product and service attributes of "pre-purchase expectation" and" post-purchase evaluation"(based on the expectation disconfirmation model and also be used as an ideal point to measure "perceived product attribute position”), “ideal preference”(from the ideal point) and “perceived quality” (from Kano model) and “over-all satisfaction”(is used to make a comparison to each index) with five-point Likert scale.

The Parameters Estimation

It uses maximum likelihood estimate (MLE) to estimate the parameters in these three models. The results are shown in Table 1.

Table 1 The Results of Parameters Estimation

	Expectation Disconfirmation Model	Ideal Point Model	Kano Model
μ_x	2.925	--	--
σ_x	1.223	--	--
μ_y	3.007	--	--
σ_y	1.345	--	--
ρ	0.689	--	--
λ	--	1.003	--
θ	--	--	0.255
α	--	--	0.498
β	--	--	1.232
ε	--	--	0.021

The Model Comparison

It uses the root-mean-square deviation (RMSD) and Chi-square test to make comparisons among the expectation disconfirmation model, ideal point model and Kano model to show which model is more predictable and more applicable.

For RMSD, it can be calculated as $m^{-1}[\sum_{w=1}^{m}(S_w - R_W)^2]^{\frac{1}{2}}$ which is used to find the fitness between simulation data (S_W) and real (empirical) data(R_W) analysis. The simulation data is calculated when the parameters have been estimated by half of the empirical data. Thus, in the first step, the 924 sample size is divided into two parts, one for parameters estimation (the sample size $m_1=461$) and another (the sample size $m_2=463$) for RMSD calibration. And $m_1+ m_2=m=924$. The results show less RMSD means the proposed model fits the real data and has higher prediction power (Table 2).

For the Chi-square test, this research compares the overall satisfaction which is calculated from the expectation disconfirmation model, ideal point model and Kano model to find the goodness of fit. The higher percentage of goodness of fit also demonstrates the proposed model is close to the real situation.

Table 2 A Comparison of Satisfaction Models

	Expectation Disconfirmation Model		Ideal point model		Kano model	
RMSD	3.501		4.232		3.678	
Chi-square Test	SF	Dis-SF	SF	Dis-SF ion	SF	Dis-SF
Fitness Rate	89.77%	90.01%	92.94%	93.88%	93.22%	90.01%
	X^2=288.021(p<.00)		X^2=291.112 (p<.00)		X^2=285.138 (p<.00)	

Note: "SF" is the abbreviation of satisfaction. "Dis-SF" is the abbreviation of dissatisfaction.

As seen in Table 2, the results show that in the RMSD index, the expectation disconfirmation model gets the highest fitness and the Kano model gets the second position. However, in the Chi-square test, the ideal point model demonstrates a higher goodness of fit than the Kano and expectation disconfirmation model.

The ideal point model shows different results in the RMSD index and Chi-square test. To calculate customer satisfaction, it should provide information on the ideal position (ideal preference) that the customer holds before purchasing or receiving service when using the ideal point. However, the customer's ideal position or preference point is too abstract compared to the variables (such as pre-purchase expectation or perceived quality) of other satisfaction models.

The expectation disconfirmation model shows lower RMSD means it has a higher match to the real data. There are many parameters which are considered in the model construction to portray the various or dynamic structures of satisfaction. Thus, it can be more fit o real situations. On the other hand, it requires more data for calibration to obtain the parameter estimation results and calculate the model probability. Thus, it causes the lowest goodness of fit in the Chi-square test.

Conclusion

This article has compared the satisfaction stochastic model based on expectation disconfirmation theory, ideal point theory and Kano model theory. The results show that expectation disconfirmation gets the highest fitness in the RMSD index but the lowest goodness of fit in the Chi-square test. On the contrary, the ideal point model demonstrates opposite results on the RMSD index and Chi-square test. Different from the ideal point model Kano model, the expectation disconfirmation model has more parameters and is more complicated to estimate. It allows for elastic adjustment of parameters to account for variability in satisfaction. But relatively speaking, it also requires more data to make the model stable.

On the other hand, the structure of the ideal point model is simpler than the other two models. There is only one parameter to be estimated and easier to apply. However, the measurement of the ideal point is more abstract, so it is less accurate than the expectation disconfirmation model when dealing with the various and dynamic satisfaction measurements.

The Kano model is intermediate level in comparison to the other two models. This model is suitable for the product design stage as it allows for a preliminary understanding of consumer-perceived product or service quality, which can be linked to post-use satisfaction assessments. It can also link from the side of product or service design to customer satisfaction evaluation in the enterprise resource planning(ERP) process in advance.

In the future, other industry applications or other databases can be used to test these three models. It may show different results of model fitness in different traits of data. Other variables such as the linkage of customer purchase behaviour, retention (eg. Huang 2021a) or other variables (eg. Huang 2018a) can also be considered in these three models to compare the predictive power among the three models.

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