

Measuring the Service Quality of Bank by Beta Distribution SERVQUAL

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Abstract

Original Research Article

This study suggests a conceptual method to describe customer perception and expectation by Beta distribution, which replaces the estimated average value with coefficient of variance through the characteristics of probability distribution. Through the case study of three commercial banks in Taiwan, to explore what the key factors need to be improved in bank of Taiwan is, in addition, what difference will be resulted if the technique of statistical inference is involved. The result shows four items are different between the conventional gap analysis and distribution based analysis.

Keywords: SERVQUAL; Gap analysis; Beta distribution; Service quality.

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INTRODUCTION

Financial market always carries weights in the history of economic development of all countries, especially in Taiwan's economic development, it contributed greatly. Bank is the main body of finance, thus how to improve service quality, increase customer satisfaction and then create high efficiency to stimulate economic prosperity are issues deserving the bankers' attention. In recent years, many scholars dedicated to study different quality characteristics in banking service in hope to improve the working efficiency, service quality and procedure, as well as to increase operating costs in banks to achieve the enterprise target on customer satisfaction. Therefore, service quality constitutes the main competitive tool for banks [1]. The research results of scholars as Saha [2] and Shah *et al.*, [3] pointed out that service quality of bank are important factors to affect achievements and customer satisfaction.

Since SERVQUAL was proposed by Parasuraman *et al.*, [4], it has widely accepted and applied in the domain of service quality measurement, especially in bank service quality, such as Cui *et al.*, [5]; Ilyas *et al.*, [6]; Patidar & Verma (2013) [7]; Ariffin *et al.*, [8]; Grazhdani *et al.*, [9]; Tan *et al.*, [10]; Widodo *et al.*, [11]. However, there were several arguments raised still [12]. One of them is rarely discussed, that is, the computation of gap scores by only average, without considering the variance and the characteristics of probability distribution. As for the description and settlement of sample data, only concentration tendency is insufficient, dispersion tendency is also needed. Variation, in simple yet profound terms, variation

represents the difference between an ideal and an actual situation. An ideal represents a standard of perfection uniquely. This, however, also makes improvement and progress possible.

However, the current quality measurement and management in service industry only uses the concept of concentration tendency without any consideration for dispersion tendency. In addition, by selecting appropriate samples from SERVQUAL with the purpose of assessing the service quality, the inferential statistic is an optimal method. The inferential statistic enables preset accuracy of estimation with fewer samples by utilizing the probability theory. Beta distribution fits for describing the gap between customer perception and expectation, thus this research suggested a conceptual method to describe customer perception and expectation by Beta distribution, which replaces the estimated average value by gap analysis with coefficient of variance through the characteristics of probability distribution. Hence, through the case study of three commercial banks in Taiwan, not only summarizes the research findings, providing the strategic direction of improvement of service quality for bank managers, but also compare the different analysis results between this method and conventional gap analysis method.

METHODOLOGY

Beta Distribution

Beta distribution is a continuous probability distribution, $B(i, j)$ with integer values of i and j is the distribution of the j -th highest of a sample of $i+j$, independent random variables uniformly distributed

between 0 and 1. The cumulative probability from 0 to x is thus the probability that the j -th highest value is less than x , in other words, it is the probability that at least i of the random variables are less than x , a probability given by summing over the binomial distribution with

its p parameter set to x . This shows the intimate connection between the beta distribution and the binomial distribution. The expected value and variance of a beta random variable X with parameters α and β are given as following:

$$E(X) = \frac{\alpha}{\alpha + \beta}, \text{Var}(X) = \frac{\alpha\beta}{(\alpha + \beta)^2(\alpha + \beta + 1)}$$

Then, α and β can get the point estimate from the sample data by the following:

$$\hat{\alpha} = \bar{x} \left[\left(\frac{\bar{x}(1-\bar{x})}{s^2} \right) - 1 \right], \hat{\beta} = (1 - \bar{x}) \left[\left(\frac{\bar{x}(1-\bar{x})}{s^2} \right) - 1 \right]$$

Where \bar{x} stands for the sample mean; s^2 represents the biased sample variance.

Applied to SERVQUAL

According to Johnson [13], the random variable usually depends on beta distribution when it is between 0 and 1. Therefore, if the scoring interval of expectation and perception for each element in the SERVQUAL questionnaire being limited within [0,1], i.e. “1” stands for extremely high expectation and 100%

customer satisfaction, and “0” stands for extremely low expectation or extreme dissatisfaction. Beta distribution is suitable for describing the distribution of customer expectation and perception. If the beta distribution of $B_p(\alpha_1, \beta_1)$ is assumed as the perception and the beta distribution of $B_e(\alpha_2, \beta_2)$ being assumed as expectation, the gap between perception and expectation would become the difference of the two beta distributions, with the natures as follows:

$$P \sim B_p(\alpha_1, \beta_1), E \sim B_e(\alpha_2, \beta_2), \text{ then: } E(P - E) = \mu_p - \mu_e, \text{Var}(P - E) = \text{Var}(P) + \text{Var}(E) - 2\text{Cov}(P, E)$$

Where: covariance is the measure of how much two variables (P & E) vary together.

The gap score measurement is changed from by average to by coefficient of variance. The coefficient of variance is a kind of relative difference magnitude,

being used to compare data dispersions with different or same unit, as well as big data gap. The measurement method is to divide the standard deviation by the quotient percentage computed by the expectation value. Thus the new gap score is:

$$\text{New gap score} = \frac{\hat{\mu}_P - \hat{\mu}_E}{\sqrt{\hat{\text{Var}}(P) + \hat{\text{Var}}(E) - 2\text{Cov}(P, E)}} \dots\dots\dots (1)$$

CASE STUDY

Design of research

The SERVQUAL questionnaire is based on the original dimension and elements, but the dimensions and elements are adjusted accordingly with the character in bank service, and be reviewed the wording designed by administration department of bank. Thus, conduct a small-scale pre-test of such questionnaires to make sure their contents are easy-to-understand, user-friendly, and acceptable to those testees. After the significance of its feasibility and reliability has been confirmed, it is dispensed to the formal questionnaire. The questionnaire is still given based on the form of Likert 7 point scale, and be analyzed by the conventional gap analysis method and Beta distribution based method after being completed and collected, in order to make a comparison between the two methods. The questionnaire location was set at the gates of a bank in Taipei, Hsinchu and Taichung of Taiwan respectively.

Data Collection

The data is collected from the interview of randomly sampled customers in each bank during office hours. They are requested to fill out questionnaires and return them on the spot. Meanwhile, the part-time workers are reminded to dispense questionnaires proportionately across each customer’s gender and age, so as not to be over concentrated on a certain gender or age group. Total 550 questionnaires were distributed, among which 550 were recollected. Except invalid ones, the valid questionnaires amounted at 486, taking 88.36% of all. The Cronbach’s α coefficient was 0.8739 with enough reliability.

Sample Status

In the 486 valid questionnaires, 208 are from male, taking 42.80%; 278 are from female, taking 57.20%. In terms of marital status, 325 are from the married, taking 66.87%; and 161 are from the unmarried, taking 33.13%. In terms of age group, 55 are from the age group below 25, taking 11.32%; 273 are

from the age group from 26 to 40, taking 56.17%; and 158 are from the age group above 41, taking 32.51%.

Result of conventional gap analysis

By responded questionnaires, first, the average of each element was calculated by conventional gap analysis method respectively. The gap score of each element can be gotten by the perceived average minus

expected average. The analysis result is shown as the Table II, showing all the 33 elements under the 6 dimensions, the customer perceptions are all worse than the expectations, which shows that there are much necessary improvement in all items for the three commercial banks, especially on item 30, 19, 25, 17 and 13, the gaps are more distinct.

Table-1: Result of conventional gap analysis

Dimensions	Elements	Perception	Expectation	Gap	Improved top 5
		Mean	Mean		
1	1	0.673	0.767	-0.094	
	2	0.630	0.771	-0.141	
	3	0.661	0.756	-0.095	
	4	0.661	0.769	-0.108	
	5	0.671	0.743	-0.072	
	6	0.646	0.769	-0.123	
2	7	0.660	0.765	-0.105	
	8	0.645	0.775	-0.130	
	9	0.646	0.801	-0.155	
	10	0.671	0.747	-0.076	
3	11	0.642	0.754	-0.112	
	12	0.634	0.775	-0.141	
	13	0.625	0.782	-0.157	5
	14	0.661	0.763	-0.102	
	15	0.657	0.759	-0.102	
	16	0.631	0.750	-0.119	
	17	0.625	0.799	-0.174	4
4	18	0.658	0.784	-0.126	
	19	0.640	0.821	-0.181	2
	20	0.641	0.789	-0.148	
	21	0.631	0.764	-0.133	
	22	0.652	0.798	-0.146	
	23	0.620	0.772	-0.152	
	24	0.636	0.779	-0.143	
5	25	0.624	0.799	-0.175	3
	26	0.629	0.755	-0.126	
6	27	0.662	0.768	-0.106	
	28	0.663	0.798	-0.135	
	29	0.652	0.806	-0.154	
	30	0.616	0.804	-0.188	1
	31	0.638	0.756	-0.118	
	32	0.622	0.778	-0.156	
	33	0.632	0.758	-0.126	

Result of Beta Distribution Based Analysis

By Beta distribution based analysis method, first, calculate the standard deviation of perception and expectation, then $\hat{\alpha}$, $\hat{\beta}$, $\hat{E}(X)$ and $\hat{Var}(X)$ can be calculated, then calculate all the new gap scores by bring it into formula (1) as shown in Table-2. The

difference from conventional gap analysis is that some gap scores of many items decrease and some increase, thus the improved priority creates big difference. The top five items of improvement are item 19, 24, 9, 23 and 25, what is different from top five items 30, 19, 25, 17 and 13 in the conventional gap analysis.

Table-2: Result of Beta distribution based analysis

	Perception						Expectation						Cov.	Gap	New	Imprived
	\bar{X}	σ	$\hat{\alpha}$	$\hat{\beta}$	$\hat{E}(P)$	$\hat{Var}(P)$	\bar{X}	σ	$\hat{\alpha}$	$\hat{\beta}$	$\hat{E}(P)$	$\hat{Var}(P)$				
1	0.673	0.147	6.138	2.978	0.673	0.022	0.767	0.153	5.074	1.545	0.767	0.023	0.003	-1.841		
2	0.630	0.168	4.587	2.693	0.630	0.028	0.771	0.152	5.145	1.529	0.771	0.023	0.005	-2.279		
3	0.661	0.154	5.547	2.850	0.661	0.024	0.756	0.144	5.947	1.915	0.756	0.021	5E-05	-2.141		
4	0.661	0.160	5.116	2.625	0.661	0.026	0.769	0.157	4.800	1.438	0.769	0.025	0.003	-1.927		
5	0.671	0.142	6.717	3.293	0.671	0.020	0.743	0.174	3.957	1.366	0.743	0.030	0.001	-1.378		
6	0.646	0.150	5.923	3.241	0.646	0.022	0.769	0.158	4.672	1.405	0.769	0.025	0.002	-2.393		
7	0.660	0.169	4.527	2.327	0.660	0.029	0.765	0.160	4.579	1.403	0.765	0.026	0.001	-1.865		
8	0.645	0.150	5.921	3.259	0.645	0.022	0.775	0.150	5.197	1.507	0.775	0.023	0.002	-2.665		
9	0.646	0.156	5.438	2.975	0.646	0.024	0.801	0.119	8.188	2.034	0.801	0.014	0.001	-3.804	3	
10	0.671	0.174	4.231	2.078	0.671	0.030	0.747	0.186	3.320	1.124	0.747	0.035	0.001	-1.141		
11	0.642	0.165	4.775	2.661	0.642	0.027	0.754	0.175	3.827	1.247	0.754	0.031	0.003	-1.761		
12	0.634	0.182	3.796	2.194	0.634	0.033	0.775	0.177	3.536	1.026	0.775	0.031	0.005	-	1.873	
13	0.625	0.156	5.380	3.235	0.625	0.024	0.782	0.160	4.431	1.239	0.782	0.026	0.005	-2.610		
14	0.661	0.147	6.205	3.187	0.661	0.022	0.763	0.145	5.795	1.801	0.763	0.021	0.001	-2.261		
15	0.657	0.165	4.763	2.489	0.657	0.027	0.759	0.152	5.215	1.655	0.759	0.023	0.002	-1.845		

DISCUSSION

Discussion on perception gap of service quality

From Table-1, the customers' differences on perception and expectation for the 33 items of service quality are all distinctly different. All the 33 items show the surveyed customers' perception and expectation degrees, and show much necessary improvement in each item for commercial banks in Taiwan. The items of "The working staffs have enough professional knowledge and ability"; "The bank can send bank statement on time"; "the bank has computerized in an all-round way to avoid artificial errors"; "extend business hours of the bank (extend the business hour to 7:00 p.m.)," and "The bank can avoid delivering incorrect materials to customers". Except the item of "the bank has computerized to avoid artificial error" requires investment on hardware, the rest four items can be improved soon by bank managers.

Possible reasons for result differences by Beta distribution based analysis and conventional gap analysis

Conventional gap analysis method regards the perception and expectation as two independent groups, while they are not necessarily independent. From the covariance in Table-2, the correlation of beta distribution based analysis can be found, although their correlation is not so distinct.

CONCLUSION

The competition in financial market in Taiwan became fierce in recent years, stimulating how to improve management system and management strategy became an important subject for bank managers. Although the bank service quality was not immediately relative to the current benefits, it still constituted an imminent subject. This study aims at the bank service quality with three commercial banks as its objects. All the findings in this study not only provides demonstrations on bank service quality, being of practical reference value for bank managers on management and strategy planning, but also compares and proves greater rationality and efficiency of the beta distribution based analysis in contrast with the conventional gap analysis, providing more accurate information for bank managers. Still, this study has some limits as:

1. Manpower, time, and costs; issues in questionnaire response and few samples.
2. Case studies are restricted to the comparison of three banks but there is no other case in other service industries.

For the follow-up research, we suggest:

1. Further exploration and comparison analysis in other service industries and large samples;
2. In addition to the Beta distribution based analysis method in this study, we can explore this issue

from another point of view such Fuzzy linguistic rather than point estimator; process capability indices that mean and variance can be incorporated into measurement.

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