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Adapting Fuzzy Linguistic Servqual Model: A Comparative Analysis of Bank Services

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Abstract: Fuzzy logic provides a useful tool for dealing with decisions in which the phenomena are imprecise and vague. The current paper aims to construct a fuzzy SERVQUAL method for evaluating the service quality of banks in Malaysia for different market segments, namely conventional, Islamic and foreign banks. Further, a comparison of service quality gaps has been assessed with respect to demographic characteristics of the customers to answer a fundamental question "What do customers want from banking services and which elements of service quality is important for different groups of customers?" The data is collected using structured questionnaire from 766 bank customers, consisting of 465, 200 and 101 customers respectively from conventional, foreign and Islamic banks. First, the effectiveness of the Fuzzy linguistic scale and the Likert scale was compared by using the test of internal consistencies on dimensions of service quality. Further, the rigorous parametric statistical tests are carried out to check for the appropriateness of statistical analysis to be performed for the comparative analysis. Finally, the SERVQUAL gaps are analyzed and compared across 3 market segments and different groups of customers based on demographic characteristics by using non-parametric approach to derive the implications for the bank management.

Key words: Fuzzy linguistic scale · SERVQUAL · Bank services · Non-parametric approach

INTRODUCTION

Business enterprises whether involved in manufacturing of products or delivering service or both recognize *quality* as a major competing weapon either to improve or maintain or regain their market share. Many researchers [1-4] have pointed out that delivering quality service is essential for survival if not success in today's competitive environment. Therefore, industries are contemplating on development of innovative ways and means using quality management principles with a view to design methods and procedures so that effective control and the management of quality can be assured in the pursuit of excellence.

The banks offer the similar or generic financial products to its customers. Hence just being innovative in developing competitively priced financial products and opening up more banking channels are not enough. Today, the bank has to serve the increasingly diverse and sophisticated needs of the customers. Undoubtedly Malaysia has witnessed incredible evolution in technology in the banking sector for last two decades by creating new inexpensive channels like ATM, telephone or internet banking. This has resulted in the shift in the customers' focus from their costly branch networks to less expensive channels, causing the reduced customer contact [5]. Further, an increasingly innovative and aggressive environment, coupled with deregulation, has created fierce competition among the banks. Thus it is important for the banks not just to focus on technology and put forward more banking channels to its customers, but also to recuperate in terms of service quality. Banks that excel in quality service can have a distinct marketing edge since improved levels of service quality are related to higher revenues, increased cross-sell ratios, higher customer retention [6] and expanded market shares [7]. This is so because the satisfied customers lead to customer loyalty and in return translate into higher profit [8].

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A series of studies have been conducted by Parasuraman *et al*. [4, 9-12] to define service quality and identify the criteria that customers use while1 evaluating the service quality in any service organization. The service quality is defined as "the extent of discrepancy between customers' expectations or desires and their perception of what is delivered". In other words, it is the comparison of what customers expect before the use of the product/service with their experience of what is delivered. The SERVQUAL model originally pioneered by Parasuraman *et al*. [9] consist of 22 statements measuring 5 critical factors of service quality namely *tangibility*, *reliability*, *responsiveness*, *assurance* and *empathy*. The required data for the assessment of service quality through the SERVQUAL model are quantitative in nature which can be expressed in terms of exact numbers. However, when the study is being performed in the qualitative environment and the knowledge associated with that is vague and ambiguous, the data may not be expressed as exact numbers. Most often, researchers have claimed that individuals cannot use an exact number to express their opinion about a situation: instead a linguistic assessment is used to represent that specific numerical value [13-17]. Often, a proper linguistic variable is created to explain the ambiguity and vagueness associated with the domain of the problem. Thus the concept of the expression can be determined using fuzzy numbers using a membership function. Since linguistic assessment is approximate, triangular and trapezoidal membership functions seem to be more appropriate for responding to the ambiguity of these assessments [18].

The current study aims to construct a fuzzy SERVQUAL method for evaluating the service quality of banks in Malaysia. A comparative analysis across three market segments-conventional, Islamic and foreign banks as well as across different groups of customers based on demographic characteristics is carried out with respect to six common critical factors of SERVQUAL using the appropriate statistical tools.

The paper is structured as follows. The next section provides review of important literature on service quality with special reference to banking sector. Then, theoretical framework describing the SERVQUAL is briefly discussed. Thereafter, it provides a detailed description of data collection including the content of instrument, sampling framework and the sampling technique. It is followed by the description of fuzzy linguistic scale and the empirical findings of the study. Finally, the study concludes with managerial implications and future scope.

Literature Review: Service quality as the area of research has drawn the attention of researchers as well as practitioners for last three decades, owing to its sturdy impact on business performance, lower costs, customer satisfaction, customer loyalty and profitability [19-28]. There has been continuous growth in the literature with focus on the definition, modeling, measurement and applications, leading to development of sound base for the researchers in the area of service quality.

The literature reveals a number of models pertaining to the service quality measurement such as *technical and functional quality model* by Grönroos [29]; *GAP model* by Parasuraman *et al*. [4]; *attribute service quality model* by Haywood-Farmer [30]; *synthesized model of service quality* by Brogowicz *et al*. [31]; *attribute and overall affect model* by Dabholkar [32]; the *P-C-P attributes model* by Philip and Hazlett [33]; *internal service quality model* by Frost and Kumar [34]etc. However undoubtedly, SERVQUAL, originally pioneered by Parasuraman *et al*. [4, 9-12] is one of the most accepted and widely used assessment tools. According to Gerrard and Cunningham [35], the pioneer study of Parasuraman *et al*. [4] has been a major driving force in developing an increased understanding of and knowledge about service quality. Service quality by them is defined as the gap between customers' expectation of service and their perception of the service experience. The popularity of their Gap model can be viewed in terms of widespread application after pioneering work by Parasuraman *et al*. [4] in various industries across the globe suchas medical services [36], dental services [37], travel and tourism [38], hospitality [39-40], higher education [41], accounting firms [42], construction professionals [43], public services [44-46] and mobile communications [47, 48] just to name a few. However, the area where the SERVQUAL model has been experimented most is the banking sector.

In Malaysia a number of studies [49-52] have focused on assessing the service quality of electronic banking. However, the major focus of these studies was to assess the impact of technology on service delivery in Malaysia banking sector. Some other studies [53-55] focused on assessing the service quality of a particular market segment to the Malaysian banking sector. Izah and Wan Zulqurnain [54] focused on service quality in the financial services industry in Malaysia, particularly in Islamic banks and insurance, whereas Ramayah *et al*. [55] focused on just one foreign bank in the northern region of Peninsular Malaysia. A very few studies focused on assessing the overall service quality of banks in Malaysia. Kumar *et al*. [5] assessed the relative importance of critical factors using the dominance analysis on a modified SERVQUAL model for the Malaysian banking sector as a whole. In subsequent study, Kumar *et al*. [56] made a comparison between two market segments namely conventional and Islamic banks based on common critical factors. It is known fact that the perception and expectation of the customers are subjective in nature and thus service quality gaps may vary from one group of customers to others. However, hardly any study in the Malaysian context focused on statistically answering a fundamental question "what critical factors of service quality are important for different group of customers"? Segmenting customers based on demographic characteristics continue to be one of the most popular and well-accepted approach. A marketer must know and understand demographics to assess the size, reach and efficiency of the market [57]. Three key demographic segmentation variables are age, sex and income [58].

Gender is one of the most critical demographic variables as men and women can behave differently as consumers. Male and female differ in their attitudes and behavior based on the genetic characters and some part on socialization. Males tend to be selective processors of information, whereas females tend to be comprehensive processors of information [59]. Age segmentation allows a marketer to determine how wants and needs change as an individual matures [59]. Age influences consumers' decision when they got information and it is an important condition for estimate service quality [60]. Income has also seen as an effective segmentation base because of its ability to predict a person's willingness to purchase. In Malaysian context, race is another important demographic variable to be considered. Malaysia's cultural mosaic is marked by many different cultures, but several in particular have had especially lasting influence on the country. Chief among these is the ancient Malay culture and the cultures of Malaysia's two most prominent trading partners throughout history-the Chinese and the Indians. The co-existence of three races with different religion could be one of the important factors that can have influence on customers' attitude about the services.

The current study contributes to the literature significantly in many ways. Firstly, most of the previous studies except few exceptions [61-63] are based on the assumption that customers can express their expectation and perception on bank services in terms of exact numbers. This study uses fuzzy linguistic scale to assess the service quality gaps. Secondly, most of the previous studies used the parametric tests with an assumption that data on perception and expectation are normally distributed. This study uses non-parametric approach upon the evidence of violation of the assumptions of normality and homogeneity of variance. Thirdly, this is perhaps the only study which focuses on all the market segments of Malaysian banking sector with a reasonably large sample size. Finally, as the scores on perception and expectations are subjective, the comparison of service quality gaps has been assessed with respect to demographic characteristics of the customers to answer a fundamental question "What do customers want from banking services and which elements of service quality is important for different group of customers?"

Theoretical Framework: The five-gap model of service quality developed by Parasuraman *et al*. [4, 9] is an important customer satisfaction framework. The model identifies five key discrepancies or gaps relating to managerial perceptions of service quality and tasks associated with service delivery to customers. The first four gaps are identified as functions of the way in which service is delivered, whereas Gap 5 pertains to the customer and as such is considered to be the true measure of service quality. In this study, the original five dimensions namely *tangibility*, *reliability*, *responsiveness*, *assurance* and *empathy*, consisted of 22 statements are taken from the SERVQUAL model originally pioneered by Parasuraman *et al*. [9]. As pointed out by Kumar *et al*. [56], the convenience is one of major concern for the bank customers particularly in Malaysia. The perception of service "convenience" may affect customers' overall evaluation of the service, including satisfaction with the service and perceived service quality and fairness [64]. Following Kumar *et al*. [5, 56], the additional 4 items were added for the sixth dimension, i.e., convenience. The respondents are asked to rate all 26 statements each on expectation and as well as perception on a 7-point likert scale.

SERVQUAL Instrument, Sampling Framework and Sample Size: The primary data for the current study has been collected through survey method by using the SERVQUAL instrument, which consists of three sections: Section 1 deals with customers' usage of banking channels and their banking behavior. Section 2 contains of total 26 items, out of which original 22 items related to 5 dimensions of service quality are obtained from Parasuraman *et al*. [9] and 4 items related to the dimension "convenience" are taken from Kumar *et al*. [5].

The respondents are asked to rate each of the 26 statement using the balanced Likert scale of 1 to 7 with mid-point (1 = strongly disagree, 7 = strongly agree). All 26 statements are being reshuffled to make sure that questions related to one dimension are not grouped together. This is just to avoid pre-determined assumptions made by the respondents on each dimension that might result in similar ratings for all statements under the same dimension. Finally, section 3 contains the questions related to socio-demographic profiles of respondents. The secondary data are collected from internet, government agencies and Central Bank of Malaysia to support the primary data analysis

The target population for the study is the bank customers from conventional, Islamic and Foreign banks. The sampling units consist of customers residing in major cities around Klang Valley, Malaysia particularly in Kuala Lumpur and Shah Alam, the capital of Selangor State. The people in this region have access to all kinds of banking channels and thus can be considered as the representative of the target population for the evaluation of banks' service quality in Malaysia.

A group of 10 students from the class of Research Methodology were trained by the researchers to complete the survey. Keeping in mind the number of banks operating under each classification, 5 students were asked to target customers of conventional bank and respectively 3 and 2 students were assigned the job to target the customers of foreign and Islamic banks. The respondents were basically targeted at bank branches, shopping malls and universities. At bank branches, the respondents were requested to participate in the survey when they were found waiting for their turn for banking transactions. The respondents in shopping malls and university were requested to participate in the survey when they were not too busy with their activities and were basically in the relaxing mood.

The duration for fieldwork was kept for two months with a target sample size of 1000 bank customers. The average response rate from the customers was quite encouraging and it was possible to complete 836 surveys within the stipulated time period, missing the target by just 16.4%. However, a total 70 survey forms were rejected either because of excessive missing data or inconsistencies in customers' responses. With a total rejection rate of 8.4%, we ended up with a total valid sample size of 766, consisting of 465, 200 and 101 bank customers respectively from conventional, foreign and Islamic banks.

Techniques of Analysis

Fuzzy Servqual: The subjective evaluation data can be more adequately expressed in linguistic variables. Conventionally designed questionnaire frequently use the Likert Scale to gauge the feeling of respondents. Owing to the fuzziness of human thinking, this approach is inadequate and too simple to rule subject's way and measure complex human thinking and cognition. Tsai *et al.* [65] proposed a fuzzy SERVQUAL approach to clarify the positioning of service quality in the department store market and proposed implementation priorities for different service strategies.

A fuzzy set P defined in space X is set of pairs, $\mathrm{P} = \{(x, \mu_{\mathrm{P}}(x)), x \in X\}, \ \forall\, x \in X,$ where the fuzzy set P is characterized by its membership function $\mu_{\mathrm{P}} : X \to [0,1]$ which associates with each element $x \in X,$ a real number $\mu_{\mathrm{P}}(x) \in [0,1]$. The value $\mu_{\mathrm{P}}(x)$ at x represents the grade of membership of x in P and is interpreted as the membership degree to which $x \in P$ So the closer the value $\mu_{\mathrm{P}}(x)$ is to 1, the more $x \in P$ Hence

$$\mu_{\mathrm{P}}(x) = \begin{cases} 1, & x \in \mathrm{P} \\ 0, & x \notin \mathrm{P}. \end{cases}$$

According to Dubois and Prade [66], a fuzzy member is defined to be a fuzzy triangular number (p_1, p_2, p_3) if its membership function is entirely described by three parameters $(p_1 < p_2 < p_3) : \dfrac{n!}{r!(n-r)!}$

$$\mu_{\mathrm{P}}(x) = \begin{cases} \dfrac{x - p_1}{p_2 - p_1}, & \text{if } x \in [p_1, p_2] \\ \dfrac{p_3 - x}{p_3 - p_2}, & \text{if } x \in [p_2, p_3] \\ 0, & \text{otherwise.} \end{cases}$$

This study applied the triangular membership function and adopts the 6th of 8 conversion scales suggested by Chen *et al.* [67], which is depicted in Figure 1. Table 1 provides the fuzzy number conversion based on Likert seven-point measurement.

Aggregation operations on fuzzy numbers are operations by which several fuzzy numbers are combined to produce a single fuzzy number. The arithmetic mean aggregation operator defined on n fuzzy numbers (p_{1i}, p_{2i}, p_{3i}), $i = 1,2,\ldots,n$ produces the result $(\overline{p_1}, \overline{p_2}, \overline{p_3})$, where $\overline{p_{ji}} = n^{-1}\sum_{i=1}^{n} p_{ji}, j = 1,2,3.$

Table 1: Converted Fuzzy number.

Scales selected	Triangle Fuzzy numbers
Very Dissatisfied (VD)	(0, 0.1, 0.2)
Dissatisfied (D)	(0.1, 0.2,0.3)
Fair (F)	(0.4,0.5,0.6)
Slightly Satisfied (SS)	(0.5,0.65,0.8)
Satisfied (S)	(0.7,0.8,0.9)
Very Satisfied (VS)	(0.8,0.9,1.0)

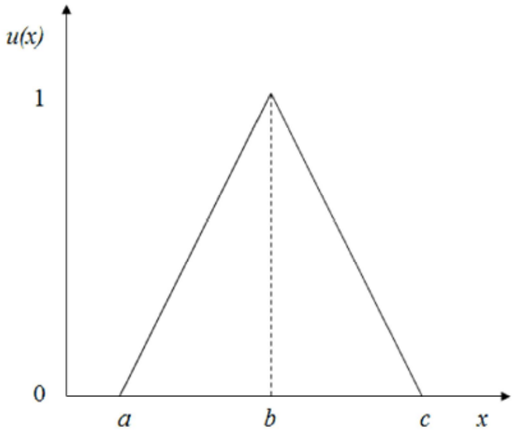

Fig. 1: Triangular fuzzy number.

The fuzzy service quality gap based on triangular fuzzy numbers is the difference between the $\widetilde{P}$ (perception) and $\widetilde{E}$ (expectation) and is defined as follows:

$\widetilde{P}(-)\widetilde{E} = (\overline{p_1},\ \overline{p_2},\ \overline{p_3})(-)(\overline{e_1},\ \overline{e_2},\ \overline{e_3}) = (\overline{p_1} - \overline{e_3},\ \overline{p_2} - \overline{e_2},\ \overline{p_3} - \overline{e_1}),$ where $\overline{e_{ji}} = n^{-1}\sum_{i=1}^{n} e_{ji},\ j = 1,2,3.$

In order to obtain a crisp output, the gravity center method has been used to defuzzy the fuzzy member. The crisp value after defuzzy can be defined as $Df = l + 3^{-1}[(u-l)+(m-l)],$ where l, m and u are respectively the minimum, medium and maximum triangular fuzzy numbers. Hence, the aggregate defuzzy number for the given n fuzzy numbers $(p_{1i}, p_{2i}, p_{3i}),$ i = 1, 2, n $Df_{\mathrm{P}} = \overline{p_1} + 3^{-1}[(\overline{p_3} - \overline{p_1}) + (\overline{p_2} - \overline{p_1})],$ and the crisp service quality gap is $Df_{\mathrm{GAP}} = 3^{-1}\sum_{j=1}^{3}(\overline{p_j} - \overline{e_j}).$

Inferential Statistics: Cronbach's a coefficient is used as a basis for reliability testing to verify whether Fuzzy logic is better than Likert scale. The distribution of demographic characteristics is determined with respect to different market segments and the association is measured using Cramer's coefficient (V). The mean scores on perception and the gap (difference between perception and expectation) fuzzy data were compared using Kruskal–Wallis one-way ANOVA and Mann-Whitney U test with respect to various demographic characteristics.

RESULTS

The Sample Characteristic and Banking Behavior: From a total of 766 respondents, 61% are the customers of conventional banks, whereas, respectively 13% and 26% of the customers are frequent users of Islamic and foreign banks for their day-to-day transactions. The comparison used in this study is strictly based on the random sample of 465 from conventional banks, 101 from Islamic banks and 200 from foreign banks. The demographic characteristics of the sample can be observed from Table 2. The nominal association between demographic characteristics and the type of bank is measured using Cramer's V based on chi-square measure. The value of V varies from 0 (corresponding to no association between the variables) to 1 (complete association). From Table 2, it is observed that there is no association between the type of bank with the variables gender and age, indicating that these variables do not have influence on the selection of bank for their transactions. But the other demographic variables, such as, race and income has significant influence on the selection of the bank. Most of the customers of Islamic banks are Malays who basically belong to Muslim community.

Table 3 reports the banking behavior of customers in three market segments. The most important channel for the customers is ATM. More than 90% customers of conventional banks and 99% customers of Islamic banks use this channel. However, the users of ATM among the customers of foreign banks are relatively less, i.e., only 76.5%.The adoption of online banking is still limited in Malaysia. Approximately 52% of customers of conventional bank and only 35% of the customers of each Islamic and Foreign bank are the users of internet banking. The least popular channel is the phone banking with only 23.4%, 25.8% and 22.5% of the customers respectively from conventional, Islamic and foreign banks use this channel for their transactions.

The most important factors that affect the choice of a bank among the customers of conventional and foreign banks are convenience, followed by interest rate changes and customers' friendliness. However, as expected one of the most important factor that affect the choice of Islamic bank is its adherence to Islamic laws and principles.

Table 2: Segment wise sample characteristics.

		Frequency (%)			
Demographic	Categories	CB	IB	FB	Cramer's V Sig.
Gender	Male	53.12	46.53	45.00	0.075(0.117)
	Female	46.88	53.47	55.00	
Race	Malaysian	38.06	97.03	33.00	0.294(0.000)
	Chinese	31.61	2.97	31.00	
	Indian	28.17	0.00	34.00	
	Others	2.15	0.00	2.00	
Age	21-30	59.57	55.45	55.50	0.061(0.458)
	31-40	31.40	37.62	37.00	
	41-50	8.39	6.93	6.00	
	Above 50	0.65	0.00	1.50	
Income	Below RM 1000	11.02	3.03	19.80	0.126(0.007)
	1001 - 2000	25.27	30.30	21.32	
	2001 - 3000	45.79	44.44	43.65	
	3001 - 4000	12.31	16.16	11.17	
	Above 4000	5.62	6.06	4.06	

Note: CB: Conventional (domestic) banks, IB: Islamic banks, FB: Foreign banks

Table 3: Banking behavior of customers of different types of banks.

	Item	Category	CB	IB	FB
Usage of Banking Transactions (Relative frequency in %)	Branch banking	Yes	78.7	83.2	70.5
		No	21.3	16.8	29.5
	ATM	Yes	93.8	99.0	76.5
		No	6.2	1.0	23.5
	Phone banking	Yes	23.4	25.8	22.5
		No	76.6	74.2	77.5
	Online banking	Yes	51.8	35.6	35.0
		No	48.2	64.4	65.0
Factors affecting the choice of the bank (Relative weight in %)	Branding		7.31	4.75	9.01
	Convenience		25.45	22.07	25.15
	Recommendation		5.38	4.19	6.25
	Company requirement		9.62	14.25	9.45
	Variety of products		8.59	4.75	9.74
	Rate charges		11.47	5.87	12.21
	Flexibility in account handling		8.65	6.70	7.70
	Customer friendly		10.26	6.15	9.45
	Adherence to Islamic law		3.33	21.51	1.74
	Provision of profit sharing investment		5.00	5.03	4.65
	Provision of interest free products		4.94	4.75	4.65

The company requirement is third important factor for the choice of Islamic banks. This is so because most of the Malay organizations have strong associations with Islamic banks for their business transactions as their banking activities are consistent with the principles of Sharia law and its practical application through the development of Islamic economics. As a result, these organizations expect their employees to have their personal accounts in the same bank for convenience and uphold the goodwill with the bank.

Reliability of Measures: Likert Scale vs Fuzzy Linguistic Scale: The internal consistency of each dimension in the present context is tested using Cronbach's Coefficient á. This statistic is the most common estimate of internal consistency of items in a model. It assesses how well a set of items measures a single unidimensional object. A high value of reliability could imply that the indicators are measuring the same underlying construct. Table 4 displays the reliability values of all the six dimensions on perception and gap

Table 4: Comparison of Cronbach's Alpha Value.

			Cronbach's Alpha	
	Dimension	No. of Items	Likert Scale	Fuzzy Scale
Perception	Tangibility	4	0.664	0.904
	Reliability	5	0.863	0.959
	Responsiveness	5	0.872	0.962
	Assurance	4	0.835	0.953
	Empathy	4	0.804	0.944
	Convenience	4	0.733	0.926
Gap	Tangibility	4	0.697	0.908
	Reliability	5	0.860	0.957
	Responsiveness	5	0.856	0.957
	Assurance	4	0.828	0.949
	Empathy	4	0.852	0.955
	Convenience	4	0.802	0.941

scores for both the scales, viz., Likert and Fuzzy linguistic. The result showed dimensional reliability between 0.664 and 0.872 for the Likert scale and between 0.904 and 0.962 for the Fuzzy linguistic scale for perception whereas, the reliability coefficient of SERVQUAL dimension gaps varies between 0.697 and 0.860 for the Likert Scale and 0.908 and 0.957 for Fuzzy linguistic scale. The reliability values of all 6 dimensions are relatively much higher for Fuzzy linguistic scale compared to Likert scale for perception as well as SERVQUAL dimension gaps. This indicates that the Fuzzy linguistic scale creates more internal consistency and stability than the Likert scale. Hence, further analysis on service quality is restricted to fuzzy linguistic scale.

Verification of Basic Assumptions for Parametric Test: In conventional statistical procedures, known as parametric tests, a sample statistic is obtained to estimate the population parameter. As this estimation process involves a sample, a sampling distribution and a population, certain parametric assumptions are required to ensure all components are compatible with each other. Before analyzing the SERVQUAL gaps and comparing the service quality across the market segments or groups of customers based on demographic characteristics, rigorous parametric statistical tests are carried out on the customers' data on perception and gap scores to determine whether the basic assumptions of ANOVA are satisfied.

Independence Test: The sample for the current study has been chosen randomly and thus it satisfies the independence assumption.

Normality Check: It is always correct to compare means and by definition parametric statistics assume that the data that is being tested are normally distributed. Sample data sets are often skewed to the right for various reasons and unless the data are normalized, the comparison of mean scores across the groups is not statistically correct. The Kolmogorov-Smirnov statistic test is used to test the hypothesis that the data are normally distributed. A low significance value (<0.05) indicates that the distribution of the data differs significantly from a normal distribution. Normality test has been performed on perception as well as gap score for each dimension with respect to market segment and four important demographic characteristics, namely age, income, race and gender.

Market Segment Vs. Dimension Scores: From Table 5, one can observe that except the gap score on reliability for foreign banks, the scores on perception as well as gap on all other dimensions in all the three groups of banks show significant results, thus indicating that in general, the distribution of data differs significantly from a normal distribution for both perception as well as gap data.

Demographic Variables Vs. Dimension Scores: So far as the variable age is concerned, lower age groups show significant results and hence violate the assumptions of normality. However, the higher age groups, mainly "Above 50" show insignificant results ($p > 0.05$) in most of the dimensions for perception as well as gap scores and thus meet the normality assumption. Except other race, all other groups show significant results and thus confirming that most of the groups for the variable "race" do not meet the normality assumption with respect to six dimension scores of both perception and gap scores. Further, the test results reveal that most of the income groups are significant with respect to six dimensions of both perception and gap scores and thus can be inferred that the groups in general, do not meet the normality assumption. Finally, both the groups of the variable "gender" shows significant results with respect to dimension scores of both perception and gap scores and thus confirming that neither of the groups meet the normality assumption (see Appendix A).

Equality of Error Variance: One-way ANOVA assumes that the variances of the groups are all equal. Levene's test is used for testing the null hypothesis that the variances of the group are the same. For the market segment, Levene's Test for equality of error variance is significant ($p<0.05$) in all the dimensions for both

Table 5:Kolmogorov-Smirnov test for normality test – Market Segment.

		Perception Fuzzy		Gap Fuzzy	
Dimension	Segment	KS Statistic	Sig.	KS Statistic	Sig.
Tangibility	Conventional	0.122	0.000	0.084	0.000
	Islamic	0.154	0.000	0.121	0.001
	Foreign	0.113	0.000	0.122	0.000
Reliability	Conventional	0.101	0.000	0.082	0.000
	Islamic	0.135	0.000	0.135	0.000
	Foreign	0.119	0.000	0.055	0.200
Responsiveness	Conventional	0.108	0.000	0.055	0.002
	Islamic	0.098	0.018	0.090	0.043
	Foreign	0.111	0.000	0.092	0.000
Assurance	Conventional	0.116	0.000	0.099	0.000
	Islamic	0.169	0.000	0.134	0.000
	Foreign	0.105	0.000	0.066	0.036
Empathy	Conventional	0.107	0.000	0.075	0.000
	Islamic	0.114	0.002	0.101	0.013
	Foreign	0.143	0.000	0.136	0.000
Convenience	Conventional	0.088	0.000	0.058	0.001
	Islamic	0.104	0.009	0.108	0.005
	Foreign	0.103	0.000	0.131	0.000

Note: $p<0.05$ indicates that the distribution of the data differs significantly from a normal distribution.

Table 6: Levene's test for homogeneity of variance.

	Test of Homogeneity of Variances – Market Segment			
	Perception		Fuzzy	
Dimension	Levene's Statistic	Sig.	Levene's Statistic	Sig.
Tangibility	3.012	0.050	6.257	0.002
Reliability	14.344	0.000	6.524	0.002
Responsiveness	15.848	0.000	7.165	0.001
Assurance	6.227	0.002	0.480	0.619
Empathy	0.536	0.585	5.682	0.004
Convenience	3.106	0.045	6.484	0.002

perception and gap scores, except for the dimensions empathy for perception and assurance for scores. In general, one can observe from Table 6 that the assumption of homogeneity of variance has been violated with respect to market segment.

However, Levene's Tests for equality of error variance are insignificant (*p*> 0.05) for all the demographic characteristics in most of the dimensions for both perception and scores and thus conforms that in general, assumption of homogeneity of variance has not been violated with respect to demographic characteristics (see Appendix B).

The assumptions of normality as well as the equality of error variance have been violated for most of the dimensions based on market segment. Though the assumption of equality of error variance has been met for most of the dimensions based on demographic characteristics, the assumption of normality has been violated in general. Hence, the further analysis is restricted to non-parametric tests for testing the differences in perception and service quality gaps across the market segments as well as groups based on demographic characteristics.

Table 7: Comparison of banks w.r.t service quality factors.

Dimensions	Chi-Square	p-value
Perception-Fuzzy		
Tangibility	5.680	0.058
Reliability	3.327	0.189
Responsiveness	2.886	0.236
Assurance*	7.507	0.023
Empathy	0.331	0.847
Convenience*	6.797	0.033
Gap-Fuzzy		
Tangibility*	11.743	0.003
Reliability*	11.148	0.004
Responsiveness	2.070	0.355
Assurance	1.719	0.423
Empathy*	6.545	0.038
Convenience*	15.038	0.001

Note: *Indicates that the difference of dimension score across three banks is statistically significant at 95 per cent level of confidence.

Service quality comparison across different market segments: The three market segments are compared with respect to six quality dimensions using a non-parametric Kruskal Wallis test on Fuzzy linguistic scaled data on perception and gap. It can be inferred from Table 7 that there exists a significant difference on perception on two dimensions namely, assurance and convenience. Similarly, there exist significant difference son service quality gaps across the three market segments with respect to the dimensions-tangibility, reliability, empathy and convenience. Further analysis on pair-wise comparisons is carried out using a non-parametric Mann-Whitney U test to investigate which pair of market segments shows significant differences.

Table 8 reveals a significant difference in perception on assurance between Islamic and foreign banks. Islamic banks provide relatively more assured services to its customers compared to foreign banks with the median perception score of 0.650 and 0.575 respectively. Similarly, there is significant difference in perception on convenience between conventional and Islamic banks with median perception score of 0.575 and 0.538 respectively. Thus, customers of conventional banks experience services more conveniently compared to the customers of Islamic banks.

The service quality gap is significantly different between conventional and Islamic bank with respect to the only dimension, i.e., convenience with the median gap score as -0.275 and -0.325 respectively. There is no significant difference between the two market segments with respect to any other dimensions. However, the service quality gaps in foreign banks are significantly higher compared to conventional as well as Islamic banks with respect to the dimensions, tangibility with median gap scores as -0.213, -0.200 and -0.175and reliability with median gap scores as -0.240, -0.210 and 0.200 respectively. Additionally, the service quality gap in foreign banks is significantly higher than the conventional banks in terms of empathy with median gap scores as -0.256 and -0.250 respectively. The only dimension that shows significantly lower gap in foreign banks compared to conventional and Islamic banks is convenience with median gap score as -0.263, -0.275 and -0.325 respectively.

Service Quality Comparison Across Different Groups Based on Demographic Characteristics: Next, the differences in service quality dimensions are tested across different groups of customers based on demographic characteristics, such as, age, income, race and gender. The results of the non-parametric Kruskal Wallis test for all the demographic variables are reported in Table 9. The Mann-Whitney U test statistics of differences in perception as well as gap scores between all the possible pairs of groups for all demographic variables are shown in Appendix C.

Table 8: Pair-wise comparisons - Mann Whitney U Test.

	Conventional Vs Islamic		Islamic Vs Foreign		Conventional Vs Foreign	
Dimensions	Z	p	Z	P	Z	p
Perception						
Assurance	-1.871	0.061	-2.743	0.006	-1.503	0.133
Convenience	-2.524	0.012	-1.621	0.105	-1.104	0.270
Gap						
Tangibility	3.319	0.068	12.147	0.000	11.743	0.003
Reliability	2.636	0.104	11.254	0.001	11.148	0.004
Empathy	0.072	0.789	3.152	0.076	6.545	0.038
Convenience	6.577	0.010	13.652	0.000	15.038	0.001

Note: The p-value less than 0.05 indicate the difference is significant and the pair of banks is significantly different.

Table 9: Comparison of Service Quality dimensions across the groups based on demographic characteristics.

	Age		Race		Income		Gender	
Perception	Z-Value	p-value	Z-Value	p-value	Z-Value	p-value	Z-Value	p-value
Tangibility			4.770	0.189	30.303	0.000	-2.290	0.022
Reliability	14.168	0.003	11.758	0.008	25.562	0.000	-2.189	0.029
Response	9.426	0.024	6.887	0.076	22.246	0.000	-3.163	0.002
Assurance	7.933	0.047	7.353	0.061	16.917	0.002	-2.563	0.010
Empathy	9.819	0.020	4.743	0.192	27.505	0.000	-2.347	0.019
Convenience	13.323	0.004	2.122	0.547	36.491	0.000	-2.160	0.031
Gap								
Tangibility	17.617	0.001	10.429	0.015	41.996	0.000	-3.709	0.000
Reliability	15.922	0.001	19.945	0.000	31.834	0.000	-3.233	0.001
Response	15.189	0.002	10.805	0.013	23.937	0.000	-3.765	0.000
Assurance	17.005	0.001	7.358	0.061	18.902	0.001	-3.207	0.001
Empathy	17.581	0.001	3.585	0.310	24.180	0.000	-2.796	0.005
Convenience	19.622	0.000	2.764	0.429	35.906	0.000	-2.294	0.022

Note: p-value < 0.05 indicates that the difference in dimension score across different groups is significant at 95 per cent level of confidence.

The perception as well as gap for all the six dimensions is found to be significantly different across the four age groups. The customers of the age group “21-30” have significantly higher perception and lower service quality gaps for all six dimensions compared to the customers of the age group“31-40”. In the early stage of usage, customers might have limited experiences with all types of bank services. So there is every likely the case that their good perception on few aspects of bank services they are exposed with, might influence them to rate highly on the overall aspects of the banks. Similarly the service quality gaps of the age group “41-50” are significantly lower than the customers of the age group “31-40” in terms of all the dimensions except empathy. Finally, the service quality gaps of the customers of the age group “above 50” are significantly lower than the customers of the age group “31-40” in terms of all the dimensions except reliability. Ganesan-Lim *et al*. [68] elucidated the effect of demographic variables to perceived service quality where the age of customers affect their perceived service quality. Our study supports the claim made in their study. In general, the service quality gaps are observed to be higher in the middle age group compared to young and old-aged groups.

The perception on service quality does not differ significantly across different races except for the dimension reliability. However there is significant difference in service quality gaps across the races with respect to three dimensions namely, tangibility, reliability and responsiveness. Pair-wise comparison of different groups of race on the service quality dimensions are reported in Appendix C. The perception on reliability is found to be significantly lower among Chinese compared to Malay and Indian with median perception scores for Chinese as 0.590 and each of other two races as 0.620. Thus, both Malay and Indian customers perceive the services of the banks as relatively more reliable than the Chinese customers. Further, the service quality gaps are significantly higher in terms of all the three dimensions for the group of Chinese customers compared to Malay and Indian customers with median gap scores for Chinese on tangibility, reliability and responsiveness as -0.213, -0.240 and -0.250 respectively and both Malay and Indian each with median gap scores as -0.175, -0.210 and -0.210 respectively. Chinese customers have relatively higher expectations of services compared to other two races on the dimensions of reliability and responsiveness.

As it can be observed from the table, there are significant differences across the income groups in terms of all the six dimensions on both perception as well as gap scores. The pair-wise comparisons reveals that the customers of the income group “below RM 1000” perceive service quality significantly higher than the customers of income groups “1001-2000” and “2001-3000” in terms of all the dimensions, higher than the customers of income group “3001-4000” in terms of tangibility and empathy and higher than the customers of income group “above RM 4000” in terms of all the dimensions except responsiveness and assurance. Similarly, the perception of the customers of the income group “3001-4000” is significantly higher than the customers of income group “1001-2000” in terms of all dimensions except tangibility and reliability and higher than the customers of income group "2001-3000" in terms of all the dimensions except tangibility. The service quality gap is found to be significantly lower for the income group "below RM 1000" compared to any other income groups in terms of all six dimensions. This could be possibly because of the fact that the low income group customers are confined more towards selected services of banks such as ATM and internet banking and hardly need to walk to the bank branches for their day-to-day transactions. Their perceptions on all the dimensions of service quality of banking services are thus based on their exposure to limited bank services. Thus, their high perceptions on the limited services they are exposed to are likely to inflate their overall perception on all the dimensions of service quality, which in turn, might result in low service quality gaps.

Finally it can be revealed from the last two columns of Table 9 that perception as well as the service quality gaps differs significantly between male and female customers in all the six dimensions. Female customers perceive the service quality of banks higher than male customers in all dimensions. This in turn has resulted in significant difference in the gap scores between male and female customers with relatively higher service quality gaps for the male customers. The median service quality gaps of male and female groups on six dimensions are respectively (-0.213, -0.175), (-0.220, -0.210), (-0.250,-0.210), (-2.13, -0.188), (-0.263, -0.225) and (-0.288, -0.263), where the first and second figures inside the bracket respectively indicate the gap score for male and female groups. In Muslim countries male is responsible for financial activities outside the home while female performs domestic activities inside the home [69-71]. Due to these factors men have more access to banking, education and insurance facilities as compared to women [72]. In one of the studies, Ayadi [73] concluded that female bank customers are engaged in lesser banking activities than male customers due to lower income [74, 75 and 76]. Female customers are likely to rate dimensions of service quality high, if their perceptions on limited exposed service are high.

CONCLUSION

It is well known that the perception and expectation on service quality are generally expressed subjectively and in vague linguistic term. The current study proposes a conceptual model to assess the service quality gapin Malaysian banking sector using fuzzy set theory. Further, the study uses non-parametric approach to compare the service quality gaps with respect to 6 critical factors across three market segments namely, conventional, Islamic and foreign banks as well as across different groups of customers based on their 4 important demographic characteristics. The findings reveal that the Fuzzy linguistic scale creates higher internal consistency and stability than the Likert scale in all the dimensions of service quality. A comparison of service quality across the market segment reveal that the service quality gap is significantly higher in Islamic bank compared to conventional bank, which is significantly higher compared to the foreign banks. Thus, foreign banks in Malaysia have been relatively more successful in providing the services to their customers conveniently. Despite the initial restrictions imposed on foreign banks in Malaysia, which were designed to provide domestic banks with an early start advantage, foreign banks caught up very quickly and maintained their lead in banking technology to provide the services to their customers more conveniently through internet/phone banking as well as more advanced ATM services. Group-wise analysis based on demographic characteristics shows that the service quality gaps for male customers in terms of all 6 dimensions are significantly higher than the female customers irrespective of the market segment. Similarly the service quality gap perceived by Chinese customers is significantly higher because of higher expectation than Malay and Indian customers in terms of tangibility, reliability and responsiveness. Further, the service quality gap is lower for young and old-aged customers compared to the middle-aged customers and lower for low-income customers compared to other income group customers.

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