Service Quality Indicators in Education Setting: Application of RIDIT Method to Likert Scale Surveys

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CERTIFICATE

This is to certify that the thesis entitled "**Service Quality Indicators in EducationSetting: Application of RIDIT Method to Likert Scale Surveys**" submitted by ***Bidhan Kumar Pradhan*** in Mechanical Engineering at the National Institute of Technology, Rourkela (Deemed University) is an authentic work carried out by him under our supervision and guidance.
To the best of our knowledge, the matter embodied in the thesis has not been submitted to any other University / Institute for the award of any Degree or Diploma.

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Abstract:

Likert scale is an efficient tool that is utilized to gather data related to attributes, perceptions, values, intensions, habits and behavior changes. The present work illustrates application feasibility of RIDIT method adapted from Multi-Criteria Decision Making (MCDM) to Likert scale surveys. The proposed method has been used for selection of quality attributes in technical education setting. The performance of an institute is likely to be influenced by quality of the teacher, quality of the students, infrastructure, administration, extent of training and placement and many others. It is felt that quality and performance evaluation is necessary not only for appraisal but it is also required to improve overall service quality. In consideration of the above, the study highlights that service quality as a multi-attribute estimate. Application of RIDIT method has been proposed to determine the significant factors influencing overall quality index of an institute that would be helpful in comparing various institutes and selecting the best one for academic purposes.

Keywords: Likert scale, RIDIT method, Multi-Criteria Decision Making (MCDM)

1. Introduction

The concept of quality while applied to education sector is not well defined. Definitions of quality in education follow the general definitions of quality. The term has been defined in many ways like “excellence in education”, “value addition in education”, “fitness of educational outcome and experience for use”, “defect avoidance in the education process”, and “meeting or exceeding customer’s expectations of education”. Variations in conceptualizations of quality as well as performance in education pose extreme difficulty while formulating a single and comprehensive quality definition. Moreover, educational services are supposed to be intangible, heterogeneous, and inseparable from the administrator’s point of view whereas it is variable and perishable for the customers’ viewpoint. Further, in this highly competitive environment, students have become more discriminating in their selection and more demanding in regard to choosing appropriate colleges and universities that suits their expectations as well as perceptions. It is also important for the institutions to understand what the incoming students expect from the institution of their choice. Because, if student’s perceptions meet the extent of expectation while studying in an institute; according to students viewpoint the institute would be highly appreciated and that message would be conveyed to the junior batch of students community. Therefore, the issue of survival of the institute and the retention of the students has become an area of critical concern for most colleges and universities. Therefore, the administrators of the educational institutions should focus more on improvement of overall quality of education through continuous improvement programmes.

According to students expectations there are several factors responsible for enhancing educational quality as well as performance to satisfy their perception. However, the relative priority weights of individual factors may vary depending on variations in opinions. Therefore, which factor is to be given highest priority or vice versa; it arises a problematic situation. The common trend to tackle this type of problem is to collect expert opinion (data survey) from a number of respondents and to analyze the same to reveal the underlying behavioral nature. Another problem is the non-availability of quantitative data; because all the attributes generally taken under consideration are qualitative in nature. Therefore, expert opinion is collected in the form of scaled response. An efficient method is indeed required to analyze such type of scaled data.

I-Huei Ho et al. (2001) investigated the management and performance of engineering educational systems. The study established a performance evaluation model for engineering educational systems. The concept of balanced scorecard was explored to construct a performance evaluation model. Ana Lúcia Miranda Lopes and Edgar Augusto Lanzer (2002) addressed the issue of performance evaluation-productivity and quality-of academic departments at a University. Data Envelopment Analysis (DEA) was applied to simulate a process of cross evaluation between the departments. Emilio Martin (2003) applied DEA methodology for assessing the performance of Zaragoza University's departments (Spain). The indicators that were included in the study concerned both the teaching and the research activity of the departments. The results thereof revealed those departments that are more efficiently carrying out these activities. Finally, the author discussed about the existence of differences in the strengths and weakness between departments of different areas. John Ruggiero (2004) highlighted that in DEA with non-discretionary inputs ignores the possibility of correlation among efficiency and the non-discretionary factors. Hahn-Ming Lee et al. (2005) reported a novel personalized recommendation system with online preference analysis in a distance learning environment called *Coursebot*. Users can both browse and search for course materials by using the interface of *Coursebot*. Kosmas Kotivas et al. (2005) presented a self evaluation methodology on a specific post graduate engineering course in the critical technological area of advanced materials. The methodology developed was based on total quality management (TQM) procedures that were introduced in the higher education sector in Greece. P. Kousalya et al. (2006) applied Analytical Hierarchy Process (AHP) to a decision making problem related to an educational arena. Through survey on the expert options, the criteria that cause student absenteeism were identified and the criteria hierarchy was developed. The relative importance of those criteria for Indian environment was obtained through the opinion survey. Cai Yonghong and Lin Chongde (2006) suggested that teacher performance evaluation should find its theoretical foundation in teacher performance constructs. After making literature review, critical case study, critical interview and qualitative research, the authors proposed a new conceptual construct of teacher performance and made necessary analysis for the construct of reliability and validity in empirical approaches. Salah-Ud-Din Khan et al. (2006) developed a reliable instrument to evaluate the performance of Directors of Physical Education working in Government colleges of North West Frontier Province.

S. S. Mahapatra and M. S. Khan (2007) developed a quality measuring instrument called EduQUAL and proposed a Neural Network (NN) based integrated approach for evaluating service quality in education sector. The dimensionality of EduQUAL was validated by factor analysis followed by varimax rotation. Mary Caroline N. Castano and Emilyn Cabanda (2007) evaluated the efficiency and productivity growth of state universities and colleges (SUCs) in the Philippines. The SUCs performance was determined on the changes in total factor productivity (TFP), technological and technical efficiency. Data Envelopment Analysis (DEA) has been adopted in estimating the relative performance of SUCs. Wan Salmuni Wan Mustaffa and Hariri Kamis (2007) applied Analytic Hierarchy Process (AHP) technique to develop a staff performance appraisal system in the scenario of higher education system in Malaysia. A promotion appraisal based on the changing and globalization requirement needs a variety of criteria which should cover all their tasks, activities and contributions. The proposed technique assisted decision makers to identify and determine the priority of criteria for promoting academic staff by taking into consideration global requirements. Nina Begičević, Blaženka Divjak and Tihomir Hunjak (2007) performed factor analysis on the survey data and constructed AHP based model for decision making on e-learning implementation. Organizational readiness, that includes university framework and faculty strategy for development, as well as financial readiness, was recognized as the most influential for e-learning implementation. Mónica García Melón et al. (2008) proposed a procedure to evaluate proposals for educational innovation projects. It was reported that the proposed methodology should help the institute of educational sciences of the Polytechnic University of Valencia to choose the best Educational Project. Based on AHP the paper has been focused on the weight assignment of the different criteria chosen by the experts.

Subhajyoti Ray (2007) demonstrated the use of Analytic Hierarchy Process (AHP) to address the need of doctoral students for selection of a thesis supervisor.

Quality and performance of an institute largely depends on faculty profile, academics, infrastructure and professional growth opportunities. If they are considered as inputs to the system then pass percentage, placement and extent of contribution to academic fraternity, in terms of publications, projects and industrial consultancy etc are treated as outputs. The inputs and outputs interact in a complex manner and right combination of them determines overall quality of the institute. In doing so it is required to identify the important factors and their relative priority value in estimating institutional quality. In order to ease this decision making process encountered in such multi attribute decision making situation, two techniques viz. grey relational analysis and RIDIT method have been used and results thereof have been compared. The processes based on selection of prioritized quality attributes or indices discussed in this work enable for benchmarking of the institutes and identifies areas of improvement for enhancement of overall quality level. The application feasibility of aforesaid methods has been illustrated with the help of a case study.

2. RIDIT method

RIDIT analysis was first proposed by I. Bross and has been applied to the study of various business management and behavioral studies. RIDIT analysis is distribution free in the sense that it makes no assumption about the distribution of the population under study. Suppose that there are m items and n ordered categories listed from the most favoured to the least favoured in the scale, then, RIDIT analysis goes as follows [Chien-Ho Wu, (2007)] below.

1. Compute ridits for the reference data set

(a) Select a population to serve as a reference data set. For a Likert scale survey, the reference data set can be the total responses of the survey, if the population cannot be easily identified.

(b) Compute frequency f_j for each category of responses, where $j = 1, 2, \ldots\ldots, n$.

(c) Compute mid-point accumulated frequency F_j for each category of responses.

$$F_1 = \frac{1}{2} f_1 \qquad (1)$$

$$F_j = \frac{1}{2} f_j + \sum_{k=1}^{j-1} f_k, where\ j = 2, ..., n \quad (2)$$

(d) Compute ridit value R_j for each category of responses in the reference data set.

$$R_j = \frac{F_j}{N}, where\ j = 1, 2, ..., n. \quad (3)$$

N is the total number of responses from the Likert scale survey of interest. By definition, the expected value of R for the reference data set is always 0.5.

2. Compute ridits and mean ridits for comparison data sets. Note that a comparison data set is comprised of the frequencies of responses for each category of a Likert scale item. Since there are m Likert scale items in this illustration, there will be m comparison data sets.

(a) Compute ridit value r_{ij} for each category of scale items.

$$r_{ij} = \frac{R_j \times \pi_{ij}}{\pi_i}, where\ i = 1, ..., m. \quad (4)$$

π_{ij} is the frequency of category j for the i_{th} scale item, and π_i is a short form for the summation of frequencies for scale item i across all categories, i.e.

$$\pi_i = \sum_{k=1}^{n} \pi_{ik} \quad (5)$$

(b) Compute mean ridit ρ_i for each Likert scale item.

$$\rho_i = \sum_{k=1}^{n} r_{ik} \quad (6)$$

(c) Compute confidence interval for ρ_i. When the size of the reference data set is very large relative to that of any comparison data set, the 95% confidence interval of any ρ_i is:

$$\rho_i \pm \frac{1}{\sqrt{3\pi_i}} \quad (7)$$

(d) Test the following hypothesis using **Kruskal-Wallis** statistics W:

$$\begin{cases} H_0 : \forall i, \rho_i = 0.5 \\ H_a : \exists i, \rho_i \neq 0.5 \end{cases} \quad (8)$$

$$W = 12 \sum_{i=1}^{m} \pi_i \left(\rho_i - 0.5 \right)^2 \quad (9)$$

W follows a χ^2 distribution with $(m-1)$ degree of freedom. If H_0 cannot be accepted, examine the relationships among confidence intervals of ρ. The general rules for interpreting the values of ρ are shown below.

1. A scale item with its ρ_i value statistically deviate from 0.5 implies a significant difference in the response patterns between the reference data set and the comparison data set for the particular scale item. If the confidence interval of ρ_i contains 0.5, then it is accepted that the ρ_i value is not significantly deviate from 0.5.

2. A low value of ρ_i is preferred over a high value of ρ_i because a low value of ρ_i indicates a low probability of being in a negative propensity.

3. The response patterns of scale items with overlapped confidence intervals of ρ are considered, among the respondents, to be statistically indifferent from each other.

3. Data survey and analysis

Survey data (in 5 point Likert scale, Table 1) collected from student community of various NITs, private technical colleges as well as general colleges regarding the criteria for estimation of institutional quality as well as performance. The following factors have been selected for survey and assumed to influence educational quality level in an institute. These are as indicated below.

OP1. Location of the institute
OP2. Governing body (Govt. /semi Govt./private/autonomous body)
OP3. Number of branches (specializations in UG and PG)
OP4. Provision for studying interdisciplinary courses
OP5. Infrastructure including classrooms, labs, seminar hall, auditorium, play ground etc
OP6. Library facilities
OP7. E-learning facilities
OP8. Faculty quality
OP9. Quality of students
OP10. Administration
OP11. Professional growth opportunities and scope for entertainment
OP12. Living expenses (fooding and lodging in hostels)
OP13. Extent of medical facility

OP14. Student-teacher relationship

OP15. Discipline in hostels as well as at the institute

OP16. Student evaluation system

OP17. Fee structure

OP18. Training and placement

OP19. Research and developmental work done by the faculties

For collection of expert opinions the 5 point Likert scale has been chosen. Respondents have been directed to rate each criteria statement using a 5-point scale. The initial stage in doing RIDIT analysis is to identify a reference date set to calculate the ridits. The key to an intelligent choice of the reference data set is to achieve the space-time stability of the refined measurement system. Sometimes there is a natural choice of a reference data set. Occasionally the study series as a whole will serve as a reference data set because it is representative of some larger population. The reference data set should be representative and be large enough to ensure that the ridits of the reference data set will be stable, [Chien-Ho Wu, (2007)].

In this illustration, the whole survey data has been chosen as the reference data set. The frequencies of the responses are shown in bold figures in Table 1. The last row of Table 1 shows the ridits of the reference data set for each ordered category. As an example, the ridit value 0.98 for the category "very low (VL)" is calculated by the following expression.

$$\left(332+270+97+24+18.5\right)/760=0.98$$

The various ridits for the comparison data sets are shown in Table 2 in bold figures. The ridit value 0.2150 of category "moderate low (ML)" for scale item ***OP1*** is calculated by the following expression. $\left(10\times0.86\right)/40=0.2150$

The mean ridit of scale item ***OP1*** is calculated by the expression that follows. $\left(0.0385+0.1982+0.2150+0.1880+0.0490\right)=0.6887$

The **Kruskal-Wallis W** is calculated as follows.

$$12\times\begin{bmatrix} 40\times(0.69-0.5)^2+40\times(0.53-0.5)^2+40\times(0.66-0.5)^2+40\times(0.62-0.5)^2 \\ +40\times(0.4-0.5)^2+40\times(0.44-0.5)^2+40\times(0.46-0.5)^2+40\times(0.37-0.5)^2 \\ +40\times(0.38-0.5)^2+40\times(0.51-0.5)^2+40\times(0.58-0.5)^2+40\times(0.62-0.5)^2 \\ +40\times(0.53-0.5)^2+40\times(0.53-0.5)^2+40\times(0.51-0.5)^2+40\times(0.53-0.5)^2 \\ +40\times(0.5-0.5)^2+40\times(0.22-0.5)^2+40\times(0.46-0.5)^2 \end{bmatrix}=$$

Since the **Kruskal-Wallis W** is significantly greater than $\chi^2(19-1)=39.852$, it can be inferred that the opinions about the scale items among the respondents are statistically different somehow. From aforesaid ridit analysis a direct sorting of mean ridits in terms of the probability of being in agreeing propensity gives the following sequence (Table 3). Table 3, highlights significant attributes (ranking) affecting institutional quality according to the respondents' expert opinions.

4. Conclusion

Education is the basic human requirement and one should take effort to choose the best educational institute. Selection of academic institute depends upon several attributes related to infrastructure, faculty strength, student quality, administration, research and developmental activities, training and placement and many others. However, relative priority of these factors may vary depending on variation of individual viewpoints. In this paper an attempt has been made to rank these attributes through a strategic mathematical tool based on a databank containing a number of expert opinions. RIDIT method has been used to analyze these qualitative survey data (scaled response) and explore the relation among according to degree of importance.

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Table 1: Ridits for the reference data set

	VH (5)	*H (4)*	*ML (3)*	*L (2)*	*VL (1)*	π_i
OP01	**7**	**13**	**10**	**8**	**2**	40
OP02	**15**	**16**	**7**	**0**	**2**	40
OP03	**7**	**16**	**10**	**6**	**1**	40
OP04	**10**	**15**	**11**	**2**	**2**	40
OP05	**22**	**18**	**0**	**0**	**0**	40
OP06	**23**	**10**	**3**	**2**	**2**	40
OP07	**20**	**14**	**4**	**0**	**2**	40
OP08	**30**	**4**	**2**	**0**	**4**	40
OP09	**24**	**16**	**0**	**0**	**0**	40
OP10	**15**	**19**	**4**	**0**	**2**	40
OP11	**10**	**20**	**7**	**1**	**2**	40
OP12	**9**	**18**	**9**	**0**	**4**	40
OP13	**15**	**16**	**7**	**0**	**2**	40
OP14	**15**	**17**	**3**	**1**	**4**	40
OP15	**13**	**23**	**2**	**2**	**0**	40
OP16	**15**	**15**	**10**	**0**	**0**	40
OP17	**19**	**11**	**6**	**2**	**2**	40
OP18	**40**	**0**	**0**	**0**	**0**	40
OP19	**23**	**9**	**2**	**0**	**6**	40
f_j	332	270	97	24	37	760
$\frac{1}{2}.f_j$	166	135	48.5	12	18.5	
F_j	166	467	650.5	711	741.5	
R_j	0.22	0.61	0.86	0.94	0.98	

Note: VH: very high, H: high, ML: moderate low, L: low, VL: very low

Table 2: Ridits for the comparison data sets

	VL (5)	*L (4)*	*ML (3)*	*H (2)*	*VH (1)*	ρ_i	*L. B.*	*U. B.*
OP01	**0.0385**	**0.1982**	**0.2150**	**0.1880**	**0.0490**	0.6887	0.5974	0.7800
OP02	**0.0825**	**0.2440**	**0.1505**	**0.0000**	**0.0490**	0.5260	0.4347	0.6173
OP03	**0.0385**	**0.2440**	**0.2150**	**0.1410**	**0.0245**	0.6630	0.5717	0.7543
OP04	**0.0550**	**0.2288**	**0.2365**	**0.0470**	**0.0490**	0.6163	0.5250	0.7076
OP05	**0.1210**	**0.2745**	**0.0000**	**0.0000**	**0.0000**	0.3955	0.3042	0.4868
OP06	**0.1265**	**0.1525**	**0.0645**	**0.0470**	**0.0490**	0.4395	0.3482	0.5308
OP07	**0.1100**	**0.2135**	**0.0860**	**0.0000**	**0.0490**	0.4585	0.3672	0.5498
OP08	**0.1650**	**0.0610**	**0.0430**	**0.0000**	**0.0980**	0.3670	0.2757	0.4583
OP09	**0.1320**	**0.2440**	**0.0000**	**0.0000**	**0.0000**	0.3760	0.2847	0.4673
OP10	**0.0825**	**0.2898**	**0.0860**	**0.0000**	**0.0490**	0.5073	0.4160	0.5986
OP11	**0.0550**	**0.3050**	**0.1505**	**0.0235**	**0.0490**	0.5830	0.4917	0.6743
OP12	**0.0495**	**0.2745**	**0.1935**	**0.0000**	**0.0980**	0.6155	0.5242	0.7068
OP13	**0.0825**	**0.2440**	**0.1505**	**0.0000**	**0.0490**	0.5260	0.4347	0.6173
OP14	**0.0825**	**0.2592**	**0.0645**	**0.0235**	**0.0980**	0.5277	0.4364	0.6190
OP15	**0.0715**	**0.3508**	**0.0430**	**0.0470**	**0.0000**	0.5123	0.4210	0.6036
OP16	**0.0825**	**0.2288**	**0.2150**	**0.0000**	**0.0000**	0.5263	0.4350	0.6176
OP17	**0.1045**	**0.1678**	**0.1290**	**0.0470**	**0.0490**	0.4973	0.4060	0.5886
OP18	**0.2200**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	0.2200	0.1287	0.3113
OP19	**0.1265**	**0.1373**	**0.0430**	**0.0000**	**0.1470**	0.4538	0.3625	0.5451

Kruskal-Wallis W = ; $\chi^2(19-1) = 39.852$

Note: L.B: lower bound of the 95% confidence interval of mean ridit ρ_i. UB: upper bound of the95% confidence interval of mean ridit ρ_i

Table 3: Ranking of quality attributes in an education setting

Opinion/ criteria	*Ranking*
OP01	**18**
OP02	**11**
OP03	**17**
OP04	**16**
OP05	**4**
OP06	**5**
OP07	**7**
OP08	**2**
OP09	**3**
OP10	**9**
OP11	**14**
OP12	**15**
OP13	**11**
OP14	**13**
OP15	**10**
OP16	**12**
OP17	**8**
OP18	**1**
OP19	**6**