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A Framework for Ranking Hospitals Based on Customer Perception Using Rough Set and Soft Set Techniques

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ABSTRACT

Hospital ranking is a cumbersome task, as it involves dealing with a large volume of underlying data. Rankings are usually accomplished by comparing different dimensions of quality and services. Even the quality care measurement of a hospital is multi-dimensional: It includes the experience of both clinical care and patient care. In this research, however, the authors focus on ratings based only on customer perception. A framework which consists of two stages—Stage I and Stage II—is designed. In the first stage, the model uses a rough set in a fuzzy approximation space (RSFAS) technique to classify the data; whereas in the second stage, a fuzzy soft set (FSS) technique is employed to generate the rating score. The model is employed for comparing USA hospitals by region using annual HCAHPS survey data. This article shows how ranking of the healthcare institutions can be carried out using the RSFAS (rough set in a fuzzy approximation space) and fuzzy soft set techniques.

KEYWORDS

Decision making, Fuzzy soft set, Hospital rating, Rough set on fuzzy approximation space, Service quality

1. INTRODUCTION

The choice of hospital is very critical for a family—particularly if any family members are facing a serious or complex health problem. To select a best choice from among an array of options is an arduous task. This process becomes even more strenuous when the evaluation criteria are vague or qualitative and when the objectives vary in importance and scope. Additionally, the types of healthcare providers, their functionality, the specialists involved, and the facilities provided are distinct. Hence, there must be a decision tool which would augment the task of searching hospitals when needed. In hospital ranking, healthcare providers and medical centres are assessed by speciality—i.e., cardiology, cancer, ENT, urology, diabetes, neurology, pulmonology, nephrology, gynaecology, orthopaedic, ophthalmology, gastroenterology, etc. Besides calculating which hospitals provide the finest care for the most serious or complicated medical conditions, there is a need for focusing on those hospitals with a perfect record of common care (which is defined as care involving relatively commonplace conditions and procedures).

It is clear from various readings that better service quality boosts customer satisfaction (Radwin, 2000; Gremler, Gwinner, & Brown, 2001; Kumar, Smart, Maddern, & Maull, 2008). The impact of service quality on customer satisfaction has been extensively discussed by many authors (Lee, 2012;

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Bohm, 2013; Chia-Wen, Ting-Hsiang, & Woodside, 2013; Prabhakar, 2014). Perceived quality of service has a direct influence on satisfaction (Lee, Lee, & Yoo, 2000; Ladhari, 2009).

Today's patients are taking active role in selecting healthcare providers. Accurate ratings of hospitals are essential—as such measures regard health and well-being. However, there is no agreement between the reports of leading healthcare rating agencies. These agencies agree neither on the top-ranking hospital nor on the bottom-ranking hospital (Rothberg, Morsi, Benjamin, Pekow, & Lindenauer, 2008). This is due to variations in methods used by the rating systems. Austin et al. (2015) compare the reports of four national rating systems. The finding is that there is a lack of agreement among their ratings. This is because each system has its own rating method; and each system has a different measure of outcomes.

A study by Beukers, Kemp, and Varkevissar (2014) revealed that in a setting where prices do not matter for patients due to health insurance coverage, travel time is most significantly impactful when choosing a hospital, followed by the hospital's quality ratings and wait time. Studies on the ranking of hospitals by evaluating the quality of service in those hospitals have been done in different countries. A few of them are listed below:

- In order to determine the top hospital focusing on excellent service quality, multiple criteria decision making (MCDM) methods—Topsis, Yager's min-max technique, OWA, and compensatory AND methods—are being employed to rank few a Turkish hospitals (Akdag, Kalayer, Karagoz, Zulfikar, & Giz, 2014).
- An analysis of hospital service quality in Indonesia is carried out by Handayani, Hidayanto, Sandhyaduhita, Kusian, & Ayuningtyas (2015). This research study analyzes the dimensions required by the hospital to increase the quality of hospital services. These dimensions are human resources, process, policy, and infrastructure.
- Li et al. (2015) investigate the service quality of hospitals in nine Chinese cities. The SERVQUAL scale method was used to investigate the patient's perception of service quality at hospitals which have outpatient and inpatient facilities.
- Another study to determine service quality in the healthcare industry was conducted by Lupo (2016) in the Sicilian region of Italy. It employs an analytic hierarchy process (AHP) to obtain service quality expectations. This study revealed that service quality improvement should focus on the responsiveness of healthcare staff; the teamwork of staff; the ability of doctors to understand patient needs; self-reliability; and the swiftness of the registration-and-admission procedure.
- Meesala and Paul (2018) studied quality and consumer satisfaction in an Indian context. Their observation reflects reliability, and responsiveness contributes significantly to patient satisfaction as compared to other dimensions such as tangibility, empathy and assurance, and patient satisfaction—which, in turn, are proportional to the patient's loyalty to the hospital.

Most of the work uses the service quality framework known as SERVQUAL to measure the quality of services. (Buyukozkan, Cifci, & Guleryuz, 2011). The most widely known and discussed scale for measuring service quality is SERVQUAL. It was proposed by Parasuraman, Zeithamal, and Berry (1985). Initially, they identified 10 components of service quality: reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding, and tangibles. Then, in their 1988 work, (Parasuraman, Zeithamal, & Berry, 1988), they limited these components into five dimensions: reliability, assurance, tangibles, empathy, and responsiveness. This scale has been applied in the healthcare field in numerous studies (Dagger, Sweeney, & Johnson, 2007; Andaleeb, 2001; Bakar, Akgün, & Al Assaf, 2008; Bowers & Kiefe, 2002; Dean, 1999; Devebakan, 2005; Devebakan & Aksarayli, 2003; Lee & Yom, 2007; Lee, Lee, & Yoo, 2000; Li, 1997; Ramsaran-Fowdar, 2008; Pakdil & Harwood, 2005; Wisniewski & Wisniewski, 2005).

Researchers generally make inferences by employing statistical techniques. This growing tendency gets accented in making efficient use of organisational data through data mining and data warehousing

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