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# ALTERNATIVE APPROACH TO ANALYSING DATA OBTAINED WITH LIKERT SCALE

# LİKERT ÖLÇEĞİ İLE ELDE EDİLEN VERİLERİN ANALİZİNDE ALTERNATİF BİR YAKLAŞIM

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**Abstract**

Scales are defined as instruments developed to measure attitudes, behaviours, reactions, evaluations, etc. regarding a particular subject or object. In the literature, the Likert scale developed by Rensis Likert is generally used in studies conducted in the field of social sciences. In the analysis of the data obtained through the Likert Scale, according to the structures of the scales, while the total score is taken in some scales, the average scores related to the subdimensions are calculated in some scales and the analyses are made based on these data. In studies where analyses are made by taking the averages of both total and sub-dimensions, calculations are generally made under the assumption that the sub-dimensions and variables in the scales are of equal importance for the decision maker. The dimensions of the scale or the variables in the scale may have different importance weights in terms of evaluating the measured phenomenon according to the sector, product, region, country, culture, etc. variables. In this case, calculating the importance weight values of the scale sub-dimensions and/or variables and multiplying the variable values by these weight values may provide more accurate measurement and analysis for the decision maker. In this study, an approach in which the importance weights of the sub-dimensions of the scales are calculated with the AHP (Analytic Hierarchy Process) method is presented. The findings of the study revealed that the proposed approach can change the results in some statistical analyses.

**Keywords:** Likert Scale, Data Collection, Statistical Analysis, Analytic Hierarchy Process

**Özet**

Ölçekler belirli bir konuya veya nesneye ilişkin tutum, davranış, tepki, değerlendirme vb. yargıları ölçmek amacıyla geliştirilen araçlar olarak tanımlanmaktadır. Literatürde sosyal bilimler alanında yapılan çalışmalarda genellikle Rensis Likert tarafından geliştirilen Likert ölçeği kullanılmaktadır. Likert Ölçeği yoluyla elde edilen verilerin analizinde ölçeklerin yapılarına göre bazı ölçeklerde toplam skor alınırken, bazı ölçeklerde alt boyutlara ilişkin ortalama skorları hesaplanmakta ve analizler bu verilere dayalı olarak yapılmaktadır. Gerek toplamlı gerekse alt boyutlara ilişkin ortalamaların alınması yoluyla analiz yapılan çalışmalarda, genellikle ölçeklerde yer alan alt boyutların ve değişkenlerin

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karar verici açısından eşit öneme sahip olduğu varsayımı altında hesaplamalar yapılmaktadır. Ölçeğin boyutları veya ölçekte yer alan değişkenler sektöre, ürüne, bölgeye, ülkeye, kültüre vb. değişkenlere göre ölçüm yapılan olguyu değerlendirmek bakımından faklı önem ağırlığına sahip olabilir. Bu durumda daha sağlıklı ölçüm ve analiz yapılabilmesi için ölçek alt boyutlarının ve/veya değişkenlerin önem ağırlık değerlerinin hesaplanması ve değişken değerlerinin söz konusu ağırlık değerleri ile çarpılması, karar verici bakımından daha doğru ölçüm ve analiz yapılma imkanı sağlayabilir. Bu çalışmada ölçeklerin alt boyutlarının önem ağırlıklarının AHP (Analytic Hierarcy Process) yöntemi ile hesaplandığı bir yaklaşım ortaya konulmuştur. Çalışmada elde edilen bulgular önerilen yaklaşımın bazı istatistiksel analizlerde sonucu değiştirebildiğini ortaya koymuştur.

**Anahtar Kelimeler:** Likert Ölçeği, Veri Toplama, İstatistiksel Analiz, Analitik Hiyerarşi Süreci

## INTRODUCTION

Measurement is defined as the process of assigning values to the properties related to the evaluated elements. Instruments developed to measure the values of variables related to the characteristics of interest are referred to as scales. Scales are developed by following steps in accordance with certain procedures to measure judgments such as attitude, behaviour, reaction, evaluation, etc. regarding a certain subject or object. In the literature, the Likert scale developed by Rennis Likert is generally preferred in studies conducted in the field of social sciences. Likert scale is a five-point scale, where 1: Strongly Disagree, 5: Strongly Agree: Strongly agree, and 5: Strongly agree are used as five values. The scales generally consist of sub-dimensions. With the statements in the scale, a measurement is made regarding a specific sub-dimension related to the concept/phenomenon being studied.

The main purpose of this study is to present an alternative approach for analysing the data obtained with the Likert scale. According to the method commonly applied in the studies in the literature, the total scores of the variables in the scale are taken or the data are analysed by taking the arithmetic mean of the variables in the dimension in question according to the results of the validity and reliability analysis. While summing the variable scores and taking the arithmetic mean of the variables under the dimensions, the weight of each variable and dimension is evaluated equally. However, in real life, the meaning of each sub-dimension of the scale and the variables related to the dimensions may not always be the same for the respondents. The dimensions of the scale or the variables in the scale may have different importance weights in terms of evaluating the measured phenomenon according to the sector, product, region, country, culture, etc. variables. In such a case, weighting the dimensions and the variables in the scale in obtaining both the total scale score and the factor scores, and obtaining the total score or average score by taking these weight values into account may allow more appropriate results to be obtained. In this context, in this study, a method in which the sub-dimensions of a scale developed to measure the level of job satisfaction of employees are weighted with the Analytic Hierarchy Process (AHP) method is presented. The results obtained with the method commonly used in the literature are compared with the results obtained with the weighting method proposed in the study.

In the literature, the discussions on the Likert scale have generally focused on how many categories the scale will have and whether the data obtained with the Likert scale are ordinal scale data or data that should be evaluated on an interval scale. Because the number of categories is considered as the main factor determining whether the data are ordinal or interval scale, and the measurement level of the data is accepted as a determinant of which parametric or nonparametric tests will be applied (Wu, 2007:2851). In the literature, there are many studies claiming that the data obtained with Likert scale are at ordinal measurement level or interval measurement level. Jaminssion (2004) claimed that the relative values of the intervals in the data obtained with the Likert scale are not

equal to each other in terms of the decision maker and therefore the data obtained with the Likert scale are ordinal data and argued that it is more accurate to perform nonparametric tests (Subedi, 2016: 40). Turan et al. (2015) drew attention to the distinction between Likert type questions and Likert scale and stated that nonparametric tests can be applied for Likert type questions and parametric tests can be applied for Likert scale questions (Turan et al., 2015: 195). Norman (2010), on the other hand, made comparative analyses in his study and revealed that the preference of parametric tests for the data obtained with Likert scale generally allows for obtaining more accurate and statistically healthy data (Sullivan & Artino, 2013: 542). Chakrabartty (2011) put forward an approach in which the values of the statements in the scale are weighted to analyse the data obtained with Likert scale. In this study, weight values were calculated based on the relative probabilities of the values of the variables.

**Analysing The Data Obtained Through the Scale**

Scales are defined as systematic tools that allow the assignment of numerical values in order to make evaluations about objects, events, attitudes, reactions, etc. The most widely used scale type in social sciences studies is the Likert scale developed by Renis Likert (1932). Since it is easy to apply, code and analyse, it has found a wide application area in studies conducted in different fields (Turan et al. 2015: 187). The general using of Likert-type scales in the literature is 5 or 7-category scale structure (Chakrabartty, 2011, 31). In the studies in the literature, it is stated that data with 5 and 7 categories are more suitable for parametric testing (Subedi, 2016: 40). The data obtained with Likert scale questions are accepted as ordinal data in some studies and as interval scale data in some studies (Turan et al., 2015: 195).

In the analysis of the data obtained through Likert Scale, according to the structure of the scales, while the total score is taken in some scales, the average scores of the sub-dimensions are calculated in some scales, and analyses are made based on these data (İlerler, 2006: 137). While some researchers state that Likert-type scales are summed scales, some researchers state that taking the average of the statements in the sub-dimensions is more accurate in terms of parametric tests on the data obtained from the scale (Cafio & Perla, 2008: 1150). In summed scales, the total value of the scale is calculated by summing the scores of the variables in the scale under the assumption that the weight of each variable and sub-dimension is equal. In studies analysed by taking the averages of the sub-dimensions, calculations are generally made under the assumption that the sub-dimensions and variables in the scales have equal importance for the decision maker.

**Recommended Approach**

In the data obtained with the Likert scale, the weight of each variable is evaluated equally while taking the arithmetic mean of the total scores and the variables under the dimensions. However, the meaning of each sub-dimension of the scale and the variables related to the dimensions may not always be the same importance for the respondents. The sub-dimensions of the scale or the variables in the scale may have different importance weights in terms of evaluating the measured phenomenon according to the sector, product, region, country, culture, etc. variables. For example, if a scale developed to measure 8 dimensions of product quality (performance, additional features, durability, reliability, serviceability, suitability, aesthetics, perceived quality) is taken as an example, it is possible that quality dimensions have different importance weights in terms of evaluating product quality for products produced by enterprises in different sectors. The aesthetics dimension, which may be of relatively low importance for a CNC machine, may be of great importance for a mobile phone. In this case, when measuring product quality, dimensions should have different weight values according to the sector or products. The same may be true for the variables under the dimensions. While a variable under the aesthetics dimension is more important for the aesthetic measurement of the phone, it may have lower importance in terms of aesthetic evaluation of another product. In this case, weighting the sub-dimensions of the scales and the variables under the dimensions may give more accurate results that will reflect the decision maker's opinion more clearly. For this purpose, this study presents a method in which the variable scores of the scales are

weighted by AHP method. The weight values of the sub-dimensions in the scales were calculated by AHP method and variable scores were obtained by multiplying the statements related to the sub-dimensions by the weight values related to the dimensions.

The AHP method used in the study was developed by Thomas L. Saaty in the late 1970s. AHP is a multi-criteria decision-making method that addresses decision problems in a hierarchical structure and is based on pairwise comparison. Multi-criteria decision-making methods are approaches that enable the decision maker to make systematic decisions according to a large number of independent criteria (Ömürbek et al., 2013: 5). AHP is used in many studies in the literature to solve complex decision-making problems in many areas such as strategic planning, organisational resource utilisation, evaluation of strategic alternatives, selection of new production technologies, and location selection in multi-criteria situations (Yang and Shi, 2002: 5). AHP method is generally used in the literature for the calculation of criteria weights in multicriteria decision problems. AHP is a method based on subjective judgements that transforms the comparative data obtained based on experience into numerical values and enables them to be used in the decision-making process.

Table 1
Saaty's Scale of AHP Relative Importance

| Intensity | Definition |
|---|---|
| 1 | Equal Importance |
| 3 | Moderate Importance |
| 5 | Strong Importance |
| 7 | Very Strong Importance |
| 9 | Extreme Importance |
| 2,4,6,8 | Intermediate Values |

In the AHP method, after the decision alternatives and the criteria that will be the reference for decision-making are determined, a decision hierarchy is formed according to these alternatives and criteria. In the second step, a pairwise comparison matrix is formed, and weight vectors are determined for the criteria. After the calculation of the consistency degrees for pairwise comparisons, the priority values for the alternatives are calculated and ranking is made according to the calculated weight values. In the method, the upper limit for the Consistency Ratio, which shows the validity of pairwise comparisons, is set as 0.10. If the consistency ratio is less than 0.10, pairwise comparisons are considered valid. The importance levels of alternatives in pairwise comparisons are determined according to the scale given in Table 1 (Saaty, 1980: 6-24).

**Model Application**

For a better understanding of the approach proposed in the study, the data obtained from a study evaluating the job satisfaction levels of doctors in Şırnak province were used. The data obtained from a sample of 100 doctors working in the central district of Şırnak province were analysed. As a case study, it was deemed sufficient to use the data obtained from 100 people to understand the subject. As a job satisfaction scale, the job satisfaction scale translated and adapted into Turkish by Çağlar (2005) based on the job satisfaction indicators of the American Labour Institute was preferred. This job satisfaction scale consists of 17 items and five dimensions, namely employed institution, the working environment, quality of work, salary, fatigue and stress. Confirmatory factor analysis was performed and the scale was validated and the reliability coefficients of both the scale and the sub-dimensions were found to be above the value of 0.7, which is expressed as an acceptable reliability value in the literature.

In the first stage of the application, a pairwise comparison matrix was created according to the AHP pairwise comparison scale to determine the importance weights of the sub-dimensions in the scale. In the creation of the pairwise comparison matrix, the evaluation of a doctor who has a master's degree in business administration, in which the purpose of the study was explained, was taken. The pairwise comparison matrix for the sub-dimensions of the job satisfaction scale is given in Table 2.

Table 2
AHP Pairwise Comparison Matrix

| Subdimensions Of Scale | Employed Institution | Working Environment | Qualification of Work | Salary | Fatigue and Stress |
|---|---|---|---|---|---|
| Employed Institution | 1,00 | 3,00 | 1/5 | 1/3 | 1/2 |
| Working Environment | 1/3 | 1,00 | 1/7 | 1/5 | 1/3 |
| Qualification of Work | 5,00 | 7,00 | 1,00 | 2,00 | 3,00 |
| Salary | 3,00 | 5,00 | 1/2 | 1,00 | 2,00 |
| Fatigue and Stress | 2,00 | 3,00 | 1/3 | 1/2 | 1,00 |

After the creation of the pairwise comparison matrix, the importance weights of the subdimensions of the job satisfaction scale were calculated by following the application steps of the AHP method as given in Table 3.

Table 3
Importance Weights for the Sub-Dimensions of the Job Satisfaction Scale

| Subdimensions of Scale | Weight Values |
|---|---|
| Employed Institution | 0,099 |
| Working Environment | 0,049 |
| Qualification of Work | 0,441 |
| Salary | 0,260 |
| Fatigue and Stress | 0,152 |

After determining the importance weights of the sub-dimensions of the scale, the values of the variables related to the sub-dimensions were multiplied by the importance weight of each subdimension. It can be considered that the importance weight of each sub-dimension in the scale is not the same and the variables (Item- Item) related to the sub-dimensions do not have the same importance weight related to the measurement. In this case, it is possible to calculate the importance weights of the variables related to the sub-dimensions with the AHP method and multiply the variable values by the calculated importance weight and perform the analyses on the data obtained. However, in this study, since it is assumed that the importance weights of the items under the sub-dimensions are the same, the variable values were multiplied by the calculated importance weights of the dimensions. The sub-dimension averages before and after multiplying the variable values by the importance weights of the dimensions are presented in Table 4.

Table 4
Sub-Dimension Averages Before and After Weighting

| Averages Calculated Without Weight | | Average Calculated By Weight Values | |
|---|---|---|---|
| Subdimensions | Average | Subdimensions | Average |
| Employed Institution | 4,3306 | Employed Institution | 0,4287 |
| Working Environment | 4,3311 | Working Environment | 0,2122 |
| Qualification of Work | 4,1074 | Qualification of Work | 4,1074 |
| Salary | 3,7723 | Salary | 0,9808 |
| Fatigue and Stress | 4,685 | Fatigue and Stress | 0,7121 |

As seen in Table 4, after multiplying the variable values by the importance weights, the order of the mean values of the sub-dimensions changed. In cases where each sub-dimension has a different level of importance for decision makers, it can be stated that the value obtained in the second case yields healthier results. Moreover, the use of weight values can change the results in tests based on the values of the averages of two variables such as "dependent sample t test". In Table 5, the results of the independent sample t-test conducted to test the significance of the difference between the Fatigue and stress

dimension and Salary dimension averages, which have the highest and lowest averages before the use of weight values, and the results of the independent sample t-test conducted to test the significance of the difference between the quality of work dimension and employed institution dimension averages, which have the highest and lowest averages after the use of weight values, are given.

Table 5
Difference of Lowest and Highest Average Values Before and After Weight Values

| Variables | Difference of Means | t | p |
|---|---|---|---|
| Fatigue and Stress - Salary | 0,913 | 9,871 | 0,000 |
| Qualification of Work - Employed Institution | 3,895 | 43,183 | 0,000 |

According to the results shown in Table 5, the difference between the mean of the Fatigue and stress dimension, which had the highest value before the use of importance weights, and the mean of the Salary dimension, which had the lowest value, was found to be significant and the value of the t statistic was found to be 9,871. After the use of importance weights, the difference between the mean of the Quality of work dimension, which had the highest value, and the mean of the employed institution dimension, which had the lowest value, was also found to be significant, but the value of the t statistic was found to be 43,183. This analysis result is given as an example that the use of importance weights in determining the values of variables can change the result in statistical tests sensitive to the magnitude of variable values.

## CONCLUSION

In this study, an alternative approach has been put forward in which the importance weights calculated according to the subjective judgments of the decision makers regarding the subdimensions of the scale are taken into account in the analysis of the data obtained through Likert scale. In the literature, the importance weights of the sub-dimensions of the scale and the variables under the sub-dimensions are generally accepted as equal when analysing the data obtained through Likert scale. However, in field applications, in reality, especially the subdimensions of the scales may not always have the same importance weight. For example, in the use of a scale in which product quality dimensions are evaluated, the importance of aesthetic dimension and durability dimension will be different for different products. Based on this logic, in this study, a sample application was made based on the assumption that the sub-dimensions of the job satisfaction scale adapted into Turkish by Çağlar (2005) will have different importance weights for different professions.

In the application, the importance weights of the sub-dimensions of the scale in terms of the profession of doctor were obtained by using the AHP method. In order to calculate the AHP weights, the pairwise comparison matrix for the sub-dimensions was created by the evaluation of a doctor who has a master's degree in the field of processing by explaining the purpose of the study because he has knowledge about both job satisfaction and the profession. According to the results obtained with the AHP method, the highest importance weight value was obtained for the "Quality of the work" dimension, while the lowest importance weight value was obtained for the "Working environment" sub-dimension. The mean values of the sub-dimensions changed after the weighting process. In addition, according to the results of the dependent sample t-test conducted to test whether there is a significant difference between the mean values of the subdimensions, while the t-value for the difference between the mean values of the dimensions with the lowest and highest mean values before weighting was 9,871, the t-value after weighting was found to be 43,183. Accordingly, it can be said that the weighting process affects the results of the tests based on the comparison of the mean values of the variables.

After the weighting process, the values and ranking values of the variables multiplied by the weight values of the sub-dimensions naturally change. In this case, it is expected that multiplying the variables by the weights of the sub-dimensions in non-parametric tests, which are based on the ranking values of the variables, will affect the results of the tests. A result obtained as a disadvantage of multiplying the weight values of the sub-dimensions by the variables is the possibility of decreasing the overall reliability value of the scale.

Since all of the variables related to the sub-dimensions were multiplied by the same probability values in the application related to the study, the reliability values of each of the sub-dimensions did not change, but since each sub-dimension had a different weight value, the values of the variables in the scale that were related to different sub-dimensions differed, which led to a decrease in the overall reliability coefficient of the scale. The Chronbach's Alpha coefficient, which was found to be 0.841 as a result of the reliability analysis without using weight values in the application, was obtained as 0.761 according to the reliability analysis results after the variables were multiplied by weight values.

In this study, it is aimed to present a different approach for analysing the data obtained with Likert Scale. In cases where the sub-dimensions of the scale do not have equal importance in terms of measuring the phenomenon measured in contexts such as practitioner, sector, profession, field, etc., an approach has been put forward in which the importance weights of the sub-dimensions are calculated by the AHP method. In addition to the calculation of the weight values of the sub-dimensions, it may be possible to calculate the weight values of the variables by treating each variable in the scale as a sub-criteria and multiplying the variable values by these weight values if needed. In addition, as the AHP method was used in this study, it is also possible to calculate the weight values of the sub-dimensions with a different weight calculation method in the literature.

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