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A REVIEW ON THE RIDIT ANALYSIS

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ABSTRACT

Appropriate methods for analysis of ordinal data, though familiar to statisticians are less well known to practicing scientists and clinicians. Consequently, treatment of ordinal data has been inconsistent, with some investigators analyzing ordinal ratings as if they were true quantitative measurements yielding means and standard errors and others treating similar data as purely nominal categories, ignoring even the ordered nature of the responses. Ridit Analysis is a statistical method for comparing ordinal-scale responses. It was introduced by Bross as a means of comparing ordinal scale responses such as degree of injury, dissatisfaction, preference or agreement. Since then, his technique has found application in such fields as epidemiology, questionnaire design, biomedicine and psychology. The Ridit score does not require a normal distribution and preserves differences present in the (ordinal) data. It can be applied to nominal, interval and ratio data as well. The aim of this study is to introduce this method to the researchers. For this aim a simulated data was used.

Key words: Ridit Analysis, Ordinal Data.

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1. INTRODUCTION

In many scientific studies in the biological and behavioral sciences the scientist has to work with a response variable which falls in the "borderland" between dichotomous classifications (e.g. "lived-dead", "yes-no") and refined measurement systems. Sometimes the response variable is a subjective scale (such as minor, moderate, severe). At other times the response variable takes numerical values but the measurement system is heavily dependent on the quality of experimental material or the technical skill of the scientist. These "borderland" response variables may not be adequately analyzed by the chi-square family of statistical methods and at the same time the t-test family of techniques may not be appropriate. In this situation Ridit Analysis may serve as a "missing link" between the two traditional families of statistical methods (Bross, 1958).

Because effectiveness has been recorded as a dichotomous variable, methods designed for one nominal and one ordinal variable may be just as effective as those designed for two ordinal variables. One such method is Ridit Analysis (Lewis and Baldwin, 1997).

Ridit Analysis is a statistical method for comparing ordinal-scale responses. It was introduced by Bross as a means of comparing ordinal scale responses such as degree of injury, dissatisfaction, preference or agreement. Since then, his technique has found application in such fields as epidemiology, questionnaire design, biomedicine and psychology (Beder and Heim, 1990). For example, Ridit Analysis was first applied in dental research to the comparative study of marginal fracture of amalgam restoration, with fracture graded on a five point or a six point ordered scale by Fleiss and etc. (Fleiss et al., 1979).

Ridit means 'Relative to an Identified Distribution' and is originally developed and applied by Bross for the analysis of ordinal data. The Ridit score does not require a normal distribution and preserves differences present in the (ordinal) data. It can be applied to nominal, interval and ratio data as well. Ridit Analysis illustrates the relative position of the score of a particular group against an identified distribution of a reference group. According to Bross, the normal value of a Ridit score is between 0 and 1 (Goossen, 2001).

The name Ridit has its origins with the probit and logit, the ''it'' meaning type of transformation. Where probits relate to a theoretical distribution (the normal distribution), Ridits relate to an observed, empirical distribution, **R**elative to an **I**dentified **D**istribution, that is, based on the observed distribution of a variable for a set of observations (Doyle and Dorling, 2002).

The aim of this study is to introduce this method to the researchers in Turkey.

2. MATERIALS AND METHODS

In general, Bross proposed a method for assigning quantitative values to ranked categorical data. His assignment function is as follows:
Let p_i , $i = 1, 2, \ldots\ldots k$, denote the empirical proportion of N items which fall into the i th ranked category when there are k categories; then

$$\frac{1}{2}\left(\sum_{j<i} p_j - \sum_{j>i} p_j\right) + 0.5 \qquad (1)$$

is the value (called the Ridit value) assigned to category i (Brockett and Levine, 1977).

Although standard numeric and statistical methods suffice for quantitative data, ordinal data pose special problems: without further assumptions, they generate no measured amounts appropriate for numeric analysis (Donaldson, 1988).

The first step in Ridit Analysis involves the choice of an identified distribution. For this purpose, several alternatives may be offered to the practitioner. The choice of the identified distribution is the critical stage in Ridit Analysis as it forms the baseline of subsequent studies. For example, if the aim is to assess the preference of a set of products in comparison with a product that has a historical role (current product, competing product, etc.) then the distribution function associated with the latter product may be chosen as a reference distribution. The analysis will therefore focus on how products differ from this standard product. Alternatively, if no reference product emerges, the distribution function representative of the pooled data may be considered as an identified distribution (Pouplard et al., 1997).

The procedure is as follows: from a reference population with the same categories one determines a “Ridit” or score for each category. This score for each category is the percentile rank of an item in the reference population and is equal to the number of items in all lower categories plus one-half the number of items in the subject category, all divided by the population size. Once the Ridits for each category have been determined, they are taken as values of a dependent variable for the other (comparison) groups and the usual normal distribution family of statistics is applied (e.g., means, standart deviation, etc.) (Flora, 974).

Ridits for each category of the reference group are calculated as the proportion of cases below the category plus one half the proportion of cases in the category. Ridits are surrogates for the cumulative probabilities that would be observed if the response could be measured on a continuous scale. To evaluate a variable in samples from other populations using the same response scale, each category is assigned the corresponding Ridit from the reference group as a numeric score (each ‘mild’ response would receive a numeric score of 0.10, etc.). These scores are then treated as ordinary numbers to compute a ‘mean Ridit’ for each comparison group. This is the procedure that should be followed to compare study results against known norms. With experimental data, however, the ‘reference group’ is unknown, and one of the groups must be selected as the reference. Although the choice is statistically arbitrary, it is usual to consider a 'control' or 'treatment as usual' group, if one exists in the study, as the reference. Mean Ridits can then be obtained for all comparison groups relative to the chosen reference condition (To calculate standard errors and confidence intervals, it is also necessary to compute Ridits for the comparison groups as well as the reference group), (Donaldson, 1988).

As an example of the method for calculating the Ridit values with one dependent variable was presented in detail with computation scheme in Table 1. In column A, it was given the frequency distribution for the 264 patients. Column B is simply the frequencies in column A divided by 2 so that we have one-half of column A. Column C is a cumulative frequency count based on column A. Column D, which is the sum of columns B and C, gives us the needed cumulative frequencies plus one-half the frequency of the particular category of interest. Finally, in column E, the Ridit value is computed by dividing the entry in column D by N, the total number of patients in this sample. The values in column E are the Ridit values for the particular categories. Column F is a check column, which is obtained by multiplying column A by column E. This is the computation one performs in order to calculate the average Ridit for a particular class of interest and is a check in this instance because the Ridit value for the reference class should be equal to 0.50 (Norman, 1969).

Table 1. An Example for Ridit Computation

Groups	A Frequency	B ½ Column A	C Cumulative Frequency	D Columns B + C	E Ridit Values (Column D/N)	F Check (A*E)
1	4	2.0	0	2.0	0.008	0.032
2	11	5.5	4	9.5	0.036	0.396
3	17	8.5	15	23.5	0.089	1.513
4	39	19.5	32	51.5	0.195	7.605
5	60	30.0	71	101.0	0.383	22.980
6	48	24.0	131	155.0	0.587	28.176
7	40	20.0	179	199.0	0.754	30.160
8	33	16.5	219	235.5	0.892	29.436
9	12	6.0	252	258.0	0.977	11.724
Total	264		264			132.022
Average Ridit			132.022 / 264 = 0.50			

A noteworthy feature of Ridit Analysis is related to the fact that the average Ridits have a probabilistic interpretation. This property should be at the forefront of the practitioner's mind in sorting out the outcomes of any analysis based upon Ridits. This property states that the average Ridit of each product is (an estimate of) the probability that this product is better than the reference product. Thus, a product that has an average Ridit greater than 0.5 is likely to be preferred to the product taken as reference. Conversely, a product with an average Ridit smaller than 0.5 is likely to be less preferred than the reference product. In comparison, the average Ridit of the reference distribution is always equal to 0.5.

Furthermore, the Ridit Analysis also makes it possible to compare any two products with respect to each other (i.e. without involving the reference distribution). If the average Ridits of products *i* and *j* are respectively denoted by r_i and r_j, then an estimate of the probability p_{ij} that product *i* is better than product j can be obtained very simply by adding 0.5 to the numerical difference between r_i and r_j; that is

$$p_{ij} = 0.5 + r_i - r_j \tag{2}$$

Bross remarked that this rule is an approximate one which might break down if the difference $r_i - r_j$ is close to or larger than 0.5. The value 0.5 is a border value that delimits those products that are likely to be better than the 'average product' from those products that are less preferred than the 'average product' (Pouplard et al., 1997).

To check the Ridit scores, it is possible to estimate the confidence interval with the following formula:

$$1 / \sqrt{3 \times N} \tag{3}$$

For example, it is assumed that, the Ridit score is approximately 0.70, and N = 76 in the sample. Applying the formula gives the following figures:

$$1 / \sqrt{3 \times 76} = 1 / \sqrt{228} = 1 / 15.1 = 0{,}07$$

Thus the confidence intervals for this Ridit score are between

0.7 + 0.07 = 0.77 and 0.7 – 0.07 = 0.63 (Goossen, 2001).

The confidence errors for different sizes of N have been used in calculating the statistical significance of differences in average Ridit values. Differences between groups were considered statistically significant when the upper bound of the confidence interval for the lower Ridit value didn't overlap the lower bound of the confidence interval for the higher Ridit value (Norman, 1969).

To determine the meaning of the differences between groups, the odds can be calculated by A/B. A more accurate calculation is the odds ratio, which can be calculated based on the following equation:

$$(0.50 + d) / [1- (0.50 + d)] \tag{4}$$

where d is the numerical difference between average Ridits of reference and test distributions. The Odds ratio can be used as a confidence limit that an individual will be worse of than an individual in the reference distribution or be worse of than an individual from another response category. As Ridit scores are numeric scale values for variable categories, statistics as the arithmetic mean, standard deviation, standard error, analysis of variances, and principal component analysis can be used (Goossen, 2001).

Bross' paper was designed to elucidate the use of Ridits and so did not contain the mathematical ideas underlying its derivation. Bross promised to provide this derivation but it never appeared. Since Ridit Analysis is an important tool of statistical analysis, it is useful to characterize mathematical structures which lead to this assignment method. Brockett and Levine were developed two different sets of postulates which lead to essentially to Ridits (Brockett and Levine, 1977). Moreover, the exact variance and asymptotic distribution of the average Ridit is developed, including the cases in which the reference group is sampled or the comparison group is finite, by Beder and Heim (1990).

3. DISCUSSION

Ridit Analysis is suitable for the statistical processing of preference data involving ordered categories. It makes it possible to reduce the data to an easily comprehensible form without having to use complex computations and sophisticated software (Pouplard et al., 1997).

Ridit Analysis begins with the assumption that the ordered response categories represent an approximation to an underlying continuum with successive categories corresponding to consecutive intervals on the variable. But this method requires an arbitrary choice of a standard distribution against which to make comparisons. Results differ dramatically depending on this choice. Chi-square statistics and Ridit Analysis explore consistency across items within a test, but neither reveals where an individual respondent stands on the underlying concept which the test is intended to measure, or whether the test has done well in providing useful information.

Ridit Analysis, like other non-parametric procedures, can only describe differences in terms of rank order, and the precision of this description depends on the reliability of these rankings and on the number of categories in the response variable. Although more-sophisticated methods exist for analyzing ordinal response categories in terms of a presumed underlying continuum, these approaches require specialized software and generally pose far greater technical and interpretive challenges. Ridit scores, by contrast, are highly interpretable, statistically appropriate, and can be obtained directly from a table of percentages using only a calculator.

Since the mean Ridit can be derived from the Wilcoxon rank-sum test, it is not necessary to have separate hypothesis-testing procedures for the Ridit. With moderately large samples (greater than 25-30), the test of the null hypothesis of equal mean Ridit scores is equivalent to the hypothesis tested by the Wilcoxon and Mann-Whitney statistics, two interchangeable non-parametric tests provided by most computer analysis packages. For small samples, it is advisable to use programs that conduct exact non-parametric inference.

Ridit scores require minimal assumptions for valid application. To use Ridits meaningfully, one must assume that the response categories of the scale are properly ordered levels of an underlying continuum. With such data, Ridit scores are more efficient than statistics developed for purely categorical or 'nominal' scales, such as chi-square, which ignore the ordered nature of the response categories (Donaldson, 1988).

Ridit scores, unlike most purely quantitative methods, depend only on how the response categories are ordered, not on how they are coded. Even when variables have different numbers of response categories, the interpretation of their Ridit scores is similar. When there are several ordinal measures, Ridit scores provide a consistent interpretation even when the number of categories differs. Ridits can be compared consistently across several different variables, all having different numbers of categories, and even across variables measured in different studies. Like other measures of effect size, Ridit comparisons describe magnitudes of treatment effects without regard to overall sample size (although standard errors and confidence intervals depend strongly on sample size).

In summary, Ridit Analysis provides a simple alternative or adjunct to rank order statistical analysis, and may be viewed as adding an intuitively appealing, descriptive element to it (Fleiss et al., 1979).

The importance of Ridit Analysis is not yet appreciated amongst researchers in Turkey. Clearly, Ridit Analysis is being largely ignored. Researchers are unfamiliar with the concept of Ridit Analysis, or are not convinced of its fundamental importance. In conclusion, the Ridit Analysis can be used in studies without required complex analysis.

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RİDİT ANALİZİ

ÖZET

Sıralı ölçek ile ölçülmüş verilerin analizi için uygun olan metotlar, istatistikçiler tarafından bilinmesine rağmen klinisyen ve uygulama ile uğraşan bilim adamları tarafından daha az bilinen metotlardır. Dolayısıyla, sıralı verilerin sıralı yapısının göz ardı edilerek, bazı araştırmacıların yaptığı gibi ortalama ve standart hataların hesaplanabildiği kantitatif ölçümler veya nominal kategoriler gibi analiz edilmesi uygun değildir. Ridit Analizi, sıralı ölçek ile elde edilen cevapların karşılaştırılmaları için geliştirilmiş bir istatistiksel metottur. Yöntem, Bross tarafından yaralanma, tatminsizlik, tercih veya hem fikir olma düzeyleri gibi sıralı ölçekli cevapların karşılaştırılması anlamında literatüre kazandırılmıştı. Yöntem ortaya atılmasından sonra epidemiyoloji, anket düzenleme, tıbbi tedavi ve psikoloji gibi alanlarda da kullanılmıştır. Ridit değerleri normal dağılıma ihtiyaç duymaz ve sıralı verilerde mevcut olan farklılıkları belirler. Yöntem bilinen hali ile sınıflayıcı, aralıklı ve oranlı ölçek kullanılarak elde edilen verilere de uygulanabilmektedir. Bu çalışmanın amacı, araştırmacılara yöntemi tanıtmaktır. Çalışmada simülatif olarak türetilmiş veriler kullanılmıştır.

Anahtar Kelimeler: Ridit Analizi, Sıralı Veri.