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The Use of Statistics in Veterinary Sciences and The Test Methods Used

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ABSTRACT

In this study, the statistical methods mostly used in veterinary sciences were examined. Currently, a statistical audit unit is being established in all sciences and scientific journals in terms of the reliability of the study. This unit determines the reliability of the study as a result of this control by checking whether the correct method is used. Statistics starts at the design stage of the experiment and reaches the right results with the right methods. If the statistical plan is not made at the beginning of the trial, the desired results cannot be achieved. For these reasons, it would be useful to get support from a statistician in order to achieve the desired results in studies of veterinary sciences.

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INTRODUCTION

As in all experimental research sciences, statistical methods are used to analyse study results in the field of veterinary science. Statistics in general terms; production, consumption, population, health, education, agriculture, traffic, etc. in subjects, it is based on collections of data showing facts and the evaluation of these data. It is interpreted by determining whether the study results cause a significant change or how effective it is as a result of a statistical evaluation. However, the decisions and comments made in scientific studies where results are obtained using any statistical methods are shaped by the results obtained as a result of the study. Therefore, whether a decision is correct or not depends not only on the use of statistics, but also on whether the statistical method used was chosen correctly and how accurately the analysis was performed. For this reason, it is extremely important to evaluate scientific articles in terms of statistical use (Bayir and Tekin, 2022).

Veterinary science is mostly based on experimental studies. Statistical analysis is definitely required to determine the result of the experiment performed. Although there are no comparative statistics in most other sciences, it is possible to explain the results of the study using descriptive statistical methods. On the basis of these explanations which depends on the results of the study, it is accepted by the researchers. In veterinary science, however, research is supported by both descriptive and comparative analyses.

Statistics provide objectivity. When evaluating living things with the same characteristics in two different environments, statistics reveal the difference of the environment on the living thing. Conversely, in the case of different living things in the same environment or experiment, it reveals the difference of a living being. If it is the same living being and in the same environment, differences that are outside the researcher's control arise. It is necessary to repeat the study to minimise these errors. Thanks to these repetitions and safe analyses, statistical programs also provide us. In order to obtain unbiased estimates of treatment averages and trial error, the chance of one treatment falling into any trial unit must be equal to the chance of falling into another trial unit. In a well-designed experiment, it is necessary to look for features in which there is no simple, systematic error, the degree of certainty is high, and the range of validity of the results is wide (Efe *et al*., 2000).

The accuracy of statistical estimates depends on the accuracy of the figures analyzed in one place and the experimental design chosen, while the accuracy of the figures depends on the honesty of the researcher and the sensitivity he shows in his work. In this case, a researcher should definitely consult a statistician or a person who knows the subject if he does not have enough information to set up an experiment suitable for his purpose before setting up the experiment and obtaining the figures (Kayaalp and Şahinler, 1996). Otherwise, consultation after obtaining the figures often does not provide any benefit. This is because no statistical method can literally eliminate the errors that are made İn setting up the experiment. As a result, the analyses performed are scientifically incorrect or inaccurate, and the person who is consulted later becomes a partner in the scientific error made. Therefore, a researcher should consider the following issues before starting his scientific research (Bek and Efe, 1988).

1. Accurately describing the problem that is the subject of research,
2. The purpose of the study should be clearly defined,
3. To organize the problem that is the subject of the study within the framework of criticism by discussing with experts,
4. Determination of the treatments to be used in the solution of the problem that is the subject of the study,
5. The best representation of the trial material for the population,

6. Choosing a trial plan that is suitable for the purpose,
7. Determination of the number of repetitions of the experimental units to be observed,
8. The place, time, manner in which the measurements were made, etc. deciding what to do,
9. Performing statistical analysis and determining the way the results are summarized,
10. Establishment of the experiment in the light of the above mentioned,
11. Analysis after obtaining the data and interpretation of the results,
12. The result of the research should be reported clearly and clearly. Providing the necessary conditions at each of these stages will increase the scientific value of the study.

Group Comparison Tests

It is used in simple experiments where two different treatments are applied, or two different groups are compared. The hypotheses put forward in the experiment are tested using T or Z distributions depending on the number of data. A hypothesis is defined as claims or statements that are put forward about one or more populations from a statistical point of view and are possible to be true or false. When making a decision about a population, because of the population size, we have to conduct our test based on the limited amount of information provided by a sample. In order for a scientist to objective, he or she must test the claim or hypothesis put forward on the basis of evidence. For this purpose, while the "comparison of the average of two groups" method is used when comparing two different treatments, if there is a relationship between the trial units in the groups, then the "Paired Comparison Method" should be used (Akar and Şahinler, 1993).

The Method of Analysis of Variance

Analysis of variance is a statistical approach that uses whether there is a difference between the means of two different groups by using variance. Many researchers in veterinary medicine use this method. Although there are different methods used to compare the two groups (Z or T test), the most common one is the F test, i.e. Analysis of Variance (ANOVA, Analysis of Variance) (Ervural, 2020). If the number of groups to be compared is more than two, or if there are interactions between treatments, the method of variance analysis should be used.

There are some issues that should be taken into account when applying the variance analysis method. In short, they are as follows.

- Before performing a variance analysis test, variance homogeneity tests such as Fmax, Cochran, Bartlett belonging to the groups should be performed.

- If there is no homogeneity between the variances of the groups as a result of the test performed, variance analysis should be applied after converting the data with the relevant transformations (such as Logarithmic, Square Dec, Angle transformation). If the validity of the assumptions cannot be ensured by transformations, non-parametric statistical techniques should be used.

- At the beginning of the experiment, an appropriate mathematical model should be selected depending on the purpose and conditions. Otherwise, the whole experiment will be wrong.

If the effects of variables that can only be measured are investigated in the analysis, multiple regression analysis is performed, and covariance analysis is performed if the effects of independent variables that can be measured and unmeasured are investigated. In addition, the effect of variables that can also be measured by multiple regression analysis and those that cannot be measured on the

dependent variable is included in the analysis by introducing the unmeasured variable as a “dummy” variable (Büyüköztürk, 1997; Nie, 1976). In single-factor variance analysis, there is an independent variable and a dependent variable. In the two-factor variance analysis, there are two independent variables and one dependent variable. The main purpose here is to investigate the joint effect of the independent variables on dependent variables. In addition, the means of each independent variable and its corresponding group are compared according to the dependent variable, and it is investigated whether the difference between the means is significant according to their meaning Deciency.

By using the variance analysis tables in veterinary medicine, the variance elements used in the estimation of genetic parameters in animal breeding can also be estimated. In addition to using variance analysis tables to estimate variance elements, "Constrained Maximum Likelihood Method (REML)", "Maximum Likelihood Method (ML)", "Quadratic Deviation-Free Prediction Method with Minimum Variance (MIVQUE)" are also used (Kayaalp and Bek, 1994).

Nonparametric Statistics

If the assumptions of the variance analysis are not met, or if the variances between the groups are heterogeneous after the transformation is applied to the data, then the statistics to be applied are non-parametric statistics (Gamgam and Altunkaynak, 2008). If the variances between the groups are heterogeneous again, then the statistics to be applied are non-parametric statistics.

Non-parametric statistics can be used for the specified situations in veterinary medicine, as well as for various survey studies. For example, if it is desired to investigate whether there is a Deciency between calf deaths in livestock and the drugs used on the mother, the Chi Square test statistic or the Median test can be used. In addition, there are many non-parametric statistics used in veterinary medicine (such as the Kruskal Wallis Test, Mann Whitney U Test, Fridman Test, Spermann's Rank Correlation Test). It can also make use of these statistics in the analysis of the results evaluated by coding.

Kruskal Wallis One-Way Variance Analysis is the most widely used test for the null hypothesis, which claims that “more than two independent samples were drawn from the same main masses” and is a good alternative to one-way variance analysis. The alternative hypothesis is that “The median of at least one main mass is different from that of the other main masses” (Ruxton-Beauchamp 2008, Karagöz *et al*., 2009).

Mann-Whitney U Test; This test is a non-parametric alternative to the t-test applied for independent samples. instead of comparing the averages of two groups as in the t-test, the Mann-Whitney U test compares the medians of the groups. It converts the values of continuous variables into sequential within two groups. Thus, it evaluates whether the ranking between the two groups is different or not space. Since the values are transformed into a sequential form, the actual distributions of the values are not important (Kalaycı *et al.* 2006). The data must be at least on the ordinal scale. The null hypothesis takes the form of “the samples were taken from the same main audience or the main audiences from which the samples were taken are not different from each other”.

The Friedman test is a nonparametric alternative to two-way analysis of variance. Data obtained by sequential, score or interval scale for k transactions from a group is used to test the effects of transactions. Ranking points are used instead of actual observations. The null hypothesis is “transactions have no effect”, while the alternative hypothesis is “transactions have different effects” (Özdamar, 2004; Keller-Warrack, 2003).

The Spearman rank correlation coefficient test determines the relationship and the degree of the relationship. This test is a nonparametric alternative of pearson correlation coefficient. The data should be obtained independently, randomly and with at least an ordinal scale. The null hypothesis is "Events are independent of each other, they do not affect each other, there is no relationship between them", while the alternative hypothesis is "Events are not independent of each other space Decently, they affect each other, there is a relationship between them".

Multiple Comparison Tests

Multiple comparison tests are complementary techniques for analysis of variance. In this case, the validity of these tests depends on the validity and accuracy of the analysis of variance, in which the population means, and error variances used as test parameters are obtained. If a statistical difference has been found between the groups SpaceDecently as a result of the F test carried out together with the analysis of variance, one of the tests such as Lsd, Duncan, Snk, Tukey, Dunnet, Scheffe is used to reveal the difference between these groups.

The Least Significant Difference Method (LSD)

The Least Significant Difference Method (LSD), proposed by Fisher (1935), is used to make all possible binary comparisons between group means when the control hypothesis is rejected as a result of analysis variance. The Least Significant Difference Method (LSD) is used to make all possible binary comparisons between group averages. It is the most widely used method among multiple comparison methods, the easiest to use, but the least reliable. It checks the error per comparison (Düzgüneş *et al.*, 1987; Milliken and Johnson, 1992; Soysal, 2000; Kesici and Kocabaş, 2007; Montgomery 2008; Şenoğlu and Acıtaş 2010).

The Duncan Method

Another method proposed to make all possible binary comparisons between group means is the multiple range test (multiple range test), proposed by Duncan (1955). The Duncan method takes into account the position of the means in the order according to their sizes when comparing the group means (Düzgüneş *et al*., 1987; Milliken and Johnson, 1992; Soysal, 2000; Kesici and Kocabaş 2007; Montgomery, 2008; Şenoğlu and Acıtaş 2010).

Student Newman Keuls Method (SNK)

The SNK method checks the error per comparison when comparing neighboring groups. As the groups Decouple from each other and the difference between the largest group average and the smallest group average is compared, the trial head checks the error. For this reason, the error per trial is checked in the SNK test (Zar, 1999; Özdamar 2004).

The Tukey Method

The method proposed by Tukey (1949) and called by his own name is based on a binary comparison of trial averages, as in the Duncan method. The Tukey method is based on Studentized range Statistics (Range Statistics) (Düzgüneş *et al*., 1987; Milliken and Johnson, 1992; Kesici and Kocabaş, 2007; Montgomery, 2008; Şenoğlu and Acıtaş, 2010; Genç and Soysal, 2018).

The Dunnet Method

It is a method used to compare the average of the treatment groups with a control group. The aim is to compare the means of the control group and the other groups. The Dunnet method, unlike other multiple comparison tests, can also be used in the analysis of variance even if the H_0 hypothesis has not been rejected (Zar, 1999; Özdamar, 2004).

The Scheffe Method

The method is used by Scheffe (1953) to test not only a small number of pre-planned linear connections, but also all possible connections (Zar, 1999; Kuehl, 2000; Montgomery, 2008; Genç and Soysal, 2018).

However, here it is useful not to use the LSD test when the number of groups is more than four. Because in this test, since the error per trial is not constant and changes with the number of treatments, even if the p value is taken as 0.05 when the number of groups is more than four, this is not really the p value. If small differences between groups are important for the researcher, the DUNCAN test, whose error is fixed per experiment, can be used to better decipher this. Researchers often prefer the DUNCAN test, which significantly Decouples a larger number of average differences relative to the SNK and TUKEY tests, which are slightly stricter tests, since they want to find, not find, a difference between the tested treatment averages.

Regression and Correlation Analysis

If range is the subject of two variables with a cause and effect relationship, then regression and correlation analysis, which will reveal the form and amount of this relationship, finds an application area.

In agriculture for example, there are cause-and-effect relationships between plot size and parcel yield, animal age and milk yield, plant height and yield, amount of fertilizer per Decare and yield. In these types of relationships, future outcomes can be predicted using prediction equations derived from a given set of available data (such as the prediction of lactation curves and growth curves in cattle) (Kayaalp and Bek, 1991; Efe, 1992).

Of course, the validity and correct choice of the regression model used when predicting the result are also important here. Whether this model fits well or not, and whether the assumptions made for the applied regression analysis method used hold for the data we are using, should also be checked by various statistical methods (Akar and Şahinler, 1993;1994). If not, it is always possible to enter some numbers into the computer and get some numerical results as a result. But this does not mean that that analysis is valid.

CONCLUSION

This study consists of a review of statistical methods used in veterinary science. The testing methods used in veterinary sciences are not limited and are being supported by new methods every day. As in all sciences, the importance of statistics in veterinary science is increasing day by day. It strengthens the accuracy of the statistical data and increases the reliability of scientific results. Before making statistics, it should definitely be decided by consulting a good statistician with which data, which results will be examined, and which test methods will be used. If this is not paid attention to, an incorrect test method or data pattern leads us to the wrong one.

Conflict of Interest

No conflict interest. All authors contributed to the study conception and design.

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