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Statistical interpretation of data — Comparison of two means in the case of paired observations

Interprétation statistique des données — Comparaison de deux moyennes dans le cas d'observations appariées

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FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3301 was drawn up by Technical Committee ISO/TC 69, *Applications of statistical methods*, and circulated to the Member Bodies in March 1974.

It has been approved by the Member Bodies of the following countries :

Austria	India	South Africa, Rep. of
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Sweden
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Statistical interpretation of data — Comparison of two means in the case of paired observations

0 INTRODUCTION

The method specified in this International Standard, known as the method of paired observations, is a special case of the method described in table A' of ISO 2854, *Statistical interpretation of data — Techniques of estimation and tests relating to means and variances*.¹⁾

This special case is mentioned in section two of ISO 2854 immediately after the numerical illustration of table A', and a complete example of applications of the method of paired comparisons has been given in annex A of that International Standard. The importance and wide applicability of the method justify a separate International Standard being devoted to it.

1 SCOPE

This International Standard specifies a method for comparing the mean of a population of differences between paired observations with zero or any other preassigned value.

2 DEFINITION

paired observations: Two observations x_i and y_i of a certain property or characteristic are said to be paired if they are made :

- on the same element i from a population of elements but under different conditions (for example, comparison of results of two methods of analysis on the same product);
- on two distinct elements considered similar in all respects except for the systematic difference which is the subject of the test (for example, comparison of the yield from adjacent plots sown with two distinct varieties of seed).

However, it should be noted that in the second case the efficiency of the test depends on the validity of the

hypothesis that there is no other systematic difference between the individuals in the same pair other than the systematic difference under test.

3 FIELD OF APPLICATION

The method may be applied to establish a difference between two treatments. In this case, the observations x_i are carried out after the first treatment and y_i after the second treatment. The two series of results of the observations are not independent because each result x_i of the first series (first treatment) is associated with a result y_i of the second series (second treatment). The term "treatment" should be understood in a wide sense. The two treatments to be compared may, for instance, be two test methods, two measuring instruments or two laboratories, in order to detect a possible systematic error. Two treatments carried out successively on the same experimental material might interact and the value obtained might depend on the order. Good experimental design should enable such biases to be eliminated. Alternatively, only one treatment may be applied and its effect may be compared to the absence of treatment; the purpose of this comparison is then to establish the effect of that treatment.

4 CONDITIONS FOR APPLICATION

The method can be applied validly if the following two conditions are satisfied :

- the series of differences $d_i = x_i - y_i$ can be considered as a series of independent random items;
- the distribution of the differences $d_i = x_i - y_i$ between the paired observations is supposed to be normal or approximately normal.

If the distribution of these differences deviates from the normal, the technique described remains valid, provided the sample size is sufficiently large; the greater the deviation from normality, the larger the sample size required. Even in extreme cases, however, a sample size of 100 will be sufficient for most practical applications.

1) At present at the stage of draft.