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INTERNATIONAL STANDARD ISO 2854

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Statistical interpretation of data — Techniques of estimation and tests relating to means and variances

Interprétation statistique des données — Techniques d'estimation et tests portant sur des moyennes et des variances

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FOREWORD

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

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Belgium	India	South Africa, Rep. of
Brazil	Israel	Switzerland
Bulgaria	Italy	Thailand
Czechoslovakia	Japan	Turkey
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Statistical interpretation of data — Techniques of estimation and tests relating to means and variances

SECTION ONE : PRESENTATION OF CALCULATIONS

GENERAL REMARKS

1) This International Standard specifies the techniques required :

a) to estimate the mean or the variance of populations;

b) to examine certain hypotheses concerning the value of those parameters, from samples.

2) The techniques used are valid only if, in each of the populations under consideration, the sample elements are drawn at random and are independent. In the case of a finite population, elements drawn at random may be considered as independent when the population size is sufficiently large or when the sampling fraction is sufficiently small (for instance smaller than 1/10).

3) The distribution of the observed variable is assumed to be normal in each population. However, if the distribution does not deviate very much from the normal, the techniques described remain approximately valid to an extent sufficient for most practical applications, provided the sample size is not too small. For tables A, B, C and D, the sample size should be of the order of 5 to 10 at least; for all the other tables, it should be not less than about 20.[1)]

4) A certain number of techniques exist which permit the verification of the hypothesis of normality. This subject is dealt with briefly in the examples in section two and will also be dealt with in a further document (yet to be prepared). Nevertheless, this hypothesis may be admitted on the basis of information other than that provided by the sample itself. In the case where the hypothesis of normality should be rejected, the obvious method to follow is to resort to non-parametric tests or to use suitable transformations for obtaining normally distributed populations, for example $1/x$, $\log(x + a)$, $\sqrt{x + a}$, but the conclusions reached by applying these procedures described in this International Standard are only directly valid for the transformed variate; caution should be used in the translation to the original variate. For example **exp (mean log x)** is equal to the **geometric mean** of x not the arithmetic mean.

If what is really needed is an estimate of the mean or standard deviation of the variate X itself then, whether the population distribution is normal or not, an unbiassed estimation of the mean m and the population variance σ^2 is produced by the sample mean $\bar{x}$ and characteristic s^2.

5) It is desirable to accompany each statistical operation with all the particulars relevant to the source or to the method of obtaining the observations which may clarify this statistical analysis, and in particular to give the unit or the smallest unit of measurement having practical meaning.

6) It is not permissible to discard any observations or to apply any corrections to apparently doubtful observations without a justification based on experimental, technical or other evident grounds which should be clearly given. In any case the discarded or corrected values and the reason for discarding or correcting them must be mentioned.

7) In problems of estimation, the confidence level $1 - \alpha$ is the probability that the confidence interval covers the true value of the estimated parameter. Its most usual values are 0,95 and 0,99, or $\alpha = 0{,}05$ and $\alpha = 0{,}01$.

8) In problems of testing a hypothesis, the significance level is, in the two-sided cases, the probability of rejecting the null hypothesis (or tested hypothesis) if it is true (error of the first kind); in the one-sided cases, the significance level is the maximum value of this probability (maximum value of the error of the first kind). Values of $\alpha = 0{,}05$ (1 in 20 chance) or 0,01 (1 in 100 chance) are very commonly employed according to the risk which the user is prepared to take. Since a hypothesis may be rejected using $\alpha = 0{,}05$, but not when using 0,01, it is often appropriate to use the phrase : "the hypothesis is rejected at the 5 % level" or, if this is the case, "at the 1 % level". Attention is drawn to the existence of an error of the second kind. This error is committed if the null hypothesis is accepted when it is false. Terms concerning statistical tests are defined in clause 2 of ISO 3534, *Statistics — Vocabulary*[2)].

1) Studies about normal distributions are in progress in TC 69/SC 2.

2) At present at the stage of draft.