TECHNICAL REPORT

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Guide for the selection of statistical methods in standardization and specification

Guide pour la sélection des méthodes statistiques en normalisation et en spécifications

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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 13425, which is a Technical Report of type 3, was prepared by Technical Committee ISO/TC 69, *Applications of statistical methods*, Subcommittee SC 3, *Application of statistical methods in standardization*.

Introduction

Statistical methods have numerous practical applications in the manufacturing and service industries, marketing, research, laboratories and other spheres. Their effectiveness depends firstly on the suitability of the chosen method for the intended purpose and secondly on the application, the way it is used. Incorrect choice or poor application can lead to improper deductions and therefore to crucial errors and inappropriate decisions.

This is one of the reasons why ISO has produced a range of International Standards for the application of statistical methods.

This Technical Report should be seen as a descriptive catalogue of the available ISO/TC 69 International Standards and guides, published or in course of preparation, to assist readers in selecting those most suitable for their purposes, according to their needs, whether these be in decision making, problem solving or in achieving a given purpose.

Guide for the selection of statistical methods in standardization and specification

Scope

This Technical Report describes the International Standards and guides prepared by ISO/TC 69.

The documents are listed in tables according to their subject matter. The main table lists the general application categories with their subdivision into specific tables listing the documents by title and number. The types of document are identified as follows:

Published International Standard:	ISO xxxxxx
Draft International Standard:	DIS
Committee Draft:	CD
Working Draft:	WD
New work item proposal:	NP
Draft Technical Report:	DTR
Published Technical Report:	TR

Annex A gives a survey of the content and use of all the referenced standards and DISs developed by ISO/TC 69. DISs are drafts which can be amended. Both categories are documents which are available to the public. The annex contains two sets of abstracts: non-technical abstracts and technical abstracts of all these documents. Each abstract presents a brief survey of the content of the actual standard or DIS. It also gives some indications of the use of the document in different areas.

The non-technical abstracts are usually brief. In these abstracts, the number of technical terms is kept to a minimum. They give brief outlines of the actual documents.

The technical abstracts are somewhat longer. More technical terms are used. The technical abstracts also go into more depth with regard to the content and use of the actual document than the non-technical abstracts. For many documents, the two abstracts supplement each other.

Annex B lists the committee drafts, working drafts and new work item proposals in the ISO/TC 69 work programme.

Main table

AREA	SUB-AREA	SEE TABLE
General Methods	Guides	1
	Terminology and symbols	2
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Sampling		8
Reliability		See IEC/TC 56 standards
Measurement Methods and Results	Accuracy and uncertainty	9
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Table 1 : Guides

ITEM	DOCUMENT
For the selection of an acceptance sampling system, scheme or plan for inspection of discrete items in lots	TR 8550
For implementation of statistical process control (SPC)	CD 11462-1
Control charts - General guide and introduction	ISO 7870

Table 2 : Terminology

ITEM		DOCUMENT
Statistics	Probability	ISO 3534-1
	Statistics	ISO 3534-1
	Symbols	ISO 3534-1
Quality control		ISO 3534-2
Design of experiments		ISO 3534-3
Measurements methods	Accuracy	ISO 5725-1
	Capability of detection	DIS 11843-1
Attribute sampling system		ISO 2859-0

Table 3 : Estimation

ITEM	DOCUMENT	
	Variance known	Variance unknown
Mean	ISO 2854	ISO 2602
Difference of two means	ISO 2854	ISO 2854
Difference of two means (paired observations)	ISO 3301	
Variance	ISO 2854	
Ratio of two variances	ISO 2854	
Tolerance interval	ISO 3207	
Confidence interval	ISO 2602	
Median	ISO 8595	
Proportions	ISO 11453	
Power of tests	ISO 3494	

Table 4 : Comparison to a given value

ITEM	DOCUMENT
Mean	ISO 2854
Difference of two means	ISO 2854
Variance	ISO 2854
Ratio of two variances	ISO 2854
Proportions	ISO 11453
Power of tests	ISO 3494

Table 5 : Comparison of two samples

ITEM	DOCUMENT
Means	ISO 2854
Variances	ISO 2854
Paired observations	ISO 3301
Proportions	ISO 11453
Power of tests	ISO 3494

Table 6 : Tests for types of distribution

ITEM	DOCUMENT
Tests for normality	DIS 5479

Table 7 : Statistical process control (SPC)

ITEM		DOCUMENT
Guideline for implementation of SPC		CD 11462-1
Process capability		WD 12783
Control charts	General guide and introduction	ISO 7870
	Shewhart control charts	ISO 8258
	Acceptance control charts	ISO 7966
	For arithmetic average with warning limits	ISO 7873
	Cumulative sum charts	TR 7871

Table 8 : Sampling

ITEM		DOCUMENT	
		attributes	variables
Discrete "items"	Guide for selection of a sampling system, scheme or plan	TR 8550	
	Introduction to ISO 2859 sampling system	ISO 2859-0	
	Sampling plans and procedures :		
	- Indexed by Acceptable Quality Level (AQL)	ISO 2859-1	
	- Indexed by Limiting Quality Level (LQL) (for isolated lots)	ISO 2859-2	
	Skip-lot sampling procedures	ISO 2859-3	
	For percent non conforming		ISO 3951
	Sequential sampling plans	ISO 8422	ISO 8423
Bulk material	Acceptance sampling plans		CD 10725
	Statistical aspects of sampling		WD 11648
Audit	Sampling plans for audit sampling (for product or process)	NP 13447	

Table 9 : Accuracy and uncertainty

ITEM		DOCUMENT
Accuracy of measurement methods and results	General principles and definitions	ISO 5725-1
	Basic method for determination of repeatability and reproducibility	ISO 5725-2
	Intermediate measures of the precision	ISO 5725-3
	Basic methods for estimating the trueness	ISO 5725-4
	Alternative methods for the determination of the precision of a standard measurement method	WI 5725-5
	Practical applications	ISO 5725-6
Proficiency testing		NP 13528

Table 10 : Use of reference materials (RMs)

ITEM	DOCUMENT
Linear calibration using reference materials	ISO 11095
Generalities	Guide ISO 35
Use of certified reference materials	Guide ISO 33

Table 11 : Decision limit(s)

ITEM	DOCUMENT
Specifications - Construction of limiting value	CD 10576
Definitions	DIS 11843-1
Methodology	WD 11843-2

Annex A

Content and use of the referenced standards and DIS

A.1 Short non-technical abstracts of ISO/TC 69 Standards and DIS

ISO Guide 33 : Uses of certified reference materials (Developed jointly by REMCO and ISO/TC 69)

A reference material (RM) is a substance or an artefact for which one or more properties are established sufficiently well to validate a measurement system. There exist several kinds of RMs: An internal reference material is a RM developed by a user for its own internal use. An external reference material is a RM provided by someone other than the user. A certified reference material (CRM) is a RM issued and certified by an organization recognized as competent to do so. CRMs are widely used in modern technology and the demand is expected to increase. CRMs must be used consistently in order to ensure reliable measurements. The purpose of this Guide is to introduce basic concepts and practical aspects related to the use of CRMs and examine the conditions under which CRMs are properly used and when they are misused.

ISO Guide 35 : Certification of reference materials - General and statistical principles. (Developed jointly by REMCO and ISO/TC 69).

The purpose of this Guide is to provide a basic introduction to concepts and practical aspects related to the certification of reference materials (RMs). ISO Guide 33 (see above) more fully addresses concepts and practical aspects related to their use. The present Guide is intended to describe the general and statistical principles for the certification of RMs. Another purpose of this Guide is to assist in understanding valid methods for the certification of RMs and also to help potential users to better define their technical requirements. The Guide should be useful in establishing the full potential of certified reference materials as aids to assuring the accuracy and interlaboratory compatibility of measurements on a national or international scale.

ISO 2602: Statistical interpretation of test results - Estimation of the mean - Confidence interval

This international standard is limited to the point and interval estimation of the mean of a normal population on the basis of observations from a series of tests applied to a random sample of individuals drawn from such a population. The intervals may be one- or two- sided. It deals only with the case where the variance is unknown. Formulae are given for both ungrouped and grouped observations. It is not concerned with the calculation of an interval containing, with a fixed probability, at least a given fraction of the population (statistical tolerance limits).

ISO 2854 : Statistical interpretation of data - Techniques of estimation and test relating to means and variances

This international standard specifies the techniques required to estimate the mean and variance and to examine certain hypotheses concerning the values of these parameters for samples of observations from one or two normal populations drawn at random and independently. Methods to check the normality are provided. Conditions for using the methods when the assumptions are not completely satisfied are discussed. Formulae are given for ungrouped observations. The methods are illustrated by many examples.

ISO 2859-0 : Sampling procedures for inspection by attributes - Part 0 : Introduction to the ISO 2859 attribute sampling system

Part 0 of ISO 2859 is a guidance document, not a source of sampling schemes or plans. It consists of two sections. Section 1 General introduction to acceptance sampling is essentially an introduction to the sampling schemes employed in ISO 2859 and ISO 8422 but it treats the subject in a general way. It contains explanations of terms, gives practical advice on sampling inspection and discusses some underlying concepts. Section 2 The ISO 2859-1 system extends Section 1 and amplifies the introductory text and instructions contained in ISO 2859-1, by giving detailed comments and examples to assist in using the procedures and tables that make up the ISO 2859-1 system.

ISO 2859-1 : Sampling procedures for inspection by attributes - Part 1 : Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection

Part 1 of ISO 2859 specifies sampling plans and procedures for the case where lots consist of discreet items and where all the product characteristics involved in the assessment of quality are attributes. It contains sampling plans indexed by percent nonconforming and by nonconformities per 100 items. In addition to single sampling plans it contains double sampling (i.e. two-stage) and multiple sampling (seven stage) plans. ISO 2859-1 contains normal, tightened and reduced inspection plans that are intended for coordinated use on a continuing series of lots, with switching between these different levels of sampling severity in response to the recent sampling history. Through the economic and psychological pressure of potential non-acceptance, a supplier is thereby encouraged to maintain a process average quality at least as good as that which has been agreed with the customer.

ISO 2859-2 : Sampling procedures for inspection by attributes - Part 2 : Sampling plans indexed by limiting quality (LQ) for isolated lot inspection

Part 2 of ISO 2859 establishes procedures that can be used when the switching rules of ISO 2859-1 cannot be applied, with sampling plans indexed by limiting quality (LQ). Procedure A is used when both the supplier and the customer wish to regard the lot in isolation. Procedure B is used when the supplier regards the lot as one of a continuing series, but the customer considers the lot received in isolation. The LQ is used to indicate a quality level at which there is usually less than a 10% risk of the customer accepting the lot. The LQ is expressed in terms of the percentage nonconforming in the submitted lots, but can also be used for the case where quality is expressed in terms of nonconformities per 100 items.