Second edition
2014-06-01

Statistical methods in process management — Capability and performance —

Part 1: General principles and concepts

Méthodes statistiques dans la gestion de processus — Aptitude et performance —

Partie 1: Principes et concepts généraux

Reference number
ISO 22514-1:2014(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

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 procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 69, *Applications of statistical methods*, Subcommittee 4, *Applications of statistical methods in process management*.

This second edition cancels and replaces the first edition (ISO 22514-1:2009), which has been technically revised.

ISO 22514 consists of the following parts, under the general title *Statistical methods in process management — Capability and performance*:

— *Part 1: General principles and concepts*

— *Part 2: Process capability and performance of time-dependent process models*

— *Part 3: Machine performance studies for measured data on discrete parts*

— *Part 4: Process capability estimates and performance measures* [Technical Report]

— *Part 6: Process capability statistics for characteristics following a multivariate normal distribution*

— *Part 7: Capability of measurement processes*

— *Part 8: Machine performance of a multi-state production process*

An additional part, dealing with process capability statistics for attribute characteristics, is planned.

Introduction

This general introduction to capability treats the subject's capability and performance in a general way. To understand fully the concepts, it would be helpful to consult ISO 22514-2, ISO 22514-3, and ISO/TR 22514-4. These documents extend this introductory explanation to more specific uses of the procedures.

A process can be either a discrete process or a continuous process. A discrete process generates a sequence of distinguishable items and a continuous process generates a continuous product (e.g. a lane of paper).

The purpose of a process is to manufacture a product or perform a service, which satisfies a set of preset specifications. The specifications for a process under investigation are defined for one or more characteristics of the product or service. However, in process performance or capability, only one characteristic is considered at a time. The characteristic can either be measurable, countable, or it can be a property. The process is, thus, generating either a discrete or a continuous stochastic process. The discrete process can either be a process of real numbers, a process of natural numbers, or a process telling which event from a set of events has occurred for the individual items. As an example, the set of events for the individual items could be {colour acceptable; colour not acceptable}.

In general, the notation for a discrete stochastic process is $\{X_i\}$, where X_i is the outcome of element no. i in the process. In case the characteristic is a property X_i, it is a value given to each of the events in the set of events used for characterizing the process. For a discrete process, the index i is normally the number of the item in the generated sequence of items. However, sometimes it might be more convenient to use the time from a fixed point as the index. When the process is continuous, a number of possibilities exist for the index depending on the nature of the product. When the product is e.g. a lane of paper, the index could be the length from a starting point or it could be the time from a fixed point.

It should be noted that normally a serial correlation exists in a stochastic process.

A stochastic process is either stationary or non-stationary. The stringent definition of a stationary stochastic process will not be given here. However, for a stationary process a distribution exists for X_i, which is independent of i.

Stochastic processes that satisfy the specifications are either stationary processes or well-defined non-stationary processes (e.g. periodic processes).

To evaluate a process, a performance study is performed. In fact, a performance study starts as a theoretical study of all the elements in the process before the process is physically implemented. When the parameters of the various stages in the process have been analysed and redefined, the process is implemented (might be only as a test process).

Based on sampling from the implemented process, the numerical part of the performance study of the process is started. A number of questions concerning the process will, beyond any reasonable doubt, be answered correctly. The most important question to be answered is whether the process is a stationary process, which is stable or predictable for a reasonable period. For the process, it is then important to identify the probability distribution of the process and to obtain estimates of the distribution parameters with a reasonable small variance. Based on this information, the next stage in the performance study would be to map the properties of the characteristics under investigation and decide whether they are acceptable. If the properties cannot be accepted, the parameters of the process itself will be changed in order to obtain a process with acceptable properties.

Consider a well-defined and implemented process that has been accepted using a performance study. The next stage for the process would then be to ensure that the parameters of the process and thus, of the stochastic process do not change, or changes in a predicted way. This is performed by defining a suitable capability study.

These studies of performance and capability indices are today more and more used to assess production equipment, a process, or even measurement equipment relative to specification criteria. Different types of studies are used depending on the circumstances.