**Doc: MSD 03 (26008)/C**
**ISO 24185: 2022**

***For Comments Only***

**Draft Indian Standard**

# Evaluation of the Uncertainty of Measurements from a Stationary Autocorrelated Process

**ICS 17.020**

| | |
|---|---|
| **Not to be reproduced without the permission of BIS or used as Standard** | **Last Date for receipt of Comments is August 2024** |

NATIONAL FOREWORD

*(Formal clauses to be added later on)*

The text of the International Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

In this adopted standard, reference appears to an International Standard for which Indian Standard also exists. The corresponding Indian Standard, which is to be substituted in its place, is listed below along with its degree of equivalence for the editions indicated:

| *International Standard* | *Corresponding Indian Standard* | *Degree of Equivalence* |
|---|---|---|
| ISO 3534-2, Statistics — Vocabulary and symbols — Part 2: Applied statistics | IS 7920 (Part 2):2012 ISO 3534-2:2006, Statistics — Vocabulary and symbols: Part 2 applied statistics (Third Revision) | Identical |

Annex A is informative only.

---

**Note**: The technical content of the document is not available on website. For details, please refer the corresponding ISO 24185: 2022 or kindly contact:

Head
Management and Systems Department
Bureau of Indian Standards
Manak Bhawan, 9, B.S. Zafar Marg
New Delhi – 110 002
Email: msd@bis.org.in
Telephone/Fax: 011-23231106

## Scope

This document describes a method to evaluate the standard uncertainty for a process mean, arising from observable variation in successive possibly autocorrelated measurements. In this document, the successive measurements are restricted to stationary processes. This document also includes tests for validity of assumptions. The resulting uncertainty is related to that arising from observable measurements while other sources of uncertainty are also considered.

## Introduction

In metrology, it is common practice that the dispersion or standard deviation of the average of repeated measurements, i.e., the standard uncertainty of the sample mean, is calculated by the sample standard deviation of the measurements divided by the square root of the sample size. The calculated standard uncertainty is an estimator of the standard deviation of the sample mean when the repeated measurements have the same mean and variance and are uncorrelated. However, it often happens that the measurements are correlated. In continuous productions such as in the chemical industry, most process data on quality characteristics are self-correlated over time or autocorrelated. In general, autocorrelation can be caused by the measuring system, the dynamics of the process, or both. In many cases, the data can exhibit a drifting behaviour. In biology, random biological variation, for example, the random burst in the secretion of some substance that influences the blood pressure, can have a sustained effect so that several consecutive measurements are all influenced by the same random phenomenon. In data collection, when the sampling interval is short, autocorrelation, especially positive autocorrelation of the data, is a concern.

When the measurements are from an autocorrelated process, it is inappropriate to evaluate the standard uncertainty of the sample mean as described above. As stated in ISO/IEC Guide 98-3:2008, 4.2.7, "If the random variations in the observations of an input quantity are correlated, for example, in time, the mean and experimental standard deviation of the mean as given in 4.2.1 and 4.2.3 may be inappropriate estimators (C.2.25) of the desired statistics (C.2.23)."

Autocorrelated processes can be classified to be two kinds of processes based on whether they are stationary or nonstationary:

a) Stationary process – a direct extension of an independent and identically distributed (i.i.d.) sequence. An autocorrelated process is stationary if it is in a state of "statistical equilibrium". This implies that the basic behaviour of the process does not change in time. In particular, a stationary process has a mean and variance that are constants over time;
b) Nonstationary process – a process that is not stationary.

The aim of this document is to provide a method to evaluate the standard uncertainty of the mean of measurements from a stationary process.