
**Geographic information — Data quality
measures**

Information géographique — Mesures de la qualité des données

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

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An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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.

ISO/TS 19138 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

Knowledge of the quality of geographic data is often crucial for the application of the data, as different users and different applications often have different data quality requirements. A user of geographic data may have multiple datasets from which to choose. Therefore, it is necessary to compare the quality of the datasets to determine which best fulfils the requirements of the user. To facilitate such comparisons, it is essential that the results of the quality reports are expressed in a comparable way and that there is a common understanding of the data quality measures that have been used. These data quality measures provide descriptors of the quality of geographic data through comparison with the universe of discourse. The use of incompatible measures makes data quality comparisons impossible to perform.

Data quality needs to be reported by the producer and evaluated by the user against his or her requirements for different criteria and data quality measures. It is essential that reported quality for a dataset contains the quality measurements that may be of interest to a potential user of the dataset, and that the metrics used to determine the quality are reported and available to the user.

ISO 19113 establishes the principles for the description of geographic data quality and specifies components for reporting quality information. Procedures for the evaluation of geographic data quality are described in ISO 19114.

The objective of this Technical Specification is to guide the producer in choosing the right data quality measures for data quality reporting, and the user in the evaluation of the usefulness of a dataset by standardizing the components and structures of data quality measures and by defining commonly used data quality measures.

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Geographic information — Data quality measures

1 Scope

This Technical Specification defines a set of data quality measures. These can be used when reporting data quality for the data quality subelements identified in ISO 19113. Multiple measures are defined for each data quality subelement, and the choice of which to use will depend on the type of data and its intended purpose.

The data quality measures are structured so that they can be maintained in a register established in conformance with ISO 19135.

This Technical Specification does not attempt to describe every possible data quality measure, only a set of commonly used ones.

2 Conformance

Any set of data quality measures claiming conformance with this Technical Specification shall pass all of the conditions specified in the abstract test suite (Annex A).

3 Normative references

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The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 19103:2005, *Geographic information — Conceptual schema language*

ISO 19113:2002, *Geographic information — Quality principles*

ISO 19115:2003, *Geographic information — Metadata*

ISO 19135:2005, *Geographic information — Procedures for item registration*

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1

correctness

correspondence with the universe of discourse

4.2

data quality basic measure

generic data quality measure used as a basis for the creation of specific data quality measures

NOTE Data quality basic measures are abstract data types. They cannot be used directly when reporting data quality.

4.3
data quality scope

extent or characteristic(s) of the data for which quality information is reported

[ISO 19113]

NOTE A data quality scope for a dataset can comprise a dataset series to which the dataset belongs, the dataset itself, or a smaller grouping of data located physically within the dataset sharing common characteristics. Common characteristics can be an identified feature type, feature attribute, or feature relationship; data collection criteria; original source; or a specified geographic or temporal extent.

4.4
error

discrepancy with the universe of discourse

4.5
measurand

particular quantity subject to measurement

[International Vocabulary of Basic and General Terms in Metrology (VIM)]

4.6
universe of discourse

view of the real or hypothetical world that includes everything of interest

[ISO 19101]

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5 Relationships to other standards

ISO 19113 describes relevant data quality elements and their corresponding data quality subelements and it indicates how quality should be reported. ISO 19114 describes procedures for the evaluation of quantitative quality. ISO 19115 contains elements and classes for data quality reporting within the UML models and data dictionaries.

ISO 19113 specifies a set of descriptors for a data quality subelement, for use in recording data quality. One of these descriptors is the data quality measure. A data quality measure is described by the components listed in 7.1.

Table 1 provides a list of data quality elements and data quality subelements as defined in ISO 19113.

Table 1 — Data quality elements and data quality subelements with definitions (ISO 19113)

Data quality element	Data quality subelement	Definition
completeness	commission	excess data present in a dataset
	omission	data absent from a dataset
logical consistency	conceptual consistency	adherence to rules of the conceptual schema
	domain consistency	adherence of values to the value domains
	format consistency	degree to which data is stored in accordance with the physical structure of the dataset
	topological consistency	correctness of the explicitly encoded topological characteristics of a dataset
positional accuracy	absolute or external accuracy	closeness of reported coordinate values to values accepted as or being true
	relative or internal accuracy	closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true
	gridded data position accuracy	closeness of gridded data position values to values accepted as or being true
temporal accuracy	accuracy of a time measurement	correctness of the temporal references of an item (reporting of error in time measurement)
	temporal consistency	correctness of ordered events or sequences, if reported
	temporal validity	validity of data with respect to time
thematic accuracy	classification correctness	comparison of the classes assigned to features or their attributes to a universe of discourse (e.g. ground truth or reference dataset)
	non-quantitative attribute correctness	correctness of non-quantitative attribute
	quantitative attribute accuracy	accuracy of quantitative attributes

6 Register

A register of data quality measures shall contain a set of data quality measures, described using the components listed in 7.1. The registration procedures shall be performed according to ISO 19135.

Annex D of this Technical Specification contains the list of standardized data quality measures. A register shall contain these data quality measures and may also contain additional data quality measures submitted through the procedures defined within ISO 19135. The registration process also allows retiring data quality measures.

7 Components of a data quality measure

7.1 List of components

Each data quality measure shall be described using the following technical components:

- name (7.2.1)
- alias (7.2.2)

- data quality element (7.2.3)
- data quality subelement (7.2.4)
- data quality basic measure (7.2.5)
- definition (7.2.6)
- description (7.2.7)
- parameter (7.2.8)
- data quality value type (7.2.9)
- data quality value structure (7.2.10)
- source reference (7.2.11)
- example (7.2.12)
- identifier (7.2.13)

7.2 Component details

7.2.1 Name

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Name refers to the name of the data quality measure.

If the data quality measure already has a commonly used name, this name should be used. If no name exists, a name shall be chosen that reflects the nature of the measure.

NOTE The component name is specified in the base standard for registers, ISO 19135.

7.2.2 Alias

Alias refers to other recognized name for the same data quality measure. It may be a different commonly used name, or an abbreviation or a short name.

More than one alias may be provided.

7.2.3 Data quality element

Data quality element refers to the name of the data quality element to which this data quality measure applies.

NOTE A list of data quality elements is provided in Table 1.

7.2.4 Data quality subelement

Data quality subelement refers to the name of the data quality subelement to which this data quality measure applies.

NOTE A list of data quality subelements is provided in Table 1.

7.2.5 Data quality basic measure

Each data quality basic measure is described by its name, definition and value type. Data quality basic measures are identified by their names.

A variety of data quality measures are based on counting of erroneous items. There are also several data quality measures dealing with the uncertainty of numerical values. In order to avoid repetition, all possible methods of constructing counting-related data quality measures as well as general statistical measures for one- and two-dimensional random variables shall be defined in terms of data quality basic measures.

The data quality basic measures are defined in Annex C.

If a data quality measure is based on one of the set of data quality basic measures, the name of the data quality basic measure shall be provided in the field data quality basic measure. If the data quality measure is not based on a data quality basic measure, it shall be indicated in this field that a data quality basic measure is not applicable. The data quality basic measures shall also be used as appropriate for creating new data quality measures, for instance for reporting unclosed surface patches or other application-dependent data quality measures.

7.2.6 Definition

Definition states the fundamental concept of the data quality measure.

If the data quality measure is derived from a data quality basic measure, the definition is based on the data quality basic measure definition and specialized for this data quality measure.

NOTE The component definition is specified in the base standard for registers, ISO 19135.

7.2.7 Description

Description refers to the description of the data quality measure including methods of calculation, with all formulae and/or illustrations needed to establish the result of applying the measure.

If the data quality measure uses the concept of errors, it shall be stated how an item shall be classified as incorrect.

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NOTE The component description is specified in the base standard for registers, ISO 19135.

7.2.8 Parameter

Parameter refers to an auxiliary variable used by the data quality measure. It shall include name, definition and description.

More than one parameter may be provided.

7.2.9 Data quality value type

Data quality value type refers to the value type for reporting a data quality result.

A data quality value type shall be provided for a data quality result. The data types defined in ISO/TS 19103 shall be used when appropriate.

Table 2 — Examples of data quality value types

Boolean
Real
Integer
Ratio (numerator of type integer : denominator of type integer)
Percentage
Measure(s) [value(s) + unit(s)]

7.2.10 Data quality value structure

Data quality value structure gives the structure for reporting a complex data quality result.

A data quality result may consist of multiple values. In this case, the data quality result shall be structured using the data quality value structures as given in Table 3. The structure may consist of homogeneous or heterogeneous data quality value types. The possible data quality value types are given in 7.2.9.

Table 3 — Data quality value structures

Bag
Set
Sequence
Table
Matrix
Coverage

NOTE The values within a structure can be multiple. For example, the covariance matrix as given in Table D.32 is reported as matrix of measure, where the matrix elements may have different units of measure. A list may consist of different data quality value types.

7.2.11 Source reference

Source reference gives the citation of the source of the data quality measure.

When a data quality measure for which additional information is provided in an external source is added to the list of standardized data quality measures, a reference to that source may be provided here.

NOTE The component source reference is specified in the base standard for registers, ISO 19135.
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7.2.12 Example

Example may provide examples of applying the data quality measure or the result obtained for the data quality measure.

More than one example may be provided.

7.2.13 Identifier

Identifier consists of an integer number that uniquely identifies a data quality measure.

If data quality measures are administered in a register, then identifiers may only be assigned by the register manager.

NOTE The component identifier is specified in the base standard for registers, ISO 19135.

7.2.14 Obligation of the above-listed components

Some of the components are mandatory, others are conditional or optional. Table B.1 provides further information on the obligation of each technical component.

7.3 Standardized data quality measures

In order to make data quality related metadata and data quality reports comparable, standardized data quality measures shall be used in evaluating and reporting data quality, where appropriate. Annex D gives a list of commonly used data quality measures with all required components for data quality measures as specified in this Technical Specification.

Annex A (normative)

Abstract test suite

A.1 Test case identifier: Component test

- a) Test purpose: to determine conformance by ensuring that all necessary components of a data quality measure are provided.
- b) Test method: examine the entry for the data quality measure and verify that the components have been provided as required by Table B.1.
- c) Reference: 7.2 and Annex B.
- d) Test type: Capability.

A.2 Test case identifier: Name test

- a) Test purpose: to determine if a distinct name for the data quality measure is used.
- b) Test method: determine if the name for the data quality measure is distinct from other measures with different concepts, and if the name is not in conflict with other data quality basic measures, their definitions and descriptions.
- c) Reference: 7.2.1 <https://standards.iteh.ai/catalog/standards/sist/43ad4659-cb02-4673-8d7e-3b40d9363fc/iso-ts-19138-2006>
- d) Test type: Capability.

A.3 Test case identifier: Data quality element and subelement test

- a) Test purpose: to determine
 - if data quality element and subelement are assigned;
 - if they are taken from the list of data quality elements and subelements in ISO 19113 or if they are an additional data quality element and subelement created in conformance with the rules of ISO 19113;
 - if the data quality measure is relevant for the given data quality element and subelement.
- b) Test method: check if proper values are assigned to the data quality element and subelement components and if the data quality measure has bearing on these.
- c) Reference: 7.2.3 and 7.2.4.
- d) Test type: Capability.

A.4 Test case identifier: Data quality basic measure test

- a) Test purpose: to determine if a data quality measure is properly derived from a data quality basic measure.
- b) Test method: check if an appropriate data quality basic measure for the data quality measure exists and, if it does, that the data quality measure is utilizing this data quality basic measure in conformance with this Technical Specification.
- c) Reference: 7.2.5.
- d) Test type: Capability.

A.5 Test case identifier: Definition test

- a) Test purpose: to determine if a fitting, correct and complete definition is provided.
- b) Test method: check that the given definition contains no ambiguities and that it is in conformance with characteristics of a definition as stated in ISO 19135:2005, 7.3.1.
- c) Reference: 7.2.6 and ISO 19135:2005, 7.3.1.
- d) Test type: Capability.

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A.6 Test case identifier: Description test

- a) Test purpose: to determine if an exhaustive description is provided.
- b) Test method: check if the description contains a comprehensive explanation with all required formulae to facilitate the application of the data quality measure.
- c) Reference: 7.2.7.
- d) Test type: Capability.

A.7 Test case identifier: Parameter test

- a) Test purpose: to determine if required parameters are provided.
- b) Test method: check if all parameters occurring in the description are provided in the parameter component.
- c) Reference: 7.2.8.
- d) Test type: Capability.

A.8 Test case identifier: Data quality value type test

- a) Test purpose: to determine if a proper data quality value type is provided.
- b) Test method: check if the provided data quality value type is included in the list in Table 3.
- c) Reference: 7.2.9.
- d) Test type: Capability.

A.9 Test case identifier: Source reference test

- a) Test purpose: to determine if a proper source reference is provided.
- b) Test method: check if the cited reference source exists and if it reflects the concept of the provided data quality measure.
- c) Reference: 7.2.11.
- d) Test type: Capability.

A.10 Test case identifier: Example test

- a) Test purpose: to determine if the example, if provided, is a valid example for the data quality measure.
- b) Test method: check if the example is free of errors and if it is representative of the usage of the data quality measure.
- c) Reference: 7.2.12.
- d) Test type: Capability.

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