INTERNATIONAL STANDARD

ISO 11056

Second edition
2021-05

Sensory analysis — Methodology — Magnitude estimation method

Analyse sensorielle — Méthodologie — Méthode d'estimation de la grandeur

Reference number
ISO 11056:2021(E)

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Published in Switzerland

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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 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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 12, *Sensory analysis*.

This second edition cancels and replaces the first edition (ISO 11056:1999), which has been technically revised. It also incorporates the amendments ISO 11056:1999/Amd.1:2013 and ISO 11056:1999/Amd.2:2015. The main changes compared with the previous edition concern the statistical treatment of the examples in Annex B:

— the Assessor factor is considered as fixed factor or as random factor (in the previous edition, the Assessor factor was always considered as a fixed factor);

— the R commands used to process the examples and to obtain the different tables are given explicitly (in the previous edition, only the tables of results were given);

— the numerical examples have been preserved without any modification to allow the user to understand the evolution in the processing of the tables;

— a new example has been added as B.2.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Magnitude estimation is a psychophysical scaling technique where assessors assign numerical values to the estimated magnitude of an attribute. The only constraint placed upon the assessor is that the values assigned should conform to a ratio principle, i.e. if the attribute appears to be twice as strong in sample B in comparison with sample A, the value assigned to sample B has to be twice that assigned to sample A. Attributes such as intensity, pleasantness or acceptability may be assessed using magnitude estimation.

Magnitude estimation method is often considered as being less susceptible to "end-effects" than the methods which employ an experimenter-defined continuous or discontinuous response scale. These "end-effects" occur when the assessors are unfamiliar with the extent of the sensations elicited by the products. Then assessors can assign one of the initial samples to a category which is too close to one of the ends of the scale. Consequently, they then find themselves short of graduations and are obliged to classify samples perceived as being different into the same category. This should not occur with magnitude estimation since, in theory, there are an infinite number of categories.

Allowing each assessor to start the process at any numerical value, i.e. to use their own scale, gives rise to a particularly important "assessor" effect. However, there are various ways of solving this problem:

— the analysis of variance (ANOVA) allows the "assessor" effect and the interactions to be taken into account;

— the assessors can be forced to a common scale by use of a reference sample to which a value has been assigned;

— the data supplied by each assessor can be reduced to a common scale by applying one rescaling methods.

It is up to the experimenter to choose the most appropriate approach based on the circumstances.

Magnitude estimation is the privileged method to determine the Steven's equation psychophysical power function. It can also be used to solve concrete problems.

NOTE The magnitude estimation method is not the most efficient technique for determining small differences between stimuli or for conducting assessments in the vicinity of a detection threshold.

EXAMPLE 1 A company produces a moderately successful beverage, but recent products which are sweeter, produced by a competitor, have made inroads into their shares of the market. It is decided to increase the sweetness level by one third in an attempt to recapture some of the market loss. In formulating the new product, knowing the power function of the sweetener will provide an estimation of the amount of sweetener necessary to reach the one third increase in sweetness level.

EXAMPLE 2 In the formulation of the new diet beverage, the intensity of the desired sweetness is known, but it is not yet decided whether to use aspartame or sucrose as a sweetener. Knowing the power functions of each substance, the iso sweetness lines can be plotted to determine the concentrations of each sweetener necessary for the desired sweetness level. This information coupled with cost/volume information can help inform the decision about which sweetener is more cost effective.

The calculations in Annex B were performed using R functions. Access to R packages is free. This information is given for the convenience of users of this document and does not constitute an endorsement or recommendation by ISO of the exclusive use of R packages. Other software may be used to perform the calculations required by this document.

The files are in the ME folder under the USB DISK H (format Text (separator: tabulation)).

The results can sometimes vary due to rounding errors, depending on the software used.

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Sensory analysis — Methodology — Magnitude estimation method

1 Scope

This document specifies a method for applying magnitude estimation to the evaluation of sensory attributes. The methodology specified covers the training of assessors, and obtaining magnitude estimations as well as their statistical interpretation.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3534-1, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

ISO 3534-3, *Statistics — Vocabulary and symbols — Part 3: Design of experiments*

ISO 4121, *Sensory analysis — Guidelines for the use of quantitative response scales*

ISO 5492, *Sensory analysis — Vocabulary*

ISO 6658, *Sensory analysis — Methodology — General guidance*

ISO 8586, *Sensory analysis — General guidelines for the selection, training and monitoring of selected assessors and expert sensory assessors*

ISO 8589, *Sensory analysis — General guidance for the design of test rooms*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3534-1, ISO 3534-3, ISO 5492 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
magnitude estimation
process of assigning values to the intensity of a sensation elicited by a product attribute, or to its hedonic value, so the ratio between the assigned value and the assessor's perception of the attribute remains the same

3.2
external reference
first sample presented as a reference in a sample series in relation to which all subsequent samples are then assessed

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3.3
internal reference
first sample introduced in a sample series in relation to which all subsequent samples are then assessed, and presented to the assessor as if it was a test sample

3.4
modulus
numerical value assigned to the *external reference* (3.2), which can be defined by the person conducting the test (fixed modulus) or left to the assessor to choose (non-fixed modulus)

3.5
rescaling
process that consists of multiplying the raw data supplied by each assessor by a factor which reduces the data of all the assessors to a common scale

Note 1 to entry: Adding the logarithm of this factor to the logarithm of the raw data is an equivalent process.

3.6
Steven's equation psychophysical power function
relationship that is expressed as:

$$R = KS^n$$

where

R is the assessor's response (e.g. perceived intensity);

K is the constant which reconciles the units of measurement used for R and S;

S is the stimulus (concentration of a chemical substance or physical variable);

n is the exponent of the power function and the slope of the regression curve for R and S when they are expressed in logarithmic units.

Note 1 to entry: In practice, Stevens's equation is generally transformed into natural logarithms:

$$\ln R = \ln K + n \ln S$$

4 Principle

Samples are presented successively to assessors, who are requested to record the intensity of an attribute of each sample by complying with the ratio principle.

The values are assigned by referring to the value of the first sample of the series. For this first sample, either each assessor is free to assign a value to it, or the value is fixed by the person conducting the test. The latter case is called "fixed modulus".

5 General test conditions

For the general test conditions, such as those concerning the facilities, preparation, presentation and coding of samples, International Standards on general methodology shall be followed, in particular ISO 6658 and ISO 8589, as well as those describing the methods using scales and categories, in particular ISO 4121.

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