

ISO 28037:2026-07 (E)

Determination and use of straight-line calibration functions

Contents	Page
Foreword	vi
Introduction	viii
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Conventions and notation	4
4.1 General	4
4.2 Symbols	5
5 Principles of straight-line calibration	6
5.1 General	6
5.2 Inputs to determining the calibration function	7
5.2.1 Measured data	7
5.2.2 Associated uncertainties and covariances	7
5.3 Determining the calibration function	8
5.3.1 Line parameters	8
5.3.2 Input uncertainty information	8
5.3.3 Output uncertainty information	9
5.4 Numerical treatment	9
5.5 Uncertainties and covariance associated with the calibration function parameters	9
5.5.1 Line parameter uncertainties	9
5.5.2 Primary outputs	10
5.6 Validation of the model	10
5.6.1 Departure of data points from fitted calibration function	10
5.6.2 Testing under normality	10
5.6.3 Relevance of prior uncertainty information	11
5.6.4 Failure of model validation	11
5.7 Use of the calibration function	11
5.7.1 Inverse evaluation	11
5.7.2 Forward evaluation	11
5.8 Determining the ordinary least-squares' straight-line fit to data	11
5.8.1 Ordinary least-squares objective function	11
5.8.2 Steps in the calculation	12
5.8.3 Extension to other forms of input uncertainty information	12
6 Uncertainties associated with the response data only and no covariance	12
6.1 Model	12
6.1.1 Input information	12
6.1.2 Statistical model	13
6.1.3 Objective function	13
6.2 Calibration parameter estimates and associated standard uncertainties and covariance ..	13
6.2.1 Steps in the calculation	13
6.2.2 Solution properties	14
6.3 Validation of the model	15
6.4 Organization of the calculation	15
6.5 Illustrative examples	16

7	Uncertainties associated with the stimulus and the response data and no covariance	16
7.1	Model	16
7.1.1	Input information	16
7.1.2	Statistical model	16
7.1.3	Objective function	17
7.2	Calibration parameter estimates and associated standard uncertainties and covariance	19
7.2.1	Calculation procedure	19
7.2.2	Solution properties	20
7.3	Validation of the model	21
7.4	Example	21
8	Uncertainties and covariances associated only with the response data	21
8.1	Model	21
8.1.1	Input information	21
8.1.2	Statistical model	22
8.1.3	Objective function	22
8.2	Calibration parameter estimates and associated standard uncertainties and covariance	22
8.2.1	General	22
8.2.2	Calculation procedure	22
8.2.3	Solution properties	23
8.3	Validation of the model	24
8.4	Organization of the calculations	24
8.5	Example	25
9	Uncertainties and covariances associated with the stimulus and the response data	25
9.1	Model	25
9.1.1	Input information	25
9.1.2	Statistical model	26
9.1.3	Line parameter estimates	26
9.2	Calibration parameter estimates and associated standard uncertainties and covariance	26
9.2.1	Calculation procedure	26
9.2.2	Solution properties	30
9.3	Validation of the model	30
9.4	Illustrative examples	30
10	Use of the calibration function	31
10.1	General	31
10.2	Inverse evaluation	31
10.2.1	Input information	31
10.2.2	Computation	31
10.3	Forward evaluation	32
10.3.1	Input information	32
10.3.2	Computation	32
Annex A (informative) Matrix operations		33
Annex B (informative) Orthogonal factorization approach to solving the generalized Gauss-Markov problem		39
Annex C (informative) Provision of uncertainties and covariances associated with the measured stimulus and response values		42
Annex D (informative) Uncertainties known up to a scale factor		46
Annex E (informative) Examples illustrating straight-line regression for all uncertainty structures		48
Annex F (informative) GUM-consistent straight-line parameter uncertainties in the errors-in-variables' case		63
Annex G (informative) Non-GUM-consistent calculation procedures		65
Bibliography		76