Requirements for the Module statistics_lib.base_functions

Conventions

Requirements listed in this document are constructed according to the following structure:

Requirement ID: REQ-UVW-XYZ

Title: Title / name of the requirement

Description: Description / definition of the requirement

Verification Method: I / A / T / D

The requirement ID starts with the fixed prefix 'REQ'. The prefix is followed by 3 letters abbreviation (in here 'UVW'), which defines the requiement type - e.g. 'FUN' for a functional and capability requirement, 'AWM' for an alarm, warnings and operator messages, etc. The last part of the ID is a 3-digits *hexadecimal* number (0..9|A..F), with the first digit identifing the module, the second digit identifing a class / function, and the last digit - the requirement ordering number for this object. E.g. 'REQ-FUN-112'. Each requirement type has its own counter, thus 'REQ-FUN-112' and 'REQ-AWN-112' requirements are different entities, but they refer to the same object (class or function) within the same module.

The verification method for a requirement is given by a single letter according to the table below:

Term	Definition
Inspection (I)	Control or visual verification
Analysis (A)	Verification based upon analytical evidences
Test (T)	Verification of quantitative characteristics with quantitative measurement
Demonstration (D)	Verification of operational characteristics without quantitative measurement

Functional and capability requirements

Requirement ID: REQ-FUN-100

Title: Functionality implemented by the module (scope)

Description: The module should implement a number of functions to calculate the basic 1D and 2D statistical properties of a data set:

- 1D statstics
  - Arithmetic mean
  - Variance with the Bessel correction (sample variance) and without the correction (population variance)
  - Standard deviation with the Bessel correction (sample deviation) and without the correction (population deviation)

    - Standard error of the mean of a data set (as population - i.e. without Bessel correction)
    - Skewness with the Bessel correction (sample skewness) and without the correction (population skewness)
    - Excess kurtosis with the Bessel correction (sample kurtosis) and without the correction (population kurtosis)
    - Generic Nth moment of a data set distributiion (as population - i.e. without Bessel correction) - both central and non-central variants, as well as central and non-central normalized variants
    - Mean squared uncertanty of the measured data points
    - 'Full' standard error of the mean of a data set as population and including the individual data points 'measurement uncertainties'
- 2D statics
    - Covariance of a 2D data set (as population - i.e. without Bessel correction)
    - Pearson's coefficient of correlation *r* of a 2D data set (as population - i.e. without Bessel correction)
    - Generic Nth-Mth moment of a 2D data set distributiion (as population - i.e. without Bessel correction) - both central and non-central variants, as well as central and non-central normalized variants

Verification Method: A

Requirement ID: REQ-FUN-101

Title: Input and ouput data format

Description: The 1D statistics functions should accept the input data set as any flat sequence (e.g. list or tuple) of real numbers (int or float) or instances of a data type class imlementing a 'real life measurement' with the associated uncertainty of the measurement, which is API compatible with the **phyqus_lib.base_classes.MeasuredValue** class, i.e. the 'mean' value of the measurement being accessible via field / property *Value* and the associated uncertainty - via field / property *SE*. Such sequence does not have to be homogeneous, and it may be an arbitrary mixture of such instances, integer and floating point numbers. A 2D statistical data set should be passed as two such sequences of the same length. The return values of the functions must be a real number - integer of floating point.

Verification Method: T

Alarms, warnings and operator messages

Requirement ID: REQ-AWM-100

Title: Unacceptable type of the input data

Description: The **TypeError** or its sub-class should be raised in response to the unacceptable input (argument(s) data type(s)) in the following situations:

- A 1D data set (or one of the sub-sets of the 2D data set) is not a flat sequence of real numbers of 'real life measurements' with the associated uncertainties, which means:
    - The respective argument is not a sequence, OR
    - The respective argument is a sequence, but, at least, one element of it is neither integer, or floating point number, or an instance of a measurement with the associated uncertainty data

type class

- A power of a statistical moment is not an integer number

Verification Method: T

Requirement ID: REQ-AWM-101

Title: Unacceptable value(s) of the input data

Description: The **ValueError** or its sub-class should be raised in response to the unacceptable input (argument(s) data value(s)) in the following situations:

- A 1D data set (or one of the sub-sets of the 2D data set) is an empty sequence
- The length of the sequence is shorter than the 'number of the degrees of freedom' in the case of the Bessel-corrected functions; i.e. 2 for the sample variance and standard deviation, 3 for the sample skewness, and 4 for the sample kurtosis
- The lengths of the sub-sets of a 2D data set are not equal
- A power of a statistical moment is an integer, but it is not positive

Verification Method: T