Jan Hnízdil, Josef Heidler and Zdeněk Havel

Anthropomotorics- statistical data treatment

Introduction

the presented publication is intended for statistics in Anthropomotorics for students of all study fields of the study program physical education and sport. This is a modified and
supplemented edition of the script "Exercises in Anthropomotorics" from 2008. The addition of the script mainly concerns the implementation of procedures for calculating individual statistical tests using statistical software Jamovi. This software package is functional in offline mode and can be installed from the link https://www.jamovi.org/ Download version 1.2.27 solid.
The chapters are arranged in such a way that the letters "S" are the names of the topics of the individual seminars and it is advisable for the student to prepare for them.
The introductory theory is followed by a demonstration of the calculation of an example of the basic procedure of mathematical statistics, a method according to which it is possible to calculate similar examples. Each seminar also contains practical examples for individual completion of self-study.
Attachments are listed at the end of the script. On the one hand, these are seminar tasks No. 1–4, from which the teacher determines the task to be processed in a given year.
The script contains a brief text, rather work procedures for solving a similar assignment. Students will find more detailed information and an explanation of specialized articles in the recommended literature.

Thanks: It is our nice duty to thank both reviewers Doc. RNDr. T. Zdráhal, CSc. and Mgr. David Cihlář, PhD for the assessment of the text, comments and additions. However, the authors are responsible for any errors and omissions. We will be grateful to students and other kind readers for comments and warnings of possible errors and ambiguities in the text.

Authors

S 1 Basic characteristics of statistical files

THEORY Statistical classification of data and their basic processing, basic characteristics of statistical files.
Measuring scales_
The results of measurement or expert assessment can be expressed according to the characteristics and properties of the data on scales (measuring scales), which can be sorted according to their increasing degree of perfection in the order:

1) Scale nominal
Here we assign numbers to objects, which determine the affiliation of the object to one of the non-overlapping categories. The number assigned to the object does not indicate quality or quantity, it can also be replaced by a symbol. The classification here is not limited to a dichotomous system, we can classify objects into more categories. Numbers can be assigned to objects in a way that, for example, car registration (license plates) is performed.

2) Scale ordinal
It is given by descending or ascending numbers into classes. Each of the classes therefore, has a different qualitative value, which we are not able to define precisely. Neighboring classes may differ from each other by an unequally large interval. As the name implies, order matters. An example is sports results in the form of various rankings, rankings. School grades fall into this category due to their nature, but in practice these data are handled in an inappropriate manner, unsuitable for non-parametric data (averaging).
We express data on nominal and ordinal scales nonparametric nature.

3) Scale interval
The shift in perfection compared to the previous scale is ensured by a constant unit of measurement. There are the same intervals between adjacent classes. Therefore, in addition to the order, we can also determine the difference between the individual data. The zero point is determined by agreement. An example is measuring the temperature in º C, or determining the time (hour, day).

4) Scale equiinterval
In addition to the interval scale, this scale also has an absolute, natural zero point. It is used for measurement and it is possible to use all mathematical operations here. We work with data on interval and equinterval scales parametric nature.

Tab.1 Main types of specific scales

MERNÁ SCALE	BASIC OPERATION	RELATION	CHARACTERISTICS	SAMPLE	USEFUL STATISTICAL	JAMOVI SYMBOL
Nominal	Classification	= ≠	numbering, such as object naming	male = 1 female = 0 swimmer non-swimmer	frequency mode, percentage, χ^2 -test	
Ordinal	Assessment	<>	determination afterradí, without unit měřmeasurement	skircourse, cooperatives according to performance	Frequency, mode, median, coef. correlation χ^2 -test	
Metric - Interval	Measurement	equality intervalas	zero point by agreement, constant unit measurement	motor age	Mean, std. deviation	
Metric - Equinetrval	Measurement	equality relationship	prnatural zero point. const. jednotka měřmeasurement	measurement distance, height, force…	correlation, significance tests	

TASK

Assign the appropriate scales to these variables:

- flexibility test ……
- the resulting table of the Ice Hockey World Championships ……
- numbers on the jersey of a football team ……
- push – ups ……
- Cooper test result ……
- Iowa Brace test results ……

THEORY

Frequency:

absolute - (n_i) Frequency of the character *xi*
cumulative absolute (*Ni*)
relative (*fi*) - calculated according to the formula

$$f_i = \frac{n_1 \cdot 100}{n}$$

cumulative relative (*Fi*)

EXAMPLE

Character value x_i	Frequency		Cumulative	
	absolute ni	relative f_i	absolute N_i	relative F_i
43	2	13.33	2	13.33
48	3	20.00	5	33.33
53	4	26.66	9	59.99
58	6	40.00	15	99.99
Σ	**15**	**99.99**	**15**	**99.99**

THEORY

Basic characteristics of statistical files

Measures of positioning: arithmetic mean $\bar{x}$
mode $\hat{x}$ (Mo) (highest frequency)
median $\tilde{x}$ (Me)(middle variable)

Measures of variability: standard deviation *s*
variance s^2 or var *x* (reflects the variation of all characters)
range *R*

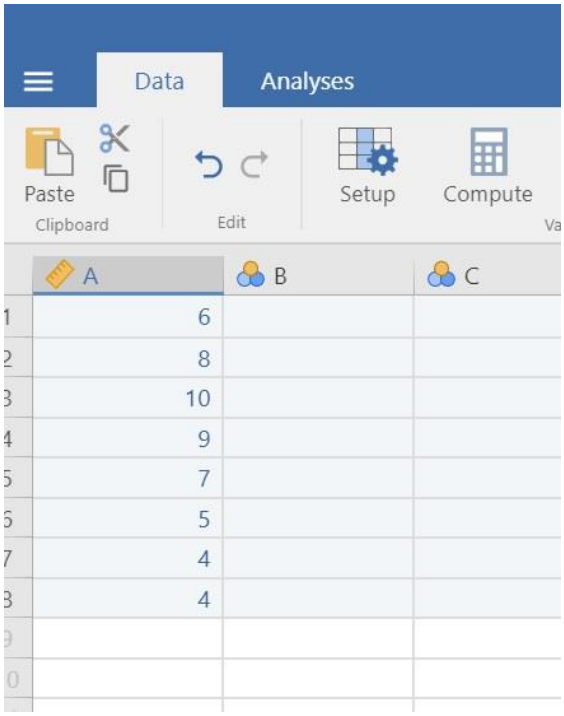
Calculation of mean, and standard deviation

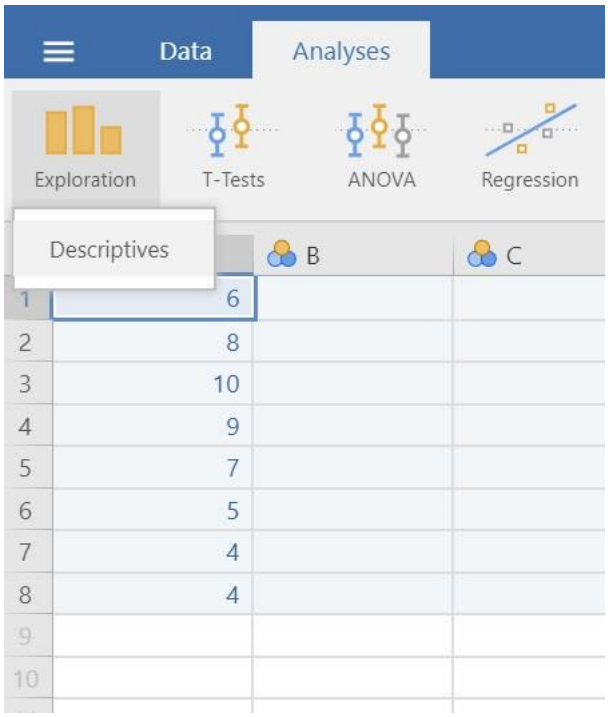
$$\bar{x} = \frac{\sum x_i}{n} \qquad s = \sqrt{\frac{\sum (x_i - \bar{x})}{n}}$$

Establish basic measures of position and variability using the Jamovi program.
Use this data:

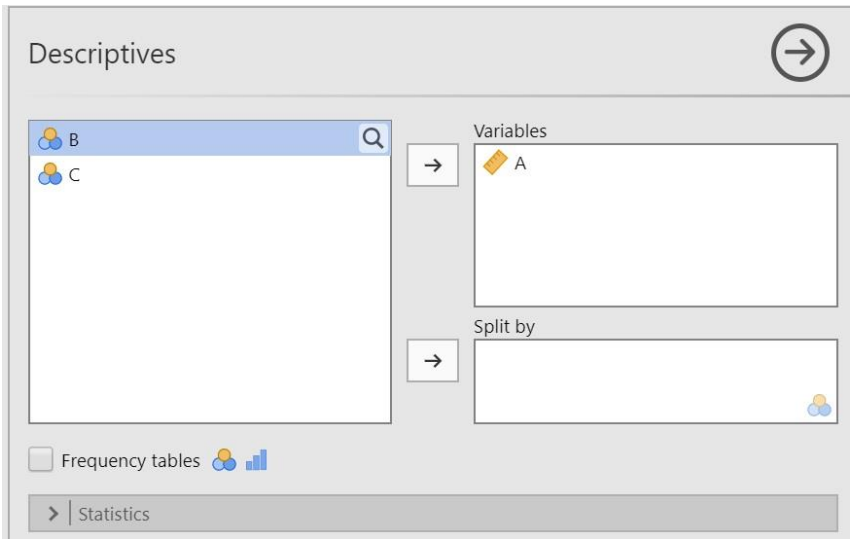
Number of push-ups
6
8
10
9
7
5
4
4

Copy the values to the Data tab, followed by the Analyzes Exploration and Descriptives options

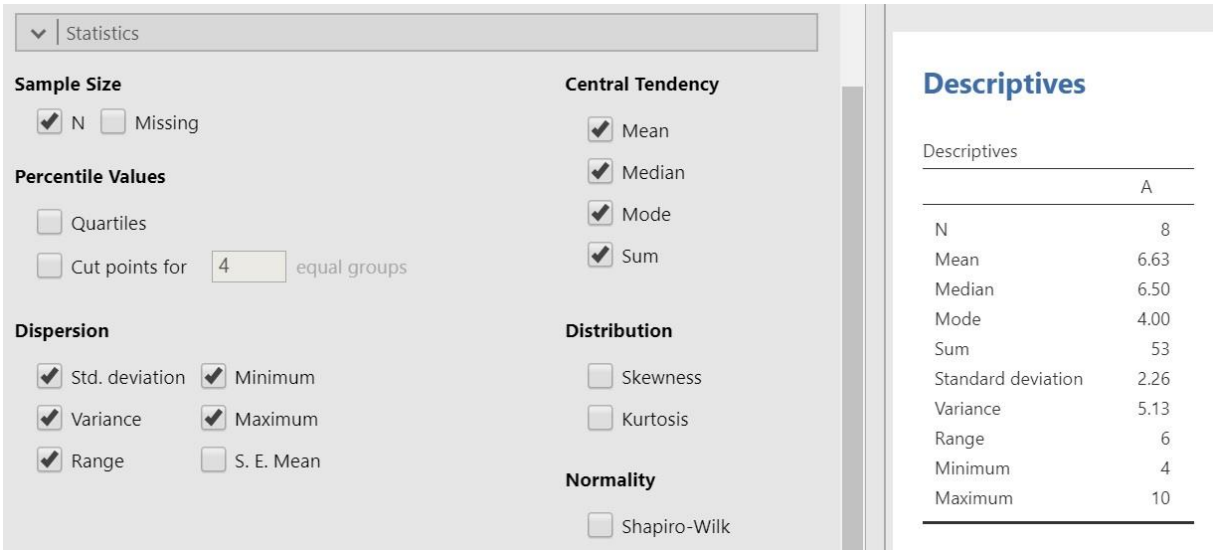




Select the data (A) and go to Statistics



Select the following items and the desired results will then be displayed in the right window (Descriptives):



TASKS

Statistical data processing:
Record your body height in cm according to the individual fields of study in the form at:
https://docs.google.com/spreadsheets/d/1tW1SoQu40IVkjYb3cdb4eoEcmMPzHAknxa9fT27FG6U/edit?usp=sharing

Using the Jamovi program:
1) Determine the highest and lowest value, calculate the range of variation. Specify the median
value.
2) Calculate the arithmetic mean of body height and the standard deviation of your study group. Determine the median and the mode.