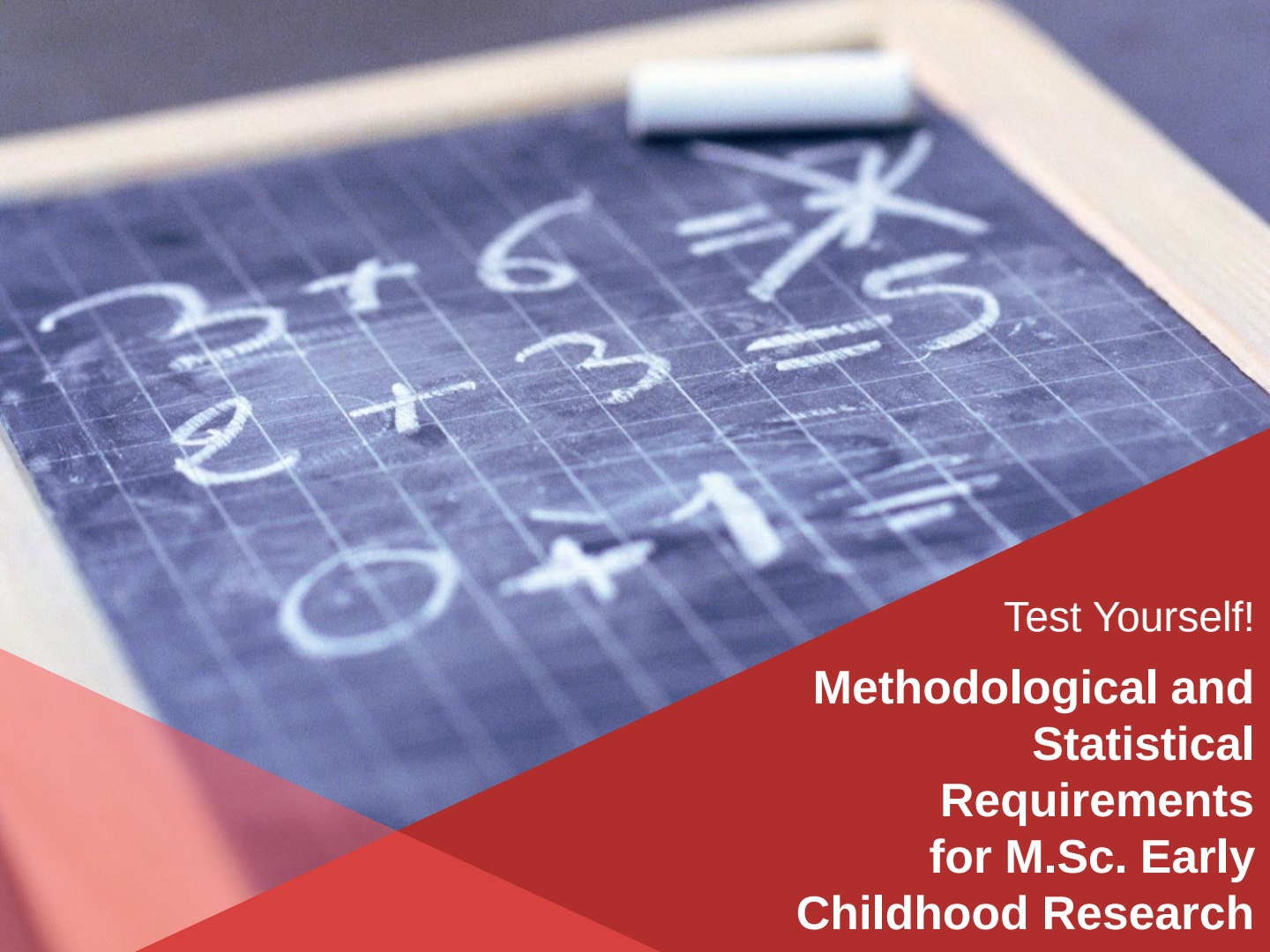

Test Yourself!

Methodological and Statistical Requirements for M.Sc. Early Childhood Research

HOW IT WORKS

For the M.Sc. Early Childhood Research, sufficient knowledge in methods and statistics is one important requirement.

Are you unsure whether your knowledge of statistics is sufficient for this Master's program? Would you like to know what you already know well and what you should improve?

Then this self-test is the right one for you.

You will find 20 questions here. Questions and answers alternate. Please look at the question first and write down your answer. Then you look at the next page where you will find the correct answer. Please note if your answer was correct and if you get a point. For every correctly answered question there is one point.

At the end you can add up your points and find out how good your knowledge is.

Good luck!

QUESTION 1

What is a correlation and how is it calculated?

ANSWER 1

A correlation describes the relationship between two variables. If 2 variables are correlated, the values of one variable co-occur with certain values of the other.

A commonly used correlation coefficient is the one of Pearson. It is a standardised measure giving information about the direction and strength of a relation.

Calculation: $r = \frac{\sum_{m=1}^{n}(x_m - \bar{x})(y_m - \bar{y})}{n} \frac{1}{s_x s_y}$

- x_m: $single\ values\ of\ variable\ x$
- $\bar{x}$: $mean\ of\ x$
- y_m: $single\ values\ of\ variable\ y$
- $\bar{y}$: $mean\ of\ y$
- n: $sample\ size$
- s_x: $standard\ deviation\ of\ x$
- s_y: $standard\ deviation\ of\ y$

QUESTION 2

Name two common effect sizes in statistics. How are they calculated?

ANSWER 2

Cohen's d: $d = \frac{\bar{x}_1 - \bar{x}_2}{s}$

- $\bar{x}_1$: $mean\ of\ sample\ 1$
- $\bar{x}_2$: $mean\ of\ sample\ 2$
- s: $pooled\ standard\ deviation$

Signal-to-noise Ratio: $\phi^2 = \frac{\sigma_\tau^2}{\sigma_\varepsilon^2}$

- σ_τ^2: $variance\ of\ the\ condition\ effect$
- σ_ε^2: $residual\ variance$

QUESTION 3

What are key differences between parametric and non-parametric statistical tests?

ANSWER 3

- Parametric tests make assumptions (normally distributed data, homogeneity of variance, interval data, independence), if they are not fulfilled their results can be pretty wrong.
- Non-parametric tests have less strict assumptions concerning the distribution of the dependent variables. However, the expressiveness and statistical power of non-parametric tests is more restricted.

QUESTION 4

Give an example for nominal-, ordinal-, and interval-scaled variables.

ANSWER 4

- Nominal: Species
- Ordinal: Places in a run
- Interval: Likert scale

QUESTION 5

What is a confidence interval? Give an example.

ANSWER 5

The (1-α) confidence interval is the area around an estimated parameter for which is true, that it covers the true population parameter with a probability of 1-α.

A confidence coefficient of e.g. 95% says the following: if you draw many (infinite) random samples of the same size of a population and derive the confidence interval of each of them, then 95% of them will comprise the true population parameter.

- Example: Confidence interval for the mean

QUESTION 6

Explain the terms internal and external validity.

ANSWER 6

Internal validity:

- Is there an alternative explanation for the observed effect (other than the explanation sought by the researchers)?
- Internal validity allows statements about whether the causal conclusion based on a study is warranted or not.

External validity

- Would we obtain similar effects if we varied the studied population and/or the contextual factors?
- External validity allows statements about whether the generalization of the study results to other contexts is warranted or not.

QUESTION 7

What are key features of an experiment?

ANSWER 7

The key feature of an experiment is that variation in independent variable is artificially generated.

Thereby, the independent variable is maximally controlled during the measurement of the variation of the dependent variable.

Experiments have a high internal validity, i.e. alternative explanations can be excluded.

QUESTION 8

Give an example of an experiment and explain the terms ‚independent' and ‚dependent' variable.

ANSWER 8

A researcher would like to know whether children share equally dependent on whether they should share chocolate or gummi bears.

- Independent variable: kind of sweet (i.e. chocolate and gummi bears)
- Dependent variable: Proportion that is shared

QUESTION 9

What is an Analysis of Variance? What are its assumptions?

ANSWER 9

An ANOVA allows for comparisons of means of different groups by explaining the variance of dependent variables through the influence of independent variables.

Assumptions are:

- Independence of Residuals
- Normal Distribution of Residuals
- Equal Residual Variance Across Treatments

QUESTION 10

What is a linear regression?

ANSWER 10

A linear regression is the attempt to predict a criteria (dependent variable) with the help of an interval scaled predictor (independent variable). It is assumed that criteria and predictor are correlated and that there is a causal relationship. Furthermore, it is assumed that the relation is linear, i.e. the predicted values are depictable on a line. Aim is to keep the mistake of the prediction as small as possible.

- E.g. Preparation time for an exam predicts exam result.

QUESTION 11

Explain the method of ‚least squares' in linear regression.

ANSWER 11

By the method of least squares, the regression line for which the residuals (difference between an observed value and the fitted value provided by the regression model) are smallest, can be determined.

QUESTION 12

What is the difference between a correlation and an interaction of two interval-scaled variables?

ANSWER 12

A correlation means that values of one variable relate in some way to values of another variable. This says nothing about whether they interact in their effect on a third variable.

An interaction between two variables means the effect of one of those variables on a third variable is not constant – the effect differs at different values of the other. If two variables interact, they may or may not be associated.

QUESTION 13

Give 5 examples of non-experimental research methods in psychology.

ANSWER 13

- Interview
- Observation
- Correlational research
- Qualitative research (ask for experience of people in a nonnumerical way)
- Questionnaire

QUESTION 14

Say you want to investigate the effect of gender and height on IQ using linear regression. Write down the regression equation depicting both intercepts and regression coefficients.

ANSWER 14

$$IQ_i = b_0 + b_{1[i]} * x_{gender[i]} + b_{2[i]} * x_{height[i]} + e_i$$

- b_0: $intercept$
- b_1: $regress.coefficient\ for\ gender$
- b_2: $regress.coefficient\ for\ height$
- i: $observations$

QUESTION 15

You have asked participants about their gender and whether or not they watch football regularly. How would you analyse whether the two variables are independent or dependent, i.e. is there an association of gender and watching football?

ANSWER 15

Measurement of relationship for 2 nominal variables: Cramer's V

QUESTION 16

What is the difference between standard deviation and standard error? How are they calculated?

ANSWER 16

The standard deviation is a measure of dispersion of the data.

The standard error provides an estimate of the precision of a parameter and is used when one wants to make inferences about data from a sample to some relevant population.

- $s_x = \sqrt{\frac{\sum_{m=1}^{n}(x_m - \bar{x})^2}{n}}$
- $se(\bar{x}) = \frac{s_x}{\sqrt{n}}$
- x_m: $single\ values\ of\ variable\ x$
- $\bar{x}$: $mean\ of\ x$
- n: $sample\ size$
- s_x: $standard\ deviation\ of\ x$

QUESTION 17

What is a p-value?

ANSWER 17

A p-value is the probability of obtaining an effect at least as extreme as the one in your sample data, assuming the truth of the null hypothesis. The p-value is a conditioned probability: $p=P(E|H_0)$.

QUESTION 18

What is the difference between a research question and a research hypothesis?

ANSWER 18

Unlike research questions which can be more general, a research hypothesis articulates a prediction that can be empirically tested and is thus open to falsification. Claims on scientific empirical hypotheses are:

- Accessible by senses / testable
- Falsifiable
- Theoretically reasonable
- Generality

QUESTION 19

How do you calculate the following measures: mean (arithmetic), median, mode, variance, standard deviation, 1st and 3rd quartile?

ANSWER 19 (1)

mean

- $\bar{x} = \frac{1}{n}\sum_{m=1}^{n} x_m$
- x_m: $single\ values\ of\ variable\ x$
- n: $sample\ size$

median

- odd n: median = value of the person with rank $\frac{n+1}{2}$
- even n: median = mean of persons with ranks $\frac{n}{2}$ and $\frac{n}{2}$ +1
- n: $sample\ size$

mode

- value with the highest frequency in the data range
- category wich occurs most often (NOT the frequency of the category!)
- cannot be calculated if every value occurs just once

ANSWER 19 (2)

variance

- $Var = s_x^2 = \frac{\sum_{m=1}^{n}(x_m - \bar{x}^2)}{n}$

- x_m: $single\ values\ of\ variable\ x$
- $\bar{x}$: $mean\ of\ x$
- n: $sample\ size$
- s_x: $standard\ deviation\ of\ x$

standard deviation

- $s_x = \sqrt{Var} = \sqrt{\frac{\sum_{m=1}^{n}(x_m - \bar{x})^2}{n}}$
- x_m: $single\ values\ of\ variable\ x$
- $\bar{x}$: $mean\ of\ x$
- n: $sample\ size$

ANSWER 19 (3)

1st quartile

- value of the sorted sequence that is at the xth position where x= round(0.25*(n+1))

3rd quartile

- value of the sorted sequence that is at the xth position where x= round(0.75*(n+1))
- n: $sample\ size$

QUESTION 20

For which kind of variables are boxplots an appropriate illustration?

ANSWER 20

Variables on a metric level of measurement.

GREAT! YOU ARE DONE!

Now you can add up your points.

17 to 20 correct answers: Great! You are in good shape to start the methods module in the first semester.

12 - 17 correct answers: Good, but be prepared to invest extra time during the first semester to read up on introductory material. We would recommend you to visit the methods crash course before you start into the semester.

Less than 12 correct answers: Please make sure to attend statistics courses before the start of the semester and to get more involved with the topic. Also, we would highly recommend you to visit the methods crash course before you start into the semester.