

Methodological skills – final test

(UvA RMA Linguistics, spring 2012, by Tamas Biro)

It is going to be an open-book exam, which should take not more than 120 minutes, but the room has been booked for four hours to give you ample time if needed.

Topics:

- Issues discussed in class (partially covered by parts of the pdf presentations)
- Sampling methods and research designs:
 - o Chapters in Judd and Neuman
 - o Recommended: Moore and McCabe, chapter 3
- Basic probability theory (independence of events, disjoint events, conditional probability).
- Basic statistics: descriptive statistics (e.g., from Moore and McCabe, chapter 1)
- The notion of *sampling distribution*, the *Central Limit Theorem*
- The notions of reliability and validity; lurking variables
- The notions of significance, confidence interval and power. Type I and Type II errors.
 - o Two articles by Cohen
 - o Recommended: Moore and McCabe chapters 5 and 6
- The notion of independence and correlation
- SPSS: understanding the output produced by SPSS, given examples (extremely) similar to the assignments during the three SPSS labs.
 - o Recommended: make sure you have worked yourself through the three labs.
- Basic tests:
 - o z-test vs. t-test
 - o one-tailed vs. two-tailed
 - o one-sample vs. two-sample vs. paired-sample
 - o Chi-squared test for independence in a contingency table
 - o Proportions: Chi-squared test for goodness-of-fit and z-test for proportions
 - o ANOVA (from Runyon and Haber, or Moore and McCabe, chapters 12 and 13):
 - What is the null hypothesis and what does it test, when to use it, how to interpret the p-value.
 - Designs
 - Basic idea: total, between-group, within-group
 - F-test and its degrees of freedom
- Calculations by hand:
 - o Descriptives: min, max, range, quartiles, IQR, mean, median, standard deviation.
 - o One-sample z-test and t-test, given the tables

Mock exam

Part 1: multiple-choice test

1. The median of a sample is
 - a. a parameter
 - b. a statistic
 - c. a statistics
 - d. measure of spread
2. The goal of inferential statistics is...
 - a. to describe the basic properties of the sample
 - b. to use the sample to tell something about the population
 - c. to use the population to tell something about the sample
 - d. to reject the alternative hypothesis
3. Event A and event B are independent...
 - a. if they cannot occur at the same time
 - b. if the probability of A occurring does not influence the probability of B occurring
 - c. if event A occurring entails event B not occurring
 - d. if event A occurring entails event B occurring
4. The interquartile range is
 - a. a measure of spread
 - b. a measure of the centre
 - c. useful
 - d. useless
5. The median cannot be used in the case of a
 - a. nominal variable
 - b. ordinal variable
 - c. logarithmic variable
 - d. ratio var
6. In a simple random sample, the cases are
 - a. normally distributed
 - b. mutually exclusive
 - c. independent
7. Which one of the following is *not* a probability sampling method
 - a. stratified sampling
 - b. quota sampling
 - c. snowball sampling
8. A procedure is reliable
 - a. if repeating the experiment many times results in similar results
 - b. if the outcome of the experiment answers our research question
9. The Central Limit Theorem refers to
 - a. any statistic
 - b. the sampling distribution of the median
 - c. a Normal distribution
 - d. the population size
10. You use a z-test when
 - a. you want to know the mean of the sample
 - b. you know the standard deviation of the population
 - c. you want to know the correlation between two variables
 - d. when the samples are not independent

Part 2. Paper-and-pen calculations

You have collected the following observations: 2, 7, -2, 1, 6, -1, 0, 3, 2.

Calculate

- 2.1. the median:
- 2.2. the mode:
- 2.3. the mean:
- 2.4. the interquartile range:
- 2.5. the variance with n :
- 2.6. the standard deviation with $n-1$:
- 2.7. You would like to test if these observation originate from a population whose mean is $\mu = 4.5$. Calculate the t-statistic.
- 2.8. What degree of freedom are you going to use in a t-test?

Part 3. Tests (choice, interpretation)

3.1. Take the following two-way table:

	N	Prep	V	Adj
Spanish	4	6	7	6
Portuguese	6	9	14	5
Catalan	8	12	9	18

- Describe what type of data are usually plotted in such a table.
- You are interested in testing the independence of the two variables. What does it mean?
- What test are you using? How do we call the statistic on which this test is based?
- What is the sampling distribution of this statistic? In particular, what is the degree of freedom that defines the distribution?
- Imagine that the observed counts and the expected counts differ very much. What would you preliminarily conclude?

3.2. You are conducting a survey to compare whether political preferences are different in the countryside from those in towns.

- Describe a few possible mistakes to be avoided that you should consider while designing the experiment.
- What is the working hypothesis you would like to test?
- What statistical procedure are you going to perform? (NB: there are more possibilities!)
- What is the null hypothesis of the statistical procedure(s) you have chosen?
- What is the alternative hypothesis?
- What do you have to check before running the statistical procedure?
- Suppose you get $p = 0.039$. How do you proceed? What can be your conclusion?

Interpretation of tests

1. In Lab 3, you got the following SPSS output. What could you conclude?

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	90% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 AFTER - BEFORE	1,450	3,203	,716	,211	2,689	2,024	19	,057

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	90% Confidence Interval of the Difference	
					Lower	Upper
IMPROVEMENT	2,024	19	,057	1,45000	,2115	2,6885

Part 4: Issues and articles

(NB: in the real exam, there will be much less questions in this section.)

1. Jacob Cohen, in his article “The Earth is Round”, discusses “probabilistic sillogisms”. Explain what the problem is with the kind of train of thought that “appears at least implicitly in article after article”.
2. a. Based on Judd’s and Neuman’s chapters, explain what the advantages and disadvantages of probabilistic sampling are. b. Explain (based on the discussion in class, and based on your understanding of statistics) why statistical procedures require random samples.
3. Bachman distinguishes between “norm-referenced tests” and “criterion-referenced tests”. Explain what the difference between the two are. Explain what reliability and validity mean in these two cases.
4. Summarize the main methodological issues raised by a paper of your choice (presented by yourself or by a fellow student).
5. Explain what a “95% confidence interval of the mean” means.
6. Explain why it is wrong to conclude that “we can accept the null hypothesis”.
7. Why do you use the Normal quantile plot for?
8. What is the difference between Type I-error and Type-II error?
9. What assumptions do you have to consider before doing a two-sample t-test?
10. Explain what the difference between “within-group variance” and “between-group variance” is in the case of ANOVA.