PhD Course on "Data Analysis"

Prof.ssa Galina Paramei
Liverpool Hope University UK

Total: 12 hours (4 classes x 3 hours)

1. Basic statistical concepts. Requirements for application of parametric methods
A lecture and a practical (3 hours) will include two parts relating to (1) basic statistical concepts and (2) tests of normality, the requirement for applying parametric methods of data analysis.
Outline of the lecture:
(1) Basic concepts of a data sample
  - Scale levels of data
  - Parameters of data distribution: skewness, kurtosis
  - Measures of central tendency and measures of dispersion
  - Levene's test: assessing equality of variances in two or more data samples
(2) Tests of normality

  - Skewness statistics as an indicator of data distribution normality
  - Shapiro-Wilk test of normality (for samples of < 50)
  - Kolmogorov-Smirnov test of normality (for samples of ≥ 50)
  - Log transformation of skewed data as a way to obtain normally distributed data.

Students will be provided with examples of data samples illustrating the concepts and exemplary calculations using the tests of normality.

2. Tests of Pairwise Comparison
A lecture and a practical (3 hours) will introduce *t*-tests, parametric methods of analysis estimating differences between two data samples and their non-parametric analogues. The notion of effect size.
Outline of the lecture:
(1) *t*-test for two independent participant samples
  - Levene's test: assessing equality of variances in the compared data samples
  - Understanding the *t* parameter (difference between the means of two data samples) and the degree of freedom measure
(2) *t*-test for data from the same sample of participants at two different conditions
(3) Mann-Whitney *U* test (between-participants design)

  - Non-parametric analogue of *t*-test for two independent participant samples: Estimating difference for non-normally distributed data.
(4) Wilcoxon rank test (within-participants design)

  - Non-parametric analogue of *t*-test for related data samples: Estimating difference for non-normally distributed data.

Scuola di Dottorato di Scienze Naturali ed Ingegneristiche
Strada Le Grazie, 15 - 37129 Verona | T + 045 802 7026
laura.marcazzan@univr.it
P. IVA 01541040232 | C.F. 93009870234

3. One-Way Analysis of Variance (ANOVA) and its Non-Parametric Analogue

A lecture and a practical (3 hours) will introduce one-way ANOVA, a parametric method of analysis of variance to estimate differences between more than two data samples, and Kruskal-Wallis H test, its non-parametric analogue.

Outline of the lecture:

(1) One-way ANOVA

- Levene's test: assessing equality of variances in the compared data samples
- Understanding the F parameter (of global difference between all data samples)
- Post hoc analysis of difference between pairs of samples
- Correction of p-values for multiple comparisons. Bonferroni correction (robust and conservative test). Tukey correction (most powerful test for doing all pairwise comparisons)

(2) Kruskal-Wallis H test

- Non-parametric analogue of one-way ANOVA: Estimating difference between samples of non-normally distributed data. Understanding the chi-square statistic
- Post hoc analysis of difference between pairs of samples using Mann-Whitney U test (between-participants design) or Wilcoxon rank test (within-participants design)

Students will be provided with exemplary calculations using data sets suitable for applying ANOVA and Kruskal-Wallis H test.

4. Complex Analysis of Variance (ANOVA)

A lecture and a practical (3 hours) will introduce two-way ANOVA, a parametric method of analysis of variance to estimate differences between two or more data samples, with two independent variables.

Outline of the lecture:

- Two-way ANOVA: considering differences with regards to two independent variables, one with n levels and the other with m levels
- Understanding the main effect and degrees of freedom
- Understanding the interaction effect and degrees of freedom
- Pairwise post hoc analyses of differences
- Correction of p-values for multiple comparisons. Bonferroni test
- Introducing, by analogue, a three-way ANOVA

Students will be provided with exemplary calculations using data sets suitable for applying two-way ANOVA.

The course will be held in room G on Wed. 23, 30, June 6 and 13, from 14:30 to 17:30.

The course amounts to 3 CFU of the Doctoral School.

Scuola di Dottorato di Scienze Naturali ed Ingegneristiche
Strada Le Grazie, 15 - 37129 Verona | T + 045 802 7026
laura.marcazzan@univr.it
P. IVA 01541040232 | C.F. 93009870234