Universitat Autònoma de Barcelona

2019/2020

Statistics and Psychometric Models

Code: 104881
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	OT	4	0

Contact

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Use of Languages

Principal working language: catalan (cat)

Some groups entirely in English: No

Some groups entirely in Catalan: Yes

Some groups entirely in Spanish: No

Prerequisites

It is highly recommended to have acquired the competences worked on in the two previous methodological subjects: "Methods, designs and research techniques" and "Data analysis". Therefore, the students have to be able to understand and apply the methodology used for research in psychology, as well as basic descriptive and inferential data analysis techniques.

Objectives and Contextualisation

"Statistical and psychometric models" is taught in the second semester of the second year, after having completed the two previous subjects on methodology, through which the students must have acquired the foundations of research methodology and data analysis.

On the basis of these previous subjects, in the current subject students will now move on to more complex statistical models, of a multivariable nature, introducing analytical solutions to three common phenomena in psychological research: interaction between variables; statistical control of confusing variables; and reduction in the dimensionality of data.

The training objectives of this subject are:

1. To learn the concept of a statistical model as an approach to the multidimensionality of research in psychology.

2. To understand the relationship between the research design used and the corresponding data analysis.

3. To know when and how to apply data-reduction techniques.

At the end of the course, students must be able to:

1. Specify the statistical model appropriate to the objectives and hypotheses of psychological research when research design allows this.

2. Distinguish between models that respond to a predictive hypothesis and those that respond to an explanatory hypothesis.

3. If necessary, include interaction variables and/or adjustment variables in the model.

4. Decide on the need to keep terms of interaction and/or adjustment variables in the model.

5. Correctly estimate and interpret the coefficients of a regression model.

6. Delimit the main aspects to be diagnosed when validating the model.

7. Know how to apply a principal-components analysis to reduce data dimensionality; correctly determine the number of components retained; optimal rotation of the said components; and perform an adequate interpretation of their meaning.

8. Understand the statistical analysis carried out in research papers that use predictive or explanatory statistical models, or data-reduction models.

9. Know the basic statistical vocabulary in Catalan, Spanish and English.

10. Know the basic elements of statistical analysis software.

Competences

- Correctly use a wide range of statistical software and programming languages, choosing the best one for each analysis, and adapting it to new necessities.
- Critically and rigorously assess one's own work as well as that of others.
- Formulate statistical hypotheses and develop strategies to confirm or refute them.
- Identify the usefulness of statistics in different areas of knowledge and apply it correctly in order to obtain relevant conclusions.
- Interpret results, draw conclusions and write up technical reports in the field of statistics.
- Make efficient use of the literature and digital resources to obtain information.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Use quality criteria to critically assess the work done.
- Work cooperatively in a multidisciplinary context, respecting the roles of the different members of the team.

Learning Outcomes

1. Critically assess the work done on the basis of quality criteria.
2. Design and conduct hypothesis tests in the different fields of application studied.
3. Draw conclusions that are consistent with the experimental context specific to the discipline, based on the results obtained.
4. Draw up technical reports that clearly express the results and conclusions of the study using vocabulary specific to the field of application.
5. Interpret statistical results in applied contexts.
6. Justify the choice of method for each particular application context.
7. Make effective use of references and electronic resources to obtain information.
8. Reappraise one's own ideas and those of others through rigorous, critical reflection.
9. Recognize the importance of the statistical methods studied within each particular application.
10. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
11. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
12. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
13. Use different programmes, both open-source and commercial, associated with the different applied branches.

14. Work cooperatively in a multidisciplinary context, accepting and respecting the roles of the different team members.

Content

U1. Analysis of internal consistency
. Association between items
. Internal consistency
. Cronbach's alpha
. Coefficient of discrimination
. Analysis of items
. Spearman-Brown prophecy
U2. Consistency vs. Agreement
. Individual measure versus average
. Intraclass correlation
. Contingency coefficient
. Cohen's Kappa
U3. Data reduction: one-dimensional principal components analysis
. Factor scores
. Factor loadings
. Eigenvalues and explained variance
. Communalities
. Residuals
U4. Data reduction: Multidimensional principal components analysis
. Assumptions of the model
. Criteria for data reduction
. Interpretation
. Adjustment criteria
U5. Data reduction: rotation
. Orthogonal and oblique rotations
. Simple structure
. Differences between rotated and no rotated solutions
. Variance explained by the rotated factors
. Graphic representations
. Interpretation
U6. Introduction to confirmatory factor analysis
. Exploratory versus confirmatory factor analysis
. Basic principles
. Identification of the model
. Goodness-of-fit indexes
. Structural equation modelling
. Comparison of models
U7. One-way analysis of variance with independent groups
. The logic of analysis of variance
. Structural equation and decomposition of the variability
. 'A priori' contrasts
. 'A posteriori' contrasts
. Testing assumptions of linear model
U8. Analysis of variance of factorial designs
. The concept of interaction
. Structural equation: effects in a factorial design
. Study of the interaction: analysis of simple effects
. Contrasts applied to main effects and simple effects.
U9. Analysis of variance applied to multifactor designs
. Exploratory versus confirmatory analysis
. High-order interactions
. Criteria for adjusting the model
. Interaction contrasts

. Analysis of simple effects
. Predictive equations
U10. Simple linear regression
. Pearson correlation
. Least squares estimation of the regression model
. Determination coefficient
. Inferences
. Predictive models and explanatory models
. Use of the model to make predictions
. Diagnostics of the model
U11. Multiple linear regression: predictive models
. Automatic selection methods
. Selection of all possible subsets
. Use of the model to make predictions
. Binary predictors
. Categorical predictors.
U12. Multiple linear regression: explanatory models
. Modifying variables: generation and selection of interaction terms
. Confounding variables: inclusion and selection of adjustment variables
. Selection of the best explanatory model in the presence of interaction and confusion
. Interpretation of the coefficients of the model in the presence of interaction and confusion
U13. Overview of nonlinear models

Methodology

This course provides different activities based on active-learning methodologies that are centred on the student. This involves a "hybrid" approach in which we combine traditional teaching resources with other resources aimed at encouraging meaningful and cooperative learning.

1. Directed activities (30 % ECTS)

    1.1. Theoretical classes: lecture with multimedia support (12%).

    1.2. Practical classes: approaching and resolving different problems based on published research. These sessions will be held in classrooms equipped with computers (18%).

2. Supervised activities (5 % ECTS)

    2.1. Students will produce a critical review of statistical and psychometric analyses of research previously selected by the lecturers (5%).

3. Autonomous activities (65 % ECTS)

    3.1. Reading the "Theory Schemes" in preparation for the theoretical classes (20%).

    3.2. Monitoring and participation in discussion forums coordinated by lecturers and managed through the virtual campus (5%).

    3.3. Practical review of the main analytical procedures in the course through computer tutorials prepared by the lecturers (6%).

    3.4. Bibliographic and documentary consultations additional to those selected by the subject lecturers (5%).

    3.5. Self-study: completion of summaries, diagrams and conceptual maps (20%).

    3.6. Evaluation activities (9%).

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical classes (small groups): approach and resolution of different practical problems of investigation analysis	26	1.04	
Theoretical classes: master class with multimedia support	19.5	0.78	
Type: Supervised			
Supervision by the teacher of the resolution of the practices carried out autonomously	7.5	0.3	
Type: Autonomous			
Additional bibliographic and documentary consultations to those selected by the teachers for the subject	7	0.28	
Monitoring and participation in discussion forums coordinated by teachers and managed through the virtual campus	7.5	0.3	
Practical review of the main analytical procedures of the course through the resolution of the practices prepared by the professors	9	0.36	
Reading the "Theory Schemes" for the preparation of theoretical classes	30	1.2	
Self-study: Completion of summaries, diagrams and conceptual maps	37.5	1.5	

Assessment

The subject has a system of continuous evaluation based on the results obtained during the realisation of the 5 learning evidences described below:

Evidences (EV) 1, 3 and 4 are carried out in groups of two students. They consist of independently analysing and interpreting the data from practical cases related to the different parts of the course programme. This written work must be totally original and must not be copied from other sources or groups. In order to be evaluated in each EV, students must have assisted at 2/3 of the corresponding weekly practical sessions. In the first two weeks of class, through an integrated application on the virtual campus, students must confirm who their partner will be. The weighting given to these evidences is 15%, 7.5% and 7.5%, respectively, and this work must be submitted through the virtual campus. At the discretion of the lecturers, the grade obtained in each EV may require an individual oral defence.

Ev2 and 5 are individual exams and have two parts. The first (30%) consists of a test having approximately 20 questions (three response options each). Students will be able to bring printed material of their own production, but no electronic devices are allowed. Lecturers will make the statement and certain Stata-result tables available to the students a few hours before the completion of the test. The second part will be an exercise in Stata (10%) to be carried out in the faculty computer classes. This will consist of single-answer questions and no material external to the exercise may be brought in for use.

During week 19-20, the test for EV2 and/or 5 can be re-assessed. In accordance with UAB regulations, students who have not passed the subject will be able to re-assess under the following conditions: 1) they have fulfilled evidences with a weighting of at least 2/3 of the total course grade and 2) they have a continuous-assessment grade of 3.5 or higher as the sum of EV1 to EV5. The grade awarded fr the re-assessed evidence will replace thatobtained previously in the respective evidence.

A student who has given evidence of learning with a weighting of less than 40% will be considered as 'not evaluable'.

Link to the assessment guidelines for all Faculty degrees:
https://www.uab.cat/web/estudiar/graus/graus/avaluacions-1345722525858.html

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evidence 1: Delivery of the results of the analyzes made autonomously of a practical problem regarding reliability and ACP. It must be done in pairs (approx. 4-7 weeks)	15	0	0	8, 1, 2, 4, 3, 5, 6, 12, 10, 11, 9, 14, 13, 7
Evidence 2: Written evidence consisting of a part of multiple choice questions related to reliability and reduction of dimensionality (30%) and a practical part with Stata (10%) (1st period of evaluation)	40	3	0.12	2, 3, 5, 6, 9, 13
Evidence 3. Delivery of the results of the analyzes carried out autonomously of a practical problem related to the analysis of the variance. It must be done in pairs (approx. Weeks 11-14)	7,5	0	0	1, 2, 4, 3, 5, 6, 12, 9, 13, 7
Evidence 4. Delivery of the results of the analyzes carried out autonomously of a practical problem related to the regression analysis. It must be done in pairs (at the end of the 2nd half of the course) (approximately weeks 15-17)	7,5	0	0	8, 1, 2, 4, 3, 5, 6, 9, 14, 13, 7
Evidence 5: Written evidence consisting of a part of multiple choice questions related to regression and ANOVA (30%) and a practical part with Stata (10%) (2nd evaluation period)	40	3	0.12	2, 4, 3, 5, 6, 9, 13

Bibliography

Domènech, J.M. i Granero, R. (2004). Anàlisi de dades en Psicologia (Vols. 1 i 2) (2ª Ed.). Barcelona: Signo.

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Meltzoff, J. (2000). Crítica a la investigación. Psicología y campos afines. Madrid: Alianza Editorial. (Traducción del original de 1998).

Viladrich, M.C., Doval, E., Prat, R. i Vall-llovera, M. (2005). Psicometría. Barcelona: Edicions UOC.

Abad, F.J., Olea, J., Ponsoda, V. i García, C. (2011). Medición en ciencias sociales y de la salud. Madrid: Síntesis.