

Statistical and Psychometric Models

Code: 102570
ECTS Credits: 6

Degree	Type	Year	Semester
2502443 Psychology	OB	2	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Eduardo Doval Diéguez
Email: Eduardo.Doval@uab.cat

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

Teachers

Juan Martín Aliága Ugarte
Ariadna Angulo Brunet
Jennifer Morata Serrano
Albert Espelt Hernandez
Genis Prat Ortega
Marina Bosque Prous
Eva Penelo Werner
Albert Bonillo Martín

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

- Develop critical thought and reasoning and be able to communicate them effectively, both in your own language and second or third languages.
- Distinguish between the design of research, procedures and techniques to evaluate hypotheses, contrast them and interpret the results.
- Maintain a favourable attitude towards the permanent updating through critical evaluation of scientific documentation, taking into account its origin, situating it in an epistemological framework and identifying and contrasting its contributions in relation to the available disciplinary knowledge.
- Recognise and evaluate the procedures and techniques applied to the construction and adaptation of the instruments of evaluation in psychology.
- Recognise the deontological code and act ethically.
- 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.
- Use computer programmes for data management and analysis.
- Use different ICTs for different purposes.

Learning Outcomes

1. Adequately interpret the results obtained from the application of the linear model and the techniques for reduction of dimensionality.
2. Assess and contrast models, tools and techniques and decide which are best suited to psychometric analysis.

3. Assess and contrast models, tools and techniques and decide which are most suitable for statistical analysis.
4. Correctly interpret the results obtained from the application of psychometric evidence presented.
5. Describe statistical indicators of reliability and validity based on test theory.
6. Describe the main features of the probability of statistical inference, estimation and hypothesis testing in the development of psychometric tests.
7. Develop critical thought and reasoning and be able to communicate them effectively, both in your own language and second or third languages.
8. Draw reasoned conclusions from the results obtained after applying psychometric methods and techniques to respond to a research hypothesis.
9. Draw reasoned conclusions from the results obtained after applying statistical methods and technic which can respond to a research hypothesis.
10. Identify key models and psychometric analysis techniques and interpret the results obtained adequately.
11. Identify the general linear models and some techniques for multivariable statistical analysis and interpret the results obtained adequately.
12. Maintain a favourable attitude towards the permanent updating through critical evaluation of scientific documentation, taking into account its origin, situating it in an epistemological framework and identifying and contrasting its contributions in relation to the available disciplinary knowledge.
13. Make adequate use of data analysis tools in the development of psychometric tests.
14. Recognise the deontological code and act ethically.
15. Relate the results obtained by applying data analysis techniques to the theoretical approaches that originated the research hypothesis/es.
16. 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.
17. Use computer programmes for data management and analysis.
18. Use different ICTs for different purposes.
19. Use the scoring criteria and interpretation of scores to draw conclusions about the characteristics of the people tested.

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
 - . Interactions, contrasts and simple effects
 - . Criteria for adjusting the model
- 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.

N.B. The proposed teaching and assessment methodologies may experience some modifications as a result of the restrictions on face-to-face learning imposed by the health authorities. The teaching staff will use the Moodle classroom or the usual communication channel to specify whether the different directed and assessment activities are to be carried out on site or online, as instructed by the Faculty.

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	5, 6, 7, 9, 8, 17, 10, 4, 12, 16, 15, 13, 19, 18, 3, 2
Theoretical classes: master class with multimedia support	19.5	0.78	5, 6, 17, 11, 10, 1, 12, 15, 13, 19, 3, 2
Type: Supervised			
Supervision by the teacher of the resolution of the practices carried out autonomously	7.5	0.3	5, 6, 10, 15, 3, 2
Type: Autonomous			
Additional bibliographic and documentary consultations to those selected by the teachers for the subject	7	0.28	5, 6, 9, 8, 10, 4, 12, 13, 18
Monitoring and participation in discussion forums coordinated by teachers and managed through the virtual campus	7.5	0.3	7, 12, 14, 18
Practical review of the main analytical procedures of the course through the resolution of the practices prepared by the professors	9	0.36	6, 10, 4, 12, 15
Reading the "Theory Schemes" for the preparation of theoretical classes	30	1.2	5, 6, 7, 10, 12, 15
Self-study: Completion of summaries, diagrams and conceptual maps	37.5	1.5	5, 6, 7, 9, 8, 17, 10, 4, 12, 15, 13, 19, 18, 3, 2

Assessment

EV1 and EV3 are performed in groups of two people. The writing must be totally original and not copied from other sources or groups. In order for an evidence to be evaluated, it will be necessary to have attended 2/3 of its practices in person. Students must report in the first two weeks of class, through an application integrated into the virtual campus, with whom they will form a partner to carry out the work. The weight of each of these evidences is 15%. These evidences will be delivered through the Campus Virtual.

The EV2 and EV4 (individual exams) have two parts. The first (30%) will consist of a test of approximately 20 questions (three answer options, penalty for errors; two errors discount one correct, according to the usual criteria k-1): students can take printed material of their own making but not electronic devices. The student will have the statement and some Stata results tables a few hours before. The second part will be a Stata exercise (10%) to be carried out in the computer rooms of the faculty. It will consist of single-answer questions and no material can be brought.

At demand of the teaching staff, the grade obtained in each of the evidences may require an individual defense.

The responses to all the evaluation evidence must be original (writings detected from other sources or copied or plagiarized responses will not be accepted). A breach of this condition implies the nullification of the evidence. More than one non-compliance will suppose a final qualification of 0 in the subject (in application to

the regulations on evaluation of the UAB and of the Psychology degree:

<https://www.uab.cat/web/estudiar/graus/graus/avaluacions-1345722525858.html>). These measures will be applied to all the people involved in the evaluation irregularity.

In order to pass the subject through continuous assessment, the following criteria must be met: 1) The weighted sum of all the evidence must be equal to or greater than 5 points. 2) The average of EV2 and EV4 should be 4.5 or higher (on a scale of 0 to 10); otherwise the maximum grade in the course will be 4.9.

In accordance with the UAB regulations, students who have not passed the course and who meet: 1) have carried out evidence with a weight of at least 2/3 of the total and 2) have a continuous assessment mark 3.5 or higher, may be eligible for resit. The test type part of the EV2 and/or EV4 can be recovered. The grade of the recovered evidence will replace the grade previously obtained and the total grade will be recalculated with the criteria aforementioned.

A student who has submitted evidence of learning with a weight equal to or greater than 4 points (40%) will be recorded as 'evaluable'.

Second or subsequent enrollment students may opt for a single non-recoverable synthesis test that will consist of a face-to-face test that will cover the entire subject. Students interested must notify the coordination of the subject before the date of delivery of the first evidence.

Link to the guidelines for assessment of the faculty's 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	5, 7, 8, 17, 11, 10, 1, 4, 12, 16, 14, 15, 13, 19, 18, 2
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	5, 6, 17, 10, 1, 4, 12, 15, 13, 19, 18, 2
Evidence 3. Delivery of the results of the analyzes carried out autonomously of a practical problem related to the analysis of the variance and regression. It must be done in pairs (approx. Weeks 13-15)	15	0	0	6, 7, 9, 17, 11, 12, 16, 15, 18, 3
Evidence 4: Writtend 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	17, 11, 12, 14, 15, 18, 3

Bibliography

Reference manuals:

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

Kleinbaum, D.G., Kupper, L.L., Nizam, A., Muller, K. & Rosenberg, E.S. (2012). *Applied Regression Analysis and other Multivariable Methods*. (5ª ed.). Boston (MA): Cengage Learning, Inc.

López-Roldán, P.; Fachelli, S. (2016). *Análisis de varianza*. En P. López-Roldán & S. Fachelli, Metodología de la Investigación Social Cuantitativa. Bellaterra (Cerdanyola del Vallès): Dipòsit Digital de Documents, Universitat Autònoma de Barcelona. 1ª edición. Edición digital: <http://ddd.uab.cat/record/163568>

Other references:

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

Martínez Arias, R. (1995). *Psicometría: Teoría de los tests psicológicos y educativos*. Madrid: Síntesis.

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

Viladrich, M.C. & Doval, E. (Eds.) (2008). *Psicometria*. Barcelona: Edicions UOC.