Universitat Autònoma de Barcelona

2022/2023

Quantitative Archaeology

Code: 100715
ECTS Credits: 6

Degree	Type	Year	Semester
2500241 Archaeology	OB	3	1

Contact

Name: Juan Antonio Barceló Álvarez
Email: juanantonio.barcelo@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

Prerequisites

Standard Knowledge of basic arithmetic and computation at a user level.

Objectives and Contextualisation

Although the majority of archaeologists still do not believe it, archeology is a mathematical discipline (as it was asserted by David Clarke) equally with chemistry, physics, etc.. That is, we have to solve archaeological problems using reasoning methods developed in mathematical language. The difficulty is that most students from Humanities do not know their maths. Although there are many computer programs that would help us to apply these mathematical, the truth is that its use seems to be too complicated for those without the necessary skills. So this course has been scheduled, following step by step easy to follow examples of all techniques used in archeology, documenting a schematic, intuitive, simple and direct of all statistical functions that may become useful for archaeologists. The introduction to statistical techniques will not be based on formulas, but the explanation of the underlying logics. Calculations will performed by a computer program. The course is specially designed for students of archeology that wish to become future professionals in our discipline that not only have no idea of mathematics, and they learnt to hate them in their school years . Numbers appear in large numbers, but operations (arithmetic, algebraic, etc.) will be obviated and replaced by intuitive explanations of what is intended with these techniques.

Thematically, the course is an introduction to classical statistics, initially discussing the quantitative data and archaeological measurements, the most common presenting descriptive statistics and introducing students to the procedures of statistical inference, such as qualitative tests for contingency tables, analysis of variance, the study of correlations between variables, etc.. The course presents the foundations of studies of classification and multidimensional analysis, leaving aside a brief examination geostatistics and statistical analysis of time series.

Competences

- Carrying out and managing archaeology fieldwork: excavation and survey.
- Managing the main methods, techniques and analytic tools in archaeology.
- 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 ethic relevant issues.

Learning Outcomes

1. Applying both knowledge and analytical skills to the resolution of problems related to their area of study.
2. Applying proper techniques and analytical tools in case studies.
3. Autonomously searching, selecting and processing information both from structured sources (databases, bibliographies, specialized magazines) and from across the network.
4. Interpreting the archaeological fieldwork results by placing them into their historical context.
5. Using computing tools, both basics (word processor or databases, for example) and specialised software needed in the professional practice of archaeology.
6. Using the specific interpretational and technical vocabulary of the discipline.

Content

Introduction to Quantification in Social Sciences and Archeology. What does "Statistics" mean? Why it is so important.

The execrable world of Numbers. Observation, Measurement and Quantification.

Measurement of Space and Time in Archeology

From measurements to data. Representation and Coding of archaeological information. Database.

Presentation of a case study. Exercise with Excel.

The concept of variability. Measurement of Variability.

Measurement of variability. Histograms and One-Dimensional Statistics

What is chance? The importance of randomness.

Statistical design of a research. Statistical Contrasting of Models and Hypothesis Testing File

Contingency Tables and Correspondence Analysis.

Student t test. Comparison of Qualitative and Quantitative Variables

Analysis of Variance.

The concept of correlation

The concept of linear and nonlinear regression

Introduction to Principal Component Analysis

Measurement of Similarity. Introduction to the use of Euclidean distance

Group and dendrogram analysis (Cluster Analysis)

Classification and Typology. Theoretical Debate

General review of all statistical techniques used throughout the course

Archeology and Statistics. Theoretical Debate

Methodology

DIRECTED ACTIVITY 40% Attendance to theoretical classes led by the teacher. Attendance at seminar and practical sessions with computers and specific software led by the teacher. classes are held in a special computer room. Comprehensive reading of texts.

SELF-ORGANIZED ACTIVITY 55% Personal study. Use of computer software. A very special computer program has been chosen for this course: PAST -Paleontological Statistics-, original by Øyvind Hammer, D.A.T. Harper and P.D. Ryan. There are many very comprehensive programs to perform statistical calculations, PAST has advantages: it is free and students can freely download it from the Internet and install it on their personal computers (http://folk.uio.no/ ohammer / past); the program is tailored to its use in paleontology and archeology. This means that it includes some features that do not appear in general purpose programs (such as cladistics, serialization, morphometry, and stratigraphic comparison). Likewise, it does not include features rarely used in our disciplines, which allows the program to be tighter and less confusing. PAST is easy to use, and suitable for introductory courses in quantitative paleontology and archeology. students are required to have a USB PenDrive to load the data being distributed. Data analysis work with materials that students can download at the beginning of the course. It is advisable that students have their own computer in order to do the autonomous activities with the recommended free software. Consultation of specialized bibliography. part of the documentation is in English.

EVALUATION 5% Carrying out written tests Review of results

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical Homework	15	0.6	1, 6
Practical work at class	20	0.8	1, 6
Theoretical content	5	0.2	4
Type: Supervised			
Tutorials	20	0.8	2, 1, 5
Type: Autonomous			
Student Work	90	3.6	2, 1, 3, 5

Assessment

Homework, activities and class participation will be carried out through forums, wikis and / or discussions of exercises through Videoconference, Moodle, Teams, etc. The teaching staff will ensure that the student can access or offer alternative means that are within their reach.

Avaluationtests will not take place at a single session in the University.

(1) Exhaustive statistical analysis of a case study throughout the course. Parts of this analysis must be submitted each week. The entire case study (evaluable). integrating the corrected weekly exercise, will be delivered to the teaching staff the second week of December. The delivery may be made electronically, using the mechanism communicated by lecturers in each case.

(2) Final work on a new archaeological case proposed by the lecturer. The data is discussed in class and part of the calculations too, during the last week of the course in December. Next, and individually, the students will prepare an individual written work with a length of 25-30 pages, explaining the most appropriate statistical techniques to solve the archaeological questions raised by this case. The work must be delivered in January. The delivery may be made electronically, using the mechanism communicated by lecturers in each case. All written works submitted by students for evaluation are re-evaluable. This decision will be made in each case after a personalized interview (face-to-face or by electronic means) with the main lecturer. This tutorial should serve to comment on the quality of the work presented and the main errors. It is not mandatory in all cases, only when the student intends to request the re-evaluation. The delivery date of the re-evaluation and its particular characteristics will also be taken on a case-by-case basis, and by mutual agreement between the lecturer and the student.

CONTINUEDEVALUATION: Weekly exercises and text comments (20%). First case study (35%). Second case study (Final Work): (45%).

The student will receive the grade of Non-evaluable as long as they have not submitted one of the two main works required for the evaluation.

In the event that the student makes any irregularity that may lead to a significant variation in the grade of an assessment act, this assessment act will be rated 0, regardless of the disciplinary process that may be instructed. In the event of several irregularities in the acts of evaluation of the same subject, the final grade for this subject will be 0.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continuous Evaluation. Week work	20	0	0	2, 1, 6, 5
First written essay	35	0	0	2, 1, 3, 4, 6, 5
Second Written Essay	45	0	0	2, 1, 6, 5

Bibliography

REFERENCE BOOKS

Victor M. Fernández-Martínez. *Arqueo-Estadística. Métodos cuantitativos en Arqueología*. AlianzaEditorial.

BANNING, E., 2020, *The Archaeologist's Laboratory: The Analysis of Archaeological Evidence.* Springer. (Interdisciplinary Contributions to Archaeology)

HAMMER,O., HARPER,D., 2005, *Paleontological Data Analysis*. Blackwell.

GILLINGS, M., HACIGÜZELLER, P., LOCK, G., 2020, *Archaeological Spatial Analysis: A Methodological Guide.* Routledge.

BARCELO, J.A., MORELL, B., 2020, Métodos cronométricos en Arqueología, historia y paleontología. Editorial Dextra. Madrid

CASTIELLO, M., 2022, *Computational and machine Learning Tools for Archaeological Site Modeling.* Springer. SBN-13: 978-3030885663

NAKOINTZ,O., KNITTER,D., 2018, *Modelling human behavior in landscape.* Springer, SBN-13: 978-3319805931

BARCELÓ, J.A., BOGDANOVIC, I., 2015, *Mathematics and Archaeology.* CRC Press.

OTHER BIBLIOGRAPHY

ABELSON, R.P.., 1998, *La estadística razonada: reglas y principios.* Buenos Aires: Paidos.

ALDRED, O., 2022, *The archaeology of moviment.* Routledge ISBN-13: 978-0367195397

ARNOLD,T., TILTON,L., 2015, *Humanities Data in R: Exploring Networks, geospatial Data, Images and text*. Springer. ISBN-13: 978-3319207018

BARCELÓ, J.A:, 2009, *Computational Intelligence in Archaeology*. Information Science reference, IGI Group. Inc.

BAXTER, M.J., 2003, *Statistics in Archaeology*. London, Arnold Publ.

BAXTER,M.J., 1994, *Exploratory Multivariate Analysis in Archaeology.* Edinburgh University Press.

BEVAN, A., LAKE, M., 2016, *Computational Approaches to Archaeological Spaces* (UCL Institute of Archaeology Publications Book 60)

Carlson, D.L., 2017, *Quantitative Methods in Archaeology Using R* (Cambridge Manuals in Archaeology)

CHAMBERLAIN, D., 2006, *Demography in Archaeology.* Cambridge University press.

CLARK, A.E., GINGERICH, J.A. 2022, Intrasite Spatial Analysis of mobile and Semisendentary peoples. University of Utah press. · ISBN-13 ： 978-1647690441

COLEMAN, S., COLLINS,P., 2020, *LOCATING THE FIELD: Space, place and context in Anthropology.* Routledge. ASA Monograph. ISBN-13: 978-1845204020

CONNOLLY, J., LAKE, M., 2009, *Sistemas de Información geográfica aplicados a la Arqueología.* Ediciones Bellaterra

DAEMS,D., 2021, *Social complexity and complex systems in Archaeology.* Routledge, BN-13: 978-0367590536

DE SMITH, M.J., GOODCHILD, M., LONGLEY, P., 2009, *Geospatial Analysis.* Winchelsea Press. (www.spatialanalysisonline.com)

DE VAUX, VELLEMAN, BOCK*, Stats: Data and Models* (3 edición). Pearson, Addison-Wesley (con ejercicios y programas para estudiantes: http://www.pearsonhighered.com/educator/product/Stats-Data-and-Models/0321692551.page
DJINDJIAN,F., 1992, *Les méthodes pour l'Archéologie*. Paris: Armand Colin

FORTE,M., CAMPANA,S., 2018, *Digital Methods and Remote sensing in Archaeology.* Springer ISBN-13: 978-3319821474

FLETCHER,M., LOCK,G., 1992, *Digging Numbers. Elementary Statistics for Archaeologists*. Oxford Archaeological Commitee.

GARTSKI, K., 2020, Digital Innovations in European Archaeology. *Routledge. I*SBN-13: 978-1108744126

GROSSMANN, D.R., 2021, *Insights into Social Inequality: A quantitative study of neolithic to early Medieval Societies.* Sidestone Press. · ISBN-13 ： 978-9088909771

HUVILA, I., 2020, *Archaeology and Archaeological Information in the Digital Society*. Routledge. ISBN BN-13: 978-0367590536

KAMERMANS, H., LEUSEN, M.J., VERHAGEN , P., 2009, *Archaeological Prediction and Risk Management*. Leiden University

KROONENBERG, P. 2022, *Multivariate Humanities*, Springer (SBN-13: 978-3030691523)

LEE LYMAN, R., 2008, *Quantitative Paleozoology*. Cambridge University Press.
LOCK, G., 2003, *Using Computers in Archaeology*. Routledge, London.

LÓPEZ VARELA, S. (ed.), 2018. The Encyclopedia of Archaeological Sciences, 4 Volume Set. Wiley.

MCCALL, G.S., 2018, *Strategies for Quantitative Research: Archaeology by Numbers*. Routledge.

McHUGH, F., 1999, *Theoretical and Quantitative Approaches to the Study of Mortuary Practice*. Oxford, ArcheoPress (BAR Int. Series S 785)

ORTON, C., 2000, *Sampling in Archaeology*. Cambirdge University Press.

ORTON,C., 1980, *Matemáticas para Arqueólogos* Alianza Editorial (AU522)

READ, D., 2007, *Artifact Classification*. Left Coast press.

SAQUALI, M., VAN DER LINDEN, M., 2019, *Integrating Qualitative and Social Science factors in Archaeological modelling.* Springer SBN-13: 978-3030127220

SELLIER, P., 2021, Quantifying the deads: Using bone counts and Mortality profiles in Burial Archaeology. Oxbow Books · ISBN-13 ： 978-1789252903

SOBKOWIAK-TABAKA,I., 2022, *Quantifying Stone age movility Springer* SBN-13: 978-3030943677

SHENNAN,S., 1992, *Arqueología Cuantiativa*. Barcelona, Ed. Crítica.

VANPOOL, T.L., Y ROBERT D. LEONARD, 2010,*Quantitative Analysis in Archaeology*. Wiley.

ZIMMERMAN, L., GREEN, 2007, W., *The Archaeologist's Toolkit*. (7 vol.) Altamira Press.

Software

PAST. https://www.nhm.uio.no/english/research/infrastructure/past/ (Sobre Windows i sobre Mac)

OxCal. https://c14.arch.ox.ac.uk/oxcal.html

ChronoModel. https://chronomodel.com/ https://github.com/Chronomodel/chronomodel/releases/tag/v2.0.18

R. https://www.r-project.org/