Academic Year/course: 2021/22

66853 - Quantitative epidemiology and advanced statistics

Syllabus Information

Academic Year: 2021/22
Subject: 66853 - Quantitative epidemiology and advanced statistics
Faculty / School: 105 - Facultad de Veterinaria
Degree: 617 - Master's in Global Health: Integration of Environmental, Human and Animal Health
ECTS: 6.0
Year: 1
Semester: First semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The goal of the course is to train the student to handle a set of tools that will complement and expand those obtained previously in the course "Qualitative tools applied to health". In addition, they will provide skills for the design and analysis of epidemiological and statistical studies, the graphic and spatial representation of the health situation of populations and the performance of risk analysis for decision making.

1.2. Context and importance of this course in the degree

This subject is part of the group of compulsory subjects and is included in a block of two subjects together with "Qualitative tools applied to health". Within the master's programme, it is located immediately after the two initial compulsory subjects "One Health: Origin, Evolution and Future" and "One Welfare: Environment, Sustainability and Animal-Human Relationship". The competencies acquired in this subject will serve as a basis and can be used in all the electives that are programmed below. In addition, it complements the optional course of "Animal Experimentation" as regards the design and analysis of working protocols in animal experimentation, field tests and clinical trials.

1.3. Recommendations to take this course

Basic knowledge of descriptive and analytical statistics as well as epidemiology is required in relation to sampling, assessment of diagnostic tests, measurement of disease and design of observational studies.

2. Learning goals

2.1. Competences

2.1.1. Basic competences

On successful completion of this course, students will be able to:

- Know and apply computer tools and Information and Communication Technologies to analyse and gather information in the health field.
- Interpret, analyse and evaluate theories and results of research work in the field of health.
- Design, develop and lead projects in the field of health.
- Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.
- Apply the knowledge acquired and their problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
- Integrate knowledge and deal with the complexity of making judgements based on incomplete or limited information, including reflections on the social and ethical responsibilities linked to the application of their knowledge and judgements.
- Communicate their findings and the ultimate knowledge and reasons behind them to specialist and non-specialist

audiences in a clear and unambiguous manner.

- Possess the learning skills that will enable them to continue studying in a largely self-directed or autonomous manner.

2.1.2. Transversal competences

- Identify, analyse and solve problems with scientific criteria and make decisions with initiative, creativity and critical reasoning.
- Acquire the knowledge and skills necessary for the development of work and research in an autonomous way
- Communicate and transmit knowledge and research results, both orally and in writing.
- Ability to work in a multidisciplinary group.

2.1.3. Specific competences

On successful completion of this course, students will be able to:

- Understand and be able to apply the basic tools of global health research (human/public, animal and environmental).
- Apply the epidemiological tools and mathematical models needed for health monitoring, surveillance and research.
- Apply and analyse the bibliographic resources and those available on the web to obtain the necessary information for the approach of the research work and for the discussion of the results.

2.2. Learning goals

In order to pass this course, the student must demonstrate the following results:

- Learn to use statistical analysis and its interpretation in global health.
- Use the tools of quantitative epidemiology in observational studies as a basis for health decision-making.
- Apply risk analysis at the population level and make decisions based on it.
- Manage and interpret spatial health information.
- Numerically and graphically describe the results from a sample data set.
- Lay out and contrast statistical hypotheses and interpret them correctly.
- Design and implement a qualitative risk analysis for decision making.
- Design a multi-stage sampling to know the presence of a disease in a population and estimate its prevalence.
- Assessing the reliability of diagnostic tests.
- Calculating the prevalence and incidence of a disease.
- Estimate risk factors by discarding confounding factors and identifying interaction variables.
- Represent spatially the health information.

2.3. Importance of learning goals

The course contributes to the training of professionals in the field of global health, as it provides several fundamental tools for their professional activity, covering statistical and epidemiological analysis, risk analysis and spatial representation of information. This training is part of the multidisciplinary environment needed for research and development of global health projects.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

Students must demonstrate that they have achieved the intended learning outcomes through the following continuous assessment activities to be carried out individually or in groups:

1. Resolution of statistic exercises and problems at the end of the practical sessions.
2. Resolution of risk analysis related questions.
3. Resolution of exercises and problems at the end of the practical sessions of epidemiology.
4. Resolution of geographical information systems related questions.
5. Presentation of a work of spatial representation of epidemiological and/or statistical results.

The activities will be performed at the classroom and delivered at the end of each session, by email or through the ADD of the subject and will be part of the student's logbook.

The valuation of each activity is reflected in the following table:

Assessment system	% valuation

Resolution of statistic exercises and problems	33.5 %
Risk analysis assignment	8 %
Resolution of epidemiology exercises and problems	33.5 %
Resolution of geographical information systems related questions	17%
Work of spatial representation	8 %

Global assessment

Students who have not passed a minimum of 80% of the proposed activities must prove that they have acquired the practical skills corresponding to the teaching not received by means of a specific exam consisting of a written evaluation of the theoretical (40 % of the final grade) and practical contents similar to those performed during the course (60 % of the final grade) and will be part of the student?s portfolio.

Marking system

According with the Regulation of Learning Assessment Standards of the University of Zaragoza (Agreement of the Governing Council of 22 December 2010), the results obtained by the student will be graded according to the following numerical scale from 0 to 10, with the expression of one decimal place, to which the corresponding qualitative grade may be added:

0-4.9: FAIL

5.0-6.9: PASS

7.0-8.9: GOOD (NT)

9.0-10: EXCELLENT (SB)

Students with a grade over 9.0 might be awarded with honours and it could be given to more than the 5% of the enrolled students during the academic year.

In application of Article 158 of the Statutes of the University of Zaragoza, the provisional examination grades will be publicly displayed for a minimum of 7 days, and the students will be able to review their examinations, for which the place, date and time foreseen for this purpose will be indicated.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The course will be taught by professors from various departments and areas of knowledge (Applied Mathematics, Animal Health, Preventive Medicine and Public Health, Geography and Land Management) with the aim of offering a multidisciplinary approach.

The learning process that has been designed for this subject is based on a combination of the following methods:

- Theoretical lectures by teachers, with the help of audiovisual media, supported by the publication of abstracts and supplementary material in the ADD to encourage prior study and participation in class by students.
- Practice sessions in the computer classroom that include the handling of design programs and database management (Microsoft Access 2016) and programming languages for statistical and graphical analysis (R) and geographic information systems.
- Presentation of examples of application of the above tools.
- Problem solving and case studies, aiming at the acquisition of practical skills.

4.2. Learning tasks

The learning activities include theoretical lectures given by professors from the University of Zaragoza. Students will also be required to solve problems and case studies (in the classroom and computer room). Finally, the student's autonomous work is required, for the understanding of the theoretical and practical knowledge acquired. The distribution of hours of these activities is described in the following table.

Activity	Number of hours	% onsite
Lecture(theoretical-practical)	60	100
Student?s autonomous work	90	0

4.3. Syllabus

The program offered to the student to help him/her achieve the expected results includes the following contents.

Theoretical and practical content:

Module 1. Advanced statistics: description, analysis and modelling.

1.1. Probability and Bayes' theorem (5 h): Random variable. Probability distribution of a random variable. Discrete distributions and associated functions in R. Continuous distributions and associated functions in R. Conditional probability. Concept of independence from random variables. Bayes' Theorem.

1.2. Descriptive statistics (5 h): Descriptive statistics. Measurements in moments (centralizing, dispersion and shape) and in ordinations (percentiles). Graphic representations. Definition of statistical inference. Sample distribution from a statistician. Confidence intervals. Contrast of hypothesis. Basic elements. Types of errors. Level of significance. Concept of p-value. Types of hypothesis testing. Parametric and non-parametric.

1.3. Hypothesis contrasts (5 h): Normality contrast (Shapiro-Wilk). Q-Q plot. Chi-square test. Contrast of hypotheses associated with the average. (T test, Wilcoxon test). Contrast of hypotheses associated with variance (Fisher's test). Correlation and correlation test.

1.4. Linear models (5 h): Introduction to linear models in R. Assumptions of a linear model. Simple regression. Analysis of Variance to one way. Linear models with various effects (fixed, random and covariates). Introduction to generalized linear models.

Module 2. Risk analysis

2.1. Principles of risk analysis for decision making (2 h)

2.2. Qualitative risk analysis, approach to a disease model (3 h): Overview and definitions From signal to rapid risk assessment. Step 0 - Preparation. Step 1 - Gathering event information Step 2 - Literature search. Step 3 - Extract the relevant evidence. Step 4 - Evaluate the evidence. Step 5 - Risk estimation

Module 3. Advanced epidemiology.

3.1. Sample design (5 h). Probabilistic and non-probabilistic sampling methods. Sample size calculation. Detecting disease. Estimate average. Estimate prevalence. Estimate differences between proportions.

3.2. Evaluation of reliability of diagnostic tests (5 h): Estimation of sensitivity, specificity and predictive values. Combination of diagnostic tests. Agreement between tests. Test evaluation in the absence of gold standard.

3.3. Design and analysis of observational studies (5 h). Types of studies. Estimation of risk factors. Interpretation of risk. Stratified studies: interaction and confusion.

3.4. Multivariate epidemiological studies (5 h). Logistic regression models.

Module 4. GIS (Geographic Information System): Use of maps and spatial analysis.

4.1. Introduction to geographic information systems (5 h). Definition and applications of geographic information systems. Management and organization of data. Systems for the representation of geographical space in GIS.

4.2. Geographic data management (3 h). Obtaining and organizing information. Creation and maintenance of geographical databases. Data models.

4.3. Spatial analysis and visualization (8 h). Basic concepts of geographical analysis. Vector data analysis. Modeling and analysis with raster data Visualization of geographic data in GIS.

4.4. Course planning and calendar

The calendar of the master and the progr3amming of the theory and practice sessions of the course will appear throughout the month of September on the website of the Faculty of Veterinary, on the following address: http://veterinaria.unizar.es/ which will be updated at the beginning of the each academic year.

Coordinator:

Chelo Ferreira.   E-mail: cferrei@unizar.es

Tutorials:

Tutorial?s office hours will be set up on the first day of the subject in each academic year.

4.5. Bibliography and recommended resources

In the ADD, the list of updated bibliography and recommended resources will be shown, and as far as possible, they will be available before the theoretical and practical sessions, so that the student can consult them beforehand and thus favour the understanding of them and a more active participation.