Universidad Zaragoza

Academic Year/course: 2021/22

28418 - Quantitative and molecular genetics in animal breeding

Syllabus Information

Academic Year: 2021/22
Subject: 28418 - Quantitative and molecular genetics in animal breeding
Faculty / School: 105 - Facultad de Veterinaria
Degree: 451 - Degree in Veterinary Science
ECTS: 6.0
Year: 2
Semester: Second semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The aims of this course are to:

- Know the scientific bases of the disciplines that integrate animal genetic improvement.
- Know how to apply the methods and techniques of evaluation of reproducers in theoretical contexts.
- Know the formulation of improvement strategies in species of zootechnical interest.
- Integrate into programmes for animal genetic improvement, molecular genetics and conservation of genetic resources, being able to provide alternatives that improve the effectiveness of these programmes.
- Give genetic advice in pathologies of hereditary origin.
- Know the possibilities of application of transgenesis and gene therapy in veterinary medicine.

1.2. Context and importance of this course in the degree

Animal breeding is one of the fundamental pillars of animal production. It configures the genetic structure of livestock populations to achieve production objectives. In this context, animal breeding is the basis for the cost-effectiveness and sustainability of the production of food of animal origin.

This course aims to provide training in the disciplines on which animal breeding is based. The general objective is to train professionals who have the operational capacity to establish and evaluate animal breeding programmes.

From the methodological point of view, animal breeding is a broad and complex discipline in which several subjects come together. Its foundation lies in population and quantitative genetics, based on applied statistical techniques.

Until now, this information was constituted by the phenotypic manifestation of the genes involved and by the genealogical relationships between the animals in the population. This approach forms the basis of the current animal breeding programmes of companies and breeders' associations. On the other hand, molecular genetics, based on molecular biology techniques, are increasingly involved in animal breeding programmes both from the point of view of genome observation and modification.

1.3. Recommendations to take this course

It is desirable that the student has acquired the skills relating to the basic training subjects of the first year and first four months of the second year. Those corresponding to Genetics and Statistics are considered very relevant.

2. Learning goals

2.1. Competences

Student?s competencies after completing the course:

Generic transversal competences:

1. Ability to analyze and synthesize
2. Robustness in the basic knowledge of the profession
3. Oral and written communication.
4. Skills to retrieve and analyze information from different sources
5. Ability to pose and solve problems
6. Critical capacity and generation of new ideas
7. Propose and evaluate hypotheses
8. Relate and integrate concepts and ideas
9. Development of the sense of logic.
10. Ability to reason and interpret facts and concepts.

Specific competences:

1. Analyze traits that take part in an objective or selection criteria, with their factors, properties and limitations.
2. Make initial proposals for genetic improvement plans that are consistent with the proposed formulations.
3. Develop the genetic analysis of a character.
4. Understand, justify and propose new guidelines for genetic improvement and conservation.
5. Give genetic counseling.
6. To make proposals for the use of gene transfer in the veterinary profession.
7. Know the appropriate measures to estimate and control inbreeding levels for conservation purposes.

2.2. Learning goals

If students complete the course successfully, they should be able to

1. Include the fundamentals of animal genetic improvement developed from productive, genealogical and molecular information.

2. Know the genetic analysis of the characters involved in the objectives and selection criteria.

3. Develop and interpretate results of genetic evaluation models of selection candidates using

genealogical, phenotypic and molecular information.

4. Discern between basic alternatives oriented to the design of improvement plans in livestock breeds and selection schemes for specialized genetic lines.

5. Know the appropriate measures to estimate and control inbreeding levels.

6. Give genetic advice in pathologies of hereditary origin.

7. Learn the methodological bases and applications of gene transfer in Veterinary Medicine.

2.3. Importance of learning goals

It allows to know the principles of the genetic improvement, as an element of the veterinary profession. In addition, it must provide skills for the approach of genetic evaluation models and information organization/treatment, promoting attitudes favorable to livestock associationism, performance control and technical innovation.

3. Assessment (1st and 2nd call)

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

Evaluation activities

The student must demonstrate that has achieved the intended learning outcomes through the following assessment activities...

1. Theory exam: Development of multiple choice, short and essay-type questions during 1.5 hours (40 % of the grade) on the dates scheduled by the center at the end of the semester. Weights of every question in the global mark will be indicated. Wrong answers in the multiple-choice test will be penalized with 1 divided the number of wrong options times the weight of the question in the global mark.
2. Problems: Development of multiple-choice test and resolution of problems, posed in theoretical scenarios (30% of the grade) on the same date as the theory test. Weights of every question in the global mark will be indicated. Wrong answers in the multiple-choice test will be penalized with 1 divided the number of wrong options times the weight of the question in the global mark.
3. Practices: We will deal with approaches that the students will have to solve individually (20% of the grade). The assessment will be carried out throughout the semester, once the corresponding practical sessions have been completed.
4. Seminars: To be held in groups, publicly presenting the specific results proposed to each (10% of the rating). The assessment will be carried out throughout the semester, once the corresponding seminars have been held.

Sections 1 and 2 must be passed separately with at least a rating of 4 of 10.

Marking system:

According to the national regulation Law 1025/2003, 5th of September which lays down the European system of credits andmarking system for the university degree.

0-4,9: FAIL.

5,0-6,9: PASS

7,0-8,9: GOOD (NT).

9,0-10: EXCELLENT (SB).

As the article 158 of the Statutes of the University of Zaragoza lays down, provisional grades will be displayed at least for 7 days and students will be able to review them on the date, time and place provided for that purpose.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The program includes the following activities (each unit involves two theoretical teaching sessions)

1. Theoretical lectures. In 30 sessions of 1 hour, to develop key concepts.
2. Problems. In 12 sessions of 1 hour, raised to solve theoretical situations.
3. Practices. 8 on line sessions of two hours supported with simulation programs freely available.
4. Seminars. In 2-hour on line sessions to analyze and discuss with professor different proposed situations.

In 8 sessions of 2 hours supported by freely available simulation programs (https://sites.google.

with free statistical analysis software (www.r-project.org) and through access to online database

The resolution of proposed cases is a non-presential activity for the student.

4.2. Learning tasks

The learning activities will consist of attending theoretical, practical and problem lectures and to delvelop and present two seminars on topics proposed by the teaching staff. In addition, the student will attend the presentations of their classmates and must carry out individual study.

4.3. Syllabus

Theoretical lectures and problems:

BLOCK 1. INTRODUCTION

Unit 1. An approach to animal breeding. Objectives and selection criteria.

BLOCK 2. GENETIC STRUCTURE OF A QUANTITATIVE TRAIT

Unit 2. Values, means and variances.
Unit 3. Genetic relationship and inbreeding.
Unit 4. Resemblance between relatives, heritability and repeatability.

BLOCK 3. SELECTION

Unit 5. Response to selection and correlated response.
Unit 6. Selection indexes.
Unit 7. Best Linear Unbiased Predictor (BLUP)

BLOCK 4. MOLECULAR GENETICS AND SELECTION.

Unit 8. Linkage disequilibrium and detection of Quantitative Trait Loci (QTL)
Unit 9. Gene and marker assisted selection.
Unit 10. Genomic selection.

BLOCK 5. CROSSBREEDING

Unir 11. Heterosis and complementarity.
Unit 12. Crossbreeding designs.

BLOCK 6. CONSERVATION

Unit 13. Inbreeding depression and effective population size.

Unit 14. Conservation genetics.

BLOCK 7, BREEDING PROGRAMS

Unit 15. Introduction to breeding programs in non-prolific species: ruminant and horses.

Unit 16. Introduction to breeding programs in prolific species: pigs, poultry, rabbits and fish.

BLOCK 8. INHERITANCE OF DISEASES IN DOMESTIC ANIMALS

Unit 17. Hereditary diseases associated with single copy genes and a multigenic inheritance.

Unit 18. Control and eradication of hereditary diseases.

BLOCK 9. GENOME MODIFICATION IN ANIMAL BREEDING

Unit 19. Transgenesis as a tool in Veterinary sciences.

Unit 20. Therapies based on the genetic modification and its applications in animal breeding.

Practical Lectures:

1. Effect of selection of the genetic structure of the populations.
2. Genetic relatedness and inbreeding.
3. Resemblance between relatives.
4. Heritability.
5. Selection indexes.
6. Best Linear Unbiased Prediction (BLUP)
7. Marker assisted selection and genomic selection.
8. Genetic basis of hereditary diseases.

4.4. Course planning and calendar

The dates and key milestones of the subject are described in detail, along with those of other subjects of the degree of Veterinary, on the website of the Faculty of Veterinary (link http://veterinaria.unizar.es/gradoveterinaria/). This link will be updated at the beginning of each academic year.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28418