Universitat Autònoma de Barcelona

2019/2020

Genetic Improvement

Code: 102673
ECTS Credits: 6

Degree	Type	Year	Semester
2502445 Veterinary Medicine	OB	3	2

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

Teachers

Jordi Jordana Vidal

Prerequisites

There are no official prerequisites, although it is advisable for the student:

- Know the fundamental concepts of Mendelian Genetics, Molecular Genetics and Biostatistics.
- Have elementary notions of Matrix Algebra.
- You could read scientific texts in English.
- Know how to use the basic computer tools at the user level.

Objectives and Contextualisation

Animl Breeding is a compulsory subject of 6 ECTS taught during the 2nd semester of the third year of the Veterinary degree.

Regarding the general objectives of the subject, these will consist in the student acquiring the sufficient knowledge, theoretical and practical, that allow him in his professional future, analyze and collaborate efficiently in management from his Genetics background, of domestic animal populations, both in the establishment of conservation programs, programs of selection and conventional genetic improvement and genomic selection, as well as in the genetic control of diseases.

The specific training goals cn be splited into:

- Acquire knowledge to measure and quantify the genetic variability of populations, both from molecular and genealogical data.
- Critically analyze the parameters of genetic diversity of a population and its relationship with other populations.
- Decide, based on the parameters obtained, the most suitable pairings in a population, to maintain the maximum ancestral genetic variability.
- Understanding the explanatory model of the inheritance of complex (polygene) characters and the measurement of this variability based on the degree of similarity between related individuals. Calculation of genetic parameters for interesting characters.

- Develop evaluation methods of candidates for selection and understand the factors that condition genetic progress in the different selection strategies.
- Understand the implications of the different crossing systems as a tool for genetic improvement.
- Acquire a vision of the current methods of gene detection that affect complex characters, and their application in the context of conservation, genetic improvement and disease control.
- Analyze examples of programs for the conservation, selection and control of diseases in domestic species.

Competences

- Demonstrate knowledge and understanding of the aspects of organisation, finance and management in all fields of the veterinary profession.
- Demonstrate knowledge and use of statistical concepts and methods applicable to veterinary science.

Learning Outcomes

1. Analyse the dynamics of genes in populations, and the main factors conditioning the same.
2. Apply breeders knowledge of genetic evaluation to the selection and improvement of domestic animal populations, and issue judgements on existing conservation and improvement programs.
3. Apply the concept of regression to breeder evaluations.
4. Apply the principles of probability and distribution theory to the resolution of genetic problems.
5. Describe the basic genetic evaluation procedures used by breeders.
6. Identify the principles and application of programs for the genetic control of diseases.
7. Interpret the explanatory model of polygenic inheritance and its relationship with the similarity between relatives and genetic parameters.
8. Interpret the scientific principles for establishing genetic improvement programs in terms of sustainability and conservation of biodiversity, at the same time respecting animal welfare.
9. Use analysis of variance to find out the genetic and environmental sources of variability.
10. Use between variable association statistics (covariances, correlation) and their relation with analysis of variance to estimate the degree of similarity between relatives and genetic parameters.

Content

The overall content of the subject, distributed by blocks, will be the following:

- Block 1: General approach of Conservation and Improvement Programs in domestic species. Concept of breed and structure of Genealogical Books. (3h)
- Block 2: Measurement and quantification of genetic variability. Hardy-Weinberg genetic equilibrium. (4h)
- Block 3: Estimation of the parameters of genetic diversity in small populations: based on molecular data and from genealogical data. (5h)
- Block 4: The infinitesimal model for complex characters (quantitative or polygenic). (7h)
- Block 5: Estimation of genetic parameters of interest for the selection and improvement of the characters. (5h)
- Block 6: Conventional selection methods and genetic evaluation of the candidates for breeders: selection indexes, BLUP and genomic evaluation. (9h)
- Block 7: Measurement of the genetic progress, expected and observed, in a population. Routes for improvement. Selection assisted by markers and genomic selection. Diffusion of progress. (5h)
- Block 8: Crossroads of breeds and / or populations as a tool for genetic improvement. (3h)
- Block 9: Genetic control of hereditary diseases. (3h)

Likewise, the student will become familiar with problem solving through an approach based on self-learning. This part of the subject will consist of two thematic blocks:

Block A. Problems of Population Genetics

Block B. Problems of Genetic Improvement

There will be four practices in computerized classroom:
MG1: Introduction to the DCBSP program (2h)
MG2: Selection of players of the DCBSP program (2h)
MG3: Matrix treatment through computer programs (2h)
MG4: Simulation in Animal Improvement: Genup (2h)

Methodology

The teaching methodology that will be used during the whole learning process is based essentially on the student's work, and will be the teacher in charge of helping him, both in terms of the acquisition and interpretation of the information related to the subject, as in the direction of your work. In accordance with the teaching objectives of the subject, the training activities that will be carried out are:

Master classes: With these classes, the student acquires the fundamental knowledge of the subject, with practical examples that will be solved in class, which will also be worked out and complemented in seminars, tutorials and practices in the computer room. It will be interactive master classes in which dialogue with students will be encouraged and based on audiovisual materials, mainly Power Point presentations, which will be posted in advance to the Virtual Campus.

Self-learning - Problem solving: Students will be given a large collection of solved problems, explaining how to deal with them and solve them in a very detailed and didactic way. This tool will allow students to familiarize themselves, in an autonomous but guided way, with the most practical aspect of the subject.

Self-learning - Selection in simulated populations: Each student will manage an herd of dairy cows individually, generated by simulation. All the phenotypic, genealogical and animal genetic information will be available, making practical decisions about the fate of the different animals, as well as evaluating their consequences over time.

Self-learning - Group work: This activity aims to encourage group work, as well as enhance the capacity to use computer resources. We will try to write and analyze a small program for the BLUP evaluation in a practical case of animal selection.

Practices in the computerized classroom: These works will be an invaluable complement to establish the basis of self-learning (selection in simulated populations) and help to better understand what has been explained in theory classes. Likewise, they will help in the preparation and resolution of the BLUP work, in group, proposed.

Tutorials: Sessions previously arranged (email) to resolve doubts and hold discussions on specific contents of the subject, problems and proposed practical work.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Master classes	44	1.76	1, 3, 2, 4, 5, 6, 7, 8, 10, 9
Practices in the computerized classroom	8	0.32	2, 5, 8, 10
Type: Supervised			
Tutorials	4	0.16	1, 3, 2, 4, 5, 6, 7, 8, 10, 9
Type: Autonomous			
Preparation of reports	23	0.92	3, 2, 5, 8, 10
Problem solving	10	0.4	1, 3, 2, 4, 5, 6, 7, 8, 10, 9

Selection in simulated populations	14	0.56	1, 3, 2, 4, 5, 6, 7, 8, 10, 9
Self-learning	44	1.76	1, 3, 2, 4, 5, 6, 7, 8, 10, 9

Assessment

The assessment will be mainly individual and will be carried out continuously in the context of the different training activities that have been programmed.

There will be two theoretical partial exams, through a test type test consisting of 60 questions, with two alternate, true / false answers. The exams will last 1.5 hours. The results of the partial exams will represent 70% of the final mark (35% each).

Likewise, a work will be carried out, in groups of up to four students, according to what has been specified in the section of educational activities. This will qualify 10% of the final mark. This work is compulsory to surpass the subject. In the event that a student suspends the subject, the qualification obtained at work will be saved for the next calls, although he may refer to it if he wishes to opt for a better note (this will entail renunciation of the qualification obtained previously).

The genetic progress obtained in the selection activity in simulated populations (DCBSP program) will represent the remaining 20% of the final mark. This will be calculated by taking as a reference (maximum score) the average of the 10 students with more genetic progress. At the same time, binding conditions will be established during the selection. In case they are not met, the rating will be 0, regardless of the genetic progress achieved. The inclusion of additional penalties is foreseen in the event of partially or totally omitting the planned selection activities. In the event that a student suspends the subject, the note of the simulation exercise will be saved for the next calls, although he may refer to it if he wishes to opt for the note (this will entail the waiver of the qualification obtained previously).

Students who have failed any of the two partial exams can retrieve them to the corresponding final recovery exam (60 questions with two alternate, true / false answers). Students who have passed the partial examinations can also present themselves to the recovery, they want to improve the grade obtained.

Group work will not be recoverable. Students who have suspended the simulation exercise can recover it by delivering a reasoned report of the decisions taken during the exercise, as well as the consequences there of on the results obtained, placing a special emphasis on discussing the possible errors committed, as well as proposing alternative actions. The report will be done individually and will be delivered on the same day as the final exam for the recovery of the subject.

It will be considered that a student is not evaluable if he has participated in assessment activities that represent $\leq$ 15% of the final grade.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Elavoration of a report	10%	0	0	2, 5, 8, 10
First partial exam: Bloks 1 to 5	35%	1.5	0.06	1, 4, 7, 8, 10, 9
Second partial exam: Bloks 6 to 9	35%	1.5	0.06	3, 2, 5, 6, 8
Selection exercise	20%	0	0	3, 2, 5, 7, 8, 10

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