Syllabus

P000048 Genome-wide predictions in breeding: genotype-phenotype associations and genomic selection, 5.0 Credits

Subjects

Biology

Education cycle

Postgraduate level

Grading scale

Pass / Failed
The requirements for attaining different grades are described in the course assessment criteria which are contained in a supplement to the course syllabus. Current information on assessment criteria shall be made available at the start of the course.

Language

English

Prior knowledge

Applicants must be enrolled in a PhD program within the biology or related sciences. Basic knowledge of R and command line usage are strongly recommended.

Objectives

After completing the course, the students will be able to:

- Use the acquired theoretical background to design genome-wide predictions in breeding.
- Understand the theory and best practices to run genome-wide association studies.
- Design genomic selection analyses adapted to the species (crop or animal) of interest.
- Discuss new strategies in plant and animal breeding.

Content

This course has been designed for PhD students registered in the Organismal Biology Research School, in collaboration with the SLU breeding network. Experts in the plant and animal breeding areas at our university collaborate to answer common questions: (1) how to associate phenotypes and genotypes and (2) how to accelerate marker-assisted selection in the era of high throughput genome sequencing. While plant and animal populations are intrinsically different, quantitative genetics principles and association mapping methods rely on the same theoretical basis. Along the three weeks of this course, students from all the faculties across campuses will be able to review basic principles of association mapping, study in detail the bioinformatic methods today available, and do extensive hands-on work both on pre-designed examples or using their own data sets.

Aims of the course:

- The course provides the theoretical and statistical framework to apply in GWAS and Genomic Selection.
- Students will examine the most recent advances in the field and will have the opportunity to contrast plant and animal mapping strategies.
- They will analyse pre-designed datasets, testing different methods and ultimately will design in-silico experiments to apply

in their own PhD projects.

Pedagogical form

On campus

Lectures: basic concepts of mapping populations, phenotyping, sequencing strategies, statistical models, etc.

Journal club – discussion of papers, from classic to frontier science reports.

Genomics laboratories: students will be challenged with pre-designed data sets and protocols, or they can bring their own data sets, provided the size of the files are manageable in laptops and will not consume too much time running models in class.

Time table

Week 1: Theoretical background in breeding

Breeding strategies – Introduction

Molecular biology in breeding

Breeding for Resistance

Breeding for quality

Breeding and Biodiversity

**Weeks 2 & 3: Theory and in silico laboratories. **

- **GWAS**

Population genetics and quality control of genotype data

*Quantitative genetics and complex traits *

Getting started with genome-wide association studies

Advanced genome-wide association studies

- **Genomic selection**

Introduction to GS

Best Linear Unbiased Predictor

Factors affecting Genomic Selection

Single step model

Cross-Validations

Formats and requirements for examination

Pass/Fail. Students must attend at least 80% of the theoretical/practical sessions planned during weeks 2 and 3 of the course. A final evaluation will consist of an oral presentation of the results of the genomics laboratories. The course coordinators and selected instructors will assess the quality and content of the presentations. If a student fails a test, the examiner may give the student a supplementary assignment, provided this is possible and there is reason to do so.

If a student has been granted targeted study support because of a disability, the examiner has the right to offer the student an adapted test, or provide an alternative form of assessment.

If this course is discontinued, SLU will decide on transitional provisions for the examination of students admitted under this syllabus who have not yet been awarded a Pass grade.

For the assessment an independent project (degree project), the examiner may also allow a student to add supplemental information after the deadline for submission. For more information, please refer to the Education Planning and Administration Handbook.

Responsible department

Department of Plant Biology