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E.T.S. de Ingenieros
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ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

203000026 - Genomics Assited Breeding

DEGREE PROGRAMME

20BC - Master Universitario En Biologia Computacional

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 1

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Learning guide

1. Description

1.1. Subject details

Name of the subject	203000026 - Genomics Assited Breeding
No of credits	3 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	20BC - Master Universitario en Biologia Computacional
Centre	20 - E.T.S. De Ingenieria Agronomica, Alimentaria Y De Biosistemas
Academic year	2022-23

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Laura Pascual Bañuls (Subject coordinator)		laura.pascual@upm.es	Sin horario. El responsable de la asignatura y tutorías es el Dr. Julio Isidro Sánchez

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

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2.3. External faculty

Name and surname	Email	Institution
Julio Isidro Y Sánchez	j.isidro@upm.es	Centro de Biotecnología y Genómica de Plantas UPM-INIA

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Although, the course is not aimed at students with advanced statistical skills, they should be familiar with statistical concepts. Course tutorials will use statistical packages in R, and experience is R is recommended but is not essential.

4. Skills and learning outcomes *

4.1. Skills to be learned

CE02 - Utilizar sistemas operativos, programas y herramientas de uso común en biología computacional, así como, manejar plataformas de cómputo de altas prestaciones, lenguajes de programación y análisis bioinformáticos

CE03 - Analizar e interpretar bioinformáticamente los datos que se derivan de las tecnologías ómicas, y proponer soluciones bioinformáticas en relación a dichos datos.

CE05 - Utilizar herramientas de biología computacional para el análisis genómico, incluida la genómica comparativa y biología evolutiva.

CE10 - Conocimiento de las técnicas de representación del conocimiento reutilizables y modelos de razonamiento en entornos centralizados y distribuidos a utilizar en la resolución de problemas que impliquen conducta inteligente.

CG02 - Familiarizarse con el trabajo y los métodos de la Biología Computacional en condiciones reales,

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adquiriendo la capacidad de diseñar aplicaciones/experimentos de forma independiente y describir, cuantificar, analizar y evaluar críticamente los resultados obtenidos.

CG03 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con el area de la Biología Computacional.

CT03 - Tener compromiso bioético y profesional y respeto por la sostenibilidad ambiental.

4.2. Learning outcomes

RA15 - Conocimiento de las herramientas genómicas para caracterización de bancos de recursos genéticos y su utilización en programas de mejora.

RA13 - Conocer los últimos desarrollos, técnicas y herramientas en bioinformática y biología computacional aplicada a los programas de mejora genético

RA14 - Conocimientos para aplicar las nuevas tecnologías genómicas a proyectos reales de mejora genética de cultivos

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

A number of advances in genetics and genomics have greatly enhanced our understanding of structural and functional aspects of plant genomes and have integrated basic knowledge in ways that can enhance our ability to improve crop plants to our benefit. New knowledge and new tools are changing the strategies used in crop plant research that reduce the costs and increase the throughput of the assays. There is a continuing need to integrate disciplines such as struc- tural genomics, transcriptomics, proteomics and metabolomics with plant physiology and plant breeding. The ultimate goal of a breeder is to assay the genetic makeup of individuals plants to select desirable genotypes in breeding populations. The sooner the selection is applied the better genetic gain can be obtained. Marker assisted breeding has evolved to genomic assisted breeding for crop improvement due to the rapid decline in the cost of genotyping profiling per individual.

In this course, we are focusing in Genomic Selection (GS)/prediction (GP) as a breeding approach that uses genome-wide molecular markers in prediction of breeding values for multi- genic quantitative traits.

The aim of this course is to provide a basic quantitative and statistical framework to apply GS in a routine manner.

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In this sense, the course is focusing on the application of plant breeding concepts through practical exercises in R.

The learning outcomes upon course completion are:

- To develop a basic understanding of plant breeding and quantitative genetics for crop im- provement.

- Determine the most effective and efficient molecular marker method to use for common plant breeding strategies.

- To build the fundamental knowledge to build GS/GP models from scratch.

- To understand the difference between one step vs. Two steps methods in GS.

5.2. Syllabus

1. Quantitative genetics

2. Genomic selection

3. Plant breeding methods and genomics assisted breeding

4. Statistical analyses for genomics assisted breeding

5. Bioionformatics approaches in genomics assisted breeding

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6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Topic 1. Plant breeding overview. Review of Quantitative genetics/ Quantitative trait loci** Duration: 02:00			
2	**Topic 1. Plant breeding overview. Review of Quantitative genetics/ Quantitative trait loci** Duration: 02:00			
3				**Topic 1** Continuous assessment Presential Duration: 02:00
4	**Topic 2. Genomic selection/ Machine learning approach** Duration: 02:00			
5	**Topic 2** Duration: 02:00			
6				**Topic 2** Continuous assessment Presential Duration: 02:00
7	**Topic 3. Plant breeding methods and genomics assisted breeding** Duration: 02:00			
8	**Topic 3** Duration: 02:00			
9				**Topic 3** Continuous assessment Presential Duration: 02:00
10	**Topic 4. Statistical analyses for genomics assisted breeding** Duration: 02:00			

11	Topic 4 Duration: 02:00			
12				Topic 4 Continuous assessment Presential Duration: 02:00
13	Topic 5. Bioionformatics approaches in genomics assisted breeding Duration: 02:00			
14	Topic 5 Duration: 02:00			
15				Topic 5 Continuous assessment Presential Duration: 02:00
16				
17				Global exam Continuous assessment Presential Duration: 02:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

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7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Topic 1		Face-to-face	02:00	10%	5 / 10	CG02 CG03 CE05 CE02 CE03 CT03 CE10
6	Topic 2		Face-to-face	02:00	10%	5 / 10	CG02 CG03 CE05 CE02 CE03 CT03 CE10
9	Topic 3		Face-to-face	02:00	10%	5 / 10	CG02 CG03 CE05 CE02 CE03 CT03 CE10
12	Topic 4		Face-to-face	02:00	10%	5 / 10	CG02 CG03 CE05 CE02 CE03 CT03 CE10
15	Topic 5		Face-to-face	02:00	10%	5 / 10	CG02 CG03 CE05 CE02 CE03 CT03 CE10

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							CG02
17	Global exam		Face-to-face	02:00	50%	5 / 10	CG03
							CE05
							CE02
							CE03
							CT03
							CE10

7.1.2. Global examination

No se ha definido la evaluacion sólo por prueba final.

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Examen escrito		Face-to-face	01:00	100%	5 / 10	CG02 CG03 CE05 CE02 CE03 CT03 CE10

7.2. Assessment criteria

Assessments will be based on your overall number of points earned out of the total possible points.

- Progressive evaluation: 50% of final grade.

- Global evaluation: 50% of final grade.

Further minor adjustments in final grades may be made at the discretion of the instructor based upon attendance and class participation. If you haven't passed the minimal grade to gain the learning outcomes of the module, a final exam will be provided. This exam will last 60 minutes and will be worth 100% of a total of 5 out of 10 grade.

The results will follow the scheme established by the UPM in 2012 as A: Excelent, B: Advanced, C: Satisfactory, D: Not satisfactory.

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8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Principles of Plant Genetics and Breeding, 2 ed. by George Acquaah. 2012 Wiley-Blackwell Publishing, West Sussex, UK. ISBN 978-0-470-66475-9	Bibliography	
Falconer DS, Mackay TFC (1996) Introduction to quantitative genetics, 4th edn. Longman, New York	Bibliography	
Meuwissen THE, Hayes BJ, Goddard ME (2001) Prediction of total genetic value using genome-wide dense marker maps. Genetics 157:1819-1829	Bibliography	
Bernardo, R., 2002. Breeding for quantitative traits in plants (Vol. 1, p. 369). Woodbury, MN: Stemma press.	Bibliography	
Heslot N, Yang HP, Sorrells ME, Jannink JL (2012) Genomic selection in plant breeding: a comparison of models. Crop Sci 52:146-160	Bibliography	
Isidro, J., Jannink, J. L., Akdemir, D., Poland, J., Heslot, N., & Sorrells, M. E. (2015). Training set optimization under population structure in genomic selection. Theoretical and applied genetics, 128, 145-158.	Bibliography	

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Isidro J, Akdemir D, Burke J (2017) Genomic selection. In: The world wheat book, pp 1001-1019	Bibliography	

9. Other information

9.1. Other information about the subject

La asignatura se relaciona con el ODS12.