Complex traits are determined by the combined action of several genes and the environment. They are characterised in quantitative terms using statistical methods and it is widely recognised that susceptibility to prevalent infections in domesticated animals can be so described as well as classical animal production traits.

The development of genomic technology in recent years has had an immense impact on all areas of genetics. Genetic mapping and genome sequencing programmes of human, mouse and other organisms have generated many markers for mapping genes influencing complex traits. These developments have led to a requirement for training young researchers working in the area of genome studies in population and statistical genetics, quantitative genetics and bioinformatics in an environment which exposes them to state-of-the-art science.

This programme is based in the Institute of Evolutionary Biology and the Roslin Institute at the University of Edinburgh in collaboration with staff working in the Scottish Agricultural College. It provides training in genetics and quantitative skills which are increasingly required by industry and research to exploit the explosion of information in genomics. Students gain the knowledge and skills required to apply quantitative genetics theory to practical problems in the animal-science industry, and to undertake research in quantitative genetics, genome analysis and animal improvement.

Programme aims
• To provide postgraduate level education in population and quantitative genetics and genomics
• To train students in statistical technologies used in quantitative genome analysis and animal improvement

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1 The information contained in this Programme Specification should be used as a guide to the content of a degree programme and should not be interpreted as a contract.
• To prepare students for research and employment in the animal improvement industry by providing MSc projects in a world-class research environment in genome analysis

10) Educational aims of programme:

To deliver a comprehensive training in current approaches to animal breeding and quantitative genomics to students with backgrounds in biological or physical sciences.

By specifying no particular prior knowledge except exposure to and recognition of the importance of quantitative approaches in biology, we allow students with the broadest possible background who know they are interested in genomic analysis to enter. From basic quantitative concepts in genetics and statistics we build up to the latest statistical methodologies used in genome analysis to prepare the students for study in animal improvement and complex trait analysis, and a project in this area in one of the internationally recognised research groups that contribute to the course.

11) Programme outcomes:

11a) Knowledge and understanding

• An understanding of general concepts in population and quantitative genetics and genomics
• A solid grounding in the statistical methods required
• In-depth knowledge of animal improvement and complex trait analysis

11b) Graduate attributes: Skills and abilities in Research and Enquiry

Through tutorials, assessed essay writing, and extensive computer based practical classwork, students gain essential skills for work in research and industry. These include:

• Interpretation of scientific papers
• Critical analysis and synthesis of scientific information
• Ability to conduct independent research
• Ability to place findings in context and suggest new research ideas
• Execution and writing up an independent research project
• Reporting of research data in formats suitable for publication
• Correct application of statistical methodologies and careful interpretation of results

11c) Graduate Attributes: Skills and abilities in Personal and Intellectual Autonomy

Critical and analytical thought is an essential element for a professional in the field of animal improvement and is developed during the course through a high degree of independent working and instruction. By the end of the course students are able to:

• Assimilate information from different sources into a single thread
• Critically assess reports in the scientific literature
• Perform complex statistical analyses and summarise the results logically
• Become familiar with multiple approaches to the analysis of genomic data
• Apply fundamental knowledge of genetics to animal improvement

11d) Graduate Attributes: Skills and abilities in Communication

Communication is an essential element of training in research and industry. Students acquire abilities in:

• Acquisition of knowledge from the scientific literature
• Accessing online information sources
• Scientific writing, in essays, short and long reports.
• Preparation of scientific posters
• Preparation of effective Powerpoint slides for oral presentations
• Delivery of oral presentations
• Responding to unrehearsed questions in oral presentation
11e) **Graduate Attributes: Skills and abilities in Personal Effectiveness**
The students develop as individuals and as members of a small class facing the same challenges. They gain confidence in and abilities in
- Project planning
- Time management
- Independent working
- Manage stress effectively
- Learning to interact positively with other group members in the environment of a research group

11f) **Technical/practical skills**
- Identification of appropriate statistical methods for the analysis of genetic data
- Application of quantitative genomics and animal improvement techniques through computer-based practicals
- General IT skills including data retrieval and the use of spreadsheets and other databases
- Computing skills and experience of a variety of software packages
12 Programme structure and features

Entry Requirements
Applications are welcomed from candidates with a strong interest in quantitative genetics and genomics who have a first degree in either:

Biological Sciences, Agriculture or Animal Sciences, and who can show evidence of quantitative skills acquired at University level
or
Mathematics, Statistics or Physics, and who are intending to transfer into the biological sciences.

The minimum entry requirement is a 2.2 Honours degree or equivalent and the majority of students accepted on the course have at least a 2.1 or other additional experience.
Evidence of proficiency in English must be provided by non-native English speakers. Details of the English language qualifications that are currently accepted by the University of Edinburgh can be found here.

Course structure
Students take courses totalling 180 credits. All courses are SCQF Level 11 (Postgraduate)

Taught stage (120 credits)

Semester 1 (50 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population and Quantitative Genetics (PGBI11001)</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>Genetic Interpretation (PGBI11002)</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Statistics and Data Analysis (PGBI11003)</td>
<td>20</td>
<td>11</td>
</tr>
</tbody>
</table>

Semester 2 (70 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genome Analysis (PGBI11004)</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>Further courses*</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>Mini Research Project (PGBI11007)</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Principles of Genetic Improvement (PGBI11010)**</td>
<td>20</td>
<td>11</td>
</tr>
</tbody>
</table>

* Taken from level 11 courses in Biological Sciences or Informatics. A booklet giving details, as well as restrictions on choice of courses will be available for students entering the programme to facilitate advance planning.
**core course

Dissertation Stage (60 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation (PGBI1011)</td>
<td>60</td>
</tr>
</tbody>
</table>

Progression requirements
Students who gain >50% overall and >50% in at least 80 of the 120 credits in the final overall assessment of the taught stage at the end of May can proceed to the dissertation stage, and carry out a full-time research project from June – August.
Students who gain >40% overall and >40% in at least 80 of the 120 credits in the final overall assessment who do not qualify to proceed will be awarded the Diploma and leave in June.

Assessment
Assessment for the taught stage is by written examinations, in-course assignments and project work. The assessment split for the taught stage is as follows:

a) written examination papers (open and closed-book) approximately 50% of total*
b) in-course assessment approximately 50% of total*

*depending on options chosen
Students who proceed to the dissertation stage carry out a full-time research project from June to August, which is assessed by a 15,000 word written dissertation.

Modes of study
Both part-time (2 year) and full-time (1-year) registration is available. A variety of teaching methods are used including lectures, tutorials, computer-based practicals, and discussions of recent scientific papers. There is also a substantial research component, with a mini-project undertaken in Semester 2 and a full time 3-month research project carried out over the summer. Students receive individual supervision for the mini project and dissertation components of the course.

Exit awards
To be awarded the MSc, students must successfully complete both the taught and dissertation stages. Students may elect to exit at the end of the taught stage with the award of Diploma. Both the MSc and the Diploma may be awarded with Distinction.