Graduate Module: Genetic analyses of complex traits

Instructors:

1. Dr. Karim Karimi, Postdoctoral Fellow

Department of Animal Science, Faculty of Agriculture

E-mail: Karim.Karimi@dal.ca

Phone: (902)814 4442

2. Dr. Duy Ngoc Do, Postdoctoral Fellow

Department of Animal Science, Faculty of Agriculture

E-mail: duy.do@dal.ca

Phone: (819) 5715310

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Background:

The module will introduce multiple elements required to perform genetic analyses of complex traits for plant and livestock species. Topics will include: 1) complex traits: genetics and heritability; 2) data exploration and editing; 3) model parameter selections; 4) univariate models and heritability estimation; 5) bivariate models and genetic correlation.

Prerequisites:

Graduate students with basic knowledge of genetics and R program

Delivery: This module will be comprised of 5 weeks of 1.5-hour lectures, discussions, and computer lab work. The students will study theory aspects of linear models in animal and plant breeding and practice the data analysis using several programs specialized for genetic analyses such as R program, ASReml or DMU packages.

Evaluation: Assessment of this module will be in the form of participation in the lectures, three assignments and the final report at the end of the module.

 Class Participation: 30%

 Assignments: 40%

 Project report: 30%

1) Complex traits: genetics and heritability

- Introduction to quantitative traits
- Approaches to understanding genetic architecture of complex traits
- Polygenic inheritance

Practice editing pedigree information using R

2) Data exploration and editing

- Importance of data editing
- Big data and handling heavy data

Practice data editing with reshape and data-table packages in R

3) Model parameter selections

- Introduction to linear mixed models
- Fixed and random effects

Practice testing significances of effects using ASREML and lmerTest

4) Univariate models and heritability estimation

- Variance components
- Heritability definition and estimation

Practice estimating variance components and heritability using univariate models with ASREML and DMU packages

5) Bivariate models and genetic correlation.

- Multi-trait selections in animal breeding
- Breeding values
- Genetic correlations and selection index

Practice running bivariate models and estimating of genetic correlations using ASREML and DMU package

Course Assignment: Estimate genetic parameters.