Day 2
Quantitative Genetics: Introduction

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My Quantitative Genetics Journey

- First learned Quant. Gen. in plant breeding classes
  - Relied heavily on assumptions and simplifications
- Truly learned Quant. Gen. while developing AlphaSimR
  - Assumptions and simplification don’t work
- Applying theory to optimize breeding programs
  - AlphaSimR is one tool in the toolbox

Areas of Focus

- Augment traditional Quant. Gen. training
  - Review some formulas
  - Conceptual introduction to complex concepts
  - Provide AlphaSimR demonstrations

- Use of theory to tune simulations
  - Empirical data should guide simulation
  - Simulation should guide empirical data collection

Historic use of Quant. Gen. in Breeding

- The Breeder's Equation
  - Popularized by Lush
    - See Hill, 2014
  - Uses specific assumptions
  - Can be generally applied

$$Gain = \frac{ih\sigma_A}{L}$$

i: Selection intensity

h: Accuracy

σ_A: Diversity

L: Generation interval

- Optimization of phenotyping
  - Fisher and block designs
  - See R/selectiongain
  - Inbred line development

From Infinitesimal to Finite

- Classic theory uses the infinitesimal model
  - Assumes an infinite number of causal loci
  - Each has an infinitesimal average effect
    - It is not assumed that all effects are additive
  - Usually uses deterministic simulations

- Many finite loci behave similarly to the infinitesimal model
  - Behavior changes with fewer loci (Mendelian vs Polygenic)
  - Typically modeled using stochastic simulation

Why use Stochastic Simulations?

- Doesn’t require deterministic formulas
  - Long-term genetic gain
  - Non-random mating
  - Genomic selection
- Can handle greater complexity
  - Model whole breeding programs
  - Test more targeted questions
- Modern computing makes it feasible

Upcoming Topics

- Additive effects
  - Introduce theoretical concepts
- Dominance effects
  - Emphasis on tuning simulations
- Epistatic effects
  - Scratch the surface
- Genetic maps and recombination
- Autopolyploids