Livestock Breeding and Genomics

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20 September 2019

Content

- Course administration
- Linear Algebra
- R/RStudio
- Introduction to Livestock Breeding and Genomics

Who Is Who

- Your name
- Study Major
- Why this course
- Previous experiences in animal breeding / R / statistics / ...

Goals

- Official goals: http://www.vorlesungsverzeichnis.ethz.ch/Vorlesungsverzeichnis/lerneinheit.view?lang=en&lerneinheitId=131686&semkez=2019W&ansicht=KATALOGDATEN&
- Understanding basic concepts such as
  - selection
  - breeding value
  - selection response
- Be able to exlpain certain phenomena (see next slide)
- Better understanding of statistics
- Exercises in R

Comments from farmers

- “Deep cow families” (Schweizer Bauer - https://www.schweizerbauer.ch/tiere/milchvieh/eine-komplette-kuh-zuechten-17854.html)
- “I have not met anybody who can explain the concept of a breeding value. My cow has a breeding value of -900 and still gives milk.” (Leserbrief im Schweizer Bauer)

Information

- Website: https://charlotte-ngs.github.io/LBGFS2019/
- Credit points: Written exam on 20.12.2019

Lecture plan

- Type G
- Plan from next week:
  - exercise hour: 9-10
  - lecture: 10-12

Course program

Week	Date	Topic
1	20.09	Introduction to Livestock Breeding and Genomics
2	27.09	Quantitative Genetics/Single Locus
3	04.10	Genetic Evaluation with Different Sources of Information
4	11.10	Genetic Covariance Between Relatives
5	18.10	Best Linear Unbiased Prediction - Univariate Analysis
6	25.10	Best Linear Unbiased Prediction - Multivariate Analysis
7	01.11	Models with Random Environmental Effects
8	08.11	Analysis of Longitudinal Data
9	15.11	Variance Components Estimation
10	22.11	Linkage Disequilibrium
11	29.11	Genomic Selection
12	06.12	Genom-Wide Association Studies
13	13.12	Questions, Test Exam
14	20.12	Exam

Exercises

- Topics of each lecture are repeated in exercise
- Exercise hours can be used to work on problems
- Solutions are presented one week later
- Exercise platform: (will be available soon)

Your experiences

- ... in quantitative genetics, statistics, linear algebra
- Do you know any programming languages, if yes which one?
- What tools are you using when you work with data (projects, BSc thesis, MSc thesis)
- Were there any lectures in which you got in contact with programming languages, which ones?
- Are you interested in learning how to program?

Prerequisites

- None
- all concepts will be explained
- Helpful are
    - quantitative genetics
    - statistics
    - linear algebra
    - R

Introduction to Livestock Breeding

- Terminology
  - Livestock breeding
  - Animal breeding
  - Ambiguous use
- History
  - Traditional breeding
  - Genomics

Fundamental Questions

- What is the best animal?
- How to find it?

Phenotypes and Genotypes

$$P = G + E$$

where P and E are observed and G is unknown

Improving Animal Populations

- Improvement via breeding $\rightarrow$ long-term
- Two tools

1. selection
   - process to determine parents of next generation
   - natural selection in wildlife and livestock
   - artificial selection in livestock: fix a goal and rank
2. mating
   - which animal is bred to which
   - extreme
   - complementary
   - heterosis - crossbreeding

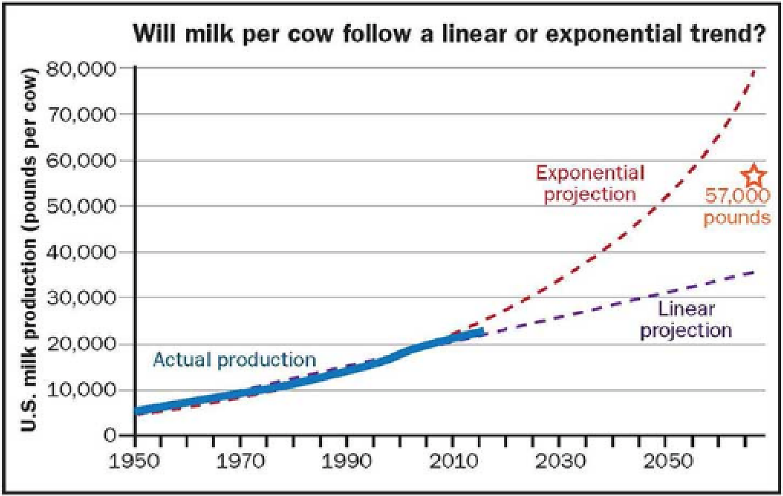
Statistics

- BLUP
- Bayesian methods

Computer Science

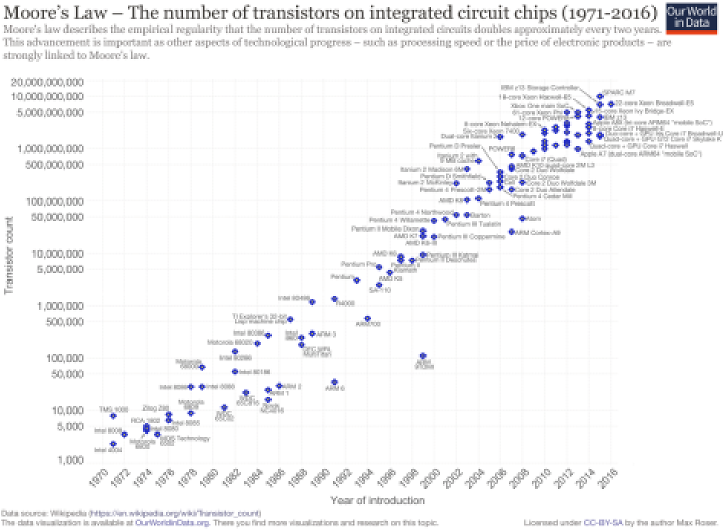
- Methods have been developed in 1940's - 1950's
- Progress occured later
- Development of cheap computing power

Milk Yield



Milk Performance per Cow
(Source: https://hoards.com/article-20808-what-will-dairy-cows-and-farms-look-like-in-50-years.html)

Computer Performance



Source: https://en.wikipedia.org/wiki/Moore%27s_law