

# Livestock Breeding and Genomics

Peter von Rohr

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# Content

- ▶ Introduction to course
- ▶ Linear Algebra
- ▶ Introduction to R/RStudio

# Who Is Who

- ▶ Study Major
- ▶ Why this course
- ▶ Previous experiences in / R / statistics / ...

# Goals

- ▶ Understanding the basics
- ▶ Be able to explain 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/LBGFS2018/>
- ▶ Credit points: Written exam on 21.12.2018

# Lecture plan

- ▶ Type G
- ▶ From next week:
  - ▶ exercise hour: 9-10
  - ▶ lecture: 10-12

## Course program

Week	Date	Topic
1	21.09	Introduction to Livestock Breeding and Genomics
2	28.09	Quantitative Genetics/Single Locus
3	05.10	Genetic Evaluation with Different Sources of Information
4	12.10	Genetic Covariance Between Relatives
5	19.10	Best Linear Unbiased Prediction - Univariate Analysis
6	26.10	Best Linear Unbiased Prediction - Multivariate Analysis
7	02.11	Models with Random Environmental Effects
8	09.11	Analysis of Longitudinal Data
9	16.11	Variance Components Estimation
10	23.11	Linkage Disequilibrium
11	30.11	Genomic Selection
12	07.12	Genom-Wide Association Studies
13	14.12	Questions, Test Exam
14	21.12	Exam



# Prerequisites

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

# 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: <http://r4tea.rteastem.org:8787>

# Your experiences

- ▶ 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?

# 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

Two tools

1. selection
2. mating

# Statistics

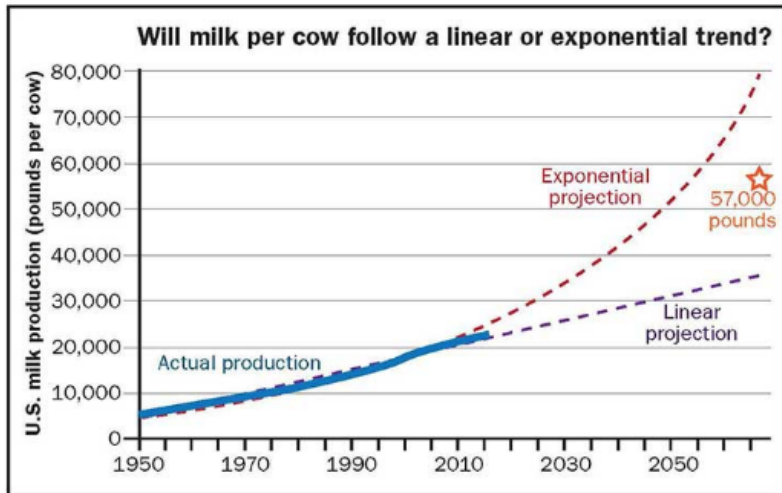
- ▶ BLUP
- ▶ Bayesian methods



# Computer Science

- ▶ Methods have been developed in 1940's - 1950's
- ▶ Progress occurred 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>)

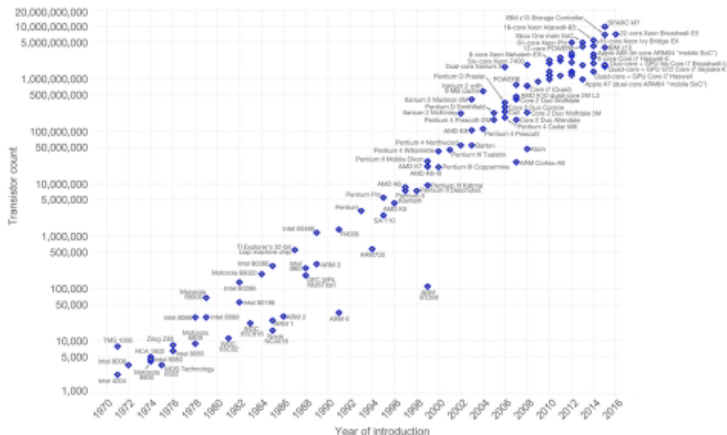
# Computer Performance

## Moore's Law – The number of transistors on integrated circuit chips (1971-2016)

Our World  
in Data

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years.

This advancement is important as other aspects of technological progress – such as processing speed or the price of electronic products – are strongly linked to Moore's law.



Data source: Wikipedia ([https://en.wikipedia.org/wiki/Transistor\\_count](https://en.wikipedia.org/wiki/Transistor_count))

The data visualization is available at [OurWorldInData.org](https://www.ourworldindata.org). There you find more visualizations and research on this topic.

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Source: [https://en.wikipedia.org/wiki/Moore%27s\\_law](https://en.wikipedia.org/wiki/Moore%27s_law)