Course outline weeks 7–11
27th April–29th May

BIOSCI220

Students are expected to be able to

- Identify the following types of variables in the dataset
  - discrete
  - continuous
- Write their own R code to summarise each variable using an appropriate plot. Specifically be able to produce the following plots
  - boxplot
  - scatter plot
  - histogram
  - barplot
- Represent their data as a clean data frame in R and manipulate it accordingly. Use of [& : etc.
- Communicate a summary of the dataset accurately and concisely
- Communicate any limitations relevant to the dataset

Short pre-lecture quiz

Week 7 (beginning 27th April): Experimental design

Learning objectives

By the end of this lab student should be able to

- Identify the independent and dependent variable in an experiment
- Describe the setup of the following experimental designs
  - independent measures
  - repeated measures
  - matched pairs
- Identify the type of design used in the given case studies
- Discuss the advantages and disadvantages of different design types
- Critique experimental designs used in the the given case studies
- Design an experiment that follows good experimental design principles

Mini lectures

- What is experimental design?
- Variable types
- Experiment validity
- Types of experimental design

Lab

- In groups discuss the experiments covered in these articles. Identify the following.
  - explanatory variable
  - response veriable
  - treatment
- Discuss the experimental design. For example, is randomisation, blinding, placebo, or matched pair design, used in the experiment?
- Discuss potential flaws of the experiments. For example are there any confounding or interacting vaiables?
- **Design and carry out your own experiment**
  - Use this tool to test your reaction time.
  - Does size of the character affect your reaction time?

Week 8 (beginning 4th May): Visualising and analysing multivariate data

Learning objectives

By the end of this lab student should be able to

- Discuss the aims and motivations of Multidimensional Scaling (MDS) and its relevance in biology
- List and summarise the three main types of MDS:
  - classical MDS
  - metric MDS
  - non-metric MDS
- Write R code to create an MDS plot appropriate to the given dataset
- Interpret an MDS plot
- Explain the aims and motivation behind Principal Component Analysis (PCA) and its relevance in biology
- Write R code to carry out PCA
- Interpret the effectively communicate the output of a PCA

Mini lectures

Lab

Week 9 (beginning 11th May): Hypothesis testing

Learning objectives

By the end of this lab student should be able to

- List appropriate questions posed by the biological questions and outline an appropriate hypothesis test that would answer it
- Describe the aims of the following hypothesis tests
  - one-sample t-test
  - two-sample t-test
  - randomization test
- List the aims of hypothesis testing and write out the appropriate null and alternative hypothesis using statistical notation
- Write R code to carry out an hypothesis test using the appropriate variables in their dataset. Specifically write R code to carry out

  - one-sample t-test
  - two-sample t-test
  - randomization test
- Interpret and communicate the findings of an hypothesis test accurately and concisely
- List the limitations of the hypothesis in relation to the questions posed by the data

Mini lectures

Lab

Week 10 (beginning 18th May): Introduction to linear modelling

Learning objectives

By the end of this lab student should be able to

- Develop a biologically relevant question of interest from the dataset and identify the following types of variables in the dataset
  - response variable
  - explanatory variables
- Express their question of interest accurately and concisely
- Carry out and interpret tests for the existence of relationships between explanatory variables and the response in a linear model
- Write R code to fit a linear model with a single continuous explanatory variable
- Write R code to fit a linear model with a continuous explanatory variable and a factor explanatory variable
- Interpret estimated effects with reference to confidence intervals from linear regression models. Specifically the interpretation of
  - the intercept
  - the effect of a factor
  - the effect of a one-unit increase in a numeric variable
  - the effect of an x-unit increase in a numeric variable
- Critique the fitted model

Mini lectures

Lab

Week 11 (beginning 25th May): Modelling II

Learning objectives

By the end of this lab student should be able to

- Write R code to fit a linear model with interaction terms in the explanatory variables
- Interpret estimated effects with reference to confidence intervals from linear regression models. Specifically the interpretation of
  - main effects in a model with an interaction
  - the effect of one variable when others are included in the model
- Explain why you may want to include interaction effects in a linear model
- Describe the differences between the operators : and * in R model-fitting formulae
- Critique the fitted model

Mini lectures

Lab