

Learning Objectives weeks 7–11, 27th April–29th May

BIOSCI220

What we assume the students are able to do

- 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 (using tidyverse??)
- Communicate a summary of the dataset accurately and concisely
- Communicate any limitations relevant to the dataset

Week 7 (beginning 27th April): Experimental design

By the end of this lab student should be able to

- 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 (interactive experiment in lab?)

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

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

Week 9 (beginning 11th May): Hypothesis testing

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

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

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

Week 11 (beginning 25th May): Modelling II

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