

One day crash course on creating Biomarker panels

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Class 1: Basics and experimental design

9:30-10:30

Learning outcomes:

- Know how to create and interpret a two-sample t-test
- Understand what a p-value means
- Be able to perform a simple sample size calculation
- Understand the basics of experimental design

Slides:

- Intro slide
 - Syllabus/timetable for the day
 - General goal: be able to create a statistical model of a biomarker panel and check that it is robust
 - Basics of data: continuous vs discrete, ordinal vs interval vs nominal
 - Two examples: prostate cancer (regression)
 - South African Heart Rate data (classification)
 - Testing differences between groups; the two-sample t-test
 - Sampling distributions of data
 - Null and alternative hypotheses
 - Drawing pictures
 - Getting and understanding the p-value
 - What the p-value is not
 - Introduction to sample size calculations
 - Type 1 and Type 2 error
 - Drawing pictures
 - The magic formula
 - Getting the values to put in to the formula
 - Possible extensions
 - Design of Experiments
 - The golden rule of designing an experiment
 - Blocking
 - Randomisation
 - Replication
 - More complicated experiments
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Class 2: Regression and classification

10:45-11:45

Learning outcomes:

- Be able to understand the structure of regression and classification models
- Know how to read and interpret the output of a statistical model
- Be familiar with some of the extensions to basic regression and classification models

Slides:

- Regression vs Classification: what's the difference?
- Response and explanatory variables
- A basic regression model
- Example: prostate cancer
- Reading the output of the model
- Plotting the fit
- Expanding the model with two explanatory variables
- Expanding the fit even more
- Regularisation and shrinkage
- Lasso; Ridge and Elastic Net
- Dealing with interactions
- Even more advanced regression approaches
- Intro to classification models
- The logit transformation
- Example: SA Heart rate
- Extending the model
- Understanding the output
- Plotting the fitted model
- Regularisation and shrinkage for classification
- More advanced classification approaches

Class 3: Model checking and performance

12:00-13:00

Learning outcomes:

- Be able to read and understand regression diagnostic plots
- Be able to compare statistical models using information criteria and cross-validation
- Understand the different types of classification metrics
- Understand and interpret ROC curves and AUC values

Slides:

- Regression diagnostics
- Residual plots
- The ANOVA table
- Classification diagnostics
- Model comparison
- Cross-validation
- Right ways and wrong ways to do cross validation
- Sensitivity and specificity
- Choosing a probability cut-off: Youden's index

- The ROC curve
 - AUC
 - Calibration
 - Decision curve analysis
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Practical 1: Introduction to Rstudio

14:00-15:00

The different parts of Rstudio Using the console window Using the Script window Creating a script Writing comments Running a script Reading in data Different data types Combine, data frames and lists Running functions Creating simple scatter plots

Practical 2: Running models and their diagnostics

15:30-16:30

Pick one of the script files (one for Prostate data - regression, one for South African data - classification) and run the files, answering the questions as you go.