Computational Cognitive Science, Tutorial 02

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1 Installing R and RStudio

The aim of this week's tutorial is to get you up and running with the R programming language, as well as getting you to think more about how we can use the tools from Bayesian inference to understand human cognition.

Before attending this week's tutorial I recommend downloading and installing R on your own machine. You can download R from `http://cran.r-project.org`, and the associated IDE RStudio from `http://www.rstudio.com`. If you need detailed instructions on installing R and RStudio, chapters 3 and 4 of Dan's 'Learning Statistics with R' textbook provides a fairly comprehensive guide to setting R up on different operating systems (which you can download from here: `http://health.adelaide.edu.au/psychology/ccs/teaching/lsr/`, and is worth a read if you have the time!). Otherwise, feel free to e-mail me if you run into any issues.

2 Introduction to R

In the first part of the tutorial I'll provide a brief overview of the R programming language, so bring your laptop with R and RStudio installed if you want to follow along! Additionally if you have time, have a look through Dan's code examples of the lotto and battleships problems from lecture 3, which you can download from MyUni. If we have spare time after going through the basics of R, I'll try and explain the code step-by-step in class, as it provides a good example of how to computationally perform Bayesian inference.

3 Bayesian Inference

- Here's a classic application of Bayes' Theorem that is very similar to the taxicab example presented in Lecture 2:

  > 1% of women at age forty who participate in routine screening have breast cancer. 80% of women with breast cancer will get positive mammographies. 9.6% of women without breast cancer will also get positive mammographies. A woman in this age group had a positive mammography in a routine screening. What is the probability that she actually has breast cancer?

- Provide an example of how the human visual system might be explained using Marr's three levels of explanation (the computational, the algorithmic and the implementation level).

- Bayes' Theorem provides a basic model for explaining how people might perform reasoning. How might you restate the following statements in terms of Bayes' theorem?

  – "Extraordinary claims require extraordinary evidence" (Carl Sagan)

- "When you have eliminated the impossible, whatever remains, however improbable, must be the truth" (Sherlock Holmes)
- "Everything should be made as simple as possible, but not simpler" (Albert Einstein)
- "Errors using inadequate data are much less than those using no data at all" (Charles Babbage)

Translate each of these statements into the language of Bayesian inference, explaining them in terms of priors, likelihoods and posteriors.