SYLLABUS AND TIMETABLE

Day 1

Models of Causation in Epidemiology
• Models: Causal criteria (Bradford Hill) and Sufficient Component Cause Model (Rothman)
• Counterfactual / Potential Outcomes Model (Rubin)

Potential Outcome Model
• “Missing data” and how we substitute “exchangeable” populations for what we can’t observe - why perfect RCTs work
• The inevitable problems with most RCTs and observational studies
• Confounding, Selection Bias, Information Bias

Directed Acyclic Graphs (DAGs)
• Formalizing assumptions for your causal model
• What’s your DAG workshop?

Quantitative Bias Analysis (QBA):
• Principles
• Why do it?

Selection Bias
• Conditioning on common effect(s) and dependent on participation by exposure and outcome
• Study design options – complete case versus imputation
• QBA to explore implications of, and corrections for, selection bias
Day 2

Confounding
- Conditioning on common cause(s) or variables on back-door path
- Regression model building strategies thought to achieve appropriate confounder adjustment – the art and science
- Other methods for dealing with confounding – Propensity Scores, and Inverse Probability Treatment Weighting (IPTW), Instrumental variables (IV)
- QBA to explore implications of unmeasured and residual confounding

Interaction and Effect Measure Modification

Day 3

Information Bias
- Misclassification (categorical variables) and measurement error (continuous variables)
- QBA on misclassification in exposures, outcomes and confounders

Dealing with “difficult issues”
- Workshop – group discussion of examples provided by course participants

Direct and Indirect effects

Probabilistic Bias Analysis
- Bringing it all together – simultaneous assessment of selection, confounding and information bias.

Course Prerequisites
This course will assume knowledge of epidemiology study design and analytical methods, the basic principles of systematic error (confounding, selection and information biases) and biostatistics up to multivariable regression. For example, successful completion of a Diploma or Masters of Public Health course in epidemiology and biostatistics (or similar) will usually provide the necessary basis to undertake this course.

Participants
The course is primarily intended for PhD students, early career researchers, and perhaps advanced MPH students who have a basic background in epidemiology and who wish to add depth to their understanding of some of the fundamental issues in epidemiological research.

Course materials and resources
- Lectures: Powerpoint slides used in teaching will be handed out as a course book at the start of the course. (All readings, however, will be available via DROPBOX – see below.) Often key points are missing from the handouts, as course attendees will be expected to deduce these key points in class and write them into their course-book.
• **Texts:** The course draws strongly on two key text books.
  1. Rothman, Greenland and Lash (2008). *Modern Epidemiology*. (3rd Ed.) Lippincott Williams & Wilkins. It is strongly recommended that course attendees either have their own, or have very ready access to, this text. Chapter 19, *Bias Analysis*, is provided in the readings file on dropbox. This is a dense chapter, but extremely well organised and comprehensive. For attendees wishing to enhance their learning, reading pages 345-63 before the course and pages 363-80 will assist.
  2. Lash, Fox, Fink (2009). *Applying Quantitative Bias Analysis to Epidemiological Data*. Springer. This is an excellent text. A strong point is the range of easy to use Excel spreadsheets for conducting quantitative bias analysis that accompany the text, available at: [http://sites.google.com/site/biasanalysis/](http://sites.google.com/site/biasanalysis/). These Excel spreadsheets will be provided to attendees, and used for class exercises during the course.

• **Readings:** We have selected a number of readings that correspond to the major topics covered in the course. The readings are available on “DROPBOX” ([https://www.dropbox.com/](https://www.dropbox.com/))

  **Causation and Counterfactuals**

  **DAGs**

  **Confounding**

  **Multiple Imputation**
  - Sterne et al. Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls. *BMJ* 2009. 38 doi: 10.1136/bmj.b2393
Propensity Scores

- Glynn RJ, Schneeweis S, Sturmer T “Indications for propensity scores and review of their use in pharmacoepidemiology” *Basic Clin Pharmacol Toxicol* 2006; 98(3):253-9

Instrumental Variables


Marginal Structural Models and Inverse Probability Treatment Weighting


Quantitative Bias Analysis

### TIMETABLE

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<tbody>
<tr>
<td>0900 to 1030</td>
<td>• Course Overview [TB]</td>
<td>• Confounding [TB]:</td>
<td>• Information bias [TB]:</td>
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<tr>
<td></td>
<td>• Quantitative bias analysis (QBA) overview [TB]</td>
<td>o Properties, counterfactual, DAGs</td>
<td>o Definitions, DAGs, etc</td>
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<tr>
<td></td>
<td>• Causation [JL]</td>
<td>o Approaches to regression model building</td>
<td>• Information bias analysis³:</td>
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<td>o QBA Class exercises – Excel</td>
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<tr>
<td>1100 to 1230</td>
<td>• Potential Outcomes Model [JL]</td>
<td>• Other methods for confounding [JL]:</td>
<td>• Probabilistic bias analysis ²:</td>
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<td>• DAGs [JL]</td>
<td>o Propensity scores</td>
<td>o Distributions, Monte Carlo, etc</td>
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<td>• What’s your DAG? (class workshop) [JL/TB]</td>
<td>o MSM / IPTW</td>
<td>o Class exercise – Excel</td>
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<td>1330 to 1500</td>
<td>• Selection bias ² [TB]:</td>
<td>• Other methods for confounding (cont) [JL]:</td>
<td>• Class workshop: [TB, LJ]</td>
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<tr>
<td></td>
<td>o Definitions and DAGs</td>
<td>o Instrumental Variables</td>
<td>o Case studies of ‘difficult’ issues. Structure: brief presentation, class discussion.</td>
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<td>o Study design options – complete case vs imputation</td>
<td>• Interaction (if time): [TB]</td>
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<td>• What does OR measure [TB]</td>
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<td>1530 to 1700</td>
<td>• Selection QBA ⁴ [TB]:</td>
<td>• Confounding bias analysis ² [TB]:</td>
<td>• Direct and Indirect Effects [TB]</td>
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<td>o Formulas</td>
<td>o Formulas</td>
<td>• Multiple bias analysis [TB]:</td>
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<td>o QBA Class exercises – Excel</td>
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<td>o Modern Epi Ch 19 example</td>
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<td>• Quiz</td>
<td>• Quiz</td>
<td>• Final Quiz</td>
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1 Spreadsheet for class: 2c. Misclassification for TB Adv Epi Class Exercises.xls
3 Spreadsheets for class: ‘Selection Bias, TB, I.xls’ and ‘Selection Bias, TB, II.xls’
4 Spreadsheets for class: 2a. Selection Bias for TB Adv Epi Class Exercises.xls
5 Spreadsheet for class: 2b. Unmeasured Confounding for TB Adv Epi Class Exercises.xls