620.152 Introduction to Biomedical Statistics — Semester 2, 2007
Answers to Problem set 2

1.i. observational study: the treatment is not imposed;  ii. women aged 40–44 (at the start of the study);  iii. prospective study;  iv. response = \( I(MI) \), explanatory variable = \( I(OC) \);  [here and elsewhere, \( I(A) \) denotes an indicator function: 1 if \( A \) is true, 0 otherwise]  v. to control for age; though, of course, this study as reported would only apply to women in that age group;  vi. something simple!

\[
\begin{array}{ccc}
\text{OC} & 3/1000 & \text{or} \\
\text{N} & 1/1000 & \text{or}
\end{array}
\]

2.(a) patients are assigned randomly to get treatment or not; the experiment can be blind to the patient; it may not be able to be double-blind as the surgeon/anaesthetist may need to know for safety reasons.

(b)–(d) (my) randomisation using MINITAB, simulation and analysis:

MTB > set PR
DATA> 92 83 83 69 68 67 81 82 86 76 95 92 64 75 77 79 85 88 72
DATA> end
MTB > set BB
DATA> 10(0) 10(1)
DATA> end
MTB > sample 20 BB BB
MTB > let Y=PR-10*BB
MTB > desc Y;
SUBC> by BB.

<table>
<thead>
<tr>
<th>Variable</th>
<th>BB</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>Minimum</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>0</td>
<td>10</td>
<td>69.50</td>
<td>9.18</td>
<td>57.00</td>
<td>61.00</td>
<td>69.00</td>
<td>77.50</td>
<td>82.00</td>
</tr>
</tbody>
</table>

Note: results will vary between students, depending on the randomisation result. As there are \( \binom{20}{10} = 184756 \) different results, it is very unlikely that two students would have the same result.
Tutorial problems

4.(a) whether exercise increases lactic acid — and by how much? (b) observational study; (c) individuals at the conference; (d) increase in lactate levels; (e) age is a lurking variable; (f) individual’s fitness level.

5.(a) individual subjects (worried about anxiety? . . . how were they chosen?); response variable = difference in anxiety level, explanatory variable, treatment = meditation; (b) experimental study: random allocation of treatments; (c) no (presumably each individual knows whether or not what therapy they receive is meditation); an individual may respond better to a treatment they believe will do them good — a blind study would avoid this problem; (d) yes: gender is confounded with the treatment.

6.(a) treatments were not actively imposed; (b) this was a survey, and again, treatments were not imposed.

7. experimental unit = male physicians, response variable = heart attacks (or perhaps heart problems), explanatory variable, treatment = aspirin.

Additional problems

8.(a)i. false: the purpose of placebos is to make dissimilar treatment appear similar; ii. false: only in randomised trials can we rely on comparability, and then only within the limits of random variation; iii. true: the so-called “placebo effect”; iv. true: this is desirable because the assessor may want the treatment to work, for example, and this could affect their judgement; v. true: you need to account for the fact that an improvement due to treatment could be the result of the patient receiving some attention and not necessarily an improvement due to the actual treatment (here placebo = no treatment).

(b)i. true; ii. false: the double refers to the blindness of the patient and clinician (to the treatment being used); iii. false: the patients should have had the trial described to them and have been told that they were equally likely to receive the standard or new treatment (often new treatments are compared with the prevailing ‘gold’ standard); iv. false: such a design is called a cross-over trial, where all subjects receive both treatments. (Cross-over trials are useful where one is concerned in measuring short-term relief of signs or symptoms in chronic conditions such as asthma. For each patient one then has an evaluation of both treatments, and so within-patient rather than between-patient comparisons can be made. However, cross-over trials cannot be used to demonstrate the long-term action of a treatment.) v. true.

9. experimental units = chicks; explanatory variables = corn types, protein levels, response variable = weight gain of chicks.

10.(a) experimental units = infants & mothers; dependent variable = birthweight; independent variable = mother’s smoking status; (b) observational study: mother’s smoking status is not imposed; (c) race, (physical) size of parents, socio-economic status, mother’s health, pre-natal care, . . . ; we can choose the mothers so that (some of) these variables are similar in the two groups.

11.(a)i. designed experiment; treatment (injections) are imposed on subjects (patients); ii. a vitamin-D deficiency sufferer; iii. possible confounding of gender with treatment; (b)i. $t = 23.35, P = 0.000$, there is significant evidence that the mean $250 HD_3$ level has risen in the four months following the injection; ii. $(62.0, 78.0)$.

12.(a) response = crop yield, explanatory variable = fertiliser type; (b) it is needed as a point of comparison: a control group: A and B might produce large crop yields, but are they better than C? (c) no: with only three plots there is no replication and hence differences in crop yield may be due to variability between plots; (d) random ordering of $(AAABBBCCC)$ → $(123456789)$; (e)i. soil moisture might affect crop yield; ii. group plots with similar soil moisture together, thus creating blocks (columns); and in each block run a mini-experiment by randomising the order of the fertilisers.