Problem Set Template

Your Name Here

Due Date, 2012

Problem 1

A) Answer to Problem 1(A) here. To illustrate how to use the `eqnarray*` and the in-line math environments, I have included a sample response (to a problem from a causal inference class in the Statistics Department at Harvard).

We can show that regression on just the treatment indicator is identical to the average treatment effect obtained from Neyman. Let us specify a linear regression as: $Y_i^{obs} = \beta_0 + \beta_1 \cdot W_i + \varepsilon_i$, where W_i is the treatment indicator for unit i and $\varepsilon_i \sim \mathcal{N}(0, \sigma^2)$.

Then, we know that minimizing the sum of squared residuals over the coefficients yields:

$\hat{\tau}_{OLS} = \dfrac{\sum(W_i - \bar{W})(Y_i^{obs} - \bar{Y}^{obs})}{\sum(W_i - \bar{W})^2}$

Let's work with the numerator first and rewrite it:

$$\begin{aligned}
\sum(W_i - \bar{W})(Y_i^{obs} - \bar{Y}^{obs}) &= \sum_{i:W_i=0} -\bar{W}(Y_i^{obs} - \bar{Y}^{obs}) + \sum_{i:W_i=1} (1-\bar{W})(Y_i^{obs} - \bar{Y}^{obs}) \\
&= -\bar{W} \sum_{i:W_i=0} (Y_i^{obs} - \bar{Y}^{obs}) + (1-\bar{W}) \sum_{i:W_i=1} (Y_i^{obs} - \bar{Y}^{obs}) \\
&= -\bar{W} \sum_{i:W_i=0} (Y_i^{obs}) + \bar{W} N_C \bar{Y}^{obs} + (1-\bar{W}) \sum_{i:W_i=1} (Y_i^{obs}) - (1-\bar{W}) N_T \bar{Y}^{obs} \\
&= -\bar{W} \sum_{i:W_i=0} (Y_i^{obs}) + (1-\bar{W}) \sum_{i:W_i=1} (Y_i^{obs}) - N_T \bar{Y}^{obs} + \bar{W} N_T \bar{Y}^{obs} + \bar{W} N_C \bar{Y}^{obs} \\
&= -\bar{W} \sum_{i:W_i=0} (Y_i^{obs}) + (1-\bar{W}) \sum_{i:W_i=1} (Y_i^{obs}) - N_T \bar{Y}^{obs} + \bar{W} N \bar{Y}^{obs} \\
&= -\frac{N_T}{N} \sum_{i:W_i=0} (Y_i^{obs}) + (1 - \frac{N_T}{N}) \sum_{i:W_i=1} (Y_i^{obs}) - N_T \bar{Y}^{obs} + \frac{N_T}{N} \cdot N \bar{Y}^{obs} \\
&= -\frac{N_T}{N} \sum_{i:W_i=0} (Y_i^{obs}) + (1 - \frac{N_T}{N}) \sum_{i:W_i=1} (Y_i^{obs}) \\
&= \frac{N_C}{N} \sum_{i:W_i=1} (Y_i^{obs}) - \frac{N_T}{N} \sum_{i:W_i=0} (Y_i^{obs})
\end{aligned}$$

We could put the final answer in a box like this, and/or change the color to make it stand out.

i) Answer to Problem 1(A)(i) here.

ii) Answer to Problem 1(A)(ii) here.

iii) Answer to Problem 1(A)(iii) here.

B) Answer to Problem 1(B) here.

Example of typesetting a table. Note that I omitted the `table` environment because I didn't want the captioning or the table as a float (but generally, this is recommended when dealing with many tables since they are automatically numbered).

Subclass	Estimated Propensity Score Bounds	Number Treated Units	Number Control Units
1	[0,0.00104]	1	278
2	(0.00104, 0.00469]	1	277
3	(0.00469, 0.0184]	4	275
4	(0.0184,0.1289]	10	268
5	(0.1289,1]	169	110

i) Answer to Problem 1(B)(i) here.

ii) Answer to Problem 1(B)(ii) here.

iii) Answer to Problem 1(B)(iii) here.

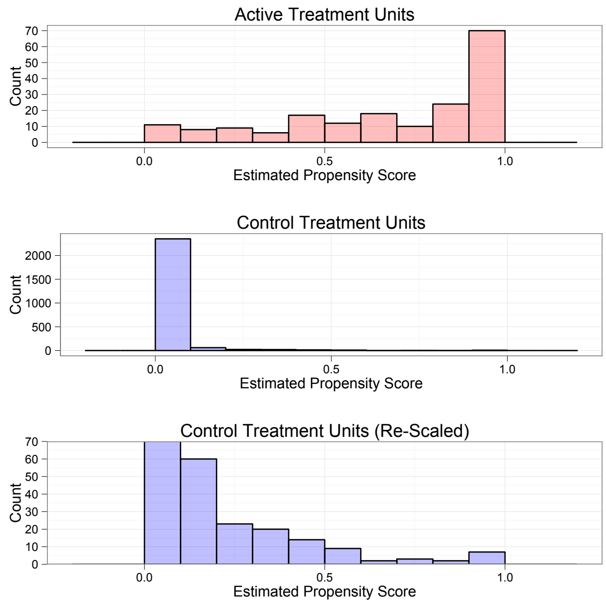
C) Answer to Problem 1(C) here.

Example of typesetting Figure 1 using the `figure` environment. Note how due to figure size, LaTeX automatically pushes it onto the next page, despite the fact that we have specified `h!` as an option telling LaTeX to place the float exactly here. Omitting `h!` as an option would lead to the figure being positioned at the end of the document, which may be preferable in some cases. Note that I am using the `hyperref` package to provide hyperlink support and cross-referencing between where I mention "Figure 1" in the text above and where the actual graphic is positioned in the text (this is a more advanced function and is purely optional).

D) Answer to Problem 1(D) here.

E) Answer to Problem 1(E) here.

Figure 1: Distributions of Estimated Propensity Scores for Original Sample



Problem 2

A) Answer to Problem 2(A) here.

B) Answer to Problem 2(B) here.

Problem 3

Answer to Problem 3 here.

Problem 4

A) Answer to Problem 4(A) here.

B) Answer to Problem 4(B) here.