Problem Set 3 — Political Science 599

Due Thursday, 13 October 2005

Instructions: Please type this problem set single spaced. When presenting tables, do not cut and paste from statistical programs directly into your word processor. Make real tables with sensible significant digits. Embed any figures (i.e. graphics) or tables into the text. Make equations, when necessary, that look nice, and that are well explained in terms of the symbols and variables used. Use numbers for equations, figures, and tables. If you have questions about how this should work, look at a recent copy of the APSR. In responding to the questions use your own words rather than quoting from books. If you quote from books, explain the quotes in your own words. Include an appendix at the end of the problem set containing the code you used to read, manipulate, and analyze the datasets. The appendix should have separate sections for each question. Someone should be able to "run" a given section of your appendix to produce the results for a given question. You may hand-write (neatly) the solutions to the math problems or use an equation editor or LaTeX. And of course, show your work.

1. For two of the following three articles,

   (a) Explain how the author drew the sample. Define the population. Evaluate the relationship between the sample and population. Give precise reasons for your evaluation.

   (b) What statistical techniques does the author use to draw information from the data?

   (c) Precisely what inferences does the author draw from precisely what numbers? Evaluate these inferences. Include measurement in your evaluation. Give precise reasons for your evaluation.

   (d) With the tools you have now, what exactly could you do to provide more evidence about the inferences the author wishes to draw? Use only the data the author has already collected. What would you learn from your fancy techniques?

   (e) If you were given $50,000 to investigate the same question the author has examined, exactly how would you spend it and why would you spend it that way? What would you get from your $50,000?

   (1) Allport and Hartman. 1925. "The Measurement and Motivation of Atypical Opinion in a Certain Group." *APSR* 19(4, Nov):735-760

   (2) Eldersveld. 1949. "The Influence of Metropolitan Party Pluralities in Presidential Elections Since 1920." *APSR* 43(6, Dec):1189-1206.

   (3) Russell and Wright. 1933. "National Attitudes on the Far Eastern Controversy." *APSR* 27(4, Aug):555-576

2. Generate 3 Bernoulli distributed random variables, each with 100 observations with $p = .3, .5, .7$ respectively. Before you look at your simulated data, say what you think the mean, median, mode and standard deviation ought to be given what you know about Bernoulli random variables in general. Now calculate the mean, median, mode, and standard deviation for each of these variables. Briefly explain why you might expect the quantities that you calculate from the data to be different from the quantities you calculate based on your statistical theory.

3. Do the following from Wonnacott and Wonnacott. Show your work.
   5-20, 5-26, 5-30, 5-32, 5-37, 6-8, 6-28, 6-44,

4. (a) Find the derivative of $w = 3u-1$ (b) First find $\frac{\partial y}{\partial x_1}$, then find $\frac{\partial y}{\partial x_2}$ of $y = (2x_1 + 3)(x_2 - 2)$. Do the same for $y = \frac{4x_1+3}{x_2-2}$. (c) If $y = u^3 + 1$ and $u = 5 - x^3$, find $\frac{dy}{dx}$. (d) What is a partial derivative?

5. Evaluate the following:

   $$\text{(a)} \int_{-1}^{3} x^3 dx \qquad \text{(b)} \int_{1}^{5} 3x^2 dx \qquad \text{(c)} \int_{0}^{1} x(x^2+6) dx \qquad \text{(d)} \int_{2}^{3} (\mathrm{e}^{2x} + \mathrm{e}^{x}) dx$$

   (e) What is a definite integral? Hows does it relate to the area under a curve? How could we use it when we're thinking about probability? In your answer, cite at least 2 math, calculus, or statistics books that help you think about the answer to these questions

6. Find the probability that X≥2 for a random variable with pdf defined by

$$f(x) = \begin{cases} \frac{1}{b-a}, \text{ for } a \leq x \leq b \\ 0, \text{ otherwise} \end{cases}$$

, where $a = -1, b = 5$. Show that your answer can be found *both* using the rules of high school geometry *and* calculus (i.e. prove to yourself that calculus actually works to give answers to such questions about probability). What kind of pdf were you working with here?

7. For the following functions, find the roots; for the equations find the solutions:

(a) $x^2 - 5x + 6 = x - 2$ (b) $\frac{2}{x^2 - 16} + \frac{1}{2x + 8} = 0$ (c) $f(x) = \frac{x+1}{4} - \frac{x-2}{3}$ (d) $x^2 + 5x - 7 = 0$

(e) $x^4 - 10x^2 + 9 = 0$ (f) What does it mean to find the roots of a function?

8. (a) Graph $y = -3 + 2x$. (b) Find a value of k such that the curve of $y = x^2 + kx + 9$ will be tangent to the x-axis. Draw this graph. (c) Find a value of k such that the graph of $y = 2x^2 + kx - 24$ crosses the x-axis where $x = 8$. Draw this graph.

9. Find the relative maxima and minima of y by the second-derivative test:

(a) $y = -2x^2 + 8x + 25$ (b) $y = x^3 + 6x^2 + 7$

(c) Explain how to find maxima and minima. Don't use jargon. Cite at least 2 math, calculus, or statistics books that help you think about the answer to this question.