36-303: Sampling, Surveys & Society
HW04: Due Tue Feb 21, 2012 on Blackboard

Reminders:

- **FIRST MIDTERM HAS BEEN MOVED TO MAR 1** (one week later than originally planned). If you have a conflict with the new date please email me *soon* to make other arrangements.
- Things coming up:

  Due Thu Feb 23: Team Working Agreement.
  - Read and do the exercises in the twa.pdf file available at `http://www.stat.cmu.edu/~brian/303`.
  - Turn in a completed team working agreement
    - On paper and signed by everyone on your team. Every team member should also have a signed copy.
    - Submit a copy on Blackboard to me.

  Due Thu Mar 01: Team Assig. II.4
  - Turn in revised versions of A, B, C, D, E, F, and G for the single project you will do this semester. Details in "project-schedule.pdf" handout (available at the class website, `http://www.stat.cmu.edu/~brian/303`).

  Due Thu Mar 08: IRB (some teams only)
  - If your team have chosen a project with human subjects (people are the units of your population) then your team must complete an IRB application (see link at `http://www.stat.cmu.edu/~brian/303`). You must turn this in to me on blackboard (not the IRB), by **Thu Mar 8**.
  - If your survey does not involve human respondents, you do not need to complete an IRB form.
- Things to read:
  - You should be reading Lohr, Appendix B (handout, also available at class website).
  - For lectures Feb 21 & 23: Groves, Ch's 7 & 8.
- Clear, careful writing and interpretation of results is an important part of both weekly homeworks and the projects. *I always expect neatly typed or neatly handwritten work.*
- Always be judicious about including computer output and graphs: show enough that we can clearly see what you are doing, but not so much that we will get lost or bored leafing through your work!
- Mostly homeworks will be submitted on Blackboard.

Exercises to Turn In (there are 2 groups of exercises):

(See next page)

1. For the following, do not provide responses based on politics, social desirability, etc. Instead, provide analytic responses based on the principles outlined in Groves, Ch 7, and/or in class.

   (a) Groves, Ch 7, p. 255 #1.

   (b) Groves, Ch 7, pp. 255–256, #5.

   (c) Groves, Ch 7, p. 256, #6.

   (d) Groves, Ch 7, pp 256–257, #8.

2. Recall the "Randomized response" model, from lecture, for the question:

   > Flip a coin, but dont tell me whether its heads or tails.
   > - If heads, answer truthfully: have you ever cheated in a CMU class?
   > - If tails, answer truthfully: is the last digit of your SSN odd?

   Recall from lecture that

   $$\pi = \frac{\lambda - (1/2) \cdot (1 - p)}{p}$$

   where $p = P[Heads]$; $\pi = P[Cheat]$; and $\lambda = P[Yes]$. Consider a SRS of n students *with replacement*[1]. Let $\hat{\lambda}$ be the fraction of "Yes" answers in the survey, and let $\hat{\pi} = (\hat{\lambda} - \frac{1}{2}(1 - p))/p$.

   (a) Show that $E[\hat{\pi}] = \pi$.

   (b) Express $Var(\hat{\pi})$ in terms of $Var(\hat{\lambda})$ and show that, as p gets closer and closer to 1, $Var(\hat{\pi})$ gets closer and closer to $Var(\hat{\lambda})$.

   (c) Suppose you use a fair coin, so that $p = \frac{1}{2}$, and you think the true rate of cheating on campus is around 0.10. How large a sample would you need, so that a 95% confidence interval for π would be only 0.02 wide?

[1] Surveys are seldom conducted this way, but it is easier for the math.