# Homework 1

S320/520

Due at the beginning of class, Thursday 3rd September

**Please write "S320" or "S520" at the top of your homework.**
All students should answer all questions. Trosset question numbers refer to the hardcover textbook. Show all working and include any graphs you are asked to draw.

1. In class, we discussed the randomized controlled experiment that showed the Salk vaccine was successful at preventing polio. The same year, there was another large-scale test of the Salk vaccine, carried out by the National Foundation for Infantile Paralysis (NFIP). In that study, there was no randomization—all second-graders at participating schools were offered the vaccine. However, many second-graders did not receive the vaccine because their parents objected or for other reasons.

   The results of the randomized controlled experiment were:

   - Of 201,000 students who received the vaccine, 59 developed polio.
   - Of 201,000 students who received the placebo, 142 developed polio.

   The results of the NFIP study were:

   - Of 222,000 vaccinated second-graders, 56 developed polio.
   - Of 124,000 unvaccinated second-graders, 54 developed polio.

   (a) For the randomized controlled experiment, find the percentage that developed polio out of the students who got the vaccine, and the percentage that developed polio out of the students who got the placebo.

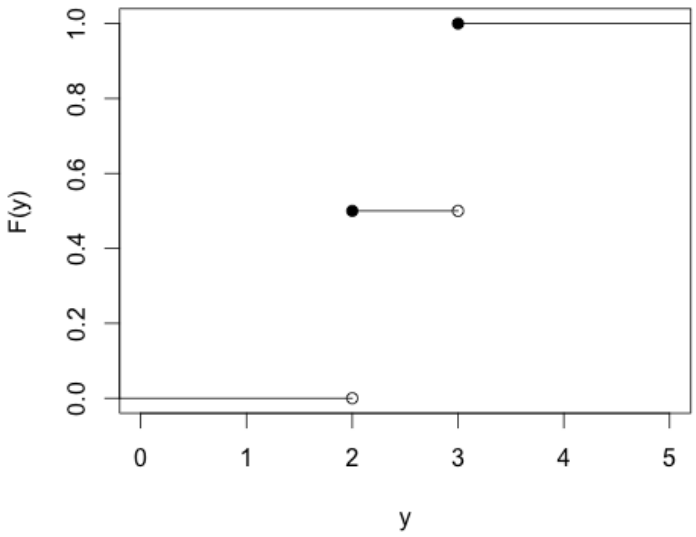
   (b) For the NFIP study, find the percentage of the vaccinated second-graders that developed polio and the percentage of the unvaccinated second-graders that developed polio.

   (c) Why is the polio percentage in the placebo group so different from the polio percentage in the NFIP unvaccinated group? Which of the two estimates is strongly biased, and why?

2. (a) Draw a graph of the following piecewise function $F(y)$:

$$F(y) = \begin{cases} 0 & y < -2 \\ \frac{y+2}{4} & -2 \leq y < 2 \\ 1 & y \geq 2 \end{cases}$$

(b) Write down a formal mathematical expression for the piecewise function $F(y)$ pictured in the graph below:




3. Trosset exercise 3.7.1 (Venn diagram and probabilities.)

4. Trosset exercise 3.7.5 (four fair dice.)

5. Trosset exercise 3.7.6 (dreidl.) Note: Parts of this question are *extremely* hard, and you are advised to go to the TA's or the lecturer's office hours for help.