

MONT 105Q – Mathematical Journeys

Problem Set 6

**Due:** in class, Friday, April 15

1. Doctors have determined that about 2.29% of all human pregnancies result in children who have major birth defects. A study of the effect of folic acid (reported in the *New England Journal of Medicine*) found that out of a random sample of  $n = 2701$  women given folic acid as a dietary supplement during pregnancy, 35 of the children had major birth defects. (For simplicity, assume there were no twins or higher multiples.)

- A) Identify an appropriate test to decide whether taking folic acid reduces the incidence of major birth defects. Give the null and alternative hypotheses, describe how the test statistic would be computed, and state the rejection region for a test with  $\alpha = .01$ .
- B) Now carry out your test. Is there sufficient evidence to conclude that women who take folic acid have a reduced risk of having children with major birth defects? Explain.

*Comment:* This is a simplified version of the actual study. That involved randomly assigning women to a treatment group (getting folic acid) and a control group (getting only a placebo) and comparing the rates of birth defects.

2. (Assuming it is possible to generate “truly random” samples of likely Republican voters – a BIG assumption, of course!), how many people would you need to include in a poll in order to predict the percentage of people who will vote for Donald Trump in next week’s New York primary to within a margin of error of  $\pm 3\%$ ?

3. Cadmium, a heavy metal, is toxic to humans. Vegetables and fungi are able to absorb and accumulate cadmium at high concentrations from the soil they grow in. A safety limit of 0.5 ppm cadmium in mushrooms has been proposed and a study published in the *Journal of Environmental Science and Health* measured the cadmium levels in a random sample of  $n = 12$  edible mushrooms of the species *Boletus pinicola*. The published data was as follows (all cadmium levels in parts per million)

0.24, 0.59, 0.62, 0.16, 0.77, 1.33, 0.92, 0.19, 0.33, 0.25, 0.59, 0.32

- A) What are the average cadmium level and the SD of the cadmium level in this mushroom sample?
- B) Describe an appropriate test to decide whether the cadmium level in these mushrooms exceeds the safety limit of .5 ppm. Give the null and alternative hypotheses, describe how the test statistic would be computed, and state the rejection region for a test with  $\alpha = .05$ . (Note: You will need to use the  $t$ -table here appropriately; this is not a large sample since  $n < 30$ .)
- C) Carry out your test and explain the results.