Bios 312: Modern Regression Analysis
January 18, 2012
Lab 1: Power and sample size

In this lab, we will consider power and sample size calculations for the simple linear regression model. Calculations can be carried out easily using either G*Power (Mac, PC) or the Power and Sample Size program "PS" (PC).

Part A: Comparison of two drugs using t-test and regression

An investigator is comparing the amount of blood vessel dilation after exposure to one of two drugs (A and B). She believes that drug A dilates vessels to an average of 10 mm and drug B dilates vessels to an average of 11 mm (i.e. a 1 mm increase in dilation), and this increase would be of scientific interest. Pilot data indicates the standard deviation of vessel dilation for drug A and drug B is about 2 mm. She is planning a study in which 50 mice are given drug A and 50 mice are given drug B. Use a significance level of 0.05 when answering the following questions.

1. If we plan to use a 2-sample t-test to analyze the data, what is the power of the proposed design?

2. If we plan to use a simple linear regression to analyze the data, what is the power of the proposed design?

3. Compare the results obtained with G*Power/PS to those obtained using the formulas given in the notes. Why are they (slightly) different?

4. Suppose that the investigator is also able to measure the baseline vessel diameter before exposure to either drug for every mouse. How could you incorporate this data into your analysis plan to obtain a more precise study? Which parameter(s) in the power calculation would the baseline diameter likely impact?

Part B: Power for dose response

Suppose an investigator is interested in measuring the vessel diameter as a function of dose for drug A. Suppose that in pilot data the standard deviation of vessel diameter (σ_y) was 90 mm, the standard deviation of dose of 15 mg, and the observed slope was 2 mm/mg. For the proposed study, the investigator believes a slope of 1.5 mm/mg is important to detect. 100 mice will be given the drug according to one of the following study designs.

Design A: 50 mice will be given a dose of 10 mg, and 50 mice will be given a dose 40 mg

Design B: 25 mice will be given a dose of 10 mg, 25 mice will be given a dose of 20 mg, 25 mice will be given a dose of 30 mg, and 25 mice will be given a dose of 40 mg

Design C: Random number generation will be used to assign each of 100 mice a dose between 10 mg and 40 mg from the uniform distribution.

1. Calculate the variability of the dose, σ_x, for each of the three designs

2. Find the power to detect a first-order (linear) trend in dose of 1.5 mm/mg for each design. Use a significance level of 0.05 and a null hypothesis of a slope of 0 mm/mg.

3. What kind of scientific hypotheses can be tested with each of the designs? In other words, what scientific hypotheses can be tested with design C (or B) that cannot be tested with design A?