Biostats VHM 802 Course
Winter 2015, Atlantic Veterinary College, PEI
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Exercises for Session 13: Sample size and power

Exercise 13.1
Power for one sample
You are about to plan sampling of painted turtles (*Chrysemus picta*) in order to measure the shell lengths of female turtles. Data on females of the painted turtle (Jolicoeur & Mosimann, 1960) showed a standard deviation of about $2.1cm$ (shell lengths ranged approximately $10-18cm$).

Compute the necessary sample sizes under the following (somewhat ad-hoc) requirements for your study:

a) a 95% confidence interval for the mean shell length should have a length of approximately $2cm$,

b) assuming it would be of interest to detect a mean difference of $1cm$ between the specific population sampled and the species average (using Cox's rule),

c) assuming a power of 0.8 is required for detecting a mean difference of $1cm$ between the specific population sampled and the species average; repeat with powers of 0.7 and 0.9.

Explain why under the requirement of a) an observed difference in shell length of $1cm$ between the specific population and the species average corresponds to $P = 0.05$ in a significance test. Are any additional assumption(s) needed for this to hold? Use this information to explain why the sample size requirement in c) is much stronger than in a), and hence leads to a larger sample size.

Exercise 13.2
Power analysis for a project application I
A project to evaluate the effect of internal parasite burdens on energy metabolism in periparurient cattle, plans to use cows already involved in an ongoing clinical trial which are treated with either parasiticide or placebo. To determine a desired sample size, it is considered desirable to be able to detect a certain difference between these groups for one particular measurement, the beta-hydroxybutyrate (BHB) concentration in milk. Compute the necessary sample size to detect a BHB difference of 300 μmol/l when the standard deviation is estimated at 650 μmol/l; use a power of 0.8 and a significance level of 0.05. The researcher opted for including a total of 200 cows in the study; try to come up with good reasons for this choice.

Exercise 13.3
Power analysis for a project application II
A project to evaluate the effect of a social marketing campaign on change toward smoke free homes is carried out in two geographically separate (but similar) regions of Canada. The social marketing campaign takes place in only one of the regions. In both regions, telephone interviews will be carried out before and after the campaign period. The interest is in comparing, between the two regions, the proportion of households (with an adult smoker and a child) interviewed which give their status as "precontemplatory" towards changing the household from a smoking to a non-smoking environment. A pilot study showed the proportion of "precontemplatory" homes to be about 0.55. Determine the required sample size to detect with power 0.8 an effect (difference in proportions) of 0.1. Repeat the calculation with an effect of 0.01.

Exercise 13.4

Power calculation in a random effects model (continuation of Exercise 10.4)

Consider again the data in the Additional Exercise 10.4, on comparison of two strains of mice bred to give high and low pH-values. It is of interest to use the data to assess the necessary sample size to show a significant difference between the mean pH-values of the two strains. Note that a power calculation based on the observed difference is of questionable utility (see the notes for references on "post-hoc" power calculations). We focus instead on a tentative minimal difference of interest of 0.05 (units of pH).

a) Compute the power of the actual design to determine a difference between the two strains of 0.05 units. (*Hint:* the comparison of strains can be done on the litter means; thus, we need to compute the estimated variance or standard deviation of litter means.)

b) Determine the necessary sample size to achieve a power of 0.8.

c) Repeat the calculation from b) for an alternative design with only 2 mice per litter. Does it require the same number of mice? – more? – less? (try to guess the answer before doing the calculation).