Power Analysis as
a tool for program planning

– some caveats

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Power Analysis

– why the topic makes us groan inwardly

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Power analysis at its worst:

> *a bad attempt at achieving a dubious goal, wrapped in a veneer of statistical legitimacy*

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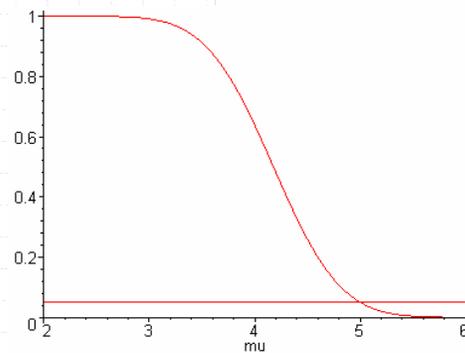$$\overline{X} \leq 5 - 1.645 \, s \big/ \sqrt{n}$$

- Power: Probability of rejecting Null hypothesis, as a function of μ
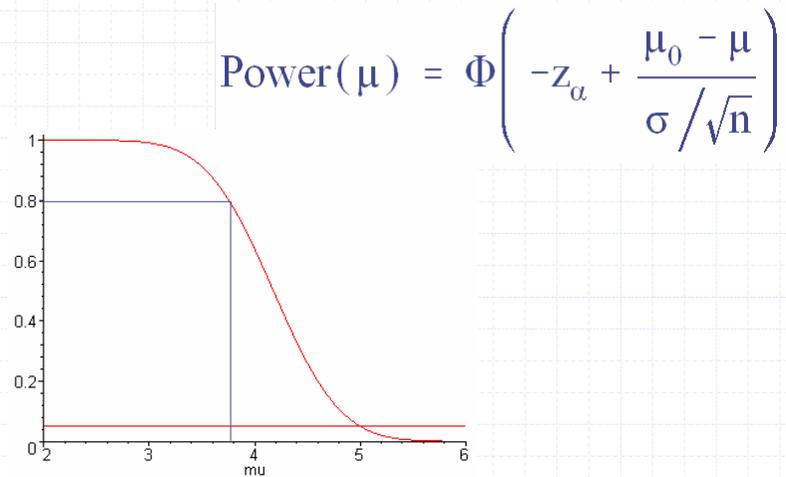
A simple power function

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Necessary Sample Size

$$\text{Power}(\mu) = \Phi\left(-z_\alpha + \frac{\mu_0 - \mu}{\sigma/\sqrt{n}}\right)$$

leads to

$$n = \frac{(z_\beta + z_\alpha)^2 \, \sigma^2}{(\mu_0 - \mu_A)^2}$$

Power Calculation
can be deceptively easy

- Planning value of variance directly proportional to necessary sample size
- Normal distribution?
- Homoscedasticity?

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Planning a monitoring program

- "We want to have an 80% chance of detecting a 10% decline over a 15 year period"

Planning a monitoring program

◆ "We want to have an 80% chance of detecting a 10% decline over a 15 year period"
◆ The Siren Song of canned software

Typical problems:
- Overly simplistic model of population change
- Overly simplistic model of data generation
- Little or no basis for parameter specification
- Unrealistic expectations

A suggestion

◆ Prior to data collection, create fake data set(s), including all potential sources of variation.
◆ Analyze fake data in advance of study … after data collection, there should be nothing left to do.
◆ Use simulation based power analysis for clearly defined questions.
◆ Bayesian approach to Frequentist problem: express uncertainty in terms of distributions on parameters.

Observations yesterday

◆ What matters is advanced thinking

◆ Power depends on method of analysis as well as type of data

◆ Power analysis not bad *per se*, but overly simplistic power analysis can lend greater legitimacy to a poorly planned study than is merited.

A power analysis using BUGS

◆ Pr(Detect gnatcatcher) in T visits.

◆ Planning data: 46 birds banded, number of observations by 10 observers recorded.

◆ 141 sightings: estimate p by 141/460 ?

(See BUGS file)