# Biostat 140.623
# Practice Quiz 1 A
# Answer Key

The **first two questions** involve general knowledge:

1) Which of the following is the best definition for **power**? (Circle only one response.)

   **a) The probability of rejecting the null hypothesis when a specific alternative hypothesis is true.**
   b) The probability of rejecting the null hypothesis when the null hypothesis is true.
   c) Type II error.
   d) The probability of making a Type II error.
   e) The probability of failing to reject the null hypothesis when the null hypothesis is true.

2) Which of the following affect the **width of a confidence interval** for a population mean? (Circle only one response.)

   a) The sample size.
   b) The variance of values in the population.
   c) The confidence level ($100x[1-\alpha]$).
   d) Both a & b, but not c.
   **e) a, b and c.**

**Questions 3-5** involve the following situation: A drug company wishes to market a new drug to control irregular heartbeat. It will conduct a pilot study to explore whether its drug is effective at slowing heart rate. Two equal-sized samples will be randomly selected; one will be administered the new drug, and the other will be administered placebo. The outcome of interest is the **change in heart rate** between a baseline evaluation (before therapy begins) and an evaluation after eight weeks of therapy. Assume that change in heart rate is normally distributed with **variance = 30 beats per minute** in the population being treated, regardless of therapy.

3) The company will construct a 95% confidence interval for the difference in heart rate change between the two study populations, comparing treatment with placebo to treatment with their drug. How large a sample must be randomized to each treatment group to achieve an interval with total width = 4 beats per minute (±2 beats per minute)?

a) 16
b) 32
**c) 58** **The form of the CI is $\bar{X}_1 - \bar{X}_2 \pm 1.96\sqrt{\frac{\sigma^2}{n}+\frac{\sigma^2}{n}}$, where $\bar{X}_1$ and $\bar{X}_2$ are sample mean change in the drug and placebo groups, respectively. Thus, d= $1.96\sqrt{\frac{2\sigma^2}{n}}$, i.e. solving for sample size, n=$(1.96)^2\frac{2\sigma^2}{d^2}$. To achieve d=2, as specified, n=$(1.96)^2\frac{2*30}{4}$=57.6.**
d) 868
e) 1728

4) Suppose that the company decides to randomize **20 individuals to each drug group**. It will conduct a two-sided test of the null hypothesis of no difference in mean heart rate change between drug and placebo groups at **Type I error level $\alpha$ =.10**. What is the mean difference that can be detected with **power=.8**?

a) 4.8 beats per minute.
b) 5.6 beats per minute.
c) 24 beats per minute.
**d) 4.3 beats per minute.**

**As provided on the formula sheet, the per-group sample size is given by $n=\frac{(z_{\alpha/2}+z_\beta)^2 2\sigma^2}{\Delta^2}$. We need to determine the $\Delta$ that can be detected; solving for this yields $\Delta=\frac{(z_{\alpha/2}+z_\beta)\sqrt{2\sigma^2}}{\sqrt{n}}$. Because $\alpha$ =.10, $z_{\alpha/2}$=1.645, and because power = .8, $\beta$ =.20 and $z_\beta$=0.84. Plugging into the expression for $\Delta$, we have $\Delta=\frac{(1.645+.84)\sqrt{2*30}}{\sqrt{20}}$=4.3.**

e) 5.1 beats per minute.
f) 3.7 beats per minute.

5) Which of the following is the best definition for **power in this study**? (Circle only one response.)

a) The probability of **failing to conclude that mean heart rate change differs** between drug and placebo groups if there really **is** a difference.
b) The probability of **failing to conclude that mean heart rate change differs** in drug and placebo groups if there really is **no** difference.
c) The probability of **concluding that mean heart rate change differs** between drug and placebo groups assuming that there really is **no** difference.
***d) The probability of concluding that mean heart rate change differs between drug and placebo groups assuming that there really is a difference.***

**Power is the probability of rejecting the null hypothesis when a specific alternative hypothesis is true. Here, we reject the null when we conclude that mean heart rate change differs between the two groups and the specific alternative hypothesis is that there really is a difference.**

e) **Failing to conclude that mean heart rate change differs** between drug and placebo groups if there really **is** a difference.

 