

Introduction to Biostatistics (BIOS 4120)
Breheny

Quiz 3 (Practice)

Real quiz 3: Thursday, April 9

1. According to the Child Health and Development Study, the average pregnancy length (for women who do not suffer a miscarriage) is 279 days, with a standard deviation of 16 days. Furthermore, the distribution is approximately normal. Calling day 279 the "due date",

- (a) What percent of women go into labor more than 4 weeks early (28 days before their due date)?

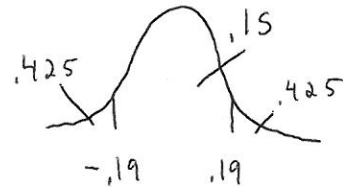
$$28 / 16 = 1.75$$

$$P(Z < -1.75) = .04, \text{ or } 4\%$$

- (b) What percent of women go into labor within 3 days of their due date?

$$\frac{3}{16} = .1875$$

$$P(-.19 < Z < .19) = .15, \text{ or } 15\%$$



- (c) If five women are pregnant, what is the probability that at least 1 of them will give birth within 3 days of their due date?

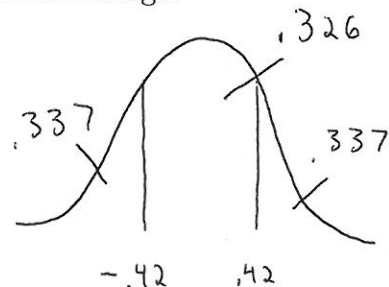
$$\begin{aligned} P(\text{at least one}) &= 1 - P(0) \\ &= 1 - \frac{5!}{5!0!} (.15)^0 (.85)^5 \\ &= 1 - .444 = 0.556 \end{aligned}$$

- (d) If five women are pregnant, what is the probability that the average length of their pregnancies will be within 3 days of the national average?

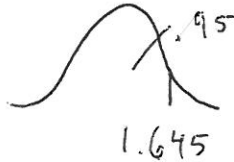
$$SE = \frac{16}{\sqrt{5}} = 7.155$$

$$\frac{3}{7.155} = 0.419$$

$$P(-.419 < Z < .419) = .326$$



- (e) A researcher proposes to call a baby "overdue" if the length of the mother's pregnancy is greater than the 95th percentile of pregnancy lengths. What cutoff is this researcher proposing?



$$279 + 1.645(16) = 305.3 \text{ days}$$

- (f) Which is more probable: that an individual woman will give birth a month early, or that, in a group of five, at least one woman will give birth a month early?
- (g) Which is more probable: that an individual woman will give birth a month early, or that, in a group of five, the average length of pregnancy will be less than a month below the national average?

2. Polycystic ovary syndrome is one of the most common female endocrine disorders and one of the leading causes of female infertility. One of its principal features is the excessive production of testosterone and other masculinizing hormones.

Researchers at Yale published a study in 2007 involving 48 women with polycystic ovary syndrome who were randomly assigned to take either simvastatin (Zocor) for 12 weeks followed by a control therapy for 12 weeks, or control therapy for 12 weeks followed by simvastatin for 12 weeks. The primary outcome of the study was the decrease in total testosterone on simvastatin compared with control. The results of the study are listed below:

	Total testosterone (ng/ml)		
	Control	Simvastatin	Difference
Mean	0.57	0.48	-0.09
SD	0.24	0.20	0.21

- (a) Conduct an appropriate hypothesis test of whether the average production of testosterone on the control therapy is equal to that of the average production of testosterone on simvastatin.

$$SE = \frac{0.21}{\sqrt{48}} = 0.03$$

$$df = 47$$

$$t = -\frac{0.09}{0.03} = -3$$

$$p = 1 - P(-3 < t < 3) < 0.005$$

- (b) Calculate a 95% confidence interval for the average reduction in testosterone on simvastatin compared with control.

$$t_{95\%} \text{ for } 45 \text{ df} = 2.01$$

$$0.09 \pm 2.01(0.03) = (0.03, 0.15) \text{ ng/ml}$$

- (c) Based on this study, what can we say about whether simvastatin reduces testosterone levels in women with polycystic ovary syndrome?

Simvastatin significantly reduces testosterone levels in women with PCOS, on average somewhere between 0.03 and 0.15 ng/ml.

3. Critical patients are sometimes put on mechanical ventilators to assist or replace the function of breathing. A serious side-effect of this procedure is ventilator-associated pneumonia (VAP). In one study of patients who were mechanically ventilated in the intensive care units of six different hospitals, researchers found that 63 out of 472 patients developed VAP. Calculate a 95% confidence interval for the proportion of all mechanically ventilated patients who will develop VAP.

$$\hat{p} = \frac{63}{472} = 0.1335$$

$$SE = \sqrt{\frac{.1335(1-.1335)}{472}} = 0.0157$$

$$0.1335 \pm 1.96(0.0157) = (10.3\%, 16.4\%)$$