**Chapter 9.1 – Type I & Type II Error and Power in Significance Tests**

**Example:** Slow response times by paramedics, firefighters, and policemen can have serious consequences for accident victims. In the case of life-threatening injuries, victims generally need medical attention within 8 minutes of the accident. Several cities have begun to monitor emergency response times. In one such city, the mean response time to all accidents involving life-threatening injuries last year was *μ* = 6.7 minutes. Emergency personnel arrived within 8 minutes after 78% of all calls involving life-threatening injuries last year. The city manager shares this information and encourages these first responders to “do better.” At the end of the year, the city manager selects an SRS of 400 calls involving life-threatening injuries and examines the response times.

(a) State hypotheses for a significance test to determine whether the average response time has decreased. Be sure to define the parameter of interest.

*μ* = mean response time for all accidents involving life-threatening injuries in the city. *H*0: *μ* = 6.7; *Ha*: *μ* < 6.7.

(b) Describe a Type I error and a Type II error in this setting, and explain the consequences of each.

Type I error: The city concludes that the response time has improved when it really hasn’t. Type II error: The city concludes that the response time has not improved when it really has.

(c) Which is more serious in this setting: a Type I error or a Type II error? Justify your answer.

A Type I error would be worse. The city may stop trying to improve its response times because they think they have met the goal when, in fact, they haven’t. More people could die.

1. You are thinking about opening a restaurant and are searching for a good location. From research you have done, you know that the mean income of those living near the restaurant must be over $85,000 to support the type of upscale restaurant you wish to open. You decide to take a simple random sample of 50 people living near one potential location. Based on the mean income of this sample, you will decide whether to open a restaurant there.[**8**](javascript:top.ShowFootnote('9_8'))

(a) State appropriate null and alternative hypotheses. Be sure to define your parameter.

(b) Describe a Type I and a Type II error, and explain the consequences of each.

(c) If you had to choose one of the “standard” significance levels for your significance test, would you choose *α* = 0.01, 0.05, or 0.10? Justify your choice using Type I & Type II errors & power.

1. Your company markets a computerized device for detecting high blood pressure. The device measures an individual’s blood pressure once per hour at a randomly selected time throughout a 12-hour period. Then it calculates the mean systolic (top number) pressure for the sample of measurements. Based on the sample results, the device determines whether there is significant evidence that the individual’s actual mean systolic pressure is greater than 130. If so, it recommends that the person seek medical attention.

(a) State appropriate null and alternative hypotheses in this setting. Be sure to define your parameter.

(b) Describe a Type I and a Type II error, and explain the consequences of each.

(c) The blood pressure device can be adjusted to decrease one error probability at the cost of an increase in the other error probability. Which error probability would you choose to make smaller, and why?

1. A drug manufacturer claims that fewer than 10% of patients who take its new drug for treating Alzheimer’s disease will experience nausea. To test this claim, a significance test is carried out of *H*0:*p* = 0.10; *Ha*:*p* < 0.10. You learn that the power of this test at the 5% significance level against the alternative *p* = 0.08 is 0.64.

(a) Explain in simple language what “power = 0.64” means in this setting.

(b) You could get higher power against the same alternative with the same *α* by changing the number of measurements you make. Should you make more measurements or fewer to increase power? Explain.

(c) If you decide to use *α* = 0.01 in place of *α* = 0.05, with no other changes in the test, will the power increase or decrease? Justify your answer.