7.3.1 - 7.3.3 See Section III of this Manual.

• **7.3.4** If we reject H_0 (i.e., if the drug is approved) then we eliminate the possibility of a Type II error. (But by rejecting H_0 we may have made a Type I error.)

7.3.5 A type II error may have been made.

• **7.3.6** Yes; because zero is outside of the confidence interval, we know that the P-value is less than 0.05, so we reject the hypothesis that $\mu_1 - \mu_2 = 0$.

7.3.7 Yes; because zero is outside of the confidence interval, we know that the P-value is less than .05, so the P-value is less than .10. Thus, we reject the hypothesis that $\mu_1 - \mu_2 = 0$.

7.3.8 (a) H_0: The new technique has no effect on the mean cheese aging time.
H_A: The new technique reduces the mean cheese aging time.

(b) A Type I error would conclude that the new technique reduces aging time when, in fact, it does not.

(c) A Type II error would occur if there were no significant evidence found for a reduction in aging time when, in fact, the new technique reduces aging time.

(d) Argument for Type I: A Type I error is more serious because millions of dollars will be spent on equipment that is not necessary.

Argument for Type II: A Type II error is more serious because we would not make the necessary equipment changes to achieve higher profits in the long run.

7.3.9 False. The scientist rejected H_0 based on a bad calculation, not based on having samples that yielded an unusually large t_s value. However, it is possible that H_0 is false and should be rejected (and that the data leading to P-value=0.23 were a fluke).

7.3.10 (ii) is correct. The researchers retained H_0. If H_0 is true then they reached a correct conclusion but it might be that H_A is true and thus H_0 should have been rejected.

7.3.11 No. A large P-value only indicates that there is a lack of evidence for a difference between the population mean systolic volumes under the two treatments. There may be no difference, or there may be a difference that was too small to detect with the sample sizes used.

• **7.4.1** No, this does not mean that living in Arizona exacerbates breathing problems. To determine this, we would need to know whether breathing problems get better or worse for people in Arizona. In fact, people with respiratory problems often move to Arizona because the dry air is good for them. This would explain the association between living in Arizona and having breathing problems.

7.4.2 In this observational study, the effect of implants on illness is confounded with the effects on illness of smoking, drinking heavily, using hair dye, and having an abortion.

7.4.3 (a) The explanatory variable is whether or not a woman has had breast implants.

(b) The response variable is illness (whether or not one is ill).

(c) The observational units are individual women.

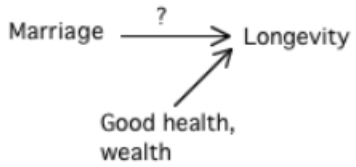
• **7.4.4 (a)** The explanatory variable is coffee consumption rate.

(b) The response variable is coronary heart disease (present or absent).

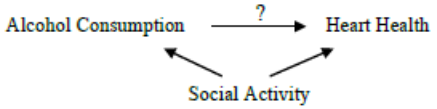
(c) The observational units are subjects (i.e., the 1,040 persons).

7.4.5 One relevant extraneous variable is the genetic make up of the citizens of these six countries. It may well be that genetic predisposition for heart disease is the reason that the death rates vary from country to country and that the amount of fat in the diet is relatively unimportant. (That is, certain people were at risk for heart disease, because of their genes; their diet made little difference.) Another possibly relevant extraneous variable is the ability to detect heart disease as the cause of death. That is, it might be that actual heart disease death rates are fairly uniform across these six countries, but that heart disease is diagnosed more often in the U.S., Canada, and Australia than in Italy and Japan.

7.4.6 The conclusion that marriage causes increased longevity is not warranted. Being married might promote good health and great longevity, but it might be that being in good health, having a good job, being wealthy, etc. lead to longevity and to an increased likelihood of being married.

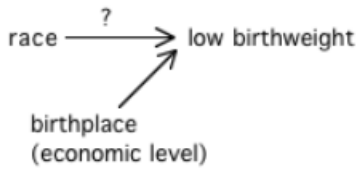


7.4.7 To establish a causal relationship an experiment is required. In this case, an experiment of this nature (where alcohol is randomly administered to one group and a placebo to another for many years) is unethical. There are many possible confounding variables or spurious relationships possible. For example, drinking alcohol in moderation might lead to heart health, but being involved socially with others might also have cardiac benefits as well as increase the likelihood of at least social drinking.



7.4.8 The effect that race has on low birthweight is confounded with the effect of where a woman is born -- which, in turn, may be confounded with economic level. It may be that U.S.-born black women are poorer, and have less access to prenatal care, than do African-born black women who live in

Illinois. This would explain why U.S.-born black women have a high percentage of low birthweight babies.



7.4.9 (a) As an observational study, we will not be able to establish a causal relationship between the book release date and injuries. There could be other events on these weekends that are causing a drop. Note to students: If you could go back in time and re-release these books, could you think of an experiment to test the hypothesis that there are fewer injuries, on average, on Harry Potter weekends?

(b) H_0: The mean number of injuries is the same for both types of weekends ($\mu_1 = \mu_2$)
H_A: The mean number of injuries differs between the types of weekends ($\mu_1 \neq \mu_2$)

$$SE_{(\bar{Y}_1-\bar{Y}_2)} = \sqrt{\frac{0.7^2}{2}+\frac{10.4^2}{24}} = 2.18$$

$t_s = (36.5 - 67.4)/2.179 = -14.2$. Using Table 4 with df=24 we have $t_{0.0005} = 3.745$. Thus P-value < 0.0005x2 = 0.001, so we reject H_0. There is strong evidence ($P < 0.001$) to conclude that the number of injuries is related to the type of weekend.

7.4.10 Only 1 statement is true. (i) is true; this is what rejecting H_0 is all about. (ii) is false; the difference need not be important. (iii) is false; we cannot infer causation from an observational study.