# Review Questions for Chapter 10

1. If arousal is the dependent variable and stress is the independent variable,
   1. What would be the null hypothesis?
   2. What would be an experimental hypothesis?
2. Using the terms, dependent variable, independent variable, and either “causes a change in” or “does not cause a change in”, state the general form of
   1. An experimental hypothesis
   2. A null hypothesis
3. Match the following
   1. Dependent variable \_\_\_participants not receiving the treatment
   2. Independent variable \_\_\_treatment does not have an effect
   3. Null hypothesis \_\_\_treatment has an effect
   4. Experimental hypothesis \_\_\_effect (a response measured by the researcher)
   5. Control group \_\_\_participants receiving the treatment
   6. Experimental group \_\_\_suspected cause manipulated by experimenter
   7. Statistically significant \_\_\_rejection of null hypothesis
   8. Null results \_\_ Difference between groups is greater than what

would be expected by chance alone

1. Why would it be a mistake to run all 80 of the treatment group participants in a large classroom at 8:00 am and then run all 80 of the control group participants in the same classroom at 11 am?
2. Imagine a simple experiment in which one group gets a treatment (e.g., caffeine) and the other group gets no treatment.
   1. What does random assignment do in this case?
   2. What will happen if the treatment has no effect?
   3. What will happen if the treatment has an effect?
3. What does it mean if the results of a simple experiment are statistically significant at the p < .05
4. Match the following
   1. The null hypothesis is true and *p* = .05 \_\_ 5% chance of being wrong

\_\_ 95% chance of being correct

* 1. The null hypothesis is false and *p* = .05 \_\_ error rate can’t be determined

1. What can you do to reduce your risk of making a
   1. Type 1 error
   2. Type 2 error
2. Two simple experiments both use the same independent variable, the same dependent variable, and the same alpha level ( use *p* < .01). One experiment, however, studies 100 participants whereas the other studies 10,000 participants. The experiment using 10,000 participants is
   1. More likely to make a Type 1 error
   2. More likely to make a Type 2 error
   3. Less likely to make a Type 1 error
   4. Less likely to make a Type 2 error
3. Two simple experiments both use the same independent variable, the same dependent variable, and the same number of participants. One experiment, however, uses an alpha level of .05 whereas the other uses an alpha level of .01. The experiment using an alpha level of .01 is
   1. More likely to make a Type 1 error
   2. More likely to make a Type 2 error
   3. Less likely to make a Type 1 error
   4. Less likely to make a Type 2 error
   5. Less likely to make a Type 1 error, but more likely to make a Type 2 error.
   6. More likely to make a Type 1 error, but less likely to make a Type 2 error
   7. More likely to make both a Type 1 error and a Type 2 error
   8. Less likely to make either a Type 1 or a Type 2 error.
4. Why can’t we just look at the mean difference between the control and experimental groups to determine whether the treatment had an effect?
5. Match the following
   1. Big *t* \_\_\_\_Big difference between means of the two groups
   2. Small *t* \_\_\_\_Small difference between means of the two groups

\_\_\_\_Small sample size

\_\_\_\_Large sample size

\_\_\_\_Large *p* value

\_\_\_\_Small *p* value

\_\_\_\_small differences between scores ***within*** each group

\_\_\_\_large differences between scores ***within*** each group

\_\_\_\_ statistically significant

\_\_\_\_ not statistically significant

1. What are inferential statistics? Why do we need them to analyze the results of a simple experiment?
2. What calculation do you do to get the top part of the *t r*atio (*t* test)?
3. What is the name of the term that is the bottom of the t-test? What does it measure directly? What do we infer from that term?
4. How can remembering “t(ea) is for two” help you remember two key facts about the t-test?
5. Describe two advantages of doing a simple experiment that studies 80 participants over doing a simple experiment that studies 40 participants.
6. What is the central limit theorem? How does it work?

# Answers to Review Questions for Chapter 10

1. If arousal is the dependent variable and stress is the independent variable,
   1. What would be the null hypothesis?

**Stress does not change arousal.**

* 1. What would be an experimental hypothesis?

**Stress increases arousal.**

1. Using the terms, dependent variable, independent variable, and either “causes a change in” or “does not cause a change in”, state the general form of
   1. An experimental hypothesis

**Varying the independent variable causes a change in the dependent variable.**

* 1. A null hypothesis

**Varying the independent variable does not cause a change in the dependent variable.**

1. Match the following
   1. Dependent variable \_e\_\_participants not receiving the treatment
   2. Independent variable \_c\_\_treatment does not have an effect
   3. Null hypothesis \_\_d\_treatment has an effect
   4. Experimental hypothesis \_a\_\_effect (a response measured by the researcher)
   5. Control group \_\_f\_participants receiving the treatment
   6. Experimental group \_b\_\_suspected cause manipulated by experimenter
   7. Statistically significant \_g\_\_rejection of null hypothesis
   8. Null results \_h\_ Difference between groups is greater than

what would be expected by chance alone

1. Why would it be a mistake to run all 80 of the treatment group participants in a large classroom at 8:00 am and then run all 80 of the control group participants in the same classroom at 11 am?
   1. The assumption that observations are independent—a key assumption of the *t* test (and of most statistical significance tests ) would be violated, so you should not trust the results of such a study. That is, rather than having 160 participants, for the purpose of analysis, you have 2 independent units (the 8am group and the 10 am group) because qny difference between the 8 am session and the 10 am session (e.g., being tested at different times of day, as well as any random differences such as a noise in the hall, a participant coughing or coming in late) would, like the treatment, be a difference that could account for any difference in the two groups’ behaviors.
2. Imagine a simple experiment in which one group gets a treatment (e.g., caffeine) and the other group gets no treatment.
   1. What does random assignment do in this case?

Random assignment makes it so the experimental group and the control group are random samples of a unique population: the study’s participants. So, before the treatment is introduced, the only reason the two groups (the two random samples) would differ is by chance (random error).

* 1. What will happen if the treatment has no effect?

If the treatment has no effect, the two groups would still be samples from the same population at the end of the experiment.

* 1. What will happen if the treatment has an effect?

If the treatment has an effect, the groups would, at the end of the experiment, represent different populations.

1. What does it mean if the results of a simple experiment are statistically significant at the p < .05 level?

If the null hypothesis is true (there really is no treatment effect), we would get a difference this big or larger less than 5 times in 100 by chance alone. That is, it would be unusual to get such a difference if there is no treatment effect. Given that the result would be unlikely if there was no treatment effect, many researchers would conclude that the treatment probably did have an effect. So, for many people, a statistically significant effect is one they would consider “***reliable***”—that if the study were to be repeated, they are reasonably confident that the groups would again score differently.

1. Match the following
   1. The null hypothesis is true and *p* = .05 \_a\_ 5% chance of being wrong

\_a\_ 95% chance of being correct

* 1. The null hypothesis is false and *p* = .05 \_b\_ can’t be determined from this info

1. What can you do to reduce your risk of making a
   1. Type 1 error

Choose a conservative alpha level (e.g., use .01 instead of .05)

* 1. Type 2 error
     1. Increase sample size
     2. Use a reliable measure of the dependent variable
     3. Standardize procedures
     4. Use homogenous participants
     5. Use a controlled laboratory setting

1. Two simple experiments both use the same independent variable, the same dependent variable, and the same alpha level (use *p* < .01). One experiment, however, studies 100 participants whereas the other studies 10,000 participants. The experiment using 10,000 participants is
   1. More likely to make a Type 1 error
   2. More likely to make a Type 2 error
   3. Less likely to make a Type 1 error
   4. **Less likely to make a Type 2 error**
2. Two simple experiments both use the same independent variable, the same dependent variable, and the same number of participants. One experiment, however, uses an alpha level of .05 whereas the other uses an alpha level of .01. The experiment using an alpha level of .01 is
   1. More likely to make a Type 1 error
   2. More likely to make a Type 2 error
   3. Less likely to make a Type 1 error
   4. Less likely to make a Type 2 error
   5. **Less likely to make a Type 1 error, but more likely to make a Type 2 error.**
   6. More likely to make a Type 1 error, but less likely to make a Type 2 error
   7. More likely to make both a Type 1 error and a Type 2 error
   8. Less likely to make either a Type 1 or a Type 2 error.
3. Why can’t we just look at the mean difference between the control and experimental groups to determine whether the treatment had an effect?
   1. We know that the groups could differ by chance alone: Random assignment doesn’t create identical groups.
4. Match the following
   1. Big *t* \_\_a\_\_Big difference between means of the two groups
   2. Small *t*  \_\_b\_\_Small difference between means of the two groups

\_\_a\_\_Small sample size

\_\_b\_\_Large sample size

\_\_b\_\_Large *p* value

\_\_a\_\_Small *p* value

\_\_a\_\_small differences between scores ***within*** each group

\_\_b\_\_large differences between scores ***within*** each group

\_\_\_a\_ statistically significant

\_\_b\_\_ not statistically significant

1. What are inferential statistics? Why do we need them to analyze the results of a simple experiment?
   1. Inferential statistics are statistics that allow us to infer the characteristics of a population from a sample.
   2. In the simple experiment, we think of a unique population: the experiment’s participants. We use random assignment to split that population into two halves: two random samples from the population consisting of our participants. We then use one random sample to ***infer*** what would happen if all our participants had been in the control group and the other group to ***infer*** what would happen if all our participants had been in the experimental group. So, to ***infer*** whether our participants would have scored differently if all had been in the control group rather than in the treatment group, we need to use ***inferentia****l* statistics.
2. What calculation do you do to get the top part of the *t r*atio (*t* test)?

You subtract the two group means.

1. What is the name of the term that is the bottom of the t-test? What does it measure directly? What do we infer from that term?
   1. The bottom of the t-test is the **standard error of the difference**.
   2. The standard error of the difference is a measure of the extent to which **scores within each group vary**.
   3. It is an index of the degree to which **random error** could be causing the means to differ. Remember, scores within a group are getting the same treatment, so differences between scores within a group can’t be due to the treatment. Instead, those differences must be due to nontreatment factors. The influence of nontreatment factors in a simple experiment is considered error.
2. How can remembering “t(ea) is for two” help you remember two key facts about the t-test?
   1. The t-test is good for comparing **two** groups.
   2. The degrees of freedom for the t-test is the total number of participants minus ***two***.
3. Describe two advantages of doing a simple experiment that studies 80 participants over doing a simple experiment that studies 40 participants.
   1. With more participants, you have more power.
   2. By having more than 30 participants per group, you are able to take advantage of the **central limit theorem** which means that your sample means will be normally distributed even if the population they come from is not normally distributed. This is important because the *p* values obtained from your *t* test are only accurate if the sample means are normally distributed. In other words, if you have fewer than 30 participants per group and the population’s scores are not normally distributed, you should not use a *t*-test.
4. What is the central limit theorem? How does it work?
   1. With large enough samples, the distribution of sample means will be normally distributed, regardless of the shape of the underlying distribution.
   2. Sample means from the same population differ from each other for one reason: random error—and random error is normally distributed.