Test Bank

# Chapter 11: One-way Independent Samples ANOVA

## Multiple Choice

1. Suppose that you conduct a study with three conditions and want to conduct an ANOVA to compare the means for the three conditions. The scores within each condition are not normally distributed and there are 10 scores per condition. In this case, what would you do?

A. Collect more data to increase the number of scores in each condition to 30.

B. Run the ANOVA. There are 30 scores in the study.

C. Compute a series of *t*-tests.

D. Compute a Spearman correlation.

Ans: A

Learning Objective: Assumptions

2. When conducting an independent ANOVA, *if the null hypothesis is true* what value should researchers expect the *F*-value to be close to?

A. If the null hypothesis is true, the researchers should expect a value close to 0.

B. If the null hypothesis is true, the researchers should expect a value close to 1.

C. If the null hypothesis is true, the researchers should expect a specific value but the exact expected value will depend on the degrees of freedom that the study has.

D. If the null hypothesis is true, the researchers should expect to get a large *F*-value but they don’t expect any specific *F*-value.

Ans: B

Learning Objective: Logic of ANOVA

3. When conducting an independent ANOVA, *if the null hypothesis is false* what value should researchers expect the *F*-value to be close to?

A. If the null hypothesis is false, the researchers should expect a value close to 0.

B. If the null hypothesis is false, the researchers should expect a value close to 1**.**

C. If the null hypothesis is false, the researchers should expect a specific value but the exact expected value will depend on the degrees of freedom that the study has.

D. If the null hypothesis is false, the researchers should expect to get a large *F*-value but they don’t expect any specific *F*-value.

Ans: D

Learning Objective: Logic of ANOVA

4. A professor notes that many of her students take notes on their laptops, while others take notes using paper. She wonders if using a laptop is as effective as handwriting notes because typing allows students to take notes much faster. Although this increased speed does allow for more information to be written, it also does not require as much processing of the information. While taking notes by hand, students must process the information and decide what is important. To test this possibility, the professor obtains a group of 90 students and randomly assigns each student to use a different note taking strategy while listening to an hour long lecture. The groups were:

Group 1: Handwritten notes

Group 2: Take notes on a laptop

Group 3: Take notes on a laptop, but instruct students that they should not record the lecture in as much detail as possible. Instead, they should try to write the main points.

The day after the lecture, the students took a multiple choice exam over the content of the lecture.   
Which of the following pairwise comparisons are significantly different? Select all that apply.

The SPSS output follows:  
 

A. handwritten versus laptop

B. handwritten versus laptop with main points

C. laptop versus laptop with main points

D. None of the pairwise comparisons are significant.   
Ans: A and B

Learning Objective: SPSS pairwise comparisons 

5. Which of the following statements is the best summary of the results of the overall ANOVA?



A. A one-way ANOVA revealed a significant effect of notetaking method on exam scores, *F*(2, 87) = 6.73, *p* = .002, MSE = 126.05, ηp2 = .13.

B. A one-way ANOVA revealed a nonsignificant effect of notetaking method on exam scores, *F*(2, 87) = 6.73, *p* > .05, MSE = 126.05, ηp2 = .13.

C. A one-way ANOVA revealed a significant effect of notetaking method on exam scores, *F*(2, 89) = 6.73, *p* > .05, MSE = 126.05, ηp2 = .13.

D. A one-way ANOVA revealed a nonsignificant effect of notetaking method on exam scores, *F*(2, 89) = 6.73, *p* < .05, MSE = 126.05, ηp2 = .13.

Ans: A

Learning Objective: SPSS—Interpreting results

6. Which of the following statements best summarizes the results of the post hoc tests?

A. All studying methods were equally effective.

B. Handwritten notes were significantly better than the laptop, which was significantly better than the laptop with only main points.

C. Handwritten notes were significantly better than the laptop and the laptop with only main points. The two laptop conditions were not significantly different.

D. All of the groups were significantly different from each other.

Ans: C

Learning Objective: SPSS—Interpreting post hoc results

7. The two tables contain data from two different studies on growing asparagus by “watering” them with different types of liquid. Which study will produce the smaller *mean square error* (also called the mean square within treatment)?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study 1 | | |  | Study 2 | | |
| Group 1: Kool Aid | Group 2: Orange Juice | Group 3: Water | Group 1: Kool Aid | Group 2: Orange Juice | Group 3: Water |
| 17 | 56 | 80 | 20 | 19 | 18 |
| 21 | 59 | 83 | 56 | 59 | 57 |
| 19 | 60 | 82 | 83 | 82 | 83 |
| *M*1 = 19 | *M*2 = 58.67 | *M*3 = 81.67 | *M*1 = 53 | M2 =53.33 | M3 =52.67 |
| *SD*1 = 1.63 | *SD*2 = 2.52 | *SD*3 = 1.53 | *SD*1 = 31.61 | *SD*2 = 31.88 | *SD*3 = 32.72 |

A. Study 1

B. Study 2

C. The studies will produce values that are about the same.

D. It is not possible to determine which mean square error will be larger with the provided information. You need to know the degrees of freedom.

Ans: A

Learning Objective: Logic of ANOVA

8. Which study will produce the larger *F*-value?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study 1 | | |  | Study 2 | | |
| Group 1: Kool Aid | Group 2: Orange Juice | Group 3: Water | Group 1: Kool Aid | Group 2: Orange Juice | Group 3: Water |
| 17 | 56 | 80 | 20 | 19 | 18 |
| 21 | 59 | 83 | 56 | 59 | 57 |
| 19 | 60 | 82 | 83 | 82 | 83 |
| *M*1 = 19 | *M*2 = 58.67 | *M*3 = 81.67 | *M*1 = 53 | M2 =53.33 | M3 =52.67 |
| *SD*1 = 1.63 | *SD*2 = 2.52 | SD3 = 1.53 | *SD*1 = 31.61 | *SD*2 = 31.88 | *SD*3 = 32.72 |

A. Study 1

B. Study 2

C. The studies will produce values that are about the same.

D. It is not possible to determine which *F*-value will be larger with the provided information. You need to know the degrees of freedom.

Ans: A

Learning Objective: Logic of ANOVA

9. Which study will have a larger critical value of *F*?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study 1 | | |  | Study 2 | | |
| Group 1: Kool Aid | Group 2: Orange Juice | Group 3: Water | Group 1: Kool Aid | Group 2: Orange Juice | Group 3: Water |
| 17 | 56 | 80 | 20 | 19 | 18 |
| 21 | 59 | 83 | 56 | 59 | 57 |
| 19 | 60 | 82 | 83 | 82 | 83 |
| *M*1 = 19 | *M*2 = 58.67 | *M*3 = 81.67 | *M*1 = 53 | *M*2 = 53.33 | *M*3 = 52.67 |
| *SD*1 = 1.63 | *SD*2 = 2.52 | *SD*3 = 1.53 | *SD*1 = 31.61 | *SD*2 = 31.88 | *SD*3 = 32.72 |

A. Study 1

B. Study 2

C. The studies will have critical values that are the same.

D. It is not possible to determine which critical value of F will be larger with the provided information.

Ans: C

Learning Objective: Logic of ANOVA

10. A team of researchers investigated the role of the hippocampus (which is an internal structure of the brain) when people performed learning tasks. To determine the hippocampus’ role in learning tasks the researchers took a sample of 30 rats and further divided the sample into three different samples of 10 rats each. The first sample was the control group so their hippocampuses were not touched. The second sample of rats had 10% of their hippocampuses removed. The third sample of rats had 20% of their hippocampuses removed. After the respective surgeries all rats were trained to run a complex maze and the number of days it took before each rat ran the maze without errors was recorded. Identify one thing the researchers could have done to reduce the *within-group variance* in this study.

A. Use two different species of rats.

B. Use all male rats.

C. Have at least four different researchers do the surgery on the rats.

Ans: B

Learning Objective: Logic of ANOVA—within-group variance

11. A team of researchers investigated the role of the hippocampus (which is an internal structure of the brain) when people performed learning tasks. To determine the hippocampus’ role in learning tasks the researchers took a sample of 30 rats and further divided the sample into three different samples of 10 rats each. The first sample was the control group so their hippocampuses were not touched. The second sample of rats had 10% of their hippocampuses removed. The third sample of rats had 20% of their hippocampuses removed. After the respective surgeries all rats were trained to run a complex maze and the number of days it took before each rat ran the maze without errors was recorded. Identify *the only thing* that the researchers *want* to cause *between-group variance*.

A. sampling error

B. The amount of the hippocampus removed.

C. the post hoc test

Ans: B

Learning Objective: Logic of ANOVA—between-group variance

12. A team of researchers investigated the role of the hippocampus (which is an internal structure of the brain) when people performed learning tasks. To determine the hippocampus’ role in learning tasks the researchers took a sample of 30 rats and further divided the sample into three different samples of 10 rats each. The first sample was the control group so their hippocampuses were not touched. The second sample of rats had 10% of their hippocampuses removed. The third sample of rats had 20% of their hippocampuses removed. After the respective surgeries all rats were trained to run a complex maze and the number of days it took before each rat ran the maze without errors was recorded. Identify one thing that probably contributes to the *between-group variance* that the researchers *do not want* to contribute to the between-group variance.

A. treatment effects

B. measurement error

C. the independent variable

Ans: B

Learning Objective: Logic of ANOVA—between-group variance

13. Which of the following situations would be most likely to lead to rejecting the null hypothesis?

A. There is a lot of between-group variance and a lot of within-group variance.

B. There is a lot of between-group variance and very little within-group variance.

C. There is very little between-group variance and a lot of within-group variance.

D. There is very little between-group variance and very little within-group variance.

Ans: B

Learning Objective: Logic of ANOVA

14. A researcher wrote a sentence describing the results of an Independent ANOVA that she performed. The statistical information from her study included the following information: *F*(2, 33) = 10.88, *p* < .05, MSE = 5.00, η2 = 0.40. Organize this information into an ANOVA source table and use the table you create to determine how many people were in the study

A. 165

B. 33

C. 36

D. 35

Ans: C

Learning Objective: Interpreting APA reporting statement

15. A researcher wrote a sentence describing the results of an Independent ANOVA that she performed. The statistical information from her study included the following information: *F*(2, 33) = 10.88, *p* < .05, MSE = 5.00, η2 = 0.40. Organize this information into an ANOVA source table and use the table you create to determine how many groups were in this study?

A. 2

B. 3

C. 4

D. 5

E. 6

Ans: B

Learning Objective: Interpreting APA reporting statement

16. A researcher wrote a sentence describing the results of an Independent ANOVA that she performed. The statistical information from her study included the following information: *F*(2, 33) = 10.88, *p* < .05, MSE = 5.00, η2 = .40. Does this researcher need to do post hoc tests?

A. Ye, the overall ANOVA was significant and there are more than two groups.

B. No, the overall ANOVA was significant but there are only two groups.

C. No, the effect size for the overall ANOVA was large which means that all pairwise comparisons will be significant.

D. Yes, the effect size for the overall ANOVA was large which means that the ANOVA was significant and you always need to do post hocs after a significant ANOVA.

Ans: A

Learning Objective: Interpreting APA reporting statement

17. An experimenter wants to know if having a pet or friend present while taking a stressful math test helps reduce anxiety. She recruits 120 people to participate in the study and each person takes a difficult math test under a strict time limit. The participants are also randomly assigned to take the test alone, with a friend in the room, or with a therapy dog in the room. After taking the test, participants completed a survey that assessed how stressful they found the test. Scores on the stress survey were measured on an interval scale and higher numbers indicated greater stress.

Which of the following facts suggests that the normality assumption was met?

A. The sample sizes for each group are greater than 30.

B. The standard deviations in the three groups are similar.

C. The three conditions are clearly defined and the stress survey scores are measured on an interval scale.

D. Each participant completed the stress survey independently.

Ans: A

Learning Objective: Assumptions

18. An experimenter wants to know if having a pet or friend present while taking a stressful math test helps reduce anxiety. She recruits 120 people to participate in the study and each person takes a difficult math test under a strict time limit. The participants are also randomly assigned to take the test alone, with a friend in the room, or with a therapy dog in the room. After taking the test, participants completed a survey that assessed how stressful they found the test. Scores on the stress survey were measured on an interval scale and higher numbers indicated greater stress.

Which of the following facts suggests that the homogeniety of variance assumption was met?

A. The sample sizes for each group are greater than 30.

B. The standard deviations in the three groups are similar.

C. The three conditions are clearly defined and the stress survey scores are measured on an interval scale.

D. Each participant completed the stress survey independently.

Ans: B

Learning Objective: Assumptions

19. An experimenter wants to know if having a pet or friend present while taking a stressful math test helps reduce anxiety. She recruits 120 people to participate in the study and each person takes a difficult math test under a strict time limit. The participants are also randomly assigned to take the test alone, with a friend in the room, or with a therapy dog in the room. After taking the test, participants completed a survey that assessed how stressful they found the test. Scores on the stress survey were measured on an interval scale and higher numbers indicated greater stress.

Which of the following facts suggests that the data indepence assumption was met?

A. The sample sizes for each group are greater than 30.

B. The standard deviations in the three groups are similar.

C. The three conditions are clearly defined and the stress survey scores are measured on an interval scale.

D. Each participant completed the stress survey independently.

Ans: D

Learning Objective: Assumptions

20. An experimenter wants to know if having a pet or friend present while taking a stressful math test helps reduce anxiety. She recruits 120 people to participate in the study and each person takes a difficult math test under a strict time limit. The participants are also randomly assigned to take the test alone, with a friend in the room, or with a therapy dog in the room. After taking the test, participants completed a survey that assessed how stressful they found the test. Scores on the stress survey were measured on an interval scale and higher numbers indicated greater stress.

Which of the following facts suggests that the appropriate measurement assumption was met?

A. The sample sizes for each group are greater than 30.

B. The standard deviations in the three groups are similar.

C. The three conditions are clearly defined and the stress survey scores are measured on an interval scale.

D. Each participant completed the stress survey independently.

Ans: C

Learning Objective: Assumptions

21. An experimenter wants to know if having a pet or friend present while taking a stressful math test helps reduce anxiety. She recruits 120 people to participate in the study and each person takes a difficult math test under a strict time limit. The participants are also randomly assigned to take the test alone, with a friend in the room, or with a therapy dog in the room. After taking the test, participants completed a survey that assessed how stressful they found the test. Scores on the stress survey were measured on an interval scale and higher numbers indicated greater stress.

The SPSS output for this study is below. Should the null hypothesis be rejected?



A. Yes, reject H0

B. No, do not reject H0

Ans: A

Learning Objective: SPSS—Interpreting results

22. When interpeting SPSS output of an ANOVA, how can you determine if you should reject the null hypothesis without knowing the *F*-critical value?

A. The effect size is greater than the α level of .05

B. The effect size is less than the α level of .05

C. The *p* value is less than the α level of .05

D. The *p* value is greater than the α level of .05

Ans: C

Learning Objective: SPSS—Interpreting results

23. Based on the following SPSS output which of the following pairwise comparisons are significantly different? Select all that are significant.



A. dog versus friend

B. dog versus alone

C. alone versus friend

Ans: A

Learning Objective: SPSS—Interprering post hoc tests

24. Why do you need to compute effect sizes for pairwise comparisons? What new information do you gain that is not provided by the effect size for the overall ANOVA?

A. The effect sizes for the pairwise comparisons tell you which post hoc tests were significant.

B. The effect sizes for the pairwise comparisons allow you to quantify the size of the difference between any two groups.

C. The effect sizes for the pairwise comparisons allow you to determine which independent variable was significant.

Ans: B

Learning Objective: Purpose of effect sizes for paired comparisons

25. An experimenter studying the impact of self-focus on sad feelings induced different kinds of self-focus in her participants. Some participants were given instructions to increase *public self-focus* others were given instructions to increase *private self-focus* and others were given *control instructions*. After completing their appropriate instructions each group’s *degree of happiness* was measured. A higher score indicates more happiness. The results are shown below. Should the null hypothesis be rejected?

**One Way**

****

****

**Post Hoc Tests**

****

A. Yes, reject the null.

B. No, fail to reject the null.

Ans: A

Learning Objective: SPSS—Interpreting results

26. Which of the following pairwise comparisons are significant?



A. public versus private

B. public versus control

C. private versus control

Ans: B

Learning Objective: SPSS—Interpreting pairwise comparisons

27. A pharmaceutical company has developed a new drug to treat depression called hapiagin. They have just completed an experiment assessing the safety of the drug. To test safety, 10 rats were given 20 mg of hapiagin and 10 rats were given a placebo. The study was conducted as a double blind controlled study and so the researchers did not know which rats were receiving the drug and which were receiving the placebo. The number of negative side effects displayed by each rat over the course of 8 weeks was recorded.

A. *z* for a sample mean

B. single sample *t*

C. independent measures *t*

D. repeated/related measures *t*

E. independent measures ANOVA

Ans: C

Learning Objective: Choosing test statistic

28. The results of the safety studies with the rats were promising and so the pharmaceutical company conducts a study investigating side effects in humans. Twenty people recorded the total number of side effects (e.g., nausea, headaches, rashes) they experienced over the course of 2 weeks before they took hapiagin. They then took hapiagin and recorded the total number of side effects for another week.

A. *z* for a sample mean

B. single sample *t*

C. independent measures *t*

D. repeated/related measures *t*

E. independent measures ANOVA

Ans: D

Learning Objective: Choosing test statistic

29. After completing the safety studies, the pharmaceutical company conducts a study investigating the effectiveness of the drug for alleviating the symptoms of depression. Thirty adults were recruited to participate in this study. Ten participants were given hapiagin, 10 were given a placebo, and 10 were on a waiting list (no treatment control group). This was a double-blind study. After 1 month of taking the drug, taking the placebo, or being on a waiting list, the participants were interviewed by a clinician who rated their level of depression.

A. *z* for a sample mean

B. single sample *t*

C. independent measures *t*

D. repeated/related measures *t*

E. independent measures ANOVA

Ans: E

Learning Objective: Choosing test statistic

30. In another study of hapiagin’s effectiveness, a sample of 100 moderately to severely depressed people were given hapiagin for three weeks. After the three weeks was over, each participant completed a depression inventory that yielded a depression score ranging from 0 (not depressed) to 56 (very depressed). The mean depression score of the 100 participants was then compared to the national average depression score on the depression inventory which had a µ = 35 and σ = 14.

A. *z* for a sample mean

B. single sample *t*

C. independent measures *t*

D. repeated/related measures *t*

E. independent measures ANOVA

Ans: A

Learning Objective: Choosing test statistic

31. Unfortunately for the pharmaceutical company some “bad” stories were surfacing about hapiagin. Some females who had been using hapiagin for more than 1 year were reporting “substantial hair loss”. The company wanted to know if the amount of hair loss reported by those using hapiagin was significantly higher than a control group of women who were not using hapiagin.

A. *z* for a sample mean

B. single sample *t*

C. independent measures *t*

D. repeated/related measures *t*

E. independent measures ANOVA

Ans: E

Learning Objective: Choosing test statistic

32. A pharmaceutical company has developed a new drug to treat depression called hapiagin. They have just completed an experiment assessing the safety of the drug. To test safety, 10 rats were given 20 mg of hapiagin and 10 rats were given a placebo. The study was conducted as a double-blind controlled study and so the researchers did not know which rats were receiving the drug and which were receiving the placebo. The number of negative side effects displayed by each rat over the course of 8 weeks was recorded.

Which statistic should be used to analyze these data?

A. *z* for a sample mean

B. single sample *t*

C. related samples *t*

D. independent samples *t*

E. one-way ANOVA

F. two-way ANOVA

Ans: D

Learning Objective: Choosing test statistic

33. The results of the safety studies with the rats were promising and so the pharmaceutical company conducts a study investigating side effects in humans. Twenty people recorded the total number of side effects (e.g., nausea, headaches, rashes) they experienced over the course of 2 weeks before they took hapiagin. They then took hapiagin and recorded the total number of side effects for another week.

Which statistic should be used to analyze these data?

A. *z* for a sample mean

B. single sample *t*

C. related samples *t*

D. independent samples *t*

E. one-way ANOVA

F. two-way ANOVA

Ans: C

Learning Objective: Choosing test statistic

34. After completing the safety studies, the pharmaceutical company conducts a study investigating the effectiveness of the drug for alleviating the symptoms of depression. Thirty adults were recruited to participate in this study. Ten participants were given hapiagin, 10 were given a placebo, and 10 were on a waiting list (no treatment control group). This was a double-blind study. After 1 month of taking the drug, taking the placebo, or being on a waiting list, the participants were interviewed by a clinician who rated their level of depression

Which statistic should be used to analyze these data?

A. *z* for a sample mean

B. single sample *t*

C. related samples *t*

D. independent samples *t*

E. one-way ANOVA

F. two-way ANOVA

Ans: E

Learning Objective: Choosing test statistic

35. Suppose you have just conducted an experiment in which your participants were given either Drug A, Drug B, or Drug C. Further suppose that the data from these three drug conditions are listed below.

Drug A data: 5, 6, 9; Drug B data: 7, 9, 6; Drug C data: 3, 4, 2

How would you enter these data into SPSS?

A.

|  |  |
| --- | --- |
| Drug Condition | Score |
| A | 5 |
| A | 6 |
| A | 9 |
| B | 7 |
| B | 9 |
| B | 6 |
| C | 3 |
| C | 4 |
| C | 2 |

B.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Drug | A | A | A | B | B | B | C | C | C |
| Score | 5 | 6 | 9 | 7 | 9 | 6 | 3 | 4 | 2 |

Ans: A

Learning Objective: SPSS—Data entry

36. Coffee drinkers often claim that the caffeine in the coffee makes them more alert. A researcher wonders if this enhanced alertness is a merely an illusion or if caffeine actually makes people more alert. To test the effect of caffeine on alertness, the researcher asks people to drink one cup of caffeinated coffee, one cup of plain water, one cup of caffeinated water, or one cup of decaffeinated coffee. After drinking the beverage, each participant was given an electroencephalogram (EEG). The researcher hypothesized that the caffeinated beverages would result in greater electrical activity than the non-caffeinated beverages. Which of the following would be most likely to *reduce* the *individual differences* in this study?

A. Only use people in the study who are between the ages of 25 and 35 rather than 25 and 75.

B. Increase the amount of beverage participants drink from one cup to two cups.

C. Have experienced EEG technicians collect data rather than train students to administer an EEG.

D. Including as many different types of people as possible in the study (i.e., men and women, people from different regions of the country, etc.)

Ans: A

Learning Objective: Logic of ANOVA

37. Coffee drinkers often claim that the caffeine in the coffee makes them more alert. A researcher wonders if this enhanced alertness is a merely an illusion or if caffeine actually makes people more alert. To test the effect of caffeine on alertness, the researcher asks people to drink one cup of caffeinated coffee, one cup of plain water, one cup of caffeinated water, or one cup of decaffeinated coffee. After drinking the beverage, each participant was given an electroencephalogram (EEG). The researcher hypothesized that the caffeinated beverages would result in greater electrical activity than the non-caffeinated beverages. Which of the following would be most likely to *increase*the *individual differences* in this study?

A. Only use people in the study who are between the ages of 25 and 35 rather than 25 and 75.

B. Increase the amount of beverage participants drink from one cup to two cups.

C. Have experienced EEG technicians collect data rather than train students to administer an EEG.

D. Including as many different types of people as possible in the study (i.e., men and women, people from different regions of the country, etc.)

Ans: D

Learning Objective: Logic of ANOVA

38. Coffee drinkers often claim that the caffeine in the coffee makes them more alert. A researcher wonders if this enhanced alertness is a merely an illusion or if caffeine actually makes people more alert. To test the effect of caffeine on alertness, the researcher asks people to drink one cup of caffeinated coffee, one cup of plain water, one cup of caffeinated water, or one cup of decaffeinated coffee. After drinking the beverage each participant was given an electroencephalogram (EEG). The researcher hypothesized that the caffeinated beverages would result in greater electrical activity than the non-caffeinated beverages. Which of the following would be most likely to *decrease*the *measurement error* in this study?

A. Only use people in the study who are between the ages of 25 and 35 rather than 25 and 75.

B. Increase the amount of beverage participants drink from one cup to two cups.

C. Have experienced EEG technicians collect data rather than train students to administer an EEG.

D. Including as many different types of people as possible in the study (i.e., men and women, people from different regions of the country, etc.)

Ans: C

Learning Objective: Logic of ANOVA

39. Coffee drinkers often claim that the caffeine in the coffee makes them more alert. A researcher wonders if this enhanced alertness is a merely an illusion or if caffeine actually makes people more alert. To test the effect of caffeine on alertness, the researcher asks people to drink one cup of caffeinated coffee, one cup of plain water, one cup of caffeinated water, or one cup of decaffeinated coffee. After drinking the beverage each participant was given an electroencephalogram (EEG). The researcher hypothesized that the caffeinated beverages would result in greater electrical activity than the non-caffeinated beverages. Which of the following would be most likely to *increase*the *size of the treatment effect* in this study?

A. Only use people in the study who are between the ages of 25 and 35 rather than 25 and 75.

B. Increase the amount of beverage participants drink from one cup to two cups.

C. Have experienced EEG technicians collect data rather than train students to administer an EEG.

D. Including as many different types of people as possible in the study (i.e., men and women, people from different regions of the country, etc.)

Ans: B

Learning Objective: Logic of ANOVA

40. Which of the following sources of variance do NOT contribute to within-group variance (error variance)?

A. treatment effects

B. individual differences

C. measurement error

Ans: A

Learning Objective: Logic of ANOVA

41. Would researchers rather increase or decrease within-group variance?

A. increase

B. decrease

Ans: B

Learning Objective: Logic of ANOVA

42. Would researchers rather increase or decrease between-group variance?

A. increase

B. decrease

Ans: A

Learning Objective: Logic of ANOVA

43. If an independent variable has no effect on a dependent variable, what should the value of the *F* ratio be close to?

A. 0

B. 1

C. the population mean

D. It depends on the number of degrees of freedom in the study.

Ans: A

Learning Objective: Logic of ANOVA

44. The researcher studying the effects of caffeine on alertness did a study and found that caffeine consumption has no effect on alertness. In her next study, she assesses participants’ *perceptions* of the effect of caffeine on alertness. In the first study, participants drank caffeinated coffee, plain water, or decaffeinated coffee and were told what they were drinking. In the second study, participants drank the same beverages but were all told that the beverage contained caffeine. After consuming one cup of the beverage, participants rated their mental alertness on a scale from 1 to 100 with higher numbers indicating greater mental alertness. The results of the two studies are as follows:

Which study will produce the larger *mean square error* (also called the mean square within treatment)?

A. Study 1

B. Study 2

C. they should be the same

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study 1: Told whether it contained caffeine or not | | |  | Study 2: Told that the beverage contained caffeine | | |
| Group 1: Water | Group 2: Decaf | Group 3: Coffee | Group 1: Water | Group 2: Decaf | Group 3: Coffee |
| 41 | 52 | 80 | 75 | 73 | 78 |
| 43 | 54 | 82 | 77 | 75 | 80 |
| 45 | 56 | 84 | 79 | 77 | 82 |

Ans: C

Learning Objective: Logic of ANOVA

45. Which study will produce the larger *mean square between treatments*?

A. Study 1

B. Study 2

C. they should be the same

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study 1: Told whether it contained caffeine or not | | |  | Study 2: Told that the beverage contained caffeine | | |
| Group 1: Water | Group 2:  Decaf | Group 3: Coffee | Group 1: Water | Group 2:  Decaf | Group 3: Coffee |
| 41 | 52 | 80 | 75 | 73 | 78 |
| 43 | 54 | 82 | 77 | 75 | 80 |
| 45 | 56 | 84 | 79 | 77 | 82 |

Ans: A

Learning Objective: Logic of ANOVA

46. Which study will produce the larger *F-value*?

A. Study 1

B. Study 2

C. they should be the same

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study 1: Told whether it contained caffeine or not | | |  | Study 2: Told that the beverage contained caffeine | | |
| Group 1: Water | Group 2: Decaf | Group 3: Coffee | Group 1: Water | Group 2: Decaf | Group 3: Coffee |
| 41 | 52 | 80 | 75 | 73 | 78 |
| 43 | 54 | 82 | 77 | 75 | 80 |
| 45 | 56 | 84 | 79 | 77 | 82 |

Ans: A

Learning Objective: Logic of ANOVA

47. Which study will have a larger *critical value of F*?

A. Study 1

B. Study 2

C. they should be the same

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study 1: Told whether it contained caffeine or not | | |  | Study 2: Told that the beverage contained caffeine | | |
| Group 1: Water | Group 2: Decaf | Group 3: Coffee | Group 1: Water | Group 2: Decaf | Group 3: Coffee |
| 41 | 52 | 80 | 75 | 73 | 78 |
| 43 | 54 | 82 | 77 | 75 | 80 |
| 45 | 56 | 84 | 79 | 77 | 82 |

Ans: C

Learning Objective: Logic of ANOVA

48. A student does an ANOVA and finds that little girls spent more time playing with dolls than boys, *F*(1, 32) = 9.00, *p* = .02. The student’s supervisor suggests that the student reports a *t*-test rather than an *F*. What would the value of the *t* be?

A. 9

B. 3

C. 18

Ans: B

Learning Objective: Relationship between independent t test and ANOVA

49. A student does an ANOVA and finds that little girls spent more time playing with dolls than boys, *F*(1, 32) = 9.00, *p* = .02. The student’s supervisor suggests that the student reports a t-test rather than an F. If the student did a *t*-test, what would the *p* value be for that test?

A. .02

B. .01

C. There is no way to tell based on the information provided.

Ans: A

Learning Objective: Relationship between independent *t*-test and ANOVA

50. The SPSS output below is from a one-way ANOVA. Use the output to answer questions.

A researcher compared the in state tuition of schools from four different regions of the United States to determine if any of them had significantly different in state tuition costs. The results are shown below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Descriptive Statistics** | | | |
| Dependent Variable: In state tuition | | | |
| Region | Mean | Std. Deviation | *N* |
| Midwest | 9290.65 | 4044.106 | 86 |
| South | 5508.16 | 4341.286 | 86 |
| West | 8693.74 | 6166.944 | 86 |
| Northeast | 11185.79 | 6182.462 | 86 |
| Total | 8669.59 | 5640.072 | 344 |
|  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Tests of Between-Subjects Effects** | | | | | | |
| Dependent Variable: In state tuition | | | | | | |
| Source | Type III Sum of Squares | *df* | Mean Square | *F* | Sig. | Partial η2 |
| Corrected model | 1437248197.523a | 3 | 479082732.508 | 17.194 | .000 | .132 |
| Intercept | 25855639378.616 | 1 | 25855639378.616 | 927.926 | .000 | .732 |
| Region | 1437248197.523 | 3 | 479082732.508 | 17.194 | .000 | .132 |
| Error | 9473724993.860 | 340 | 27863897.041 |  |  |  |
| Total | 36766612570.000 | 344 |  |  |  |  |
| Corrected total | 10910973191.384 | 343 |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Region** | | | | |
| Dependent Variable: In state tuition | | | | |
| Region | Mean | Std. Error | 95% Confidence Interval | |
| Lower Bound | Upper Bound |
| Midwest | 9290.651 | 569.209 | 8171.037 | 10410.266 |
| South | 5508.163 | 569.209 | 4388.548 | 6627.777 |
| West | 8693.744 | 569.209 | 7574.130 | 9813.359 |
| Northeast | 11185.791 | 569.209 | 10066.176 | 12305.405 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Multiple Comparisons** | | | | | | |
| Dependent Variable: In state tuition | | | | | | |
| Tukey HSD | | | | | | |
| (I) Region | (J) Region | Mean Difference (I−J) | Std. Error | Sig. | 95% Confidence Interval | |
| Lower Bound | Upper Bound |
| Midwest | South | 3782.49\* | 804.983 | .000 | 1704.20 | 5860.78 |
| West | 596.91 | 804.983 | .880 | −1481.38 | 2675.20 |
| Northeast | −1895.14 | 804.983 | .088 | −3973.43 | 183.15 |
| South | Midwest | −3782.49\* | 804.983 | .000 | −5860.78 | −1704.20 |
| West | −3185.58\* | 804.983 | .001 | −5263.87 | −1107.29 |
| Northeast | −5677.63\* | 804.983 | .000 | −7755.92 | −3599.34 |
| West | Midwest | −596.91 | 804.983 | .880 | −2675.20 | 1481.38 |
| South | 3185.58\* | 804.983 | .001 | 1107.29 | 5263.87 |
| Northeast | −2492.05\* | 804.983 | .011 | -4570.34 | −413.76 |
| Northeast | Midwest | 1895.14 | 804.983 | .088 | −183.15 | 3973.43 |
| South | 5677.63\* | 804.983 | .000 | 3599.34 | 7755.92 |
| West | 2492.05\* | 804.983 | .011 | 413.76 | 4570.34 |
| *Note.* Based on observed means. The error term is mean square error = 27863897.041. | | | | | | |
| \*The mean difference is significant at the .05 level. | | | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **In state tuition** | | | | |
| Tukey HSDa,b | | | | |
| Region | N | Subset | | |
| 1 | 2 | 3 |
| South | 86 | 5508.16 |  |  |
| West | 86 |  | 8693.74 |  |
| Midwest | 86 |  | 9290.65 | 9290.65 |
| Northeast | 86 |  |  | 11185.79 |
| Significance |  | 1.000 | 0.880 | 0.088 |

*Note.* Means for groups in homogeneous subsets are displayed. Based on observed means. The error term is Mean Square(Error) = 27863897.041.

aUses Harmonic Mean Sample Size = 86.000.

bα= .05.

Should the null hypothesis be rejected for this study?

A. Yes, reject the null.

B. No, fail to reject the null.

Ans: A

Learning Objective: SPSS—Rejecting the null

51. Based on the SPSS output in the previous question, which of the following is the best description of the in state tuition differences across the four different regions?

A. The South is significantly lower than all other regions. The West has the second lowest. The Midwest is the third lowest. The Northeast is the most expensive.

B. The South is significantly lower than all other regions. All other regions are not significantly different from each other.

C. The South is significantly lower than all other regions. The West and Midwest are the not significantly different from each other but both are significantly lower than the Northeast.

D. The South is significantly lower than all other regions. The West and Midwest are not significantly different from each other. The West is significantly lower than the Northeast.

Ans: D

Learning Objective: SPSS—Interpreting post hoc tests

## True/False

1. F ratios are always positive.

Ans: T

Learning Objective: Logic of ANOVA