11.5: Chapter 11 Exercises

Exercises

1. What does the acronym ANOVA stand for?

a) Analysis of Variance
b) Analysis of Means
c) Analyzing Various Means
d) Analysis of Variance
e) Anticipatory Nausea and Vomiting
f) Average Noise Variance

2. What would the test statistic equal if MSB = MSW?

a) -1
b) 0
c) 1
d) 4
e) 1.96

3. A researcher would like to test to see if there is a difference in the average profit between 5 different stores. Which are the correct hypotheses for an ANOVA?

a) $H_0: \mu_1 = \mu_2 = \mu_3 \quad H_1:$ At least one mean is different.
b) $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 \quad H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5$
c) $H_0: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \quad H_1: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$
d) $H_0: \sigma_B^2 \neq \sigma_W^2 \quad H_1: \sigma_B^2 = \sigma_W^2$
e) $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 \quad H_1:$ At least one mean is different

4. An ANOVA was run to test to see if there was a significant difference in the average cost between three different brands of snow skis. Random samples for each of the three brands were collected from different stores. Assume the costs are normally distributed. At α = 0.05, test to see if there is a difference in the means. State the hypotheses, fill in the ANOVA table to find the test statistic, compute the p-value, state the decision and summary.

Source	**SS**	***df***	**MS**	***F***
Between	25.3633	2		
Within	23.3617	15		
Total	48.725	17		

5. An ANOVA test was run for the per-pupil costs for private school tuition for three counties in the Portland, Oregon, metro area. Assume tuition costs are normally distributed. At α = 0.05, test to see if there is a difference in the means.

SUMMARY				
Groups	*n*	*Sum*	*Average*	*Variance*
Clackamas County	11	147215	13383.1818	36734231.36
Multnomah County	12	182365	15197.0833	33731956.63
Washington County	10	124555	12455.5	40409869.17

a) State the hypotheses.

b) Fill out the ANOVA table to find the test statistic.

ANOVA				
Source	*SS*	*df*	*MS*	*F*
Between Groups				
Within Groups				
Total				

c) Compute the p-value.

d) State the correct decision and summary.

6. Cancer is a terrible disease. Surviving may depend on the type of cancer the person has. To see if the mean survival time for several types of cancer are different, data was collected on the survival time in days of patients with one of these cancers in advanced stage. The data is from "Cancer survival story," 2013. (Please realize that this data is from 1978. There have been many advances in cancer treatment, so do not use this data as an indication of survival rates from these cancers.) Does the data indicate that there is a difference in the mean survival time for these types of cancer? Use a 1% significance level.

SUMMARY				
Groups	*n*	*Sum*	*Average*	*Variance*
Stomach	13	3718	286	119930.333
Bronchus	17	3597	211.5882	44040.6324
Colon	17	7776	457.4118	182473.007
Ovary	6	5306	884.3333	1206875.47
Breast	11	15355	1395.9091	1535038.49

a) State the hypotheses.

b) Fill in an ANOVA table to find the test statistic.

c) Compute the p-value.

d) State the correct decision and summary.

7. What does the Bonferroni comparison test for?

a) The analysis of between and within variance.
b) The difference between all the means at once.
c) The difference between two pairs of mean.
d) The sample size between the groups.

8. True or false: The Bonferroni test should only be done when you reject the null hypothesis F-test?

9. A manufacturing company wants to see if there is a significant difference in three types of plastic for a new product. They randomly sample prices for each of the three types of plastic and run an ANOVA. Use $\alpha = 0.05$ to see if there is a statistically significant difference in the mean prices. Part of the computer output is shown below.

SUMMARY				
Groups	*n*	*Sum*	*Average*	*Variance*
Plastic A	39	512	13.12821	15.48313
Plastic B	41	679	16.56098	1.302439
Plastic C	34	470	13.82353	22.08913

a) State the hypotheses.

b) Fill in the ANOVA table to find the test statistic.

ANOVA				
Source of Variation	*SS*	*df*	*MS*	*F*
Between Groups				
Within Groups				
Total	1631.939	113		

c) Compute the critical value.

d) State the decision and summary.

e) Which group(s) are significantly different based on the Bonferroni test?

10. A manager on an assembly line wants to see if they can speed up production by implementing a new switch for their conveyor belts. There are four switches to choose from and replacing all the switches along the assembly line will be quite costly. They test out each of the four designs and record assembly times. Use α = 0.05 to see if there is a statistically significant difference in the mean times.

ANOVA				
Source of Variation	*SS*	*df*	*MS*	*F*
Between Groups	80.3951	3		
Within Groups	875.9111	87		
Total	956.3062	90		

a) State the hypotheses.

b) Fill in the ANOVA table to find the test statistic.

c) Compute the critical value.

d) State the correct decision and summary.

e) Should a post-hoc Bonferroni test be done? Why?

i. No, since the p-value > α there is no difference in the means.
ii. Yes, we should always perform a post-hoc test after an ANOVA
iii. No, since we already know that there is a difference in the means.
iv. Yes, since the p-value < α we need to see where the differences are.

f) All four new switches are significantly faster than the current switch method. Of the four new types of switches, switch 3 cost the least amount to implement. Which of the 4, if any, should the manager choose?

i. The manager should stay with the old switch method since we failed to reject the null hypothesis.
ii. The manager should switch to any of the four new switches since we rejected the null hypothesis.
iii. The manager should randomly pick from switch types 1, 2 or 4.
iv. Since there is no statistically significant difference in the mean time they should choose switch 3 since it is the least expensive.

For exercises 11-16, Assume that all distributions are normal with equal population standard deviations, and the data was collected independently and randomly. Show all 5 steps for hypothesis testing. If there is a significant difference is found, run a Bonferroni test to see which means are different.

a) State the hypotheses.

b) Compute the test statistic.

c) Compute the critical value or p-value.

d) State the decision.

e) Write a summary.

11. Is a statistics class's delivery type a factor in how well students do on the final exam? The table below shows the average percent on final exams from several randomly selected classes that used the different delivery types. Use a level of significance of α = 0.10.

Face-to-Face	Blended	Online
79	70	100
77	58	66
75	55	91
68	74	91
95	76	98
78	83	74
69	66	57
65		88
65		

12. The dependent variable is the number of times a photo gets a like on social media. The independent variable is the subject matter, selfie or people, landscape, meme, or a cute animal. The researcher is exploring whether the type of photo makes a difference on the mean number of likes. A random sample of photos were taken from social media. Test to see if there is a significant difference in the means using α = 0.05.

Selfie or People	Landscape	Meme	Cute Animal
9	17	13	14
16	15	12	10
18	13	15	13
6	14	20	16
10	17	21	18
16	9	19	14
17	24	21	13
12	23	22	19
18	21	14	17
7	6	20	13
14	17	10	18

13. The dependent variable is movie ticket prices, and the groups are the geographical regions where the theaters are located (suburban, rural, urban). A random sample of ticket prices were taken from randomly chosen states. Test to see if there is a significant difference in the means using $\alpha = 0.05$.

Suburb	Rural	Urban
11.25	11.75	11.25
11	9.5	11.25
11	11.25	12.25
12.25	10.5	9.75
11.25	10	10.75
10	10	11.75
8.75	11.5	12
11	10.75	12.5
10.75	10.25	11
10.75	9.25	10.75
11.5	10.75	12
9.75	10	12
12.25	13	10.75
9.75	11	10.5
9.25	12	12.75

14. Recent research indicates that the effectiveness of antidepressant medication is directly related to the severity of the depression (Khan, Brodhead, Kolts & Brown, 2005). Based on pre-treatment depression scores, patients were divided into four groups based on their level of depression. After receiving the antidepressant medication, depression scores were measured again and the amount of improvement was recorded for each patient. The following data are similar to the results of the study. Use a significance level of $\alpha = 0.05$. Test to see if there is a difference in the mean scores.

Low Moderate	High Moderate	Moderately Severe	Severe
1.3	2.3	1.7	2.6
0.8	0.3	2.7	4.4
2.2	1.2	2.1	3.6
1.6	2.1	2.7	3.1
0.5	1.3	1.7	2.1
1.4	1.7	1.8	2
2.1	2.4	3.1	2.4
1.3	1.4	2.1	2.9
0	3.7	1.5	3.2
4	3.8	3.5	1.9
2	2.8	1.9	3.1
2.4	2.5	1.5	3
3.8	1.5	2.9	2
2.2	2.7	1.6	2.2
2.3	1.2	2.1	3.7
1.5	0.5	3.4	3.5
0.5	2	2.5	3.4
2.1	3.4	2.9	3
0.5	0.9	2.2	4.8
1.7	1.6	4.4	2.8
0.8	3.5	1.8	1.5
1.3	2.5	1.5	6.1
1.3	2.8	3.4	1.7
0.8	3.7	2.9	0.2
2.5	1.8	2.7	1.9

15. An ANOVA was run to test to see if there was a significant difference in the average cost between three different types of fabric for a new clothing company. Random samples for each of the three fabric types was collected from different manufacturers. At $\alpha = 0.10$, run an ANOVA test to see if there is a difference in the means.

SUMMARY

Groups	*n*	*Sum*	*Average*	*Variance*
A	34	10608	312	204.1212
B	37	11655	315	97.5
C	32	9600	300	2019.548

16. Three students, Linda, Tuan, and Javier, are given laboratory rats for a nutritional experiment. Each rat's weight is recorded in grams. Linda feeds her 9 rats Formula A, Tuan feeds his 9 rats Formula B, and Javier feeds his 9 rats Formula C. At the end of a specified time-period, each rat is weighed again, and the net gain in grams is recorded. Using a significance level of 0.10, test to see if there is a difference in the mean weight gain for the three formulas.

Formula A	Formula B	Formula C
44.2	10.5	42.8
39.3	52.8	41
29.5	49.2	32.8
47.9	32.1	36.5
37.3	33.5	50.2
53.6	37.3	39.7
31.2	27.2	43.6
49.9	13.1	47.7
45.1	26.3	44.2

---

17. For a two-way ANOVA, a row factor has 3 different levels, a column factor has 4 different levels. There are 15 data values in each group. Find the following.

a) The degrees of freedom for the row effect.

b) The degrees of freedom for the column effect.

c) The degrees of freedom for the interaction effect.

18. Fill out the following two-way ANOVA table.

Source	Sum of Squares	d.f.	Mean Square	*F*
Row Factor	408.33	2		
Column Factor	8.33	3		
Interaction Factor	2187	6		
Error				
Total	26872.99	49		

19. Fill out the following two-way ANOVA table.

Source	Sum of Squares	d.f.	Mean Square	*F*
Row Factor	4357.17	2		
Column Factor	341.33	1		
Interaction Factor	129.17	2		
Error	1256	6		
Total	6083.67	11		

20. Fill out the following two-way ANOVA table.

Source	Sum of Squares	d.f.	Mean Square	*F*
Row Factor	538.78	2		
Column Factor	6108.44	2		
Interaction Factor		4		
Error	1375.5	9		
Total	8268.28	17		

21. Fill out the following two-way ANOVA table.

Source	Sum of Squares	d.f.	Mean Square	*F*
Row Factor	10.08	1		
Column Factor	720.75	1		
Interaction Factor				
Error	33.33	8		
Total	904.24			

22. Fill out the following two-way ANOVA table.

Source	Sum of Squares	d.f.	Mean Square	*F*
Row Factor	227.556	1		
Column Factor	11.444	2		
Interaction Factor	7.444			
Error				
Total	463.111	17		

23. A professor is curious if class size and format for which homework is administered has an impact on students' test grades. In a particular semester, she samples 4 students in each category below and records their grade on the department-wide final exam. The data are recorded below. Assume the variables are normally distributed. Run a two-way ANOVA using $\alpha = 0.05$.

	Less Than 30 Students	More Than 30 Students
Paper HW	92, 85, 72, 84	64, 72, 80, 88
Online HW	91, 90, 75, 78	82, 55, 62, 71

Source	Sum of Squares	d.f.	Mean Square	*F*
HW Factor	68.0625			
Class Size Factor	540.5625			
Interaction Factor	76.5625			
Error				
Total	1821.9375			

24. A study was conducted to observe the impact of young adults eating a diet that is high in healthy fats. A random sample of young adults was instructed to eat a particular menu for a month. They were then tested to check a combination of recall skills, reflexes, and physical fitness and scored from 1-10 based on performance. They were divided into two groups, one eating a menu that is high in healthy fats, and the other low in healthy fats. They were also divided based on age. The data are recorded below. Assume the variables are normally distributed. Run a two-way ANOVA using $\alpha = 0.05$.

	High Fats	**Low Fats**
Age 14-16	9, 7, 8, 8, 8	5, 8, 6, 3, 4
Age 17-19	10, 9, 7, 7, 8	7, 2, 4, 6, 6
Age 20-22	8, 10, 10, 9, 9	8, 7, 5, 8, 6

Source	**Sum of Squares**	**d.f.**	**Mean Square**	***F***
Age Factor	13.067			
Diet Factor	58.8			
Interaction Factor	0.8			
Error	49.2			
Total	121.867			

25. A door-to-door sales company sells three types of vacuums. The company manager is interested to find out if the type of vacuum sold has an effect on whether a sale is made, as well as what time of day the sale is made. She samples 36 sales representatives and divides them into the following categories, then records their sales (in hundreds of dollars) for a week. Assume the variables are normally distributed. Run a two-way ANOVA using $\alpha = 0.05$.

	Vacuum 1	**Vacuum 2**	**Vacuum 3**
Morning	5.3, 4.2, 3.1, 4.8	6.2, 5.9, 7.1, 5.5	4.2, 3.9, 6.1, 4.8
Afternoon	4.8, 4.7, 5.1, 3.7	6.8, 7.2, 6.6, 5.3	4.1, 4.1, 5.3, 3.9
Evening	4.8, 4.9, 5.5, 5.7	7.5, 8.2, 9.1, 6.4	4.1, 5.2, 5.9, 4.3

Source	**Sum of Squares**	**d.f.**	**Mean Square**	***F***
Time of Day				
Vacuum Type	36.2872			
Interaction	2.3878			
Error	17.8675			
Total	62.3897			

26. A customer shopping for a used car is curious if the price of a vehicle varies based on type of vehicle and location of used car dealership. She samples 5 vehicles in each category below and records the price of each vehicle. Each vehicle is in similar shape in regards to age, mileage, and condition. A two-way ANOVA test was run and the information from the test is summarized in the table below. State all 3 hypotheses, critical values, decisions and summaries using $\alpha = 0.05$.

	SUV	Truck	Sedan
Urban Location	22,564 21,150 23,564 25,400 28,100	25,460 26,800 27,100 25,230 24,150	14,560 13,255 16,812 15,500 15,854
Rural Location	20,640 19,200 21,400 18,246 19,452	24,200 25,198 23,299 25,600 26,410	12,541 13,600 12,452 11,500 13,989

Source	Sum of Squares	d.f.	Mean Square	*F*
Location	47557466.13	1	47557466.13	19.622
Vehicle	677943740.9	2	338971870.4	139.862
Interaction	15926222.87	2	7963111.433	3.286
Error	58166875.6	24	2423619.817	
Total	799594305.5	29		

27. A sample of patients are tested for cholesterol level and divided into categories by age and by location of residence in the United States. The data are recorded below. Assume the variables are normally distributed. A two-way ANOVA test was run and the information from the test is summarized in the table below. State all 3 hypotheses, critical values, decisions and summaries using $\alpha = 0.05$.

	East Coast	Midwest	South	West Coast
18-35 yrs.	185, 193, 172	202, 193, 187	220, 218, 198	184, 199, 203
36-53 yrs.	202, 218, 199	205, 219, 215	205, 224, 229	205, 187, 190
54+ yrs.	222, 231, 206	215, 209, 197	225, 233, 214	184, 212, 216

Source	Sum of Squares	d.f.	Mean Square	*F*
Age Factor	1922.000	2	961.000	7.863
Location Factor	2093.333	3	697.778	5.709
Interaction Factor	1067.333	6	177.889	1.455
Error	2933.333	24	122.222	
Total	8016.000	35		

28. The employees at a local nursery swear by a certain variety of tomato seed and a certain variety of fertilizer. To test their instincts, they take a sample of 3 varieties of tomato seed and 4 varieties of fertilizer and find the following yield of tomatoes from each tomato plant. Assume the variables are normally distributed. Run a two-way ANOVA using $\alpha = 0.05$.

	Fertilizer 1	Fertilizer 2	Fertilizer 3	Fertilizer 4
Seed 1	23, 25, 29	21, 20, 22	26, 20, 22	27, 25, 24
Seed 2	21, 25, 30	29, 19, 25	24, 21, 20	23, 27, 28
Seed 3	19, 18, 15	14, 16, 18	20, 17, 17	16, 19, 18

Source	Sum of Squares	d.f.	Mean Square	*F*
Seed Factor	367.1667			
Fertilizer Factor	47.4167			
Interaction Factor	36.8333			
Error Factor	185.3333			
Total	636.75			

29. An obstetrician feels that her patients who are taller and leaner before becoming pregnant typically have quicker deliveries. She samples 3 women in each of the following categories of Height and Body Mass Index and records the time they spent in the pushing phase of labor in minutes. All women in the sample had a natural vaginal delivery and it was their first childbirth. The data are recorded below. Assume the variables are normally distributed. Run a two-way ANOVA using α = 0.05.

	BMI 20-24	BMI 25-29	BMI 30-35
58 – 63 in.	143, 95, 162	212, 51, 146	208, 162, 84
64 – 69 in.	165, 45, 130	133, 42, 110	125, 137, 162
70 – 75 in.	89, 102, 35	46, 33, 114	95, 125, 110

Source	Sum of Squares	d.f.	Mean Square	*F*
Height Factor	14814.5185			
BMI Factor	6216.5185			
Interaction Factor	1016.5926			
Error Factor	42910.6667			
Total	64958.2963			

Solutions to Odd-Numbered Exercises

1. a

3. e

5. $H_0 : \mu_1 = \mu_2 = \mu_3$; H_1 : At least one mean is different.
F = 0.5902; p-value = 0.5605.
Do not reject H_0. There is not enough evidence to support the claim that there is a difference in the mean per-pupil costs for private school tuition for three counties in the Portland, Oregon, metro area.

7. c

9. a) $H_0 : \mu_A = \mu_B = \mu_C$; H_1 : At least one mean is different.
b) $F = 10.64046$
c) $F_\alpha = 3.0781$
d) Reject H_0. There is enough evidence to support the claim that there is a difference in the mean price of the three types of plastic.
e) $H_0 : \mu_A = \mu_B$; $H_1 = \mu_A \neq \mu_B$; p-value=0; reject H_0. There is significant difference in price between plastics A and B. $H_0 : \mu_A = \mu_C$; $H_1 = \mu_A \neq \mu_C$; p-value = 1; do not reject H_0. There is not a significant difference in price

between plastics A and C. $H_0: \mu_B = \mu_C$; $H_1 = \mu_B \neq \mu_C$; p-value = 0.003; reject H_0. There is significant difference in price between plastics B and C.

11. $H_0: \mu_1 = \mu_2 = \mu_3$; H_1 : At least one mean is different. F = 2.5459; p-value = 0.0904; do not reject H_0. There is not enough evidence to support the claim that there is a difference in the mean movie ticket prices by geographical regions.

13. $H_0: \mu_1 = \mu_2 = \mu_3$; H_1 : At least one mean is different. F = 2.7121; p-value = 0.0896; reject H_0. There is sufficient evidence to support the claim that course delivery type is a factor in final exam score.

15. $H_0: \mu_A = \mu_B = \mu_C$; H_1 : At least one mean is different. F = 2.895; p-value = 0.06; reject H_0. 0. There is sufficient evidence to support the claim that there is a difference in the mean cost between three different types of fabric.
$H_0: \mu_A = \mu_B$; $H_1: \mu_A \neq \mu_B$; p-value = 1; do not reject H_0. There is not a significant difference in the mean cost of fabrics A and B. $H_0: \mu_A = \mu_C$; $H_1: \mu_A \neq \mu_C$; p-value = 0.222; do not reject H_0. There is not a significant difference in the mean cost of fabrics A and C. $H_0: \mu_B = \mu_C$; $H_1: \mu_B \neq \mu_C$; p-value = 0.07; reject H_0. There is significant difference in the mean cost of fabrics B and C.

17. a) $df_{\mathrm{A}} = 2, df_{\mathrm{E}} = 168$
b) $df_{\mathrm{B}} = 3, df_{\mathrm{E}} = 168$
c) $df_{\mathrm{A\times B}} = 6, df_{\mathrm{E}} = 168$

19.

Source	SS	d.f.	MS	*F*
Row	4357.17	2	2178.585	10.4073
Col.	341.33	1	341.33	1.6306
Int.	129.17	2	64.585	0.3085
Error	1256	6	209.3333	
Total	6083.67	11		

21.

Source	SS	d.f.	MS	*F*
Row	10.08	1	10.08	2.4194
Col.	720.75	1	720.75	172.9973
Int.	140.08	1	140.08	33.6226
Error	33.33	8	4.16625	
Total	904.24	11		

23. H_0 : The format of the homework (paper vs. online) has no effect on the mean test grade. H_1 : The format of the homework (paper vs. online) has an effect on the mean test grade. F = 0.7185; CV = F.INV.RT(0.05,1,12) = 4.7472; do not reject H_0. There is not enough evidence to support the claim that the format of the homework (paper vs. online) has an effect on the mean test grade.
H_0 : The class size has no effect on the mean test grade. H_1 : The class size has an effect on the mean test grade. F = 5.7064; CV = F.INV.RT(0.05,1,12) = 4.7472; reject H_0. There is enough evidence to support the claim that the class size has an effect on the mean test grade.
H_0 : There is no interaction effect between the format of the homework (paper vs. online) and the class size on the mean test grade. H_1 : There is an interaction effect between the format of the homework (paper vs. online) and the class size on the mean test grade. F = 0.8082; CV = F.INV.RT(0.05,1,12) = 4.7472; do not reject H_0. There is not

enough evidence to support the claim that there is an interaction effect between the format of the homework (paper vs. online) and the class size on the mean test grade.

25. H_0 : The time of day has no effect on the mean number of vacuum sales. H_1 : The time of day has an effect on the mean number of vacuum sales. F = 4.4179; CV = F.INV.RT(0.05,2,27) = 3.3541; reject H_0. There is enough evidence to support the claim that the time of day has an effect on the mean number of vacuum sales.
H_0 : The type of vacuum has no effect on the mean number of vacuum sales. H_1 : The type of vacuum has an effect on the mean number of vacuum sales. F = 27.4172; CV = F.INV.RT(0.05,2,27) = 3.3541; reject H_0. There is enough evidence to support the claim that the type of vacuum has an effect on the mean number of vacuum sales.
H_0 : There is no interaction effect between time of day and type of vacuum on the mean number of vacuum sales. H_1 : There is an interaction effect between time of day and type of vacuum on the mean number of vacuum sales. F = 0.9021; CV = F.INV.RT(0.05,4,27) = 2.7278; do not reject H_0. There is not enough evidence to support the claim that there is an interaction effect between time of day and type of vacuum on the mean number of vacuum sales.

27. H_0 : Age has no effect on the mean cholesterol level. H_1 : Age has an effect on the mean cholesterol level. F = 7.863; CV = F.INV.RT(0.05,2,24) = 3.4028; reject H_0. There is enough evidence to support the claim that age has an effect on the mean cholesterol level.
H_0 : Location has no effect on the mean cholesterol level. H_1 : Location has no effect on the mean cholesterol level. F = 5.709; CV = F.INV.RT(0.05,3,24) = 3.0087; reject H_0. There is enough evidence to support the claim that the location has an effect on the mean cholesterol level.
H_0 : There is no interaction effect between age and location on the mean cholesterol level. H_1 : There is an interaction effect between age and location on the mean cholesterol level. F = 1.455; CV = F.INV.RT(0.05,6,24) = 2.5082; do not reject H_0. There is not enough evidence to support the claim that there is an interaction effect between age and location on the mean cholesterol level.

29. H_0 : Height has no effect on the mean delivery time. H_1 : Height has an effect on the mean delivery time. F = 3.2798; CV = F.INV.RT(0.05,2,19) = 3.5219; do not reject H_0. There is not enough evidence to support the claim that height has an effect on the mean delivery time.
H_0 : BMI has no effect on the mean delivery time. H_1 : BMI has an effect on the mean delivery time. F = 1.3763; CV = F.INV.RT(0.05,2,19) = 3.5219; do not reject H_0. There is not enough evidence to support the claim that BMI has an effect on the mean delivery time.
H_0 : There is no interaction effect between the height and BMI on the mean delivery time. H_1 : There is an interaction effect between the height and BMI on the mean delivery time. F = 0.1125; CV = F.INV.RT(0.05,4,19) = 2.8951; do not reject H_0. There is not enough evidence to support the claim that there is an interaction effect between the height and BMI on the mean delivery time.