

Stat 301 Review (Test 2)

Below is a table of the tests that we covered in chapters 6, 7, 12 and 13. You will need to know the following for each of the tests:

1. Given a problem, which test should be used?
2. How to write the hypotheses for the problem.
3. How to calculate and/or read the test statistic from the printout.
4. How to calculate and/or read the P-value from the printout.
5. What conclusions should be drawn?

Type of test	When is it used?	Confidence interval	Hypothesis test procedure
1-sample z-test	<ul style="list-style-type: none"> • One set of data • σ is known • Quantitative data 	$\bar{x} \pm z^* \left(\frac{\sigma}{\sqrt{n}} \right)$ <p>To find the z^* value, look at the last row of the t-table.</p>	<p><u>Hypotheses:</u> $H_0 : \mu = \mu_0$ versus $H_a : \mu > \mu_0, H_a : \mu < \mu_0$ or $H_a : \mu \neq \mu_0$</p> <p><u>Test Statistic:</u> $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$</p> <p><u>P-value:</u> $H_a : \mu > \mu_0$, use $P(Z > z)$, $H_a : \mu < \mu_0$, use $P(Z < z)$, or $H_a : \mu \neq \mu_0$, use $2P(Z > z)$ Look up P-values on TABLE A</p>
1-sample t-test	<ul style="list-style-type: none"> • One set of data • σ is unknown • Quantitative data 	<p>Find the confidence interval from SPSS printout (be sure to add in the test value)</p> <p style="text-align: center;">OR</p> $\bar{x} \pm t^* \left(\frac{s}{\sqrt{n}} \right)$ <p>To find the t^* value, look at the n-1 degrees of freedom row on the t-table.</p>	<p><u>Hypotheses:</u> $H_0 : \mu = \mu_0$ versus $H_a : \mu > \mu_0, H_a : \mu < \mu_0$ or $H_a : \mu \neq \mu_0$</p> <p><u>Test Statistic:</u> $t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$ OR read SPSS printout</p> <p><u>P-value:</u> $H_a : \mu > \mu_0$, use $P(T > t)$, $H_a : \mu < \mu_0$, use $P(T < t)$ or $H_a : \mu \neq \mu_0$, use $2P(T > t)$ Look up P-values on the t-table (df=n-1) OR read SPSS printout</p>
Matched-pairs	<ul style="list-style-type: none"> • Values are matched. Either both measurements are recorded on the same unit or a before after study is conducted. • Quantitative data 	<p>Find the confidence interval from SPSS printout</p> <p style="text-align: center;">OR</p> $\bar{x}_{diff} \pm t^* \left(\frac{s_{diff}}{\sqrt{n}} \right)$ <p>To find the t^* value, look at the n-1 degrees of freedom row on the t-table.</p>	<p><u>Hypotheses:</u> $H_0 : \mu_{diff} = 0$ versus $H_a : \mu_{diff} > 0, H_a : \mu_{diff} < 0$ or $H_a : \mu_{diff} \neq 0$</p> <p><u>Test Statistic:</u> $t = \frac{\bar{x}_{diff} - 0}{s_{diff} / \sqrt{n}}$ OR read SPSS printout</p> <p><u>P-value:</u> $H_a : \mu_{diff} > 0$, use $P(T > t)$, $H_a : \mu_{diff} < 0$, use $P(T < t)$ or $H_a : \mu_{diff} \neq 0$, use $2P(T > t)$ Look up P-values on the t-table (df=n-1) OR read SPSS printout</p>

<p>2-sample t-test</p>	<ul style="list-style-type: none"> Data comes from two independent samples selected from two independent populations or a completely randomized experiment with two factor levels or treatments. Quantitative data 	<p>Find the confidence interval from the SPSS printout</p> <p style="text-align: center;">OR</p> $\bar{x}_1 - \bar{x}_2 \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$ <p>To find the t^* value, look at the smaller of $n_1 - 1$ and $n_2 - 1$ degrees of freedom row on the t-table.</p>	<p><u>Hypotheses:</u> $H_0 : \mu_1 = \mu_2$ versus $H_a : \mu_1 > \mu_2, H_a : \mu_1 < \mu_2$ or $H_a : \mu_1 \neq \mu_2$</p> <p><u>Test Statistic:</u> $t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$ OR read SPSS printout</p> <p><u>P-value:</u> $H_a : \mu_1 > \mu_2$, use $P(T > t)$, $H_a : \mu_1 < \mu_2$, use $P(T < t)$ or $H_a : \mu_1 \neq \mu_2$, use $2P(T > t)$ Look up P-values on the t-table OR read SPSS printout</p>
<p>One-way ANOVA</p>	<ul style="list-style-type: none"> Data comes from more than two independent samples or from an experiment with one factor with multiple levels of that factor. Quantitative data 	<p>None</p>	<p><u>Hypotheses:</u> $H_0 : \mu_1 = \mu_2 = \mu_3 = \dots = \mu_I$ $H_a : \text{not all the } \mu_i \text{'s are the same}$</p> <p><u>Test statistic:</u> Read F from the SPSS printout.</p> <p><u>P-value:</u> Read P-value from the SPSS printout.</p> <p><u>Further analysis:</u> If you reject the null hypothesis, further analysis is necessary to determine which means are different. Bonferroni's procedure is one possibility.</p> <p>Appropriate if 2 (smallest s) > largest s</p>
<p>Two-way ANOVA</p>	<ul style="list-style-type: none"> Compares the means of populations that are classified two ways or the mean response in a two-factor experiment. Quantitative data 	<p>None</p>	<p><u>Hypotheses:</u> H_0 : main effect of A is zero H_a : main effect of A is not zero</p> <p>H_0 : main effect of B is zero H_a : main effect of B is not zero</p> <p>H_0 : interaction between A and B is zero H_a : interaction between A and B is not zero</p> <p><u>Test statistics:</u> Read F from the SPSS printout.</p> <p><u>P-value:</u> Read P-value from the SPSS printout.</p>

There are some additional concepts that you will need to understand. They are listed below:

1. Assumptions that need to be met in order to perform the following tests or calculate the confidence intervals.
2. How robust the tests above are to the assumption of normality with respect to the sample size.
3. Whether the test you are performing is reasonable considering the distribution of your data and your sample size.
4. The relationship between confidence intervals and two-sided tests and when a confidence interval can be used to draw conclusions regarding a hypothesis test.
5. How large a sample is needed to gain a certain margin of error in a one-sample Z-test?
6. Know how to test the standard deviations to see if it is OK to pool the variances in both the one and two-way ANOVAs.
7. Calculate R^2 and the estimate for σ .
8. When it is better to calculate a confidence interval versus conduct a hypothesis test.
9. Determine which means are different in ANOVA given the SPSS printout in Bonferroni's procedure.
10. Be able to describe and interpret side-by-side boxplots and plots of means for the one-way and two-way ANOVAs.
11. Know how the two-way ANOVA is different from the one-way ANOVA and two-sample comparison of means.
12. Know how to recognize the response variable, factors, number of levels for each factor and the total number of observations.
13. Be able to interpret the appropriate graphs for both one-way and two-way ANOVAs.

The following problems have been taken from old tests.

Problems 1-4 are multiple choice. There may be more than one correct answer for each question. Circle ALL answers which are correct.

1. Circle the letter of the following methods that would decrease the width of a confidence interval for a mean, if all else stays the same.
 - a. Increase the sample size.
 - b. Decrease the sample size.
 - c. Increase the level of confidence.
 - d. Decrease the level of confidence.
 - e. None of the above.

2. A 95% confidence interval indicates that:
 - a. 95% of the intervals constructed using this process based on same-sized samples from this population will include the population mean.
 - b. 95% of the time the interval will include the sample mean
 - c. 95% of the possible population means will be included by the interval
 - d. 95% of the possible sample means (same-size samples) will be included by the interval
 - e. None of the above.

3. Which of the following is true if your P-value is 0.01 and your α is 0.05?
 - a. You reject H_a .
 - b. You do not reject H_a .
 - c. Your results are significant.
 - d. Your results are not significant.
 - e. None of the above.

4. John took a simple random sample of 25 lemon drop packs from a box that was shipped to him, and he counted how many lemon drops were in each pack. From the sample, he calculated a 99% confidence interval of (25.99, 34.02). The company claims that their packs of lemon drops each contain an average of 36 lemon drops. John wanted to use his confidence interval to determine if the company was correct. Conclusion?
 - a. The company is correct.
 - b. John would fail to reject his null hypothesis at the 1% level of significance because 36 falls outside the range of the confidence interval.
 - c. John would reject his null hypothesis at the 1% significance level because 36 falls outside the range of the confidence interval.
 - d. John would reject his null hypothesis at the 5% since the 95% confidence interval is more narrow than the 99% confidence interval, so it would also not contain 36.
 - e. Both c and d are correct.

MATCHING: (3 points each) For problems 5-14, in each of the three boxes, specify which type of problem it is. For the type of story, it can be any of the following (specify by the letter):

- A. 1-sample mean C. 2-sample comparison of means E. Matched pairs
 B. One-way ANOVA D. Two-way ANOVA

	Type of Story	Distribution (Z, t, or F)	Test or CI?
5. Is there a difference in the population average number of green M&Ms for plain, peanut and almond M&M packs?			
6. Estimate the population mean number of green M&Ms in a “fun pack” if the population standard deviation is 0.4?			
7. Do the colors (red, orange, yellow, green, blue, and brown) and type of M&M (plain, peanut and almond) have an effect on the cost of producing the M&M on average in the population?			
8. A report from the M&M/Mars candy company claims that there is an average of 5 brown M&Ms in each fun pack. If we sample of 50 fun packs, do we agree that 5 is the population mean number of brown M&Ms per pack?			
9. On average, are there a larger number of brown plain M&Ms than brown peanut M&Ms in their respective “fun packs” in the population?			
10. Estimate the population average difference between the number of blue and brown M&Ms in each “fun pack” by checking 100 different bags.			
11. Do the type of M&M (plain, peanut and almond) and age of taste tester (kid, teen, adult, senior citizen) have an effect on the population mean taste rating (on a 1-10 scale)?			
12. Estimate the population mean difference in taste ratings (on a 1-10 scale) kids give plain M&Ms and adults give plain M&Ms.			
13. Estimate the population average weight of 10 M&Ms if the standard deviation for the sample is 0.4.			
14. Is the population average number of green M&Ms in a family-size pack more than 50 if we know $\sigma = 0.3$?			

15. A drug company has developed a new “statin” type drug that reduces total cholesterol levels (HDL + LDL), measured in mg/dl, in male patients with a high risk of heart attacks. The drug company wants to determine the effectiveness of its new drug; as a start, company researchers measured the cholesterol level of a random sample of 16 high risk male patients. The results of a stemplot are shown below along with the SPSS output from the data:

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Cholesterol level	16	241.63	14.975	3.744

cholesterol levels Stem-and-Leaf Plot

Frequency	Stem & Leaf
1.00	21 . 1
2.00	22 . 09
3.00	23 . 068
6.00	24 . 012589
2.00	25 . 05
1.00	26 . 0
1.00	27 . 2

The company compared the high risk group’s average cholesterol level to the target for all men, 200mg/dl. They wanted to be sure their high risk group did have higher cholesterol levels on average. The SPSS output is shown below:

One-Sample Test

	Test Value = 200					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Cholesterol level	11.119	15	.000	41.625	33.65	49.60

- a. Is a t-test procedure appropriate for this data? Why?

- b. State the hypotheses for this test.

- c. Give the test statistic, degrees of freedom, the P-value.

- d. State your conclusions in terms of the researchers' problem.

- e. What is the 95% confidence interval for the groups' cholesterol level?

- f. What is the 99% confidence interval for the groups' cholesterol level?

16. The drug company researchers now investigate the effectiveness of the new drug to reduce cholesterol level. Each member of the sample group of high risk patients is given the new drug daily for a period of 3 months. After the treatment, each of the 16 members' cholesterol level is measured and the differences in cholesterol were computed (before – after). The SPSS analysis of their test is shown below.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Cholesterol before	241.63	16	14.975	3.744
	Cholesterol after	238.56	16	14.724	3.681

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Cholesterol before - Cholesterol after	3.063	3.336	.834	1.285	4.840	3.672	15	.002

- a. What is the 95% confidence interval for the mean difference of cholesterol (before – after)?

- b. The researchers want to do a hypothesis test to determine if the new drug reduces cholesterol level on average, with a significance level of $\alpha=0.05$. State the hypotheses, the test statistic, P-value, and your conclusions in terms of the story.

- c. Would it be appropriate to use the confidence interval in part a to test whether the new drug reduces cholesterol (your test in part b)? Why or why not?

17. An experiment was conducted to determine whether there was a difference in the average weights of the combs of roosters fed two different vitamin-supplement diets. Twenty-eight healthy roosters were randomly divided into two groups, with one group receiving diet I and the other receiving diet II. After the study period, the comb weight (in milligrams) was recorded for each rooster. The output is given here:

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	99% Confidence Interval of the Difference	
									Lower	Upper
weight	Equal variances assumed	12.987	.001	4.069	26	.000	32.64286	8.02324	10.34855	54.93716
	Equal variances not assumed			4.069	16.268	.001	32.64286	8.02324	9.25955	56.02616

Answer the following questions based on the output above:

- a. State the null and alternative hypotheses for this problem.

- b. What is the test statistic? P -value?

- c. State your conclusion in terms of the problem using a significance of 0.01.

- d. Based on the output, what is a 99% confidence interval for the difference in comb weights between the two groups?

18. A food company is developing a new breakfast drink, and their market analysts are currently working on preliminary taste-testing studies. However, their SPSS output pages got dropped on the floor and the pages from two different research projects got mixed up. Unfortunately the researchers just labeled the variables x and y, so the variable names won't be of any help. Answer the questions below and on the next page using the appropriate output for the situation. (Some output won't be used at all.)

Group Statistics

group	N	Mean	Std. Deviation	Std. Error Mean
rating x	20	5.3500	1.72520	.38577
y	20	7.2500	1.77334	.39653

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
rating	Equal variances assumed	.101	.753	-3.434	38	.001	-1.90000	.55322	-3.01994	-.78006
	Equal variances not assumed			-3.434	37.971	.001	-1.90000	.55322	-3.01996	-.78004

Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	y-x	.85000	1.59852	.35744	.10187	1.59813	2.378	19	.028

For one research project, the market analysts were interested in whether customers preferred their new breakfast drink to their current breakfast drink. They asked a sample of 20 people to try each drink in a random order and rate the flavor of both on a scale of 1 to 10, 1 being “very unpleasant” and 10 being “very pleasant.” (**Note: old = x and new = y**)

- a. What type of situation is this: matched pairs or two-sample comparison of means?

- b. State the null and alternative hypotheses.

- c. What is the test statistic reported in the appropriate output on the previous page?

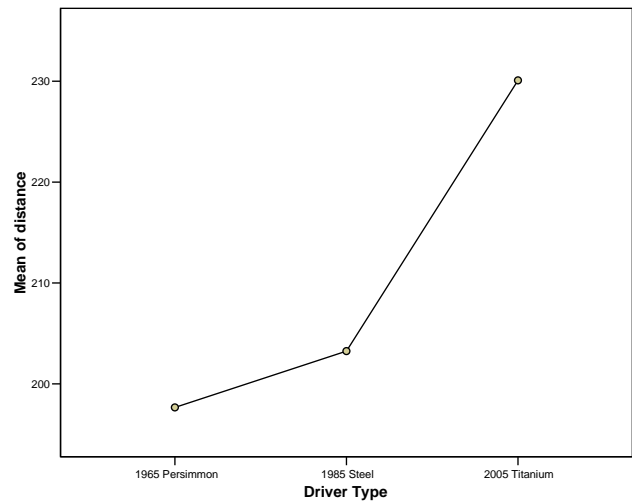
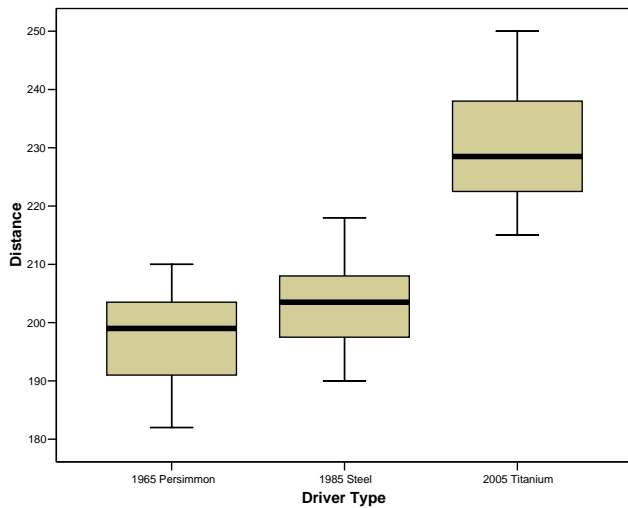
- d. If the test statistic had been missing from the output, show how you would calculate it by hand. *Give the general formula and plug in the correct numbers for the formula.* You do not need to use your calculator to compute the actual test statistic.

- e. Using the appropriate output, what is the correct P-value for the test in part b?

- f. What is your conclusion in terms of the researcher’s question? Use a 0.05 significance level.

20. You measure the weights of 24 male runners. These runners are not a random sample from a population, but you are willing to assume that their weights represent the weights of similar runners. The average weight of your sample is 61.79 kg, with a standard deviation is 4.5 kg.
- Give a 99% confidence interval for the average weight of a male runner.
 - What is your margin of error?
 - You suspected that the average weight for the population of male runners is not the 61.3 you read about in the “running” magazine article. How could you use your confidence interval from part a to do a test at the $\alpha = 0.01$ significance level? State your hypotheses and report and explain your conclusions of this test in a way the general public could understand.

21. A historical debate is occurring in golf on the impact technology is having on the game. A golfer wants to study the difference three types of drivers have on the distance the golf ball flies when hit with those drivers. The types of drivers are: (1) a steel shafted PowerBuilt persimmon, circa 1965; (2) a steel shafted TaylorMade metalwood, circa 1985; and (3) a graphite shafted titanium headed Ping, circa 2005. This golfer hits a dozen balls with each of the different drivers. An assistant measures and records the total distance for each drive; the data and SPSS results are as follows:



	N	Mean	Std. Deviation
1965 Persimmon	12	197.67	8.217
1985 Steel	12	203.25	7.689
2005 Titanium	12	230.08	10.799
Total	36	210.33	16.805

ANOVA

Distance					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8226.722	2	4113.361	43.626	.000
Within Groups	3111.500	33	94.288		
Total	11338.222	35			

Multiple Comparisons

Dependent Variable: Distance

Bonferroni

(I) Driver Type	(J) Driver Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1965 Persimmon	1985 Steel	-5.583	3.676	.415	-14.86	3.69
	2005 Titanium	-32.417*	3.676	.000	-41.69	-23.14
1985 Steel	1965 Persimmon	5.583	3.676	.415	-3.69	14.86
	2005 Titanium	-26.833*	3.676	.000	-36.11	-17.56
2005 Titanium	1965 Persimmon	32.417*	3.676	.000	23.14	41.69
	1985 Steel	26.833*	3.676	.000	17.56	36.11

*. The mean difference is significant at the .05 level.

- a. Looking at the side-by-side boxplot and the means plot, describe the comparison of distance of the three driver types.

- b. For this analysis, was it reasonable to pool the standard deviations (variances) and why? Show your work.

- c. What is the pooled standard deviation?

- d. What is R^2 ?

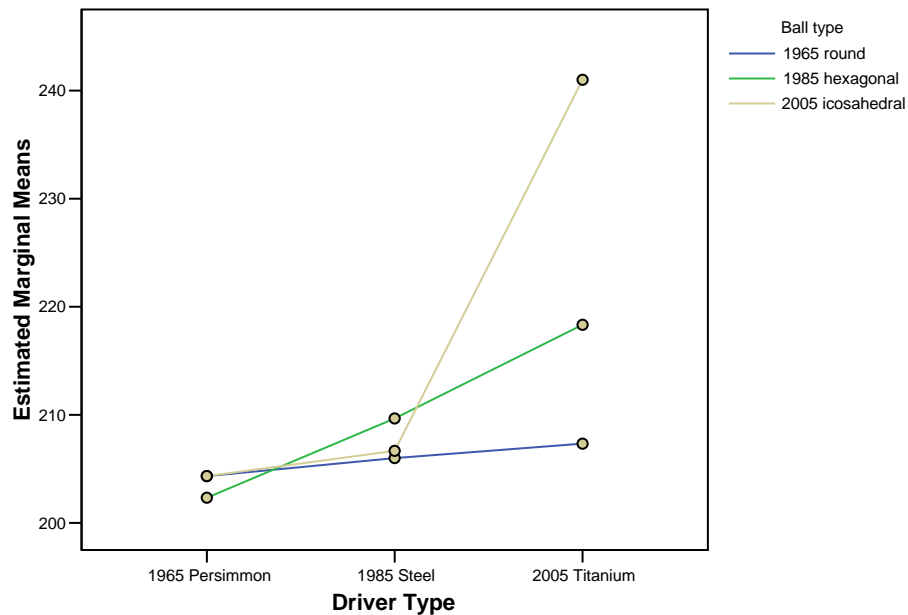
- e. The golfer is interested in comparing the mean distance among the three types of drivers. State the null and alternative hypotheses, state the test statistic, the P-value, and your conclusion in terms of the problem.

- f. Does your conclusion to part c tell the golfer everything he needs to know? If so, explain why. If not, give the golfer additional information about the three types of drivers and state where you found your information.

22. In addition to studying the effect of the driver type, the golfer wants to study the effect of the golf ball type on distance. Three types of balls were used and they are: (1) a wound ball with round dimples, circa 1965; (2) a wound ball with hexagonal dimples, circa 1985; and (3) a solid ball with icosahedra dimple pattern, circa 2005. This golfer hits three drives with each of the different balls and with each of the different drivers. Again, his assistant measures and records the total distance for each drive; the data and SPSS results are as follows:

Ball	Driver		
	1	2	3
1	208	211	210
	200	209	211
	205	198	201
2	206	203	215
	201	217	222
	200	209	218
3	199	215	247
	210	206	239
	204	199	237

Estimated Marginal Means of Distance



- a. Based on the graph on the previous page, what affects distance? The driver type? The ball type? The interaction between ball and driver? Why?

ANOVA output:

Tests of Between-Subjects Effects

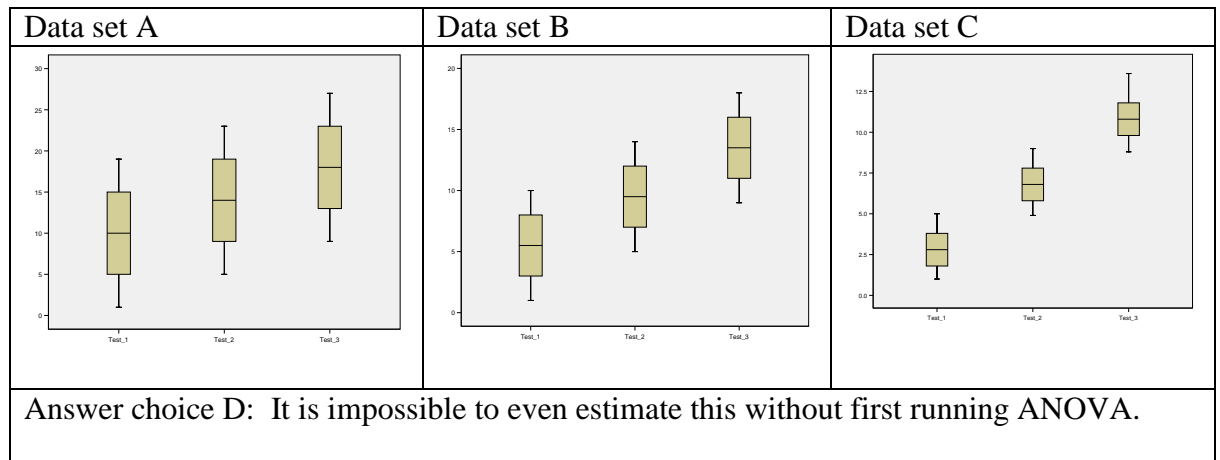
Dependent Variable: Distance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3530.000 ^a	8	441.250	13.678	.000
Intercept	1203333.333	1	1203333.333	37301.952	.000
driver	1730.889	2	865.444	26.828	.000
ball	602.889	2	301.444	9.344	.002
driver * ball	1196.222	4	299.056	9.270	.000
Error	580.667	18	32.259		
Total	1207444.000	27			
Corrected Total	4110.667	26			

a. R Squared = .859 (Adjusted R Squared = .796)

- b. Based on the ANOVA output, summarize your conclusions in terms of the problem.

23. Three data sets are represented below using side-by-side Boxplots. If we ran the one-way ANOVA on the three data sets, which data set would produce the highest F-statistic?



The math department wanted to test the effectiveness of three teaching methods in preparing students for the final exam in calculus. The instructor randomly assigned students to each of the teaching methods. Answer questions 25-29 based on the output bellow.

Descriptives

Test_scores

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	10	77.70	12.175	3.850	68.99	86.41	50	94
2	10	85.80	7.969	2.520	80.10	91.50	77	98
3	10	69.30	10.667	3.373	61.67	76.93	55	85
Total	30	77.60	12.164	2.221	73.06	82.14	50	98

ANOVA

Test_scores

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1361.400	2	680.700	6.273	.006
Within Groups	2929.800	27	108.511		
Total	4291.200	29			

Multiple Comparisons

Dependent Variable: Test_scores

Bonferroni

(I) Teaching_method	(J) Teaching_method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-8.100	4.659	.280	-19.99	3.79
	3	8.400	4.659	.248	-3.49	20.29
2	1	8.100	4.659	.280	-3.79	19.99
	3	16.500*	4.659	.004	4.61	28.39
3	1	-8.400	4.659	.248	-20.29	3.49
	2	-16.500*	4.659	.004	-28.39	-4.61

*. The mean difference is significant at the .05 level.

24. Which statement below is correct?
- One-way ANOVA is appropriate because two times the smallest standard deviation is no larger than the largest standard deviation.
 - One-way ANOVA is appropriate because two times smallest standard deviation is larger than the largest standard deviation.
 - One-way ANOVA is not appropriate because two times the smallest standard deviation is no larger than the largest standard deviation.
 - One-way ANOVA is not appropriate because two times smallest standard deviation is larger than the largest standard deviation.
 - The appropriateness of the ANOVA has nothing to do with the standard deviations.
25. Based on the ANOVA printout at the 5% level of significance,
- we reject H_0 , and conclude that there is enough evidence to show that the mean test scores from the three teaching methods are all the same.
 - we reject H_0 , and conclude that there is not enough evidence to show that the mean test scores from the three teaching methods are all the same.
 - we fail to reject H_0 , and conclude that there is not enough evidence to show that the mean test score from the three teaching methods are all the same.
 - we reject H_0 , and conclude that there is enough evidence to show that the mean test scores from the three teaching methods are not all the same.
 - we reject H_0 , and conclude that there is not enough evidence to show that the mean test scores from the three teaching methods are not all the same.
 - we reject H_0 , and conclude that there is not enough evidence to show that the mean test scores from the three teaching methods are all different.
26. What is the estimate of the pooled standard deviation?
- 2.505
 - 6.273
 - 108.511
 - 10.417
 - cannot be determined

27. Which of the following is true?

- Bonferroni's procedure is appropriate for this problem and shows us that teaching method 3 yields significantly different test results than methods 1 and 2, however there is no significant difference between the other methods.
- Bonferroni's procedure is appropriate for this problem and shows us that teaching method 3 yields significantly different test results than method 2, however there are no other significant differences.
- Bonferroni's procedure is appropriate for this problem and shows that method 3 is the best and method 2 is the worst.
- Bonferroni's procedure is not appropriate.

The output below shows the effect that color and aroma have on the number of insects trapped on sticky boards. Two colors are tested (yellow=0 and white=1) and two scents (no scent=0 or a scent=1).

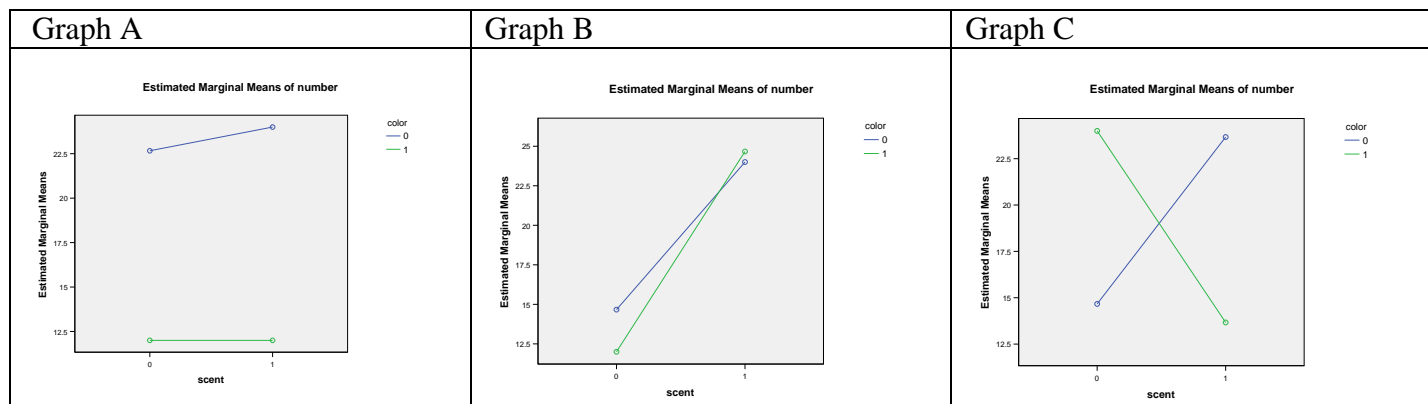
Tests of Between-Subjects Effects

Dependent Variable: number

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	388.000 ^a	3	129.333	62.080	.000
Intercept	3745.333	1	3745.333	1797.760	.000
scent	1.333	1	1.333	.640	.447
color	385.333	1	385.333	184.960	.000
scent * color	1.333	1	1.333	.640	.447
Error	16.667	8	2.083		
Total	4150.000	12			
Corrected Total	404.667	11			

a. R Squared = .959 (Adjusted R Squared = .943)

28. Choose the graph that best illustrates the output above.



29. Based on the ANOVA output, which of the conclusions below is correct.
- Both the main effects for scent and color are significant, but their interaction is not.
 - The main effects for scent and color and their interaction are all significant.
 - Only the main effect of scent is significant.
 - Only the main effect of color is significant.
 - Nothing is significant.
30. A researcher wished to compare the effect of different rates of stepping on heart rate in a step-aerobics workout. A collection of 30 adult volunteers — 15 women and 15 men — were selected from a local gym. The men were randomly divided into three groups of five subjects each. Each group did a standard step-aerobics workout with group 1 at a low rate of stepping, group 2 at a medium rate of stepping, and group 3 at a rapid rate. The women were also randomly divided into three groups of five subjects each. As with the men, each group did a standard step-aerobics workout with group 1 at a low rate of stepping, group 2 at a medium rate of stepping, and group 3 at a rapid rate. The mean heart rate at the end of the workout for all subjects was determined in beats per minute.
- What are the factors in this experiment?
 - Rate of stepping and heart rate.
 - Rate of stepping and gender.
 - Heart rate and gender.
 - Gym membership and gender.
 - What are the advantages of studying the two factors simultaneously in the same experiment?
 - It is more efficient to study two factors simultaneously rather than separately.
 - We can reduce the residual variation in a model by including a second factor thought to influence the response.
 - We can investigate interaction between factors.
 - All of the above.
 - The means plot and the P -value for the test for interaction show little evidence of interaction. What can we conclude?
 - There is little difference in the heart rates of men and women.
 - The change in heart rate due to different stepping rates is similar for men and women.
 - Changes in stepping rate are positively associated with heart rate.
 - Step exercise is equally beneficial to men and women.

Use the following output to answer questions 32 through 38:

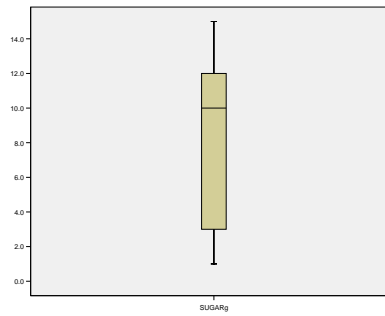
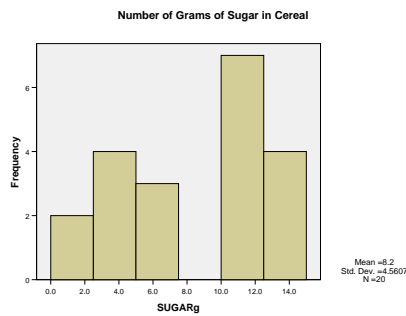
Sugar intake needs to be minimized during pregnancy for women who are diagnosed with gestational diabetes. Does this mean they should avoid breakfast cereals which can be high in sugar. A study on sugar content of breakfast cereal was conducted. A simple random sample of breakfast cereals was taken and the one sample t -test was applied to the data. Answer questions 31 through 37 based on the output below.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
SUGARg	20	8.200	4.5607	1.0198

One-Sample Test

	Test Value = 5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
SUGARg	3.138	19	.005	3.2000	1.066	5.334



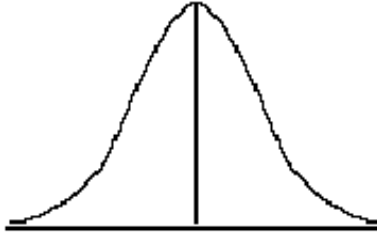
31. Which of the statements below is correct?

- It is appropriate to use the one sample t -procedure because a stratified random sample was selected.
- It is not appropriate to use the one sample t -procedure because based on the bar graph the IQR is too large.
- It is appropriate to use the one sample t -procedure because the sample size is 20 and there is no strong skewness or outliers.
- The one sample t -procedure is not appropriate because the sample size is not at least 40.

32. If you wanted to determine if the average sugar content of breakfast cereal differs from 5g your P -value would be:

a. 3.2	b. 3.138	c. 0.005
d. 0.0025	e. 0.9975	

33. For the hypothesis test in #32, graph and label the test statistic, the P -value, and μ_0 on the curve below.



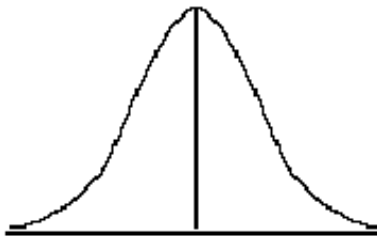
34. If you wanted to determine if the average sugar content of breakfast cereal is greater than 5g, your P -value would be:

a. 3.2	b. 3.138	c. 0.005
d. 0.0025	e. 0.9975	

35. If you wanted to determine if the average sugar content of breakfast cereal is less than 5g, your P -value would be:

a. 3.2	b. 3.138	c. 0.005
d. 0.0025	e. 0.9975	

36. For the hypothesis test in #35, graph and label the test statistic, the P -value, and μ_0 on the curve below.



37. A 95% confidence interval for the average sugar content of cereal is

- a. (1.066, 5.334)
- b. (6.066, 10.334)
- c. (9.266, 13.534)
- d. (4.204, 8.472)
- e. None of the above.

Select the correct type of test from the choices below. In the margin, write a brief explanation of why you picked that type of test. (For example, “3 independent groups with 1 quantitative variable.”)

- | | |
|----------------------------|--|
| A. One sample z -test | B. One sample t -test |
| C. Matched pairs t -test | D. Two-sample comparison of means t test |
| E. One-way ANOVA | F. Two-way ANOVA |

- 38.** An educator believes that new directed reading activities in the classroom will help elementary school pupils improve some aspects of their reading ability. She arranges for a third grade class of 21 students to take part in these activities for an 8-week period. A control classroom of 23 pupils follows the curriculum without the activities. At the end of 8 weeks, all students are given a degree of reading power test.
- 39.** An educator believes that new directed reading activities in the classroom will help elementary school pupils improve some aspects of their reading ability. She tests a group of 21 students before they take part in the activities and after they take part in the activities. She then compares the two scores.
- 40.** An agronomist wants to determine whether the average cellulose content of a variety of alfalfa is above 140 mg/g. The sample mean is 136.4 mg/g, and the population standard deviation is 5 mg/g.
- 41.** An agronomist wants to determine whether the average cellulose content of a variety of alfalfa is above 140 mg/g. The sample mean is 136.4 mg/g, and the sample standard deviation is 5 mg/g.
- 42.** Is there a difference in the population average weight of babies born to women of different races (white, African American, Hispanic, etc)?
- 43.** How do race, weight gain of the pregnant woman (less than average, average, more than average), and the interaction of race and weight gain of the woman affect the weight of the woman’s baby?