STA 3024 **EXAM 1 Practice Problems**

NOTE: These are just Practice Problems. This is NOT meant to look just like the test, and it is NOT the only thing that you should study. Make sure you know all the material from the notes, quizzes, suggested homework and the corresponding chapters in the book.

Questions 1 – 5 A poker craze swept the nation a few years ago, and some experts are concerned that it will lead to an increase in gambling addictions, particularly for adolescents. Each of the five situations presented below describes an inference that we would like to make about a **different** parameter. Match each of the five situations below with the parameter of interest from the list:

a) one mean
b) one proportion
c) difference of two independent means
d) difference of two independent proportions
e) mean of matched paired differences

B 1. A survey finds that 70% of children aged 12 to 17 have gambled in the past year.

A 2. Although most children start playing just for fun, the average age at which they start gambling for money is around 11 years old.

D 3. Among 8th graders, 42% of boys and 19% of girls gambled last year.

E 4. Although some people claim that poker playing helps children with their math skills, a study found no increase in the average students' math grades from before they started playing.

C 5. Studies have found that boys bet higher amounts of money than girls, on average.

6. An experiment was run to compare 8 groups. There were 10 observations in each group. How many degrees of freedom for error will there be?

a) 2 b) 9 c) 73 d) 72 e) 76

groups: #groups − 1 $8-1=7$
error: total − group $79-7=72$
total: total obs − 1 79
$10 \text{ obs} \times 8 \text{ groups} = 80$

7. Find the value of the test statistic:

a) 1.34
b) 45.92
c) 30.24
d) 1.52
e) 0.66

Source	df	SS	MS	F
Groups	5	229.6	45.92	1.52
Error	15	453.6	30.24	
Total	20	683.2		

$SS_g = SS_t - SS_e$

$MS = \frac{SS}{df}$

$F = \frac{MSG}{MSE}$

8. Use the F table provided to find the approximate p-value if df numerator= 3, df denominator=5, and F= 14.72. Our conclusions would be:

a) reject Ho at 0.10
b) reject Ho at 0.05
c) reject Ho at 0.025
d) reject Ho at 0.01
e) reject Ho at 0.001

table value = $9.01 < 14.72$

$p < 0.05$

9. Which of the following statements is true concerning the Mean Square Error:
   a) It is an estimate of the pooled variance for all the treatments.
   b) It can also be expressed as s_p.
   c) It represents the variability between the treatments.
   d) All of the above.
   e) None of the above.

$S_p = \sqrt{MSE}$ ← SSE

10. When there are no significant differences in treatment means in ANOVA, we see:
   a) the variability within treatments is a lot smaller than the variability between
   b) the Sums of Squares for Error are very large
   c) the F test statistic is close to 1
   d) the p-value is very small ← when sig. diff.
   e) all of the above

we want larger

H_0 wants small F values

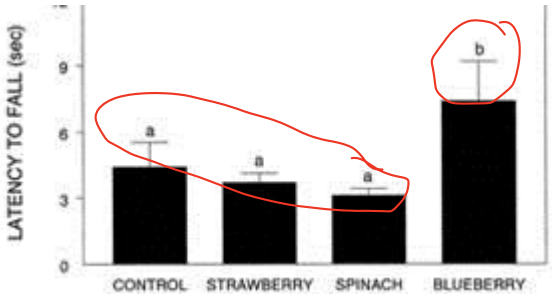
11. What does the null hypothesis of the ANOVA test say?
   a) That the sample means for all treatments in the study are equal.
   b) That the population means for all treatments in the study are equal.
   c) That the sample means for all treatments in the study are different.
   d) That the population means for all treatments in the study are different.
   e) That the population mean for at least one of the treatments in the study is different from at least one other one.

$\mu_1 = \mu_2 = \mu_3 = \ldots = \mu_n$

12. Below you will find a summary of the results of an experiment that fed rats different dietary supplements and measured their time to fall from a rotating rod. Choose the best interpretation.

   a) All treatment means are significantly different, with blueberry best, then control, then strawberry, then spinach.
   b) Blueberry is significantly better than all the rest.
   c) Blueberry is significantly better, then strawberry and spinach (not significantly different from each other), and then control.
   d) Blueberry is significantly better, then control, and finally strawberry and spinach, which are not significantly different from each other.

5 groups
- strawb spin
- control
- blueberry
3 groups



13. When making all pairwise comparisons in a study with equal sample sizes in all the four treatments, the margin of error was determined to be 7.00. Which of the following could be the summary of the results?

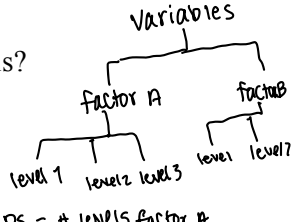
a)		b)		c)		d)	
121.5	A	121.5		121.5		121.5	
124.9	A	124.9		124.9		124.9	
128.4	B	128.4		128.4		128.4	
159.6	C	159.6		159.6		159.6	

X $159.6 - 128.4 = 31.2$ (4, 3)
✓ $128.4 - 124.9 = 3.5$ (3, 2)
✓ $128.4 - 124.5 = 6.9$ (3, 1)

14. Without replications we are unable to find:
   a) standard deviations for the groups ✓
   b) pooled standard deviation ✓
   c) MSE ✓
   d) F test statistic ✓
   e) all of the above

15. In ANOVA, which of the following would result in a more complicated statistical analysis?
   a) adding 500 more observations
   b) adding 25 more levels of a factor
   c) adding one more factor
   d) adding 10 more replications

add to existing factors/levels



groups = # levels factor A × # levels factor B

Questions 16 - 22 Cereal leaf beetles can be very harmful to the cultivation of oats in the fields. Researchers studied the effectiveness of traps constructed with bright, colorful boards, to attract the beetles. The boards were covered with sticky material, so once the beetles landed on them, they were trapped. To investigate which colors are most attractive to the beetles, six boards of each of four colors were randomly placed on oats fields. The number of insects stuck to each board was counted and summarized below.

Color	N	Mean	StDev
Blue	6	14.833	5.345
Green	6	31.500	9.915
Yellow	6	47.167	6.795
White	6	15.667	3.327

16. The p-value of the ANOVA F test, according to Minitab, was 0.000. We can conclude that there are significant differences in the average number of insects trapped on boards:
   a) for all the colors that were used in this study.
   b) for all the colors that could have been used in this study.
   c) for some of the colors that were used in this study.
   d) for some of the colors that could have been used in this study.

17. To compare all pairs of means in this study, we would need to make six different confidence intervals. If each individual confidence interval were made at the 95% confidence level, how much confidence would we have in the family of intervals?
   a) 95% b) 94% c) 70% d) 89% e) 65%

18. If we made all six pairwise confidence intervals with the Bonferroni procedure, using a family confidence of 94%, the value from the t table to use is:
   a) 2.845 b) 3.708 c) 4.032 d) 5.841

19. Which of the following methods of multiple comparisons has the worst Family Confidence?
   a) Tukey b) Fisher c) Bonferroni
   d) all of the above e) none of the above

20. Which of the following is a valid reason to use the pooled standard deviation in multiple comparisons?
   a) it's the best estimator of the variability within groups
   b) ANOVA assumes equal variances for each group
   c) the degrees of freedom associated with s_p are higher than those for each s_i
   d) all of the above
   e) none of the above

21. The 95% CI to compare the effectiveness of the yellow board to the blue board is (16.92, 31.08). We can conclude then, that:
   a) the white, yellow, green and blue boards are all significantly different in their effectiveness
   b) the yellow board is significantly more effective than the blue
   c) the blue board is significantly more effective than the yellow
   d) there is no significant difference in the effectiveness of yellow and blue boards

22. Are there any problems with the assumptions of this test?
   a) Yes – the insects do not seem randomly drawn to all the colors, so there is a bias.
   b) Yes – we suspect the population standard deviations are not equal.
   c) Yes – both the randomness and equal variance assumptions seem to be violated.
   d) No – we can't say there are any problems with the assumptions.

2 factors
- alcohol
- sleep

Questions 23 – 28 How do alcohol and sleep deprivation influence reaction time while driving? Subjects were randomly assigned to drink a beverage containing either no alcohol or 1oz. of alcohol, and to conditions of either regular sleep or 24 hours of sleep deprivation. Each group had the same number of subjects. Using a driving simulation, they recorded each subject's time (in milliseconds) to apply the car's brakes after the sudden appearance of an unexpected object. The average breaking time for each group, and the ANOVA table appear below.

	Sleep Deprivation	
Alcohol	none	24 hrs
0oz	0.68	0.81
1oz	0.77	1.35

Source	df	SS	MS	F	p
Alcohol	1	0.729	0.729	29.10	0.000
Sleepdepriv	1	0.529	0.529	21.11	0.000
* Interaction	1	0.196	0.196	7.82	0.008
Error	36	0.902	0.025		
Total	39	2.356			

$T = N - 1$ $\quad T = 3a = N - 1 \rightarrow N = 40$

23. What are the treatments in this study?
   a) 0oz alcohol, 1oz alcohol, no sleep deprivation, 24 hours sleep deprivation
   b) 0.68, 0.77, 0.81, 1.35
   c) alcohol consumption, sleep deprivation
   d) alcohol, sleep deprivation, interaction, error
   e) 0oz alcohol/no deprivation, 1oz alcohol/no deprivation, 0oz alcohol/24 hr deprivation, 1oz alcohol/24 hr deprivation,

4 groups

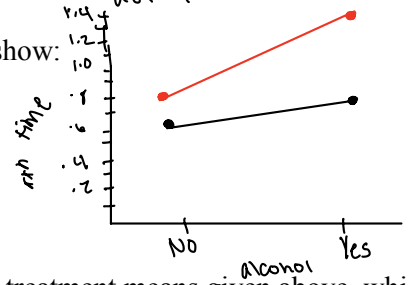
$\frac{40 \text{ obs}}{4 \text{ groups}} = 10 \text{ obs/group}$

24. How many replications are there in this study?
   a) 40 b) 9 c) 10 d) 36 e) 4

25. What is the response variable in this study? what is recorded
   a) alcohol consumption b) sleep deprivation
   c) reaction time d) milliseconds

26. What type of study is this?
   a) experiment b) observational study ← don't manipulate anything
   c) simulation d) survey ← ask questions

27. A plot of the group means above will show:
   a) lines that cross each other
   b) parallel lines
   c) non-parallel lines
   d) symmetric lines
   e) perpendicular lines



no sleep dep
24 hr sleep dep

parallel vs non-parallel
↓
do they cross?

28. Based on to the ANOVA table and the treatment means given above, which of the following is the best interpretation of the results?
   a) Both alcohol and sleep deprivation impair reaction time significantly.
   b) Alcohol and sleep deprivation impair reaction time, but not significantly.
   c) Both alcohol and sleep deprivation impair reaction time significantly, and their effects interact, creating an even greater impairment when combined.
   d) Alcohol and sleep deprivation impair reaction time, but their effects counteract each other, by lessening the impairment when combined.
   e) Neither alcohol, nor sleep deprivation, nor interaction, have a significant effect on reaction time.

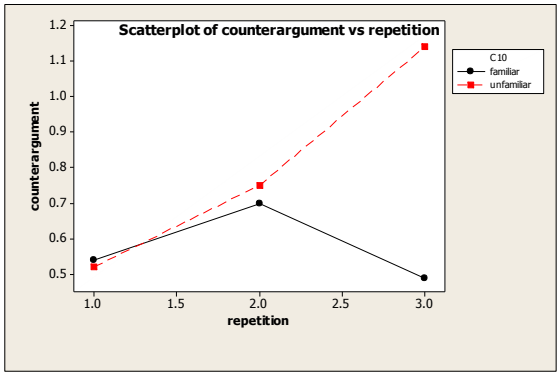
29. The error line on the ANOVA table represents:
   a) the possibility that the person making measurements made a mistake.
   b) the variability due to non-random error .
   c) all possible sources of variation that were not measured in the study.
   d) conscious efforts from the subjects to deviate from the means of their group.

30. ANOVA is a statistical procedure used to compare the _____ of different groups.
   a) means b) variances c) sample sizes d) standard deviations

31. In a study with 7 treatments, how many different pairwise comparisons would there be?
   a) 7 b) 6 c) 21 d) 42

comp = $\frac{g(g-1)}{2} = \frac{7(6)}{2} = \frac{42}{2} = 21$

32. Does repetition of an advertising message increase its effectiveness? And is there a difference depending on whether the brand is familiar or unfamiliar? The following plot represents the average "counterargument score" that measures negative attitudes towards ads of familiar and unfamiliar brands, where the ads were repeated at three levels: 1=low, 2=medium and 3=high. What is the best interpretation of this graph? Counterarguments are higher:



   a) for unfamiliar brands.
   b) for more often repeated ads.
   c) for different repetition levels, depending on whether the brand is familiar or not.
   d) all of the above.
   e) none of the above.

33 Find the value of the test statistic:
   a) 49.4
   b) 3866.7
   c) 2.32
   d) 114.5
   e) 129.1

Source	df	SS	MS	F
Groups	3	115973	38657.7	2.32
Error	16	266496	16656	
Total	19	382469		

$MS = \frac{SS}{df} \rightarrow SSE = MSE \times df_{error}$

$F = \frac{MSG}{MSE}$

34. The degrees of freedom for error in **any** ANOVA model are always:
   a) N-g b) N-1 c) df Total – df Treatments
   d) both a and c are correct e) both b and c are correct

df total

35. We are comparing three treatments, with four randomly assigned subjects to each group. The ANOVA table reports a p-value of 0.481. Which of the following statements is true?
   a) All of the treatment means are equal to zero.
   b) None of the treatment means are significantly different from zero.
   c) All of the treatment means are equal to each other.
   d) None of the treatment means are significantly different from each other.
   e) Some of the treatment means are significantly different.

large p-val = no sig. diff.

$\mu_1 = \mu_2 = \mu_3$

Questions 36 – 40 A survey asked a random sample of students questions related to their involvement in the upcoming presidential election. Each of the five situations presented below describes an inference that we would like to make about a **different** parameter. Match each of the five situations below with the parameter of interest from the list:

a) one mean
b) one proportion
c) difference of two independent means
d) difference of two independent proportions
e) mean of paired differences

B 36. Are the majority of students registered to vote? We discover that 83 out of 150 students in the sample are registered to vote.

E 37. Are students paying more attention to politics as elections draw nearer? For each student in the sample, measure the number of hours spent getting informed about the political issues relevant to the upcoming presidential election during the months of August and September.

C 38. Are older students more likely to vote? Compare the average intent to vote, (measured on a scale of 1=not a chance to 10=absolute certainty) for upperclassmen (Juniors and Seniors) and underclassmen (Freshmen and Sophomores).

D 39. Is there a gender difference in party affiliation? We note that 24 out of 75 men and 32 out of 75 women in our sample are registered as independents.

A 40. How often do students change their address? We find that, on average, students live at 2.7 different addresses while pursuing a college degree.

41. Suppose the ANOVA F test statistic is 1.06. The table reports that, for the appropriate df, the F value with Right-Tail Probability=0.05 is 2.99. Then we can say that:

a) The p-value is less than 0.05.
b) The p-value is greater than 0.05.
c) The p-value is less than 2.99.
d) The p-value is less than 1.06.
e) The test statistic is greater than 2.99.

2.99 > 1.06 ↑ our value ↑ from table ↓ NO sig. diff ↓ fail to rej. H_0

42. An experiment is run to compare 10 groups. There were 6 observations per group. Find the degrees of freedom for Error.

a) 4 b) 9 c) 5 d) 54 e) 50

$df_g: 10-1=9$
$df_E: 59-9=50$
$df_T: 10\times6-1=59$

43. In One-Way ANOVA, we estimate the variances Between the groups and Within the groups with _____ and _____ respectively.

a) MSG and MSE
b) MSE and MSG
c) SSG and SSE
d) SSE and SSG
e) F and p-value

MS ↓ MSG ↓ error

Questions 44 – 48 Cheating has become one of the major problems in education today. In spite of knowing that cheating is wrong, most students report that they have cheated at some time during their high school or college careers. Each of the five situations below describes an inference that we would like to make about a **different** parameter. Match each of the five situations below with the parameter of interest from the list.

a) one mean
b) one proportion
c) difference of two independent means
d) difference of two independent proportions
e) mean of matched paired differences

A 44. To find out if only students who are struggling in school engage in this type of behavior, we want to find out the average GPA of high school students who cheat.

B 45. Some analysts of this problem estimate that fifty percent of college students may engage in such behavior

D 46. A study of graduate students in the US and Canada found that 56% of graduate business students admitted to cheating in the past year, with many saying they cheated because they believed it was an accepted practice in business. In contrast, 39% of social science and humanities students admitted to cheating.

E 47. Some professors become suspicious if students' scores increase 15 percentage points or more from one exam to the next since the average increase is around 7 points.

C 48. Some researchers believe these behaviors need to be addressed as early as elementary school, and are interested in comparing the average age at which boys and girls start cheating.

49. The ANOVA F test statistic:
a) is used to draw inferences about population means.
b) measures how many times bigger is the variability between the groups than the variability within the groups.
c) cannot be computed if there is only one observation per treatment.
d) all of the above
e) none of the above

50. In a Two-Way ANOVA table, the variability due to treatment groups is broken down into:
a) Group, Error, Total
b) Factor A, Factor B, Factor C
c) Factor A, Factor B, Interaction
d) Factor A, Factor B, Error

51. One-Way ANOVA is an extension of significant tests for:
a) one mean
b) one proportion
c) difference of two independent means
d) difference of two independent proportions
e) mean of matched paired differences

Questions 2 – 68 Airplane ticket prices can vary considerably depending on the airline, flight date, time, and departing city. In particular, we believe small cities like Gainesville tend to have higher prices. The following is a partial computer output for comparing prices of flights to New York City around Christmas time, departing from four different airports within two hours of Gainesville.

Source	DF	SS	MS	F	P
Factor	3	345917	115306	15.67	0.000
Error	28	206097	7360.6		
Total	31	552014			

V. small

Level	N	Mean	StDev
Orlando	8	283.38	89.79
Gainesville	8	534.25	89.18
Tampa	8	277.38	54.82
Jacksonville	8	346.63	102.08

52. This problem is an example of:
a) an experiment b) an observational study c) a factorial design d) a random design

53. The response variable in this study is:
a) airports b) flights c) prices d) Gainesville e) Christmas

54. How many factors are used in this study?
a) 1 b) 32 c) 4 d) 8 e) 3

55. How many replications are used in this study?
a) 1 b) 32 c) 4 d) 8 e) 3

56. The hypotheses being tested here are:
a) Ho: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu_6=\mu_7=\mu_8$ vs Ha: not all flight means are equal
b) Ho: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4\neq\mu_5\neq\mu_6\neq\mu_7\neq\mu_8$ vs Ha: all flight means are equal
c) Ho: $\mu_1=\mu_2=\mu_3=\mu_4$ vs Ha: not all airport means are equal
d) Ho: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4$ vs Ha: all airport means are equal

$df_1 = df_g$ = numerator (3)
$df_2 = df_e$ = denominator (28)

57. To find the p-value on the F table we need to use:
a) df=31 b) df=8 c) $df_1=3$ $df_2=28$ d) $df_1=3$ $df_2=31$ e) $df_1=3$ $df_2=28$ $df_3=31$

58. We can conclude from the ANOVA test that for these four cities, the flights to New York City around Christmas time,
a) do not differ significantly in their average prices.
b) all differ significantly in their average prices.
c) all differ significantly in the variance of their prices.
d) are not all the same in their average prices.
e) are not all the same in the variance of their prices.

59. Which of the following would be appropriate to do, as a follow up to ANOVA?
a) Use Bonferroni to make individual CIs for the average price from each city.
b) See if the Tukey intervals overlap each other to determine significant differences.
c) Order the means and connect with lines those that are significantly different.
d) All of the above.
e) None of the above.

want compare btwn cities

already know; want CIs for diff. of 2 groups

create groups

(not sig. diff

60. When making all pairwise comparisons for this problem, using the Bonferroni procedure with confidence level of 94% for **EACH** interval, what would be the family confidence level?
a) 98% b) 99% c) 94% d) 95% e) 64%

$\#\text{ comp} = \frac{4(3)}{2} = 6$

$100\% - 94\% = 6\%$ per comp.

$6 \times 6\% = 36\%$

$100 - 36\% = 64\%$

61. When making all pairwise comparisons for this problem, using the Bonferroni procedure with 94% **FAMILY** confidence, what confidence level should we use for each interval?
a) 98% b) 99% c) 94% d) 95% e) 64%

$100\% - 94\% = 6\%$ off

$\frac{6\%}{6 \text{ groups}} = 1\%$ loss per group

$100\% - 1\% = 99\%$

62. When making all pairwise comparisons for this problem, using the Bonferroni procedure with 94% family confidence, how many degrees of freedom should we use for each interval?

a) 7 b) 8 c) 3 d) 28 e) 31

df error

63. The pooled standard deviation is:

a) 85.79 b) 7050.54 c) 7360.6 d) 360.41 e) 83.96

$\sqrt{MSE} = \sqrt{7360.6}$

64. When making all pairwise comparisons with 94% family confidence, the margin of error was determined to be 118.46. Which of the following is the best summary of the results?

TOS = group
G = alone

a)
T	277.38
O	283.38
J	346.63
G	534.25

b)
T	277.38
O	283.38
J	346.63
G	534.25

c)
T	277.38
O	283.38
J	346.63
G	534.25

d)
T	277.38
O	283.38
J	346.63
G	534.25

G-J = 187.62 X
J-O = 63.25 ✓
J-T = 69.25 ✓
O-T = 6 ✓

65. When making all pairwise comparisons with 94% family confidence, the margin of error was determined to be 118.46. Which of the following intervals will NOT include zero? The one comparing:

a) Tampa to Orlando
b) Tampa to Jacksonville
c) Tampa to Gainesville
d) Orlando to Jacksonville

66. Are there any problems with the assumptions necessary for the ANOVA test?

a) We can't see any problems with the assumptions.
b) Airports do not seem to be randomly selected.
c) The standard deviations are too unequal.
d) Gainesville appears to be an outlier. — for 1 point
e) All three assumptions seem violated.

$3 \times 54.82 \geq 102.08$
$164.46 \geq 102.08$ ✓ equal var

67. If we studied prices of flights to New York City, departing from these four airports, but considered different times of the year (in addition to Christmas, also Thanksgiving and Labor Day weekends), then we would be adding to the study:

another type of variable = factor

a) one more level of an existing factor
b) two more levels of an existing factor
c) one more factor with three levels now
d) two more factors with one level each

68. If we studied prices of flights to New York City only around Christmas time, but looked at flights departing from six different airports within several hours of Gainesville (adding Daytona Beach and Orlando-Sanford International airports) then we would be adding to the study:

a) one more level of an existing factor
b) two more levels of an existing factor
c) one more factor with three levels now
d) two more factors with one level each