$\boxed{\text{Solutions}}$

Final - STAT 301
Fall 2013

Name:

UIN:

Signature:

Version A:

1. Do not open this test until told to do so.
2. This is a closed book examination, However you may use two single-sided sheet of formulas that you have brought with you and the tables. You should have no other printed or written material with you on the exam. But scrap paper is allowed.
3. You have 2 hours to work on this exam. There are 25 multiple choice questions.
4. On the scantron please state the version of exam that you have.
5. You may use a calculator in the exam.
6. If there is no correct answer or if multiple answers are correct, select the **best** answer.
7. If you are unsure of what a question is asking for, do not hesitate to ask the instructor or course assistant for clarification.
8. Please only give one answer per question (the one that is closest to the solution).
9. No wearing hats that can cover ones eyes.
10. Good Luck!!!

(1-5) Many high school students take ACT exams. A student can get a grade from 0 to 36 (but only integer values, ie. 0, 1, 2,..., 36). This year the national mean score of an ACT test is 21 with standard deviation 4.8.

(1) Assume that the distribution of grades is close to normal. Calculate the probability that a student scores 23 or greater in the exam.

(A) 37.5% (B) 26.6% (C) 62.5% (D) 73.4% (E) 0.13%

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(2) Using the information given about the grading scheme, explain why using the normal approximation to calculate the probability means it won't be very accurate.

(A) The sample size of 36 is not large enough.

(B) The distribution is skewed since the mean is 21 and the median is 16.

(C) The grade is a categorical variable.

(D) The grade is a numerical discrete variable.

(E) (B) and (C).

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(3) A high school teacher teaches a class of <u>20</u> students.

What is the standard error for the sample mean of the average score in this class?

(A) $1.07 = 4.8/\sqrt{20}$ (B) $0.24 = 4.8/20$ (C) 4.8.

(D) $21.5 = 4.8 \times \sqrt{20}$ (E) $96 = 4.8 \times 20$.

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(4) Calculate the probability that the average grade in this class will be 23 or greater.

(A) 0.25% (B) 1.86% (C) 98.4% (D) 96.9% (E) 3.1%

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(5) A high school teacher is using the recently introduced Flipping method to teach his class. He believes this method may have lead to an <u>improvement</u> in the mean ACT grade compared with the national mean of 21. The average (sample mean) ACT grade in his class of 20 was 23 ($\bar{x} = 23$).

State the null and alternative of interest and do the test at the 5% level).

(A) $H_0 : \mu = 23$ against $H_A : \mu > 23$. The p-value is less than 5% so there is evidence to suggest that the mean grade is better than the national mean.

(B) $H_0 : \mu = 21$ against $H_A : \mu > 21$. The p-value is greater than 5% so there is no evidence to suggest that the mean grade is better than the national mean.

(C) $H_0 : \mu = 21$ against $H_A : \mu \neq 21$. The p-value is less than 5% so there is evidence to suggest that the mean grade is different to the national mean.

(A) $H_0 : \mu = 23$ against $H_A : \mu < 23$. The p-value is greater than 5% so there is evidence to suggest that the mean grade is better than the national mean.

(E) $H_0 : \mu = 21$ against $H_A : \mu > 21$. The p-value is less than 5% so there is evidence to suggest that the mean grade is better than the national mean.

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(6) STAIRS A student society is staging a campaign for people to use the stairwell in Blocker. Before the campaign they randomly sample 300 people in Blocker and find that 30% of them used the stairwell. After a concerted campaign to use the Stairwell (with many posters) they interview another 250 people and find that 40% of this sample use the stairwell. The society wants to test whether this different is statistically significant. Name the TWO tests that they can use.

(A) The test for two sample proportions and the independent sample t-test.

(B) The test for two sample proportions and the independent chi-squared test. 1

(C) The independent sample t-test and the one-sample t-test.

(D) The one sample test for proportions and the independent sample t-test.

(E) The independent sample t-test and the ANOVA (covered in the last class).

(7-8) STAIRS Let us return to the student society health campaign to use the stairwell. The society wants to see whether the campaign has <u>increased</u> the frequency of stairwell use.

They random interview 20 people before the campaign and then 22 people after the campaign. Before the campaign the average number of times a person used the stairs was 2.5 after the campaign the average number of times a person used the stairs was 4. The data is summarised below. Let μ_1 denote the mean after the campaign and μ_2 denote the mean before the campaign.

95% confidence interval results:

μ_1 : mean of population 1

μ_2 : mean of population 2

$\mu_1 - \mu_2$: mean difference

(without pooled variances)

Difference	Sample Mean	Std. Err.	DF	L. Limit	U. Limit
$\mu_1 - \mu_2$	1.5	0.33978602	39.719982	0.81311595	2.18688[illegible]

(7) State the null and alternative of interest and do the test at the 5% level?

(A) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 > 0$, since the p-value is less than 2.5%, there is evidence to suggest that the campaign worked. 1

(B) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 > 0$, since the p-value is greater than 5%, the difference of 1.5 can be explained by random chance and there isn't enough evidence to suggest the campaign worked.

(C) $H_0 : \mu_1 - \mu_2 = 1.5$ against $H_A : \mu_1 - \mu_2 > 1.5$, since the p-value is greater than 5%, there isn't enough evidence to suggest the campaign worked.

(D) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 < 0$, since the p-value is greater than 95%, there is no evidence to suggest that the campaign worked.

(E) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 \neq 0$, since the p-value is less than 5%, the difference of 1.5 can be explained by random chance and there isn't enough evidence to suggest the campaign worked.

(8) The student society wants to know how much impact the campaign has had. Specifically, if the campaign has lead to the difference $\mu_1 - \mu_2$ being over 4. State the null and alternative of interest and do the test at the 5% level?

(A) $H_0 : \mu_1 - \mu_2 = 4$ against $H_A : \mu_1 - \mu_2 > 4$, since the p-value is less than 2.5%, there is evidence to suggest the mean difference is over 4.

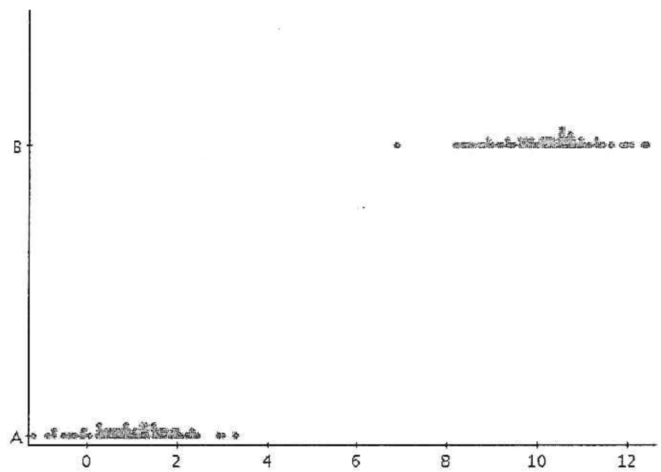
1 (B) $H_0 : \mu_1 - \mu_2 = 4$ against $H_A : \mu_1 - \mu_2 > 4$, since the p-value is greater than 50%, there isn't enough evidence to suggest the mean difference is over 4.

(C) $H_0 : \mu_1 - \mu_2 = 1.5$ against $H_A : \mu_1 - \mu_2 > 1.5$, since the p-value is greater than 5%, there isn't enough evidence to suggest the mean difference is over 1.5.

(D) $H_0 : \mu_1 - \mu_2 = 4$ against $H_A : \mu_1 - \mu_2 < 4$, since the p-value is less than 5%, there is evidence that the mean is greater than 4.

(E) $H_0 : \mu_1 - \mu_2 = 4$ against $H_A : \mu_1 - \mu_2 \neq 4$, since the p-value is less than 5%, there is evidence that the mean is greater than 4.

(9) Two samples from two populations are taken. The sample sizes for each sample is $n = 100$. We call the first sample A and the second sample B. A dotplot of the data is given below.



Let μ_A denote the mean of population A and μ_B denote the mean of population B. We test the hypothesis $H_0 : \mu_A - \mu_B = 0$ against $H_A : \mu_A - \mu_B \neq 0$. Which statement is correct.

(A) The p-value will be over 95%

(B) The p-value will be between $20 - 50\%$

(C) The p-value will be between $10 - 20\%$

1/2 (D) The p-value will be between $1 - 5\%$

(E) The p-value will be less than 1%.

(10) 50% of the human population is male and the other 50% is female. The chance that a female is pregnant in her lifetime is 80%. Using this information, what is the chance a randomly selected human will be pregnant in their lifetime?

(A) 20% (B) 64% (C) 80% (D) 25% (E) 40% 1

(11) You use Statcrunch one-sample proportion to obtain a p-value. This method uses the normal distribution to obtain the p-value. Which binomial distribution does the normal distribution best approximate?

(A) Bin(20, 0.5) (B) Bin(20, 0.2) (C) Bin(20, 0.95) 1

(D) (B) and (C) [(E)] All give a relative good approximation.

(12) You use Statcrunch one-sample proportion to obtain a p-value. This method uses the normal distribution to obtain the p-value. Which binomial distribution leads to the worst approximation by the normal distribution?

(A) Binomial Bin(20, 0.5) (B) Binomial Bin(20, 0.2) (C) Binomial Bin(20, 0.95) 1

(D) (A) and (B) [(E)] All give a relative good approximation.

(13-15) WEIGHT 16 healthy volunteers were given an extra 1000 calories a day to consume for eight weeks.

Summary statistics:

Column	n	Mean	Variance	Std. Dev.	Std. Err.	Median
weightdiff	16	4.73125	3.047625	1.7457448	0.4364362	5.05

(13) Researchers wanted to investigate whether on such an extreme diet the mean weight gain would be over 3.8kg.

Which test should be done?

(A) An independent sample t-test. (B) A matched paired t-test (C) ANOVA. 1

(D) A test on proportions (E) A chi-squared test for association.

(14) Construct a 99% confidence interval for the mean weight gain.

(A) $[4.73 \pm 2.947 \times 0.436]$

(B) $[4.73 \pm 2.947 \times 1.745]$

(C) $[3.047 \pm 2.947 \times 0.436]$

(D) $[4.73 \pm 2.602 \times 0.463]$ 1

(B) $[4.73 \pm 2.602 \times 1.745]$

(15) Suppose that the above 95% confidence interval for the mean difference is $[2.6, 5]$. How should one interprete this interval?

(A) The interval $[2.6, 5]$ can be used as a method of diagnosing ill people. If their weight gain is over 5kg it is highly likely that they are not healthy (reject the null).

(B) 95% of people who went on this extreme diet would have a weight gain of between $[2.6, 5]$

(C) If we did this experiment 100 times, the mean difference would lie in about 95 of the confidence intervals constructed. 1

(F) Two of the above above statements.

(E) None of the above.

(16) The average of a data set is zero. Which statement is true?

(A) The standard deviation MUST be zero.

(B) The number of negative and positive values MUST be the same.

(C) All the values in the data set MUST be zero.

1 (D) The data set MUST be a mix of positive and negative values.

(E) (A) and (C).

COMMENT: We include zero in our definition of positive value.

(17) Suppose I subtract 40 from every value in a data set. Which statement is true?

(A) The mean, first quartile and standard deviation decreases by 40.

(B) The mean decreases by 40 but the median stays the same.

(C) The mean and first quartile decrease by 40 but the standard deviation stays the same.

1 (D) Two of the above.

(E) None of the above.

(18) A television company is doing a survey to find out the average number of pets in a household. They take a simple random sample of 30 people from the population and ask how many pets they have. They use this to obtain an estimate for the number of pets in a household.

Comment on the accuracy of their estimator.

1 (A) There is no sampling bias.

(B) Their sample will be biased towards higher outcomes.

(C) Their sample will be biased towards lower outcomes.

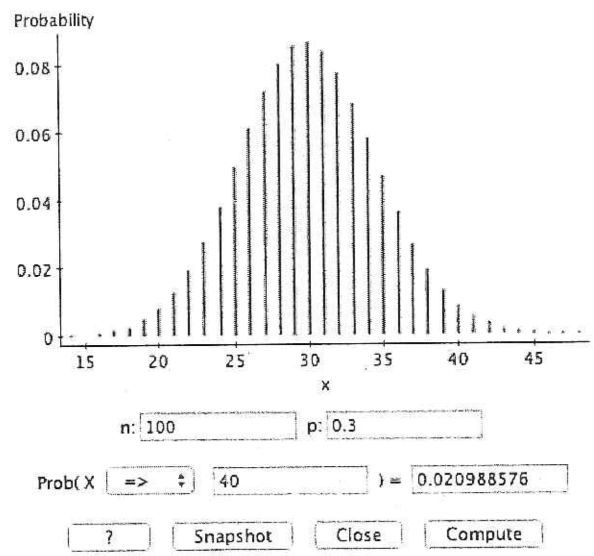
(D) Their sample will be highly biased since the sample size is so small.

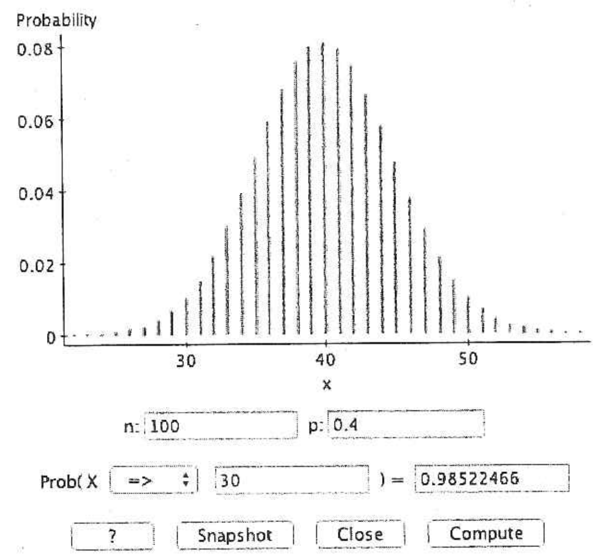
(E) Since the sample size is 30, we can use the central limit theore to remove any unwanted biases that may exist in the data. The larger the sample size the smaller the bias.

(19) The National Bureau of Statistics has recently conducted a survey on people's attitude towards drink driving. It was known that during the 1960's **30%** of the population disapproved of drink driving.

Recently, a survey was done to see whether attitudes have changed, in particular, whether now **more people disapprove of drink driving compared with 1960's.**

100 people were randomly surveyed. They found that in this sample, 40% disapproved of drink driving. What is the null and alternative of interest and the result of the test at the 5% level.





(A) $H_0 : p = 0.3$ against $H_A : p > 0.3$, the p-value is 97.91%, there is no evidence to suggest that over 30% disapprove of drinking driving.

(B) $H_0 : p = 0.4$ against $H_A : p > 0.4$, the p-value is 98.5%, there is no evidence that these days people disapprove more of drink driving than in the 60's.

(C) $H_0 : p = 0.4$ against $H_A : p > 0.4$, the p-value is 1.5%, there is evidence to suggest that over 40% of the population disapprove of drink driving.

1 (D) $H_0 : p = 0.3$ against $H_A : p > 0.3$, the p-value is 2.09%, there is evidence to suggest that over 30% of the population disapprove of drink driving.

(E) $H_0 : p = 0.4$ against $H_A : p < 0.4$, the p-value is 1.5%, there is evidence to suggest that less than 40% disapprove of drink driving.

(20) Jimmy wants to use statistics to 'prove' his research. As he learnt in his statistics class he stated his research hypothesis as the alternative and the oppositive of that as his null hypothesis.

After collecting the data, and doing the test at the 5% level, he is unable to reject the null. Disappointed with this result, he collects another sample does the test at the 5% level. Again he is unable to reject the null. He does this 8 times and, finally, on the eight attempt rejects the null. Happy that he could finally reject the null, he then writes an article saying that 'there is evidence to reject the null hypothesis, since the p-value is less than 5%'.

Comment on the accuracy of his claim.

1 (A) The chance of this happening under the null is a lot more than 5%. We cannot reject the null.

(B) It is unclear whether the test statistic has a normal distribution, therefore the p-value may not be accurate. Therefore, we cannot be sure whether we can reject the null or not.

(C) He needs to do a few more tests to be sure that his p-value is correct. If this were the case, then his argument is legitimate.

(D) His claim appears to be legitimate.

(E) (B) and (C)

(21) Ancedotal evidence suggests that people in New York are more likely to commute to work on a bike than people in Texas. I draw a random sample to see whether there is any evidence of this. What hypothesis should I use?

(A) H_0 : The number of Texans who use a bike is equal to the number of New Yorkers who use a bike against H_A : The number of Texans who bike is less than the number of New Yorkers who a bike.

1 (B) H_0 : The percentage of Texans who use a bike is equal to the percentage of New Yorkers who use bike against H_A : The percentage of Texans who use a bike is less than the percentage of New Yorkers who use a bike.

(C) H_0 : The percentage of Texans who use a bike is less than the percentage of New Yorkers who use bike against H_A : The percentage of Texans who use a bike is equal than the percentage of New Yorkers who use a bike.

(D) H_0 : The number of Texans who use a bike is less than the number of New Yorkers who use bike against H_A : The number of Texans who use a bike is equal than the number of New Yorkers who use a bike.

(E) H_0 : The number of Texans who use a bike is equal to the number of New Yorkers who use bike against H_A : The number of Texans who use a bike is greater than the number of New Yorkers who use a bike.

(22) 100 Freshman take a mathematics and English language class. It is found that the correlation between their mathematics and English is **0.15**. How do we interprete this correlation?

(A) As this correlation is so small, this suggests that there is no correlation between mathematics and english grades.

1/2 (B) If there is a correlation, it means high english grades slightly increases the chance of high maths grades.

1/2 (C) We would need to test whether the correlation is zero or not, in order to infer a relationship between the grades.

(D) (A) and (B)

1 (E) (B) and (C).

(23-25) A survey was done to investigate whether males and females had different opinions about mint chocolate. A random sample of 175 people were interviewed. The data is summarised below.

Contingency table results:

Rows: Gender

Columns: None

Cell format
Count (Row percent) (Column percent) (Total percent)

	Like	Dislike	Indifferent	Total
Male	50 (50%) (62.5%) (28.57%)	40 (40%) (57.14%) (22.86%)	10 (10%) (40%) (5.714%)	100 (100.00%) (57.14%) (57.14%)
Female	30 (40%) (37.5%) (17.14%)	30 (40%) (42.86%) (17.14%)	15 (20%) (60%) (8.571%)	75 (100.00%) (42.86%) (42.86%)
Total	80 (45.71%) (100.00%) (45.71%)	70 (40%) (100.00%) (40%)	25 (14.29%) (100.00%) (14.29%)	175 (100.00%) (100.00%) (100.00%)

(23) Based on this data (a) what proportion of males liked mint chocolate (b) what proportion of the sample disliked mint chocolate.

(A) (a) The proportion of males who liked mint chocolate was 28.57% (b) the proportion of the sample who disliked mint chocolate was 40%.

(B) (a) The proportion of males who liked mint chocolate was 62.5% (b) the proportion of the sample who disliked mint chocolate was 40%.

1 (C) (a) The proportion of males who liked mint chocolate was 50% (b) the proportion of the sample who disliked mint chocolate was 40%.

(D) (a) The proportion of males who liked mint chocolate was 50% (b) the proportion of the sample who disliked mint chocolate was 50%.

(E) (a) The proportion of males who liked mint chocolate was 28.57% (b) the proportion of the sample who disliked mint chocolate was 50%.

(24) A chi-squared test was done and the results are:

Statistic	Value
Chi-squared	3.9375

. What are the results of the test at the 5% level.

(A) We are testing H_0: no association between gender and mint chocolate preference against H_A : there is an assocation between gender and mint chocolate preference. As the p-value is less than 5% there appears to be an association.

(B) We are testing H_0: association between gender and mint chocolate preference against H_A : there is no assocation between gender and mint chocolate preference. As the p-value is less than 5% there appears to be no association.

1 (C) We are testing H_0: no association between gender and mint chocolate preference against H_A : there is an assocation between gender and mint chocolate preference. As the p-value is greater than 5% there is no evidence of an association.

(D) We are testing H_0: association between gender and mint chocolate preference against H_A : there is no assocation between gender and mint chocolate preference. As the p-value is greater than 5% there appears to an association.

(E) We are testing H_0: no association between gender and mint chocolate preference against H_A : there is an assocation between gender and mint chocolate preference. As the p-value is very small there is evidence of an association. Indeed, the data suggests that the proportion of males who like mint chocolate is greater than the proportion of females.

(25) Suppose it is known that there is no dependence between gender and their chocolate preference. What is the BEST estimator of the proportion of males in the population who like mint chocolate?

1 (A) 45.71% (B) 50% (C) 28.57% (D) 57.14%

(E) Given this additional knowledge a new data set needs to be collected.