Midterm 3 - STAT 301
Fall 2015

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 the cheat sheet provided and the tables you have brought with you. You should have no other printed or written material with you on the exam. But scrap paper is allowed.
3. You have 60 minutes to work on this exam. There are 15 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. Do all tests at the **5%** level unless specified otherwise.
9. Some questions are very easy (don't make them more complicated than they are), make sure you get these correct.
10. Please only give one answer per question (the one that is closest to the solution).
11. Good Luck!!!

(1) The department of health recommends that adults between 18-65 do at least 150 minutes of moderate to strenuous exercise per week. Health workers try to identify communities where the mean time for exercise **is below 150**, in order to educate these communities about the benefits of walking and exercise.

Recently, in a small town in Ohio, **51** residents were randomly sampled and asked how much exercise (including walking) they did in one week. The average for this sample was $\bar{x} = 120$ minutes and the **sample standard deviation** was $s = 50$.

Identify the hypothesis that is of interest to the health workers and use the t-distribution with 50 df to determine whether there is evidence to reject the null at the 5% level.

(A) $H_0 : \mu \leq 150$ vs. $H_A : \mu > 150$, the t-value $= -4.28$, therefore the p-value is greater than 99% and there is **evidence** to suggest that people in this town do enough exercise.

(B) $H_0 : \mu \geq 150$ vs. $H_A : \mu < 150$, the t-value $= -4.28$, therefore the p-value is less than 0.1% and there is strong evidence to suggest that people in this town don't do enough exercise.

(C) $H_0 : \mu \geq 150$ vs. $H_A : \mu < 150$, the p-value is 4.28% and there **some evidence** suggest that people in this town don't do enough exercise.

(D) $H_0 : \mu \geq 150$ vs. $H_A : \mu < 150$, the t-value $= -0.6$, therefore the p-value is over 20% and there is **some evidence** to suggest that people in this town don't do enough exercise.

(E) $H_0 : \mu \leq 120$ vs. $H_A : \mu > 120$, the t-value $= 4.28$, the p-value is less than 0.1% and there is no evidence to suggest that the residents in this town do over 120 minutes of exercise per week.

(2) In College Station a random sample of 51 residents was taken. The amount of exercise for this sample was $\bar{x} = 170$ and the confidence interval for the mean amount of exercise done in College Station $[160, 180]$.

(A) Clearly there is no evidence to suggest that College Station residents do **less** than the recommended amount.

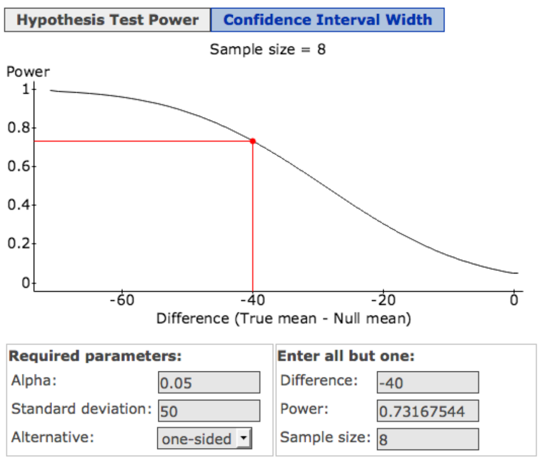
(B) Since 150 does not lie in this interval, there is some evidence to suggest that College station residents do **less** than the recommended amount. enough.

(C) The data suggests that the residents of College Station do more than the recommended amount of exercise.

(D) [A] and [C]   (E) [A] and [B].

(3) If the mean amount of exercise done in a town is 110 minutes or less, the town is determined to be a **high risk town** (as this can lead to secondary health disorders such as type II diabetes etc.).

In Hearn, a random sample of 8 individuals were randomly sampled and the hypothesis $H_0 : \mu \geq 150$ vs. $H_A : \mu < 150$ tested. Based on this sample, the p-value for this hypothesis test was 15%. A power analysis was done to assess the test's ability to detect high risk towns, where the mean is 110 minutes or less (the results of the applet are given below).



(A) We see that there is a 27% chance of the test **not** rejecting the null when the mean level is below 110. Therefore, we cannot exclude the possibility that Hearn is a high risk town.

(B) There is no evidence in the data to suggest that the residents of Hearn do less than 150 minutes exercise per week.

(C) The data suggests that the residents of Hearn **do more than** 150 minutes of exercise per week.

(D) [A] and [B] (E) [A] and [C].

(4) In court we test the hypothesis H_0 : innocent vs H_A : guilty. Which statement(s) are correct?

(A) Using a very low significance level will lead to less innocent people being convicted but also less guilty people being convicted.

(B) Using a 5% significance level will result in 5% of guilty people being convicted.

(C) Using the 5% significance level will result in 5% of innocent people being convicted.

(D) [A] and [C] (E) [B] and [C].

(5-7) Is there a **difference** between the time an adult takes to complete a maze compared with a child?

14 Adults and 10 children were asked to complete a maze. The average difference in times between the Adult and Children groups is 5.0 seconds. An independent sample t-test was done to test whether this difference is statistically significant.

Hypothesis test results:
μ_1 : Mean of Adult Minutes
μ_2 : Mean of Child Minutes
$\mu_1 - \mu_2$: Difference between two means
$H_0 : \mu_1 - \mu_2 = 0$
$H_A : \mu_1 - \mu_2 < 0$
(without pooled variances)

Difference	Sample Diff.	Std. Err.	DF
$\mu_1 - \mu_2$	-4.9995714	3.3601992	11.622185

probability	0.3	0.15	0.10	0.05	0.025	0.01	0.005
t^*	0.53	1.08	1.35	1.78	2.18	2.69	3.07

(5) In this sample, what is the average difference in maze times between the Adult and Children groups (Remember μ_1=Adults and μ_2=Children)?

(A) Adults took 5 seconds longer (B) Children took 5 seconds longer.

(C) Adults took 3.36 seconds longer (D) Children took 3.36 seconds longer.

(E) Adults were 11.62 seconds slower.

(6) Test the hypothesis that there is a **difference** between the average time an adult takes to do the maze and the average time a child takes to do it (give the hypothesis of interest and do the test at the 5% level).

(A) $H_0 : \mu_1 - \mu_2 = 0$ vs $H_A : \mu_1 - \mu_2 \neq 0$. The t-value is -0.42 and the p-value is greater than 60%, there is **no evidence** to reject the null.

(B) $H_0 : \mu_1 - \mu_2 \geq 0$ vs $H_A : \mu_1 - \mu_2 < 0$. The t-value is -0.42 and the p-value is greater than 30%, there is **no evidence** to reject the null.

(C) $H_0 : \mu_1 - \mu_2 \geq 0$ vs $H_A : \mu_1 - \mu_2 < 0$. The t-value is -0.42 and the p-value is greater than 30%, there is **evidence** to reject the null.

(D) $H_0 : \mu_1 - \mu_2 = 0$ vs $H_A : \mu_1 - \mu_2 \neq 0$. The t-value is -1.48 and the p-value is between $10 - 20\%$, there is **evidence** to reject the null.

(E) $H_0 : \mu_1 - \mu_2 = 0$ vs $H_A : \mu_1 - \mu_2 \neq 0$. The t-value is -1.48 and the p-value is between $10 - 20\%$, there is **no evidence** to reject the null.

(7) Construct a 95% confidence interval for the mean difference in maze times between adults and children.

(A) $[-4.99 \pm 1.78 \times \frac{3.36}{24}]$ (B) $[-4.99 \pm 2.18 \times 3.36]$ (C) $[-4.99 \pm 1.78 \times 3.36]$
(D) $[-4.99 \pm 1.78 \times 11.62]$ (E)$[-4.99 \pm 11.62 \times 3.36]$

(8-9) 6 people were placed on a diet to **loose weight**. Their before and after the diet are given in the figure below (noting that for this sample the average weight loss was 11 pounds). In order to see whether this difference was statistically significant Fred did both a matched t-test and independent sample t-test (since he did not know which test to use).

(8) Identify the hypothesis of interest and the result of the test.

Before	After	WeightLoss
160	145	15
140	130	10
250	225	25
183	170	13
125	120	5
90	92	-2

Hypothesis test results:
μ1 : Mean of Before
μ2 : Mean of After
μ1 - μ2 : Difference between two means
H0 : μ1 - μ2 = 0
HA : μ1 - μ2 > 0
(without pooled variances)

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
μ1 - μ2	11	29.320073	9.7083527	0.3751696	0.3578

Hypothesis test results:
μD = μ1 - μ2 : Mean of the difference between Before and After
H0 : μD = 0
HA : μD > 0

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
Before - After	11	3.7505555	5	2.9328989	0.0163

(A) We test the hypothesis $H_0 : \mu_{Before} - \mu_{After} \leq 0$ vs $H_0 : \mu_{Before} - \mu_{After} > 0$. The p-value is 1.63%, therefore there **is evidence** to suggest that the diet lead to weight loss.

(B) We test the hypothesis $H_0 : \mu_{Before} - \mu_{After} \leq 0$ vs $H_0 : \mu_{Before} - \mu_{After} > 0$. The p-value is 35.78%, therefore there **is evidence** to suggest that the diet lead to weight loss.

(C) We test the hypothesis $H_0 : \mu_{Before} - \mu_{After} \leq 0$ vs $H_0 : \mu_{Before} - \mu_{After} > 0$. The p-value is 1.63%, therefore there is **no evidence** to suggest that the diet lead to weight loss.

(D) We test the hypothesis $H_0 : \mu_{Before} - \mu_{After} \leq 0$ vs $H_0 : \mu_{Before} - \mu_{After} > 0$. The p-value is 35.78%, therefore there **is evidence** to suggest that the diet lead to weight loss.

(E) We test the hypothesis $H_0 : \mu_{Before} - \mu_{After} \leq 0$ vs $H_0 : \mu_{Before} - \mu_{After} > 0$. The p-value is 0.37%, therefore there is **no evidence** to suggest that the diet lead to weight loss.

(9) Returning to the diet data, what are the main differences between the results of the matched t-test and the independent sample t-test.

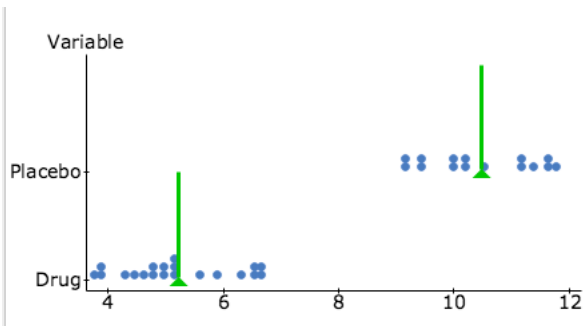
(A) By using a matched t-test we reduced the variability of the data, this makes the standard error and the corresponding p-value smaller.

(B) The standard error of the matched t-test is small, therefore the results of the matched t-test are wrong.

(C) It is clear, that we should use an independent sample t-test instead of a matched paired t-test.

(D) [A] and [C] (E) [B] and (C).

(10) In order to see whether a drug **reduces** the time of an allergic reaction, a random sample of people was taken. One group was given the placebo the other group was given the drug. A plot of the results is given below.



We want to test $H_0 : \mu_{placebo} - \mu_{Drug} \leq 0$ vs $H_A : \mu_{placebo} - \mu_{Drug} > 0$. Which is the p-value (do not calculate just look and give the most reasonable guess)?

(A) Greater than 70% (B) 50% (C) Between 10-50% (D) Between 5-10%

(E) Less than 1%.

(11) An experiment is done to see the influence of wine drinking on polyphenol levels. In a sample of 15 people there was an 4mg/l **increase** in polyphenol levels, where the 95% confidence interval for the mean is $[\mathbf{3, 5}]$.

	$H_0 : \mu \leq 0$ vs $H_A : \mu > 0$	$H_0 : \mu = 0$ vs $H_A : \mu \neq 0$	$H_0 : \mu \geq 0$ vs $H_A : \mu < 0$
A	p-value > 97.5%, cannot reject null	p-value < 5% reject null	p-value < 2.5% reject null.
B	p-value < 2.5%, reject null	p-value < 5% reject null	p-value > 97.5% cannot reject null.
C	p-value > 5%, cannot reject null	p-value > 5% cannot reject null	p-value > 5% cannot reject null.
D	p-value > 97.5%, reject null	p-value < 5% cannot reject null	p-value < 2.5% cannot reject null.
E	p-value < 2.5%, cannot reject null	p-value < 5% cannot reject null	p-value > 97.5% reject null.

(12) Based on the data choose the correct testing procedure.

1. In 2006 the average mile per gallon of medium size car was 34 mpg. This year the EPA wants to investigate whether mileage has improved amongst medium sized cars. They take a random sample of 400 medium sized cars and measure their mileage.
2. The cycling habits of students from Texas A&M and UT are compared.
3. To see whether a new teaching technique works pupils in a school are assessed before the teaching technique is applied and after the teaching technique is applied. The difference in scores are analyzed.

	[1]	[2]	[3]
(A)	One sample t-test	Independent two sample t-test	Matched t-test
(B)	Independent two sample t-test	Matched t-test	One sample t-test
(C)	One sample proportions	Matched t-test	Independent two sample t-test
(D)	Matched t-test	One sample t-test	Independent two sample t-test
(E)	Independent two sample t-test	one sample test on proportions	one sample t-test

(13) Research is being conducted to see whether student debt **differs** between states. In one study Texas is being compared with New Jersey. Let N_T denote **the number** of students in Texas with debt, N_{NJ} denote **the number** of students in NJ with debt, p_T denote **the proportion** of students in Texas in debt and p_{NJ} **the proportion** of students in NJ with debt.

Based on the discussion above, which is the hypothesis of interest?

(A) $H_0 : p_T - p_{NJ} = 0$ vs $H_A : p_T - p_{NJ} \neq 0$

(B) $H_0 : N_T - N_{NJ} = 0$ vs $H_A : N_T - N_{NJ} \neq 0$.

(C) $H_0 : p_T - p_{NJ} \neq 0$ vs $H_A : p_T - p_{NJ} = 0$.

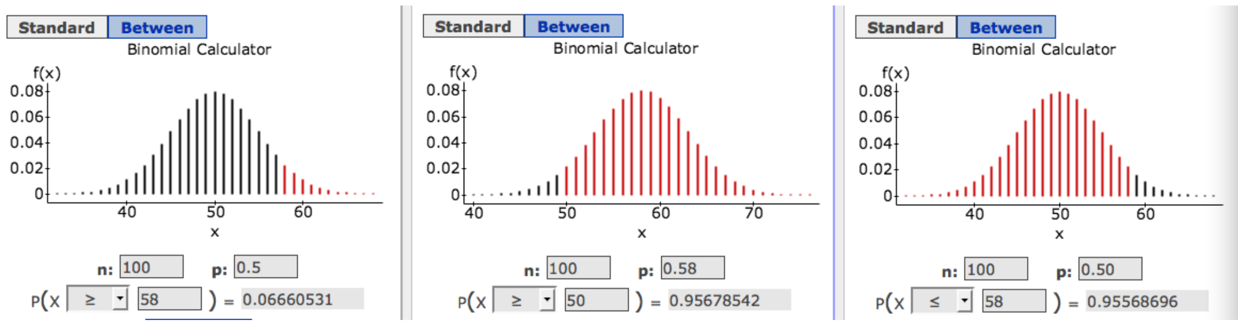
(D) $H_0 : N_T - N_{NJ} \neq 0$ vs $H_A : N_T - N_{NJ} = 0$.

(E) $H_0 : N_T - N_{NJ} \leq 0$ vs $H_A : N_T - N_{NJ} > 0$.

(14-15) A professor conjectures that **more females** than males major in the animal sciences.

In an animal science class there are 58 females out of 100 (that class is 58% female) and 42 males. She uses this data to test her conjecture.

(14) Using the plots below is there any evidence to support the professor's conjecture (let p denote the proportion of females majoring in the animal sciences)?



(A) $H_0 : p \leq 0.5$ vs $H_A : p > 0.5$. The p-value is 95.56%, there is **not enough** evidence to reject the null.

(B) $H_0 : p \leq 0.58$ vs $H_A : p > 0.58$. The p-value is 95.56%, there is **not enough** evidence to reject the null.

(C) $H_0 : p \geq 0.5$ vs $H_A : p < 0.5$. The p-value is 95.67%, there is **not enough** evidence to reject the null.

(D) $H_0 : p \leq 0.5$ vs $H_A : p > 0.5$. The p-value is 6.6%, there is **not enough** evidence to reject the null.

(E) $H_0 : p \leq 0.5$ vs $H_A : p > 0.5$. The p-value is 95.67%, there is **enough** evidence to reject the null.

(15) The same data is analysed using Statcrunch. The output is given below. Comparing the output with the results in (Q14) which were calculated using the binomial distribution.

Hypothesis test results:
p : Proportion of successes
$H_0 : p = 0.5$
$H_A : p > 0.5$

Proportion	Count	Total	Sample Prop.	Std. Err.	Z-Stat	P-value
p	58	100	0.58	0.05	1.6	0.0548

(A) The difference in p-values between Statcrunch output and the binomial given in (Q14) is very large because the binomial distribution is highly skewed.

(B) The difference in p-values between Statcrunch output and the binomial distribution is quite small because the binomial distribution is symmetric and close to normal.

(C) The Statcrunch output gives the correct/true p-values, whereas the binomial distribution only gives an approximation.

(D) (A) and (B) [E] (A) and (C).