Final - STAT 301
Fall 2016

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 cheatsheet provided. 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. Have a wonderful winter break, it was lovely to teach you.

(1) Adults at a shopping Mall were randomly selected and asked four questions. What type of variable are:

1	2	3	4
Their Height	Favourite shop	Number of items bought	How far is home

Answer:

	1	2	3	4
A	Numerical continuous	Categorical	Numerical discrete	Numerical continuous
B	Numerical continuous	Categorical	Numerical continuous	Numerical discrete
C	Numerical discrete	Categorical	Categorical	Numerical continuous
D	Numerical discrete	Numerical discrete	Numerical discrete	Numerical continuous
E	Numerical discrete	Categorical	Categorical	Binary

(2) Consider the data set $-1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1$. Which statement(s) is correct?

(A) The mean and median are zero (B) The Interquartile range is zero.

(C) The standard deviation is zero.

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

(3-4,7) [FEMALE HEIGHTS] Female heights are normally distributed with mean **65** inches and standard deviation **3** inches.

(3) What is the height of a female who is in the 70th percentile?

(A) 63.4 inches (B) 66.6 inches (C) 67.2 inches (D) 68.2 inches (E) 69 inches.

(4) What is the chance that the average height of **4 females** will be **less** than 66 inches?

(A) 90.8% (B) 74.7% (C) 66% (D) 25.2% (E) 9.1%

(5-7) [MALE HEIGHTS] The mean height of adult males is normally distributed with mean **70** inches and standard deviation **2**.

(5) Bert is an adult male, his height is **1.5** standard deviations below the mean. What is Bert's height?

(A) 73 inches (B) 68.5 inches (C) 68 inches (D) 67 inches (E) 66 inches.

(6) What proportion of adult male heights will lie between **67-71** inches?

(A) 100% (B) 69.1% (C) 62.4% (D) 50% (E) 6.7%.

(7) Suppose **female** heights are known to be normally distributed with mean **65** inches and standard deviation **3** inches. James is male and 68 inches tall.

Using equivalent percentiles, how tall would James be if he were female?

(A) 68 inches (B) 67 inches (C) 65 inches (D) 63 inches (E) 62 inches.

(8) The library has conducted a survey to understand the number of hours per day students study before finals. They surveyed 105 students. Based on this sample the average number of hours a student studied per day is 18.5 hours.

The data was put into Statcrunch and the output is given below.

One sample T confidence interval:
μ : Mean of population

95% confidence interval results:

Mean	Sample Mean	Std. Err.	DF	L. Limit	U. Limit
μ	18.5	0.40987803	104	17.687196	19.312804

Based on the output, which statement is correct.

(A) With 95% confidence, students at A&M spend on average 18.5 hours a day studying before finals.

(B) With 95% confidence, students at A&M spend on average 18.5 ± 0.8 hours a day studying before finals.

(C) 0.4 is a measure of how close the average in the sample is to the average in the population.

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

(9-13) [FILMS] Rotten Tomatoes is a website that aggregates movie reviews and scores movies from 1-100. Below we give the histogram for the rotten tomato ratings of films and its QQplot.

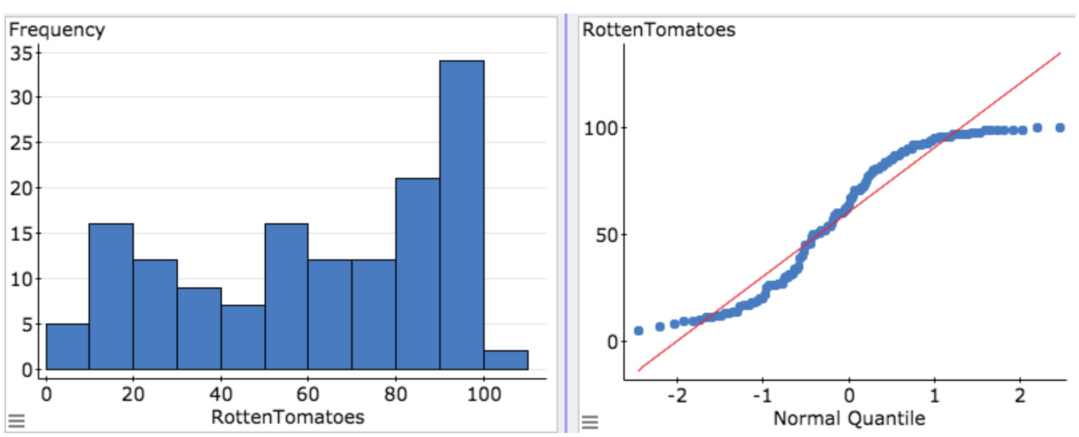


Figure 1:

(9) Using Figure 1, what description below best describes the distribution of scores?

(A) Right Skewed (B) Bell shaped (C) Normal (D) Thick tailed (E) Binomial.

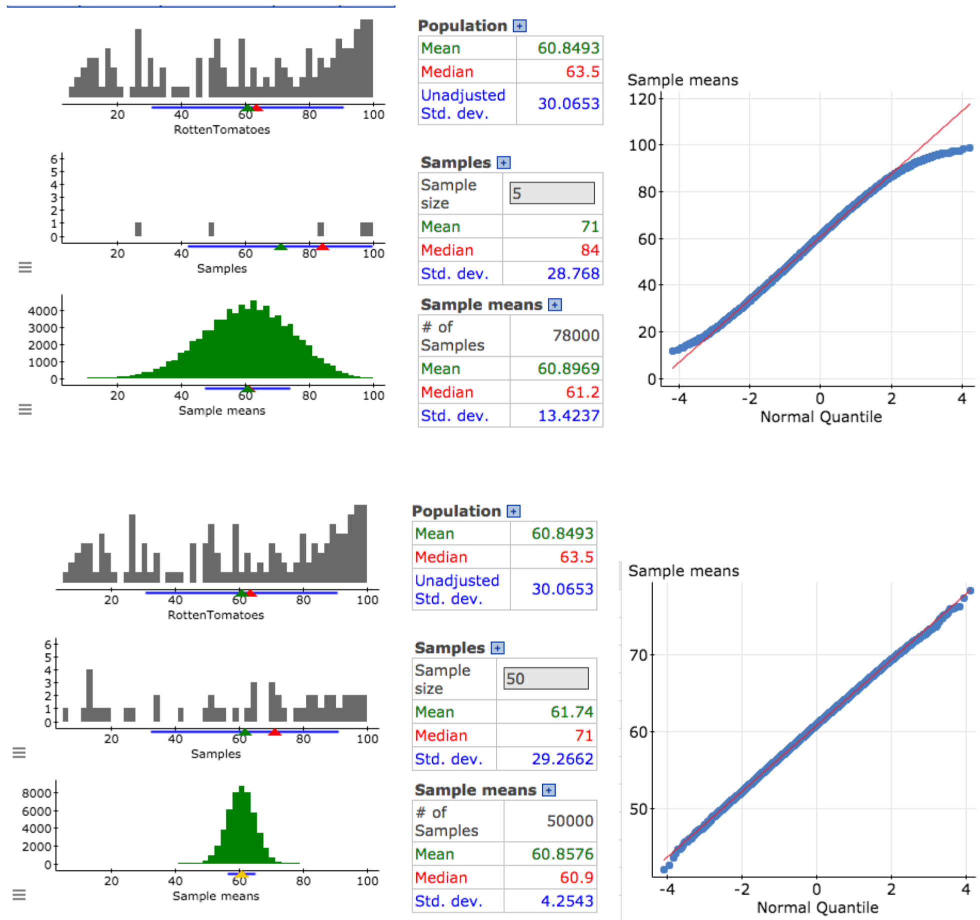


Figure 2: Top row for sample size 5. Bottom row for sample size 50.

(10) Use the histogram/QQplot of the Rotten Tomatoes scores in Figure 1 and plots below.

What does these plots tell us about the reliability of statistical conclusions about the population mean based on the sample mean?

(A) The sample mean based on a sample of **5** is normally distributed. Thus we would really have the full 95% confidence in a 95% confidence interval constructed using the normal distribution.

(B) The sample mean based on a sample of **50** is normally distributed. Thus we would really have the full 95% confidence in a 95% confidence interval constructed using the normal distribution.

(C) The standard error for the sample mean decreases as the sample size grows.

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

(11-13) A magazine wants to know if the average rating that rotten tomatoes gives a film is over 50 points. They collect the ratings of 146 films and the data is summarized below together with the critical values for a t-distribution with 145df.

One sample T hypothesis test:
μ : Mean of variable
H_0 : μ = 50
H_A : μ > 50

Hypothesis test results:

Variable	Sample Mean	Std. Err.	DF	T-Stat	P-value
RottenTomatoes	60.849315	2.4967876	145	4.3453096	<0.0001

probability	0.3	0.15	0.10	0.05	0.025	0.01	0.005
t^*	0.52	1.04	1.29	1.65	1.98	2.35	2.61

(11) We test the hypothesis $H_0 : \mu \leq 50$ vs. $H_A : \mu > 50$. Is there any evidence that the mean rating that Rotten Tomatoes gives a movie is over 50?

(A) There is no evidence that the mean score is over 50.

(B) There is strong evidence that the mean score is over 50.

(C) It is highly unlikely that this sample of 146 scores can be drawn when the global mean is 50.

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

(12) Test the hypothesis that $H_0 : \mu \leq 60$ against $H_A : \mu > 60$.

(A) The t-value is **0.34**, the p-value is between 30-50% there is **no** evidence to suggest the mean score is over 60.

(B) The t-value is $-$**0.34**, the p-value is between 30-50% there **is** evidence to suggest the mean score is over 60.

(C) The t-value is $-$**0.34**, the p-value is between 50-70% there **is** evidence to suggest the mean score is over 60.

(D) The p-value is **0.34**%, there **is** evidence to suggest the mean score is over 60.

(E) The p-value is **3.4**%, there is **no** evidence to suggest the mean score is over 60.

(13) Which statement(s) is/are correct?

(A) With 90% confidence, the **mean** rotten tomato rating is between $[60.8 \pm 4.125]$.

(B) 90% of **all** rotten tomato ratings are between $[60.8 \pm 4.125]$.

(C) With 99% confidence, the **mean** rotten tomato rating is between $[60.8 \pm 4.125]$.

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

(14) Suppose we want to compare the mean ratings of rotten tomatoes with the mean rating of Metacritic. If there any evidence of a **difference** in the mean scores i.e.

$H_0 : \mu_{\text{tomato}} - \mu_{\text{metacritic}} = 0$ vs $H_A : \mu_{\text{tomato}} - \mu_{\text{metacritic}} \neq 0$? Use the output below.

Paired T hypothesis test:
$\mu_D = \mu_1 - \mu_2$: Mean of the difference between RottenTomatoes and Metacritic
$H_0 : \mu_D = 0$
$H_A : \mu_D > 0$
Hypothesis test results:

Difference	Mean	Std. Err.	DF	T-Stat	P-value
RottenTomatoes - Metacritic	2.0410959	1.058777	145	1.9277865	0.0279

(A) The p-value is 97.2%, there is **no** evidence to suggest that there is a difference in mean scores at **either** the 5% or 10% significance level.

(B) The p-value is 5.8%, there **is** evidence of a difference at the 5% level **but no** evidence of a difference at the 10% significance level.

(C) The p-value is 5.8%, there is **no** evidence of a difference at the 5% significance level **but** there **is** evidence of a difference at the 10% significance level.

(D) The p-value is 2.8%, there is **no** evidence to suggest that there is a difference in mean scores at **either** the 5% or 10% significance level.

(E) The p-value is 1.9% there is evidence to suggest there is a difference.

(15) Researchers want to investigate the influence hens living in white or red light has on the quality of the eggs they produce. The conjecture/idea is that red light is **less** stressful than white light, thus resulting in eggs with better protein quality i.e. hens exposed to **red light** will have a **larger haugh unit** than hens exposed to **white light**. They want to see if there is any evidence of this in the data they collect.

Two groups of chickens were put under red or white light and the protein quality of their eggs measured. The sample mean for eggs of hens under red light is **103.09** whereas the sample mean for eggs of hens under white light is **101.7**. The data is summarized below. State the hypothesis of interest and the conclusion of the test (at the 5% significance level).

Two sample T hypothesis test:
μ_1 : Mean of red Haugh Unit
μ_2 : Mean of white Haugh Unit
$\mu_1 - \mu_2$: Difference between two means
$H_0 : \mu_1 - \mu_2 = 0$
$H_A : \mu_1 - \mu_2 \neq 0$
(without pooled variances)

Hypothesis test results:

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
$\mu_1 - \mu_2$	1.4278748	0.56696348	183.36581	2.5184599	0.0126

(A) $H_0 : \mu_1 - \mu_2 \leq 0$ vs. $H_A : \mu_1 - \mu_2 > 0$ the p-value is 0.63%, there **is** evidence to suggest that red light leads to eggs with **better** quality protein than white light.

(B) $H_0 : \mu_1 - \mu_2 \leq 0$ vs. $H_A : \mu_1 - \mu_2 > 0$ the p-value is 0.63%, there **is** evidence to suggest that red light leads to eggs with **worse** quality protein than white light.

(C) $H_0 : \mu_1 - \mu_2 = 0$ vs. $H_A : \mu_1 - \mu_2 \neq 0$ the p-value is 1.26%, there is **no** evidence to suggest that red light or white light leads to any difference in the quality of egg protein.

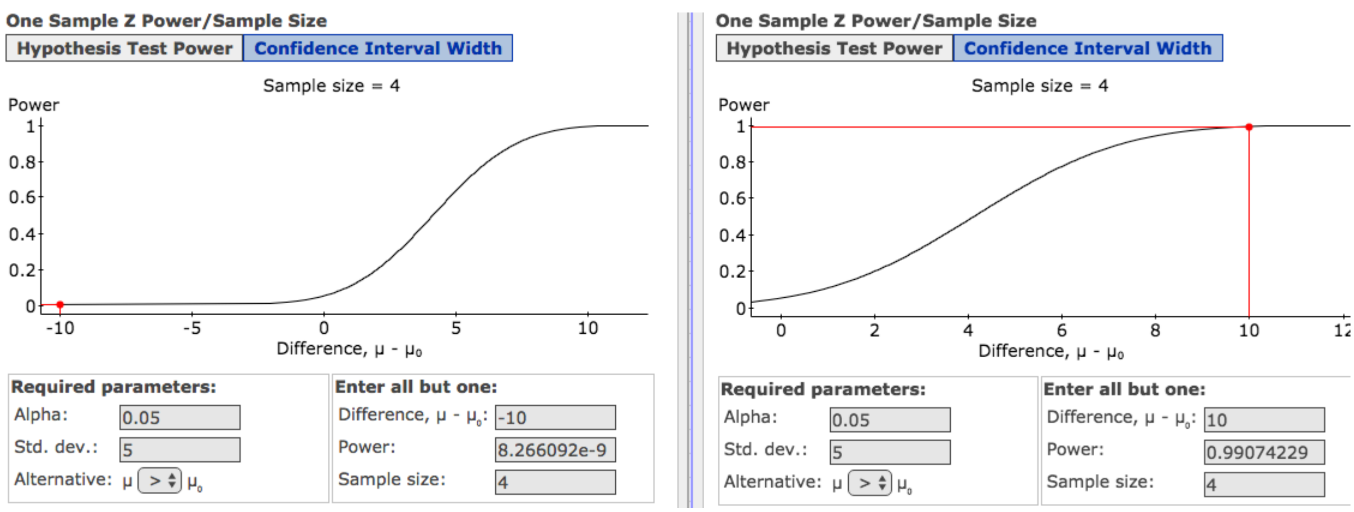
(D) $H_0 : \mu_1 - \mu_2 \leq 0$ vs. $H_A : \mu_1 - \mu_2 > 0$ the p-value is 1.26%, there is **no** evidence to suggest that red light leads to eggs with **better** quality protein than white light.

(E) $H_0 : \mu_1 - \mu_2 > 0$ vs. $H_A : \mu_1 - \mu_2 \leq 0$ the p-value is 2.52%, there **is** evidence to suggest that red light leads to eggs with **worse** quality protein than white light.

(16) Gestational diabetes is diagnosed if the mean level of glucose in blood after taking a sugary drink is **greater than** 140mg/ml.

To determine whether someone has gestational diabetes **four** blood samples are taken. The standard deviation for each blood sample is known to be $\sigma = 5mg/ml$. We test the hypothesis $H_0 : \mu \leq 140$ vs $H_A : \mu > 140$, the test is done at the 5% level.

The testing procedure is analyzed using a power analysis. A person has **critical gestational diabetes** if their mean level is $150mg/ml$ or higher. A power analysis is given below. Which statement(s) is correct?



(A) We see that there is a $\mathbf{8.2 \times 10^{-9}\%}$ chance of diagnosing gestational diabetes when a person has critical gestational diabetes.

(B) We see that there is a **95%** chance of the diagnosing gestational diabetes when a person has critical gestational diabetes.

(C) We see that there is a **99%** chance of diagnosing gestational diabetes when a person has critical gestational diabetes.

(D) The p-value is $\mathbf{8.2 \times 10^{-9}\%}$, thus there is **strong** evidence that the person has critical gestational diabetes. [E] (A) and (D).

(17) The weights of three types of geese/ducks are compared. Namely, canadian geese, muscovy ducks and snow geese, 10 of each animal is sampled. The dot plot of the weights in each group is given below.

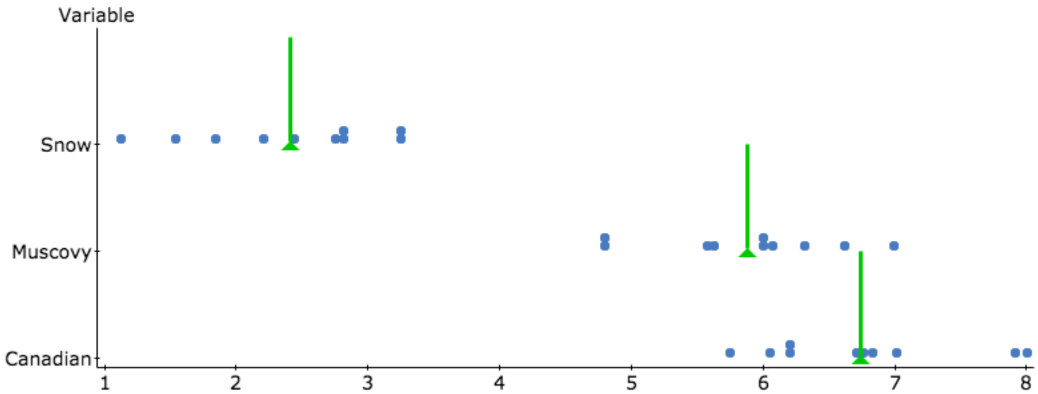


Figure 3: Average Snow = 2.4, Average Muscovy = 5.8, Average Canadian = 6.7.

Use the plot in Figure 3 to identify the correct p-value for each hypothesis. Read each hypothesis **very carefully**.

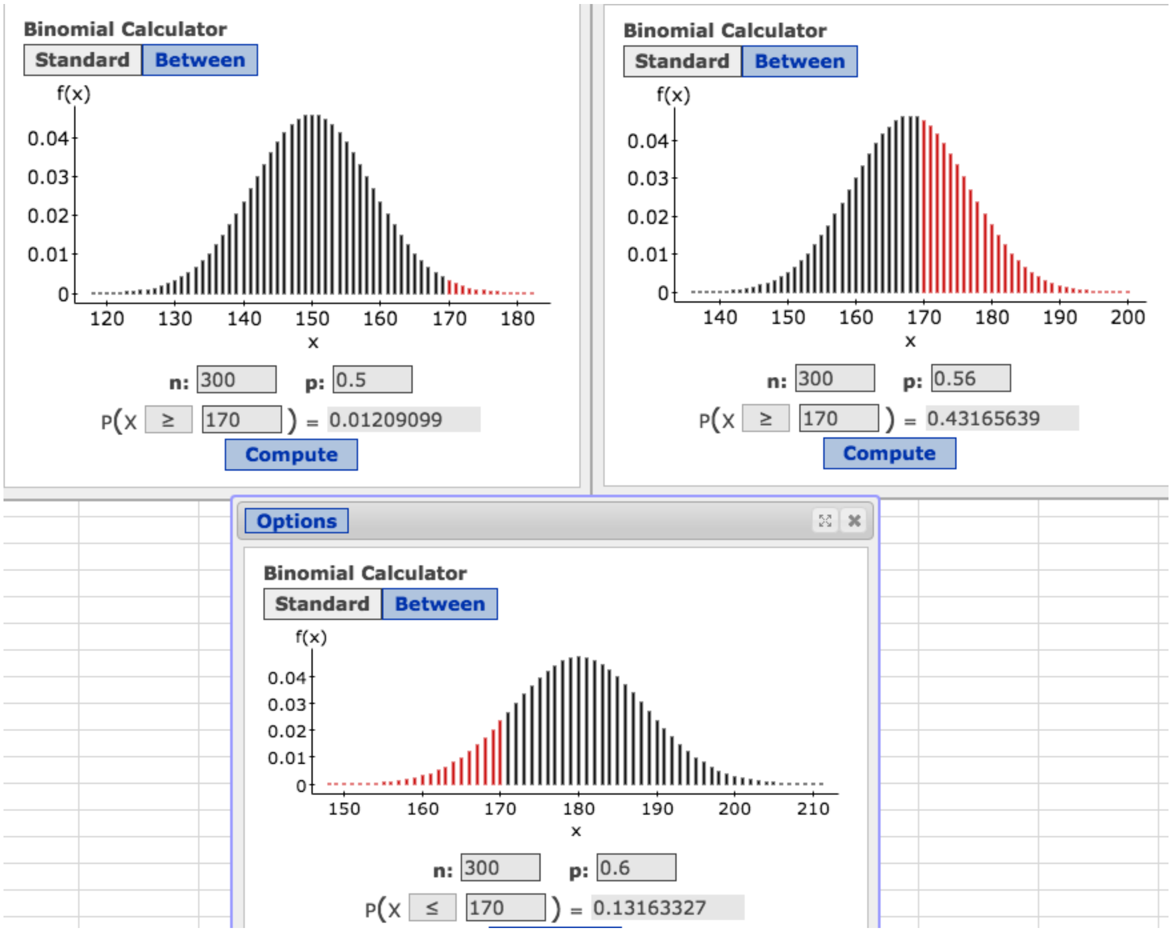
	$H_0 : \mu_{\text{Canadian}} - \mu_{\text{Snow}} \leq 0$ $H_A : \mu_{\text{Canadian}} - \mu_{\text{Snow}} > 0$	$H_0 : \mu_{\text{Muscovy}} - \mu_{\text{Snow}} \leq 0$ $H_A : \mu_{\text{Muscovy}} - \mu_{\text{Snow}} > 0$	$H_0 : \mu_{\text{Canadian}} - \mu_{\text{Muscovy}} \leq 0$ $H_A : \mu_{\text{Canadian}} - \mu_{\text{Muscovy}} > 0$
A	less than 0.1%	10-20%	10-20%
B	30-40%	greater than 50%	40-50%
C	more than 99.9%	more than 99.9%	90-99%
D	less than 0.1%	less than 0.1%	1-10%
E	greater than 50%	10-20%	less than 5%

(18) Based on how the data was collected, choose the correct testing procedure.

1. 100 hens from the same breed, were randomly alocated to two groups. Each group was subjected to different light treatments.
2. 100 movies were each evaluated by Rotten tomatoes and Metacritic and rated.
3. The examinations scores of high school students in Singapore and the US were compared.

	[1]	[2]	[3]
(A)	Independent two 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)	Independent two sample t-test	Matched t-test	Independent two sample t-test
(D)	Matched t-test	One sample t-test	Independent two sample t-test
(E)	Matched t-test	Independent two sample t-test	Matched t-test

(19) A recent survey was conducted to see whether people support the outcome of the recent US election. In a survey of 300 people, 170 (56.7% of those surveyed) said they supported the outcome of the election.



Based on the calculations above which new(s) outlets gave the correct headline (remember to think of each statement in terms of a statistical test).

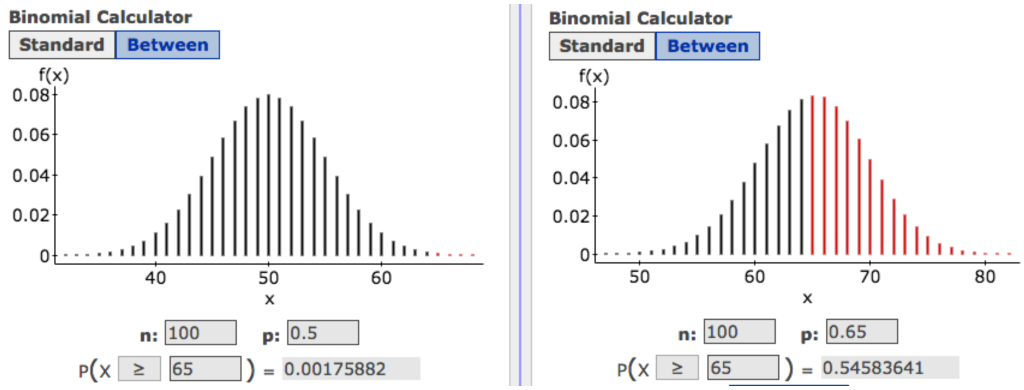
(A) Fox news: "evidence suggests majority now support the outcome of the election".

(B) Breitbart news network "evidence suggests **over** 55% now support the outcome of the election".

(C) New York Times: "evidence suggests **less than** 60% support the outcome of the election".

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

(20) In a true or false exam (where the only answer is either true or false). A student scores 65 out of a 100. From his score and the output below is there any evidence to suggest he was doing better than guessing? Let p denote the chance that the student got the question right.



(A) $H_0 : p \leq 0.65$ vs $H_A : p > 0.65$, the p-value is 54%, there is **no** evidence he was doing **better** than guessing.

(B) $H_0 : p \leq 0.5$ vs $H_A : p > 0.5$, the p-value is 0.17%, there **is** evidence he was doing **better** than guessing.

(C) $H_0 : p > 0.5$ vs $H_A : p \leq 0.5$, the p-value is 0.17%, there is evidence he was actually doing **worse** than guessing.

(D) $H_0 : p \leq 0.0017$ vs $H_A : p > 0.0017$, the p-value is 0.5%, there is **no** evidence he was doing **better** than guessing.

(E) $H_0 : p \leq 0.65$ vs $H_A : p > 0.65$, the p-value is 48%, there **is** evidence he was doing **better** than guessing.

(21) There are several treatments available for treating cocaine addiction. 100 patients addicted to cocaine were assigned randomly to one of three possible treatments. After treatment the number of relapses are summarized below.

	Desipramine	Lithium	Placebo	Total
Relapse	10	38	19	67
No Relapse	15	16	2	33
Total	25	54	21	100

What can we conclude about the treatments based on **this** group of individuals?

(A) The proportion who did not relapse in the Desipramine group is 60% whereas the proportion of those who did not relapse in the Lithium and Placebo groups are 29.6% and 9.5% respectively.

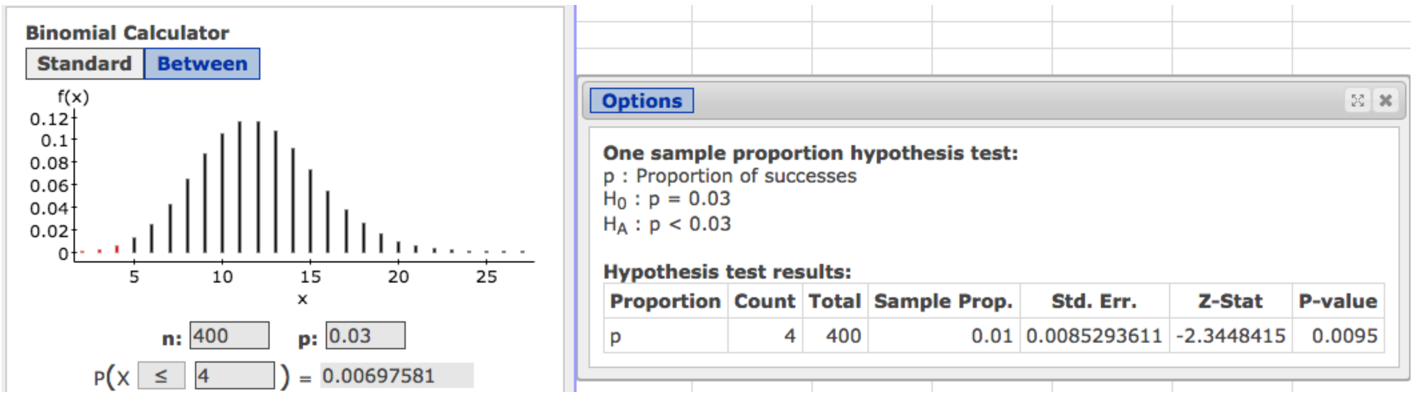
(B) The proportion who did not relapse in the Desipramine group is 15% whereas the proportion of those who did not relapse in the Lithium and Placebo groups are 16% and 2% respectively.

(C) In this sample, those in the Desipramine group are less likely to relapse than those in the other groups.

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

(22) The National Institute of Drug Abuse wants to determine what proportion of High School students (age 15-18) have taken cocaine. It is known that during the the 1990s, when cocaine use was more common, the proportion of High School students who had taken cocaine was 3%. It has been suggested the proportion has dropped.

A sample of 400 students across the country were surveyed and asked if they had taken cocaine. 4 admitted to taking cocaine. A test was conducted using both the binomial calculator and the one-sample proportion hypothesis.



(A) The descrepency in p-values (0.95% vs 0.69%) is due to a approximation of the binomial distribution with the normal distribution.

(B) The data suggests the proportion of students who admit to taking cocaine has **dropped** from 3%.

(C) Care needs to be taken, since the students may not be responding truthfully.

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

(23) Though the exact proportion of the adult population who experience an adverse reaction to Ibuprofen is unknown, it is known that the proportion is **less** than 20%.

Suppose we want to estimate the proportion of the population who experience a reaction to Ibupofen based on sample. What is the **minimum** sample size required to ensure that margin of error of the **95%** confidence interval is less than **3%**.

(A) 3484444 (B) 6829511 (C)1068 (D) 683 (E) 4.

(24) The EPA are investigating opinions in the different parts of the country on funding for renewable and non-renewable energy. They wanted to see if there is a difference in opinion about funding between people who living in Texas and those who live in Lousiana.

400 people were randomly surveyed (200 from Texas and 200 from Lousiana), they were asked whether federal funding should go to renewable or non renewable energy. The data is summarized below.

	Texas	Louisiana	Total
Renewable	130	145	275
No Renewable	70	55	125
Total	200	200	400

Two sample proportion hypothesis test:
p_1 : proportion of successes for population 1
p_2 : proportion of successes for population 2
$p_1 - p_2$: Difference in proportions
$H_0 : p_1 - p_2 = 0$
$H_A : p_1 - p_2 < 0$

Hypothesis test results:

Difference	Count1	Total1	Count2	Total2	Sample Diff.	Std. Err.	Z-Stat	P-value
$p_1 - p_2$	130	200	145	200	-0.075	0.046351241	-1.6180797	0.0528

Which statement(s) is/are correct (all tests are based on the **5%** significance level)?

(A) For $H_0 : p_1 - p_2 = 0$ vs $H_A : p_1 - p_2 \neq 0$ the p-value is 10.56% there is **no** evidence of a difference in opinions.

(B) For $H_0 : p_1 - p_2 \leq 0$ vs $H_A : p_1 - p_2 > 0$ the p-value is 94.72% there **is** evidence Texans support renewables more than Louisianans.

(C) In this sample the proportion of Louisianans who support renewable resources is greater than the proportion of Texans. However, this difference is not statistically significant.

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

(25) The chance of an infant dying from sudden infant death syndrome (SIDS) is 1 in every 8500 live births. A mother gives birth to two babies who die before the age of 6 months. A doctor calculates the chance that a mother gives birth to two babies, both of whom die of SIDS as

$$\left(\frac{1}{8500}\right)^2 = 1.38 \times 10^{-8}.$$

(A) As the chance of this happening is so small. It strongly suggests that the babies did not die of SIDS and the mother played a role in their deaths.

(B) This probability is calculated under the assumption that both deaths are independent of each other. As the babies were siblings this assumptions seems unlikely and the probability incorrect.

(C) The probability that the mother played a role in their death is $1 - 1.38 \times 10^{-8}$, which is close to 100%. Thus we determine that the mother is guilty of their death.

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