Exam 1 Stat 100 Stat Key Spring 2019

**EXAM 1: Statistics 100**

**Cover Sheet Questions** ***(1 pt.)***

**1)** What's your name? _____ _____

(Last name) (First name)

**2)** What's your net ID (email)? _____

**3)** Which Section are you in?

***Circle one:*** **i)** L1 (MWF at 12pm) **ii)** L2 (Tues/Thurs 11am) **iii)** ONLINE

Write answers in appropriate blanks. All multiple-choice questions have exactly one answer. If you circle more than one answer you will automatically be marked wrong.

***SHOW WORK** when requested, otherwise no credit. Do NOT use scrap paper.

**Make sure you have all 6 pages including the normal table (10 problems).**

**DO NOT WRITE BELOW THIS LINE**

The numbers written in each blank below indicate how many points you missed on each page. The numbers printed to the right of each blank indicate how many points each page is worth.

Page 1 _____16

Page 2 _____ 16

Page 3 _____15

Page 4 _____23

Page 5 _____29

Cover Page_____ 1

1 pt. *for answering cover page questions 1-3 correctly!*

**Total Score** _____

**WARNING-** The exams look alike but you are sitting next to people who actually have a different version than you. Copying from anyone is equivalent to giving a signed confession.

All cheating including being caught with a non-permissible calculator or formula sheet will result in a 0 and an academic integrity violation on your University record.

**There is NO CLASS on Thursday or Friday!**

**Scores will be posted on Compass by Friday morning and exams will be returned in class next week. Online students may pick up their exam in 23 Illini Hall during office hours next week.**

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**Question 1** *(9 points total)* A recent study was done to examine the possible health benefits of broccoli. The study looked at children who ate broccoli at least once per week and compared them to children who rarely, if ever, ate broccoli. The study followed the children into adulthood and found that the broccoli group had a significantly lower rate of obesity than the non-broccoli eating group.

***a)*** *(1 pt.)* What type of study is this? ***Choose one:*** **i)** Randomized Controlled Experiment **(ii)** Observational Study

***b)*** *(2 pts.)* My husband hates eating broccoli! Based only on the given information, can you conclude that I should tell him that broccoli (his worst enemy!) caused the children to have a lower rate of obesity? ***Choose one:***

- **i)** Yes, this study provides strong evidence that eating broccoli as a child does help prevent obesity in adulthood.
- **ii)** Yes, because the study compared a treatment group (broccoli eaters) to a control group (non-broccoli eaters), it's appropriate to conclude that there is a causal relationship.
- **(iii)** No, we can only conclude that eating broccoli is *associated* with lower obesity rates. It may or may not be the cause.
- **iv)** No, because the parents were in charge of giving the children broccoli, there is no way that this relationship can possibly be causal.

**c)** Below are either possible causal links, confounders or neither. (Choose answer based only on given info.)

**i)** *(2 pts.)* Genetics: Due to their family history, certain individuals are more genetically prone to obesity than others regardless of if they eat broccoli or not.
***Choose one:*** **a)** Causal Link **b)** Confounder **(c)** Neither

**ii)** *(2 pts.)* Vitamins: Broccoli contains high levels of vitamin A and vitamin C. Both of which help maintain a healthy and functional metabolism. The better your metabolism, the less likely you are to become obese.
***Choose one:*** **(a)** Causal Link **b)** Confounder **c)** Neither

**iii)** *(2 pts.)* Healthy Habits: Children whose parents encourage healthy habits are more likely to be encouraged to eat broccoli, as well as exercise regularly and eat healthy in general, both of which decrease the probability of becoming obese in adulthood.
***Choose one:*** **a)** Causal Link **(b)** Confounder **c)** Neither

**Question 2** *(7 points total)* Suppose McKinley Health Center wanted to do an experiment to see if taking vitamins prevent students at U of I from getting colds. They decide to randomly divide 200 volunteers into two groups: Group 1 takes a multivitamin every day for the entire academic year and Group 2 takes a water pill that looks like a vitamin. Neither the volunteers nor the doctors at McKinley know who's in each group. ←double blind

**a)** *(1 pt.)* How would you best describe this study? ***Choose one:***
**(i)** Randomized Double-Blind Experiment **ii)** Non-Randomized Experiment with a placebo **iii)** Observational Study

**b)** *(2 pts.)* What kind of bias will be present in this experimental design? ***Choose one:***

- **i)** Subject Bias- the volunteers knew which group they were.
- **ii)** Evaluator Bias- the evaluators could tell which group the volunteers were in
- **iii)** Both Subject and Evaluator Bias
- **iv)** Selection Bias- the volunteers decided which group they were in
- **(v)** None of the above types of bias

**c)** *(2 pts.)* Will there be confounders that the researchers will have to adjust for? ***Choose one:***

- **i)** Yes, anytime you do any study confounders will be present.
- **(ii)** No, group 1 and group 2 will be as alike as possible. b/c it was an ideal experiment!
- **iii)** Maybe, it depends on the results of the study.

**d)** *(2 pts.)* What comparison do we make at the end if people stop taking their vitamins? ***Choose one:***

- **(i)** Compare everyone in treatment to everyone in control to keep the original randomization
- **ii)** Only compare those who took their vitamins (adherers) to those who took the water pill (adherers).
- **iii)** Compare those who took their vitamins (adherers) to those who didn't take their vitamins (non-adherers).

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**Question 3** *(2 pts.)* There are two sections of Stat 100 this semester. One meets 3 times per week (MWF class) and the other meets 2 times per week (Tues/Thurs class). Which is better for learning? In order to come to a conclusion, I'd have to design an experiment. Which of the following would be best? ***Choose one***

**a)** Allow all Stat 100 students to decide which section they think will be best for them and register for that section. At the end of the semester, compare the grades of the MWF class and Tues/Thurs class to see who did better.

**b)** Put all of next semester's Stat 100 students in a MWF class and compare their grades to this semester's Tues/Thurs section to see who has a higher average.

**c)** Randomly assign half of the Stat 100 students to the MWF class and the other half to the Tues/Thurs class. At the end of the semester, compare the averages of both classes.

**d)** Give all of the students a math test. Take the students who score highest and put them in the Tues/Thurs class and then take the rest of the students and put them in the MWF class since they'll probably need to see the material 3 times per week. At the end of the semester, compare the grades of the two sections.

**Question 4** *(5 points total)* ABC 7 Chicago recently reported on a study that said that people who drink a glass of wine each night are less likely to be overweight than those who don't. The title of the article was "Drinking a glass of wine each night is equivalent to going to the gym for an hour."

**a)** *(1 pt.)* This is an example of a.... ***Choose one:*** **i)** Observational study **ii)** Randomized Controlled Experiment

**b)** *(2 pts.)* Say I thought household income could be a confounder because people with high incomes are both more likely to drink a glass of wine each night and have a gym membership to help keep their weight down. How could I check to see if household income is a confounder? Stratify @ the end of the study

**i)** At the beginning of the study, divide the subjects into subgroups based on whether or not they drink wine and then at the end of the study compare their weights.

**ii)** At the beginning of the study, divide the subjects into subgroups based on income and then at the end of the study, compare the amount of wine each income group drank

**iii)** At the end of the study, divide the subjects into subgroups based on age and compare their weights of the younger subjects who drank wine to the older subjects who drank wine.

**iv)** At the end of the study, divide the subjects into subgroups based on income and compare the weights of the high-income subjects who drank wine to the high-income subjects who did not. Do the same for the low-income subjects.

**c)** *(2 pts.)* Based only on the given information, which of the following could **confound** the results?

**i)** Alcohol- wine contains alcohol, which is known to help build muscle mass. This is why people who drink wine are in better shape than those who don't.

**ii)** Good Health- people who are in good health are more likely to go to the gym and drink a glass of wine with dinner each night.

**iii)** Grapes- wine contains grapes which are a fruit high in antioxidants. Eating fruit helps people get in better shape.

**iv)** There should not be any confounders in this type of experiment.

**Question 5** *(9 pts. total)* **pertains to the following list of 6 numbers:** 1, -4, -3, 4, 3, 5 -4, -3, 1, 3, 4, 5

**a)** *(2 pts.)* The average is 1 and the median is 2

**b)** *(3 pts.)* The **deviations** from the **average** are 0, -5, -4, 3, 2, 4 *order doesn't matter

**c)** *(2 pts.)* The sum of the deviations from the average should = 0. *Fill in the blank with a number.*

**d)** *(2 pts.)* Compute the Standard Deviation and circle your final answer. Round your answer to 2 decimal places. ***No work, no credit. You may start with the deviations you found in part (b).***

$$SD = \sqrt{\frac{0^2 + (-5)^2 + (-4)^2 + 3^2 + 2^2 + 4^2}{6}} = 3.42 \text{ or } 3.4 \text{ or } 3.41$$

Steps: ① avg ② deviations ③ square deviations ④ avg of squared deviations ⑤ square root

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**Question 6** *(5 pts. total)* Two different types of treatment are being used against tumors. After an extensive study, here are the results in the table below.

| | Treatment A | | Treatment B | |
|---|---|---|---|---|
| | **Number** | **Success Rate** | **Number** | **Success Rate** |
| **Small Tumors** | 65 | 92% | 16 | 94% |
| **Large Tumors** | 35 | 71% | 84 | 76% |
| **Total** | 100 | 85% | 100 | 79% |

**a)** *(1 pt.)* Which treatment is better for small tumors?

***Choose one:*** **i)** Treatment A (ii) Treatment B **iii)** Unknown

**b)** *(1 pt.)* Which treatment is better for large tumors?

***Choose one:*** **i)** Treatment A (ii) Treatment B **iii)** Unknown

**c)** *(1 pt.)* Which is treatment is better overall? accept any answer - confusing wording

***Choose one:*** (i) Treatment A (ii) Treatment B (iii) Unknown

**d)** *(2 pts.)* What is the best conclusion based on the data above? ***Choose one:***

**i)** It's impossible to make a decision because there is probably a mathematical error when calculating the percentages.

**ii)** It's clear that treatment A is better because we always want to compare the overall percentages when making a conclusion from a study.

**(iii)** Treatment B is better because if we look individually at both large tumors and small tumors, it has the higher success rate.

**iv)** Treatments A and B both work equally well because one works better individually, and one works better overall.

**Question 7** *(10 pts. total)* A recent survey asked college students majoring in statistics how many hours per week they spend on homework. The results are summarized in the table below.

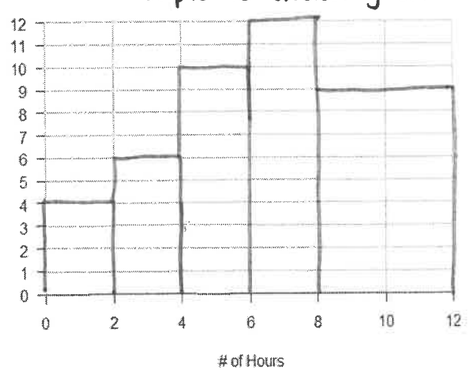
**a)** *(5 pts.)* **Fill in the 5 blanks in the table below.**

**b)** *(2 pts.)* **Draw the histogram on the graph to the right.**

2 pts for drawing correctly

| **Hours** | **Area %** | **Height of Block (% per hour)** |
|---|---|---|
| 0-2 | 8 | 4 (1 pt.) |
| 2-4 | 12 | 6 |
| 4-6 | 20 | 10 (1 pt.) |
| 6-8 | 24 | 12 (1 pt.) |
| 8-12 | 36 (1 pt.) | 9 (1 pt.) |

Sum = 100%.




**c)** *(2 pts.)* What value represents the 40th percentile? 6

40%.

**d)** *(1 pt.)* The number of people who answered 0-6 hours is _____ the number of people who answered 6-12 hours.

60%.

***Choose one:*** (i) less than **ii)** more than **iii)** the same as

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**Question 8** *(10 points total)* **Answer the following questions about measures of center and spread:**

**a)** *(3 pts.)* Consider this list of numbers: **1, 1, 1, 1, 1.** Fill in the 3 blanks below with numbers.

**v)** What is the average? 1 ii) What is the median? 1 iii) What is the SD? 0

**b)** *(3 pts.)* If the SD of a list of numbers is 1, which of the following is true? ***Circle True or False for each part.***

| | | |
|---|---|---|
| **i)** The average must be 1 | True | (False) |
| **ii)** All the numbers must be the same ⇒ SD = 0 | True | (False) |
| **iii)** If I add 1 to every number, the SD of the list is 2 | True | (False) |

**c)** Minions have an average weight of 1000g and a standard deviation of 50g. Use this information for both parts 1 & 2.

**Part 1**: If every minion eats a 100g banana, what is the new average weight and standard deviation of minions (immediately after eating)? Fill in the blanks with *NUMBERS, not words*.

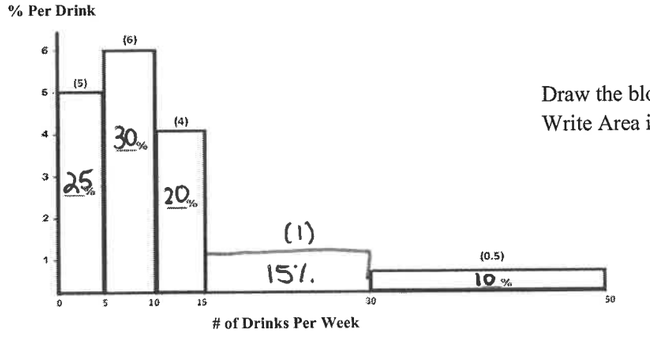
*(1 pt.)* Average 1100 g *(1 pt.)* SD 50 g

**Part 2:** Instead of eating a banana, the minions go to Mars, where the gravity is only 40% of Earth's (in other words, weight on Mars= 0.4*Weight on Earth). Ex. a 100-pound person on Earth will weigh 40 pounds on Mars.

Assuming the minions have the original average weight (1000g) and standard deviation (50g) on Earth, what will their average weight and standard deviation be on Mars?

*(1 pt.)* Average 400 g *(1 pt.)* SD 20 g

**Question 9** *(13 points total)* Below is a histogram displaying our survey results to the question: "How many alcoholic beverages do you consume per week on the average?" The 15-30 block is missing. **(Assume an even distribution throughout the interval.)**




Draw the block over the 15-30 interval.
Write Area inside block and height above block.

**a)** *(4 pts.)* Fill in the percentage for each block in the blanks provided on the histogram above.

**b)** *(1 pt.)* **Draw** in the missing block **accurately** in the histogram above.

**i)** *(1 pt.)* What is the area of the block? 15 %

**ii)** *(1 pt.)* What is the height of the block 1 % per drink.

**c)** *(2 pts.)* What percentage of students reported consuming exactly 12 alcoholic beverages per week?

***Choose one:*** **i)** 1% **ii)** 4% **iii)** 8% **iv)** 20%

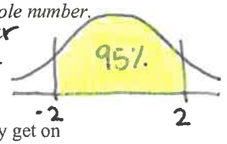
**d)** *(2 pts.)* The average is long right hand tail than the median. ***Choose one:*** **i)** greater **ii)** less **iii)** equal

**e)** *(2 pts.)* Is it appropriate to use the normal curve as an approximate histogram for this data? ***Choose one:*** **i)** yes **b)** no

**Question 10** *(29 points total)* The number of hours of sleep that students got on Reading Day is approximately normally distributed with an average of 6.5 hrs. & an SD of 1.5 hrs. Use the normal approximation to answer the following questions. **Show work where it says to or no credit!** *You may round percentages on the normal table to the nearest whole number.*

**a)** *(2 pts.)* About 95% of students got between 3.5 & 9.5 hours of sleep on Reading Day. *order doesn't matter

**Show work:** val = 6.5 + (-2)(1.5) = 3.5
val = 6.5 + (2)(1.5) = 9.5




**b)** *(2 pts.)* If a student is 1 SD **above** average, what is their z-score and how many hours of sleep did they get on Reading Day?

**z-score=** 1 **Hours of Sleep=** 8 **Show work:** val = 6.5 + (1)(1.5)

**(no work necessary)**

**c)** *(2 pts.)* If a student is 0.6 SDs **below** average, what is their z-score and how many hours of sleep did they get on Reading Day last semester? **No work, no credit.**

**z-score=** -0.6 **Hours of Sleep=** 5.6 **Show work:** val = 6.5 + (-0.6)(1.5)

**(no work necessary)**

**d)** Approximately what percent of students got between 4.7 and 5.6 hours of sleep? **No work, no credit.**

**i)** *(2 pts.)* Translate this interval into Z scores. -1.2 to -0.6

$Z = \frac{4.7 - 6.5}{1.5} = -1.2$

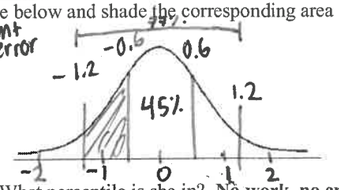
$Z = \frac{5.6 - 6.5}{1.5} = -0.6$

**ii)** *(1 pt.)* Mark the Z scores correctly onto the curve below and shade the corresponding area

**iii)** *(2 pts.)* Calculate the percent 16 % cont error

accept btwn 15.5 & 16.5

$\frac{77 - 45}{2} = 16$



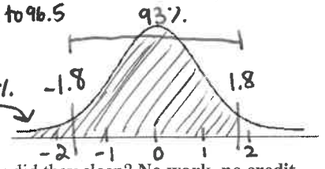

**e)** *(3 pts.)* One student claimed to sleep for 9.2 hours. What percentile is she in? **No work, no credit.** cont error

**z- score=** 1.8 **percentile=** 96.5th accept 96 to 96.5

Mark the z-score on the curve and shade the percentile!

$Z = \frac{9.2 - 6.5}{1.5} = 1.8$

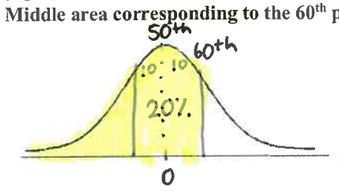
$\frac{100 - 93}{2} = 3.5\%$




**f)** *(5 pts.)* One student is in the 60th percentile. How many hours did they sleep? **No work, no credit.** cont error

**Middle area corresponding to the 60th percentile=** 20% (2 pts) **z-score=** 0.25 (1 pt) **value=** 6.875 (1 pt) **hrs.**

val = 6.5 + (0.25)(1.5)




Mark the z-score on the curve and shade the percentile! 1 pt for picture

**g)** *(2 pts.)* Another student is in the 40th percentile. How many hours did they sleep?

**z-score=** -0.25 **, value=** 6.125 **hrs. Show work:** val = 6.5 + (-0.25)(1.5)

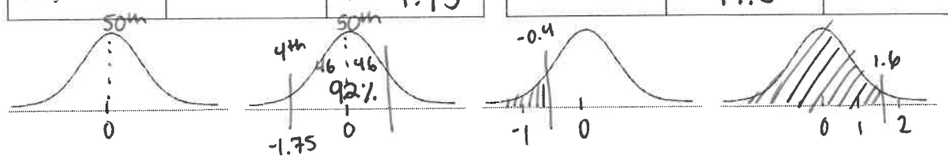
**(no work necessary)** cont error from g

**h)** *(8 pts.)* In the table below, you are given either the Z score or the percentile for 4 students. Fill in the 4 blanks.

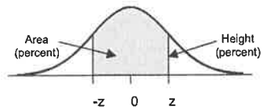
| Student | Percentile | Z-Score |
|---|---|---|
| Karle | 50th | i) 0 |
| Carly | 4th | ii) -1.75 |

| Student | Percentile | Z-Score |
|---|---|---|
| Carlie | iii) 34.5th | -0.4 |
| Karli | iv) 94.5th | 1.6 |

2 pts each, no pts for these



## STANDARD NORMAL TABLE




Standard Units

| *z* | *Area* | | *z* | *Area* | | *z* | *Area* |
|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | | 1.50 | 86.64 | | 3.00 | 99.730 |
| 0.05 | 3.99 | | 1.55 | 87.89 | | 3.05 | 99.771 |
| 0.10 | 7.97 | | 1.60 | 89.04 | | 3.10 | 99.806 |
| 0.15 | 11.92 | | 1.65 | 90.11 | | 3.15 | 99.837 |
| 0.20 | 15.85 | | 1.70 | 91.09 | | 3.20 | 99.863 |
| 0.25 | 19.74 | | 1.75 | 91.99 | | 3.25 | 99.885 |
| 0.30 | 23.58 | | 1.80 | 92.81 | | 3.30 | 99.903 |
| 0.35 | 27.37 | | 1.85 | 93.57 | | 3.35 | 99.919 |
| 0.40 | 31.08 | | 1.90 | 94.26 | | 3.40 | 99.933 |
| 0.45 | 34.73 | | 1.95 | 94.88 | | 3.45 | 99.944 |
| 0.50 | 38.29 | | 2.00 | 95.45 | | 3.50 | 99.953 |
| 0.55 | 41.77 | | 2.05 | 95.96 | | 3.55 | 99.961 |
| 0.60 | 45.15 | | 2.10 | 96.43 | | 3.60 | 99.968 |
| 0.65 | 48.43 | | 2.15 | 96.84 | | 3.65 | 99.974 |
| 0.70 | 51.61 | | 2.20 | 97.22 | | 3.70 | 99.978 |
| 0.75 | 54.67 | | 2.25 | 97.56 | | 3.75 | 99.982 |
| 0.80 | 57.63 | | 2.30 | 97.86 | | 3.80 | 99.986 |
| 0.85 | 60.47 | | 2.35 | 98.12 | | 3.85 | 99.988 |
| 0.90 | 63.19 | | 2.40 | 98.36 | | 3.90 | 99.990 |
| 0.95 | 65.79 | | 2.45 | 98.57 | | 3.95 | 99.992 |
| 1.00 | 68.27 | | 2.50 | 98.76 | | 4.00 | 99.9937 |
| 1.05 | 70.63 | | 2.55 | 98.92 | | 4.05 | 99.9949 |
| 1.10 | 72.87 | | 2.60 | 99.07 | | 4.10 | 99.9959 |
| 1.15 | 74.99 | | 2.65 | 99.20 | | 4.15 | 99.9967 |
| 1.20 | 76.99 | | 2.70 | 99.31 | | 4.20 | 99.9973 |
| 1.25 | 78.87 | | 2.75 | 99.40 | | 4.25 | 99.9979 |
| 1.30 | 80.64 | | 2.80 | 99.49 | | 4.30 | 99.9983 |
| 1.35 | 82.30 | | 2.85 | 99.56 | | 4.35 | 99.9986 |
| 1.40 | 83.85 | | 2.90 | 99.63 | | 4.40 | 99.9989 |
| 1.45 | 85.29 | | 2.95 | 99.68 | | 4.45 | 99.9991 |