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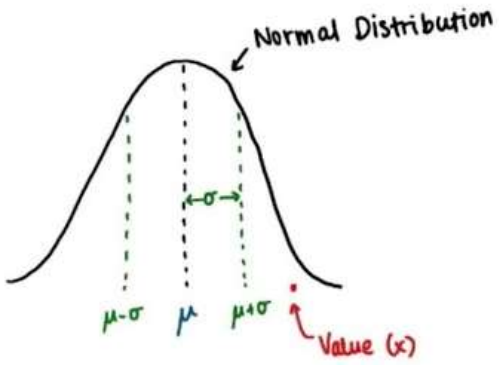
Notes for Students – Lesson 7
Sampling Distribution

Q1



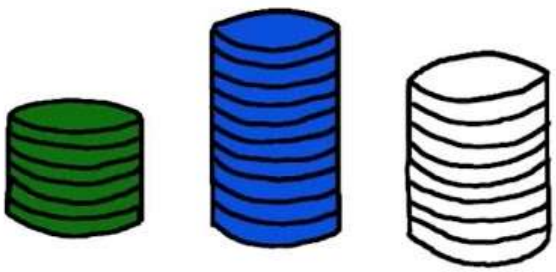
What about for a sample?
How can we compare a sample in a population to other samples in that population?

- ☐ By finding the mean of this sample
- ☐ By finding the means of other samples in this population
- ☐ By comparing the mean of this sample to the others

Q2

Roll the die twice

What's the probability that the average of your two rolls will be at least three?



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Q2-Part 1

Population: 1, 2, 3, 4

What's the mean of the "population"?

Q2- Part 2

Population: 1, 2, 3, 4

$\mu = 2.5$ (expected value)

Samples (n=2)		Sample mean	
1, 2	→	mean = 1.5	LOSE
1, 1	→	mean = 1	LOSE
3, 4	→	mean = 3.5	WIN

How many total possibilities (i.e. samples of size 2) can we select from this population?

Q2-Part 3

Population: 1, 2, 3, 4 — Find the mean of each sample.

$\mu = 2.5$ (expected value)

16 samples of size 2

1, 1	2, 1	3, 1	4, 1
1, 2	2, 2	3, 2	4, 2
1, 3	2, 3	3, 3	4, 3
1, 4	2, 4	3, 4	4, 4

Q2-Part 4

Population: 1, 2, 3, 4 — What's the mean of the sample means?

$\mu = 2.5$ (expected value)

16 samples of size 2

1, 1 $\bar{x}_1 = 1$	2, 1 $\bar{x}_5 = 1.5$	3, 1 $\bar{x}_9 = 2$	4, 1 $\bar{x}_{13} = 2.5$
1, 2 $\bar{x}_2 = 1.5$	2, 2 $\bar{x}_6 = 2$	3, 2 $\bar{x}_{10} = 2.5$	4, 2 $\bar{x}_{14} = 3$
1, 3 $\bar{x}_3 = 2$	2, 3 $\bar{x}_7 = 2.5$	3, 3 $\bar{x}_{11} = 3$	4, 3 $\bar{x}_{15} = 3.5$
1, 4 $\bar{x}_4 = 2.5$	2, 4 $\bar{x}_8 = 3$	3, 4 $\bar{x}_{12} = 3.5$	4, 4 $\bar{x}_{16} = 4$

Q2-Part 5 --- Wolfram Alpha www.math.wolfram.com

Population: 1, 2, 3, 4

$\mu = 2.5$ (expected value)

16 samples of size 2 M=2.5

Distribution of sample means = SAMPLING DISTRIBUTION

What's the shape?

- Uniform
- Bimodal
- Normal
- Skewed

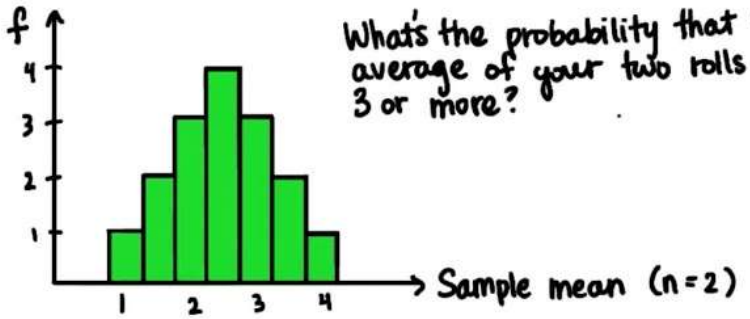
Q2-Part 6 – Let's revisit the initial question

Population: 1, 2, 3, 4

$\mu = 2.5$ (expected value)

16 samples of size 2 M=2.5

Distribution of sample means = SAMPLING DISTRIBUTION



What's the probability that the average of your two rolls will be 3 or more?

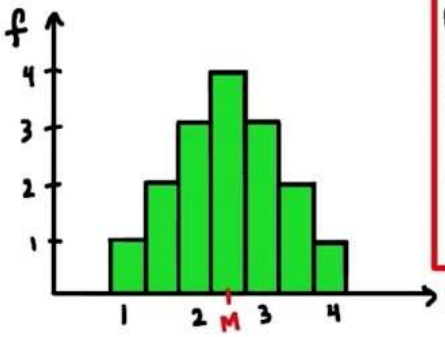
Q2-Part 7

Population: 1, 2, 3, 4

$\mu = 2.5$ (expected value)

16 samples of size 2 M=2.5

Distribution of sample means = SAMPLING DISTRIBUTION



What do we need to know to compare the mean of a single sample with the other samples in the distribution?
- total number in the population
- SD of the dist. of sample means
- total number of possible samples

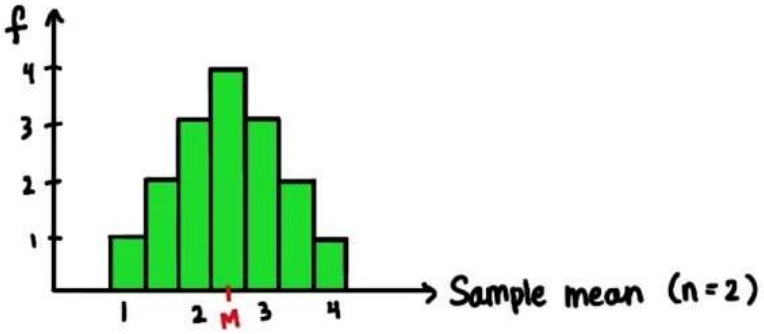
Q3 –Part A -- Calculate S.D of Sample Means (SE) and Population

Population: 1, 2, 3, 4

$\mu = 2.5$ (expected value) $\sigma =$

16 samples of size 2 M=2.5 SE =

Distribution of sample means = SAMPLING DISTRIBUTION



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Q3 –Part B

	A	B	C	D
1		2.25	1.25	
2	Population: 1	0.25	1.11803398874989	<-- sigma
3	2	0.25		
4	3	2.25		
5	4			
6	1	2.25	0.625	
7	1.5	1	0.790569415042095	<-- SE
8	2	0.25		
9	2.5	0		
10	1.5	1		
11	2	0.25		
12	2.5	0		
13	3	0.25		
14	2	0.25		
15	2.5	0		
16	3	0.25		
17	3.5	1		
18	2.5	0		
19	3	0.25		
20	3.5	1		
21	4	2.25		
22				

Distribution of sample means

Do you think the population SD (σ) and the SD of the sampling distribution (SE) have any relationship to each other?

- Yes
- No

What is the ratio of σ to SE?

$$\frac{\sigma}{SE} =$$

Do you know what this number is?

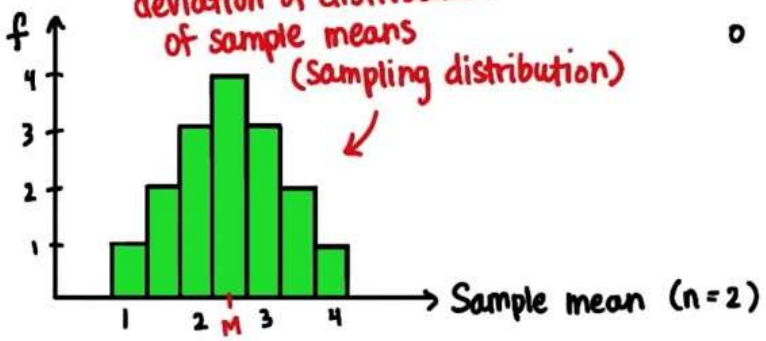
Q3 –Part C

1, 2, 3, 4

Population standard deviation

$$\frac{\sigma}{SE} = \sqrt{n}$$

Standard deviation of distribution of sample means (Sampling distribution)



What is SE?

- $SE = \sigma$
- $SE = \sqrt{n}$
- $SE = \frac{\sigma^2}{n}$
- $SE = \frac{\sigma}{\sqrt{n}}$

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DIMENSIONLESS TECHNOLOGY

The Central Limit Theorem

Q4 http://www.math.uah.edu/stat/apps/DiceExperiment.html

What happens when you roll one die at least 100 times?
The distribution is:

- o Normal
- o Skewed
- o Uniform
- o Bimodal

Example:

1, 2, 3, 4, 5, 6

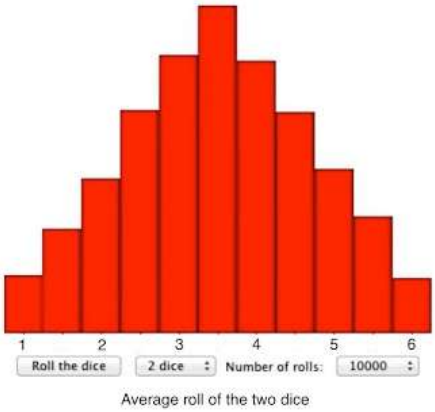
What happens when you roll two dice at least 100 times and take the average? The distribution is:

- o Normal
- o Skewed
- o Uniform
- o Bimodal

Q5

What are the mean and standard deviation of this sampling distribution with $n = 2$?

Population: 1, 2, 3, 4, 5, 6



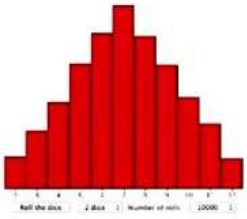
mean

standard deviation

Q6- Part 1

Population: 1, 2, 3, 4, 5, 6

$\sigma = 1.7078$



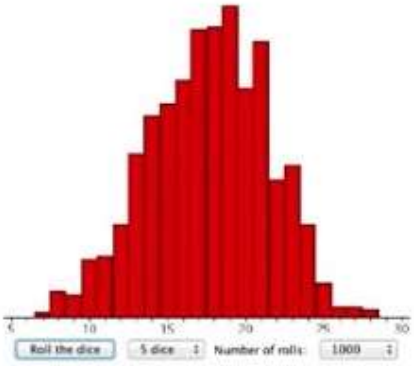
$n = 2$

$\frac{\sigma}{\sqrt{n}} = 1.2076$

Will the distribution of means of samples of size 5 be skinnier or wider than the distribution of means taken from samples of size 2?

- o Skinnier
- o Wider

Q6-Part 2

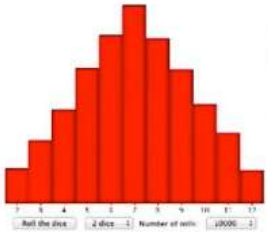


What is the standard deviation of the sampling distribution with $n = 5$?

Q6-Part 3

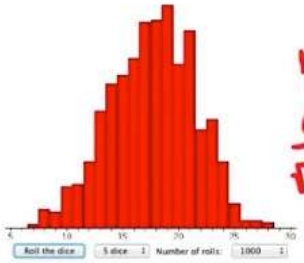
Population: 1, 2, 3, 4, 5, 6

$\sigma = 1.7078$



$n = 2$

$\frac{\sigma}{\sqrt{n}} = 1.2076$



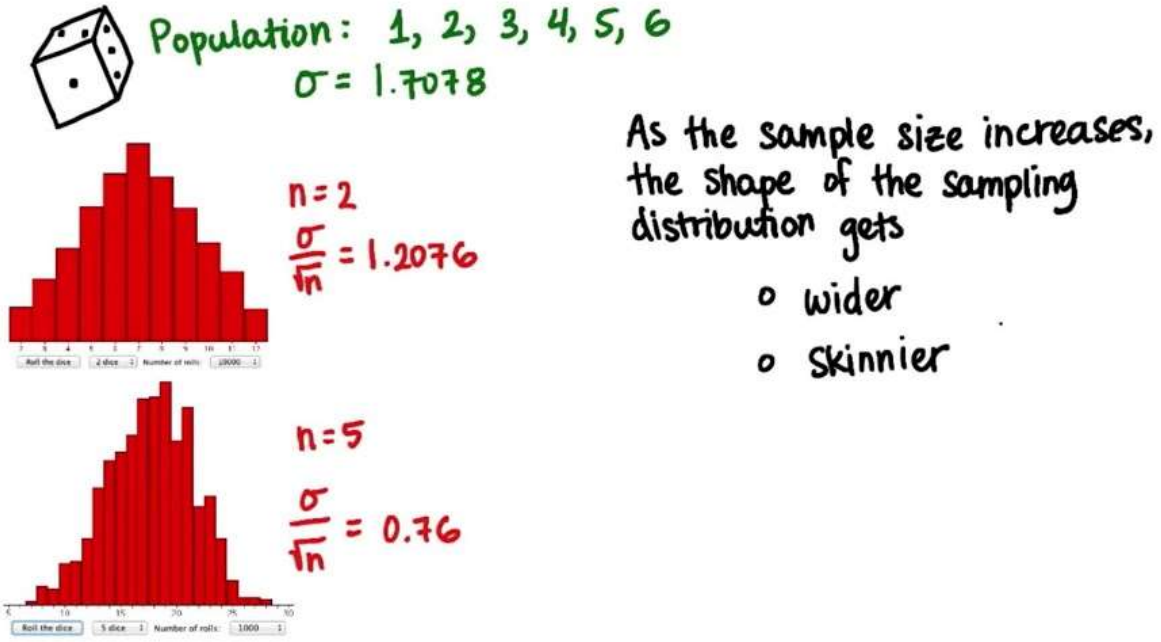
$n = 5$

$\frac{\sigma}{\sqrt{n}} = 0.76$

As the sample size increases, the standard error

- increases
- decreases

Q6-Practice :- On applet change the values of n and see the shape of the distributions.



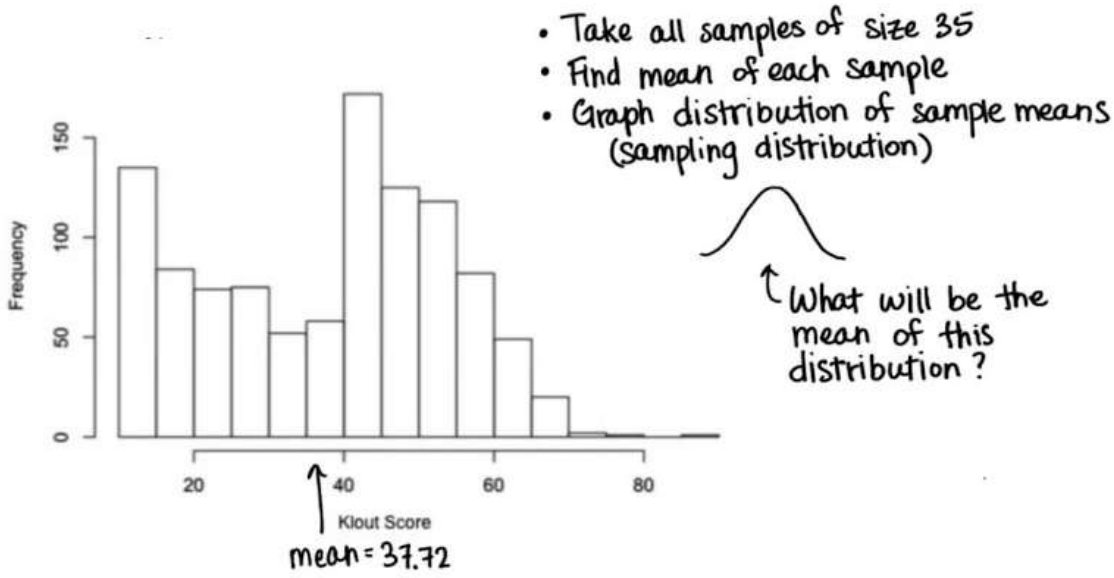
Q7:- Applet

http://onlinestatbook.com/stat_sim/sampling_dist/index.html

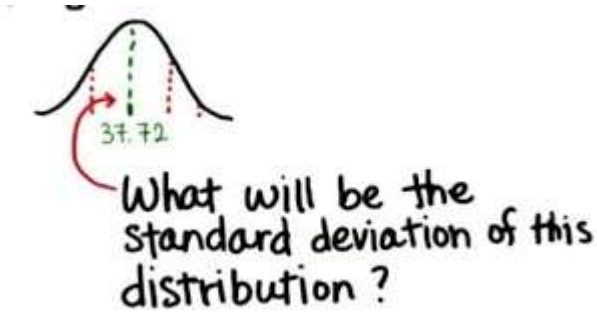
Q8:-

Open the spreadsheet of Klout scores. Calculate the mean:
standard deviation:
(population)

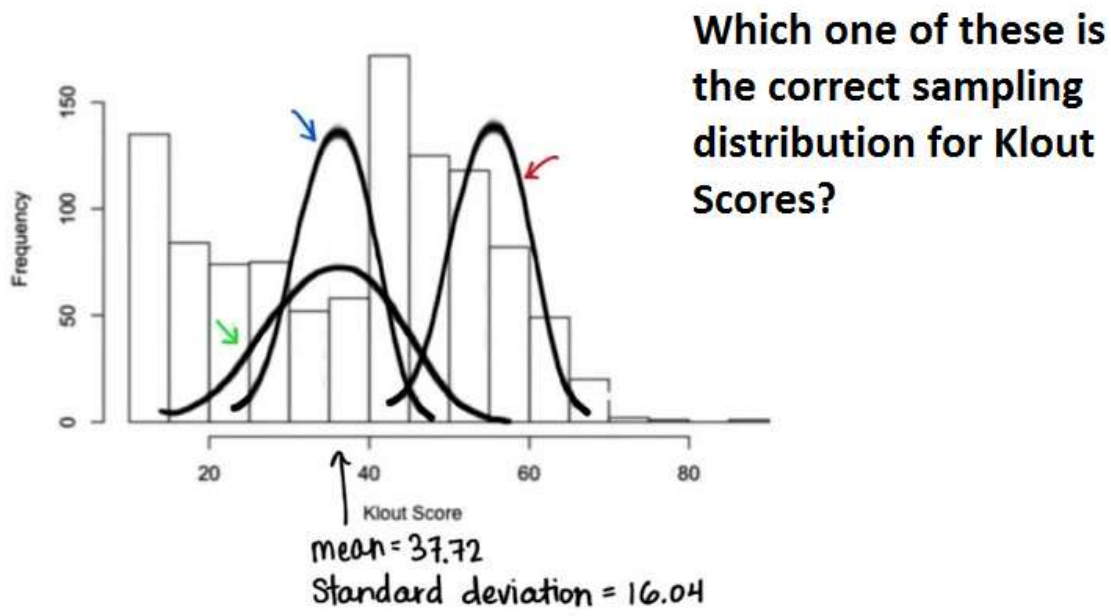
Q9- Part 1



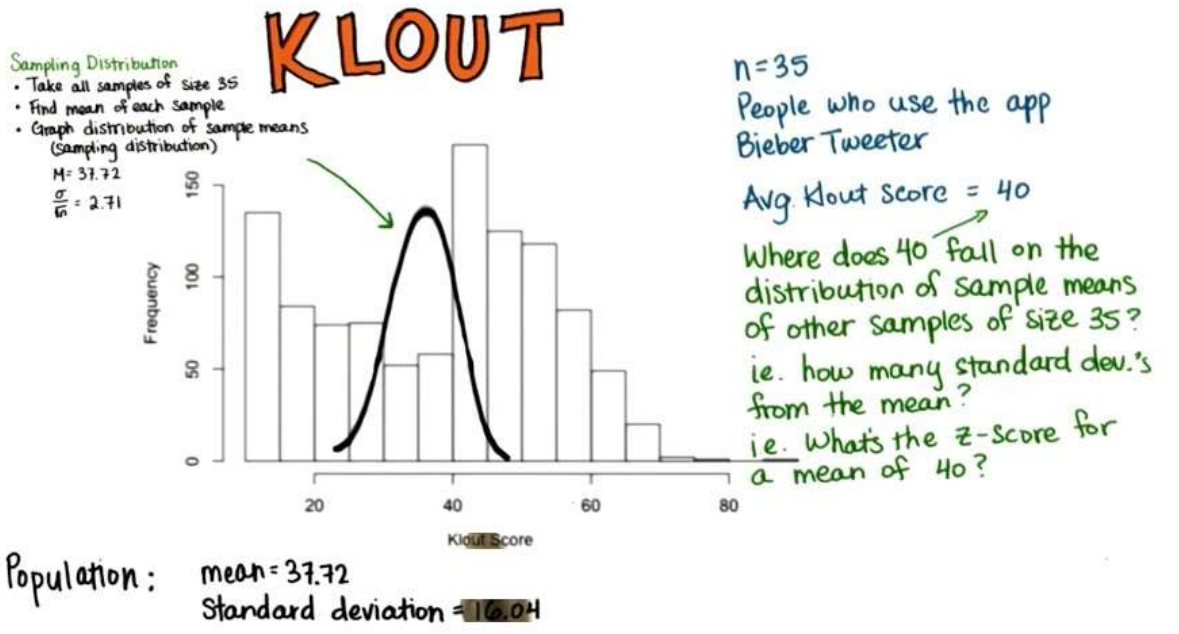
Part 2



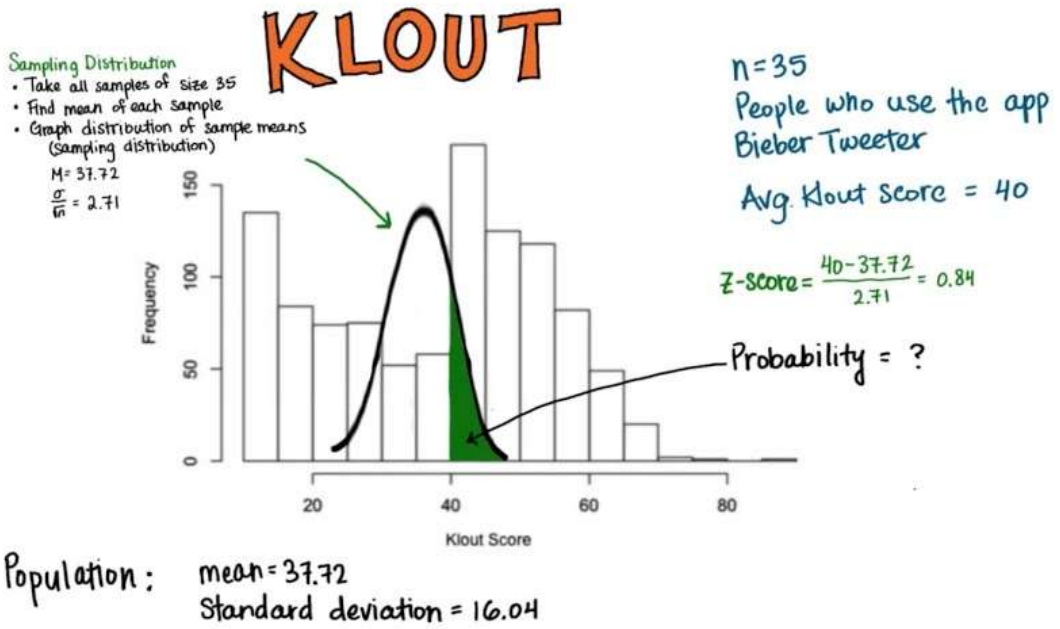
Q10:-


Which one of these is the correct sampling distribution for Klout Scores?
Frequency
0
50
100
150
20
40
60
80
Klout Score
mean = 37.72
Standard deviation = 16.04

Q11:-

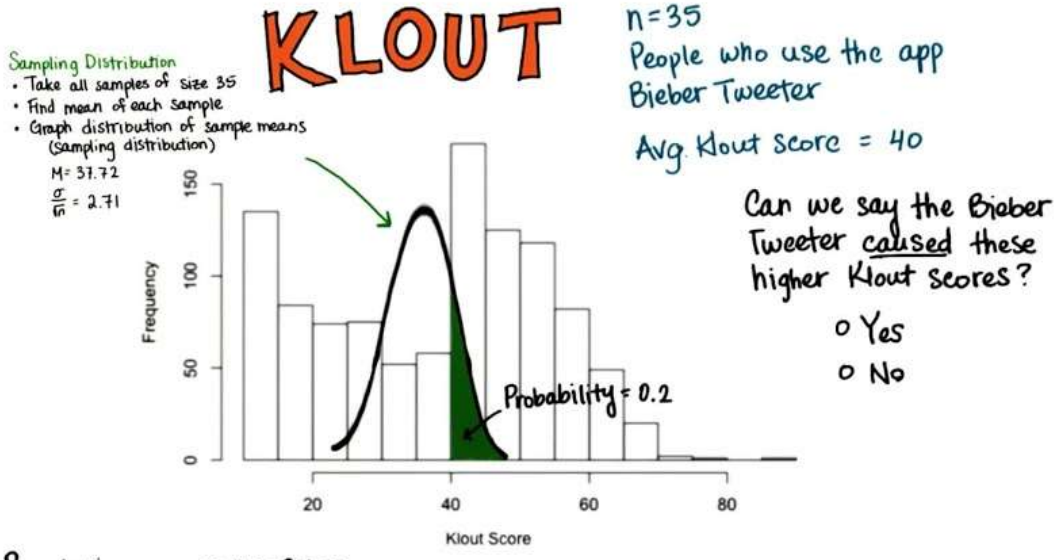

KLOUT
Sampling Distribution
• Take all samples of size 35
• Find mean of each sample
• Graph distribution of sample means (sampling distribution)
M = 37.72
σ/√n = 2.71
Frequency
0
50
100
150
20
40
60
80
Klout Score
n = 35
People who use the app
Bieber Tweeter
Avg Klout score = 40
Where does 40 fall on the distribution of sample means of other samples of size 35?
ie. how many standard dev.'s from the mean?
ie. What's the z-score for a mean of 40?
Population:
mean = 37.72
Standard deviation = 16.04

Q12- Part1



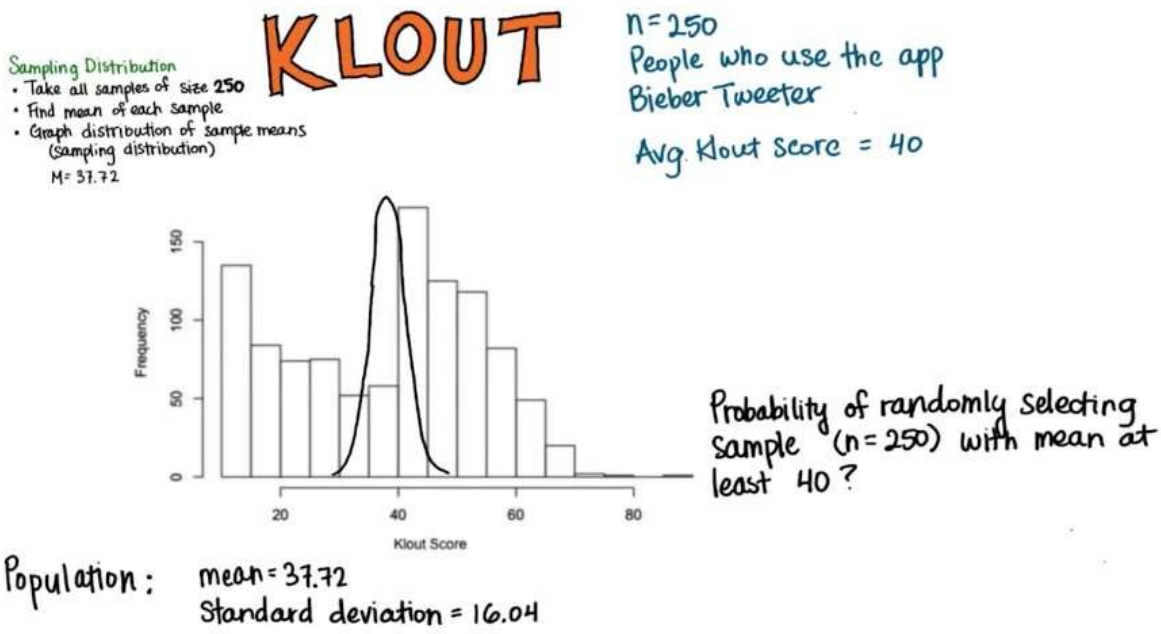
Population : mean = 37.72
Standard deviation = 16.04

Q12- Part2



Population : mean = 37.72
Standard deviation = 16.04

Q13



Class Work

https://docs.google.com/spreadsheets/d/1q7X9vFmUu639h1hJCFCdVPk61X60S42GTuQ3oPSS-6Q/edit?usp=sharing

GREAT JOB SO FAR!

TIME FOR SOMETHING FUN ☺

1. Pick a number between 1 and 1048. Click the link to access the Klout score data, and find the Klout score in the row of the number you picked. Write it down.
2. Pick 5 numbers between 1 and 1048. Find the Klout scores in these rows, take the average, and write this number down.
3. Repeat step 2 with 10 numbers.
4. Write these numbers in the Google Form (link below).