Question 1 pertains to tossing a fair coin *(8 pts.)*
Fill in the blanks with the correct numbers to make the 2 scenarios equally likely:

a) Getting 10 +/- 2 head in **20** tosses *is the same probability as* getting _____ +/- _____heads in **320** tosses

b) Getting 50% +/- 10% heads in **10** tosses *is the same probability as* getting _____% +/- _____% heads in **1,000** tosses

Question 2 pertains to the probability histograms below which display chances for coin tosses and dice rolls. *(12 pts.)*
Match the histograms with their description by writing the correct letter in each blank. *Use each histogram exactly once.*

i) The probability histogram for tossing a fair coin twice and counting the total number of heads is _____

ii) The probability histogram for tossing a fair coin 3 times and counting the total number of heads is _____

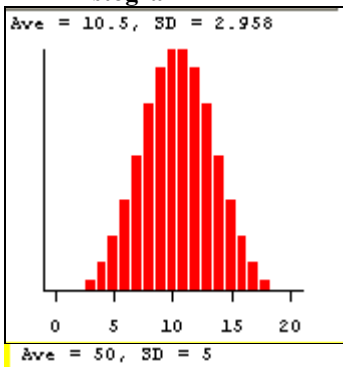
iii) The probability histogram for tossing a fair coin 100 times and counting the total number of heads is_____

iv) The probability histogram for rolling a fair die once and counting the number of spots is _____

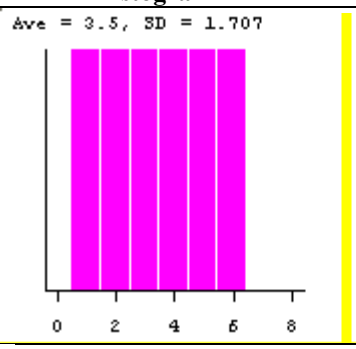
v) The probability histogram for rolling a fair die twice and counting the total number of spots is _____

vi) The probability histogram for rolling a fair die three times and counting the total number of spots is _____

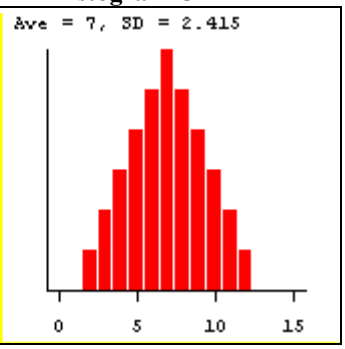
Histogram A

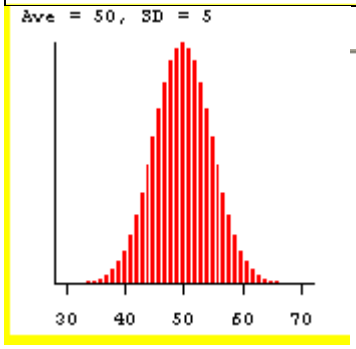


Histogram B

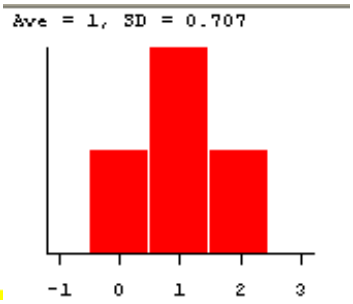


Histogram C

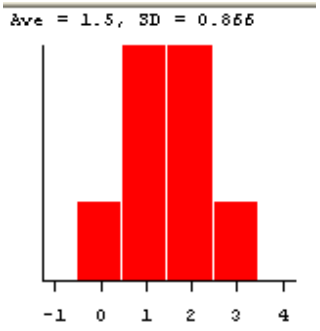




Histogram D



Histogram E



Histogram F

Question 3 *(6 pts.)*

Look at the 3 boxes below. In each box there are tickets with numbers written on them.

Box A: 1 -1 Box B: 0 1 Box C: 0 0 0 1 0

a. Which box has the largest SD? Box _____ (*2 pts*.) Which one has the smallest? Box_____(*2 pts.)*
(*Fill in each blank with the correct letter*)

b. *(2 pts.)* Suppose we add 5 to the number on each of the 9 tickets above. How would the SD in each box change?

- **i.** The SD would stay the same in all the boxes.
- **ii.** The SD would increase in all the boxes.
- **iii.** The SD would decrease in all the boxes.
- **iv.** The SD would increase or decrease depending on the box.

Question 4 (*6 pts.*) Fill in the 6 blanks below with the correct numbers to make the statements true.

a) (*3 pts)* The largest the SD of a 0-1 box can be is _____. This happens when the box has_____% 0s and _____% 1s.

b) (*3 pts)* The smallest the SD of a 0-1 box can be is _____. This happens when the box has _____% 0s and _____% 1s.

Question 5 pertains to the following situation: (*18 pts.)*

64 draws are made at random with replacement from the box containing 6 tickets: 0 0 2 2 2 6

The SD of the box is 2.

a) *(2pts.)* The smallest the sum of the **64** draws could possibly be is _____and the largest the sum could be is_____

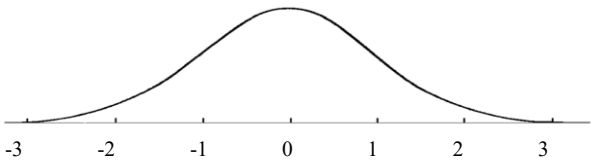
b) *(2pts.)* The expected value for the **sum** of the **64** draws is _____

c) *(2pts.)* The SE of the **sum** of the **64** draws is_____

d) *(4pts.)* Use the normal approximation and ***your answers from (b) and (c) above*** to find the **chance** that the sum of the 64 draws will be **less** than 132?

i) First calculate the Z score. ***Show work. Circle answer.*** *(2 pts.)*

ii) Now mark the Z score accurately and ***shade the area that represents the chance of getting less than 132***
Round the middle area given in the table to the nearest whole number. (1 pt. for shading)



Chance =_____% *(1 pt.)*

e) *(2pts.)* What is the expected value for the **average** of the **64** draws?_____

f) *(2pts.)* What is the SE of the **average** of the **64** draws? _____ **Show work**

Hint: For parts g and h, draw a new box.

g) *(2pts.)* What is the expected value for the **number of 2s** drawn in **64** draws? _____ **Show work**

h) *(2pts.)* What is the SE of the **number of 2s** drawn in **64** draws? _____ **Show work**

Question 6 *(4 pts.)*

ABC news conducted a public opinion poll where any Internet user could go and cast his or her vote. On Aug 12, 2016, the question was: "Who are you voting for?" 63,536 people voted, 70% voted "Trump" and 30% did not vote for Trump.

a) *(2 pts.)* What most closely resembles the relevant box model? ***Choose one:***

i) A box model is not appropriate for this poll because the sample was not randomly selected.
ii) It has 63,536 tickets; 70% marked "1" and 30% marked "0"
iii) It has millions of tickets marked with "1"s and "0"s. The exact percentages are unknown but are estimated from the sample.

b) *(2 pts.)* The main problem with this sample is … ***Choose one:***

i) Bias in the wording of the question.
ii) Sample Size
iii) Selection Bias since the people selected themselves

Question 7 pertains to the following situation: *(12 pts.)*

In roulette, there are 38 numbers, 0,00,1,2,3, 4…36. Consider betting \$1 on the four numbers 1, 2, 3, and 4. If the ball lands on any of the 4 numbers, you win \$8, but if the ball lands on any other number, you lose \$1. Imagine playing this bet **100 times.**

a) *(2 pts.)* Which of the following describes the corresponding box model?
Circle one:

i) A box that contains two tickets: 1 marked "8" and 1 marked "-1".
ii) A box that contains 38 tickets: one each of 1, 2, 3, ..., 36, 0, and 00.
iii) A box that contains 38 tickets: four marked "8" and thirty-four marked "-1".
iv) A box that contains 38 tickets: eighteen 1's, eighteen -1's, and two 0's
v) A box that contains 38 tickets: eighteen are 1's and twenty are -1's

b) *(2 pts.)* The _____ draws are made _____ replacement. (Fill in the first blank with the # of draws and the second blank with either "with" or "without")

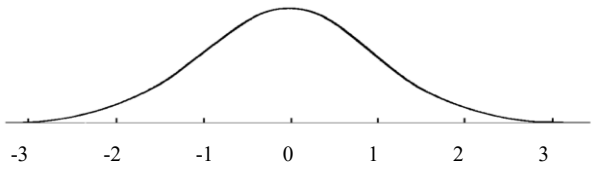
c) *(2 pts.)* The average of the box is closest to _____. *Leave your answer in fraction form.* **Show work below.**

d) *(2 pts.)* The SD of the box is closest to _____. *Round to 2 decimal places.* **Show work below.**

e) *(4 pts.)* Use the normal curve to estimate the chance that you'd win more than \$47 in 100 plays.
The EV= \$-5 and the SE= \$28.

i) *(2 pts.)* First calculate the Z score. ***Show work. Circle answer.***

ii) *(2 pts.)* Now mark the Z score accurately and ***shade the area that represents the chance of winning more than \$47***
Round the middle area given in the table to the nearest whole number. (1 pt.)



Chance =_____% (*1pt.)*

Question 8 *(5 pts.)*

A Quinnipiac poll conducted March 16-20, 2017, asked a random sample of 1,056 registered voters nation-wide: Would you say that Donald Trump is level-headed, or not? 30% responded that they would say "Yes, he is."

a) *(3 pts.)* True or False? Circle either true or false below each of the 3 statements:

i) The expected value for the percent of all registered voters nation-wide who would answer "Yes" is 30%.
Circle one: True False

ii) The expected value for the percent of all registered female voters nation-wide who would answer "Yes" is 30%.
Circle one: True False

iii) The expected value for the percent of all registered Republican voters nation-wide who would answer "Yes" is 30%.
Circle one: True False

b) *(2 pts.)* Is it possible to compute an approximate 95% confidence interval for the percent of all registered voters nation-wide who would say "Yes? ***Choose one:***

i) No, because we're not given the SD of the sample.

ii) Yes, an approximate 95% confidence interval is 30% +/- 2.8%

iii) No, because we cannot infer with 95% confidence the attitude of 180 million registered voters from data based on a sample of only 1,056 randomly selected Americans.

Question 9 pertains to the following situation: *(6 pts)*

A Time news poll conducted asked a random sample of 1,004 adults nationwide the following question "Do you support building a wall along the US-Mexico border?" On the same day MSNBC.com posted the same question on its website and allowed anyone to respond to it. 17,223 people voted on its website. Here are the results.

	Yes	No	Sample Size
Time random poll	56%	44%	1,004
MSNBC.com web-in poll	63%	37%	17,223

a) *(2 pts.)* Which survey gives a better estimate of the percentage of all US adults who would vote "YES" to building a wall on the US-Mexico border?
Choose one:

i) The MSNBC.com survey because the sample size is much larger.

ii) The Time survey because the sample was randomly selected

iii) Both surveys have about the same level of accuracy since difference in sample sizes is compensated by the differences in selection method.

b) *(2 pts.)* The SE of the percentage of people in the MSNBC.com sample who answered "YES" is closest to…
Choose one:

i) $\frac{\sqrt{.63*.37}}{\sqrt{17{,}223}}*100\%$ ii) $\sqrt{17{,}223}*\sqrt{.63*.37}*100\%$

iii) Impossible to compute a SE for this sample because it can't be translated into a box model.

c) *(2 pts.)* The SE of the percentage of people in the Time survey who answered "YES" is closest to …
Choose one:

i) $\frac{\sqrt{.56*.44}}{\sqrt{1{,}004}}*100\%$ ii) $\sqrt{1{,}004}*\sqrt{.56*.44}*100\%$

iii) Impossible to compute a SE for this sample because it's not a random sample so it can't be translated into a box model.

Question 10 *(14 pts.)*

To estimate social media use among all 40,000 UI undergrads. 400 randomly selected UI undergrads were asked "How many hours do you typically spend on social media each day?" **The average response was 3 hours with an SD of 2 hours.**

a) *(2 pts.)* Which most closely resembles the relevant box model? ***Choose one:***

- **i)** The box has 400 tickets marked with "1"s and "0"s
- **ii)** The box has 40,000 tickets marked with "1"s and "0"s
- **iii)** The box has 40,000 tickets, marked with numbers ranging from 0 to 24, the exact average is unknown but estimated from the sample.
- **iv)** The box has 400 tickets, marked with numbers ranging from about 0 to 24.
- **v)** The box has 400 tickets with an average of 3 and a SD of 2.

b) *(1 pt.)* How many draws from the box? ____

c) *(2 pts.)* ***Circle one*:** i) with replacement ii) without replacement

d) *(2 pts.)* The best estimate for the average number of hours all UI students spend on social media per day is _____

e) *(2 pts.)* What is the SE of the sample average? *Show work.* SE=_____

f) *(3 pts.)* The responses do not follow the normal curve. Is it still possible to construct a 95% confidence interval for the average exam score of all 40,000 students? **If so, fill in the upper and lower limits in the blanks provided.**

Choose one:

- **i)** No, if the data does not follow the normal curve, it's never possible to construct confidence intervals
- **ii)** No, it's not possible to construct confidence intervals for averages.
- **iii)** Yes, even though the data doesn't follow the normal curve, the probability histogram for the average of 400 draws will come pretty close to following the normal curve, so a 95% confidence interval is:

  (_____ to _____)

g) *(2 pts.)* The study also asked the 400 students what percent of their day do they typically spend on social media. The relevant box model for this question contains tickets with

- **i)** Only "1"s and "0"s
- **ii)** Only "1"s and "-1"'s
- **iii)** Numbers ranging from 0 to 100
- **iv)** A box model would not be appropriate for this question.

Question 11 *(8 pts.)*

a) *(2 pts.)* In a pre-election presidential poll in a close race, a polling organization wanted the margin of error for a 95% confidence interval to be 2%, how many people should they poll? **Assume SD=0.5.**

i) 400 **ii)** 625 **iii)** 1,111 **iv)** 2,500 **v)** 10,000

b) *(2 pts.)* What about if they wanted a 4% margin of error for a 95% confidence interval, how many people would have to be polled? **Assume SD=0.43.**

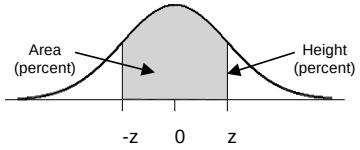
i) 400 **ii)** 625 **iii)** 462 **iv)** 2,500 **v)** 1,111

c) *(2 pts.)* In general, multiplying your sample size by 4 will _____the margin of error by _____.
Fill in the first blank with either "multiply" or "divide" and the second blank with a number.

d) *(2 pts.)* In a national election about 150 million people vote. In Illinois only about 8 million people vote. How would you adjust your answer in part (a) for a pre-election poll in Illinois?

i) keep it about the same **ii)** make it significantly smaller **iii)** make it significantly larger

STANDARD NORMAL TABLE



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