Name __Key__   # HW 14-4

1. Which of the following will have the smallest standard deviation? Explain your reasoning.
   A sampling distribution of sample means for samples of size:

   a. 15   b. 25   (c.)100

   As sample size ↑, variability in sample mean ↓.

2. Suppose you are interested in knowing how many text messages 10th, 11th and 12th graders send daily. Describe the steps that you would take to estimate the mean number of text messages per day sent by all the 10th – 12th graders at Baker High School.

   If you couldn't get all stud. responses, base est. on responses from random sample of stud. Need record of all stud. # them from 1 to n (n=#stud) i generate a selection of stud. using RN generator/table. Identify 10 stud. who were selected; ask how many texts they send/day. find mean of 10 responses → est. of mean # texts sent/day

   1. Suppose that 62 random samples based on ten student responses to the question, "How many text messages do you send per day?" resulted in the 62 sample means (rounded) shown below. by 10-12 graders

65	68	76	76	78	82	83	83	85	86	87	88	88
88	89	89	89	90	91	91	91	91	92	92	92	92
92	93	93	93	93	93	94	94	94	94	94	94	95
95	95	95	95	95	95	96	96	96	97	97	97	98
98	98	98	98	99	100	100	101	104	106			

   a. Draw a dot plot for the distribution of sample means.

   Sample Means
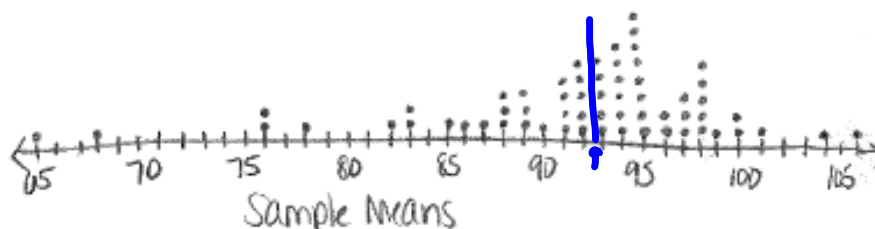
b. Based on your dot plot, would you be surprised in the actual mean number of text messages sent per day for students in Baker High School is 91.7? Why or why not?

NO, the distribution appears to be balanced around 92, so 91.7 is plausible.

2. Determine a visual estimate of the margin of error when a random sample of size 10 is used to estimate the population mean number of text messages sent per day.

Almost all sample means are roughly within 10 text messages of pop. mean 91.7, so visually the ME is 10 text messages on avg.

3. The standard deviation of the above distribution of sample mean number of text messages sent per day is 7.5. Use this to calculate and interpret the margin of error for an estimate of the population mean number of text messages sent daily by Baker students (based on a random sample of size 10 from this population).

$$ME = 2(7.5) = 15 \text{ text messages}$$

visual est. is quite a bit smaller than one using SD. However, they're the same if visual est. were to include all of the sample means from 77 to 107.

More Margin of Error When Estimating a Population Proportion

The past few days you simulated sampling distributions to learn about sampling variability in the sample proportion and the margin of error when using a random sample to estimate a population proportion. However, finding a margin of error using simulation can be cumbersome and can take a long time for each situation. Fortunately given the consistent behavior of the sampling distribution of the sample proportion for random samples, statisticians have developed a formula that will allow you to find the margin of error quickly and without simulation.

1. 30% of students participating in sports at Union High School are female (a proportion of 0.30).

    a. If you took many random samples of 50 students who play sports and made a dot plot of the proportion of females in each sample, where do you think this distribution will be centered? Explain your reasoning.

    The sampling distribution should centered around .30 (Pop. proportion)

    b. In general, for any sample size, where do you think the center of a simulated distribution of the sample proportion of females in sports at Union High School will be?

Should be centered around 0.30. Some samples will result in sampling prop. of females higher & lower than 0.30, but sampling distr. should be centered around 0.30.

2. Below are two simulated sampling distributions for the sample proportion of females in random samples from all the students at Union High School.

Simulated Sampling Distribution 1	Simulated Sampling Distribution 2
0.0 0.1 0.2 0.3 0.4 0.5 0.6 Sample Proportion	0.0 0.1 0.2 0.3 0.4 0.5 0.6 Sample Proportion
.27 to .52	.2 to .6
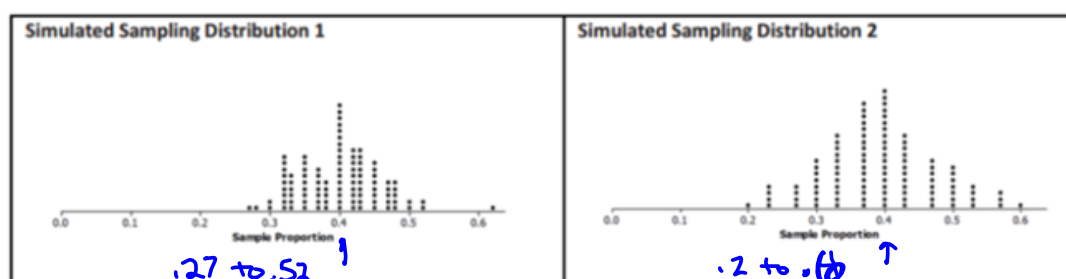
a. Based on the two sampling distributions above, what do you think is the population proportion of females? .4 (~center of distributions)

b. One of the sampling distributions above is based on random samples of size 30, and the other is based on random samples of size 60. Which sampling distribution corresponds to the sample size of 30? Explain your choice.
bigger spread so Dist #2

Conclusions:

- The sampling distribution of the sample proportion/mean is centered at the __actual__ value of the population proportion/mean.
- Sampling distribution of the sample proportion/mean is __less__ variable for larger samples than for smaller samples.
- 95% of all data lies within __2__ standard deviations from the mean.
  - Therefore, when they say create a 95% confidence interval, we use

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Estimated margin of error = 2(Standard Deviation)

95% Confidence Interval = Estimate ± 2(Standard Deviation)

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3. Elizabeth waited for 6 minutes at the drive thru at her favorite fast-food restaurant the last time she visited. She was upset about having to wait that long and notified the manager. The manager assured her that her experience was very unusual and that it would not happen again. A study of customers commissioned by this restaurant found an approximately normal distribution of results. The mean wait time was 226 seconds and the standard deviation was 38 seconds. Given this data create a 95% confidence interval.

$$CI = \bar{X} \pm 2\,SD$$
$$= 226 \pm 2(38)$$
$$= 226 \pm 76$$
$$= (150, 302) \text{ seconds}$$

Was Elizabeth's wait time unusual? Explain.

6 minutes = 360 seconds

Yes b/c 360 sec. is outside the 95% CI

4. Fifty-five students attending the prom were randomly selected to participate in a survey about the music choice at the prom. Sixty percent responded that a DJ would be preferred over a band. Members of the prom committee thought that the vote would have 50% for the DJ and 50% for the band. A simulation was run 200 times, each of sample size 55, based on the premise that 60% of the students would prefer a DJ. The mean was found to be 0.602 and standard deviation of 0.066. Using the results of the simulation, determine a plausible interval containing the middle 95% of the data. Round all values to the nearest hundredth.

$$CI = \bar{X} \pm 2\,SD$$
$$= .602 \pm 2(.066)$$
$$= .602 \pm .132$$
$$= (.470, .734)$$
$$= (.47, .73)$$

5. In 2013, approximately 1.6 million students took the Critical Reading portion of the SAT exam. The mean score, the ~~modal~~ *mode* score, and the standard deviation were calculated to be (496) 4̶3̶0̶, and (115), respectively. Which interval reflects 95% of the Critical Reading scores?

~~(1) 430 ± 115~~

(2) 496 ± 115

~~(3) 430 ± 230~~

(4) 496 ± 230

$$\bar{x} \pm 2SD$$

6. A candidate for political office commissioned a poll. His staff received responses from 900 likely voters and 55% of them said they would vote for the candidate. The staff then conducted a simulation of 1000 more polls of 900 voters, assuming that 55% of voters would vote for their candidate. The output of the simulation is shown in the diagram below.
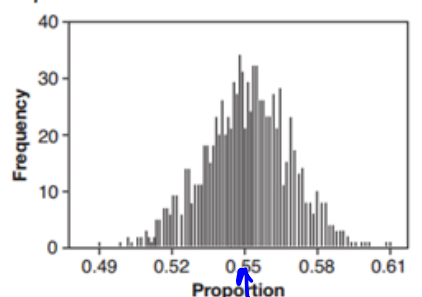
Given this output, and assuming a 95% confidence level, the margin of error for the poll is closest to

(1) 0.01   (2) 0.06 *all*   (3) 0.03   (4) 0.12

.49 to .61   .52 to .58

7. Recall the computer games rating example from yesterday. The population mean of the sampling distribution is 7.3 rating points. The standard deviation of the distribution of sample means is 1.984 rating points.

   a. What is the value of the margin of error based on this sample? Write a sentence interpreting the value of the margin of error in the context of this problem on computer game ratings.

   $$ME = 2\,SD = 2(1.984) = 3.968$$

   b. Based on the sample mean and the value of the margin of error, what is a 95% interval of plausible values for the population mean?

   $$CI = 7.3 \pm 3.968$$

   *Bring your phone/tablet to class tomorrow!

   $$(3.332, 11.268)$$