

**Unit Topic:** Sample Distributions      **Grade level:** AP Stats  
**Length of lesson:** 5 days

**Stage 1 – Desired Results**

**Content Standard(s):**

- HSS.ID.A.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
- HSS.CP.A.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
- HSS.CP.A.3 Understand the conditional probability of A given B as  $P(A \text{ and } B)/P(B)$ , and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
- HSS.CP.A.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.
- HSS.CP.A.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.
- HSS.CP.B.6 Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.
- HSS.CP.B.7 Apply the Addition Rule,  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ , and interpret the answer in terms of the model.
- HSS.CP.B.8 (+) Apply the general Multiplication Rule in a uniform probability model,  $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$ , and interpret the answer in terms of the model.
- HSS.CP.B.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.
- HSS-MD.A.1 - Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
- HSS-MD.A.2 - Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
- HSS-MD.A.3 - Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.
- HSS-MD.A.4 - Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected

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| <p>value.</p> <ul style="list-style-type: none"> <li>• HSS-MD.B.5 - Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.</li> <li>• HSS-MD.B.6 - Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).</li> <li>• HSS-MD.B.7 - Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                        |
| <p><b>Understanding (s)/goals</b></p> <p>Students will understand:</p> <ul style="list-style-type: none"> <li>• Given that variation may be random or not, conclusions are uncertain.</li> <li>• The normal distribution may be used to model variation.</li> <li>• Probabilistic reasoning allows us to anticipate patterns in data.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p><b>Essential Question(s):</b></p> <ul style="list-style-type: none"> <li>• How likely is it to get a value this large just by chance?</li> <li>• How can we anticipate patterns in the values of a statistic from one sample to another?</li> </ul> |
| <p><b>Student objectives (outcomes):</b></p> <p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Distinguish between a parameter and a statistic.</li> <li>• Create a sampling distribution using all possible samples from a small population.</li> <li>• Use the sampling distribution of a statistic to evaluate a claim about a parameter.</li> <li>• Distinguish among the distribution of a population, the distribution of a sample, and the sampling distribution of a statistic.</li> <li>• Determine if a statistic is an unbiased estimator of a population parameter.</li> <li>• Describe the relationship between sample size and the variability of a statistic.</li> <li>• Calculate the mean and standard deviation of the sampling distribution of a sample proportion <math>\hat{p}</math> and interpret the standard deviation.</li> <li>• Determine if the sampling distribution <math>\hat{p}</math> of is approximately Normal.</li> <li>• If appropriate, use a Normal distribution to calculate probabilities involving <math>\hat{p}</math> or <math>\hat{p}_1 - \hat{p}_2</math>.</li> <li>• Calculate the mean and the standard deviation of the sampling distribution of a difference in sample proportions and interpret the standard deviation.</li> <li>• Determine if the sampling distribution of <math>\hat{p}_1 - \hat{p}_2</math> is approximately Normal.</li> <li>• If appropriate, use a Normal distribution to calculate probabilities involving <math>\hat{p}</math> or <math>\hat{p}_1 - \hat{p}_2</math>.</li> <li>• Calculate the mean and standard deviation of the sampling distribution of a sample mean <math>\bar{x}</math> and interpret the standard deviation.</li> <li>• Explain how the shape of the sampling distribution of <math>\bar{x}</math> is affected by the shape of the population distribution and the sample size.</li> <li>• If appropriate, use a Normal distribution to calculate probabilities involving <math>\bar{x}</math> or <math>\bar{x}_1 - \bar{x}_2</math>.</li> <li>• Calculate the mean and the standard deviation of the sampling distribution of a difference in sample means <math>\bar{x}_1 - \bar{x}_2</math> and interpret the standard deviation.</li> <li>• Determine if the sampling distribution of <math>\bar{x}_1 - \bar{x}_2</math> is approximately Normal.</li> <li>• If appropriate, use a Normal distribution to calculate probabilities involving <math>\bar{x}</math> or</li> </ul> |                                                                                                                                                                                                                                                        |

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| $\bar{X}_1 - \bar{X}_2$       |                                                                   |
| Stage 2 – Assessment Evidence |                                                                   |
| Performance Task(s):          | Other Evidence: <ul style="list-style-type: none"><li>•</li></ul> |
| Stage 3 – Learning Plan       |                                                                   |
| Learning Activities:          |                                                                   |