Matthew Hrbacek **Lesson Plan Template**

Grade: High School (11th Grade)

Subject: Statistics

Materials: Textbook, Notebook, Writing Utensil

Technology Needed: Laptops, Projector

Instructional Strategies:

- ☒ Direct instruction
- ☒ Guided practice
- ☐ Socratic Seminar
- ☐ Learning Centers
- ☐ Lecture
- ☒ Technology integration
- ☐ Other (list)
- ☐ Peer teaching/collaboration/ cooperative learning
- ☒ Visuals/Graphic organizers
- ☐ PBL
- ☐ Discussion/Debate
- ☐ Modeling

Guided Practices and Concrete Application:

- ☒ Large group activity
- ☐ Independent activity
- ☐ Pairing/collaboration
- ☐ Simulations/Scenarios
- ☐ Other (list)
- ☐ Hands-on
- ☒ Technology integration
- ☐ Imitation/Repeat/Mimic

Explain:
I will begin my lesson with direct instruction by explaining how to use mean and standard deviation to establish the graph for a normal curve. Then, I will use technology integration by projecting an Excel spreadsheet which shows students how to find the values of mean and standard deviation and graph the normal curve.

Standard(s)

HS.S-ID.4: Use the mean and standard deviation of a 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 or tables to estimate the areas under the normal curve.

Objective(s)

Students will learn how to use spreadsheets to calculate important values such as standard deviation and mean for different outcomes. Then, they will understand how to evaluate the likelihood of certain outcomes based on this information using the distribution of a normal curve.

"I can use a spreadsheet to find the mean and standard deviation of a random sample of data. I can use this information to find a normal curve for the data in Excel and on a paper graph. I can evaluate this graph to see if it accurately represents our population data."

Bloom's Taxonomy Cognitive Level: Applying, Analyzing, Evaluating

Differentiation

Below Proficiency: The students below proficiency may struggle to understand both standard deviation and mean, and I will be able to recognize this after the opening reflection. If this is the case, they may also struggle to see how we are graphing the data. To help with this, I plan to write a list of the most important steps on the board, so that they are still able to follow what we are doing. Then, I will also walk around class as students are working, and I will try to talk with each of these students to see how they are doing with each concept. I will encourage them to work on communicating where they are struggling so that I can point them back to the correct step in fixing their problem.

Above Proficiency: The students who are above proficiency will already have a strong understanding of the use of standard deviation and mean coming into class. This will help them to understand both how to graph the normal curve and why this is an effective method of calculating population percentages. For this reason, these students will be important in leading discussion as we work through problems. These students will be expected to be more proficient than others at analyzing the graphs once we have found them.

Approaching/Emerging Proficiency: Students who are approaching proficiency should already understand the meaning of standard deviation and mean when they come into class. Then, they will likely follow most of the instructions for graphing a normal curve. They may struggle to understand how to use Excel at first, but with help, they should be able to figure this out. They also may struggle to understand how to calculate the area under the normal curve at first. I will try to call on these students the most as we are working through problems in class to keep challenging them to reach a level that is above proficiency.

Modalities/Learning Preferences: Technology Integration (using Excel), One-on-One conversations with students as they are working, Direct Instruction

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Classroom Management- (grouping(s), movement/transitions, etc.)	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)**

• Large group discussion
  ○ Students should try to participate in discussion
  ○ Students should listen respectfully to others
• Silent work
  ○ Students should work quietly and independently
  ○ Students raise their hand if they have questions
  ○ Students are expected to use technology responsibly without getting distracted.
	• Students should respect the contributions of others
	• Students should participate in the activities and problems we are working on
	• I will walk around to answer student questions while they are working
	• Students are expected to realize that the use of technology is a privilege that will be taken away if they are not using it for classwork.

Minutes	**Procedures**
1-2	**Set-up/Prep:** The only set up that is required is that students sit down and get out their notebooks and a writing utensil. I will not turn the projector on until I have introduced the lesson.
3-5	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** Students will be asked to answer the question "How would you define mean and standard deviation and why might they be important?" I will use this as an opportunity to collect attendance for the day, and students will receive credit for participating in an in-class activity. Then, we will discuss my answer. The mean of a population represents the average outcome of a data set. The standard deviation represents how much of a spread this set of data has. A small standard deviation indicates that the outcomes are very similar, while a large standard deviation represents that the outcomes may vary greatly across the population.
20	**Explain: (concepts, procedures, vocabulary, etc.)** 1. I will begin with a quick review of standard deviation and mean. "Does anyone remember the equations for calculating standard deviation and mean for a population?" 2. Then, I will introduce the new topic, graphing the population data using a normal curve. We will begin with an example. In the first example, we will graph discretely by choosing individual scores and the likelihood of attaining those scores first. The first example we will look at is the distribution of batting averages for the starting lineup of an MLB team. The averages are: .242, .244, .244, .247, .247 .247, .250, .250, .252 We see that 2 of these batting averages (.242 and .252) have a 1/9 chance of being our outcome. Next, we see that 2 batting averages (.244 and .250) have a 2/9 chance of being our outcome. Finally, 1 one of these batting averages (.247) has a 3/9 chance of being our outcome. 3. "Now that we have analyzed our data, we will graph these outcomes on a coordinate plane. We will graph the batting average as our x-coordinate, and we will graph the likelihood of each outcome as our y-coordinate." A graph for this data set is listed below. 4. Next, I will have the students observe the shape of this graph, and we will try to analyze the results of our graph, talking about what outcomes are most likely. "What can we observe about the relationship between each of our outcomes?" After we talk about the students' answers to this question, we will move into another example which will illustrate these relationships more clearly. 5. In the second example we will look at the distribution of a test scores for an English class. In this example, we are given the standard deviation and mean to begin with. The standard deviation is s = 5 and the population mean is m = 80. Now, we must draw a continuous graph illustrating the distribution of the scores. To do this, we must model our graph after the normal curve. Our important values on the graph will be determined by the equation x = m + k*s for k = -3, -2, -1, 0, 1, 2, 3. In this case, these values will be x = 65, 70, 75, 80, 85, 90, 95. We will mark each of these values on our x-axis and the graph of this is listed below. Next, we must also find the height of our graph. In this case, we choose not to label the y-axis, but I will explain to my students that the y-axis represents the frequency of a particular outcome. In this case, this would represent the number of students who received each score. 6. Now that we have the most important information, we must look at what the graph looks like. In this case, we will be looking at a normal distribution which will be represented by a bell curve. I will show students the picture of the graph, and then I will explain that this graph represents that the area in between the first standard deviation in both directions is the most likely outcome (67%). The area between the first two standard deviations contains 95% of outcomes. Finally, the area between the first three standard deviations contains 99.7% percent of all outcomes. Then, students should also be able to recognize that both sides of the graph have an equivalent area, and this represents the fact that achieving above or below the mean occurs at an equal likelihood. 7. Finally, we will finish with a brief discussion of when the normal distribution is an effective way of sampling data. I will ask students, "What might be some upsides or downsides of using a normal distribution to represent the population data?" 8. We will discuss the fact that not all distributions can be represented by a normal curve because some distributions are either skewed to one side or they may be more evenly distributed across all outcomes.
15	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)**

	Now that we have covered the important topics, I will have students take out their laptops. At the same time, I will be turning on the projector and my own laptop. We will go over an example as a class. I will use a data set of sales for a gardening company. The sales will be listed as an amount of money per month. The amounts will be listed below. January: $10,000 February: $12,000 March: $13,000 April: $18,000 May: $25,000 June: $27,000 July: $26,000 August: $22,000 September: $16,000 October: $14,000 November: $11,000 December: $$8,000 This data set has a standard deviation of $6375 and a mean of $16833. We will use Excel to calculate these numbers using the AVERAGE and STDEV functions. I will tell the students to input the data into an Excel spreadsheet, and then they will use to function to calculate these numbers by selecting the appropriate columns (i.e. AVERAGE(A1:A12) and the same for STDEV). I will be demonstrating this on the board as they calculate. Then, I will show them how to use the formula in Excel for calculating a normal distribution (NORM.DIST). We will calculate the probability of the outcome in each cell, and then we will graph this information. To do this we will input NORM.DIST(A1, 16833, 6375, FALSE). "The first argument is the cell number. The second one is our mean. The third is the standard deviation. The fourth argument determines we are calculating a discrete probability (as opposed to cumulative probability). Finally, I will show students how to use the fill tab to replicate this operation for all necessary cells. Once we have gathered all our normal distribution probabilities, I will show students how to use the table function to graph all of our data. To do this, we must select the cells of our normal distribution probabilities. Then we will choose 'Insert,' 'Table,' and 'Scatter with Smooth Lines.' This will present us with our bell-shaped curve, and I will now ask students to replicate this work with a similar problem as I walk around class to check on them.
5	**Review (wrap up and transition to next activity):** To review, I will ask students what they have learned this class, and I will ask them to reflect on how they might use Excel in the future. Then, I will ask them if they have any further questions before I let them go.

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.** I will monitor student progress by asking questions throughout class. I will also use the opening activity to gauge where students are at. Finally, I will monitor progress at the end by walking around the classroom to assess and answer any questions that students have. **Consideration for Back-up Plan:** As a back-up plan, I will have students use their calculators to graph and calculate any important information.	**Summative Assessment (linked back to objectives)** **End of lesson:** At the end of the lesson, the assessment will be for students to turn in their spreadsheet, so I am able to see how much they were able to understand. **If applicable- overall unit, chapter, concept, etc.:** Students will be expected to apply ideas learned in this lesson to generate and analyze normal distributions in a unit assessment.

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

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