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| **Name: Tiara Anderson** | **Contact Info:** | **Date:** |

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| **Lesson Title : Regression Models** | **Unit #:**  **1** | **Lesson #:**  **2** | **Activity #:**  **3** |
| **Activity Title: Linear & Exponential Regression Models** |

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| **Estimated Lesson Duration:** | **8 days** |
| **Estimated Activity Duration:** | **4 days** |

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| **Setting:** | **Classroom** |

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| **Activity Objectives:**   * To introduce student to linear regression through a hands on activity – Height vs. Shoe Size * Learn how to find a line of best fit by hand (estimate), by Desmos (estimate) and by Microsoft Excel * Learn how to find exponential curve of best fit using Microsoft Excel |

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| **Activity Guiding Questions:**   * Which applications on the phone use the most battery life? * Which applications on the phone use the least battery life? * How can we track the loss of battery life over time? * How can we predict when a phone battery will die? |

| **Next Generation Science Standards (NGSS)** | |
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| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| ☐ Asking questions (for science) and defining problems (for engineering) | ☒ Patterns |
| ☐ Developing and using models | ☐ Cause and effect |
| ☐ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☐ Analyzing and interpreting data | ☐ Systems and system models |
| ☐ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| ☐ Constructing explanations (for science) and designing solutions (for engineering) | ☐ Structure and function. |
| ☒ Engaging in argument from evidence | ☐ Stability and change. |
| ☒ Obtaining, evaluating, and communicating information |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☐ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| ☐ Demonstrating Science Knowledge **(D)** |
| ☐ Interpreting and Communicating Science Concepts **(C)** |
| ☐ Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or**  **Common Core State Standards -- Mathematics (CCSS)** | |
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| **Standards for Mathematical Practice (Check all that apply)** | |
| ☐ Make sense of problems and persevere in solving them | ☒ Useappropriate tools strategically |
| ☒ Reason abstractly and quantitatively | ☒ Attendto precision |
| ☒ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☒ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):**  S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.★  a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions, or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models. (A2, M3)  b. Informally assess the fit of a function by discussing residuals. (A2, M3)  c. Fit a linear function for a scatterplot that suggests a linear association. (A1, M1)  S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data  S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. |

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies)   * Technological Tools (Microsoft Excel, Desmos Graphing Calculator) * Meter Sticks * Height and Shoe Size Handout * Pearson Algebra I Book 5-7 Worksheet |

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| **Teacher Advance Preparation:** |

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| **Activity Procedures:**  **Day 1:** Focus- How can regression models help us make predictions?   1. Warm Up: Write the equation of a line given two points. 2. Goal: Determine Ms. Anderson’s Shoe Size (Best Fit Line by Hand)  * Produce a large table on the board with height (inches) as independent variable and shoe size (dependent variable) * With a partner, students will measure their height from foot to top of head using measuring tape and record this height on the board along with their shoe size. (Woman shoe sizes should be converted to men sizes) * Record data points on the table on given worksheet and plot them on coordinate plane. Be sure to label and scale axis appropriately. * Using a straight edge, draw a fitted line for the data. Choose two points on the line and calculate the slope (round to 2 decimal places). Write the equation of the fitted line. * Use the equation you found to find Ms. Anderson’s shoe size given her height in feet. Communicate answer in women’s size.  1. HW: Create a scatterplot and find the line of best fit by hand (Worksheet 5-7, Exercises 1-2)   **Day 2: Focus – Using tools to calculate the line of best fit**   1. Post the shoe size vs. height data on the board. 2. Teach students how to open Microsoft Excel and input the data into two columns with appropriate headers. 3. Students will then create a scatterplot of the data and insert a trend line. 4. Show students the various formatting options in Excel including legends, how to add a title, color scheme, etc. 5. Next, students will open Desmos Graphing Calculator and create an account. 6. Students will insert table with Shoe Size vs. Height data points. Show students how to adjust the window, how to save their graph and how to share it via email. 7. Insert a trend line. Interpret the meaning of the slope. Discuss the given y intercept and why we expect it to be unreasonable. Discuss the meaning of the correlation coefficient.   Day 3: **Focus – How can linear regression models help us make predictions?**   1. Evaluate the equations given in Desmos to find interpolated or extrapolated points given the shoe size (independent variable). 2. Solve equations given in Desmos to find interpolated or extrapolated data points given the Height (dependent variable). 3. Use Demos tracing tool to find the same points and verify answers found in steps 1 & 2. 4. Homework: Complete Worksheet 5-7.   **Day 3:** Focus—How can exponential regression models help us make predictions?   1. QUIZ- Linear Regression Models 2. Begin by giving students a set of data points to input in Desmos. Based on your observations, do you think the data points represent a linear model? What other models that we have studied would more closely fit the data points? 3. Introduce the exponential regression model. Use the curve to make predictions for interpolated and extrapolated data points. |

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

* Worksheet 5-7

**Summative Assessments:**

**None.**

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| **Differentiation:**  Students worked with a partner completing the activity. This gave me time to pull small groups and work with students individually. Students who struggled with the concept worked on a simpler example to start with before the Shoe Size vs. Height example. Students who advanced quickly could move on to the next activity without teacher prompting. |

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| **Reflection:**  Overall, this activity was a success. The shoe size vs. height activity allowed students to collect data, input the data into Excel and create scatterplots. Students then used Desmos Graphing Calculator to find the trend line and curve. At this point, we were able to review linear and exponential equations. Students then used the trend line and curve to find interpolated and extrapolated data points. It was meaningful to have students used the equations to make predictions. The completion of this activity, followed up with the Pearson worksheet to practice, gave students strong foundation in linear regression models as shown in the final assessment.  Unfortunately, due to limited time, I was unable to do the exponential regression model example “Death of Mr. Spud” with my students. This was a major shortcoming as it was evident in the summative assessment that students did not grasp exponential regression models as strongly as linear regression  models.  The “Charge!” activity would have also been a good addition to the activity as it allows students to collect data relating battery percentage over time as the phone is charging. Students would conduct a test and record their own data points. Create scatter plots in Excel and Desmos and find the equation for the trend line and exponential curve. Students could then compare and decide if the data is closer to a linear or exponential model. |