**Lab: Polynomial Functions *(Instructor Version)***

**Motivation:** A look into optimization done in calculus by constructing the largest rectangle given constraints and the largest volume from a set rectangular piece of paper.

**Objectives:** Students will be able to find quadratic and cubic regression equations to represent the area and volume data gathered.

**Materials:** Lab activity, two pieces of construction paper (1 for each activity), scissors, tape

**Activity 1:** **What dimensions will give you a rectangle with the largest area?**

*(This activity should take about 20 minutes, could be 30 minutes with good discussions.)*

1. Using one piece of construction paper, have your students cut a rectangle with the property that the sum of the length and the width is 11. *(You want your students to give you a variety of length/width combinations to get better data. You can assign groups to have some extra criteria such as: having a width that is smaller than the length or having equal length and width or the length being 3 more than the width, etc.)*
2. Students will measure and record the lengths of the sides and calculate the area
3. Put the following table on the board and have students fill in one row for their rectangle.

|  |  |  |  |
| --- | --- | --- | --- |
| Group | Length | Width | Area |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |

1. Students will create a scatter plot of the data from the board. What type of function should be used to model the data? *(The scatter plot can be done by hand or using technology. A possible discussion area could be what type of function should be used to model the data.)*
2. Students will find a regression function to model the data. Should the domain be restricted? *(A possible discussion area could be about a possible restricted domain)*
3. Students will determine the maximum of this function. What does the maximum represent? *(A possible discussion area would be to interpret the maximum of the function.)*

**Activity 2: What dimensions will give you a box with the biggest volume?**

*(This activity should take about 20 minutes, could be 30 minutes with good discussions.)*

1. Give each group a piece of construction paper; all groups should have the same size paper.
2. Have your students cut out congruent squares from each corner. Have your students fold in the sides and use tape to create an open-topped box. *(You want your students to give you a variety of length/width/height combinations to get better data. You can assign groups to have some extra criteria such as: cutting a square from each corner that is 1 in, 0.2 in, etc.)*
3. Your students will measure and record the length, width and height of the box and calculate the volume.
4. Put the following table on the board and have students fill in one row of the table for their groups box.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group | Length | Width | Height | Volume |
| 1 |  |  |  |  |
| 2 |  |  |  |  |

1. Students will create a scatter plot of the data. What type of polynomial should be used to model the data? *(The scatter plot can be done by hand or using technology. A possible discussion area could be what type of function should be used to model the data.)*
2. Student will find a regression equation to model the data. Should the domain be restricted? *(A possible discussion area could be about a possible restricted domain)*
3. What is the maximum of this function? What does the maximum represent? *(A possible discussion area would be to interpret the maximum of the function.)*