K	C	A	T

Name: _____

Due Date: _____

❑ 01 ❑ 05
❑ 02 ❑ 06
❑ 03 ❑ 07
❑ 04 ❑ 08

MPM2D **Assignment 2.2: Parabolas Everywhere!**

Make a copy of the blank Parabolas Everywhere Google Doc. Answer all questions in that Doc and submit online. To obtain full marks, you must show your thinking. You may answer these questions in point form.

Mathematical shapes abound in our daily life. For this assignment, you will be looking for and analysing parabolas. They're everywhere!

1. Find examples of 3 different parabolas (or parabola-esque shapes) in the world around you. Take pictures and submit them online using the assignment submission form. You must submit your pictures at least a week before the assignment is due. /T

Pictures due: _____

2. Create a copy of the blank answer template (available on the website). In the box on the front page, describe what you think the objective of this project is and what you hope to learn from it. /T

3. Insert each picture into the appropriate box on the second page. In the adjacent box, describe what the photo is and when/where it was taken. Then predict the *a* value of the parabola (positive/negative, whether the value is greater/less than 1) and your reasoning. /T

4. Insert each photo into a Desmos graph. Put each photo and associated formulas into separate folders so you can hide the ones you won't use. Include your initialled Jarvis bulldog photo. For each photo:
   - move and resize it so none of the y-intercept, vertex, or roots is on the origin.
   - create a table and choose 5 points on your parabola.
   - fit a quadratic model to those points by typing in $y_1 \sim ax_1^2 + bx_1 + c$ (change the subscripts to match the table you are using)
   - Take a screenshot of the picture + model and copy it into your assignment Doc.
   - Below the screenshot, write the quadratic model (that is, sub in the a, b, and c values) and the coefficient of determination, or R^2 value. The R^2 value tells you how well the model fits the points you chose. The closer it is to 1, the better the model fits the points. /A

5. Decide which picture gives you the best parabola. You will do the rest of this assignment using ONLY that picture. Explain your reasoning for choosing that picture. Pull your picture out of its folder so that you can turn the items in the folder off but leave the picture still on the screen. Turn off the other pictures and their models. /T

From now on, we will refer to the parabola in the picture as the **parabola** and the various equations we derive as the **models**. You have already derived the standard model; we will also derive the vertex model and the intercept model.

6. **Standard Form Model**. Choose an integer x-value that is not one of the five previously-picked points. Determine the corresponding y-coordinate using the regression model. Plot it (separately from the table) using (x,y) notation and lable the point. Does the point lie directly on or close to your picture's parabola?

7. Determine the domain, range, increasing and decreasing intervals of your picture's parabola.

We will now create, separately, the vertex and intercept/root/factored forms of the model. We will compare these models to each other and to the standard form. From now on, Desmos is only used to plot our points; all work will be done algebraically.

8. **Vertex Form Model.** Hide your regression model and the point, but leave your parabola picture. Create a folder called "Vertex form" and put the Determine the vertex and a useful point on the parabola, and ALGEBRAICALLY determine the vertex form of the model from scratch. /A

9. Convert the vertex form to standard form. Note: this will be similar, but probably won't be exactly the same as the regression model you found in question 4. /A

10. Find the roots of this model in two ways: starting from the vertex form and from the standard form. (You should get the same numbers twice). /A

11. Plot and label your vertex, the point you subbed in, the vertex form, the standard form, and the calculated roots on your Desmos graph. Copy a screenshot into your assignment.

12. Show all your work in the appropriate boxes on the assignment Doc.

13. **Intercept Form Model.** Hide the Vertex form folder. Create a folder called "Intercept form". From the picture of the parabola, determine the roots and a useful point, and ALGEBRAICALLY determine the root form of the model from scratch. /A

14. Expand your root model into standard form. Again, this should be similar, but probably won't be exactly the same as the regression model. /A

15. Find the vertex of this model in two ways: starting from the root form and from the standard form. (You should get the same vertex each time.) /A

16. Plot and label your roots, the point you subbed in, the intercept form, the standard form, and the calculated vertex on your Desmos graph. Copy a screenshot into your assignment.

17. **Conclusion and Reflection**. In the last page of the assignment, discuss your results.

Conclusion /T

Which of your pictures were actual parabolas? Explain what an R^2 value is and how you used it to determine if your pictures could be accurately modeled by a parabola. Explain why certain U-shaped models cannot be considered a parabola.

Which version gave you the best-fitting parabola, and why? Which of the methods was best at calculating the missing point(s), and why?

Reflection /T

What do you feel that you learned from this project? What did you like most? What did you like least? What suggestions do you have for us to make this project better? What do you think you could have done differently while working on this project?

NOTE: There are no necessarily right or wrong answers for these sections. Your mark here will be based on how thoughtfully you answer these questions based on your findings.

18. Lastly, put a link to your Desmos graph in the final box. Remember that if you make changes to the Desmos graph, you will have to create a new link and put it here.

HOW TO TYPE ALL THAT MATH

There is a good Chrome extension called EquatIO which typesets math using LaTeX. If this is the first time you have installed it, you will get the premium version for a month, but it still has some excellent features in the free version. You can type your math neatly as you would in Desmos; you can also hook up a microphone and use Speech Input to speak your math and watch it type it for you! Fun trick: try saying “quadratic formula” into the extension and see what happens.

In the premium version, you can use EquatIO Mobile to take a picture of hand-written math notes. It will convert it to LaTex (aka nicely printed math) form and insert it into your Doc.

Marking Rubric for Assignment 2.2: Parabolas Everywhere!

Criteria	Level 4+/4 exceeding standard	Level 3 meeting standard	Level 2 approaching standard	Level 1 beginning to approach standard	R below standard
Knowledge	Calculations have very few to no errors; any mistakes are superficial.	Calculations contain a number of careless errors, but none showing lack of understanding.	Calculations contain a few errors showing lack of understanding of material, or a few items are missing.	Calculations contain several errors showing lack of understanding of material as well as careless errors. Items are missing.	Calculations contain too many errors showing lack of understanding of material as well as careless errors. Too many items are missing.
Communication	Explanations are clear and concise. Appropriate and correct use of math terminology and symbols. All appropriate screenshots included in Google Doc.	Explanations are clear but verbose. Appropriate and mostly correct use of math terminology and symbols. All appropriate screenshots included in Google Doc.	Explanations are mostly clear and verbose. Mostly appropriate and correct use of math terminology and symbols. One or two screenshots are missing from the Google Doc.	Explanations are unclear and much too wordy. Math terminology and write-up contains many errors showing lack of understanding. Several appropriate screenshots missing from the Google Doc.	Explanations are missing or unclear to the point of confusion. Math terminology and write-up contains too many errors showing lack of understanding. Too many screenshots are missing.
Application	Choice of points for quadratic regressions appropriate and lead to the best models possible. Choice of points appropriate and lead to the best vertex model possible. Appropriate, elegant methods for finding roots used. Choice of points appropriate and lead to the best intercept model possible. Appropriate, elegant methods for finding vertex used.	Choice of points for quadratic regressions appropriate and lead to good models. Choice of points appropriate and lead to a good vertex model. Appropriate methods for finding roots used. Choice of points appropriate and lead to a good intercept model. Appropriate methods for finding vertex used.	Choice of points for quadratic regressions appropriate and lead to models that are approaching the picture. Choice of points appropriate and lead to a vertex model that is close to the picture. Mostly appropriate methods for finding roots used. Choice of points appropriate and lead to a good intercept model. Appropriate methods for finding vertex used.	Choice of points for quadratic regressions not appropriate or lead to models that are far from the picture. Choice of points not appropriate or lead to a vertex model that is far from the picture. One appropriate method for finding roots used. Choice of points not appropriate or lead to a intercept model that is far from the picture. One appropriate method for finding vertex used.	Choice of points for quadratic regressions not appropriate and lead to models that are very far from the picture. Choice of points not appropriate and lead to a vertex model that is very far from the picture. No appropriate method for finding roots used. Choice of points not appropriate and lead to a intercept model that is very far from the picture. No appropriate method for finding vertex used.
Thinking	Objective and goals are clearly stated and show considerable thought. Photos are chosen to include subjects that are clearly parabolas. Predictions, reasons for choosing main photo, conclusions, and reflection are clearly stated and show considerable thought.	Objective and goals are clearly stated and show some thought. Photos are chosen to include subjects that are sufficiently parabola-like. Predictions, reasons for choosing main photo, conclusions, and reflection are clearly stated and show some thought.	Objective and goals are somewhat clearly stated and show some thought. Photos are chosen to include subjects that are approaching parabolas. Predictions, reasons for choosing main photo, conclusions, and reflection are somewhat clearly stated and show some thought.	Objective and goals are unclear or show little thought. Photos are chosen to include subjects that are not very parabola-like. Predictions, reasons for choosing main photo, conclusions, and reflection are unclear or show little thought.	Objective and goals are unclear and show little thought. Photos are chosen to include subjects that are clearly not parabolas. Predictions, reasons for choosing main photo, conclusions, and reflection are unclear and show little thought.