**Post-Launch Analysis**

Your assembled team began with calculations to predict the height, speed, and time of your rocket flight. On the day of the launch, the team considered the 3 phases of the rocket’s flight: the boost phase, the coast phase, and the recovery phase. Today, we will consider how the functions we have discussed this semester are able to accurately describe the path of the rocket’s flight.

With your teammates, work together to answer the following questions on a separate sheet of paper. Be sure to write neatly, in complete sentence while numbering the questions as you go along.

1. Before launch, your team sketched what you believed the altitude vs. time graph would like. Do the results match your hypothesis? What forces are acting on the rocket that may have caused your prediction to be different than the actual data?

2. Study the graph of our rocket’s data, and the accompanying data set; what appears to be the rocket’s apogee, or maximum height?

3. At what time is this maximum height achieved?

4. What was the rocket’s total flight time, from lift-off to touchdown?

As previously mentioned, the rocket’s flight is broken in 3 stages: the boost phase, coast phase, and recovery stage.

5. According to your previous calculations, how long did you expect the boost phase to last?

6. When you study the graph in that same time window, does the data set look like you expect? Explain your reasoning.

7. Study the data set for the time window of the boost phase. Are there any data points that you will be removing before you model the function? Explain your reasoning.

8. At this point, you will now need to choose a function that appropriately models that data of **only the boost phase** of the rocket. Describe what is happening to the rocket during this first stage. Study the shape of the graph during the boost phase. As you analyze the data set, do you notice things like a common difference or common ratio?

Which type of function are you choosing to model the boost phase of the rocket? Explain why you made this selection.

9. What is the standard form of the function you chose?

10. Using the sliders in Fathom, create an appropriate model for the boost phase of the rocket’s flight.

11. What do the various values in your function mean? Are they values you expected? If the numbers seem off, why might this be?

12. View the residual plot for the data of the boost phase. Discuss the strength of the model based on viewing the residual plot. Should your group consider a new model, or this acceptable? Explain your reasoning.

13. Is this an appropriate model to use for the data set, until it reaches its maximum altitude? To help answer this question find the residual values for the first 5 points after the boost phase’s time window. Show your work.

At this point, your team will begin to discuss the **coast phase** of the rocket’s flight.

14. What is an appropriate domain for the coast phase of the rocket?

15. In the rocket’s coast phase, there are some repeating altitudes at different times. What is happening at this point in the rocket’s flight? Should the team consider getting rid of some of the data? Explain your reasoning.

 At this point, you will now need to choose a function that appropriately models that data of **only the coast phase** of the rocket. Study the shape of the graph during the coast phase.

16. What is the vertex form of the function you chose?

17.Using the sliders in Fathom, write a function that models the data within the coast phase of the rocket.

18. What do the values in your function represent?

19. Is this an appropriate model to use for the data set until the rocket touches the ground? To help answer this question find the residual values for the first 5 points after the coast phase’s time window. Show your work.

21. View the residual plot of the data. Sketch a picture of the plot. Discuss the strength of your model based on the results of the residual plot.

Now your team will begin to discuss the rocket’s descent during its **recovery phase**. The recovery phase begins as soon as the parachute is deployed, and then finishes when the rocket touches the ground.

22. What is an appropriate time frame for the recovery phase of the rocket?

23. What function will you use to model the recovery phase of the rocket’s flight?

24. What form of the function you will be using?

25. Use Fathom to plot a function that models the recovery phase of the rocket.. Record the results.

26. What is the contextual meaning of the slope? Be specific.

27. Use Fathom to view the residual plot for the data of the **recovery phase**. Sketch a picture of the plot. Discuss the strength of your model based on the information from the residual plot.

28. **Look at both model rocket Fathom workspaces**. As you look at both Altitude vs. Time graphs, discuss the similarities and differences. What do you think could have caused the differences in the two launches?

29. Study the first model’s Fathom workspace. How does the average rate of change on the ascent compare to the average rate of change of the descent?

30. Study the second model’s Fathom workspace. How does the average rate of change on the ascent compare to the average rate of change of the descent?

31. Imagine the second rocket was built with a parachute that was twice the size of the original. What would you expect as a result in a new altitude vs. time graph?

32. Imagine the second rocket was built with a motor that was more powerful, and was ignited for a longer period of time. What would you expect as a result in a new altitude vs. time graph?

33. Study the second model’s **Velocity vs. Time** graph. Write a paragraph describing the rocket’s flight and velocity. Make sure to designate when one phase of flight ends, and another begins.

**\*Remember: Each team will be turning in one copy of their calculation, one copy of the completed launch day packet, and the answers to these questions.**