Lab 15: Rock Drops and Max's Weight

Part 1: Rock Drops

Start by opening this lab's spreadsheet, Lab 15 Rock Drops and Max's Weight (https://bit.ly/RockDropsMaxWeightMTH098)! In the first tab of that sheet, you'll see a table of Rock Drop Data. These are from our Lab 4 videos, plus a few additional ones (if you want to see the videos, you can check them out! You don't have to, though – all the data you need's in the spreadsheet).

Start by making a scatterplot of these data (*don't select the labels in the far-left column, though*). Once you do, you'll notice that every point on the scatterplot follows a consistent pattern – except for one of them!

1. **(1 point)** Which one is different? Gimme the description (please)!

   The reason is one you probably know already: ever noticed, during a thunderstorm, that you see lightning before you hear thunder? They both happen in the sky at the same time, but the lighting (which is traveling at the speed of… well, light) moves a ***lot*** faster than the thunder (which travels at the speed of sound)!

   So, in that video you mentioned in #1, since I was relying on the ***sound*** of the rock hitting (and not the visual of it hitting), the time I registered was likely too long! So, let's take that data point out (*just click in each of the cells and delete the data*), since it's not measured as consistently as the others.

2. **(1 point)** Let's suppose these data are, indeed, linearly correlated. Use Sheets to find the trendline, and choose "Use Equation" under the "Label" menu. Make a note of the slope—what is it, in this case?

3. **(2 points)** Now, very importantly, what does that slope ***mean***? Be sure to include the proper ***unit*** in your explanation!

Here's another video: https://bit.ly/LongRockDropMTH098. Please watch it now, then go to the next page!

Reset that video, and time how long it takes until that rock hits the bottom of the 1500-foot hole (**important**! Wait for the BIG boom; the two near the beginning are the rock bouncing off the walls on the way down. It sounds kinda like dull thunder. Wait for it! 😊). Now take off about 1.3 seconds (the speed of sound is pretty slow, and it takes about that long for the sound from the rock hitting the bottom to travel back up).

4. **(1 point) (w)** Using the time that you recorded and your equation from #2, about how deep is the well?

How could we be off by ***that much***? 🤔

OK: the well is 1500 feet deep (per the video's title). Let's add this new data point (11,1500) to our dataset and see what the best fit line looks like ***now*** (you can just reuse the spaces for the Escalante one, if you want).

OK – no ***way*** that makes sense! The "best fit line" isn't ***fitting*** at all!

5. **(1 point)** And there's a reason: poke around in the "Type" options for Trendlines and see if you can find one that fits better than a straight line! Note its name here.

And you might remember that, from our Bear versus Galileo lab: Bear's formula incorrectly assumed that things on earth fall the same amount each second (linear) while Galileo said they accelerate (that's what "polynomial degree 2" means: they "curve", like a parabola).

Part 2: Max's Weight

Now let's head over to the second tab in the spreadsheet ("Max's Weight"). Here, you'll find the weights of our, Max, at various times during his infanthood and childhood.

6. **(2 points)** Start, as always, by making a scatterplot to look at the data. Comment on the behavior of the data: what's it doing as time goes from left to right on the horizontal? Be specific.

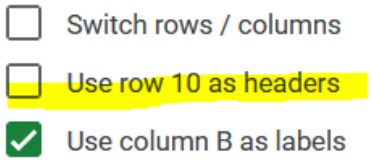
Well, it sure looks like Max's weight is going up very rapidly from month to month at first, and then, at 6 months, it slows. So let's (re)learn how to adjust the data in a scatterplot. Under the Setup menu where you chose your chart type, you should see an option called "Data range" that currently says "B3:C13". Click on this symbol next to it: ⊞ . Then highlight just the first six months of data and click "OK".

Find the best-fit line ***just*** from 0 to 6 months, using your new scatterplot. Also let Sheets find the equation.

7. **(2 points)** Does this first set of data points appear to be linearly correlated? Why or why not?

8. **(2 points)** What's the slope of that best-fit equation? And what does that slope mean?

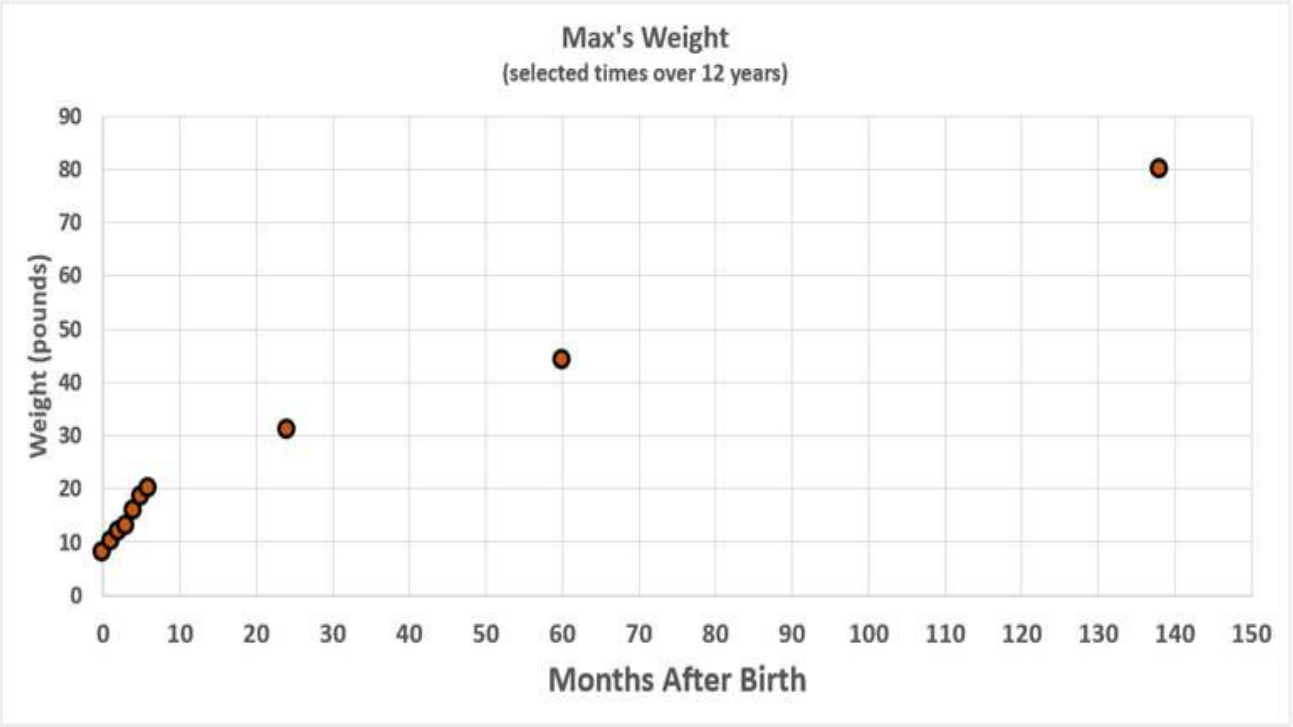
Now, let's find the best-fit line and equation for just the time period between 6 months and the end (138 months, or 11.5 years). So this time, you'll do the same as above but just highlight the last 4 rows. Also, make sure to ***un***check the box that says "use row ___ as headers" if it isn't already.



9. **(2 points)** Do ***these*** data points appear to be linearly correlated? Why or why not?

10. **(2 points)** What's the slope of ***that*** best-fit equation? And what does ***that*** slope mean?

Here's a scatterplot of the entire data set:



11. **(1 point)** Take a screenshot of that graph above and add two lines to it: one from 0 to 6 months, and then one from 6 to 138 months (you can use the same "Snipping Tool and Paint" skills you learned earlier). Each segment should reflect the best-fit models you found in the last 4 questions you did on the last page. Then paste that screenshot with your lines as your answer to this question!

So, sometimes, even though one model won't work for the entire data set, two (or even more) models can be "glued together" to describe the data well.

12. **(2 points) (w)** Assuming that the model from 6 months to 138 months continues in the same way, how much will Max weigh at age 60?

13. **(2 points)** Does your answer to #12 seem likely? Why or why not?

OK…so maybe two models glued together wasn't enough. You always need to be careful when trying to **extrapolate**: to use your model on an input far outside of your data set.

14. **(2 points)** At about what month do you think you should stop using the second model? Why? Note: there isn't any "correct" answer for this; everyone grows at different rates! You just tell me when ***you*** think his weight increase might change and why!

15. **(2 points)** That means you'd need to "glue on" at least one more model. What do you think it would look like, and why? Again, there isn't going to be one correct answer here – just tell me what you think will happen to Max's weight past that month you mentioned in #14! No need for an equation – just describe it to me!