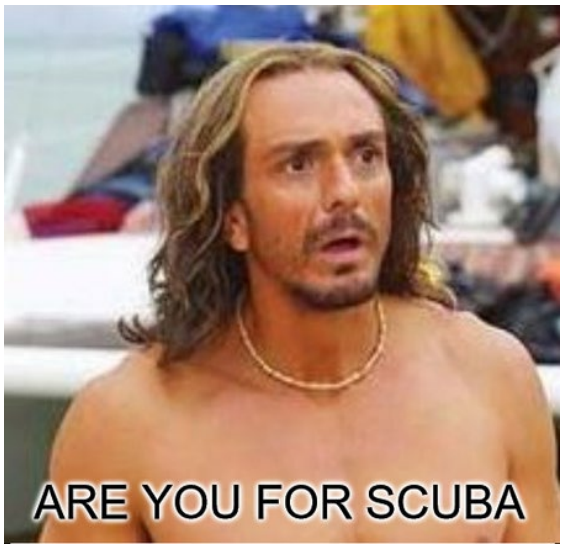
Modeling HW 5: SCUBA diving times



A few years back, my family got certified as open water SCUBA divers (our son wants to be a marine biologist, so I blame him)[1]. One of the many things you learn in SCUBA diving is how long you can be underwater before nitrogen builds up in your bloodstream to a potentially toxic level. And, that time depends on how deep you're diving!

Let's have you start by opening up this spreadsheet. Make sure you're in the "feet" tab for now. Please notice that, the deeper you dive, the less time you can stay down safely[2].

Start by creating a scatterplot of the data in Sheets.

That data doesn't look linear! Like you did in the lab, add a tendline to your data, and then poke around the trendline "type" until you find one that fits the data nicely (there's one that fits really well).

1. (**1 point**) Screen shot here – and make sure you turn the "equation" on so I can see that label on your graph! ("Customize" -> "Series" -> "Label" -> "Use Equation")

   Watch this super quick video about that (very interesting) choice you just made!

   Now click over to the "Meters" tab. For some reason (as you can see in that sheet) the PADI book we used decided to place both feet and meters in the sidebar. I wanna combine this data with the other data we have that's measured in "feet". Let's do that now – and, in doing so, learn a little about how to look up new commands in Sheets!

2. (**2 points**) There's a command in Sheets that allows you to convert between one unit of measure and another. Use Google to figure out what the command is, and then also how to use it! Place that command in cell **C3**, and then copy it down through cell **C13**. Then take a screenshot of your table (columns B through D) and include it here as your answer!

   Now copy the data you have from **C3** to **D13**, and paste it under the other data in the "Feet" sheet! Note: you'll want to use the "paste special" command…watch this video to see how!

   Now, that data looks like it fits very, very closely to the trendcurve – which is the whole idea!

   OK – let's dive deeper[3]. For sure, the No Stop Time is decreasing as the depth increases. Will the No Stop Time ever get to zero? Let's explore ***graphically***!

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[1] Note: that's not him in the picture. ☺

[2] This is not only because of the nitrogen issue, but also because air in your tank compresses as you go deeper. "One breath" underwater actually uses more "air" than it would at the surface!

[3] I'll show myself out.

Pick a couple of cells somewhere in the sheet that you haven't used yet, and label them like this!

Depth (in feet)	No Stop Time in minutes (with best fit equation)

(*no need to get fancy with the formatting – I'm just a dork*)

In the cell under "Depth (in feet)", place one of the depths from your data table (column B):

Depth (in feet)	No Stop Time in minutes (with best fit equation)
90	

Now, here comes the badass part: in the cell under "No Stop Time in minutes (with best fit equation)", ***code*** the best fit equation (but instead of using the "***x***" variable, use the cell where you placed your depth)! Here's what I get!

Depth (in feet)	No Stop Time in minutes (with best fit equation)
90	23.27042343

And, if I compare that to what the book had (25 minutes), it's pretty close! Which is one reason the curve is called "best fit"[4].

3. (**1 point**) Pick another depth from the data table, and enter it where my "90" is. What depth did you use, what No Stop Time value do you get from the best fit equation?

4. (**1 point**) How close is it to the table's time?

Goof around with the depths by changing the value in its cell. You'll notice that the No Stop Time (NST) keeps getting smaller and smaller (makes sense, right?). Do a little Googling, and find the deepest part of the oceans on earth!

5. (**1 point**) What is it, and how deep is it?

6. (**1 point**) What would the NST be at that point? I know it's tiny; gimme all those zeros!

But don't worry – if you tried to dive down there, air would be the ***least*** of your concerns...read on, and you'll see why! But first!

7. (**1 point**) Place your cursor in the cell where you coded your formula for No Stop Time and then take a screen shot so I can see your rad formula!

[4] Well, it explains the "fit" part. The "best" piece takes a bit more explaining.

Now, because of the way the equation is created (and physics), the No Stop Time will never ***reach*** zero. It'll just keep getting smaller and smaller. But there's something ***else*** you'd have to worry about besides air at depths that great!

Divers (and other folks) sometimes use the word "atmospheres" to measure pressure (you may have seen this on bike pumps or tires, if you've looked closely. Most most Americans use PSI, like we discusseed earlier). An "atmosphere" refers to the weight of the entire atmosphere above us. So, at sea level, you're at "1 atmosphere" As soon as you start diving, that pressure increases, since you have not only the actual atmosphere pressing on you, but also the water you've dived through on top of you (and water's heavy!). Incredibly enough, once you drop 10 meters, the column of air between the surface and you weighs as much as the ***entire atmosphere above sea level***! And, every additional 10 meter descent also "weighs one atmosphere."

8. (**2 points**) Look back at your depth from #5. Convert it to meters, and tell me…how many atmospheres of pressure would that diver experience[5]? Remember that at sea level, you're already at 1.

   I'mma stay up at 60 feet or less, if it's all the same to you[6]. 😊

[5] Well, for a microsecond. Until you were crushed like a soda can under a car tire. 😵

[6] Something else that happens – you start to lose colors in rainbow order, the father down you go. All the more reason to stay up higher!