Lab 3: Turtle Survival

From about June through October each year, female Olive Ridley sea turtles come ashore on the Western coast of Mexico after dark, make their way up the beach, select a nesting spot, dig a hole, lay eggs (anywhere from 80 to 120, usually), cover the nest, and then head back to sea. This is the only time the females are on land in their lives! The males never go to shore. Unfortunately, sea turtles are facing a few challenges in their environments that they're not equipped to handle:

- Commercial fishermen sometimes use illegal nets that inadvertently kill sea turtles. In August 2018, 300 sea turtles were killed in one such net.
- Climate change is increasing the temperature of the beaches on which the Olive Ridleys (and all sea turtles) lay their eggs.

- Poachers will sometimes steal the newly laid eggs in sea turtle nests and then sell the raw eggs on the streets of Mexican towns as an aphrodisiac (even though there is *no* scientific basis for this).

1. **(2 points)** Do some research and find one reason why rising beach temperatures are potentially harmful to sea turtle egg incubation.

COCC math professor Sean Rule travels down to Mexico every few years with his family to work with the federally recognized sea turtle rescue *Grupo Ecologico de la Costa Verde*. Their job is simple: each night they go out at about 1am to the beach, where they patrol (both on foot and with a dune buggy) and try to find the nests that the turtles have laid before the poachers do (and before sunrise, when the beaches heat up). Sometimes, they get lucky and see the turtles (see the picture at right), but other times, they just see that they were there, and have already laid their eggs and gone back to sea.

Once they find the nests, they dig up the eggs:

Then they relocate the eggs to the nursery off the beach, where they pack them into Styrofoam coolers that are loaded according to best practices (including humidity level and egg arrangement), and then they add the newest boxes to the nursery, where temperatures and humidity are kept at ideal levels for the hatchlings. As a result, Frank (the man who runs the nursery) claims about a 90% hatch rate; that is, 90% of all eggs that we get off the beach actually hatch. In the wild, the hatch rate is often as low as 50%.

Frank is a scientist, and he keeps amazingly detailed data. He was also kind enough to send our department the 2016 season's results. Let's pop the Google sheet Lab 3 Turtle Survival open and take a look. You'll have to click "Make A Copy" to open it.

Location in Nursery	Eggs Loaded in Box	Hatchlings Released to the Sea	Percent Live Hatches		Box Type	Loaded By
A-1	95	68	71.60%		N	FS
A-2	81	38	46.90%		N	FS
A-3	85	38	44.70%		N	Kate
A-4	100	25	25.00%		N	FS
A-5	112	36	32.10%		L	FS
A-6	63	39	61.90%		T	FS
A-7	71	53	74.60%		N	FS
A-8	94	88	93.60%		N	JC
A-9	78	74	94.90%		T	FS
A-10	92	87	94.60%		N	JC
A-11	110	94	85.50%		L	FS

Let's break this down!
- Each line represents one cooler packed with eggs.
- The important columns you need for this lab!
  - "Eggs Loaded in Box" is how many eggs went into that cooler.
  - "Hatchlings Released to the Sea" is how many baby turtles hatched, stayed alive and were released from that box.

2. **(2 points)** How is the "Percent Live Hatches" calculated? Explain it here, in words!

- Here's some other important stuff you need for this lab!
  - "Box Type" tells you which of the three types of boxes were used for that row ("N", "L", or "T". You don't need to know what the letters stand for).
  - "Loaded By" tells you who packed that box (either initials, or a name)

Take a look at the "Percent Live hatches" column. See how the numbers are color coded? Those colors correspond to the hatch rates of each box in that row, with the following legend:

No more than 40% of the eggs in that box hatched.
Box had a hatch rate more than 40%, but no more than 60%.
Box had a hatch rate more than 60%, but no more than 80%.
Box had a hatch rate more than 80%, but no more than 90%.
Box had a hatch rate more than 90%.

Frank is known to keep track of the volunteers who get "low" hatch rates and talk to them about how they're packing (ostensibly, to get them to do a better job). The other volunteers call it the "death rate talk", and they hate it.

3. **(2 points)** Find the folks who packed boxes with "low pack rates": ones who had less than a 40% hatch rate. List the initials or names of those with the low pack rates (FYI: Frank is "FS". 😊).

When Sean heard that Frank did this "Death Rate Talk", he told him, "You know, Frank – just because someone has a box that has a low hatch rate doesn't mean that they're doing anything *wrong*. There are a lot of variables that go into those eggs hatching. I mean, heck – you *yourself* have some of the lowest hatch rates in that sheet – but then, you also have some of the highest!"

To see this for yourself, click on over to the next tab, named "Data (sorted by loader)". In this sheet, the boxes are sorted by the initials (or names) of who loaded them. Here's a snapshot of Frank's boxes:

A-60	9/18	118	90	76.3%	L	DR
A-1	7/22	95	68	71.6%	N	FS
A-2	7/23	81	38	46.9%	N	FS
A-4	7/29	100	25	25.0%	N	FS
A-5	8/6	112	36	32.1%	L	FS
A-6	8/9	63	39	61.9%	T	FS
A-7	8/9	71	53	74.6%	N	FS
A-9	8/14	78	74	94.9%	T	FS
A-11	8/16	110	94	85.5%	L	FS
A-41	9/12	97	95	97.9%	N	FS
A-43	9/13	112	99	88.4%	L	FS
A-46	9/14	95	62	65.3%	N	FS
A-51	9/16	89	88	98.9%	T	FS
A-53	9/16	99	95	96.0%	N	FS
B-55	10/5	88	85	96.6%	T	FS
C-42	10/14	110	107	97.3%	N	FS
C-48	10/15	116	107	92.2%	L	FS
E-14	11/1	88	76	86.4%	T	FS
E-19	11/3	127	106	83.5%	L	FS
E-20	11/3	88	83	94.3%	T	FS
E-42	11/6	116	100	86.2%	L	FS
E-44	11/6	123	118	95.9%	L	FS
F-30	11/18	108	81	75.0%	N	FS
F-38	11/19	86	75	87.2%	N	FS
F-50	11/22	81	79	97.5%	T	FS
G-41	12/6	101	89	88.1%	N	FS
G-54	12/12	132	125	94.7%	L	FS
G-59	12/13	88	86	97.7%	T	FS
G-61	12/14	87	84	96.6%	T	FS
G-65	12/16	91	84	92.3%	T	FS
H-3	12/18	131	124	94.7%	L	FS
H-6	12/19	95	95	100.0%	N	FS
H-10	12/20	98	97	99.0%	N	GG

So sure, his two bad boxes pop out, but you know what else does? All the *awesome* box rates he got! So maybe it's better look at **all** the eggs someone loads to assess how they're doing, as far as their hatch rate goes. Let's do that for Frank!

Start by finding the top of Frank's results:

G-45	12/9	116	110	94.8%	L	CM
G-51	12/12	116	93	80.2%	L	CM
G-53	12/12	116	107	92.2%	L	CM
G-55	12/12	116	95	81.9%	L	CM
A-60	9/18	118	90	76.3%	L	DR
A-1	7/22	95	68	71.6%	N	FS
A-2	7/23	81	38	46.9%	N	FS
A-4	7/29	100	25	25.0%	N	FS
A-5	8/6	112	36	32.1%	L	FS
A-6	8/9	63	39	61.9%	T	FS
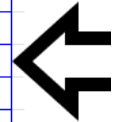
Left click and hold in the cell that has the "95" in it in that row:

G-53	12/12	116	107	92.2%	L	CM
G-55	12/12	116	95	81.9%	L	CM
A-60	9/18		90	76.3%	L	DR
A-1	7/22	95	68	71.6%	N	FS
A-2	7/23		38	46.9%	N	FS
A-4	7/29	100	25	25.0%	N	FS
A-5	8/6	112	36	32.1%	L	FS
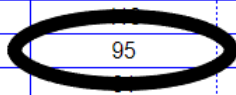
Now, while holding that, drag down all the way until Frank's last cell (its value is also 95):

G-59	12/13	88	86	97.7%	T	FS
G-61	12/14	87	84	96.6%	T	FS
G-65	12/16	91	84	92.3%	T	FS
H-3	12/18		124	94.7%	L	FS
H-6	12/19	95	95	100.0%	N	FS
H-10	12/20	98	97	99.0%	N	GG
H-5	12/19	135	120	88.9%	L	GG
H-7	12/19	74	66	89.2%	N	GG
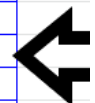
Here's where Sheets makes things easy – look at the bottom right corner of the screen:

I	GG
T	GG
T	UD

Sum: 3058 ▾

This tells you that the sum of all the numbers you selected (i.e., what you get when you add them up) is 3058. That is the total number of eggs Frank packed 9the sum of all the numbers you highlighted).

If you click the little arrow next to that sum, you will see the list at right. There's some neat stuff in there: "Count: 31" means that Frank packed a total of 31 boxes, "Min: 63" manes that the smallest number of eggs loaded into a box was 63, and so on (you don't; need these other options right now, but it's good to know they're there!

✓	Sum: 3058
	Avg: 98.64516129
	Min: 63
	Max: 132
	Count: 31
	Count Numbers: 31

4. **(2 points)** OK! Use the previous steps as a guide to find out how many **live** hatchlings Franks' boxes produced.

5. **(2 points) (w)** Using your number from #4 and the 3058 eggs that Frank packed, give me Frank's overall hatch rate. Make sure to show the calculation

Not bad at all, Frank!!

6. **(2 points) (w)** Sean's listed as "Sean" on this list. What's his overall hatch rate? Make sure to show the calculation!

7. **(2 points) (w)** What's the overall hatch rate for all boxes collected? Remember to show how you did it! How does Frank's claim back on the top of page 2 hold up here?

When Sean showed the folks at the nursery how to do this math, one of them asked him, "That seems like an awful lot of work...why not just add up the percentages for one person and divide that by how many boxes they packed?"

To address their question, he found the last person on the list (initials "SM"):

Location in Nursery	Loaded On	Eggs Loaded in Box	Hatchlings Released to the Sea	Percent Live Hatches	Box Type	Loaded By
A-16	8/23	94	84	89.4%	N	SM
A-19	8/25	104	99	95.2%	L	SM
A-23	9/1	69	20	29.0%	T	SM
A-38	9/10	106	101	95.3%	N	SM

First, he found the average their way:

$$\frac{89.4\% + 95.2\% + 29.0\% + 95.3\%}{4} \approx 77\%$$

And then he did the way described on the previous page:

$$\frac{\text{304 live hatchings}}{\text{373 eggs total}} \approx 82\%$$

8. **(2 points)** How can these two ways give results 5% different from each other? Write a couple of sentences to explain (and nope – it isn't rounding). Which way is correct? In case you get stuck, check out this video!

Now, head over to the last tab "Data (by box type)". As mentioned earlier, there are three different kinds of boxes that are used at the nursery. They each have different capacities, so when the volunteers get back from their shifts at 4:30 AM, the first thing they have to do is math to figure out which boxes they need. Frank often asks them to consider not using "L" boxes, as they're the biggest (and therefore heaviest – which makes them hard to move around once loaded).

However, he thinks that the success rates for the "L" boxes are better than the success rates for the other boxes. Let's see!

9. **(1 point)** Take a look at the data first, and write down what you think about the overall success rates of the "L" boxes versus the other 2 types. If you can't see a difference, say so!

We'll use Sheets to help us, and even learn a new formula in the process! Follow these steps.

- Left-click in the cell under "Hatch Rate for Box L":

- Type an equal sign **=**

- Now type **sum(**

- See how it's asking you for numbers? Let's supply them! Left-click and hold until all of the "Hatchlings Released to the Sea" cells for Box type L have been highlighted (you'll need to scroll for a while—there are over 200 of them!). Then press **)**

- Now, type **/**

- Next, type **sum(**

- Now, highlight all the cells that have the **total** eggs in each of the box type L (so the same rows you just highlighted, but from the "Eggs Loaded in Box" column). Then press **)**

- Finally, press **Enter**!

10. **(1 point)** What's the overall hatch rate for box type "L"?

11. **(1 point)** Repeat the previous steps for box types "N" and "T". What do you get?

12. **(1 point)** Was Frank justified in thinking that Type "L" boxes have higher hatch rates?

Sean has done a lot of statistics for this particular nursery (including working with graduate students who have been trying to help Frank achieve an even ***better*** hatch rate – which is already much better than what happens in nature, as you saw). For example, he's discovered that the turtles who lay their eggs on the south end of the beach tend to have better hatch rates than those who lay on the north end. Why? Not sure yet – as they collect more data, year to year, they'll see if that results holds up.

But, still, it is easy to get sad and angry when you read a news story like the one from August 2018 (the one where 300 adult turtles died in an illegal fishing net). Here's why.

13. **(1 point) At** what rate do sea turtle hatchlings survive to adulthood? Google it. (You're looking for a statement like "1 in a…")

14. **(2 points)** Based on the number you just found (which is an average), about how many hatchlings were born to give us the 300 that were killed by that illegal fishing net?

15. **(2 points)** How many total hatchlings did *Grupo Ecologico de la Costa Verde* release in 2016? Hint: you probably used this number back in question #7.

So you see – that one event killed ***way*** more turtles in a day than the nursery is able to help in an entire year, all because some lazy fisherman didn't want to follow the law. But that doesn't mean they should stop trying…because the next little hatchling they rescue might be the one that makes it. 😊