Lesson 12
Completing the Recursive Model – The Foundation Layer

Kristin's Story - Chapter 7

It was March 2018. Adeline, Kristin's niece, came home from kindergarten noticeably excited. She shared with her Mom a special notice of a program at her school called "Science Night!"

"I would like to invite Aunt Kristin. She will get to see my classroom, my artwork, and the rocket we are making in our science class."

The Science Night was a big success. Adeline held Kristin's hand as she showed her the many posters and pictures she and her classmates made in their art class. Kristin had a little problem figuring out what each picture was supposed to be, but with a little help from Adeline, she was able to make sense of most of the characters and stories drawn on the posters. The launch of the class rocket was especially exciting. All of the families and guests went outside and watched as a teacher ignited a rocket that Adeline and her classmates helped assemble. With a loud "5..4..3..2..1" by all the students, the rocket lifted off and made a spectacular path upward and then drifted back down to the ground with a parachute.

Kristin was introduced to Adeline's friends. She met Mathew, Jason, Dominic, Paul, Melissa, Natalie, and several others. All of them were showing off their paintings and letter books. Adeline mentioned to Kristin that both Mathew and Dominic were having their 6-year old birthday party later that week, and she was invited. Mathew had to show Kristin his younger sister who was born in August of 2017 and Dominic talked about his younger brother who was born a few months ago.

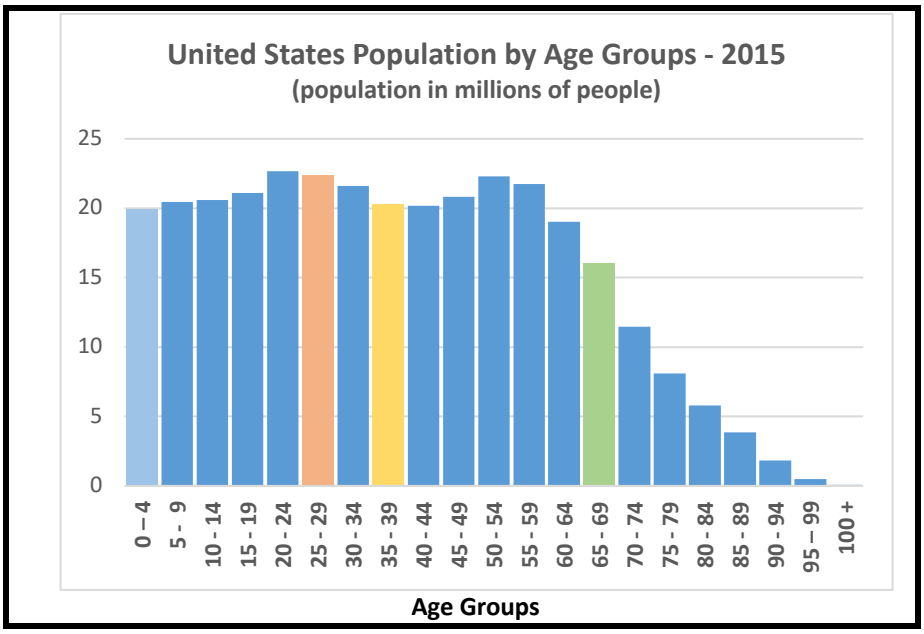
After the Science Night event, Kristin studied again the 2015 histogram of the United States population. She noted that the age group representing Adeline and her friends had approximately 20 million people. She wondered how many of those kids were now in school, and how many teachers and other people involved in education were employed to work with these students. Then she thought of Mathew's younger sister and Dominic's younger brother. She realized as she looked at the graph, they were NOT counted on this graph. They were part of a group of people – new people – who would be counted on the population graphs prepared for 2020. Kristin wondered what that number will be, and if the number of kids in that group will be similar to the number of kids in Adeline's age group.

Lesson 12 – Problems

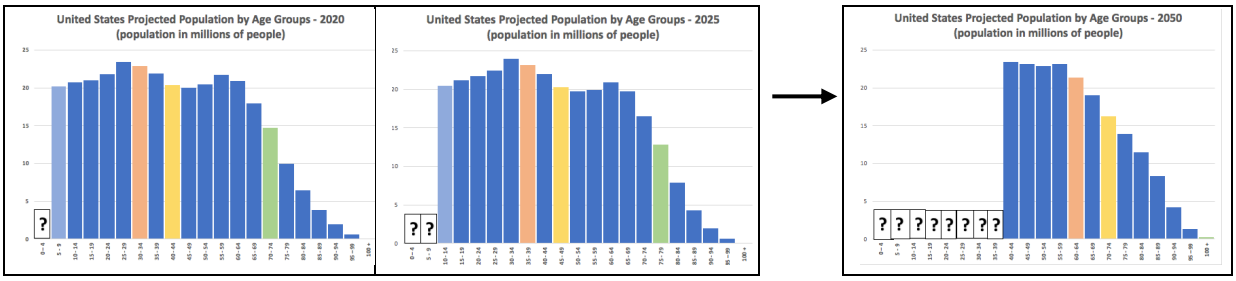
Handout needed to complete the following problems: Handout 6: *United States 2010 - 2050*

Look again at the 2015 histogram and the shape of the United States at the start of 2015 and the estimates derived from the population factors for 2020, 2025, and 2050 using the incomplete recursive model. Certain layers are color coded as we follow the characters in our stories of Adeline, Abbey, Kristin, and Kristin's mother.

Adeline			Kristin	
Abbey			Kristin's mother	



2020 **2025** **2050**



1. Adeline was born in 2012. What is her age at the start of 2015?

2. In what age group would Adeline be counted in the 2015 histogram?

3. Estimate the number of young people counted in that age group.

4. Based on Kristin's story, what do you know about Mathew's young sister and Dominic's younger brother at the start of 2015?

5. Most population graphs prepared by the United States Census Bureau use the 5-year age groups represented in the above histogram. There are people not counted in the 2015 histograms who are part of the population from 2015 to 2019. Describe these people.

6. Assume a histogram of the actual count of people was prepared in 2015 by the United States Census Bureau. If a histogram is prepared every 5 years by the Census Bureau of the actual count, when will the people described in problem 5 be represented on a United States population graph?

There were several blanks cells in **Handout 5** that could not be completed as there was no estimate of the projected number of people born in the 0 – 4 age group after 2015. **Handout 6** begins to fill in these blank cells. This ***new*** group of people, or the ***Foundation Layer***, is the first domino that impacts a country's shape looking forward. A country's shape can drastically change from events that impact the count of people born in a 5-year period.

7. If the actual count of people in the 0 – 4 age group in 2020 turns out to be larger than what people expected, what might explain the larger number of people?

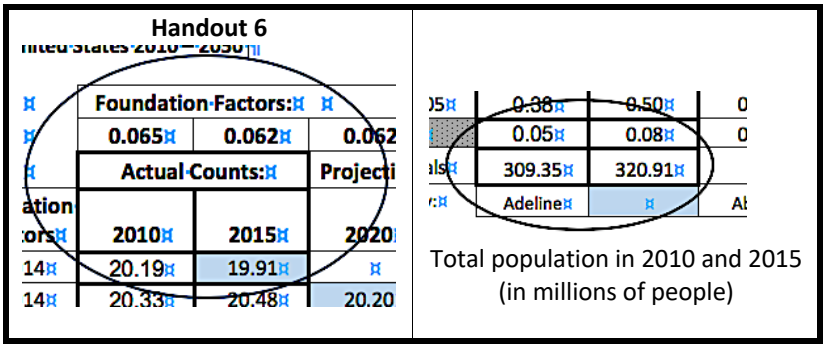
8. In a similar way, if the actual count of people in the 0 – 4 age group in 2020 is less than what people expected, what might explain the smaller number of people?

This lesson begins by deriving an estimate of the number of people in the 0 – 4 years old age group for 2020. This estimate is then used to estimate the number of 5 – 9 years old in 2025. And, just like the last lesson, the dominos begin to fall completing the estimates for all of the blank cells in **Handout** 6. This process will complete the recursive model and set-up options for several "What if …?" problems.

To begin these final steps, consider the following ratio:

$$\frac{Number\ of\ people\ 0{-}4\ at\ the\ start\ of\ 2015}{Total\ Number\ of\ people\ at\ the\ start\ of\ 2015} =$$

The decimal value of this fraction estimates the proportion of the population who were 0 – 4 years old at the start of 2015.



9. **Handout 6** indicates that the total number of people in the United States in 2010 was 309.35 million people. It also indicates there were 20.19 million people who were estimated to be 0 – 4 years old. What is the proportion of the population in 2010 who were counted in the 0 – 4 age group? Express this proportion to the nearest thousandth.

10. Based on the above proportion, what is the percent of the people in the United States who were counted in the 0 – 4 age group at the start of 2010?

11. In the same way, use **Handout 6** to derive the proportion of the United States population who were counted in the 0 – 4 age group at the start of 2015.

12. What is the percent of the United States population who were counted in the 0 – 4 age group at the start of 2015?

13. What is the difference in the count of people who were 0 – 4 years old in 2010 to the count of people who were 0 – 4 years old in 2015? What might be an explanation for this difference in the count of people born in the 5 years before 2010 and the count of people born in the 5 years before 2015?

The decimal values of the proportions derived in problems 10 and 12 are called the **Foundation Factors** for this recursive model. Note that the two factors calculated in problems 10 and 12 are similar, although the 2015 factor is slightly smaller. Note where the decimal values of the foundation factors are listed in **Handout 6**. As we look forward, assume that the foundation factor for 2020 is the same as the population factor for 2020.

14. An estimate of the count of people in 2020 who were 5 years old or older to 100+ years was 311.21 million people. Explain how this estimate was determined using **Handout 6**. Is 311.21 million people the total population of the country in 2020? Explain your answer.

15. Consider the following equation:

$$\frac{x}{x+311.21} = 0.062$$

If the above equation is used to determine an estimate of the count of people 0 – 4 years old in 2020, answer the following:

a. What does 0.062 represent in this equation? What does 311.21 represent?

b. What does x represent in this equation?

c. Solve for x to the nearest hundredth.

d. If the count of people in the 5 – 9 years old age group to the 100+ age group is greater than 311.21 millions of people, what happens to the value of x if the population factor stays the same? What happens to the count of the total population?

16. Your solution to the above equation is an estimate of the 0 - 4 years old age group in the 2020 population. Place this value in the appropriate cell of **Handout 6**. What is your estimate of the total population of the United States in 2020? Indicate in the space below how you derived the value of the total population. Also enter this value in the appropriate cell of **Handout 6**.

17. Given your estimate of the 0 - 4 age group for 2020, estimate the number of people in the 5 – 9 age group for the 2025 population group by multiplying the count derived for the 0 – 4 age group by the Population Factor for the connecting age groups of 0 – 4 to 5 – 9 years old. Indicate in the space below how you derived this value. Also enter this value in the appropriate cell of **Handout 6**.

Handout 6

		Actual Counts:		Projections:		
Age Groups	Population Factors	2010	2015	2020	2025	2(
0—4	1.014	20.19	19.91			21
5—9	1.014	20.33	20.48	20.20		
10—14	1.020	20.68	20.61	20.76	20.47	21
15—19	1.032	21.98	21.09	21.02	21.17	20

18. Revise the equation in problem 15 to estimate the count of people in the 0 – 4 age group for 2025 population using the same foundation factor of 0.062 for 2015 and 2020. Place your estimate in the proper cell of **Handout 6**. Why was it necessary to derive the estimate for the 5 – 9 age group before you derived the above estimate for the 0 – 4 age group?

19. Derive estimates for the remaining blank cells in **Handout 6**. (Remember your estimates can differ from some of the listed estimates by + 0.01 or - 0.01.)

20. After all blank cells have been filled, Identify the age group with the greatest number of people for each of the following:

Year	Age group with the greatest number of people	Percent of the country within age group (nearest tenth of a percent)
2010		
2015		
2020		
2025		
2030		
2035		
2040		
2045		
2050		

21. Why might a person who was 22 years old at the start of 2015 be highlighted in an online commercial over a person who was 42 years old at the start of 2015?