Teaching Notes

Lesson 13

"The More Things Change, the More things Stay the Same"

Overview:

This lesson focuses on the changes in the shape of the United States population based on the recursive model. Students derive summaries of age groups highlighted in the graphs. Students also reflect on the possible changes for people living in the country if the future counts derived from the model are accurate.

The problems and questions extract data from either the graphs or **Handout 6**. This lesson continues to direct students to apply their modeling tools to summarize changes in the age groups overtime. Students also summarize the impact of these changes on the country's population distribution.

An alignment of the problems in this lesson to the **Modeling Continuum** is suggested in the following table:

Modeling Continuum Classification

Level 1	Level 2	Level 3	Level 4
Problems: 7	Problems: 1, 4, 5, 6, 8, 9, 10, 11, 12, 13	Problems: 2, 3, 7	

Primary tools students use in this lesson to answer the above problems are:

Arithmetic operations, proportions, ratios, percent, interpreting proportions and percent, recursion. See the connection of these tools to high school standards in the ***Overview of the Module***.

Resources needed for this lesson:

Provide a copy of a complete Lesson 13 for each student (either printed or online). This lesson requires one additional handout for students to use to complete the problems, **Handout 6: *United States 2010 – 2050.*** Students use the completed copy of Handout 6 from Lesson 12.

Launch:

Ask students what they think the United States population might look like in 2050. Ask students how old they will be in 2050. What if people in the age groups who are younger are projected to be a larger segment of the population in 2050? How might a growing count of younger age groups impact the important decisions facing the country? What level of education might the younger age groups obtain? What careers or jobs will exist in 2050? Will people prefer owning a home or prefer renting? What if older age groups will be a larger segment of the 2050 population? Will they require more health care, or more housing arrangements for seniors? After a brief discussion and a list of the reflections involving these questions, direct students to complete the problems.

Implementation Ideas:

The problems are focused on understanding the projections derived from the recursive model. The overall changes begin to smooth out over time as the graphs begin to lose some of the distinctive highs and lows of the earlier graphs. Allow students to record their responses to the problems and also to verbally summarize what they observe in the graphs.

The problems are more subtle than several of the previous lessons, so writing out their responses and talking about them are important. Periodic discussion about the problems will help determine if the end result of the recursive model, or the projection for 2050, makes sense. Use the graphs as a way to summarize the story of how the characters in this module (and highlighted by the colors in the graphs) become part of older age groups. Note how Abbey and Adeline's age groups are not that different in the projections for 2050. Also note how Kristin's age group, and more noticeably her parent's age group, begin to reflect the changes in the counts due to dying. (If the colors are difficult to distinguish, please point out the age groups of each character in 2015, and have students identify the age groups of the characters for the intervening years.)

Lesson 1 – Problems

1. In what way does Raphine's decision to leave the country in 2018 change the count of people in the United States?
   Raphine moved to the United States in 2015. He would have been counted as an immigrant and would have changed the count of the 2020 population for his age group by a +1. His decision to return to Kenya in 2018, however, would change the count of the 2020 population by a -1. As a result of his moving into the country and then out of the country, Raphine did not change the count of the 2020 population.

   A general discussion regarding home ownership is included in the lesson. Have a brief discussion regarding home ownership based on students' answer to problem 2, and its possible impact on an economic. Outside research might be considered as this topic is

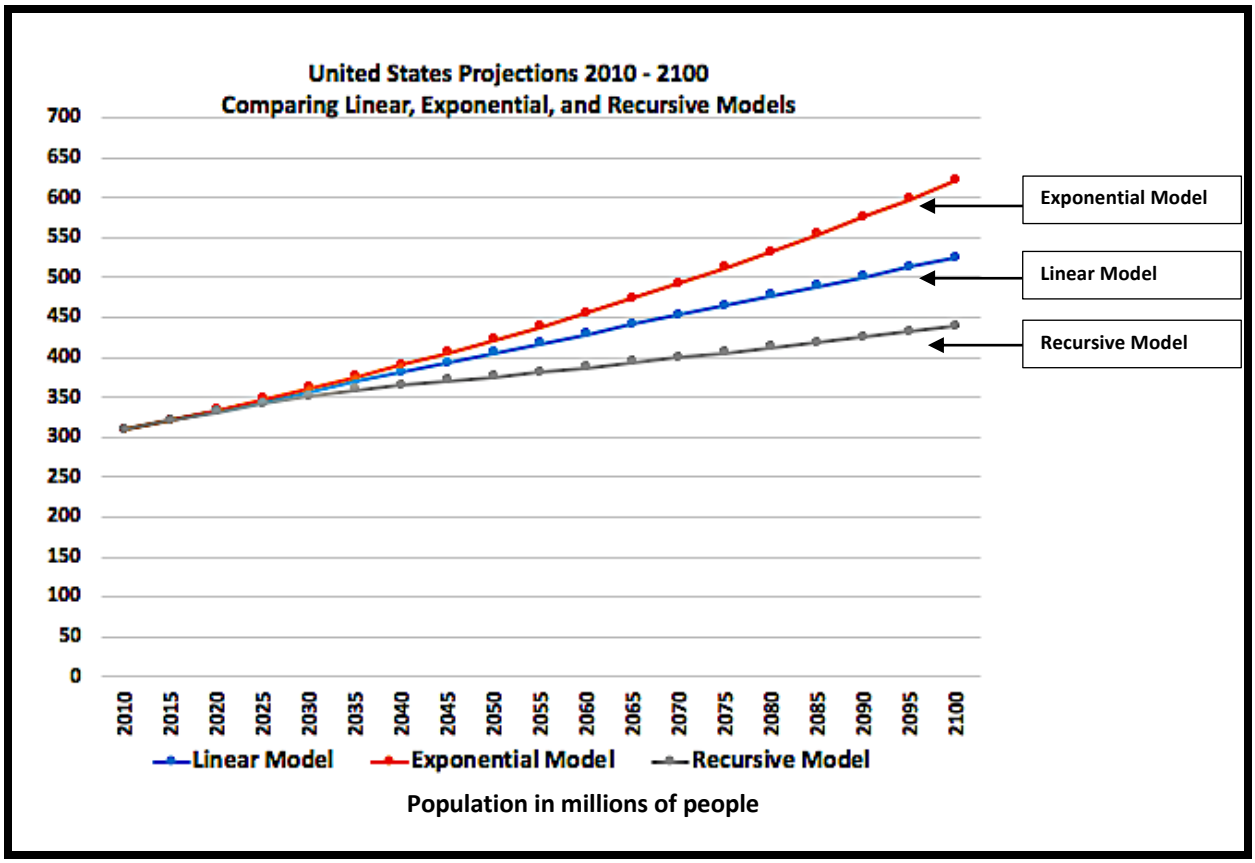
frequently mentioned as a change in the culture of the United States as more and more Millennials are deciding to rent rather than own a home. The impact may be significant.

2. If the age groups in 2050 who are under 40 years old generally do not buy a house, do you think the effect on the country's economy would be significant? Why or why not?

   A major component of the United States economy in 2015 was connected to home ownership, particularly by people 35 years old or younger. Decisions that might change the percent of people who own a house will impact the nation's economy. The recursive model is projecting a growing number of people under 35 years old by 2050, especially noteworthy when compared to similar age groups in 2035, 2040 and 2045. Other goods and services in 2050 may be considered as important factors in discussing the strengths or weaknesses of an economy.

3. What products or services might be considered important in 2050 based on the population distribution?

   Lesson 12 indicates that in 2050 the most dominant age group will be 25 – 29 years old. Several age groups close to these ages are projected to have nearly the same counts. This age group is a change from the dominant age groups projected in 2035, 2040, and 2045. What people in these age groups consider important may be the driving force of the economy in 2050. If they are similar to people in these age groups in 2015 and 2020, smaller houses, renting instead of owning a home, more energy efficient cars, fewer children and the goods and services that go along with smaller families, may be the important factors of the country's economy. Students may also note that the oldest age groups (90-year-old or older) in 2050 are projected to increase when compared to 2040 and 2045. This projected change will also affect the economy of the country.



4. The population projections for 5-year intervals are plotted for each of the models from 2010 to 2100. Answer the following.

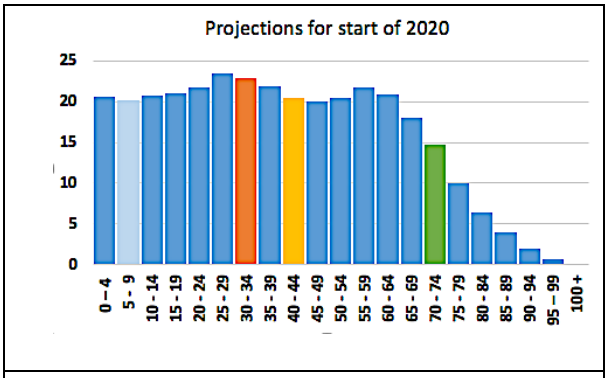
   a. Which model would result in the greatest change in the total population from 2010 to 2100? Explain your answer.

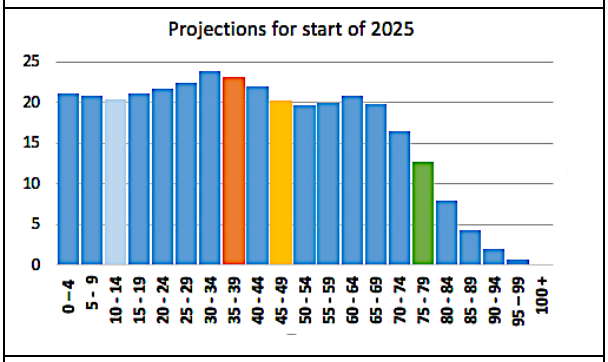
      The graph of the exponential model indicates the greatest increases in the counts. The differences in counts between the exponential model and the recursive or linear models becomes even greater over time.

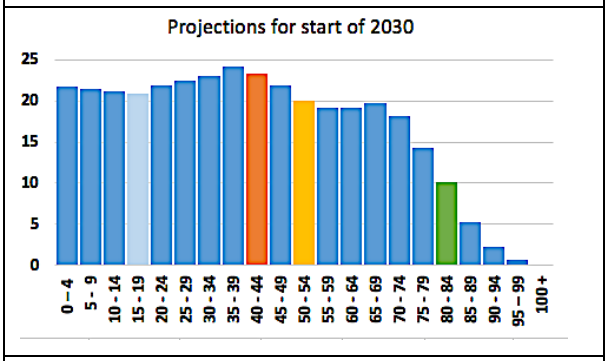
   b. Which model would result in the least change in the total population from 2010 to 2100? Explain you answer.

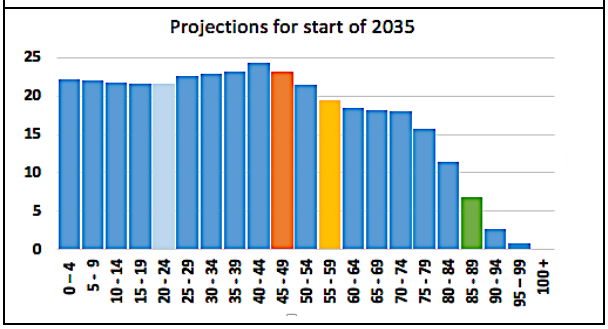
      The graph of the recursive model indicates the smallest increases over time. The recursive model's projections suggest that at some point in the future the population counts increase slightly from year to year. The graph indicates the recursive model eventually looks similar to a linear model with a slope less than the linear model derived in Lesson 8.

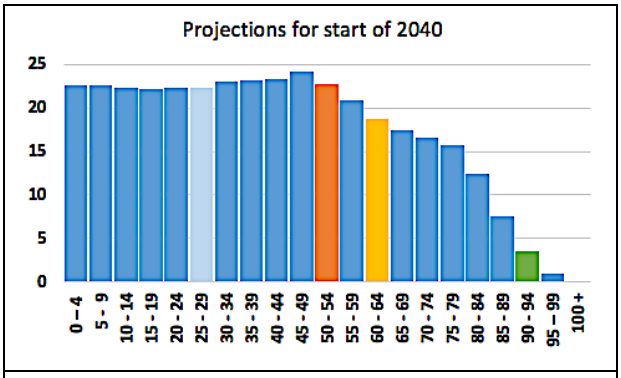
Several answers to the following questions require students to study the changes in the histograms over time:

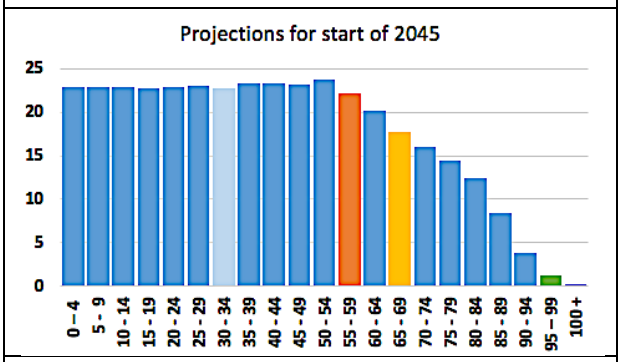


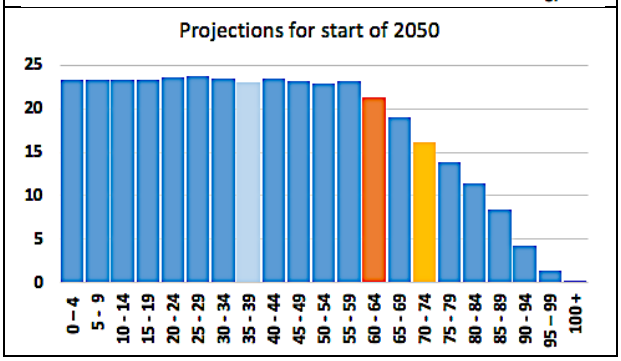












Population in millions of people for all graphs

Key:

Adeline (niece)	
Abbey (sister)	
Kristin	
Parent	

5. Answer the following:

   a. Identify at least 2 summaries of the 2025 graph that indicate it followed the 2020 graph.

      • The most dominant age group in 2020 is projected to be the 25 – 29 years old age group. The most dominant age group in 2025 is projected to be the 30 – 35 years old age group. This dominant age group aged by 5 years.

      • The 45 – 49 age group in 2020 is an interesting age group to watch in the graphs. It represents a type of "valley" with older age groups close to it having greater counts, and younger age groups close to it also having greater counts. The same visual of a "valley" is displayed in 2025 for the age group 50 – 54 years old. The pattern continued as people aged by 5 years.

   b. Identify at least 2 summaries of the 2030 graph that indicate it followed the 2025 graph.

      • The most dominant age group in 2025 is projected to be the 30 – 34 years old age group. The most dominant age group in 2030 is projected to be the 35 – 39 years old age group. The dominant age group aged by 5 years.

      • There is a similar build-up to the dominant age group. For 2025, several age groups younger that 30 – 34 years old are projected to each have increased counts until the 30 – 34 age group. This pattern is also observed in the 2030 histogram, except the age groups are projected to increase to the dominant age group of 35 – 39 years old.

   c. In what way is the population distribution as outlined in the histogram for 2035 similar to the population distribution as outlined in the histogram for 2030?

      A similar pattern of age groups increasing in count and then decreasing is observed in both histograms. The overall visual pattern for the 2035 graph is essentially similar to the pattern of the 2030 graph except shifted over by 5 years.

6. Kristin commented that the graphs for 2040, 2045, 2050 begin to look like a rectangle followed by a downward slope at the end.

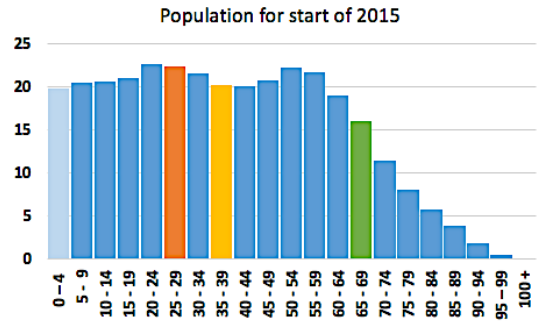
   a. What summaries of the age groups of the 2050 graph make it look like a rectangle from age groups 0 – 4 years old to 55 – 59 years old?

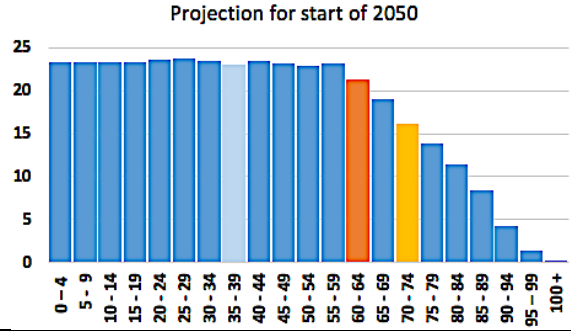
      The counts for the age groups 0 – 4 years old to the 55 – 59 years old have similar counts. The variations in the counts of these age groups are very small.

   b. What do you think is the reason for the downward slope that begins at 60 – 64 years old?

      The downward slope that begins with the 60 – 64 years old age group is due to deaths over time.

7. The following graphs provide an overall comparison of the changes of the country and the age groups from the start of 2015 to the start of 2050. The counts of the age groups are based on the counts you completed for **Handout 6**. Calculate the percent of the country's population in each of the age intervals requested for 2015 and 2050:





Estimated count of people 0 – 24 years old:
104.78 million people
Estimated count of people 25 – 49 years old:
105.29 million people
Estimated count of people 50 – 74 years old:
90.63 million people
Estimated count of people 75 – 100+ years old:
20.21 million people
Estimated total population:
320.91 million people

Country's Layers
Estimated percent of the country who are 0 – 24 years old:
104.78 / 320.91 or approximately 32.7%
Estimated percent of the country who are 25 – 49 years old:
105.29 / 320.91 or approximately 32.8%
Estimated percent of the country who are 50 – 74 years old:
90.63 / 320.91 or approximately 28.2%
Estimated percent of the country who are 75 – 100+ years old:
20.21 / 320.91 or approximately 6.3%

Projected count of people 0 – 24 years old:
116.72 million people
Projected count of people 25 – 49 years old:
116.77 million people
Projected count of people 50 – 74 years old:
102.64 million people
Projected count of people 75 – 100+ years old:
39.53 million people
Projected total population:
375.67 million people

Country's Layers
Projected percent of the country who are 0 – 24 years old:
116.72 / 375.67 or approximately 31.1%
Projected percent of the country who are 25 – 49 years old:
116.77 / 375.67 or approximately 31.1%
Projected percent of the country who are 50 – 74 years old:
102.64 / 375.67 or approximately 27.3%
Projected percent of the country who are 75 – 100+ years old:
39.53 / 375.67 or approximately 10.5%

8. Based on the above percent of the layers, describe the country's shape as bottom-layered, lower middle-layered, upper middle-layered, or top-layered for:
   a. 2015

      Lower middle-layered

b. 2050

The percent of the lower and middle layers (both lower and upper) are nearly the same in 2015 and 2050. Examining the actual estimated counts for the United States indicates the country is a lower middle-layered country in 2015 and 2020. The top layer is projected to be higher for 2050.

9. Use **Handout** 6 to estimate the 5-year age group in which the median age would be located for 2015.

   The proportion of the cumulative count to the total population is slightly more than half or 0.50 within the age group 35 – 39 years old. The median age would be an age within that interval. The United States Census Bureau reported the median age at 37.8 years for 2015.

10. Use **Handout** 6 to estimate the 5-year age group in which the median age would be located for 2050.

    The proportion of the cumulative count to the total population is slightly more than half or 0.50 within the age group 35 – 39 years old. The median age would be an age within that interval. Note that the median age has stayed the same. The median age of the country for the intervening years, however, was slightly higher. It is in 2050 that we begin to see the younger age groups gaining in count.

    There are several ways to estimate the interval that contains the median age. One way is to start adding the counts from the 25 – 29 years old age group and older, each time calculating the percent based on the total population. There was 31.1% of the population below the age of 24 years based on the summary students previously calculated, therefore, the median age would be found in age groups older than 24 years old.

11. Use **Handout** 6 to identify the age group that has the greatest projected increase in the count of people when comparing the 2015 to the 2050 counts. What is the percent increase of the 2050 count in this age group to the 2015 count of this age group?

    The greatest increase in the count of people is projected to be the 75 – 79 years old age group from 8.12 million to 13.93 million people, or an increase of 5.81 million people. After looking over the handout, students are expected to list age groups with estimated increases of several million people, and from that list, calculate the age group with the greatest increase.

12. Use **Handout** 6 to identify the age group that has the greatest projected decrease in the count of people when comparing the 2015 to the 2050 counts if any decreases exist. What is the percent decrease of the 2050 count to the 2015 count of this age group?

    There are no age groups that are projected to decrease in count. The smallest estimated increase in count is projected in the 100+ age group with a 0.16 million increase (or approximately 160,000 people).

13. Identify an age group that is projected to have the greatest percent increase of people when comparing the 2015 to the 2050 counts.

    The age group with the greatest percent increase is the age group 100+ years old. It is estimated that there will be an increase of 0.16 millions of people from 2015 to 2050 in this age group. If accurate, the percent increase from 2015 would be 200%. Remind students that although the count of this age group is projected to be small, the percent increase is projected to be the greatest. The difference of these two indicators of projected change in the population should be discussed.

Assessment Ideas:

Assessment Task:

Consider the following assessment task to determine a student's understanding of this lesson.

An online streaming company plans to produce a show that will be targeted for 55 – 59 years old. The company must make a profit with this show otherwise they will go out of business. Based on previous research, at most 20% of a targeted age group will watch a show. The company will need at least 4 million viewers to make a profit. Production of the show would only be possible at the start of 2025. If their research is accurate, in what years should the company release the show based on the data from the recursive model? Identify the years by using the column headings from Handout 6.

Do you think the company should trust the data? Explain your answer.

Comments on the Assessment Task:

Students derive that 4 million is 20% of 20 million. Therefore, students examine the counts projected for the age group 55 – 59 and determine that for the years 2040, 2045, or 2050, the estimated counts are greater than 20 million people (or 20.95 million for 2040, 22.19 million for 2045, and 23.20 million for 2050). The estimated counts are less than 20 million for the other years starting with 2025. Therefore, any of the yeas 2040, or 2045, or 2050 will have a potential number of 55 - 59 years old for the company to make a profit. In addition, point out to students (or ask them to point this out) that Abbey might be one of the viewers if the show is released in 2045.

Students are expected to comment that the years identified are the latter years of the model, and therefore, the counts may change due to events that alter population factors or the foundation factor. The further estimates are from the starting point of 2015, the more likely the estimates are not accurate. Therefore, there is some uncertainty with the years identified.

Additional comments for discussion:

This lesson highlights projected counts using the recursive model. The graphs for each of the intervening years from 2015 to 2050 show how various age groups that stood out in 2015 continue to stand out, but each group ages by 5 years in the intervening graphs. By 2050, most of the age groups (until age 60 and older) have similar projections. The "sameness" of the projections is what makes this model stand out as different, especially when compared to the overall count projected by the exponential model or the linear model. The recursive model is essentially the exponential in "chunks" with several age groups having smaller incremental changes over time. The counts of the total population of the recursive model display a leveling off from 2015 to 2050, although each projection of the total population shows an increase. Will this increase continue? Will the leveling off ultimately result in a stable impact or no changes in the total population of the country?

Changes in the population based on events that would change the intervening counts is the focus of Unit 4. "What if…?" events (for example, a decreasing number of immigrants, or war, or increasing employment opportunities that results in greater immigration) are examined in Unit 4 by changing the population factors or the foundation factor of the recursive model.