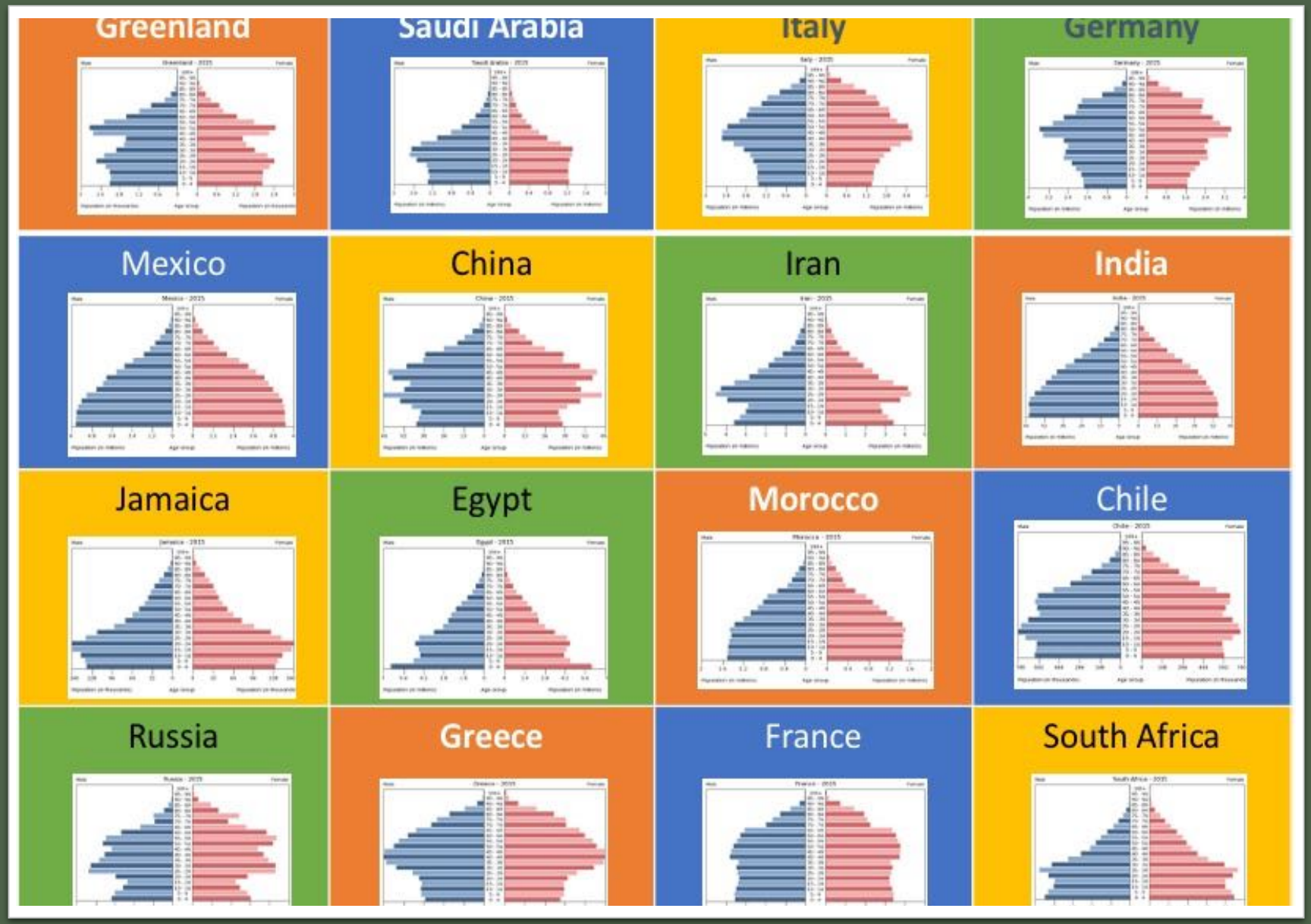


People Count Stories - Student Centered Lessons to Promote Modeling

Henry Kranendonk
Marquette University

The data stories within the population distributions of Henry's Quilt

People Count!
and the stories of …

Kristin
Generation X

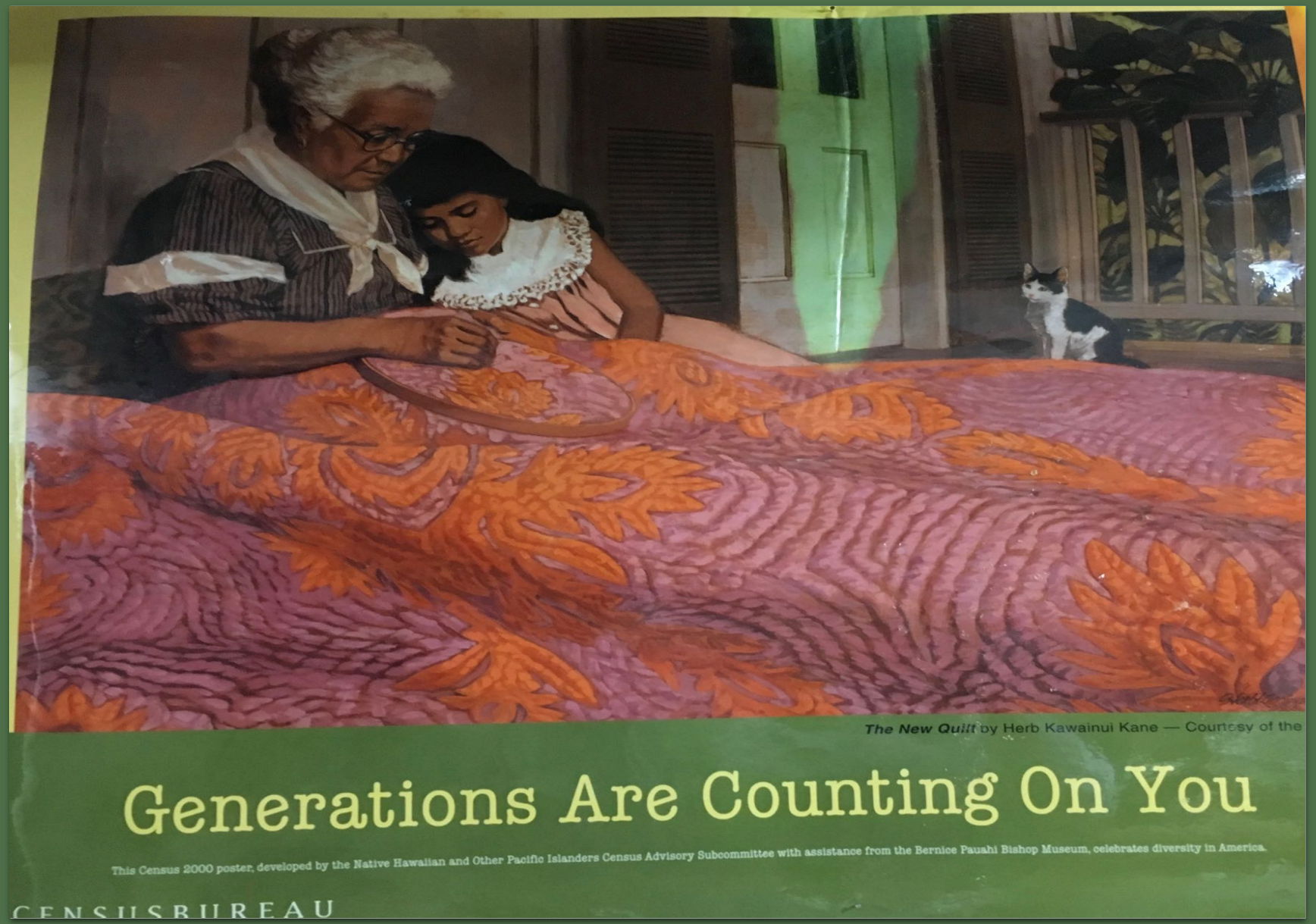
Abbey
The Millennial

Adeline
Generation Z

Parents
Baby Boomers

And generations yet to be named

*** Henry's Quilt**



Poster: United States Census Bureau 2000

Painting by Herb Kawaine Kane (Hawaii)

Painting by Johnny Lott based off a photo taken at the first count of the 2020 Census in the Aleutian Islands, Alaska

Goals for this session

- To develop and implement a model (described as a recursive model) of population projections for the United States, Kenya, and Japan

- To interpret the projections based on the recursive model as summaries of the critical factors that impact change within a country's population over time

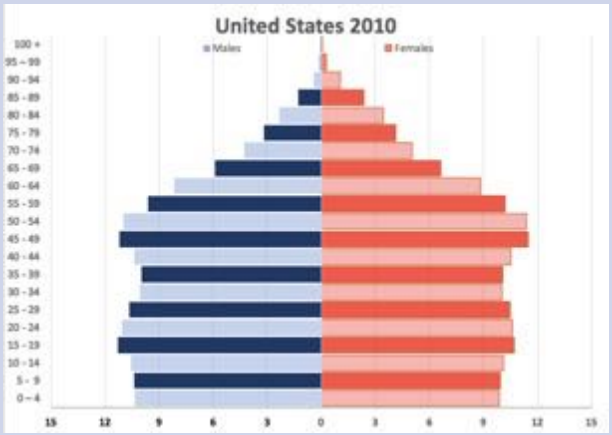
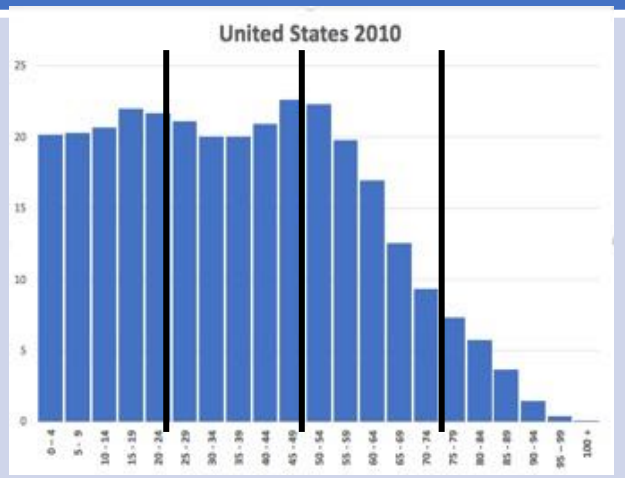
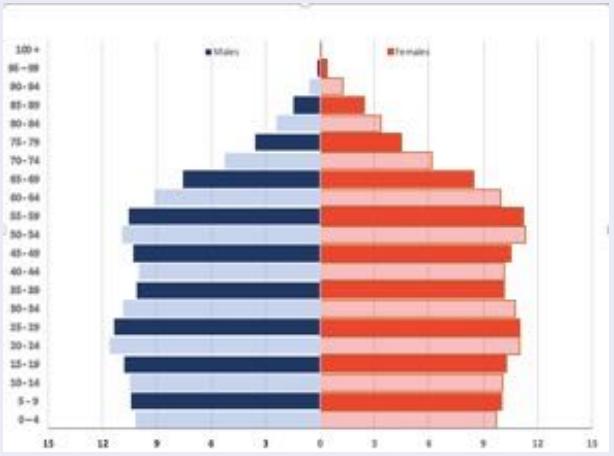
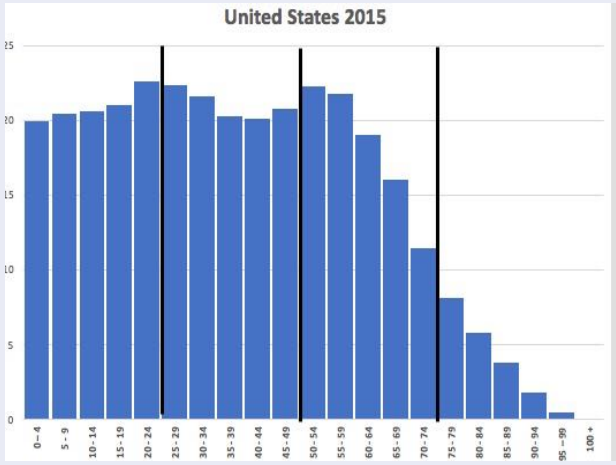
- To provide opportunities for reluctant students to develop relevant and meaningful mathematical and statistical problems (described as scenarios or data stories)

Target Population of Students

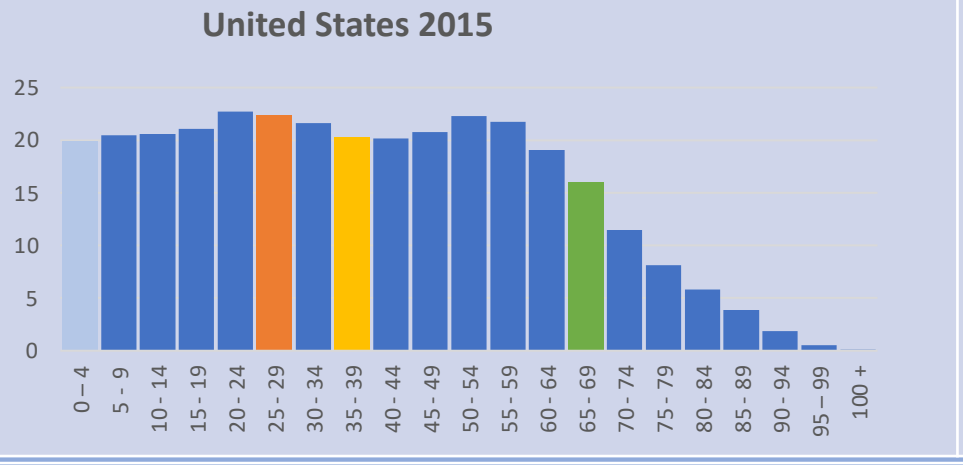
- **High school and college students not convinced that mathematics or statistics has a meaningful role in their lives.**

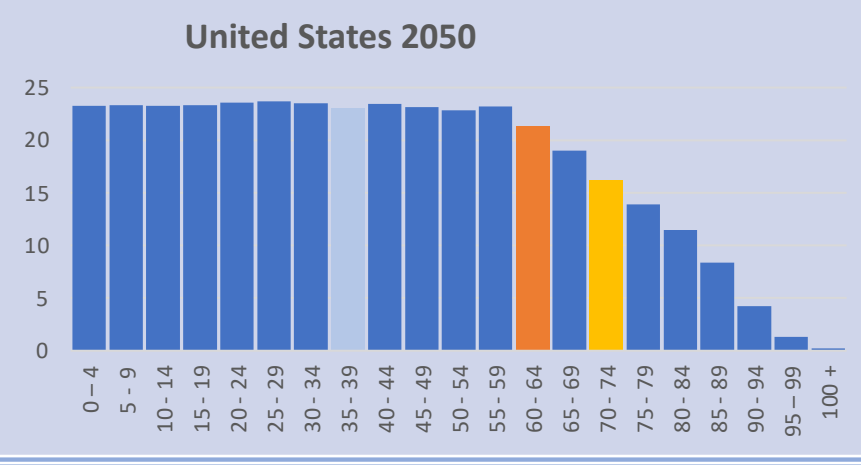
- **High school and college students interested in connecting their own family or community backgrounds to the demographic summary of their country and family background.**

What changes do we note from 2010 to 2015?

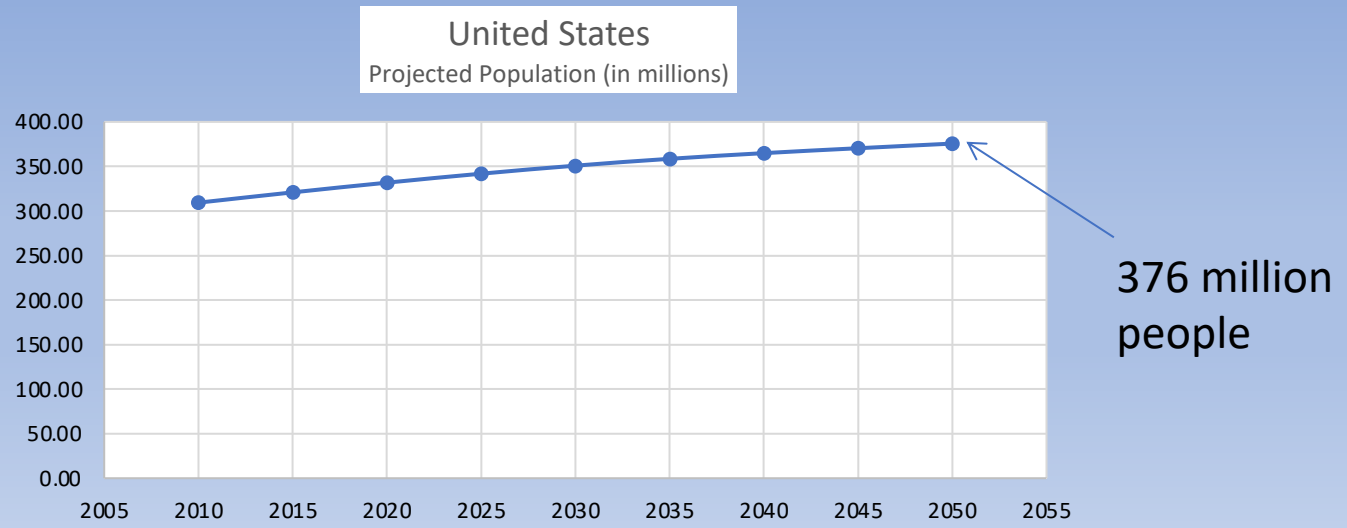
Population Pyramid Graphs	Population Histograms
	
United States 2015 	

Scenario 1: What if the factors that impact the count of people from 2010 to 2015 remained the same from 2015 to 2020. What are the factors that impact the projected counts? What would be the projected counts of the US population from 2020 – 2050 if the factors remained the same?



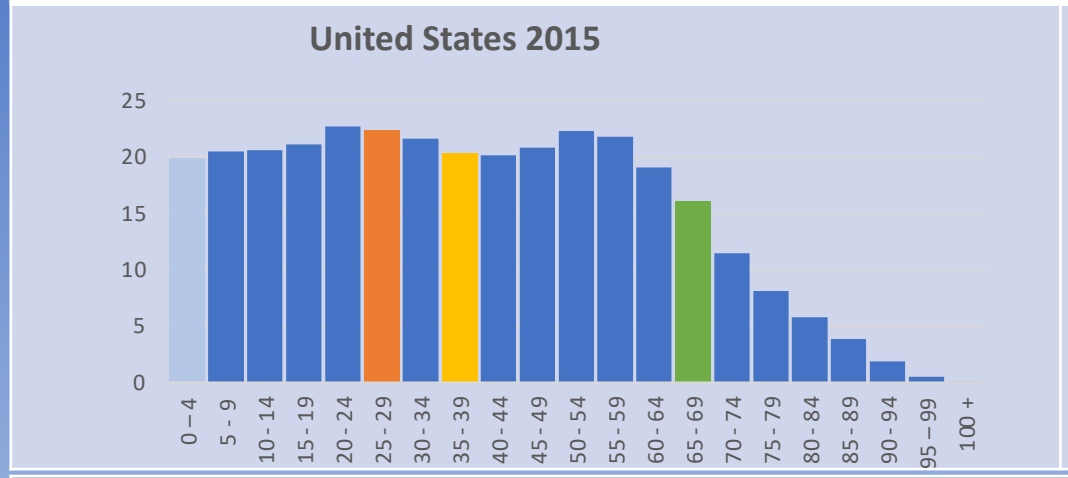


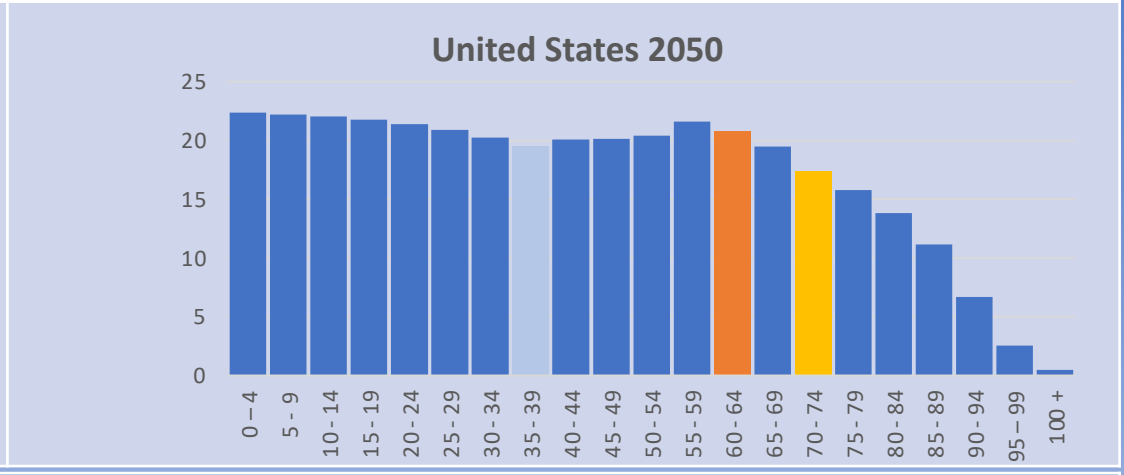
2010: 309 million people
2015: 321 million people
2020: 332 million



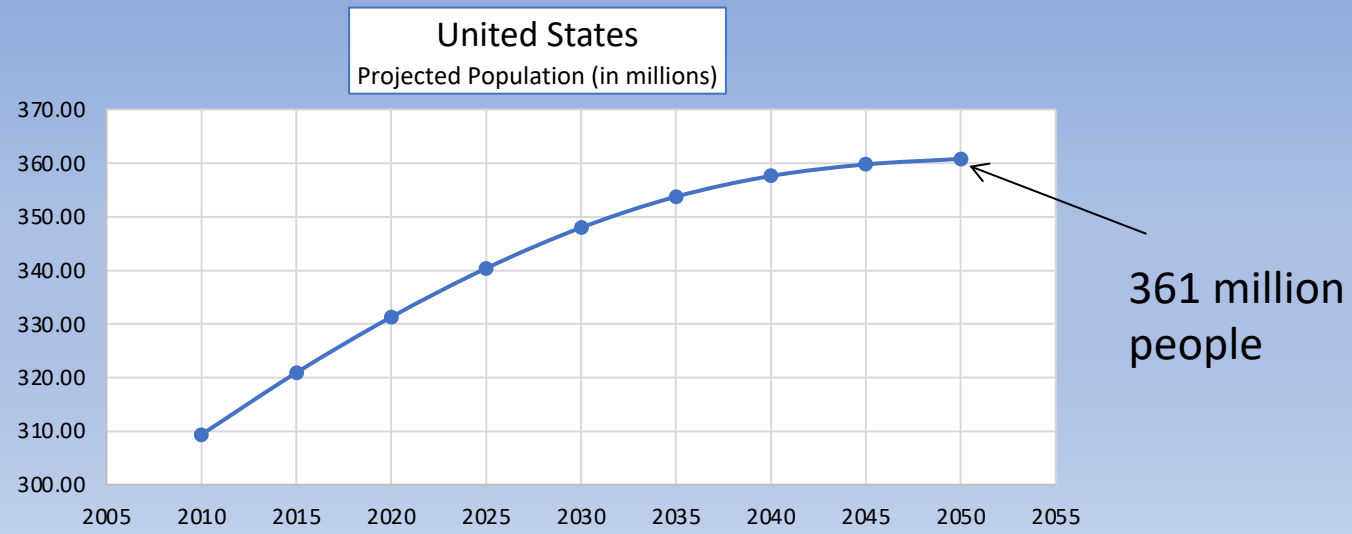
376 million people

Scenario 2: What if the factors that impact the count of people from 2010 to 2015 changed during 2015 to 2020 and resulted in the following graphs moving forward. What do you think happened during 2015 to 2020?

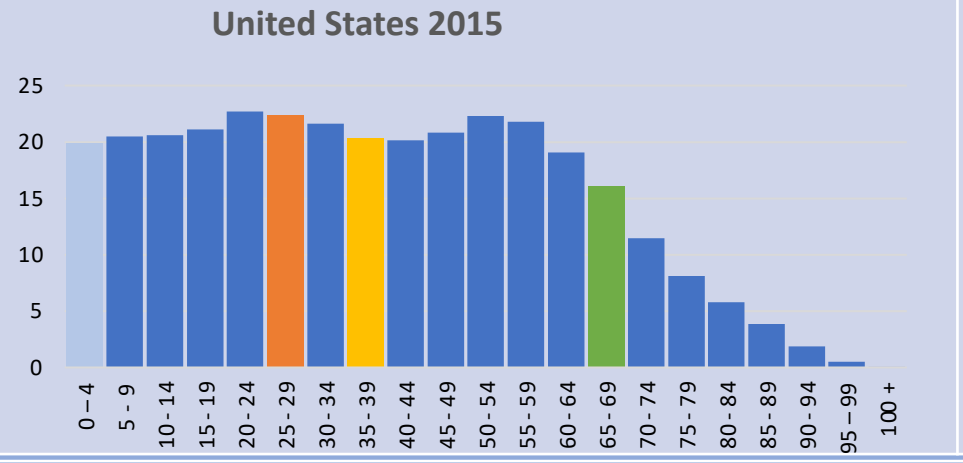


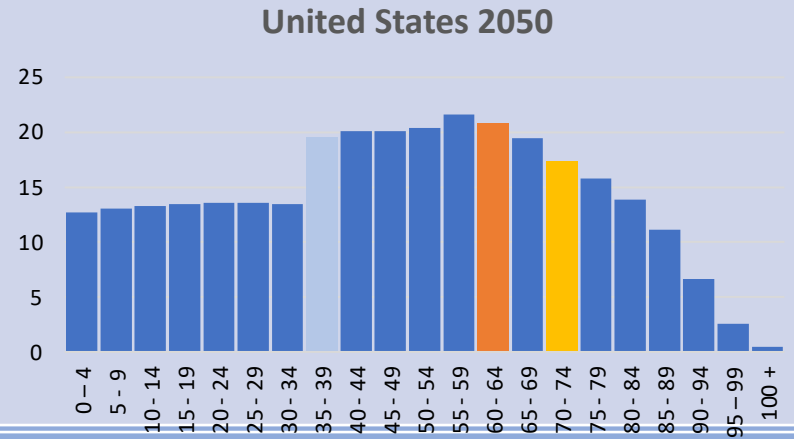


2010: 309 million people
2015: 321 million people
2020: 332 million

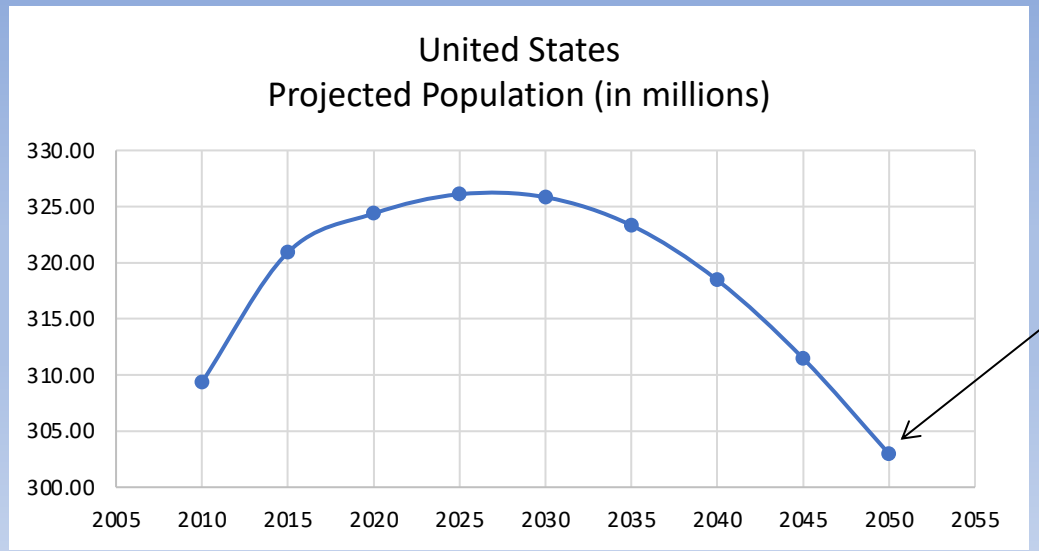


Scenario 3: What if the factors that impact the count of people from 2010 to 2015 changed during 2015 to 2020 and resulted in the following graphs moving forward. What do you think happened during 2015 to 2020?



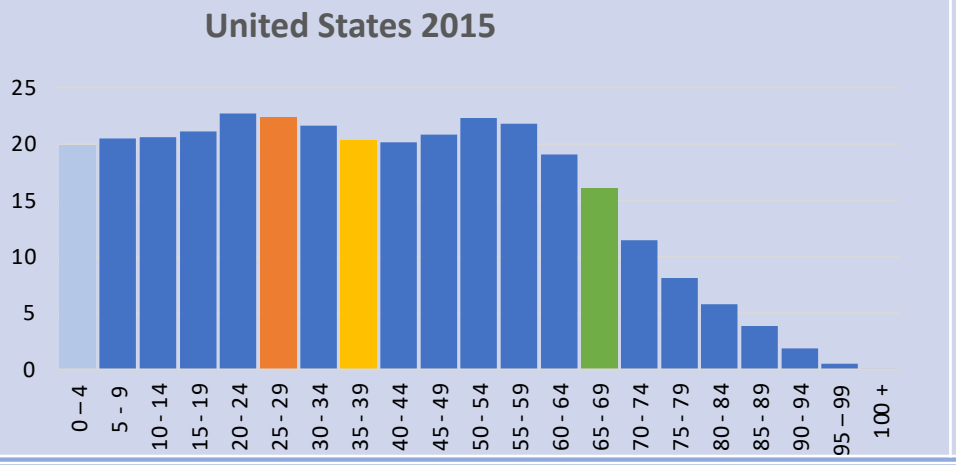


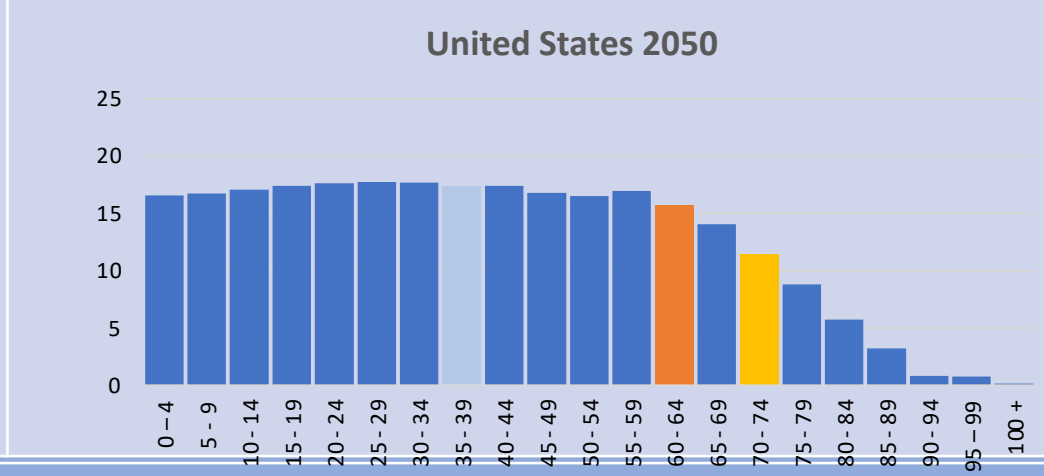
2010: 309 million people
2015: 321 million people
2020: 325 million



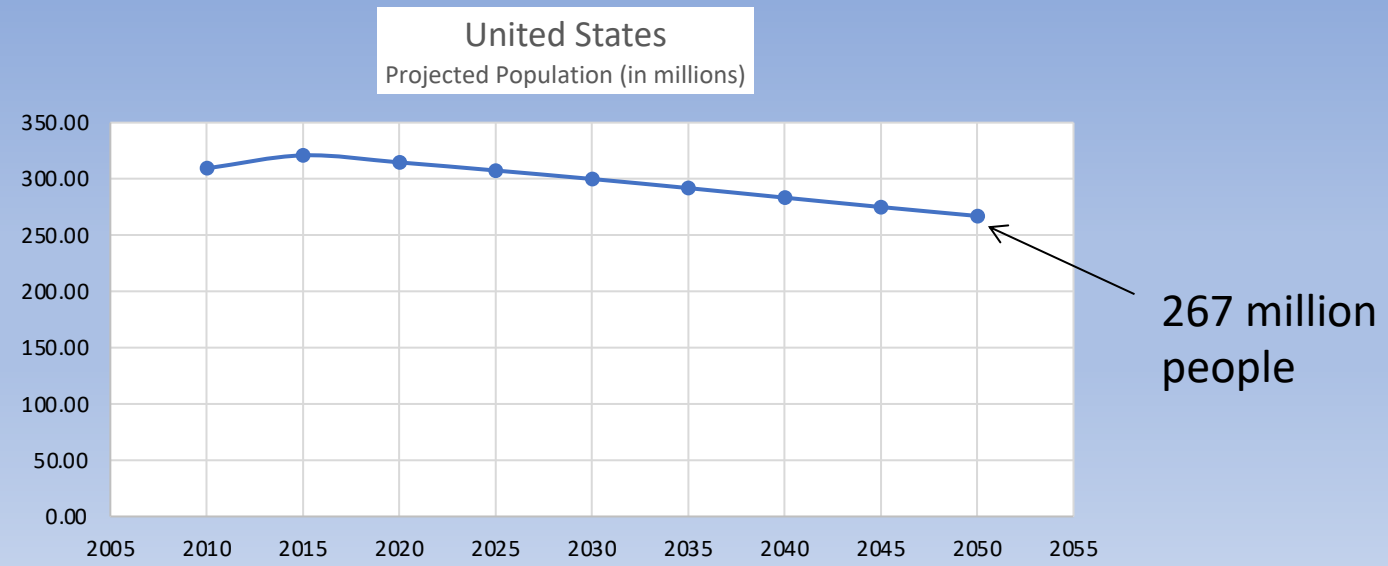
303 million people

Scenario 4: What if the factors that impact the count of people from 2010 to 2015 changed during 2015 to 2020 and resulted in the following graphs moving forward. What do you think happened during 2015 to 2020?

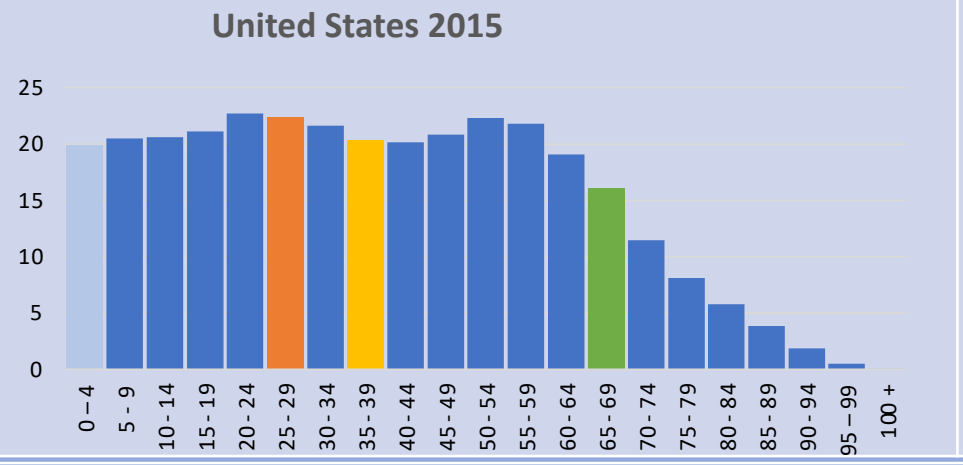


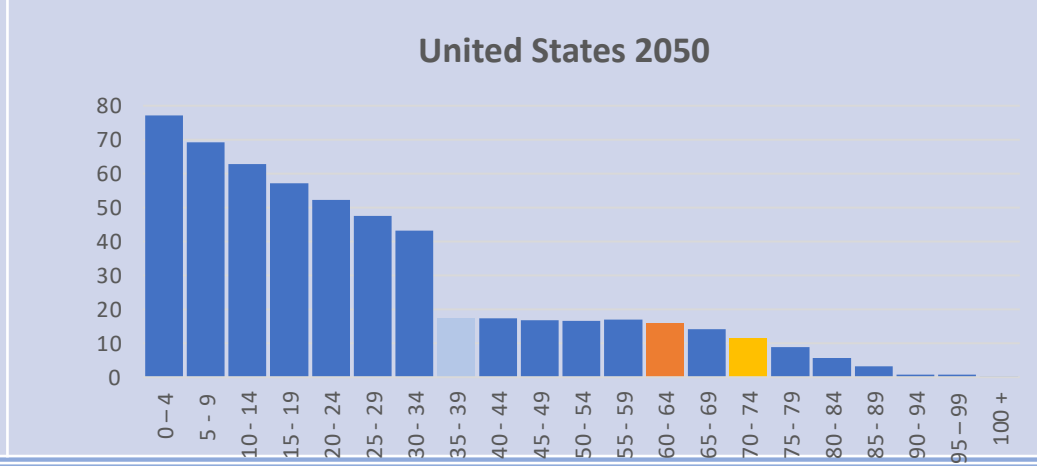


2010: 309 million people
2015: 321 million people
2020: 315 million

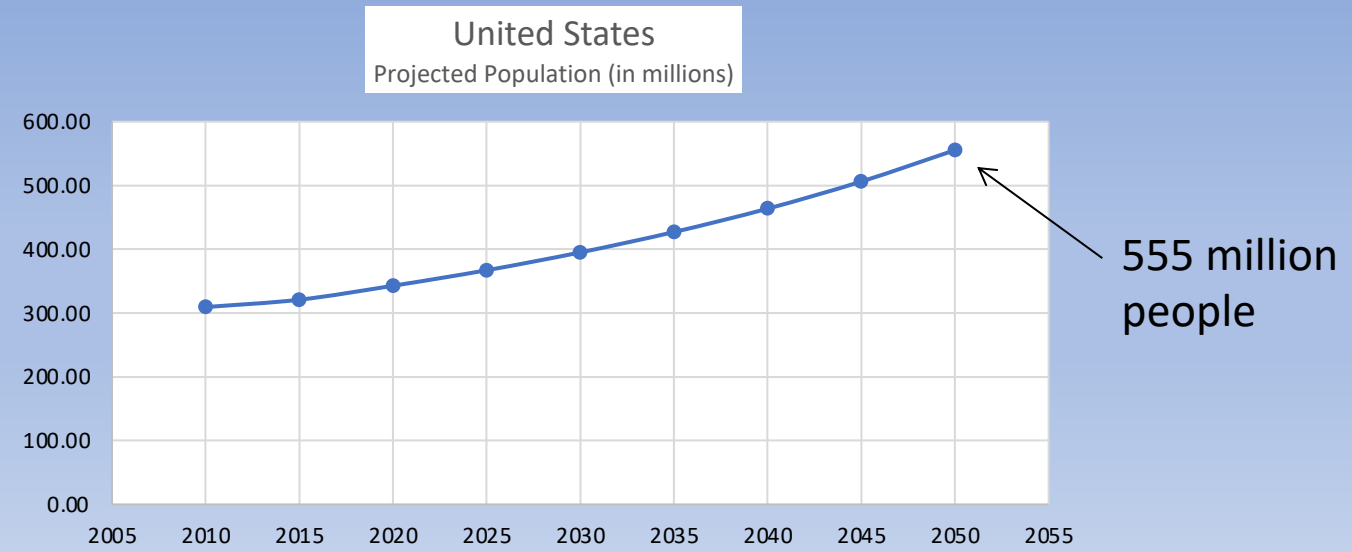


Scenario 5: What if the factors that impact the count of people from 2010 to 2015 changed during 2015 to 2020 and resulted in the following graphs moving forward. What do you think happened during 2015 to 2020?



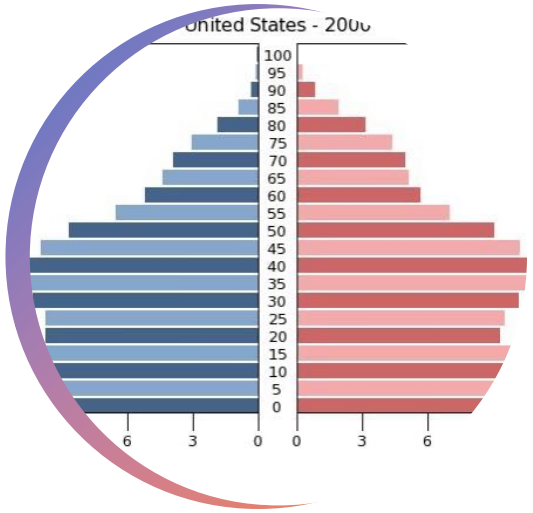


2010: 309 million people
2015: 321 million people
2020: 343 million



What are the Factors of Change?

- **Population Factors**
  - Identifies dominant changes due to:
    - Immigration
    - Emigration
    - Death
- **Foundation Factors**
  - Summarizes change due to births



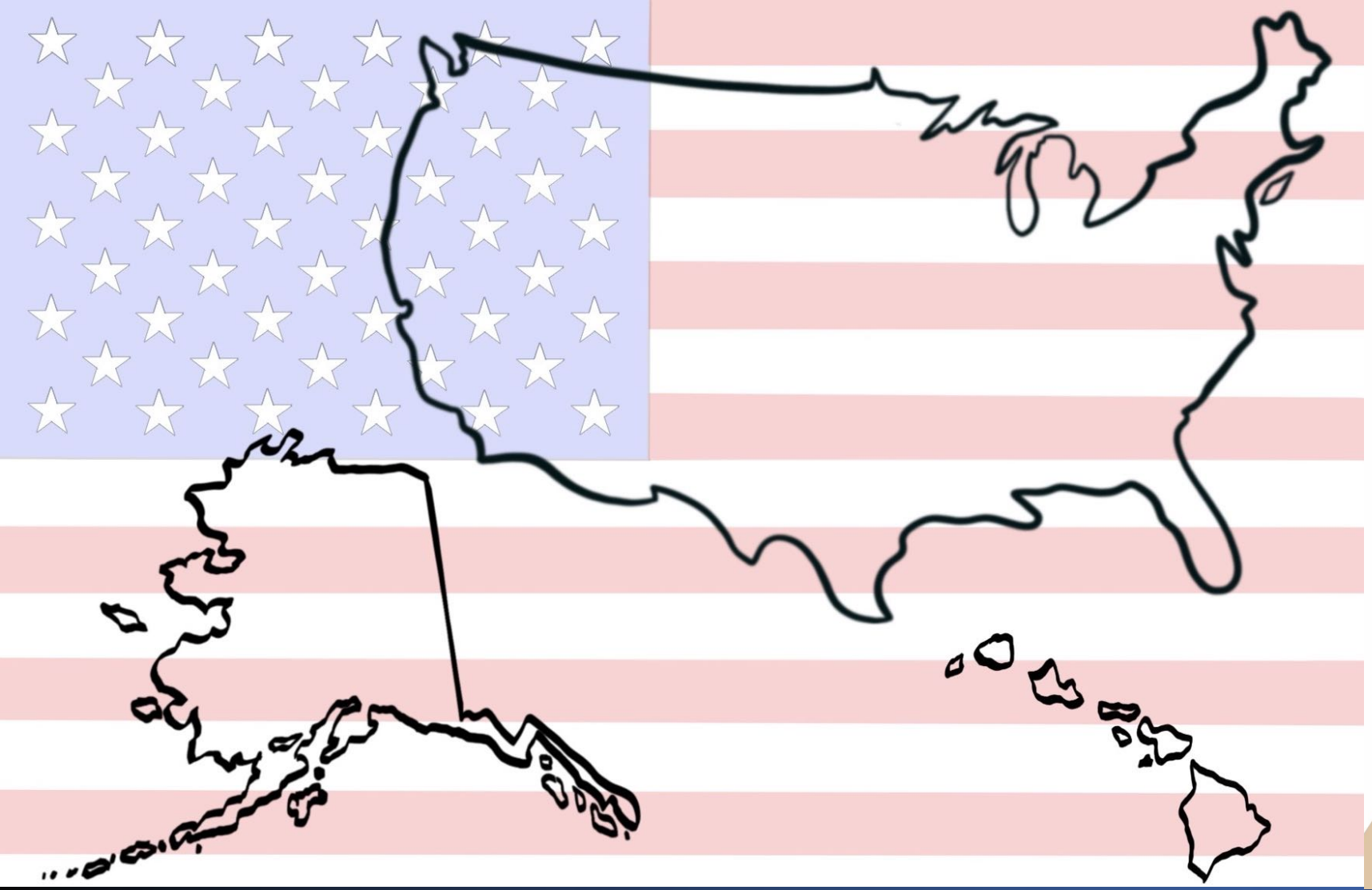
Implications of these Factors Through the Data Stories

Unit 1: A Country's Shape

Unit 2: Looking Back

Unit 3: Looking Forward

Unit 4: "What if …?"



Unit 1:
A Country's Shape (Center and Spread)

- **As we move through the data stories, think about the question: "Why is Kristin an interesting person to study in the data stories?"**

(The above question turned out to be very insightful in evaluating students understanding and interest in this material, plus identifying the first steps in the modeling continuum.)

Data Stories

Kristin's Story – Chapter 1

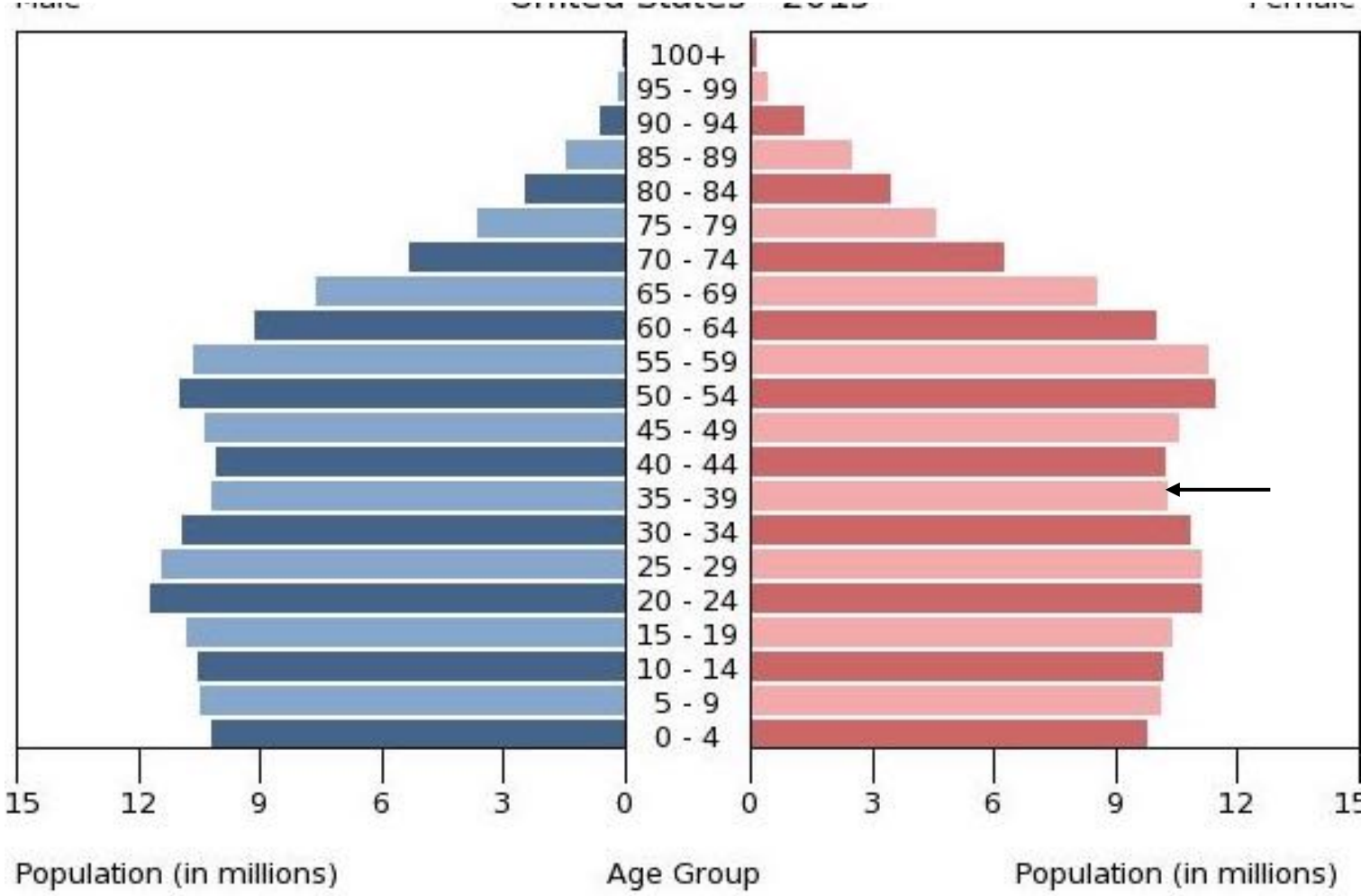
It was January 1, 2015. Kristin, a 36-year old female, lived in Milwaukee, Wisconsin. She worked 40 hours a week as a health care researcher for a community clinic. Most people involved in her research were 60 years old or older. She was responsible for obtaining basic data that included weight, height, blood pressure, heart rate, previous health concerns, vaccinations, diet and sleeping issues. She felt that the start of a new year was a good time to think about her own future.

Kristin's mother was 66 years old at the start of 2015 and in good health. She came into the clinic at least once a year and generally did not require any follow-up visits. During her most recent visit, she stated something that confused Kristin. "Based on the shape of our country, I will be entering a new layer of our country's population in the next decade, along with lots of other people." Kristin was puzzled. What did she mean?

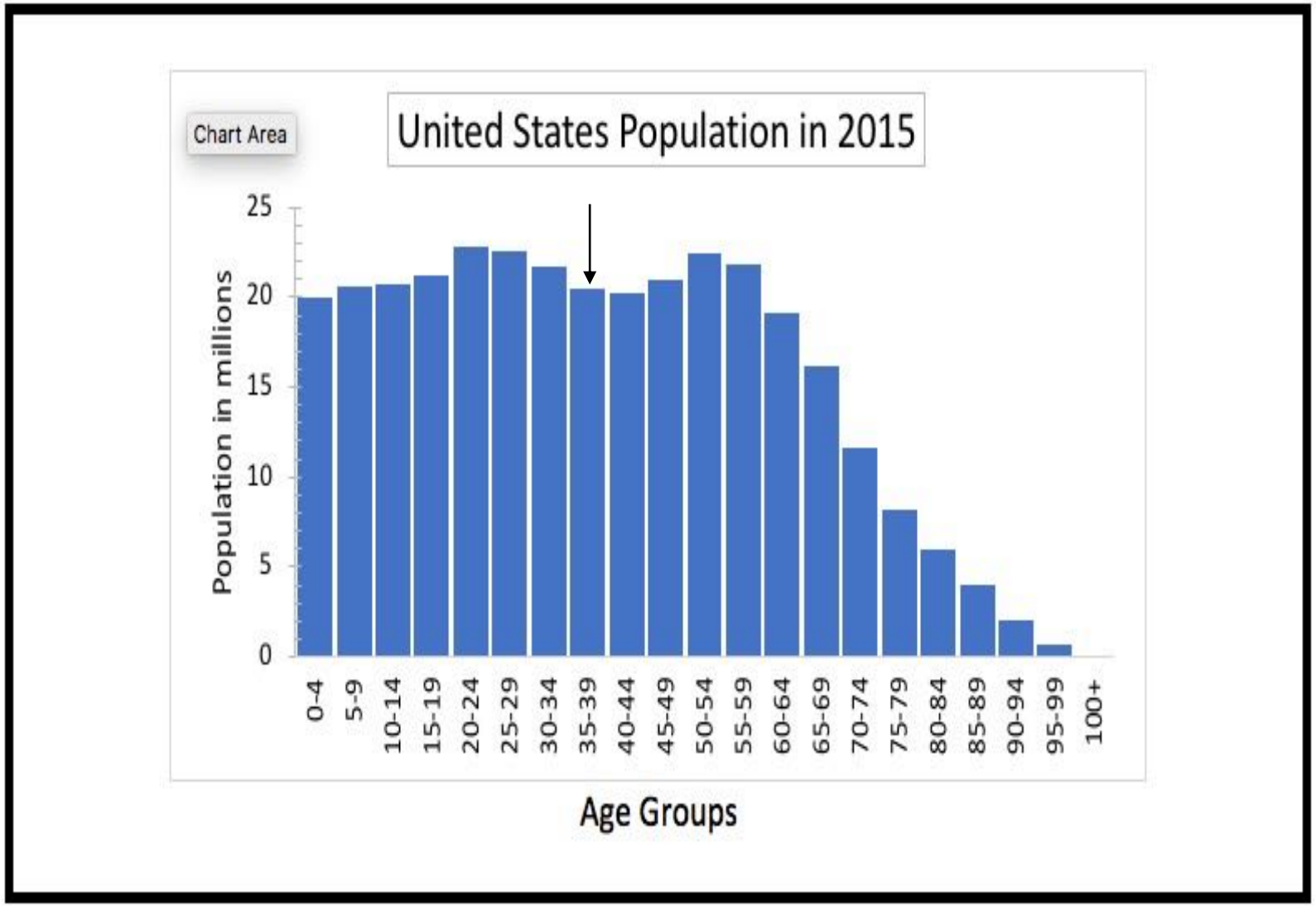
Kristin felt she could sketch the shape of the United States . Her sketch would be the shape she visualized during her study of geography in high school or college. She realized that her mother was reflecting on the fact that she was growing older, but what does age have anything to do with our country's shape? What did she mean that she was entering a new "layer"?

Shape suggested to Kristin something visual, like a square, a circle, or a triangle – something you studied in geometry. She thought again about her mother's comment. Kristin initially chalked up her mother's comment as something people say as they grow older. She found in her research, however, a ***population pyramid graph*** prepared by the United States Census

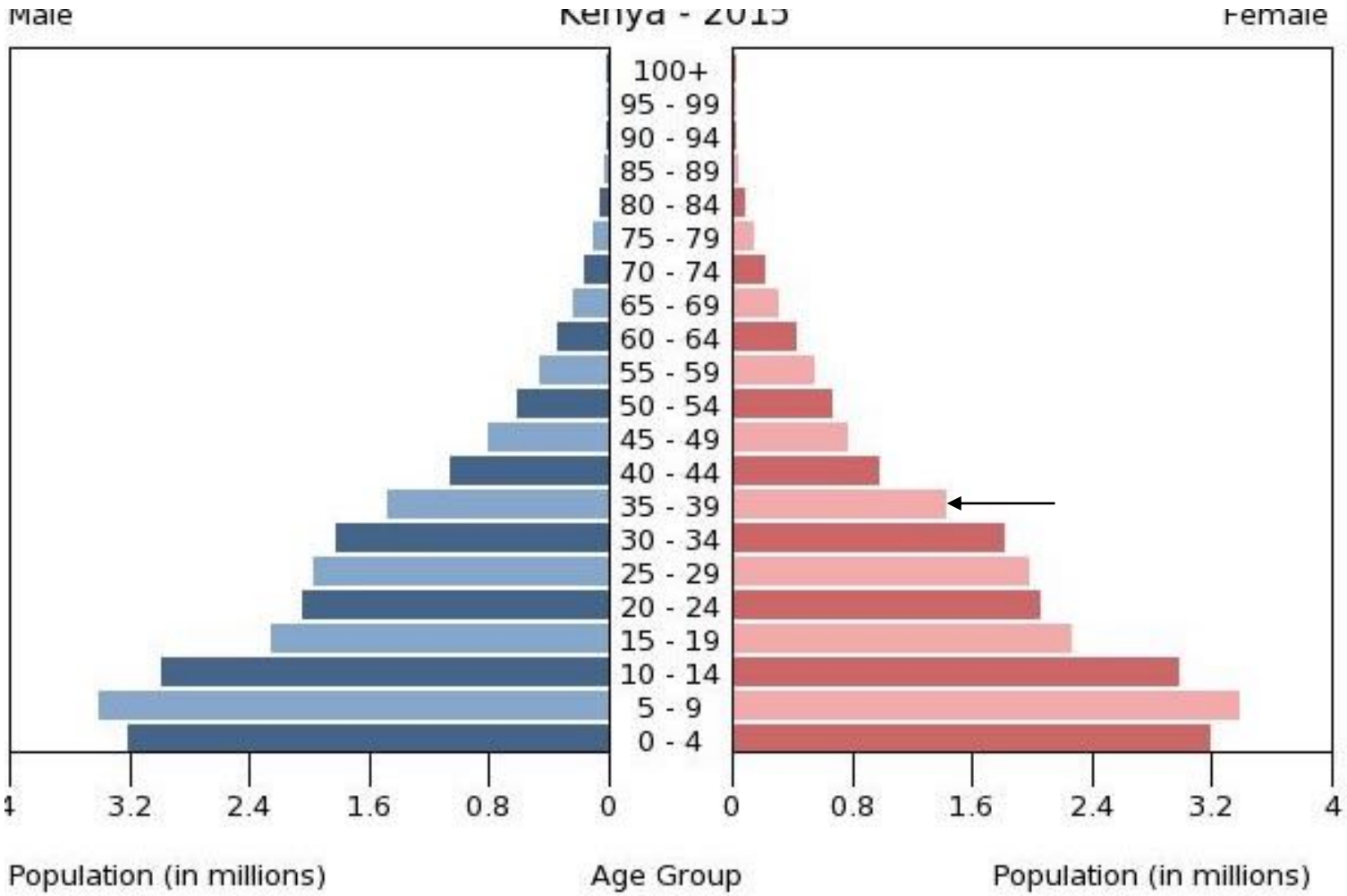
Is there a different way to describe the shape of a country?



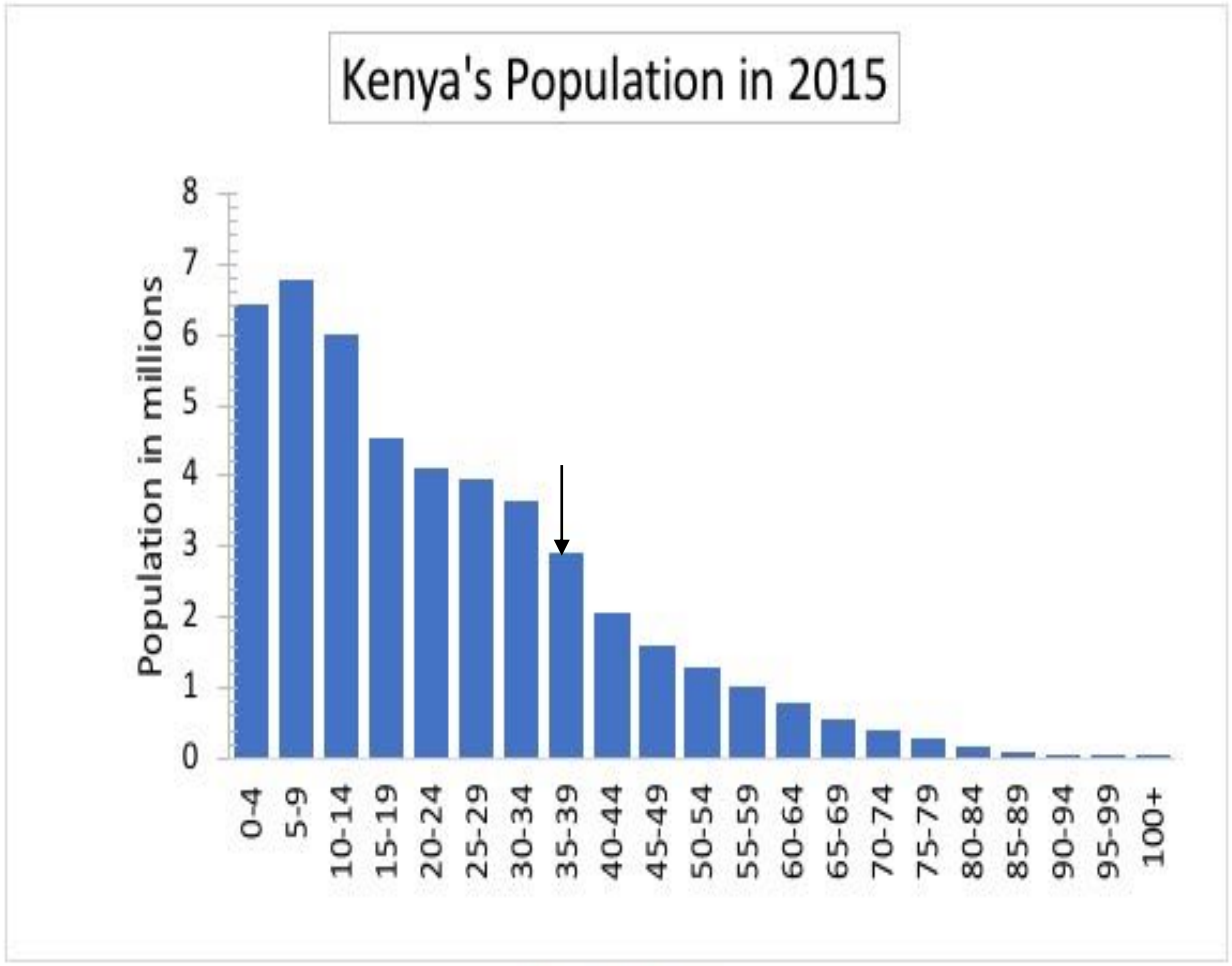
The United States - 2015



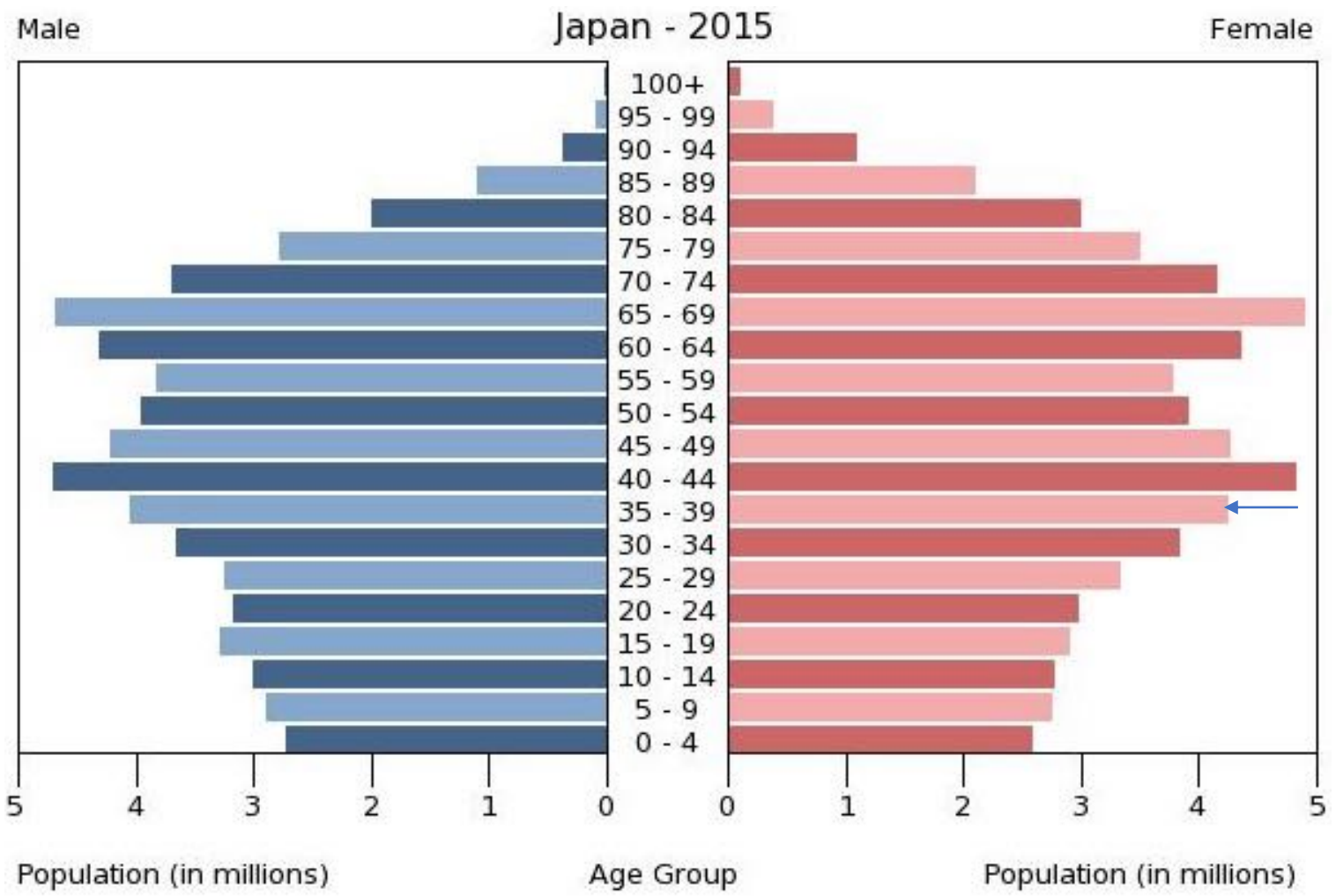
The United States - 2015


Male
Kenya - 2015
Female
100+
95 - 99
90 - 94
85 - 89
80 - 84
75 - 79
70 - 74
65 - 69
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
35 - 39
30 - 34
25 - 29
20 - 24
15 - 19
10 - 14
5 - 9
0 - 4
4
3.2
2.4
1.6
0.8
0
0
0.8
1.6
2.4
3.2
4
Population (in millions)
Age Group
Population (in millions)

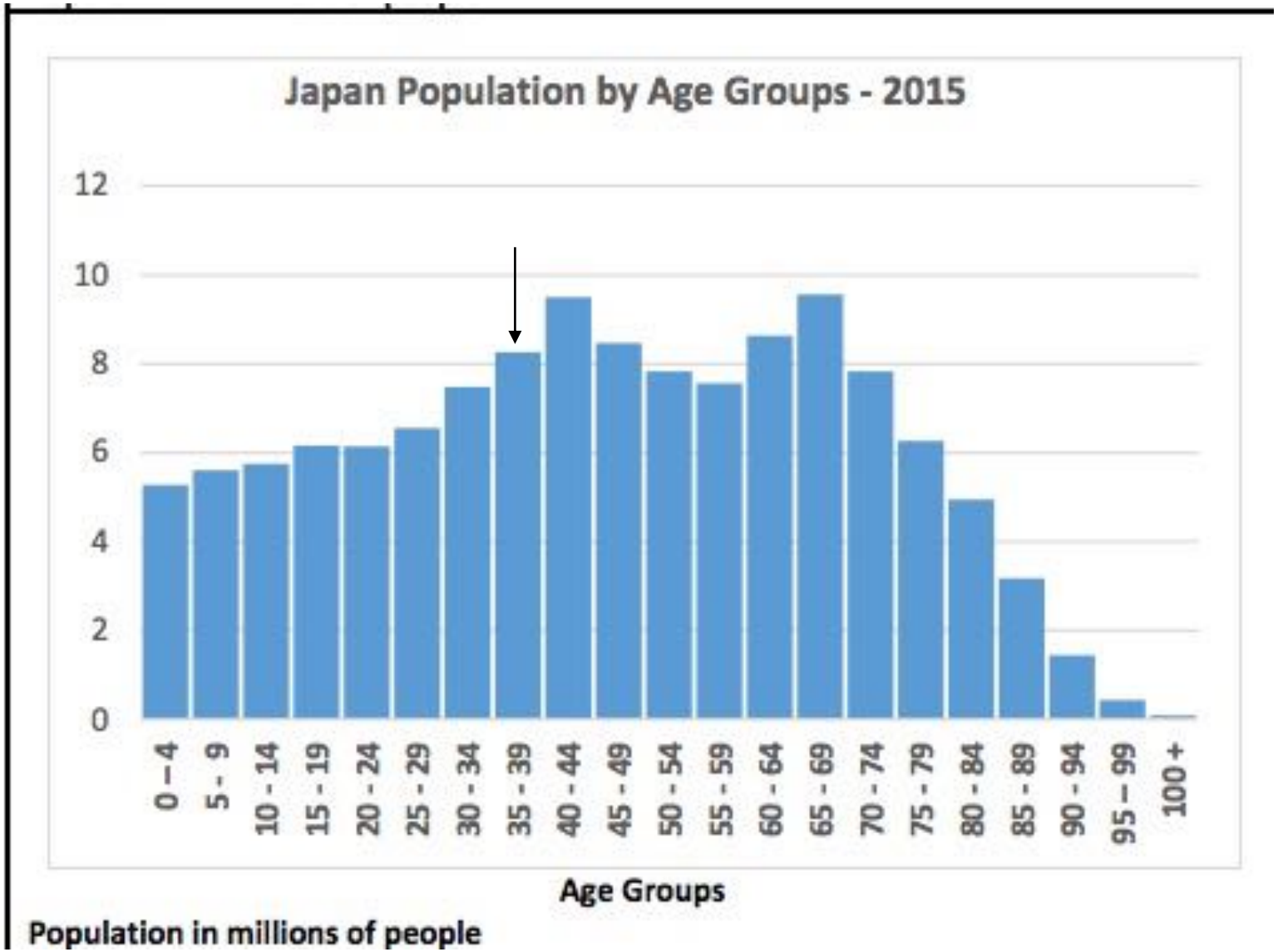
Kenya - 2015


Kenya's Population in 2015
Population in millions
0
1
2
3
4
5
6
7
8
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-89
90-94
95-99
100+
Age Groups

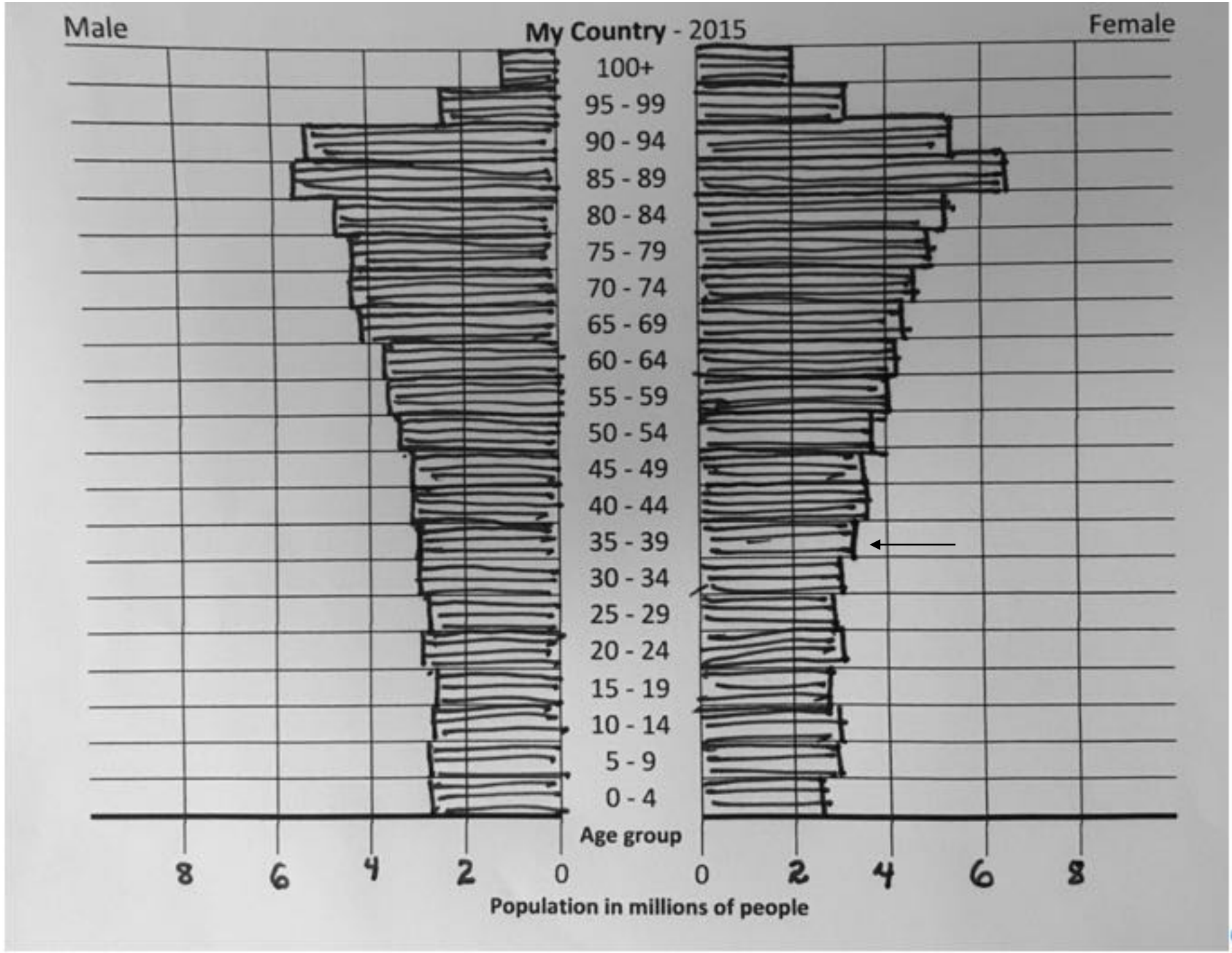
Kenya - 2015


Male
Japan - 2015
Female
100+
95 - 99
90 - 94
85 - 89
80 - 84
75 - 79
70 - 74
65 - 69
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
35 - 39
30 - 34
25 - 29
20 - 24
15 - 19
10 - 14
5 - 9
0 - 4
5
4
3
2
1
0
0
1
2
3
4
5
Population (in millions)
Age Group
Population (in millions)

Japan - 2015


Japan Population by Age Groups - 2015
12
10
8
6
4
2
0
0 – 4
5 - 9
10 - 14
15 - 19
20 - 24
25 - 29
30 - 34
35 - 39
40 - 44
45 - 49
50 - 54
55 - 59
60 - 64
65 - 69
70 - 74
75 - 79
80 - 84
85 - 89
90 - 94
95 – 99
100 +
Age Groups
Population in millions of people

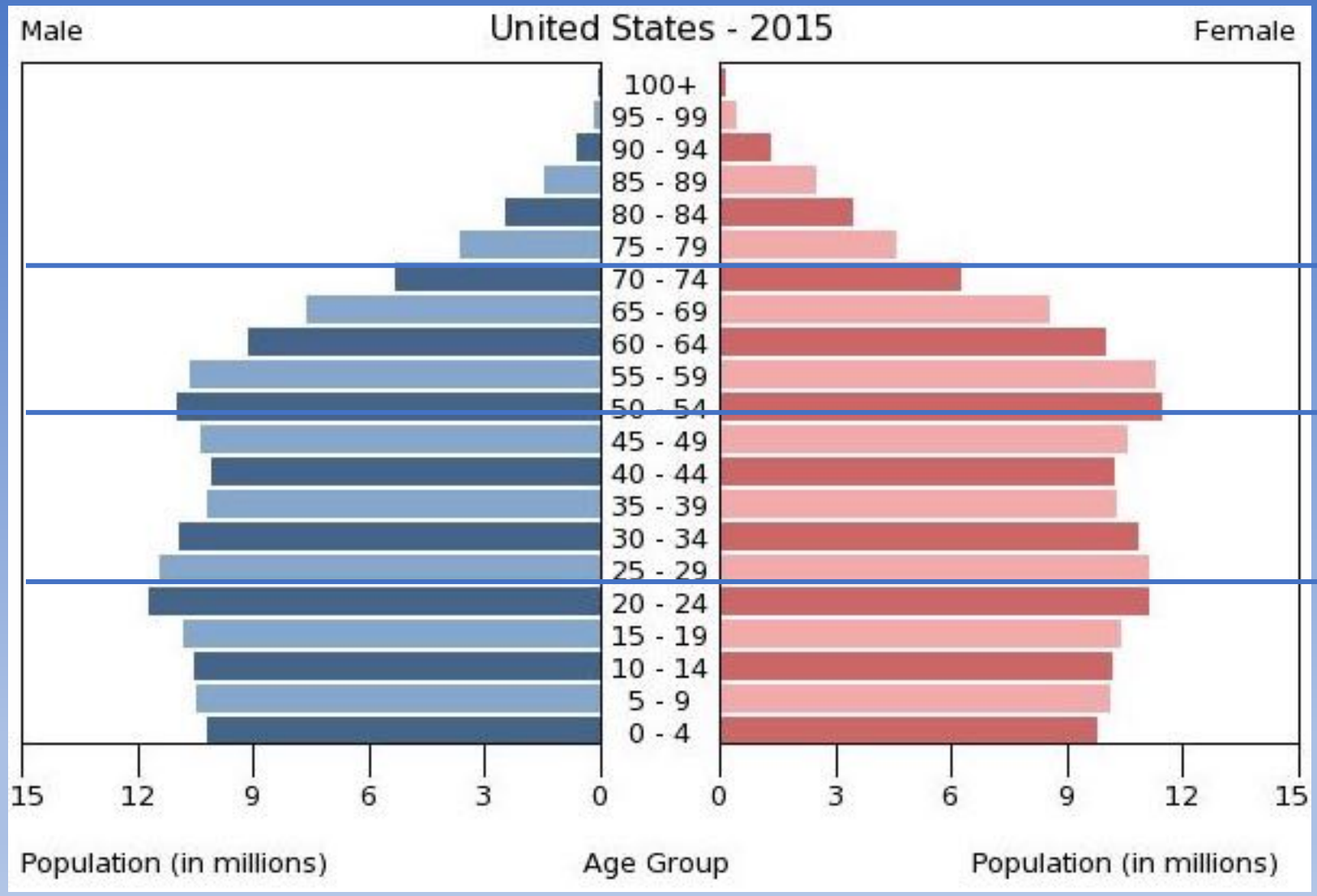
Japan - 2015


Male
My Country - 2015
Female
100+
95 - 99
90 - 94
85 - 89
80 - 84
75 - 79
70 - 74
65 - 69
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
35 - 39
30 - 34
25 - 29
20 - 24
15 - 19
10 - 14
5 - 9
0 - 4
Age group
8
6
4
2
0
0
2
4
6
8
Population in millions of people

Population Pyramid Graphs of Countries Classifications

Top-Layer **75 – 100+ years old**
Upper Middle-Layer 50 – 74 years old
Lower Middle-Layer 25 – 49 years old
Bottom-Layer 0 – 24 years old

A Lower Middle-Layered Country



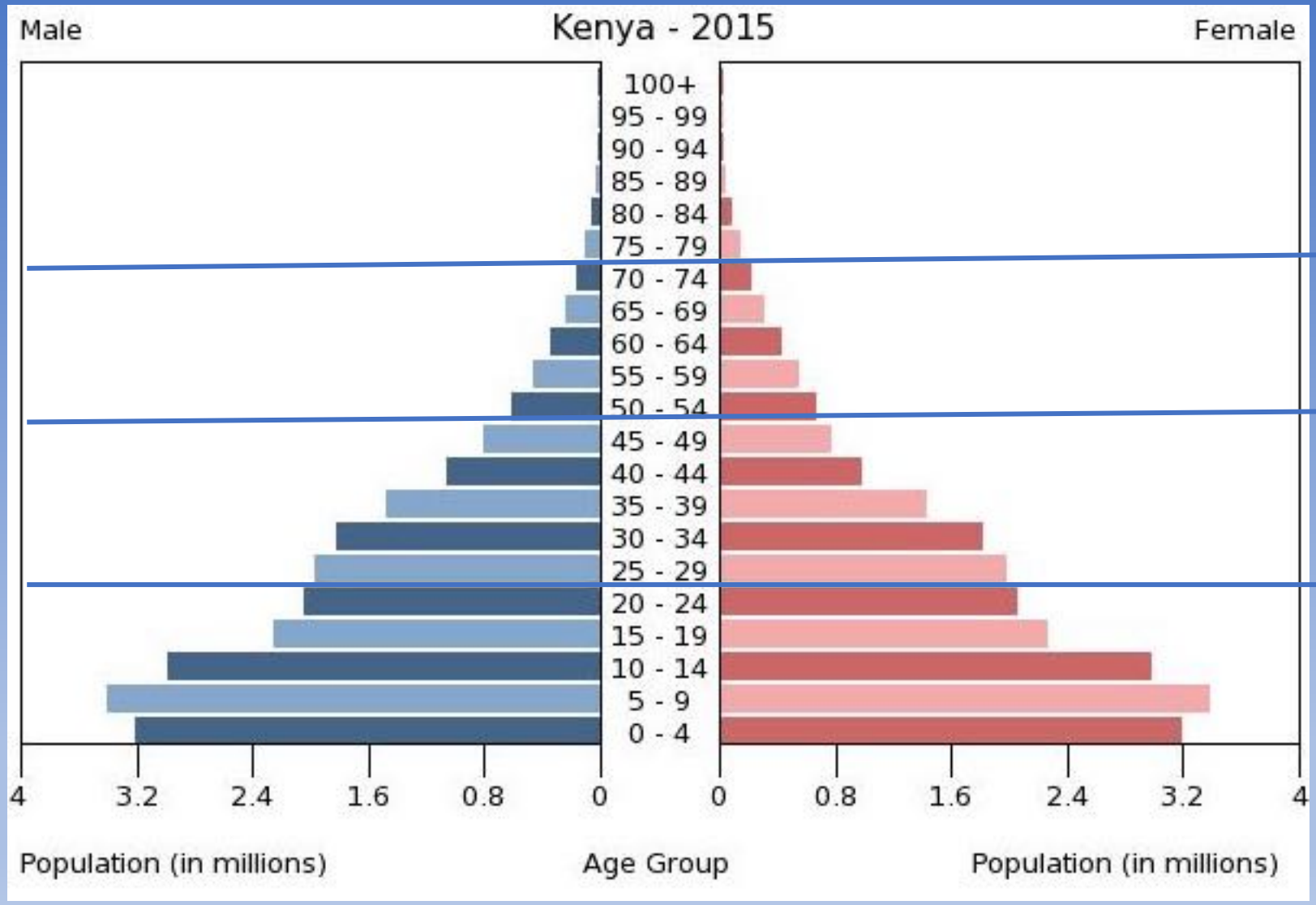
Top Layer
75 – 100+ years old
6.3%

Upper Middle-Layer
50 – 74 years old
28.2%

Lower Middle-Layer
25 – 49 years old
32.8%

Bottom Layer
0 – 24 years old
32.7%

Bottom-Layered Country



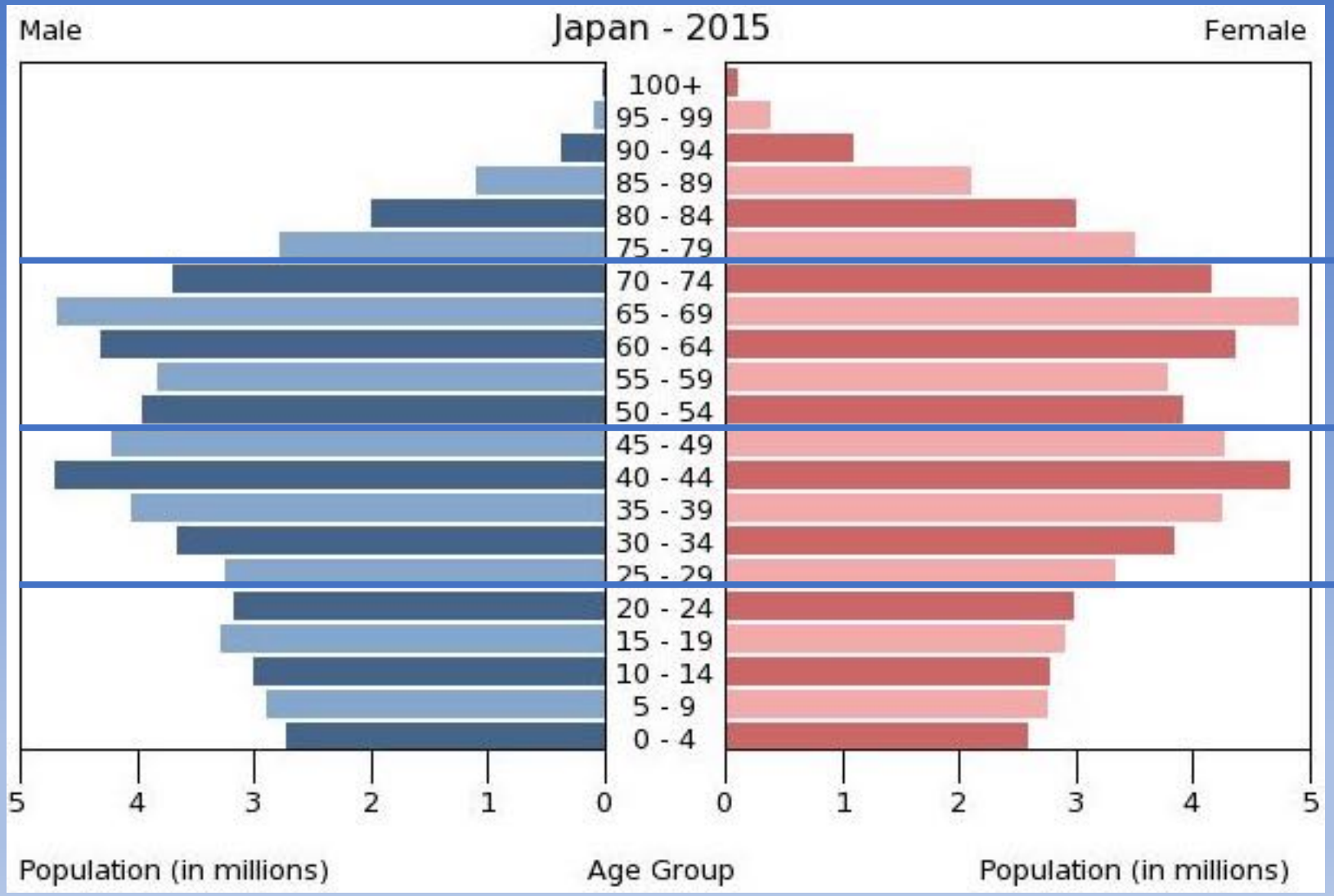
Top Layer
75 – 100+ years old
1.0%

Upper Middle-Layer
50 – 74 years old
8.4%

Lower Middle-Layer
25 – 49 years old
30.4%

Bottom-Layer
0 – 24 years old
60.2%

Upper Middle-Layered Country



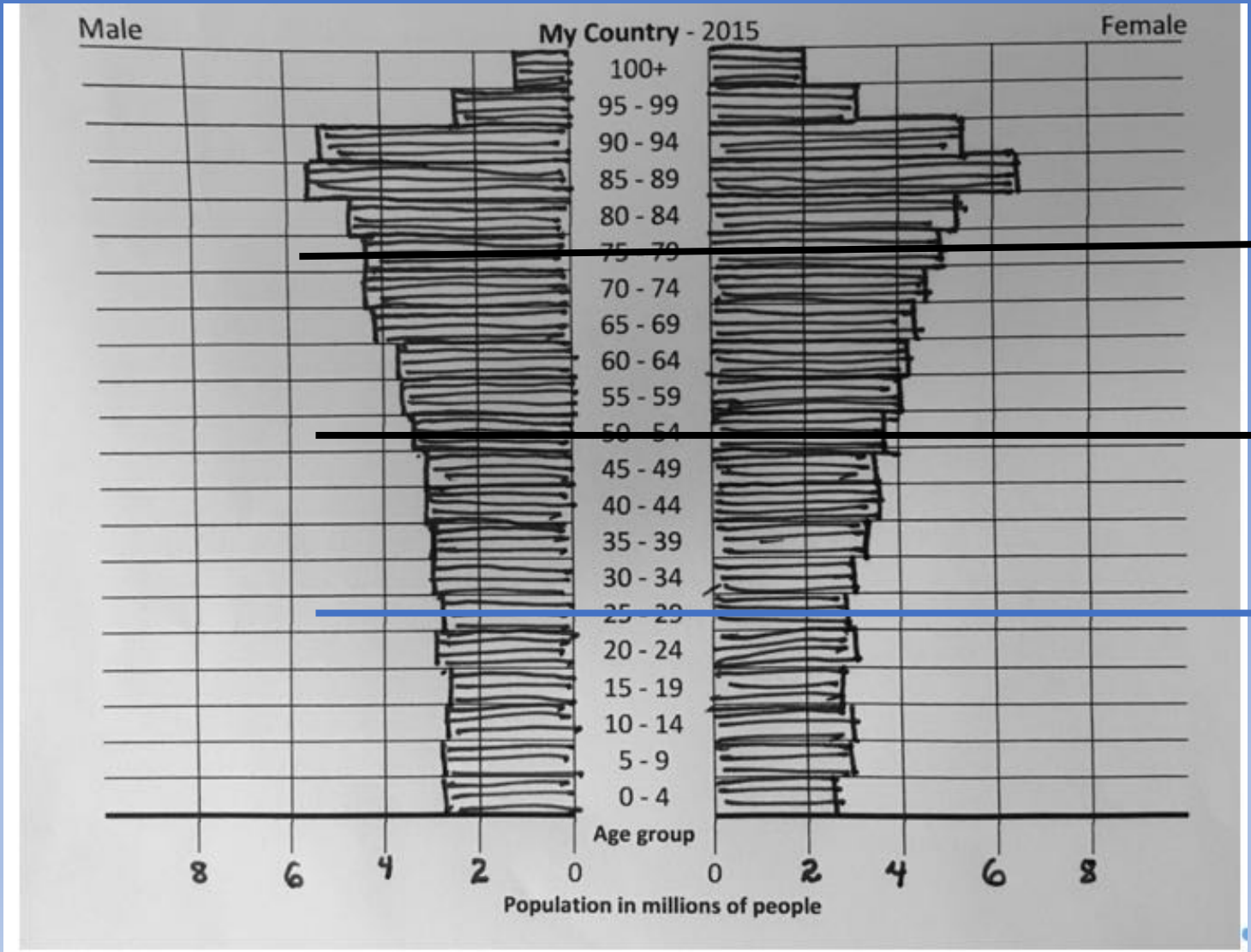
Top-Layer
75 – 100+ years old
12.9%

Upper Middle-Layer
50 – 74 years old
32.6%

Lower Middle-Layer
25 – 49 years old
31.7%

Bottom-Layer
0 – 24 years old
22.8%

My Country



Top-Layered

75 to 100+ years old

33%

Centers
2015

United States

Estimated median age: 35 – 39 years old (approximately 37 years)
Estimated mean age: 38 years old

Kenya (*)

Estimated median age: 15 – 19 years old (approximately 17 years old)
Estimated mean age: 23 years old

Japan

Estimated median age: 45 – 49 years old (approximately 46 years old)
Estimated mean age: 46 years old

Spread

2015

Kenya

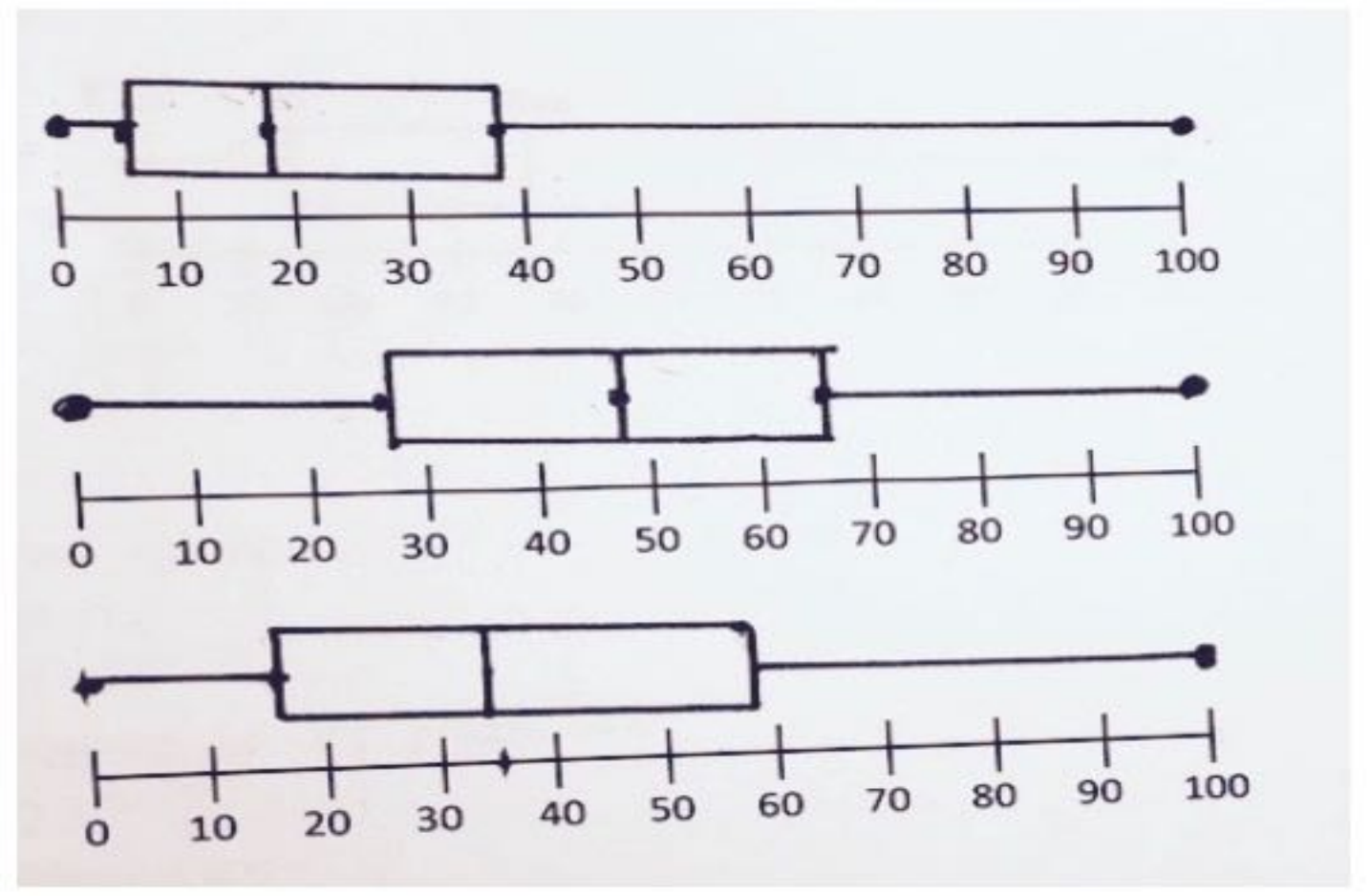
IQR approximately 27 years

Japan

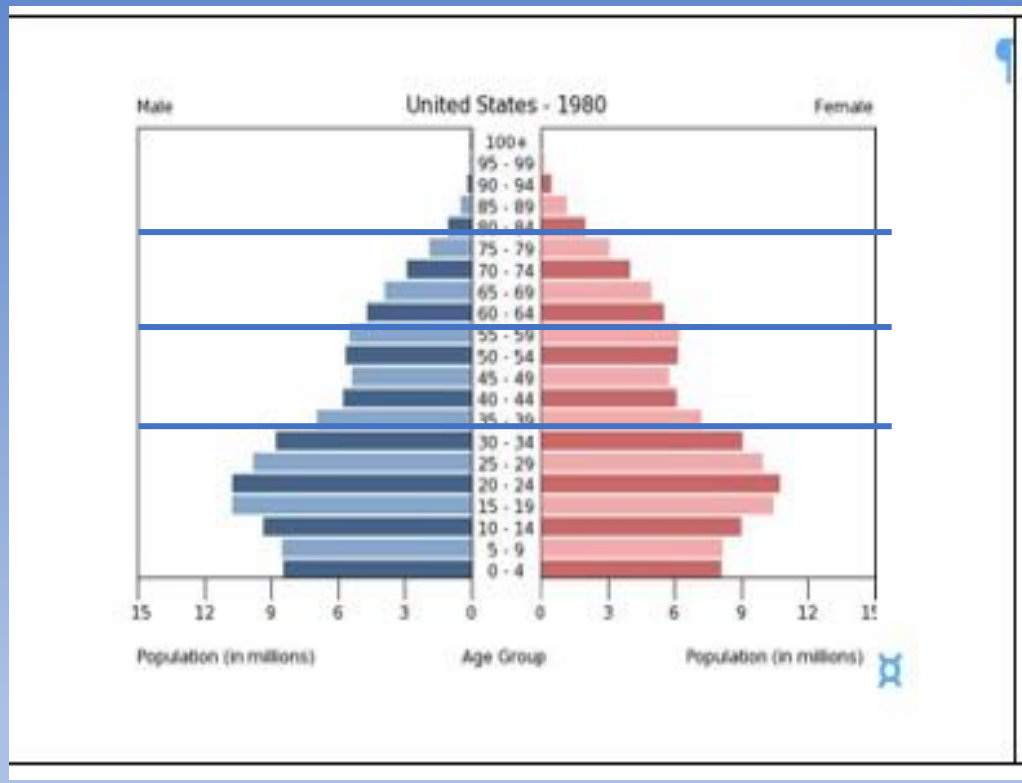
IQR approximately 39 years

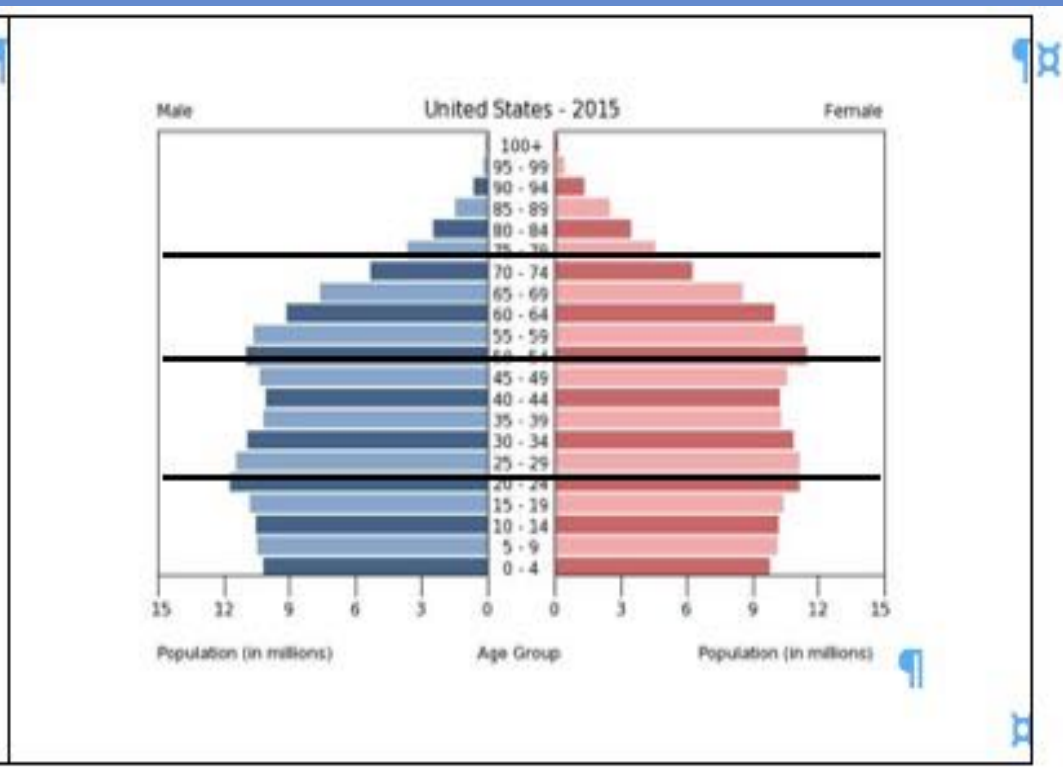
United States

IQR approximately 44 years



Unit 2:
Looking Back

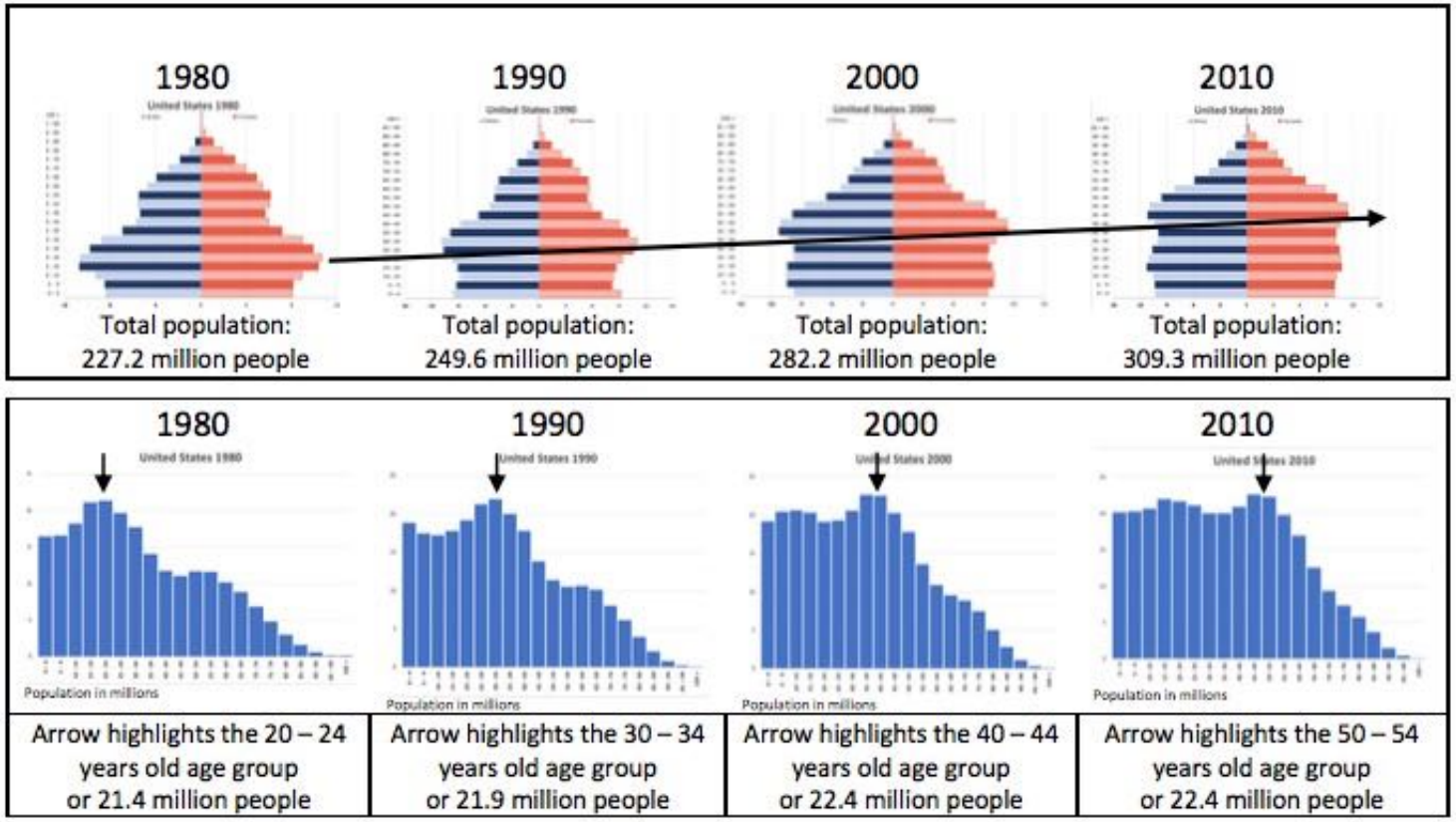




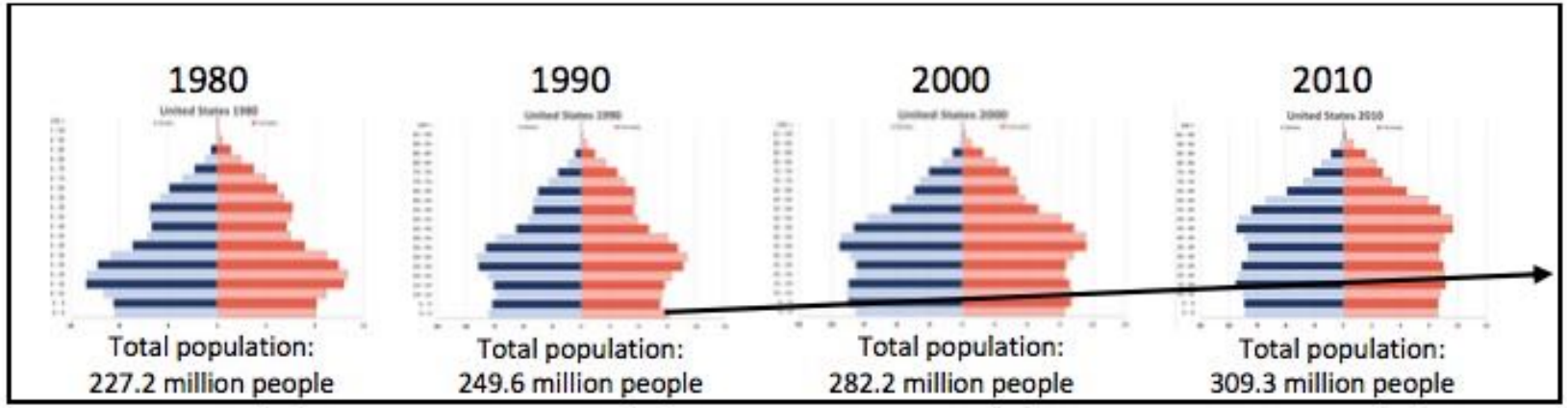
1980
Bottom-Layered

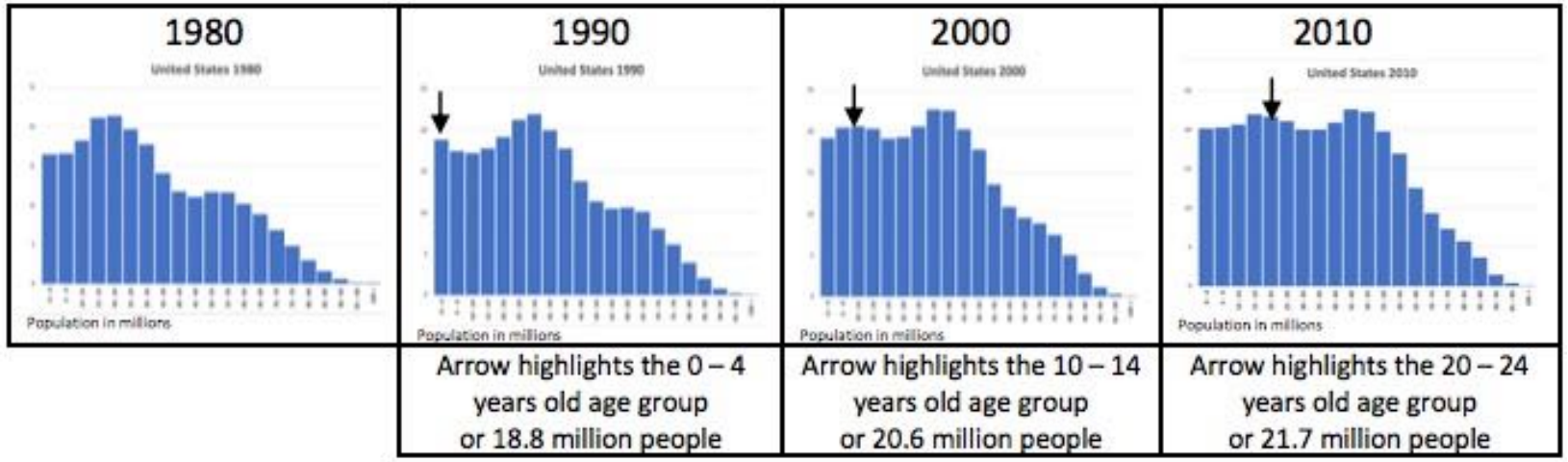
2015
Lower Middle-Layered Country

The Baby Boomers (Born 1943 – 1960)



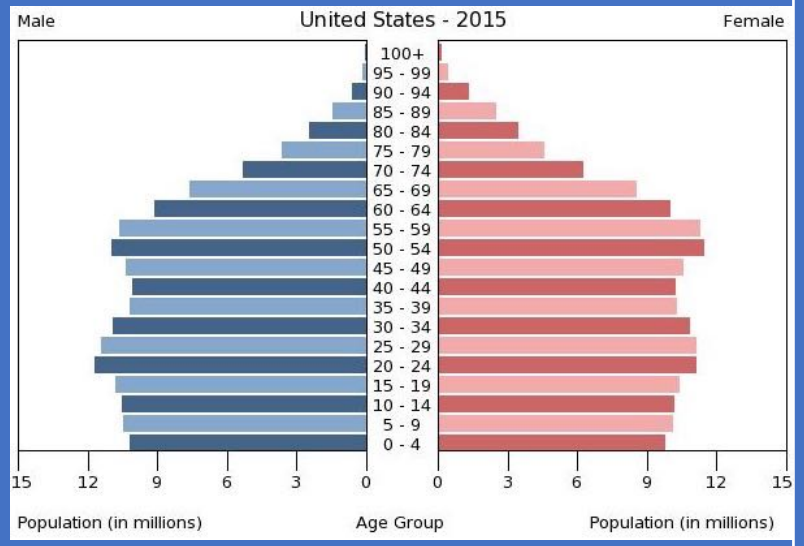
The Millennial Generation (Born 1982 – 2002)



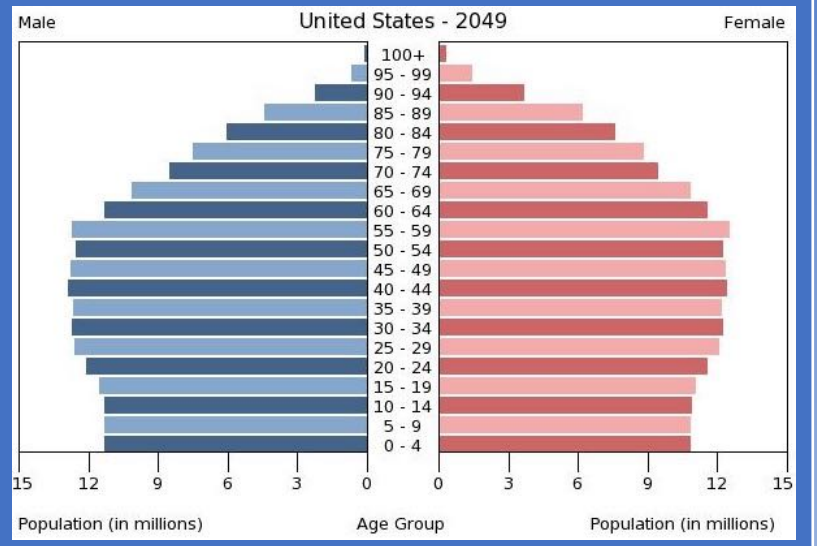


Unit 3: Looking Forward

The United States



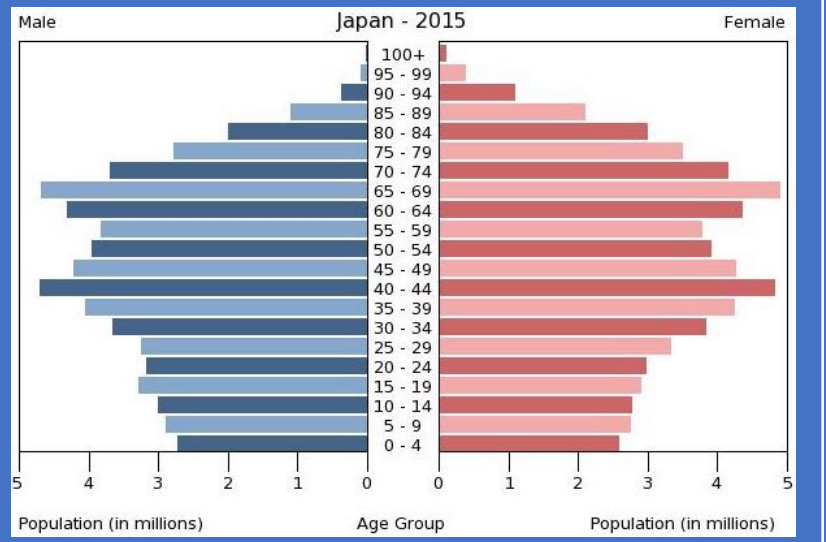
2015



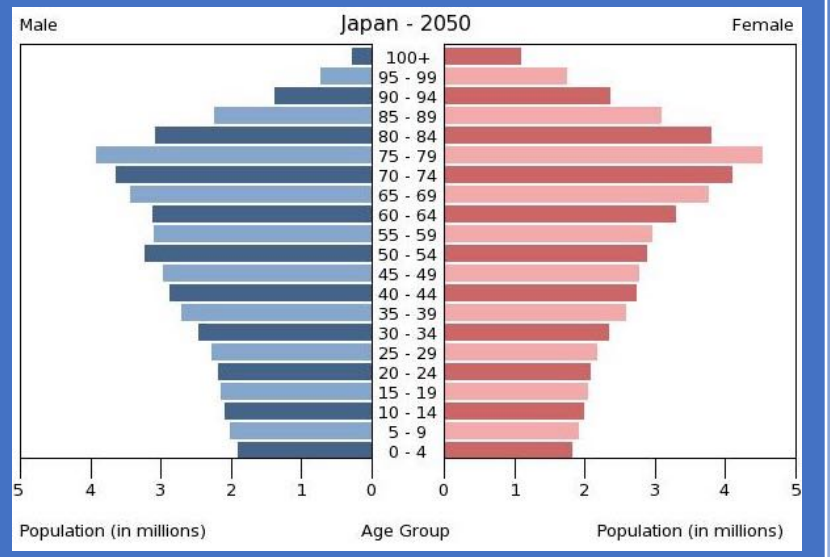
2050

- Is the population of the United States population projected to be greater in 2050 than the population in 2015??
- What age groups are projected to change the most?
- What possible challenges will the US face in 2050?
- What factors do you think were considered in predicting the 2050 population?

Japan



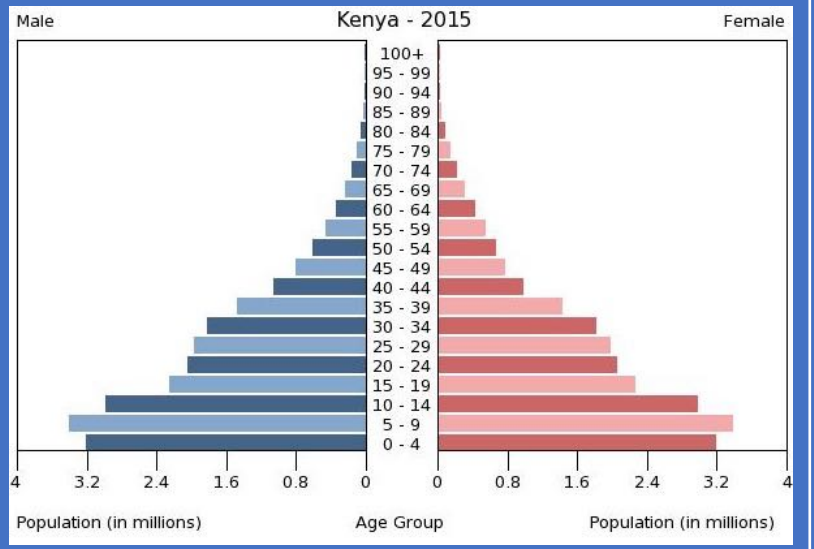
2015



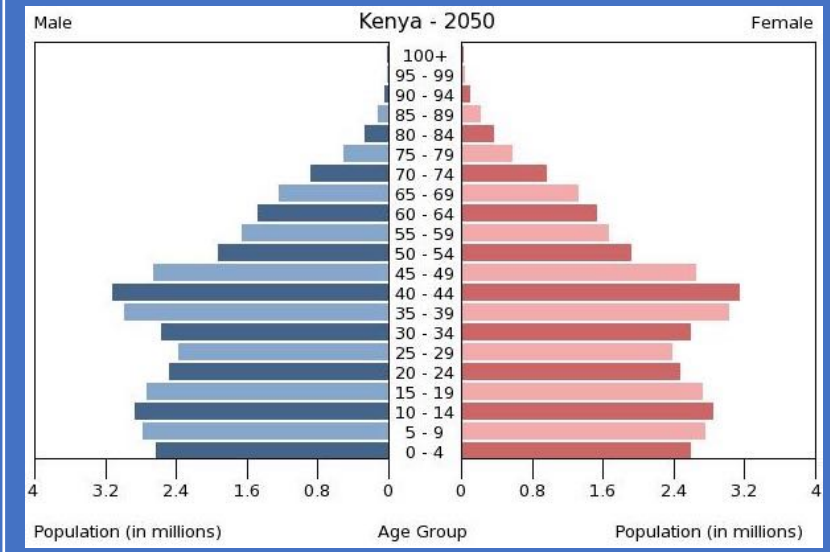
2050

- Is Japan's population projected to be greater in 2050 than 2015?
- What age groups are projected to change the most?
- What possible challenges will Japan face in 2050?
- What factors do you think were considered in predicting the 2050 population?

Kenya



2015

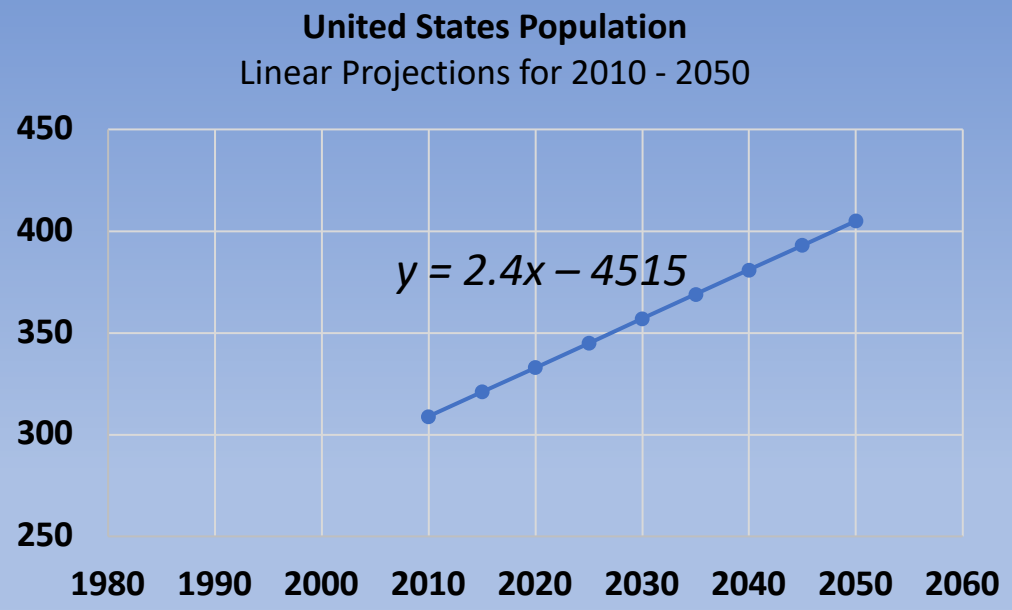


2050

- Is Kenya population in 2050 predicted to be greater than the population in 2015??
- What age groups are predicted to change the most?
- What possible challenges will Kenya face in 2050?
- What factors do you think were considered in predicting the 2050 population?

United States
Linear Model

Year	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population (in millions of people)	309	321	333	345	357	369	381	393	405
		+12	+12	+12	+12	+12	+12	+12	



United States
Exponential Model

Year	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population (in millions of people)	309	321	*334*	*347*	*361*	*375*	*390*	*405*	*421*
		$\times \frac{321}{309}$ or 1.039	$\times \frac{321}{309}$ or 1.039	$\times \frac{321}{309}$ or 1.039	$\times \frac{321}{309}$ or 1.039	$\times \frac{321}{309}$ or 1.039	$\times \frac{321}{309}$ or 1.039	$\times \frac{321}{309}$ or 1.039	

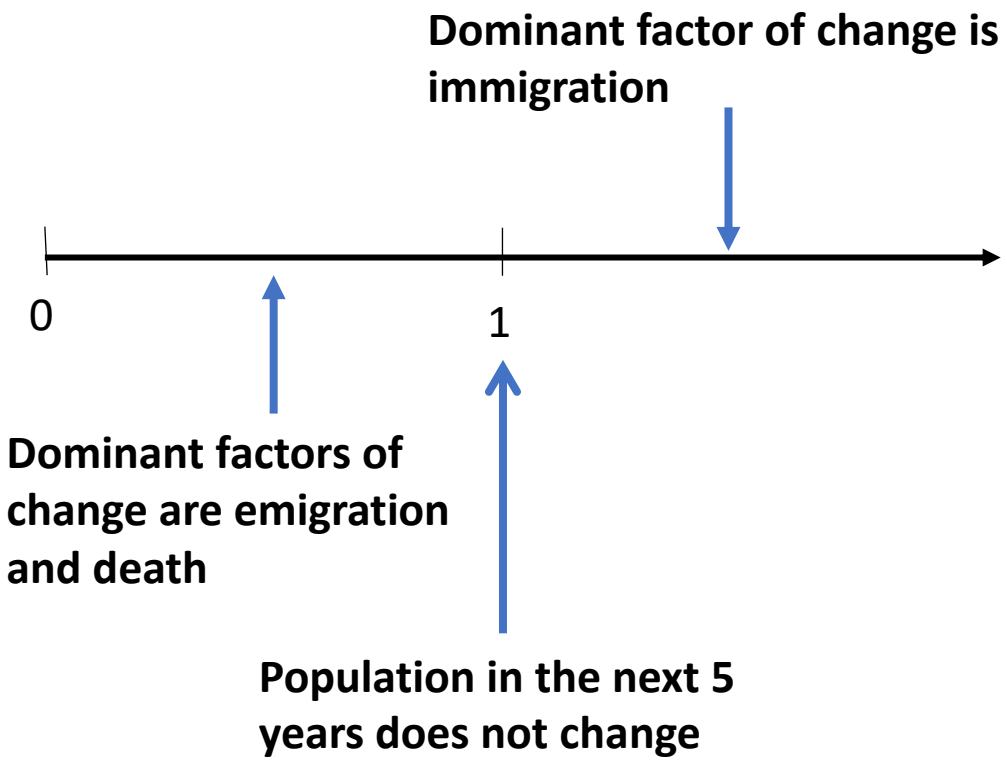
$y = 309(1.0078)^{x - 2010}$

Tools needed for building the Recursive Model

Connected Age Groups and the **Population Factors**

Age group 2010 (Counted at the start of 2010)	Connected Age Group in 2015 (Counted at the start of 2015)	Population Factor Based on the Ratio of connected age groups	Decimal equivalent of Population Factor (to the nearest thousandth)
0 – 4 20,189,589	5 – 9 20,481,130	$\frac{20,481,130}{20,189,589}$	1.014
5 – 9 20,331,807	10 – 14 20,605,579	$\frac{20,605,579}{20,331,807}$	1.013
10 – 14 20,681,215	15 – 19 21,084,710	$\frac{21,084,710}{20,681,215}$	1.020
50 – 54 22,353,471	**55 – 59 21,767,855**	$\frac{21,767,855}{22,353,471}$	**0.974**
55 – 59 19,795,182	60 – 64 19,038,554	$\frac{19,038,554}{19,795,182}$	0.962
60 – 64 16,990,224	65– 69 16,049,246	$\frac{16,049,246}{16,990,224}$	0.945

Population Factors



Population Factors

The United States

Age Groups	Population Factors
0 – 4 to 5 - 9	1.014
5 - 9 to 10 - 14	1.014
10 – 14 to 15 - 19	1.020
15 – 19 to 20 -24	1.032
20 – 24 to 25 - 29	1.032
25 – 29 to 30 - 34	1.022
30 – 34 to 35 - 39	1.012
35 – 39 to 40 - 44	1.004
40 – 44 to 45 - 49	0.995
45 – 49 to 50 - 54	0.985
50 – 54 to 55 - 59	0.974
55 – 59 to 60 - 64	0.962
60 – 64 to 65 - 69	0.945
65 – 69 to 70 - 74	0.917
70 – 74 to 75 - 79	0.869
75 – 79 to 80 -84	0.792
80 – 84 to 85 - 89	0.670
85 – 89 to 90 - 94	0.508
90 – 94 to 95 - 99	0.340
95 – 99 to 100+	0.205
100 +	

Kenya

Age Groups	Population Factors
0 – 4 to 5 - 9	0.984
5 - 9 to 10 - 14	0.990
10 – 14 to 15 - 19	0.987
15 – 19 to 20 -24	0.988
20 – 24 to 25 - 29	0.982
25 – 29 to 30 - 34	0.973
30 – 34 to 35 - 39	0.963
35 – 39 to 40 - 44	0.957
40 – 44 to 45 - 49	0.951
45 – 49 to 50 - 54	0.947
50 – 54 to 55 - 59	0.942
55 – 59 to 60 - 64	0.926
60 – 64 to 65 - 69	0.898
65 – 69 to 70 - 74	0.837
70 – 74 to 75 - 79	0.742
75 – 79 to 80 -84	0.600
80 – 84 to 85 - 89	0.500
85 – 89 to 90 - 94	0.250
90 – 94 to 95 - 99	1.000
95 – 99 to 100+	0.205
100 +	

Japan

Age Groups	Population Factors
0 – 4 to 5 - 9	0.996
5 - 9 to 10 - 14	0.998
10 – 14 to 15 - 19	0.998
15 – 19 to 20 -24	1.000
20 – 24 to 25 - 29	0.998
25 – 29 to 30 - 34	0.996
30 – 34 to 35 - 39	0.996
35 – 39 to 40 - 44	0.995
40 – 44 to 45 - 49	0.993
45 – 49 to 50 - 54	0.989
50 – 54 to 55 - 59	0.984
55 – 59 to 60 - 64	0.975
60 – 64 to 65 - 69	0.965
65 – 69 to 70 - 74	0.946
70 – 74 to 75 - 79	0.909
75 – 79 to 80 -84	0.845
80 – 84 to 85 - 89	0.742
85 – 89 to 90 - 94	0.604
90 – 94 to 95 - 99	0.427
95 – 99 to 100+	0.205
100 +	

Population of age group 0 – 4 years old 2010	**X**	**Population Factor for connected age groups**	**=>**	

Population of age group 0 – 4 years old 2010	**X**	$\frac{Population\ of\ age\ group\ 5-9\ for\ 2015}{Population\ of\ age\ group\ 0-4\ for\ 2010}$	**=**	**Population of age group 5 – 9 for 2015**

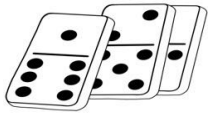
Population Factor for connected age groups 0 – 4 years old to 5 – 9 years old

Looking Forward : *Applying the Population Factor*

The United States from 2015 to 2020

Age group	Population 2015 (millions to the nearest hundredth)	Population Factor	Population 2020 (millions to the nearest hundredth)
0 – 4	19.91	1.014	
5 - 9	20.48	1.014	20.20
10 - 14	20.61	1.020	20.76
15 - 19	21.09	1.032	21.02
20 - 24	22.69	1.032	21.77
25 - 29	22.40	1.022	
30 - 34	21.62	1.012	22.90
35 - 39	20.31	1.004	
40 - 44	20.16	0.995	
45 - 49	20.80	0.985	20.05
50 - 54	22.29	0.974	20.48
55 - 59	21.77	0.962	
60 - 64	19.04	0.945	20.93
65 - 69	16.05	0.917	
70 - 74	11.48	0.869	
75 - 79	8.12	0.792	
80 - 84	5.80	0.670	
85 - 89	3.86	0.508	3.89
90 - 94	1.85	0.340	
95 – 99	0.50	0.205	
100 +	0.08		

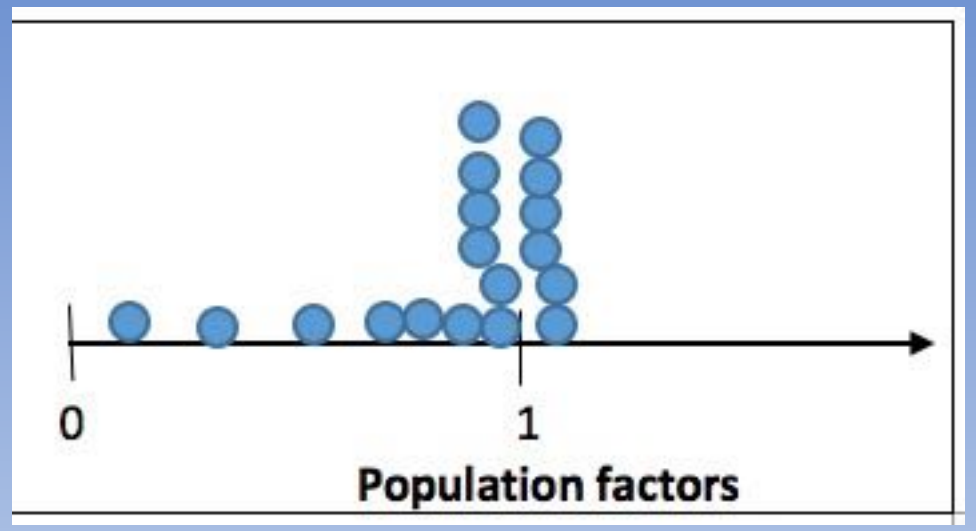
Looking Forward : *The Domino Effect*

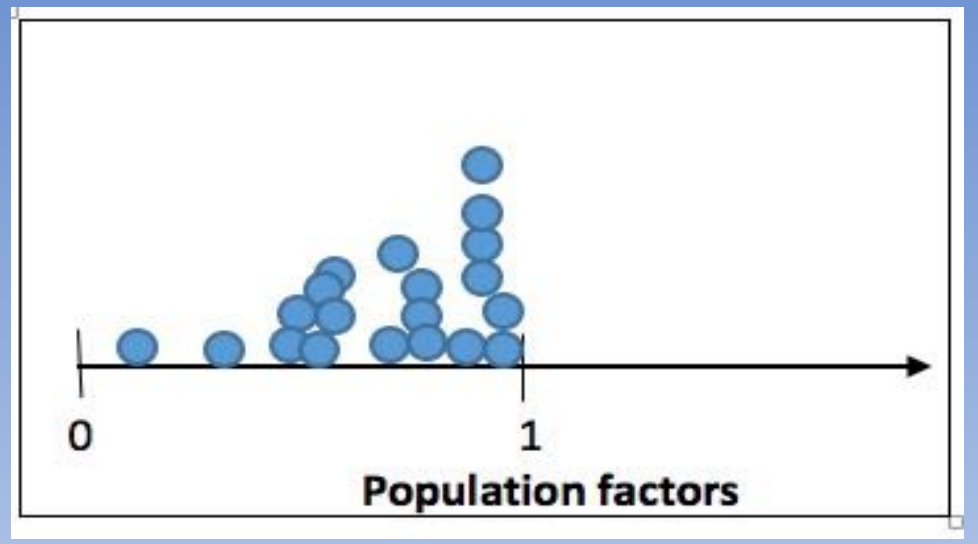


The United States from 2015 to 2020

		Actual Counts:	Projections:							
Age Groups	Population Factors	2010	2015	2020	2025	2030	2035	2040	2045	2050
0 – 4	1.014	20.19	19.91							
5 - 9	1.014	20.33	20.48	20.20						
10 - 14	1.020	20.68	20.61	20.76	20.47					
15 - 19	1.032	21.98	21.09	21.02	21.17	20.88				
20 - 24	1.032	21.70	22.69	21.77	21.70	21.86	21.55			
25 - 29	1.022	21.15	22.40	23.42	22.47	22.40	22.56	22.25		
30 - 34	1.012	20.07	21.62	22.90	23.94	22.97	22.90	23.06	22.74	
35 - 39	1.004	20.08	20.31	21.88	23.17	24.23	23.25	23.17	23.34	23.02
40 - 44	0.995	20.91	20.16	20.39	21.97	23.26	24.33	23.34	23.26	23.43
45 - 49	0.985	22.64	20.80	20.05	20.28	21.85	23.14	24.20	23.22	23.14
50 - 54	0.974	22.35	22.29	20.48	19.74	19.97	21.51	22.78	23.82	22.86
55 - 59	0.962	19.80	21.77	21.71	19.95	19.23	19.45	20.95	22.19	23.20
60 - 64	0.945	16.99	19.04	20.93	20.88	19.18	18.49	18.71	20.15	21.34
65 - 69	0.917	12.52	16.05	17.99	19.78	19.72	18.12	17.47	17.67	19.03
70 - 74	0.869	9.34	11.48	14.72	16.49	18.13	18.08	16.61	16.02	16.20
75 - 79	0.792	7.32	8.12	9.98	12.79	14.34	15.76	15.72	14.44	13.93
80 - 84	0.670	5.76	5.80	6.43	7.91	10.14	11.36	12.49	12.46	11.45
85 - 89	0.508	3.64	3.86	3.89	4.31	5.30	6.79	7.61	8.37	8.35
90 - 94	0.340	1.47	1.85	1.96	1.98	2.19	2.69	3.45	3.87	4.25
95 – 99	0.205	0.38	0.50	0.63	0.67	0.67	0.75	0.92	1.17	1.32

Which country is growing at a greater percent for each 5-year interval?





Deriving the count of the Foundation Factor for The United States

x = the count of the 0 – 4 years old

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

Projected count of people 5 – 100+ years old in 2020

Tool needed for building the Recursive Model

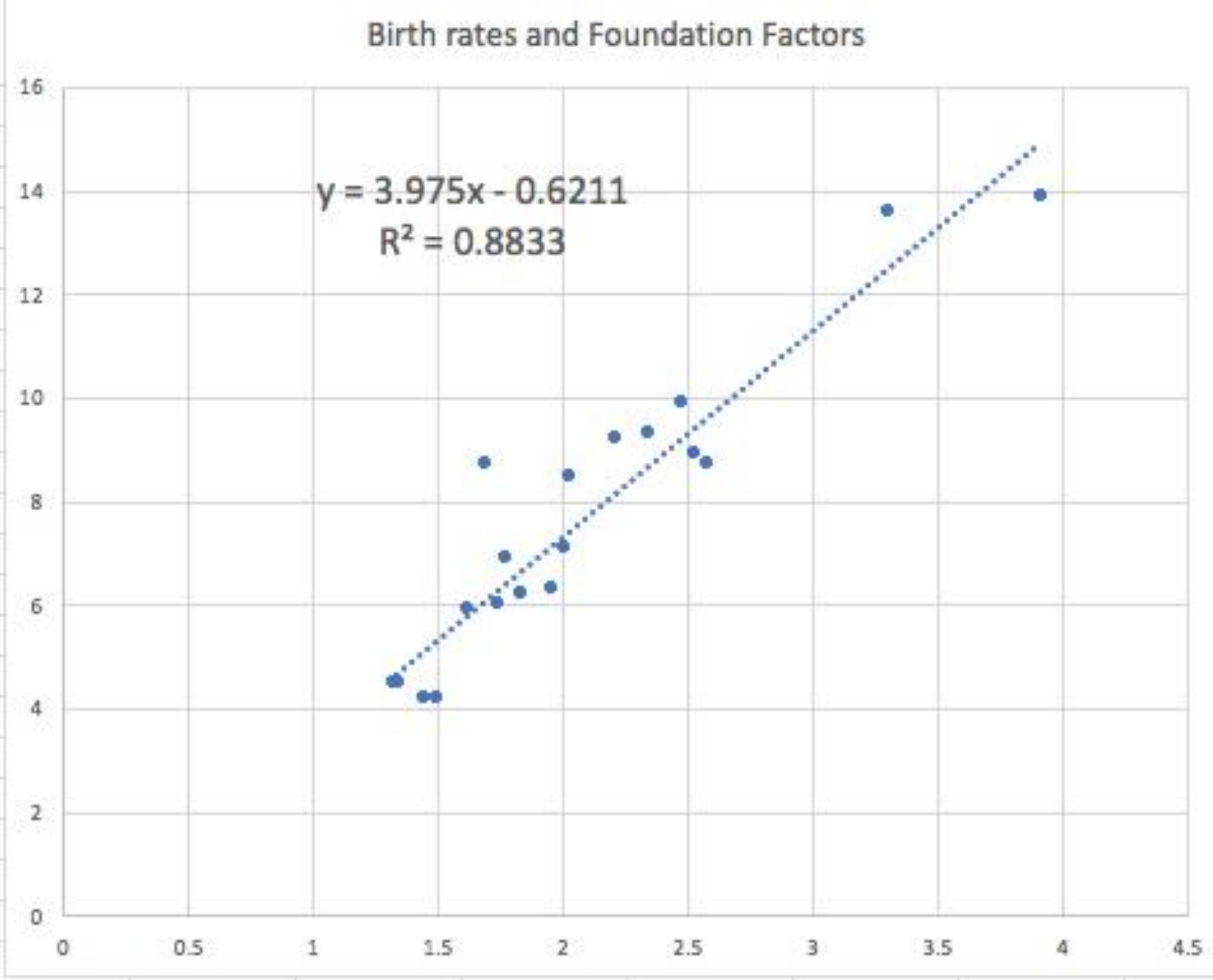
The Foundation Factor

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

The United States	Kenya	Japan
0.062	0.139	0.042

6.2% of the population of the United States in 2015 was 0 – 4 years old
13.9% of the population of Kenya in 2015 was 0 – 4 years old
4.2% of the population of Japan in 2015 was 0 – 4 years old

	Birth Rate	Foundation Factor
Japan	1.45	4.2
Germany	1.5	4.2
Greece	1.33	4.5
Italy	1.35	4.5
China	1.62	5.9
Russia	1.75	6
United States	1.84	6.2
France	1.96	6.3
Chile	1.78	6.9
Greenland	2.01	7.1
Jamaica	2.03	8.5
Iran	1.69	8.7
Saudi Arabia	2.58	8.7
Morocco	2.53	8.9
Mexico	2.22	9.2
India	2.35	9.3
South Africa	2.48	9.9
Egypt	3.31	13.6
Kenya	3.92	13.9
United States	1.84	6.2



		Foundation Factors:								
		0.065	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
		Actual Counts:		Projections:						
Age Groups	Population Factors	2010	2015	2020	2025	2030	2035	2040	2045	2050
0 – 4	1.014	20.19	19.91	**20.57**	**21.20**	21.75	22.23	22.63	22.97	23.29
5 - 9	1.014	20.33	20.48	20.20	**20.87**	**21.50**	22.07	22.55	22.95	23.30
10 - 14	1.020	20.68	20.61	20.76	20.47	21.15	21.80	22.37	22.86	23.27
15 - 19	1.032	21.98	21.09	21.02	21.17	20.88	21.57	22.23	22.81	23.31
20 - 24	1.032	21.70	22.69	21.77	21.70	21.86	21.55	**22.27**	22.95	23.55
25 - 29	1.022	21.15	22.40	23.42	22.47	22.40	22.56	22.25	22.99	**23.69**
30 - 34	1.012	20.07	21.62	22.90	23.94	22.97	22.90	23.06	22.74	23.50
35 - 39	1.004	20.08	20.31	21.88	23.17	24.23	23.25	23.17	23.34	23.02
40 - 44	0.995	20.91	20.16	20.39	21.97	23.26	**24.33**	23.34	23.26	23.43
45 - 49	0.985	22.64	20.80	20.05	20.28	21.85	23.14	**24.20**	23.22	23.14
50 - 54	0.974	22.35	22.29	20.48	19.74	19.97	21.51	22.78	**23.82**	22.86
55 - 59	0.962	19.80	21.77	21.71	19.95	19.23	19.45	20.95	22.19	23.20
60 - 64	0.945	16.99	19.04	20.93	20.88	19.18	18.49	18.71	20.15	21.34
65 - 69	0.917	12.52	16.05	17.99	19.78	19.72	18.12	17.47	17.67	19.03
70 - 74	0.869	9.34	11.48	14.72	16.49	18.13	18.08	16.61	16.02	16.20
75 - 79	0.792	7.32	8.12	9.98	12.79	14.34	15.76	15.72	14.44	13.93
80 - 84	0.670	5.76	5.80	6.43	7.91	10.14	11.36	12.49	12.46	11.45
85 - 89	0.508	3.64	3.86	3.89	4.31	5.30	6.79	7.61	8.37	8.35
90 - 94	0.340	1.47	1.85	1.96	1.98	2.19	2.69	3.45	3.87	4.25
95 – 99	0.205	0.38	0.50	0.63	0.67	0.67	0.75	0.92	1.17	1.32
100 +		0.05	0.08	0.10	0.13	0.14	0.14	0.15	0.19	0.24
	Totals	309.35	320.91	**331.78**	**341.87**	350.87	358.55	364.94	370.45	375.67

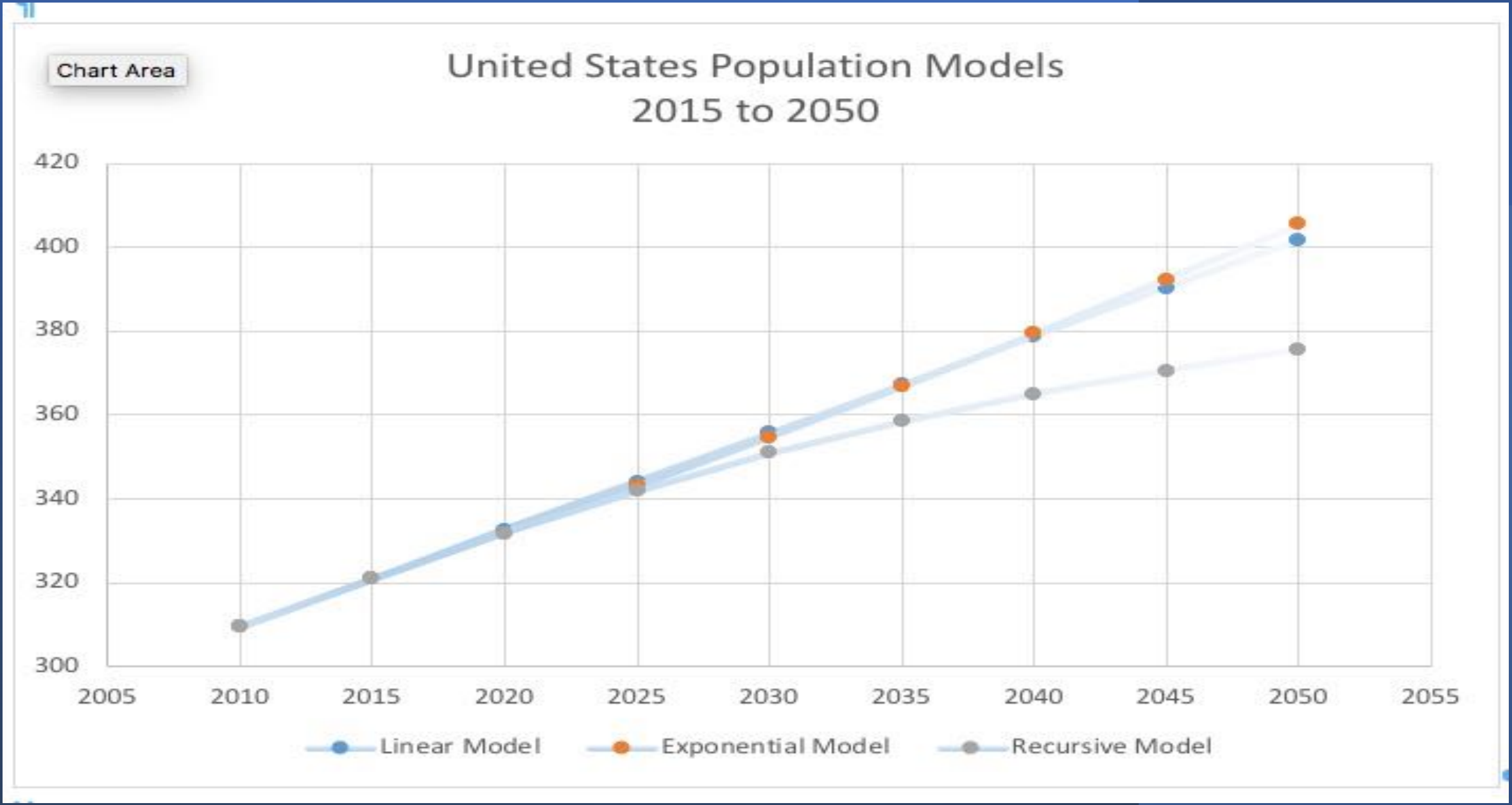
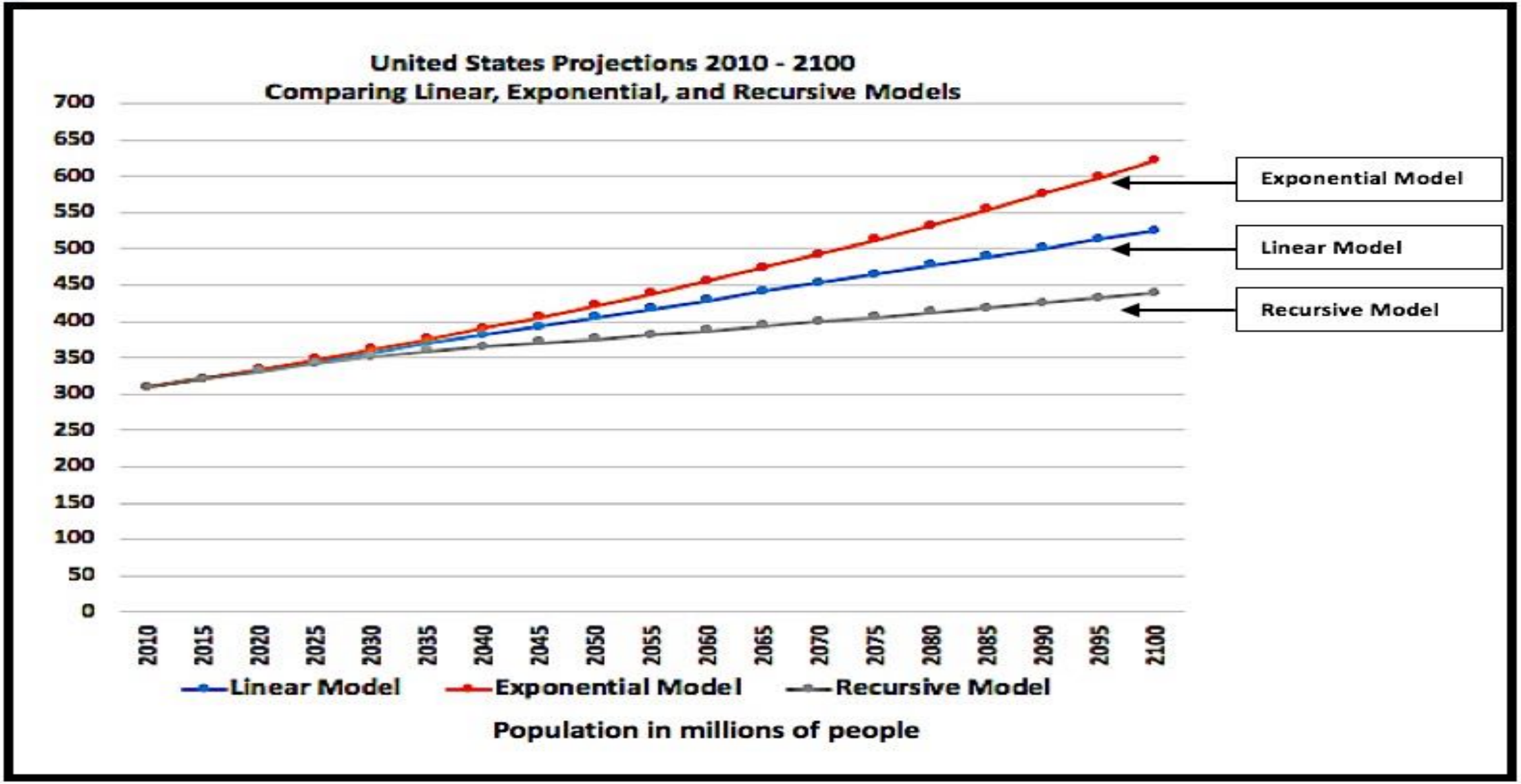


Chart Area
United States Population Models
2015 to 2050
420
400
380
360
340
320
300
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
Linear Model
Exponential Model
Recursive Model


United States Projections 2010 - 2100
Comparing Linear, Exponential, and Recursive Models
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
2085
2090
2095
2100
Linear Model
Exponential Model
Recursive Model
Population in millions of people
Exponential Model
Linear Model
Recursive Model

Unit 4: “What if ….?”

Revise the Recursive Models for The United States, Kenya, and Japan to investigate possible changes in the count of people in 2050 for the following “What if …?” scenarios.

The United States

Scenario 2: It was 2017. There was a concern about the number of immigrants in the country who are not citizens. The government set new policies that limit the number of immigrants.

Scenario 5: It is 2018. It is 2018. A major medical breakthrough has been reached in which almost every person will live well into their 100’s.

Scenario 7: It is 2018. Young people indicated in a survey that they are not likely to have children.

The United States

Unit 4: “What if ….?”

- **Scenario**: It is the start of the year 2019. A global pandemic starts. The results are deaths primarily in the age groups 65 of and older of 3 to 5 percent. What impact would this have on the projections of the 2050 estimates?

Unit 4: “What if ….?”

Kenya

Scenario 9: It is 2018. The Kenya government has been working with groups across the country to reduce the number of births.

Scenario 10: It is 2018. Improvement in health care resulted in a higher life expectancy for people who are 40 years old or older. In addition, please indicated they do not want large families.

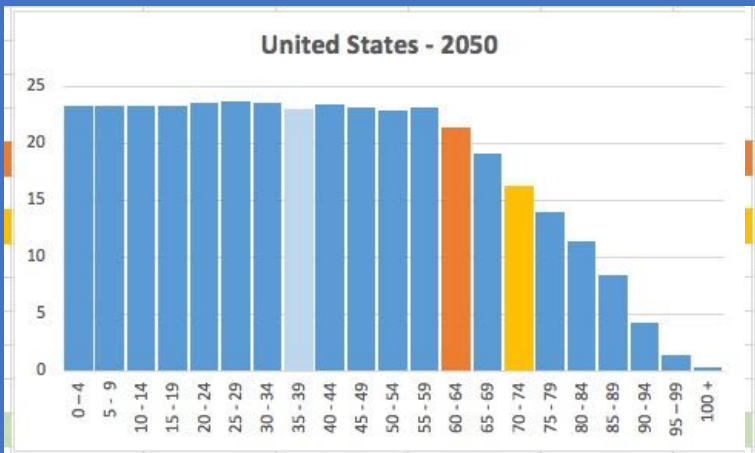
Japan

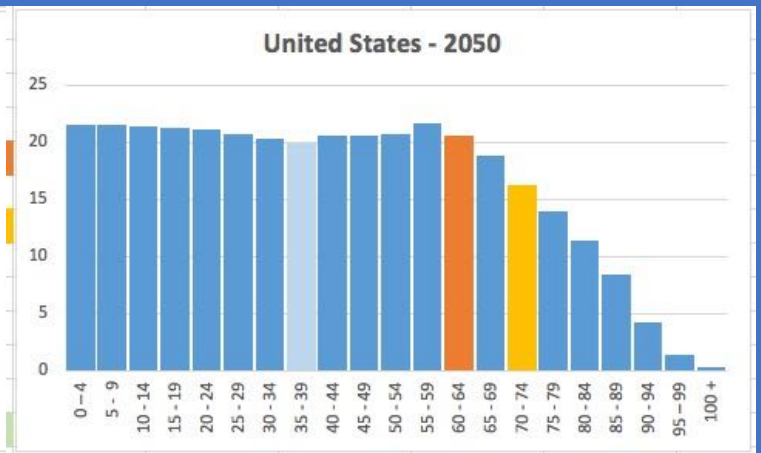
Scenario 12: It is is 2018. There is a major concern of how to care for older people. The government made an effort to encourage people 25 years old or older in other countries to move to Japan to help for older people.

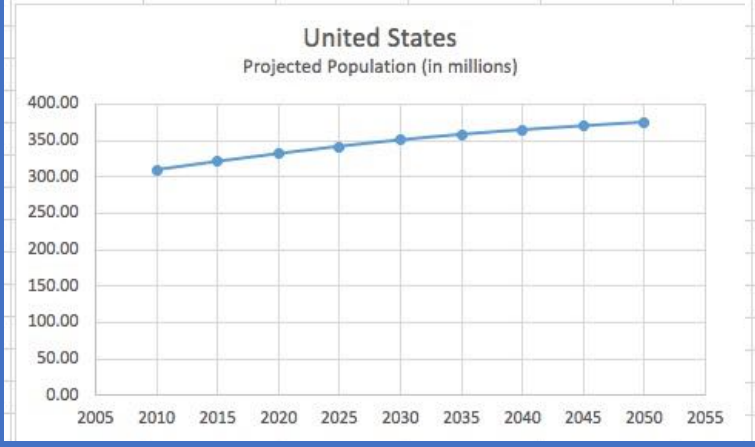
Access the Excel file:

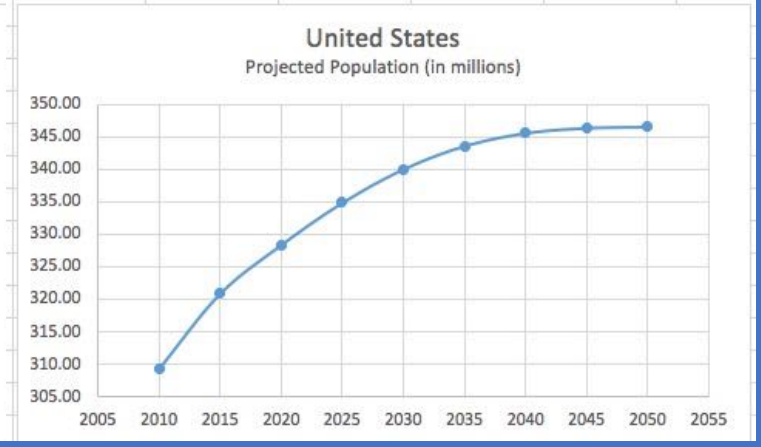
USA Recursive Model.xisx

Rework the Population Factors to indicate that the changes in count from 2015 to 2020 are not dominated by immigration.









No changes to Recursive Model

Total population

2015: 321 million people

2050: 376 million people

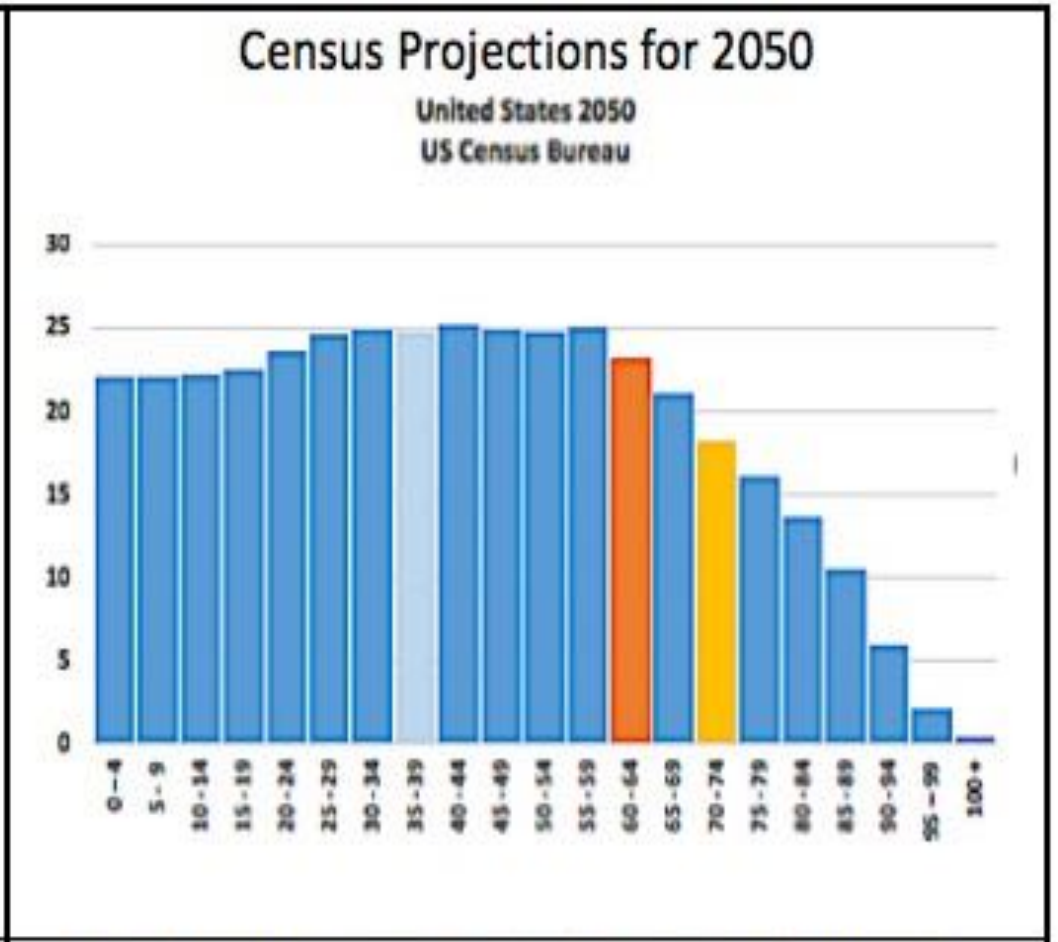
Changes to address scenario:

Total population

2015: 321 million people

2050: 347 million people

What if the total population of the United States from 2010 to 2050 is reflected in the following graphs? Tell the story of the United States from 2010 to 2050.



Using your tools (population factors and foundation factors), change the outcomes of the recursive model to match the outcomes of the US Census model (as of April 2020) for 2050.

Handout 6: The United States 2010 – 2050
Lesson 15 and 16 Summary

		Foundation Factors:								
		0.065	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
		Actual Counts:		Projections:						
Age Groups	Population Factors	2010	2015	2020	2025	2030	2035	2040	2045	2050
0 – 4		20.19	19.91	+	+	+	+	+	+	+
5 - 9		20.33	20.48		+	+	+	+	+	+
10 - 14		20.68	20.61			+	+	+	+	+
15 - 19		21.98	21.09				+	+	+	+
20 - 24		21.70	22.69					+	+	+
25 - 29		21.15	22.40						+	+
30 - 34		20.07	21.62							+
35 - 39	+	20.08	20.31							
40 - 44		20.91	20.16	+	+	+	+	+	+	+
45 - 49		22.64	20.80		+	+	+	+	+	+
50 - 54		22.35	22.29			+	+	+	+	+
55 - 59		19.80	21.77				+	+	+	+
60 - 64		16.99	19.04					+	+	+
65 - 69		12.52	16.05						+	+
70 - 74		9.34	11.48							+
75 - 79		7.32	8.12							
80 - 84		5.76	5.80							
85 - 89		3.64	3.86							
90 - 94		1.47	1.85							
95 – 99		0.38	0.50							
100 +		0.05	0.08							
	Totals	309.35	320.91	+	+	+	+	+	+	+

Handout 6: The United States 2010 – 2050
Lesson 15 and 16 Summary

		Foundation Factors:								
		0.065	0.062	0.062	0.062	0.062	0.062	-	-	-
		Actual Counts:		Projections:						
Age Groups	Population Factors	2010	2015	2020	2025	2030	2035	2040	2045	2050
0 – 4		20.19	19.91	**	**	**	**	** -	** -	** -
5 - 9		20.33	20.48		**	**	**	**	** -	** -
10 - 14		20.68	20.61			**	**	**	**	** -
15 - 19		21.98	21.09				**	**	**	**
20 - 24		21.70	22.69					**	**	**
25 - 29		21.15	22.40						**	**
30 - 34		20.07	21.62							**
35 - 39	*	20.08	20.31							
40 - 44		20.91	20.16	*	*	*	*	*	*	*
45 - 49		22.64	20.80		*	*	*	*	*	*
50 - 54		22.35	22.29			*	*	*	*	*
55 - 59		19.80	21.77				*	*	*	*
60 - 64		16.99	19.04					*	*	*
65 - 69		12.52	16.05						*	*
70 - 74	*	9.34	11.48							*
75 - 79		7.32	8.12	*	*	*	*	*	*	*
80 - 84		5.76	5.80		*	*	*	*	*	*
85 - 89		3.64	3.86			*	*	*	*	*
90 - 94		1.47	1.85				*	*	*	*
95 – 99		0.38	0.50					*	*	*
100 +		0.05	0.08						*	*
	Totals	309.35	320.91	**	**	**	**	** -	** -	** -

How Good is the Recursive Model? (Evaluating the projections)

There are currently two methods used to address the question regarding whether or not the recursive model is a good model for deriving projections.

1. **Looking back**
   Students replace the 2010 and 2015 counts in the recursive model with the 1980 and 1985 results (considered the best estimates of the actual counts). Students then compare the results project from this model with the Census counts for 2010 and 2015.

2. Comparing (and then adjusting) the recursive model projections to the US Census Bureau's projections.

Recursive Model: Projections for 2010 and 2015

United States		Foundation Factor	Foundation Factor	Foundation Factor	Foundation Factor
		0.072	0.074	0.074	0.074
Age Groups	**Population Factors**	**1980**	**1985**	**2010**	**2015**
0 – 4	1.133	16.45	17.84	22.79	23.93
5 - 9	1.028	16.60	18.64	24.59	25.83
10 - 14	1.027	18.24	17.07	24.08	25.29
15 - 19	1.007	21.11	18.73	23.53	24.73
20 - 24	1.013	21.39	21.26	22.53	23.70
25 - 29	1.017	19.69	21.67	21.78	22.83
30 - 34	0.992	17.74	20.03	20.43	22.15
35 - 39	1.001	14.08	17.60	18.05	20.27
40 - 44	0.990	11.73	14.09	19.30	18.06
45 - 49	0.982	11.05	11.61	21.53	19.10
50 - 54	0.961	11.69	10.85	21.27	21.14
55 - 59	0.924	11.81	11.23	18.57	20.43
60 - 64	0.921	10.14	10.91	15.19	17.15
65 - 69	0.854	8.81	9.34	11.19	13.99
70 - 74	0.806	6.84	7.52	7.95	9.55
75 - 79	0.700	4.83	5.51	6.10	6.41
80 - 84	0.598	2.96	3.38	4.60	4.27
85 - 89	0.443	1.58	1.77	2.89	2.75
90 - 94	0.321	0.56	0.70	1.19	1.28
95 – 99	0.205	0.12	0.18	0.36	0.38
100 +		0.02	0.03	0.07	0.07
	Totals	**227.44**	**239.96**	**307.99**	**323.31**

US Census counts:

Foundation Factor	Foundation Factor
0.065	0.062
2010	**2015**
20.19	19.91
20.33	20.48
20.68	20.61
21.98	21.09
21.70	22.69
21.15	22.40
20.07	21.62
20.08	20.31
20.91	20.16
22.64	20.80
22.35	22.29
19.80	21.77
16.99	19.04
12.52	16.05
9.34	11.48
7.32	8.12
5.76	5.80
3.64	3.86
1.47	1.85
0.38	0.50
0.05	0.08
309.35	**320.91**

The United States

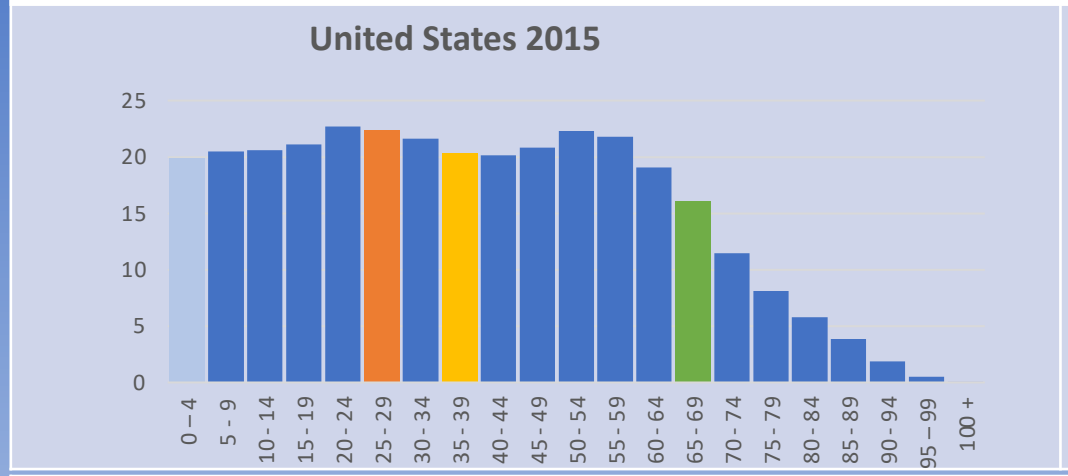
Henry's Projections compared to the Census Bureau:

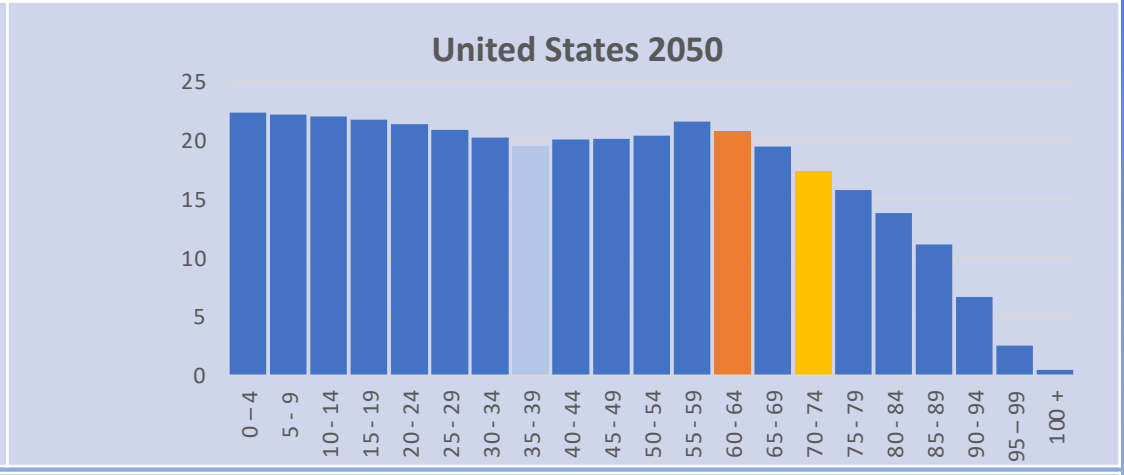
		Foundation Factors:					
		0.065	0.062	0.062	0.059	0.059	0.058
		Actual Counts:		Projections:			
Age Groups	Henry's Population Factors	2010	2015	Henry's 2020	Census Low 2020	Census Middle 2020	Census High 2020
0—4	1.014	20.19	19.91	20.57	19.43	19.46	19.48
5--9	1.014	20.33	20.48	20.20	20.37	20.43	20.47
10--14	1.020	20.68	20.61	20.76	21.74	21.83	21.88
15--19	1.032	21.98	21.09	21.02	21.53	21.62	21.69
20--24	1.032	21.70	22.69	21.77	21.41	21.54	21.62
25--29	1.022	21.15	22.40	23.42	22.86	22.96	23.06
30--34	1.012	20.07	21.62	22.90	22.78	22.90	23.03
35--39	1.004	20.08	20.31	21.88	22.17	22.29	22.43
40--44	0.995	20.91	20.16	20.39	20.53	20.64	20.79
45--49	0.985	22.64	20.80	20.05	20.47	20.51	20.66
50--54	0.974	22.35	22.29	20.48	20.70	20.85	21.00
55--59	0.962	19.80	21.77	21.71	21.42	22.19	22.36
60--64	0.945	16.99	19.04	20.93	20.97	21.07	21.24
65--69	0.917	12.52	16.05	17.99	17.79	17.96	18.14
70--74	0.869	9.34	11.48	14.72	14.29	14.49	14.71
75--79	0.792	7.32	8.12	9.98	9.47	9.64	10.13
80--84	0.670	5.76	5.80	6.43	6.04	6.14	6.45
85+		5.54	5.84	6.58	5.98	6.06	6.38
	Totals	309.35	320.46	**331.78**	**329.95**	**332.58**	**335.52**

The United States
Comparison of Population and Foundation Factors:

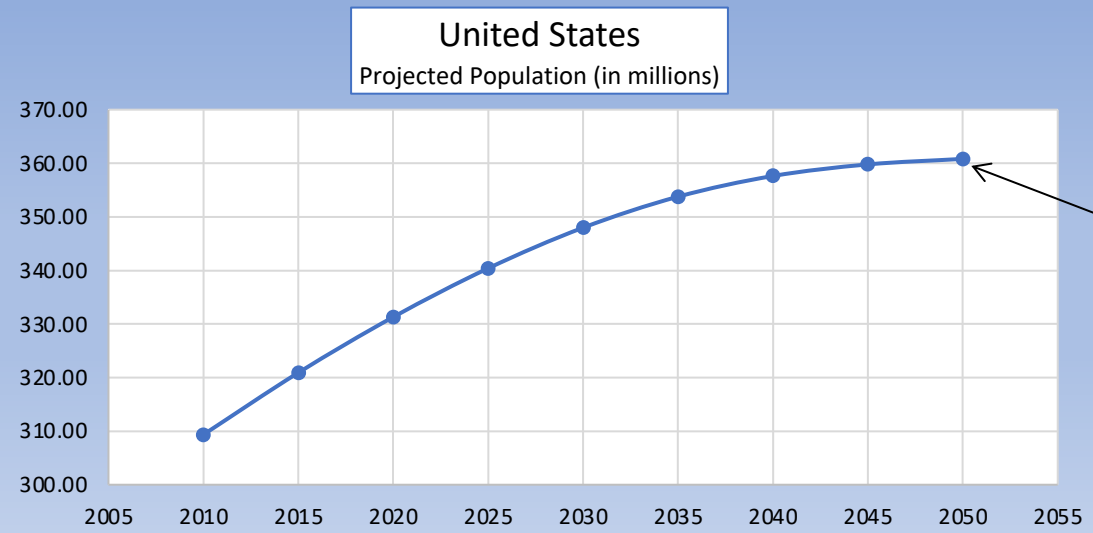
	Foundation Factors:			
	0.062	0.059	0.059	0.058
Age Groups	Henry's Population Factors 2020	Census Population Factors Low 2020	Census Population Factors Middle 2020	Census Population Factors High 2020
0 – 4	1.014	1.023	1.026	1.028
5 - 9	1.014	1.062	1.066	1.068
10 - 14	1.020	1.045	1.049	1.052
15 - 19	1.032	1.015	1.021	1.025
20 - 24	1.032	1.007	1.012	1.016
25 - 29	1.022	1.017	1.022	1.028
30 - 34	1.012	1.025	1.031	1.037
35 - 39	1.004	1.011	1.016	1.024
40 - 44	0.995	1.015	1.017	1.025
45 - 49	0.985	0.995	1.002	1.010
50 - 54	0.974	0.961	0.996	1.003
55 - 59	0.962	0.963	0.968	0.976
60 - 64	0.945	0.934	0.943	0.953
65 - 69	0.917	0.890	0.903	0.917
70 - 74	0.869	0.825	0.840	0.882
75 - 79	0.792	0.744	0.756	0.794
80 - 84	1.134*	1.031*	1.045*	1.100*
85+				

Scenario 2: Replaced the Population Factors from 2010 to 2015 with the Population Factors of Japan for that same period of time. All of Japan's Population Factors are less than 1.



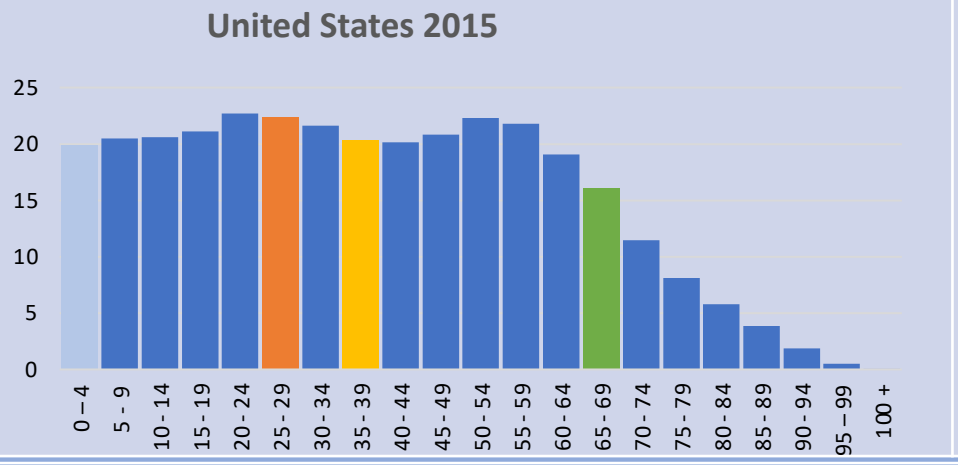


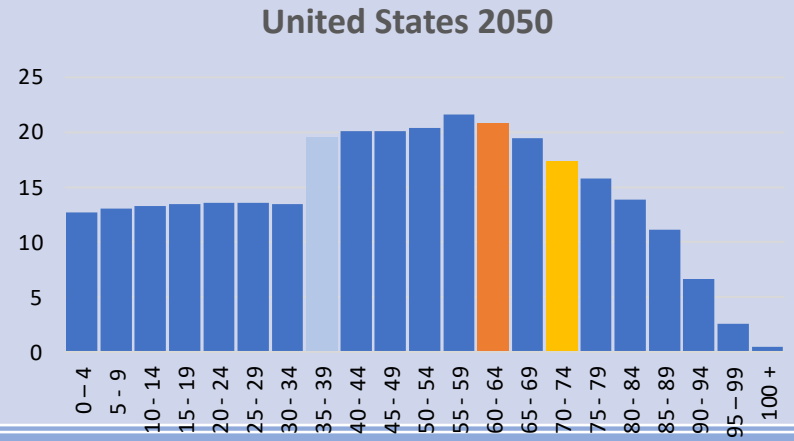
2010: 309 million people
2015: 321 million people
2020: 332 million



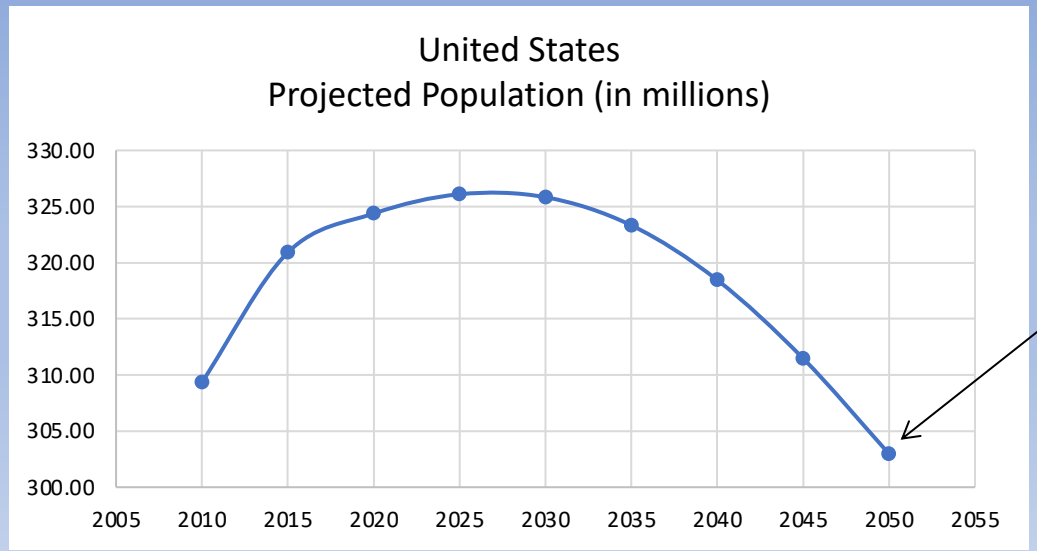
361 million people

Scenario 3: Replaced the Population Factors and the Foundation Factor with the factors for Japan from 2010 to 2015. Japan's Foundation Factor for 2015 was 0.042.



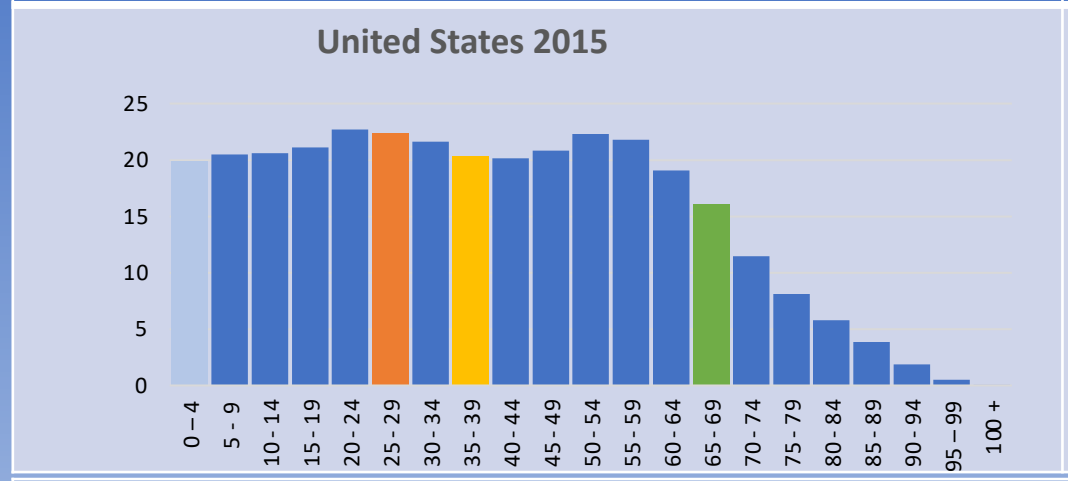


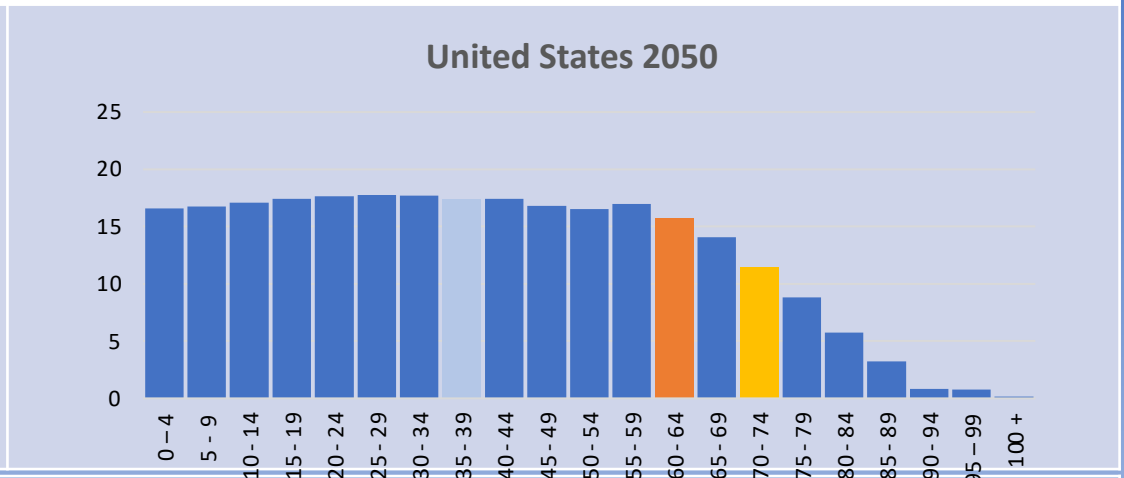
2010: 309 million people
2015: 321 million people
2020: 325 million



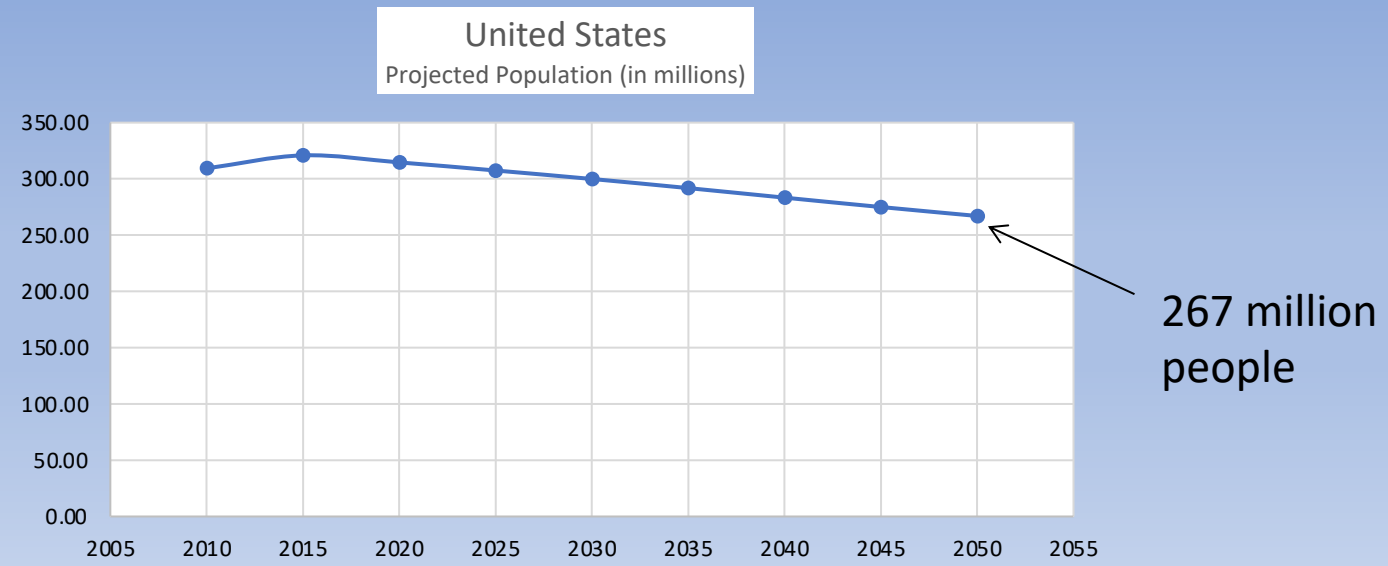
303 million people

Scenario 4: Replaced the Population Factors with the Population Factors for Kenya from 2010 – 2015. All of the population factors are less than 1.

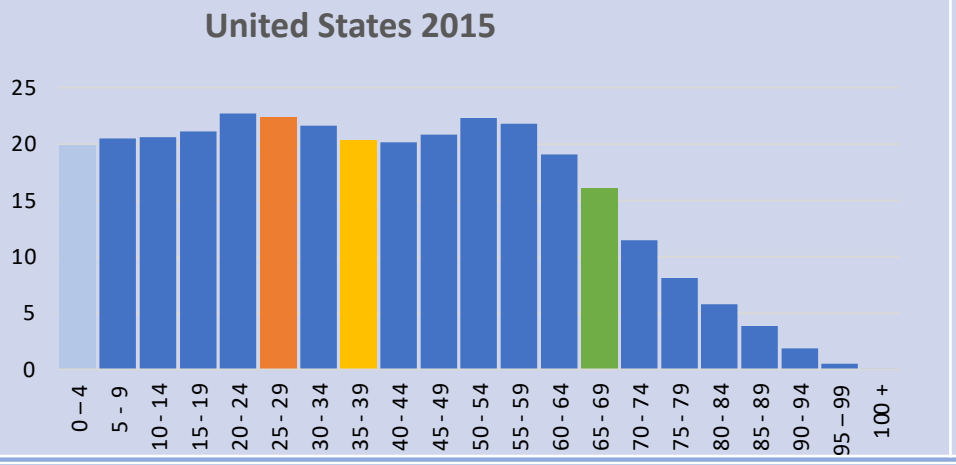


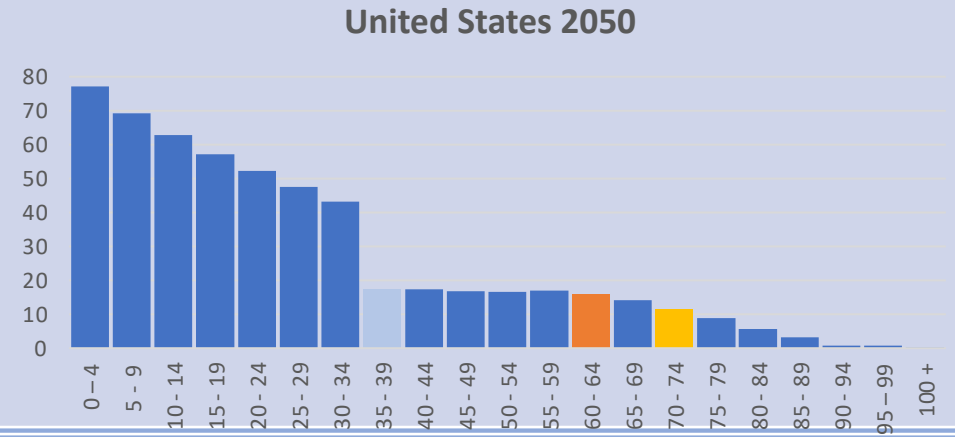


2010: 309 million people
2015: 321 million people
2020: 315 million

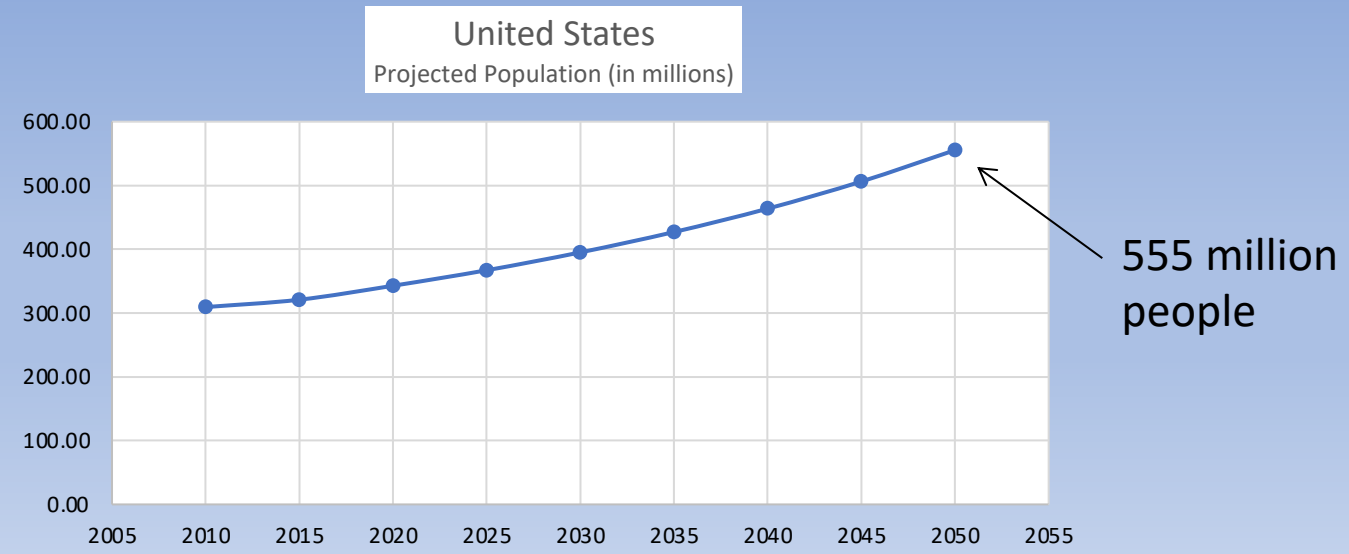


Scenario 5: Replaced the Population Factors and the Foundation Factor with the Population Factors and Foundation Factor for Kenya in 2010 – 2015. The Foundation Factor for Kenya is 0.139.





2010: 309 million people
2015: 321 million people
2020: 343 million



The Modeling Continuum

Level 1	Level 2	Level 3	Level 4
Identifying or extracting data from data sets or projections.	Summarizing data and projections from tables or graphs.	Interpreting the tools (for example, population factors, foundation factors, proportions) that are used to derive projections addressed in the lessons.	Reworking and modifying the tools used to make projections by addressing "What if …?" questions.
Answering questions directly from the presented data. Answering "What is …?" questions.	Summarizing data or outcomes in your own words. Answering "What is …?" questions using proportions, percent, or relative frequencies.	Answering questions or problems that require using the tools discussed in the lessons. Calculating new outcomes of a country's population based on changes in a country's immigration, births, and deaths.	Modifying the tools presented in the lessons that result in new population projections for real or fictitious countries. Answering questions that are a result of the modifications of a country's future population projections.

If time permits, what do you think were some of the points students addressed regarding why Kristin was an interesting person to highlight in the data stories?

American Statistical Association

People Count! (and their data stories)

(Article and link to module posted on Statistics Teacher)

https://www.statisticsteacher.org/2020/03/25/peoplecount/

Microsoft Word and Excel files of above module:
People Count

Also check out the modeling development at the
United States Census Bureau
International Data Base

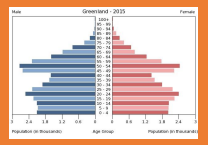
Henry Kranendonk
hkranendonk@earthlink.net

Download the Module

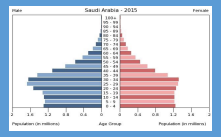
- Front Material
- Overview of the Module
- Introduction to the Module
- Unit 1
- Unit 2
- Unit 3
- Unit 4
- Handouts
- Excel Projection Files
- Quilt of Countries

Henry's Quilt

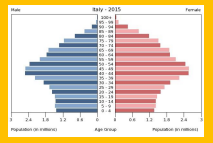
Greenland



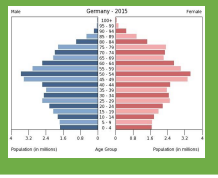
Saudi Arabia



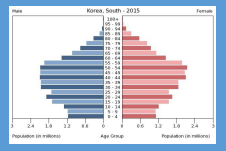
Italy



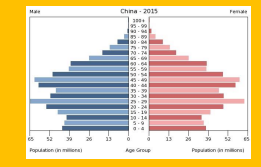
Germany



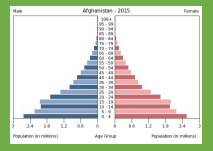
South Korea



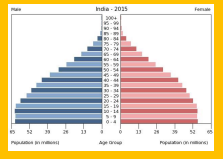
China



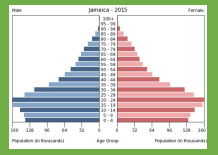
Afghanistan



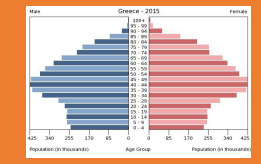
India



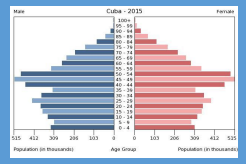
Jamaica



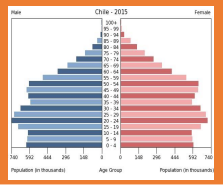
Egypt



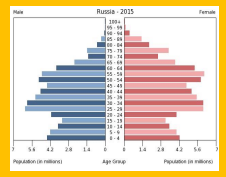
Morocco



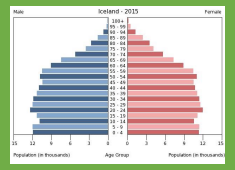
Chile



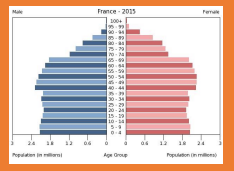
Russia



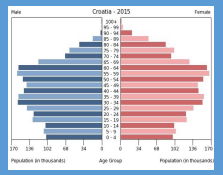
Iceland



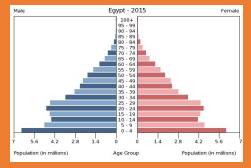
France



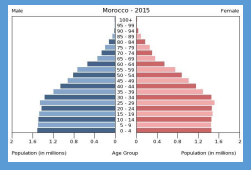
Croatia



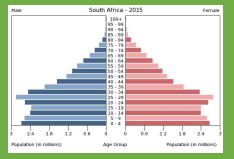
Greece



Cuba



South Africa



Norway