Introduction

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Demographic Methods (SOCI 320)

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Outline

- Definition of demography
- Demographic equation
- Demographic transition
- Age-sex structure

Definition of demography

- The scientific study of human population
- The term was coined by the Belgian statistician Achille Guillard in his 1855 book
  - *Éléments de Statistique Humaine ou Démographie Comparée*

Source: Poston, Bouvier, 2017.

Demography is destiny

- This phrase is attributed to the French mathematician and philosopher, Auguste Comte (1798–1857)
  - He is known as the “father of sociology”
  - Demography shapes the world, even if it does not determine it
  - Population change is an underlying component of almost everything happening in the world today, and therefore in the future as well

Source: Poston, Bouvier, 2017.

John Graunt (1620–1674)

- English statistician
  - Considered to be the founder of demography
  - Analyzed vital statistics of the London population
  - Studied the bills of mortality (weekly statistics of deaths) in early modern London
  - More specifically, studied death records that had been kept by London parishes since 1532

- Noticed certain regularities in death phenomena
  - Published in the book “Natural and Political Observations Made upon the Bills of Mortality” (1662)

Graunt's substantive contributions

- Recognized phenomenon of rural-urban migration
  - Urban death rate exceeded rural death rate
- Population was divided almost evenly by sex
  - Male birth rate was higher than female birth rate
    - Less females are born than males
  - Male death rate was higher than female death rate
    - Females live longer than males
- Presented mortality in terms of survivorship
  - He was the first to attempt to construct a life table...

Graunt's life table

Age	Number surviving	Age	Number surviving
0	100	46	10
6	64	56	6
16	40	66	3
26	25	76	1
36	16	86	0

Graunt's methodological contributions

- Paid attention to quality of data
- Exhibited a healthy skepticism
- Questioned the validity and reliability of data

Poston's definition

- Demography is the scientific study of the size, composition, and spatial distribution of human populations

- It investigates changes in population size, composition, and distribution, resulting from fertility, mortality, and migration

Source: Poston, Bouvier, 2017.

Concerns of demography

- Population size
- Population growth or decline
- Population processes/components
- Population distribution
- Population structure
- Population characteristics

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Primary demographic questions

- How large (or small) is the population?
- How is the population composed, in terms of age, sex, race, marital status, and so forth?
  - What are the characteristics of the population?
- How is the population distributed spatially?
  - Populations are not randomly distributed in space
- How population changes happen over time?

Source: Poston, Bouvier, 2017.

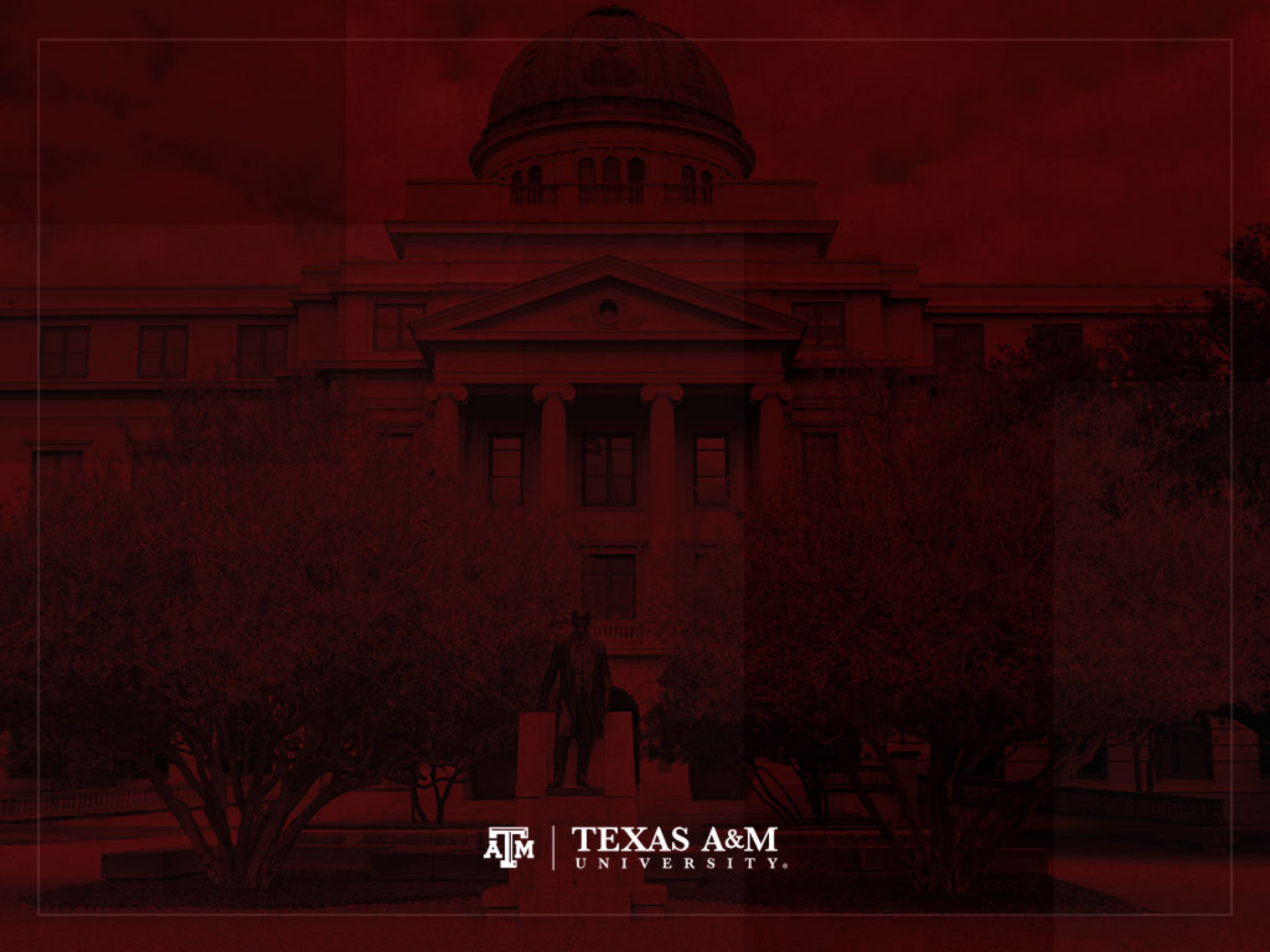
Answers to these questions

- These demographic questions are answered in terms of the three demographic processes (components of demographic change)
  - Fertility
  - Mortality
  - Migration

Source: Poston, Bouvier, 2017.

Cohort

- Cohort is a group of people who experience similar social circumstances
- People born during the same period who experience similar circumstances throughout their lives
  - Lucky Few: from around 1929 through 1945
  - Baby boomers: between around 1946 and 1964
  - Baby bust cohort (Gen. X): from mid-1960s to early 1980s
  - Millennials (Gen. Y): born in the 1980s and 1990s (or up to early 2000s)
  - Gen. Z: start around mid-1990s (or mid-2000s)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Demographic equation

- Population size can change only through the processes of fertility, mortality, and migration
- Two ways of entering a population
  - Being born or moving into it
- Two ways of leaving a population
  - Dying or moving out of it
- Population can only change by way of a limited, countable number of events

Source: Poston, Bouvier, 2017.

Basic demographic equation

$$P_{t+1} = P_t + B_{t \text{ to } t+1} - D_{t \text{ to } t+1} + I_{t \text{ to } t+1} - E_{t \text{ to } t+1}$$

- P_{t+1}: population at time $t+1$
- P_t: population at time t
- $B_{t \text{ to } t+1}$: births between times t and $t+1$
- $D_{t \text{ to } t+1}$: deaths between times t and $t+1$
- $I_{t \text{ to } t+1}$: immigrants (or in-migrants) to the population between times t and $t+1$
- $E_{t \text{ to } t+1}$: emigrants (or out-migrants) from the population between times t and $t+1$

Source: Poston, Bouvier, 2017.

Components of equation

- $P_{t+1} = P_t + B_{t \text{ to } t+1} - D_{t \text{ to } t+1} + I_{t \text{ to } t+1} - E_{t \text{ to } t+1}$
- Natural increase: $B_{t \text{ to } t+1} > D_{t \text{ to } t+1}$
- Natural decrease: $B_{t \text{ to } t+1} < D_{t \text{ to } t+1}$
  - Negative natural increase

Source: Poston, Bouvier, 2017.

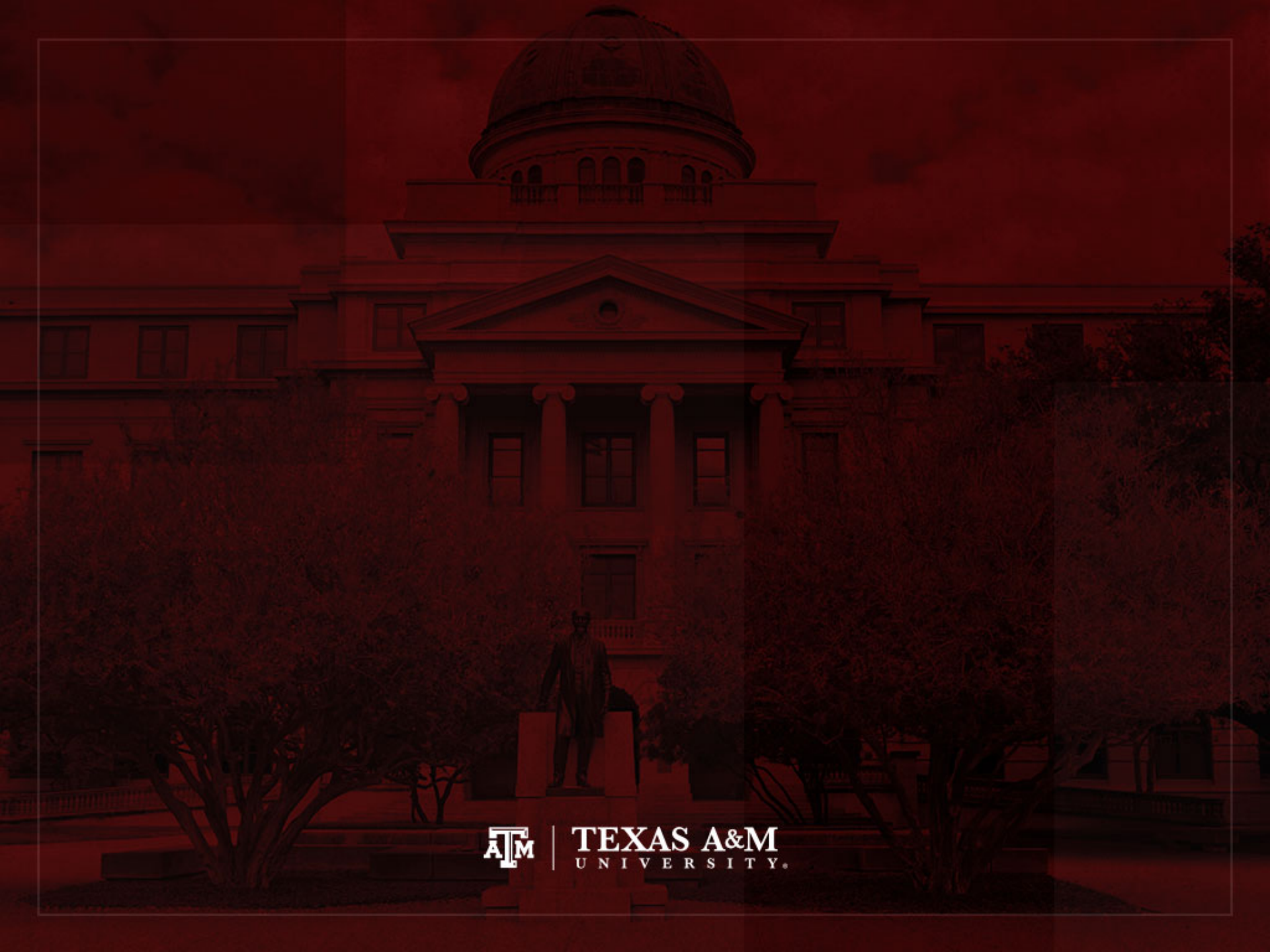
Migration components of equation

- $I_{t \text{ to } t+1} - E_{t \text{ to } t+1}$
  - Net international migration
    - Immigration minus emigration
  - Net internal migration
    - In-migration minus out-migration

- $I_{t \text{ to } t+1} < E_{t \text{ to } t+1}$
  - Negative net international migration (sending countries)
  - Negative net internal migration (net out-migration)

- $I_{t \text{ to } t+1} > E_{t \text{ to } t+1}$
  - Positive net international migration (receiving countries)
  - Positive net internal migration (net in-migration)

Source: Poston, Bouvier, 2017.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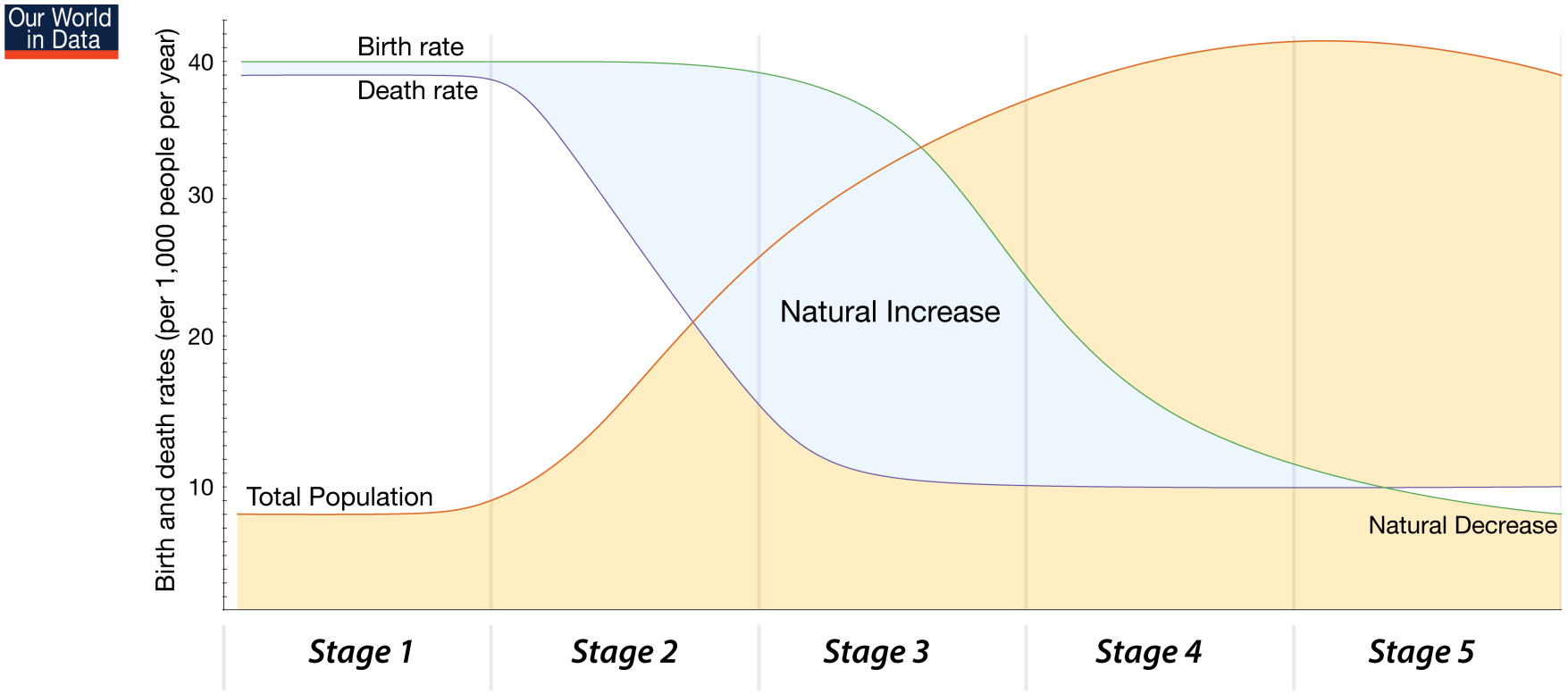
Demographic transition



	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Birth rate	*High*	*High*	*Falling*	*Low*	*Very low*
Death rate	*High*	*Falls rapidly*	*Falls more slowly*	*Low*	*Low*
Natural increase	*Stable or slow increase*	*Very rapid increase*	*Increase slows down*	*Stable or slow increase*	*Stable or slow decrease*

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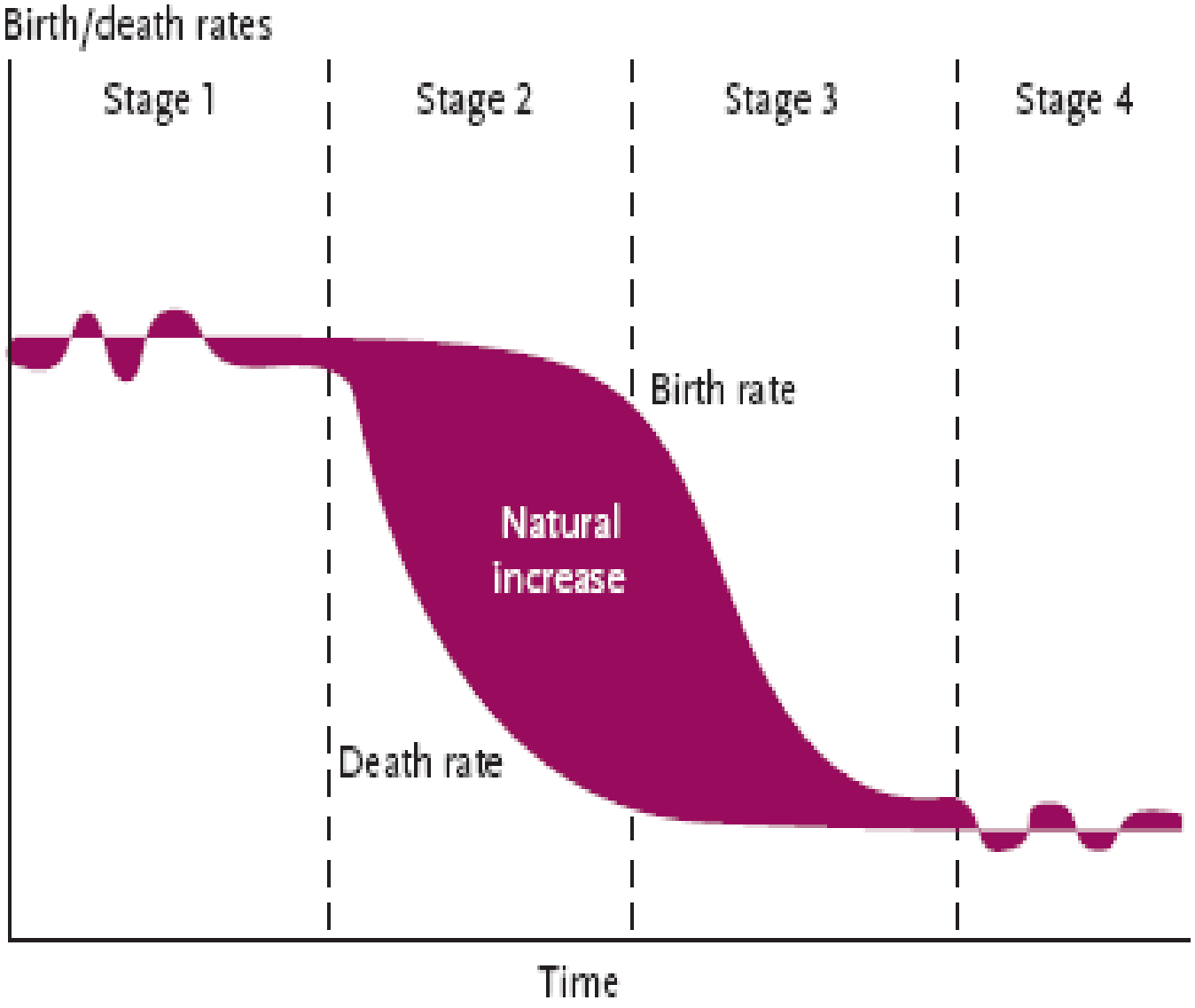
The Classic Stages of Demographic Transitions



Source: Poston, Bouvier, 2017.

Population storm

Year	Population in billions	Annual rate of growth	Annual increase in millions
1804	1	0.4	4
1927	2	1.1	22
1960	3	1.3	52
1974	4	2.0	75
1987	5	1.6	82
2000	6	1.4	77
2011	7	1.2	80
2024	8	0.9	73
2040	9	0.7	59
2061	10	0.4	38

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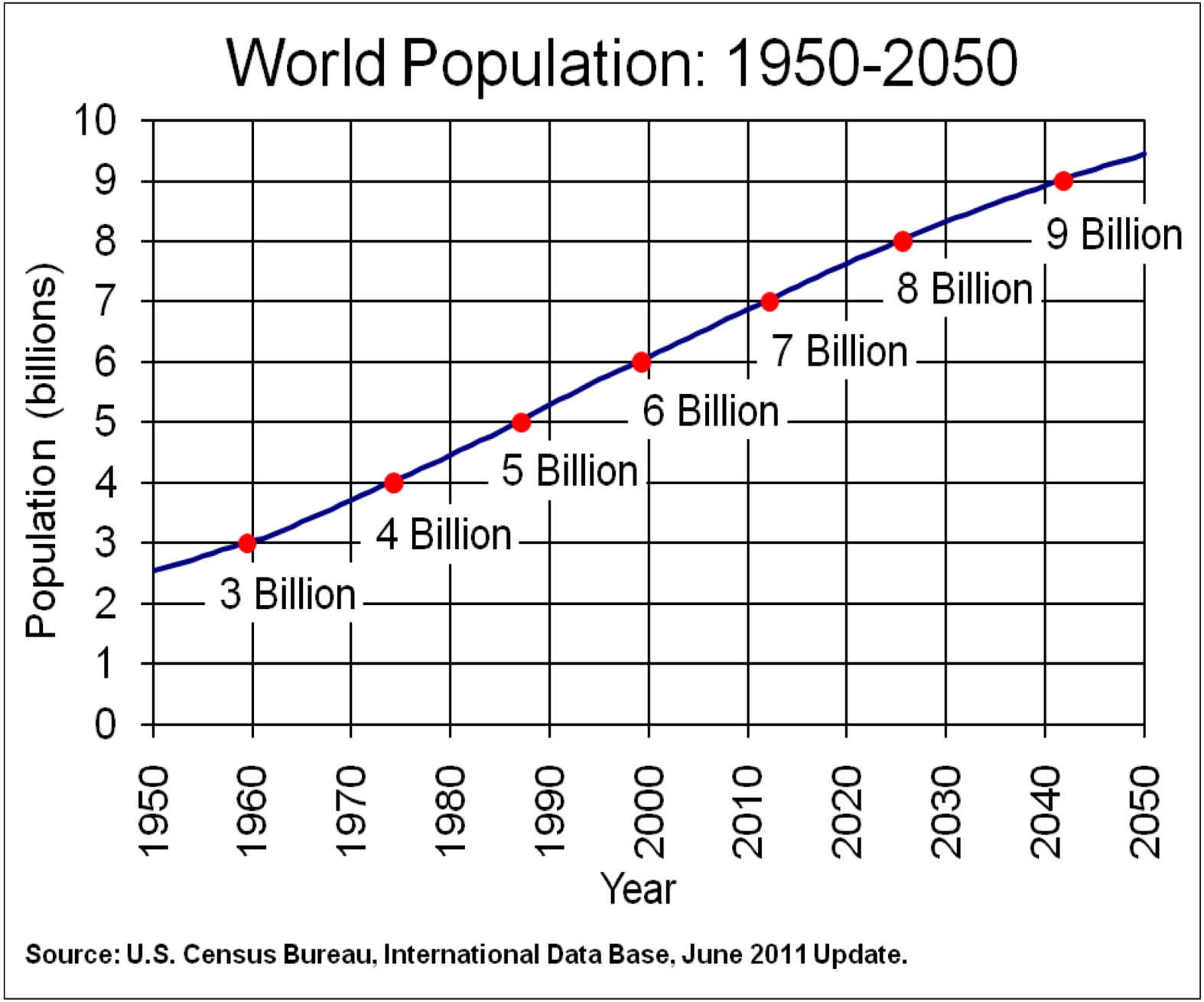
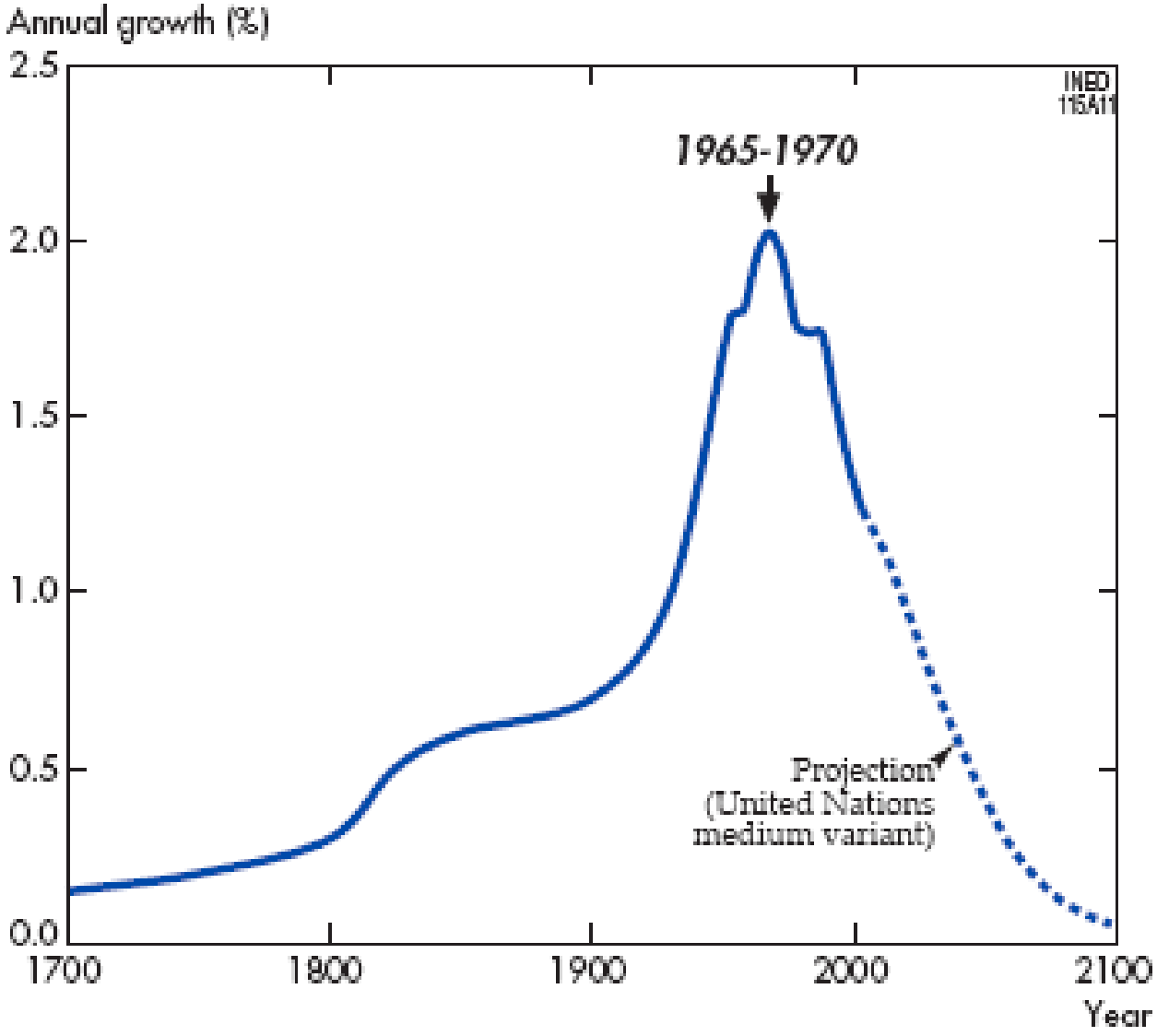


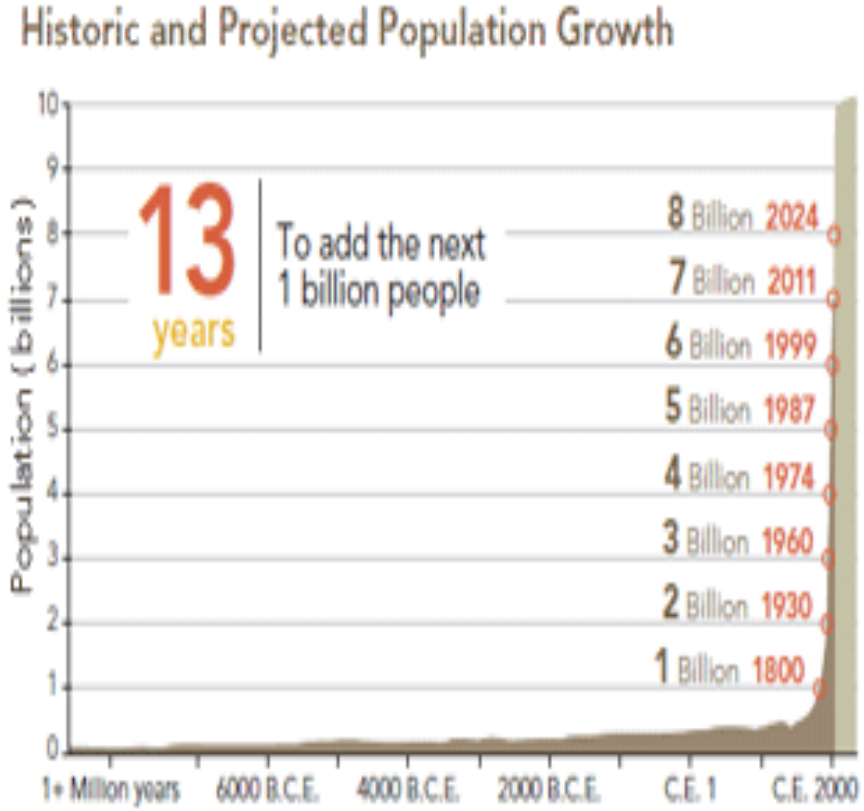
Source: Poston, Bouvier, 2017.

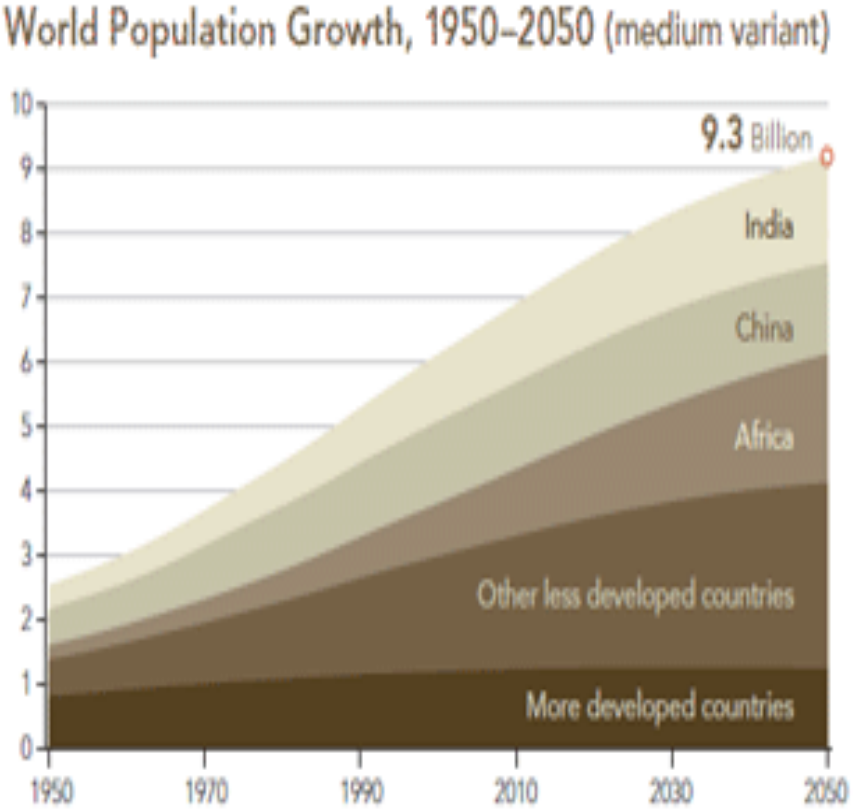
World population growth rates



Source: Poston, Bouvier, 2017.

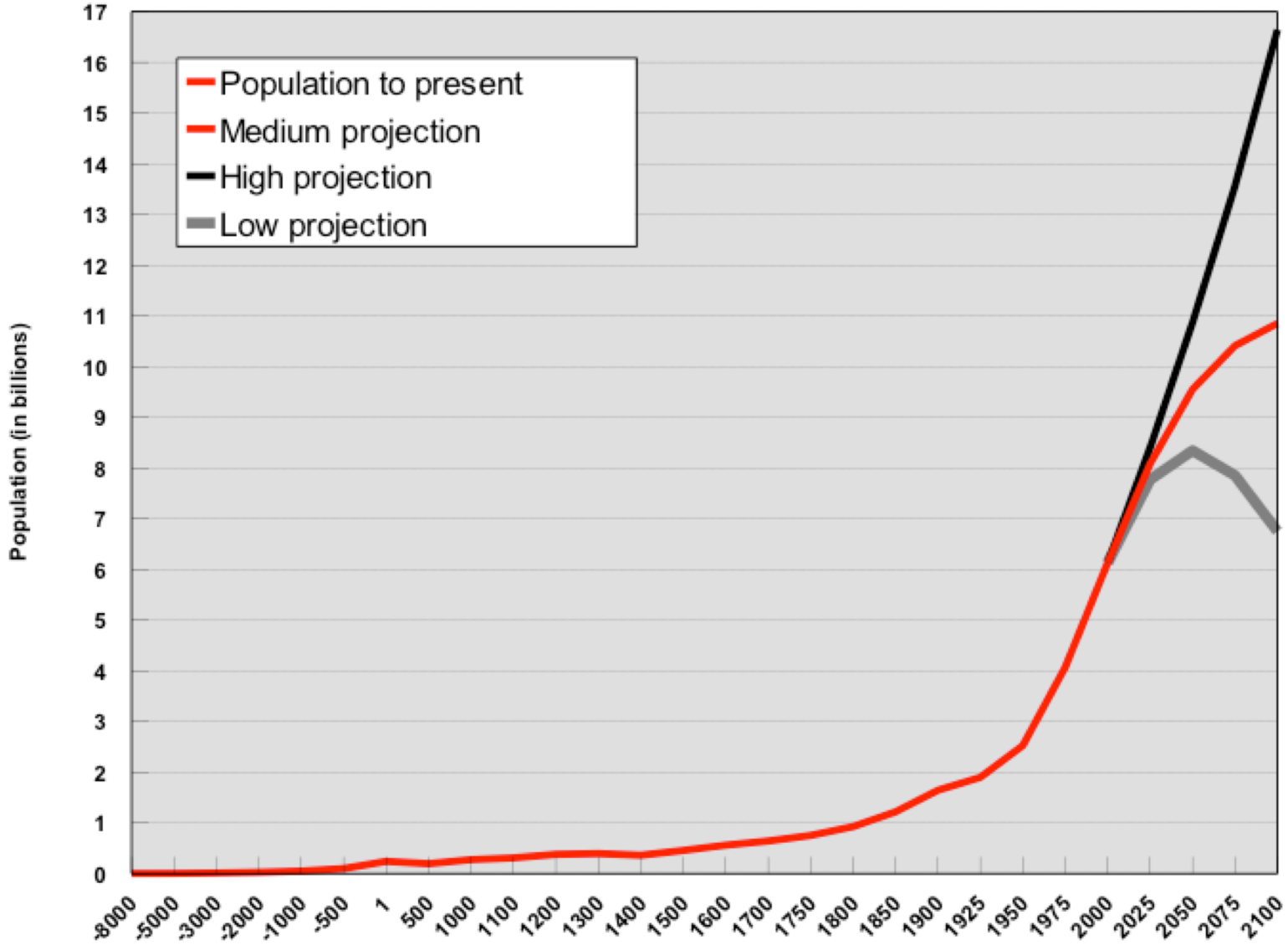
The greatest demographic change in human history





Source: Poston, Bouvier, 2017.

World's population exploded in size



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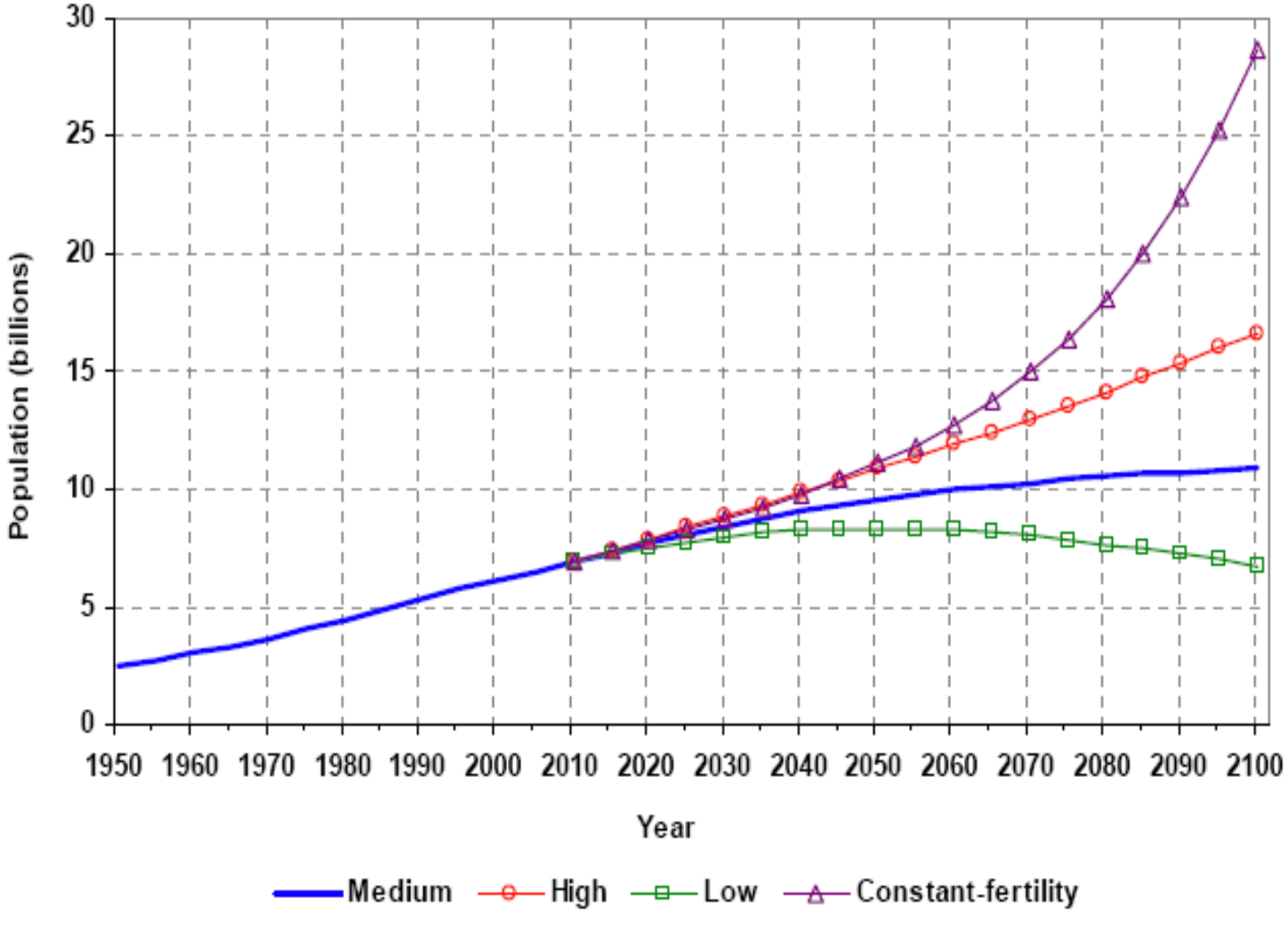
Population of the world according to different projections and variants, 1950–2100



Source: Poston, Bouvier, 2017.

Population size in billions

Continent	2013	2050	2100
America	1	1	1
Europe	1	1	1
Africa	1	2	4
Asia	4	5	5
Total	**7**	**9**	**11**

Source: Don't Panic: Hans Rosling Showing The Facts About Population (https://vimeo.com/79878808)

Population size in billions

Age group	2013	2024	2050	2100
75+				1
60–74	1	1	1	2
45–59	1	1	2	2
30–44	1	2	2	2
15–29	2	2	2	2
0–14	2	2	2	2
Total	**7**	**8**	**9**	**11**

Source: Don't Panic: Hans Rosling Showing The Facts About Population (https://vimeo.com/79878808)

Population growth

- The world's population will continue to increase for the rest of our lives
- Virtually all of it will take place in cities of developing countries

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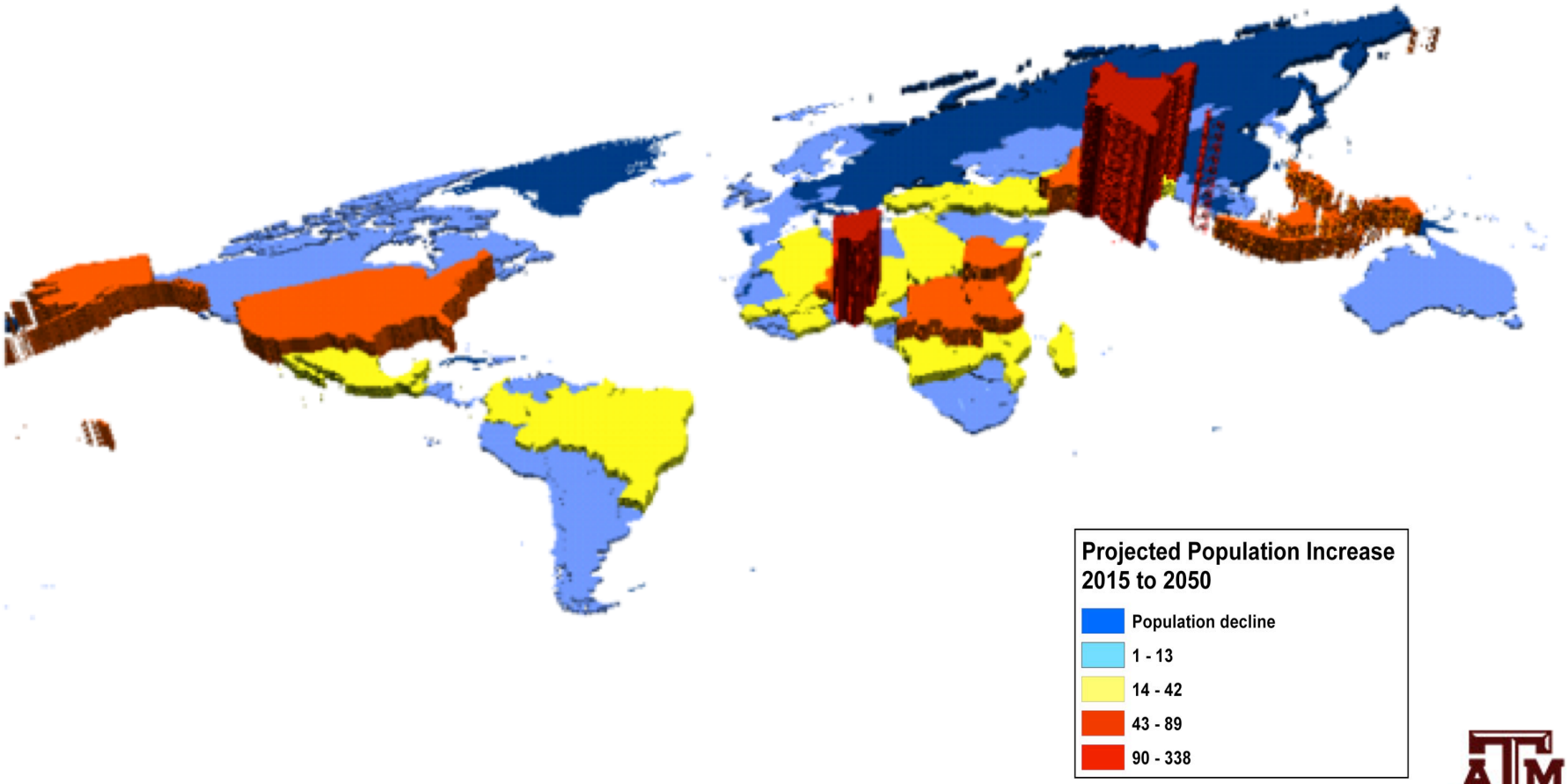
Population increase 2015–2050



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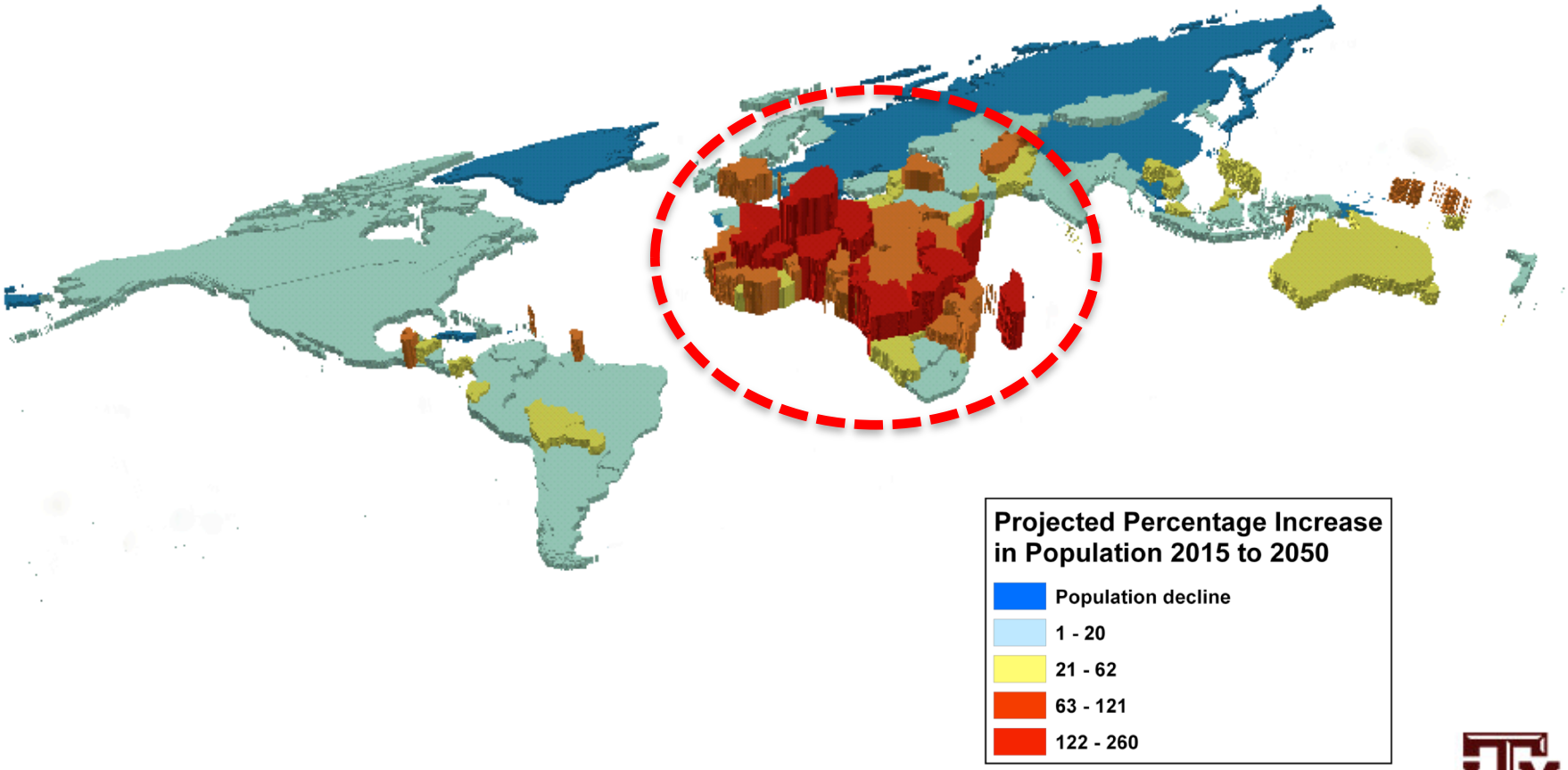
Percentage population increase 2015–2050



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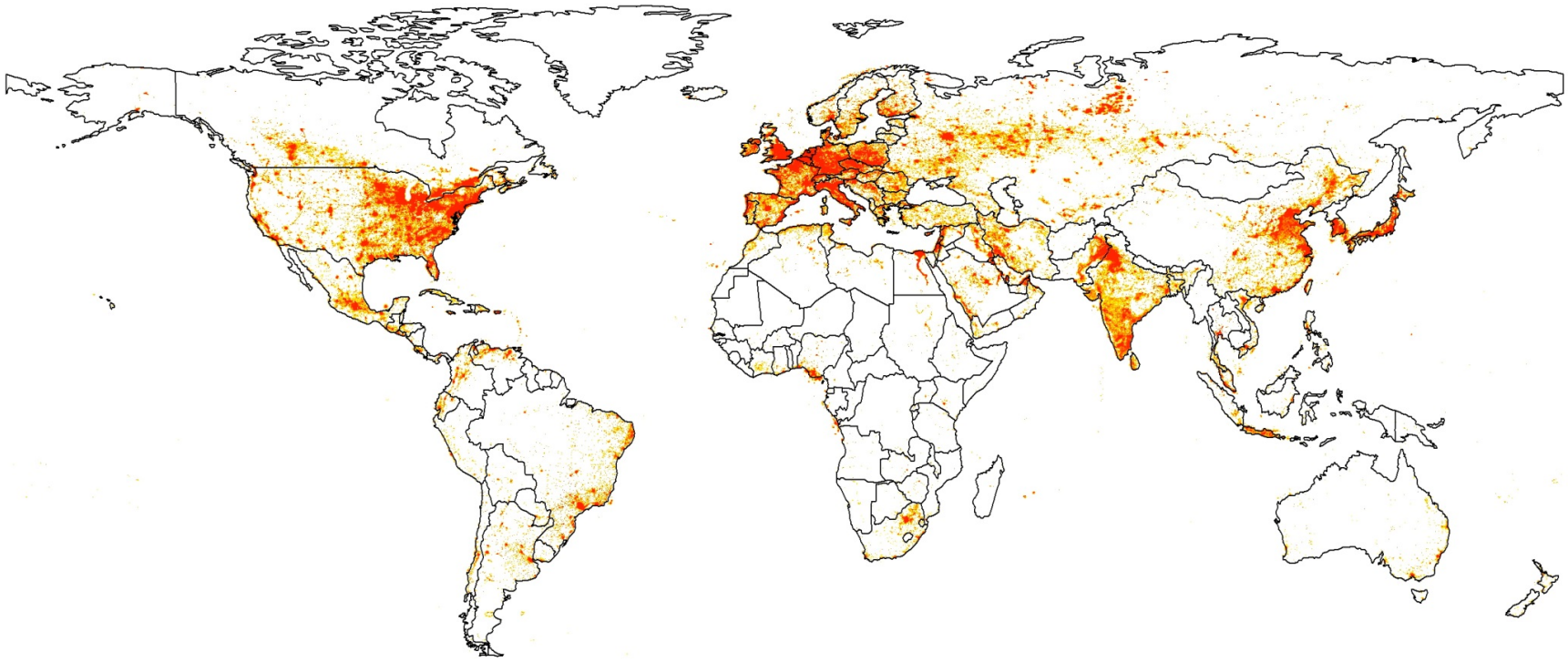
Geographic distribution of world's population, 2015



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10 most populous countries, millions

	Country	2015		Country	2050
1	China	1,402	**1**	India	1,620
2	India	1,282	**2**	China	1,385
3	United States	325	**3**	Nigeria	404
4	Indonesia	256	**4**	United States	401
5	Brazil	204	**5**	Indonesia	321
6	Pakistan	188	**6**	Pakistan	271
7	Nigeria	183	**7**	Brazil	231
8	Bangladesh	160	**8**	Bangladesh	202
9	Russia	142	**9**	Ethiopia	188
10	Japan	127	**10**	Philippines	157

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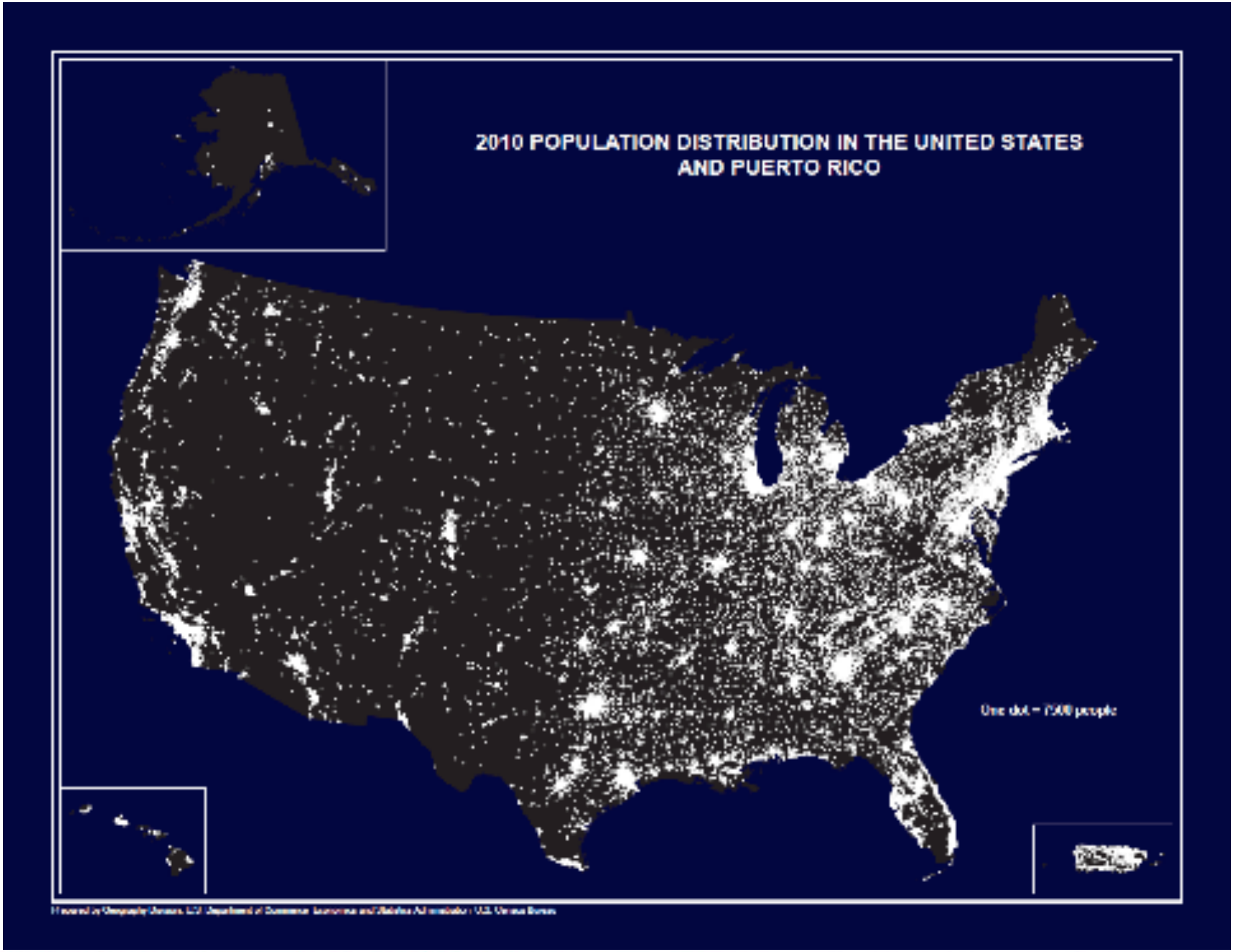

Source: Poston, Bouvier, 2017.

The past is a foreign country (1/3)

Indicators	1910	2010
World population (billions)	1.8	6.9
U.S. population (millions)	92	309
U.S. percent of world total	5.1%	4.5%
U.S. life expectancy	52	81
U.S. children per woman	3.5	1.9

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The past is a foreign country (2/3)

U.S. indicators	1910	2010
Immigrants from Italy (1900–1909); (2000–2010)	1.2 million	28,000
Immigrants from Mexico (1900–1910); (2000–2010)	123,000	1.7 million (legal immigrants)
% Foreign-born	14.7%	12.9%
% Urban	46%	81%

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The past is a foreign country (3/3)

U.S. indicators	1910	2010
Number of passenger cars	450,000	190 million
% Population under 15	32.1%	19.8%
% Population 65+	4.3%	13.0%
Average persons per household	4.4	2.6
% High school graduates	~10%	87%

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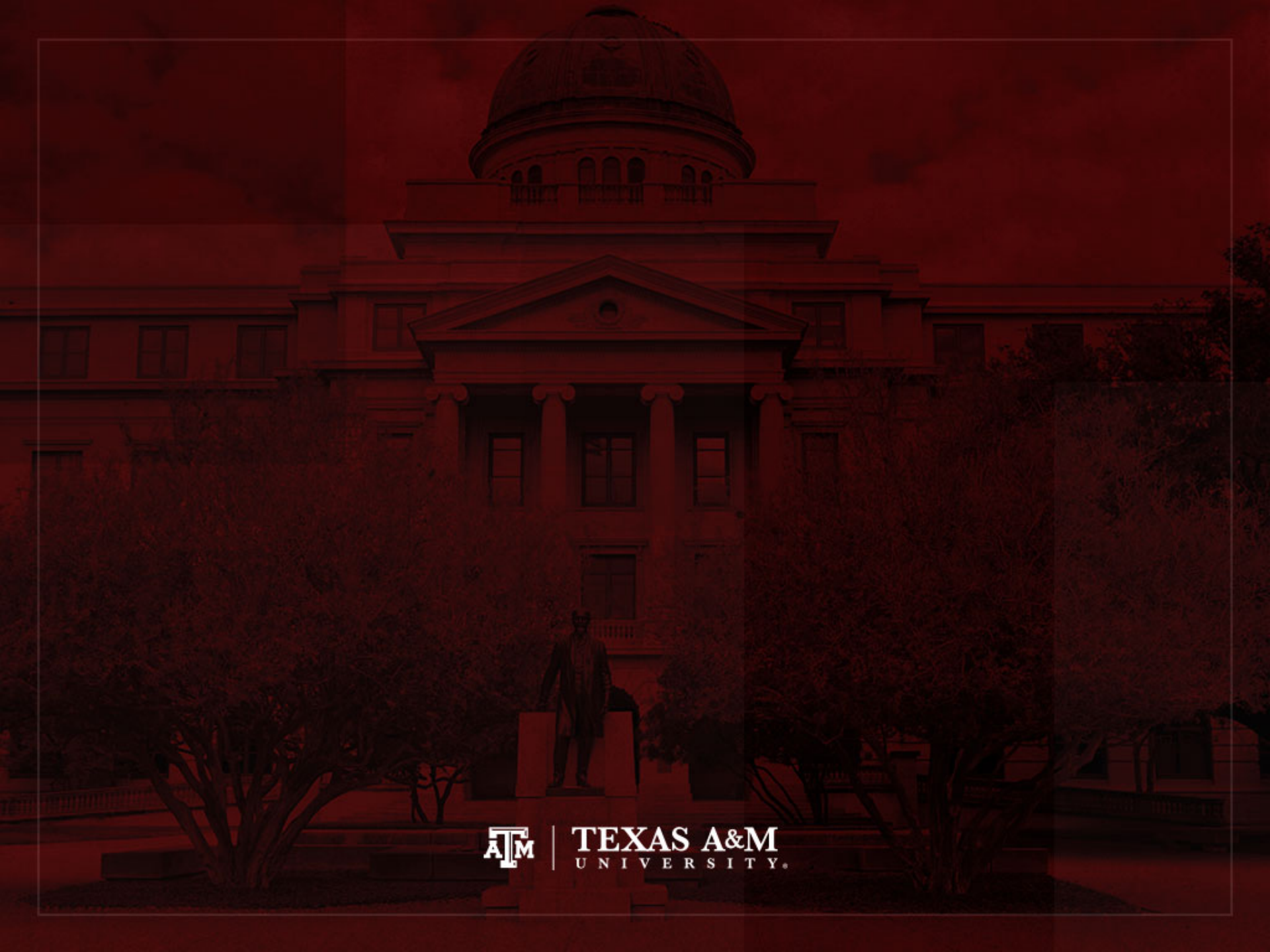
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Age-sex structure

- The most important characteristics that tell us about population structure are age and sex
- They are known as the demographic characteristics
- Age and sex are tied in with the three demographic processes
  - Fertility, mortality, migration

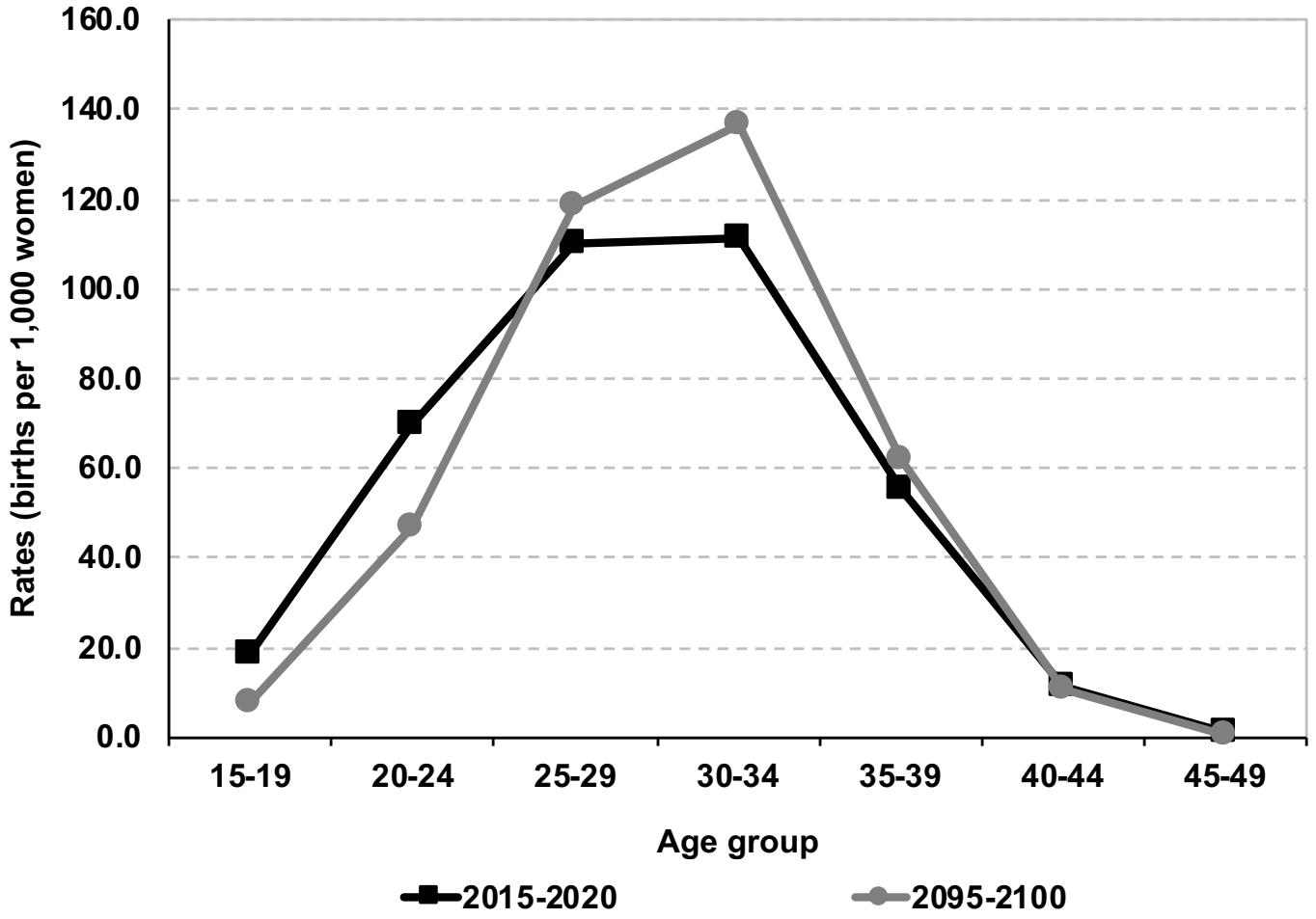
Source: Poston, Bouvier, 2017.

Fertility varies by age and sex

- Fertility (actual production of children)
  - More males are born than females
  - Normal sex ratio at birth (SRB): around 105 boys per 100 girls
- Fecundity (ability to produce children)
  - Females: between ages of around 15 and 49
  - Males: between ages of around 15 and 79

Source: Poston, Bouvier, 2017.

Age-specific fertility rates, United States



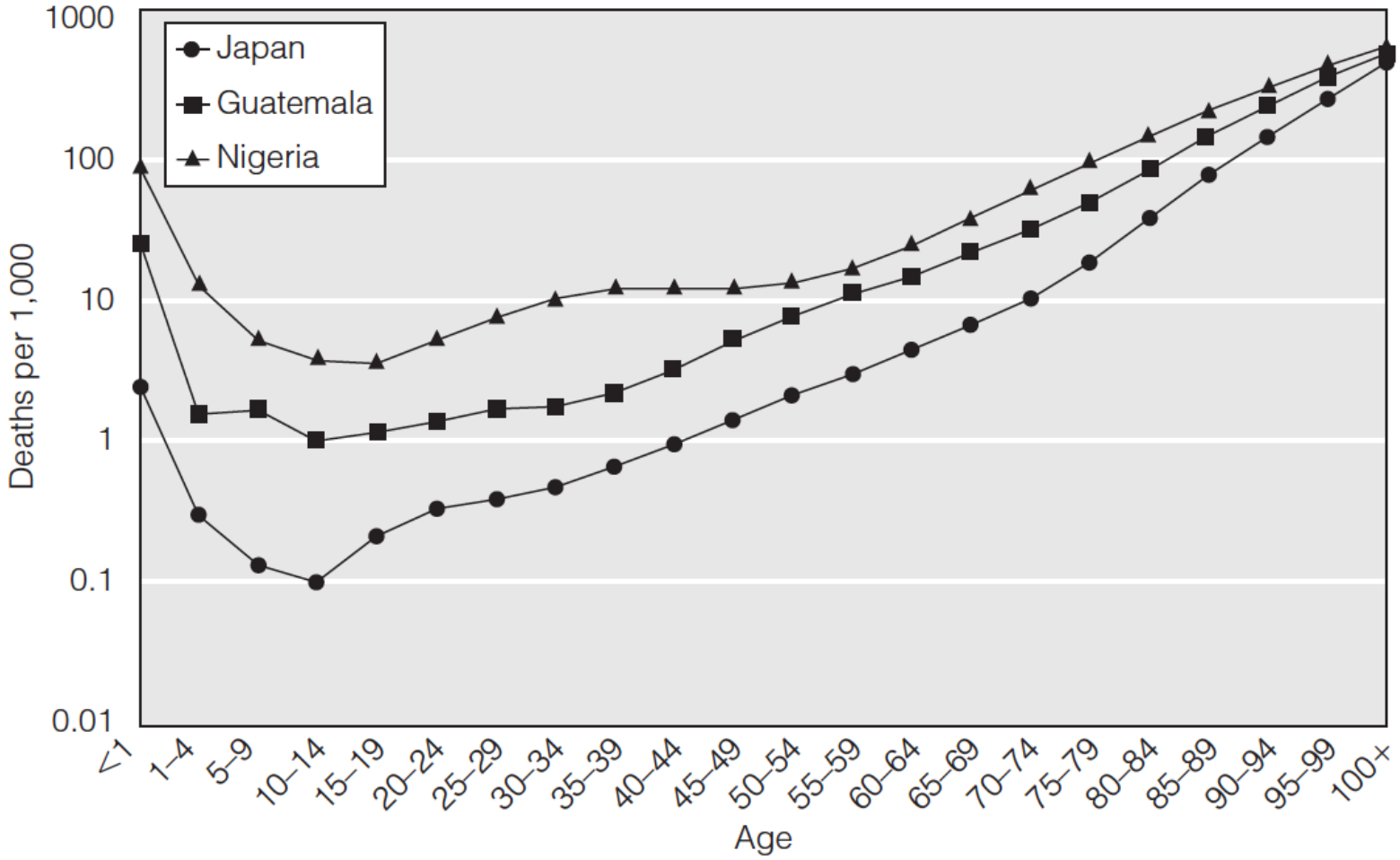
Source: United Nations, World Population Prospects 2017
https://esa.un.org/unpd/wpp/Download/Standard/Population/ (medium variant).

Mortality varies by age and sex

- Females have lower death rates than males at every age of life
- Death rates are high in the first year of life and then drop to very low levels
  - In modern populations, death rates do not reach the level of the first year of life for another 50–60 years
- Cause-specific mortality is often age related

Source: Poston, Bouvier, 2017.

Age-specific mortality rates, 2011



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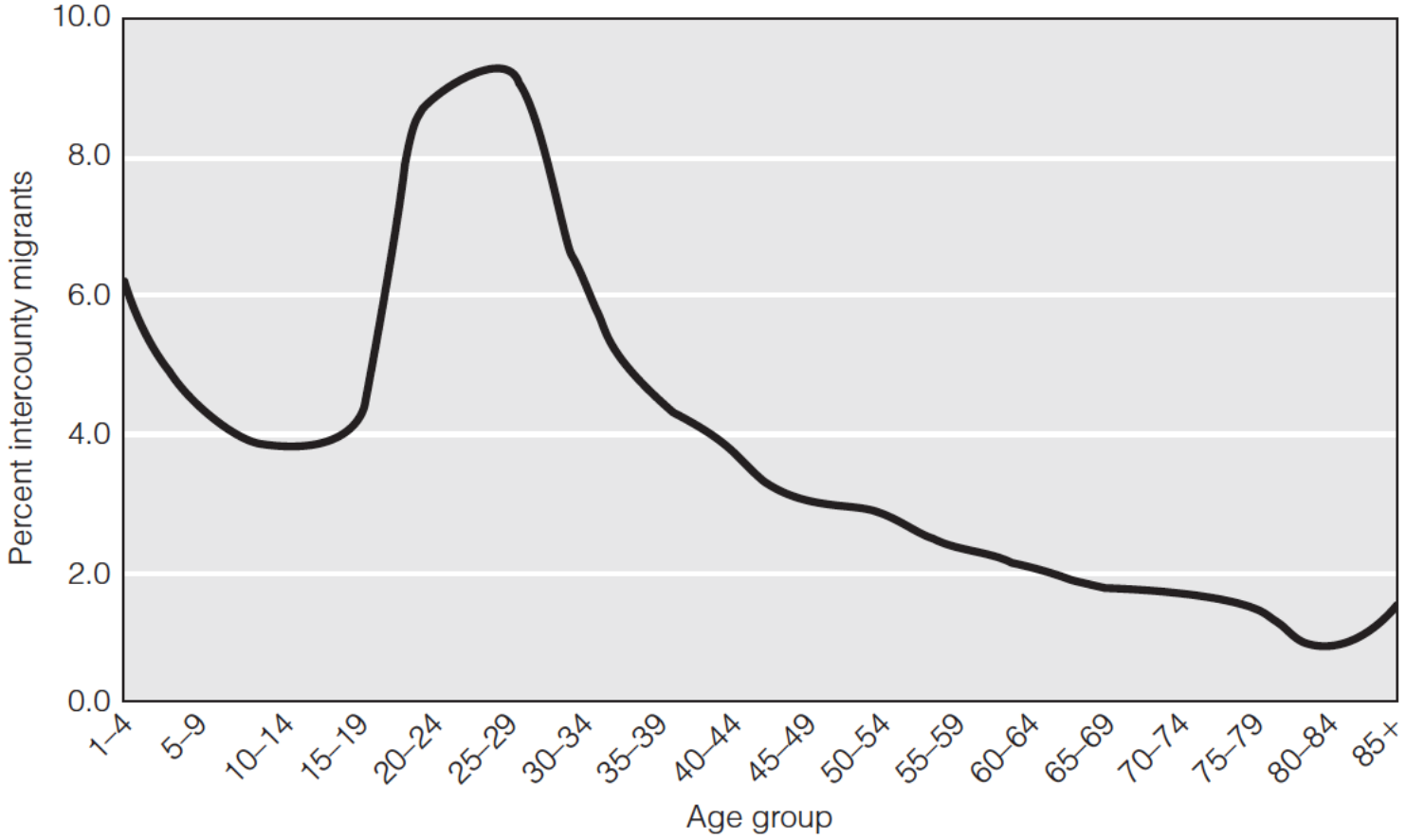
Migration varies by age and sex

- Sex is related to distance of migration
  - Long-distance migration tended to favor males
  - Short-distance migration tended to favor females
  - With increases in gender equity, migration of females and males tend to be similar
- Internal migration has highest rates among young adults

Source: Poston, Bouvier, 2017.

Age-specific migration rates, United States, 2011–2012



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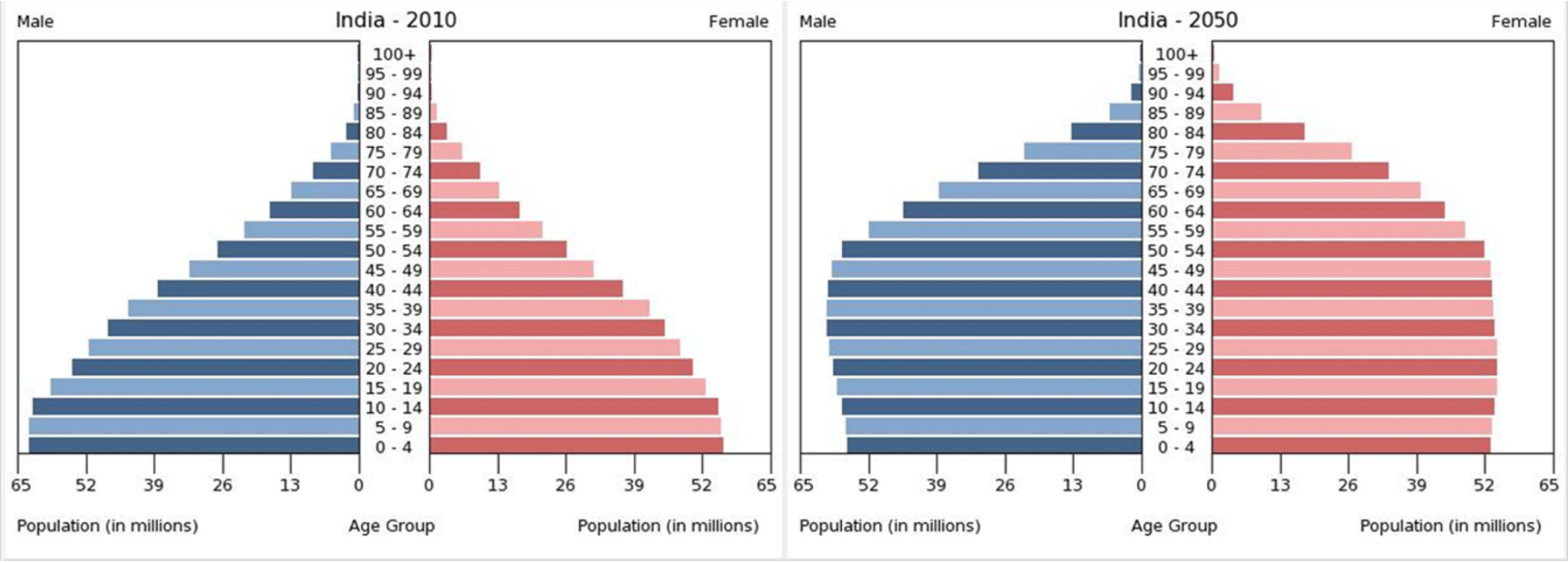
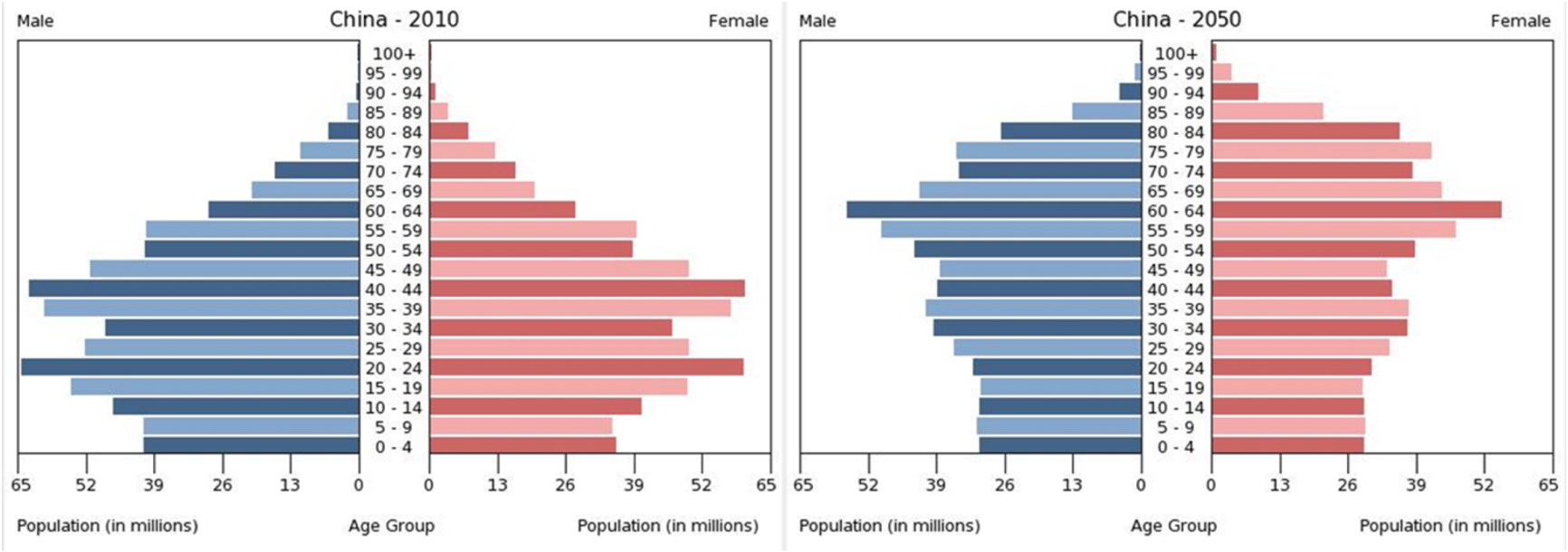
Population structure by age and sex, India, 2010–2050



Source: http://www.fdbetancor.com/wp-content/uploads/2012/10/demochallenge2.png

Population structure by age and sex, China, 2010–2050



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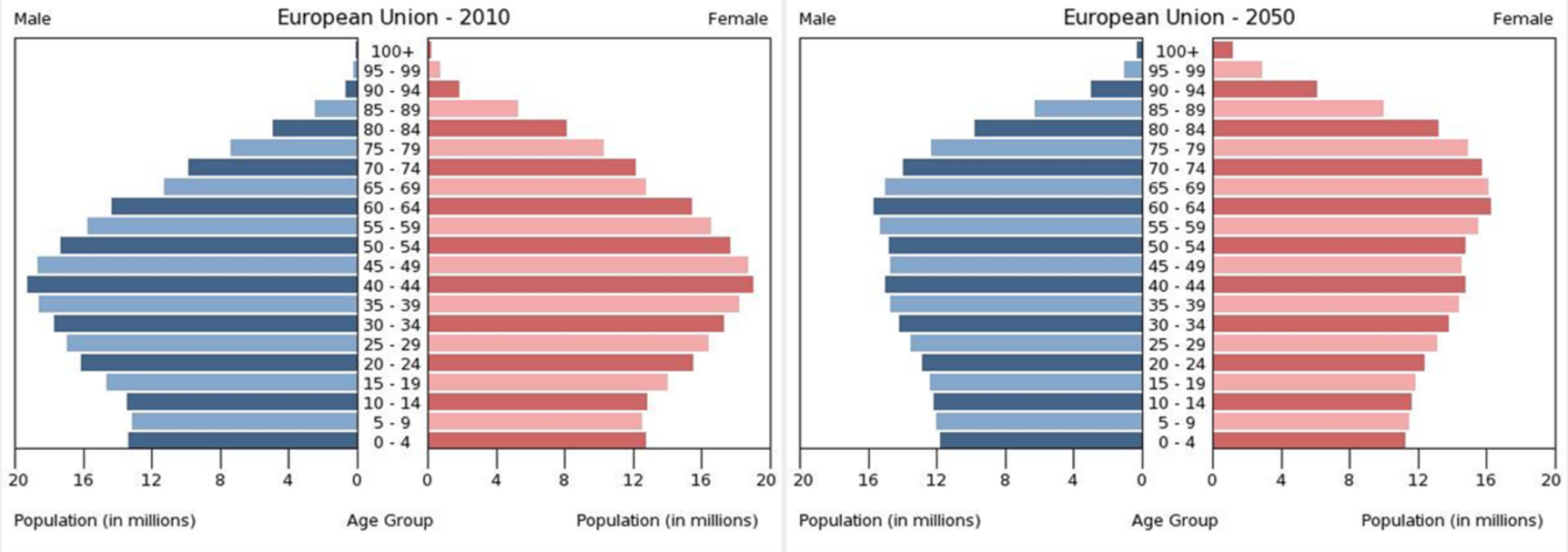
Population structure by age and sex, European Union, 2010–2050



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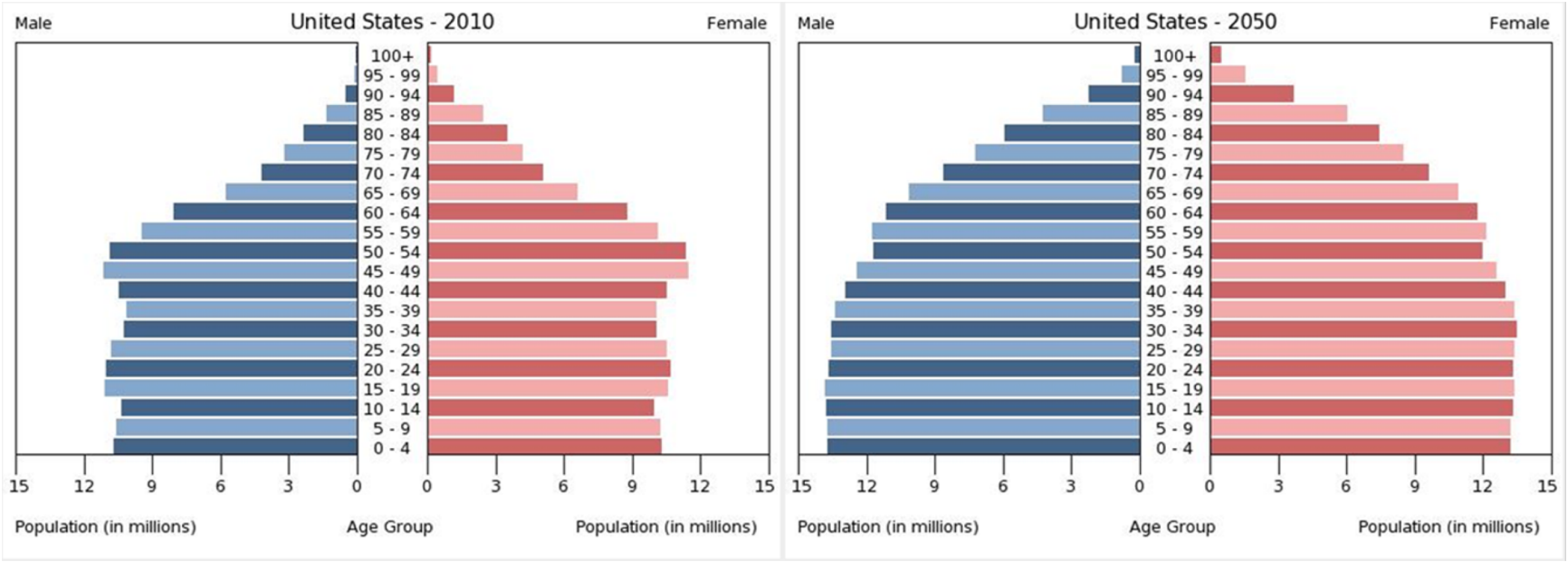
Population structure by age and sex, United States, 2010–2050



Source: http://www.fdbetancor.com/wp-content/uploads/2012/10/demochallenge2.png

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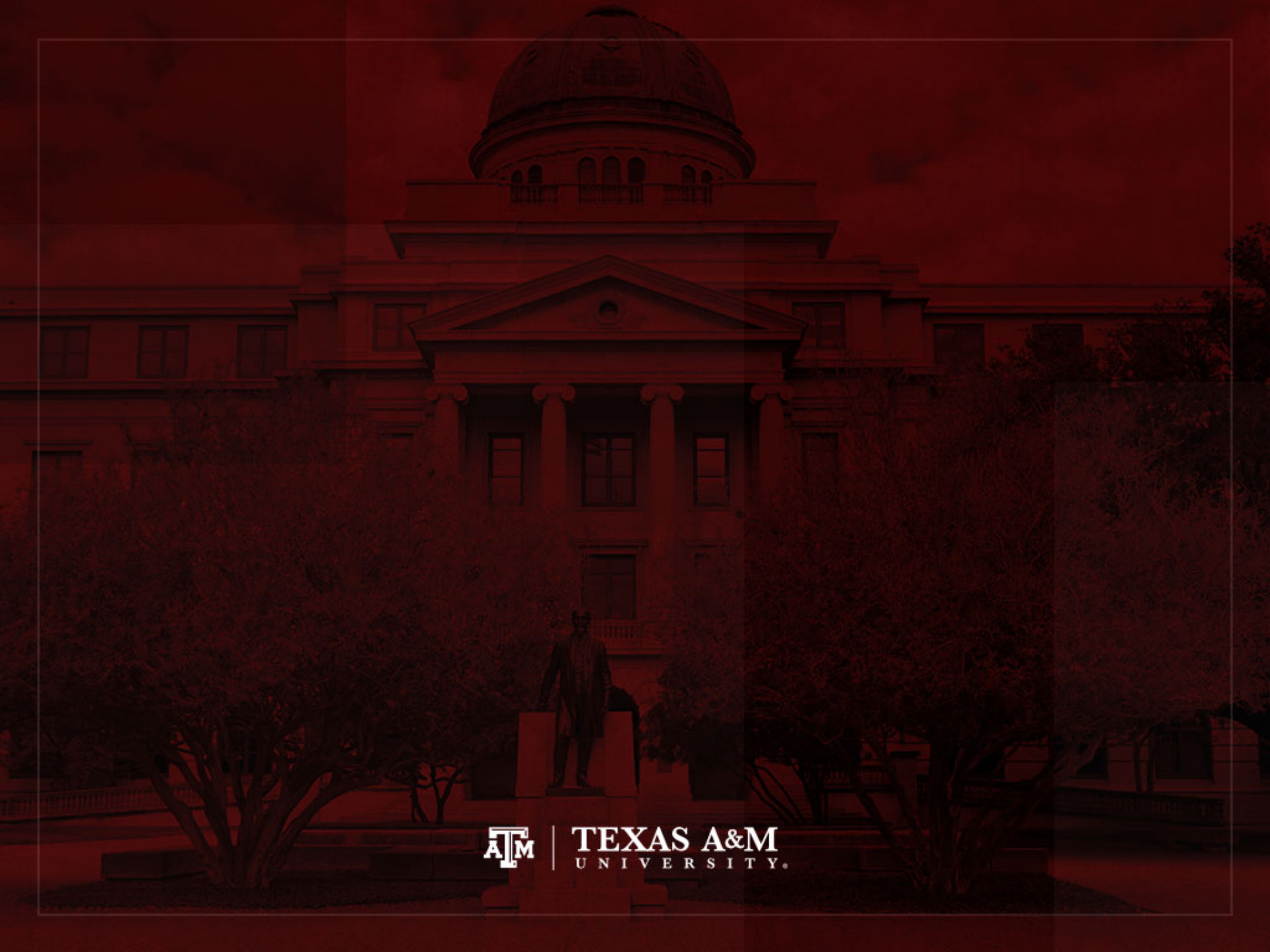
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