Lecture 1a: Introduction

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January 13, 2025
Demographic Methods (SOCI 633/320)

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Introduction

- Definition of demography
- Demographic equation
- Variables and observations
- Demographic models
- Cohorts and generations
- Age-sex structure
  - Population pyramid; Age dependency; Age heaping
  - Sex structure; Sex ratio at birth
- Five contemporary aspects of importance of demography
  - Demographic transition; Coronavirus pandemic

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, 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
  - Book “Natural and Political Observations Made upon the Bills of Mortality” (1662)

Graunt's substantive contributions

- Recognized the 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
- Demography helps understand what the past says about the future, given expected population changes

Source: Poston, Bouvier, 2017.

Concerns of demography

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

Primary demographic questions

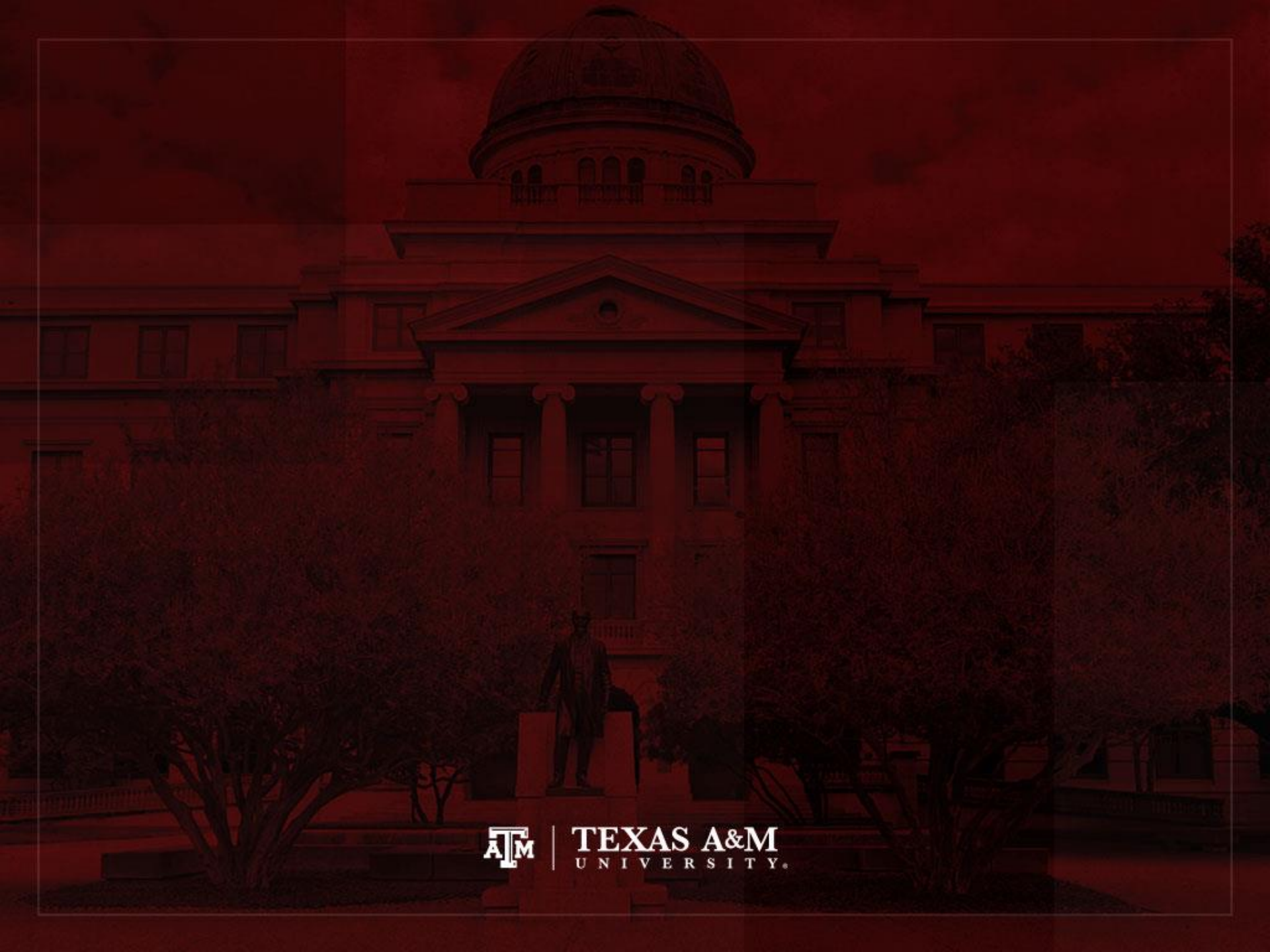
- How large (or small) is the population?
- How is the population composed, in terms of age, sex, race, marital status, and so forth?
  - What are the characteristics of the population?
- How is the population distributed spatially?
  - Populations are not randomly distributed in space
- How population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

Source: Poston, Bouvier, 2017.

Demographic components

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

Source: Poston, Bouvier, 2017.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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

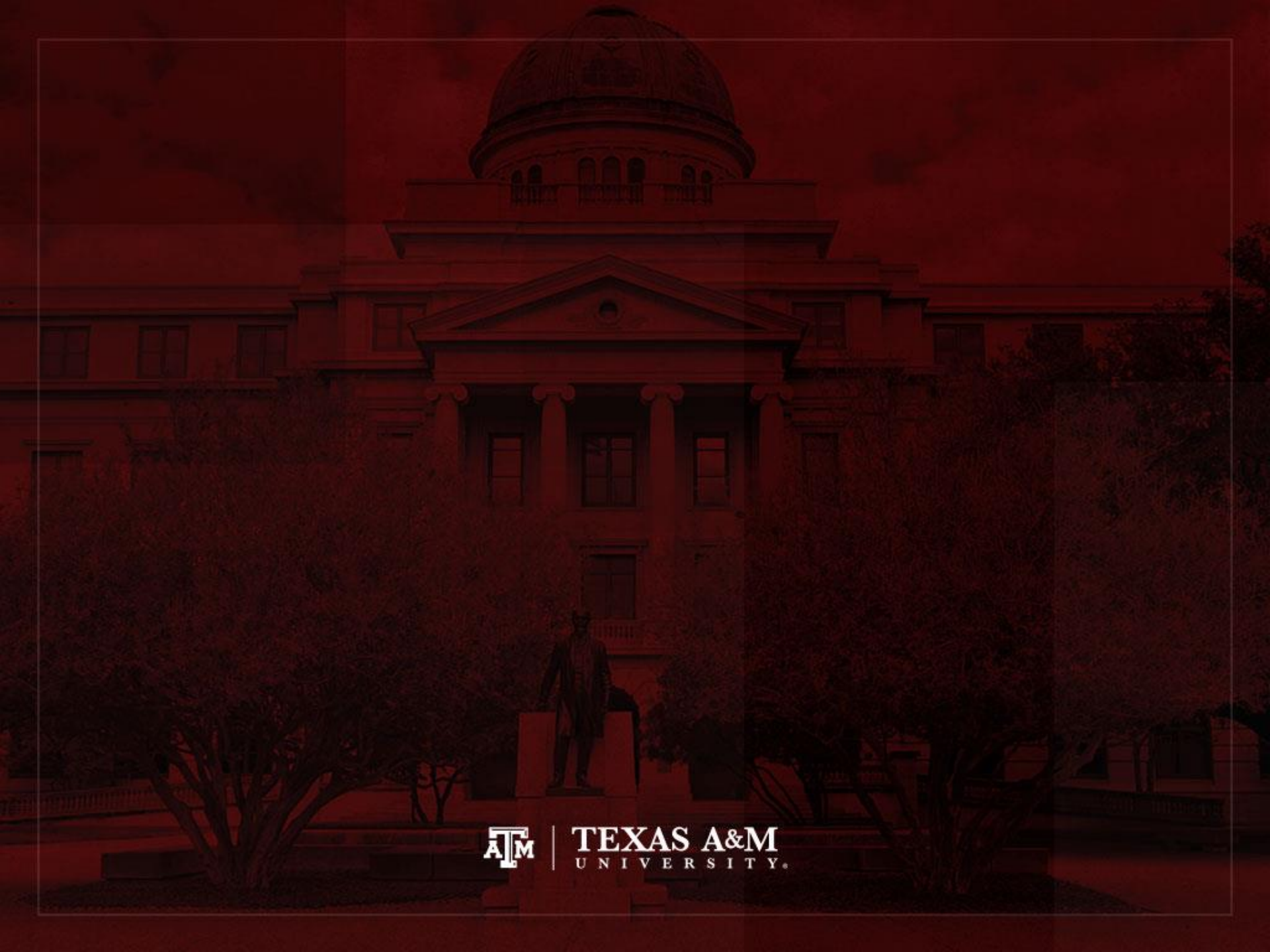
- $P_{t+1} = P_t + B_{t \text{ to } t+1} - D_{t \text{ to } t+1} + I_{t \text{ to } t+1} - E_{t \text{ to } t+1}$
- Natural increase: $B_{t \text{ to } t+1} > D_{t \text{ to } t+1}$
- Natural decrease: $B_{t \text{ to } t+1} < D_{t \text{ to } t+1}$
  - Negative natural increase

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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Variables and observations

- **Variables**
  - Characteristics that can change values from case to case
  - E.g. gender, age, race/ethnicity, number of children, place of residence, income...

- **Observations (cases)**
  - Refer to the entity from which data are collected
  - Also known as ”unit of analysis”
  - E.g. individuals, households, states, countries...

Variables

- **Variable:** a characteristic/phenomenon whose value varies (changes) from case to case, and is empirically quantifiable

- **Dependent variable:** a variable whose variation depends on another variable

- **Independent variable:** a variable whose variation produces ("causes") variation in another variable

Causation

- Theories and hypotheses are often stated in terms of the **relationships between variables**
  - Causes: independent variables
  - Effects or results: dependent variables

y	x	Use
Dependent variable	Independent variable	Econometrics
Explained variable	Explanatory variable	
Response variable	Control variable	Experimental science
Predicted variable	Predictor variable	
Outcome variable	Covariate	
Regressand	Regressor	

Association vs. causation

- Association and causation are different
  - Strong associations may be used as evidence of causal relationships (causation)
  - Associations do not prove variables are causally related
- We might have problems of reverse causality (endogeneity)
  - e.g., immigration increases competition in the labor market and affects earnings
  - Availability of jobs and income levels influence migration

Migration ⟷ **Earnings**

Observations

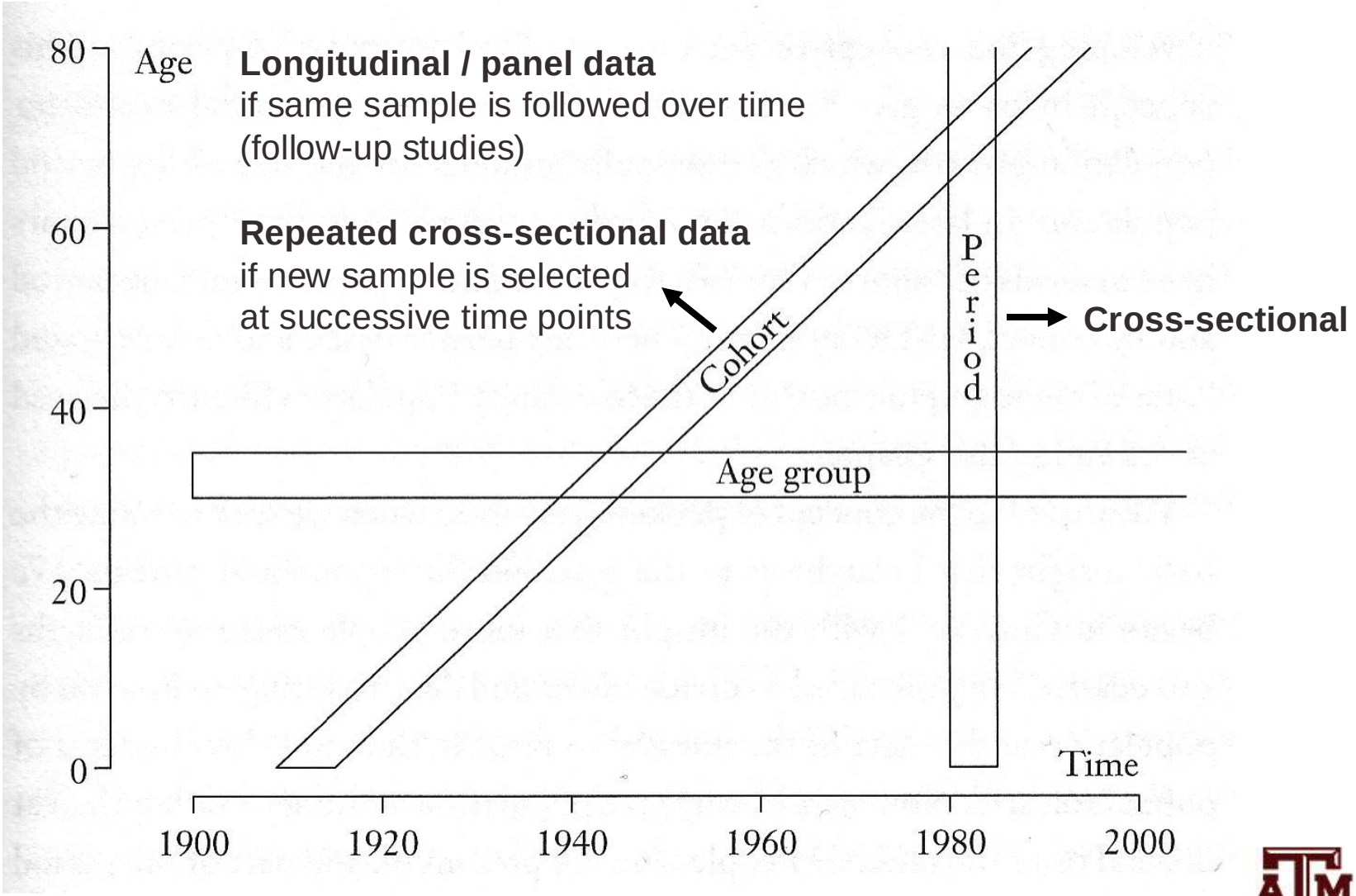
- **Observations** (cases) are collected information used to test hypotheses
- Decide how variables will be measured and how cases will be selected and tested
- Measure social reality: collect numerical data
- Information can be organized in databases
  - Variables as columns
  - Observations as rows

Example of a database

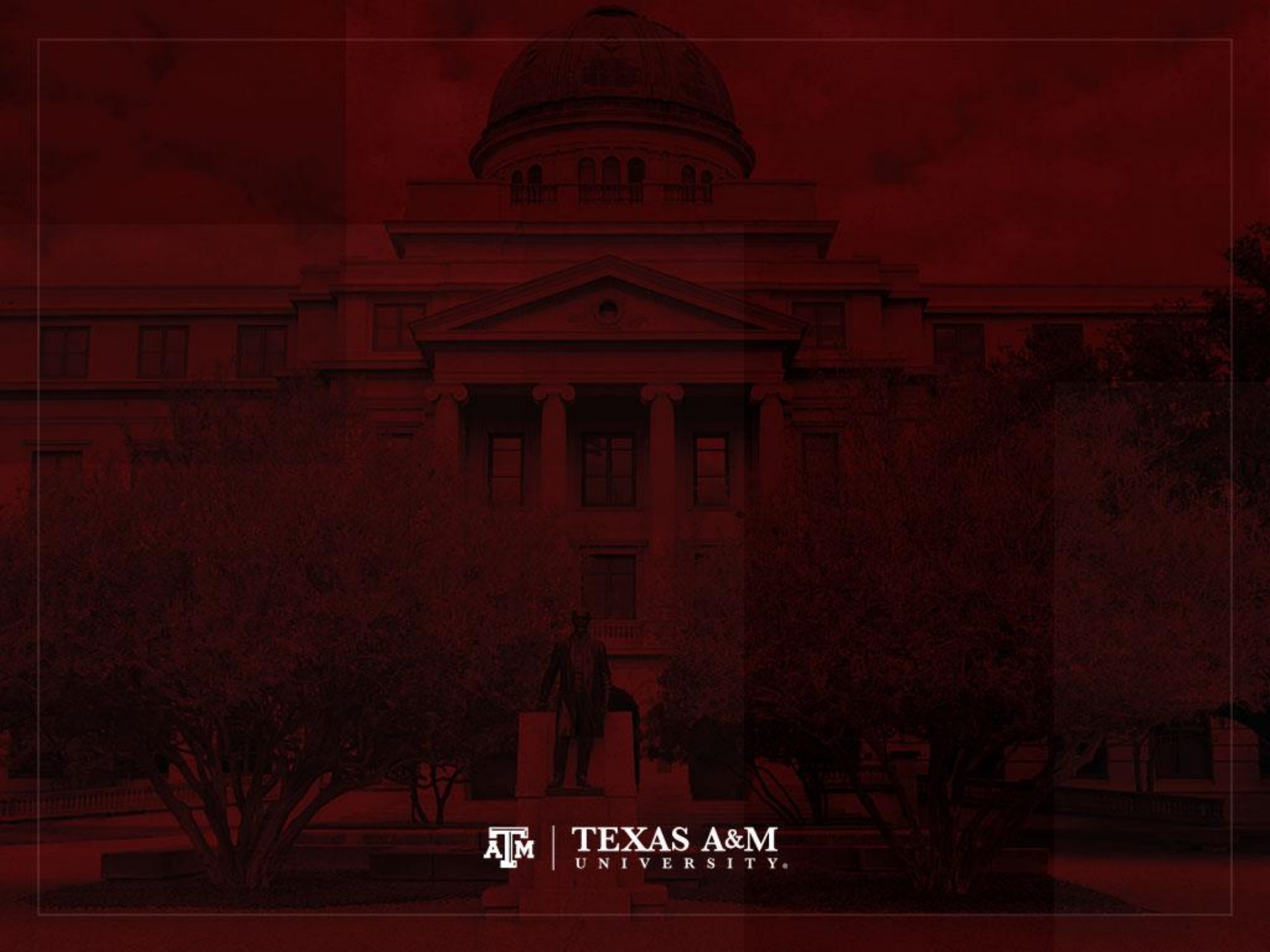
Observation	Salary per hour	Years of schooling	Years of experience in the labor market	Female	Marital status (married)
1	3.10	11	2	1	0
2	3.24	12	22	1	1
3	3.00	11	2	0	0
4	6.00	8	44	0	1
5	5.30	12	7	0	1
...	...	...	...	...	...
525	11.56	16	5	0	1
526	3.50	14	5	1	0

Source: Wooldridge, 2015.

Lexis diagram: Age, period, cohort



Source: Wachter 2014, p.33.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Demographic models

- Formal demography
- Population studies I
- Population studies II

Source: Poston, Bouvier, 2017.

Formal demography

Independent variable		Dependent variable
Demographic	→	Demographic
Examples		
1. Age composition	→	Birth rate
2. Birth rate	→	Age composition
3. Sex composition of in-migrants to a city	→	Sex ratio of the total population of the city

Source: Poston, Bouvier, 2017.

Population studies I (social demography)

Independent variable		**Dependent variable**
Non-demographic	→	Demographic

Examples

1. Social class (sociological)	→	Death rate
2. Attitude about motherhood (social psychology)	→	Number of children
3. Annual rainfall (geographical)	→	Population density
4. Economic opportunity (economic)	→	Migration

Source: Poston, Bouvier, 2017.

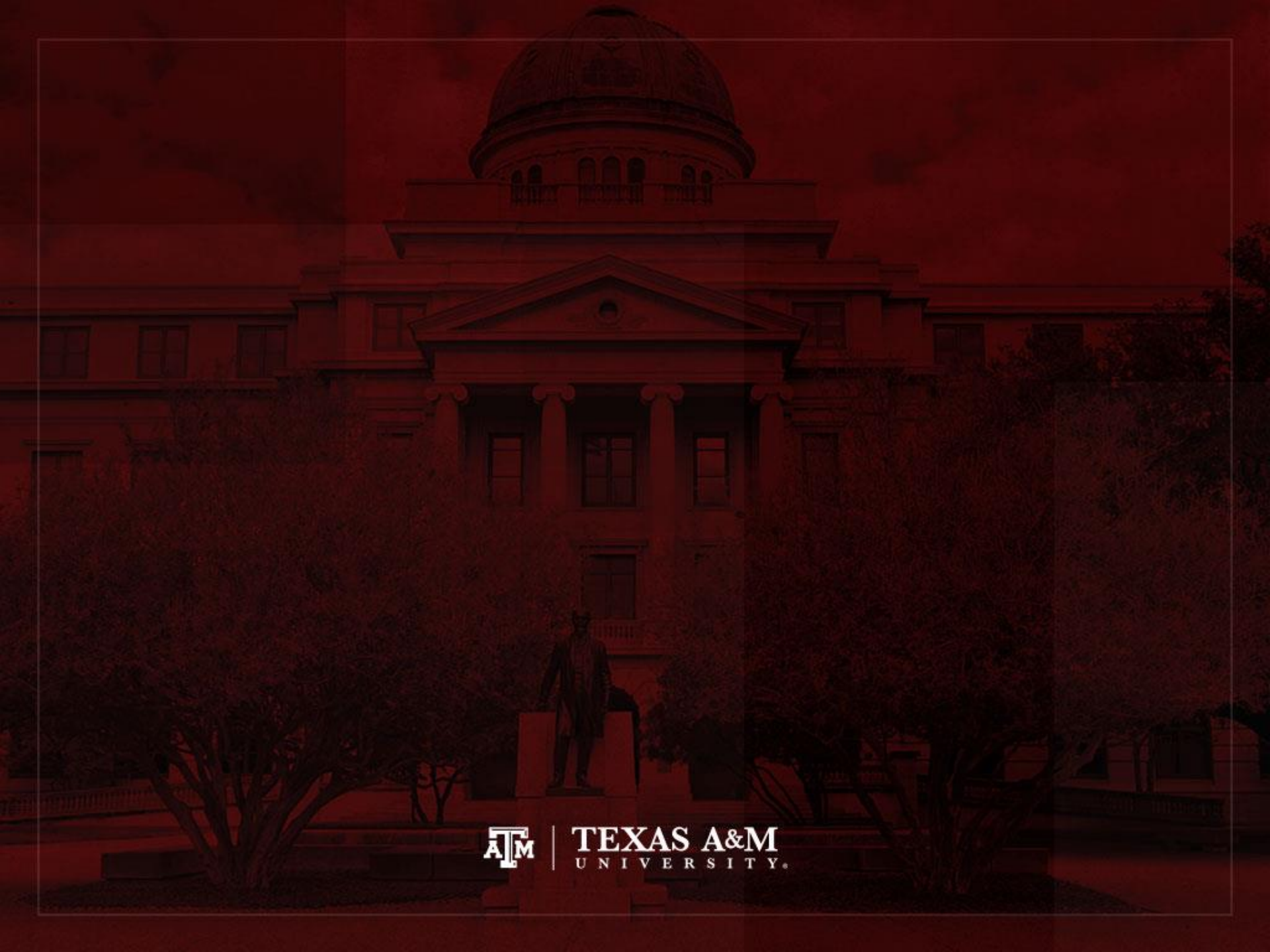
Population studies II (social demography)

Independent variable		**Dependent variable**
Demographic	→	Non-demographic

Examples

1. Age composition	→	Voting behavior (political)
2. Migration	→	Social change (sociology)
3. Birth rate	→	Need for infant & child goods/services (public health)

Source: Poston, Bouvier, 2017.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Cohorts and generations

- Cohort
  - Group of persons who have experienced a common event during a given time interval
  - Birth cohorts are sometimes referred to as generations

- Why study birth cohorts?
  - If you understand what distinctive opportunities and problems you have faced, you can find common ground with others in your generation and in other generations (Elwood Carlson)

Examples of cohorts

- People born during the same period who experience similar social circumstances throughout their lives
  - Good Warriors (Greatest Generation): born in the 1900s through the 1920s
  - Lucky Few: from around 1929 to 1945
  - Baby Boomers: between around 1946 and 1964
  - Generation X (Baby Bust Cohort): from mid-1960s to early 1980s
  - Millennials (New Boomers or Generation Y): from early 1980s to early 2000s
  - Generation Z: start in early 2000s

Lucky Few cohort

- **Lucky Few cohort**, born between 1929–1945
  - They were fewer compared to the much larger number of persons in the following cohort
  - Baby Boomer cohort, born between 1946–1964

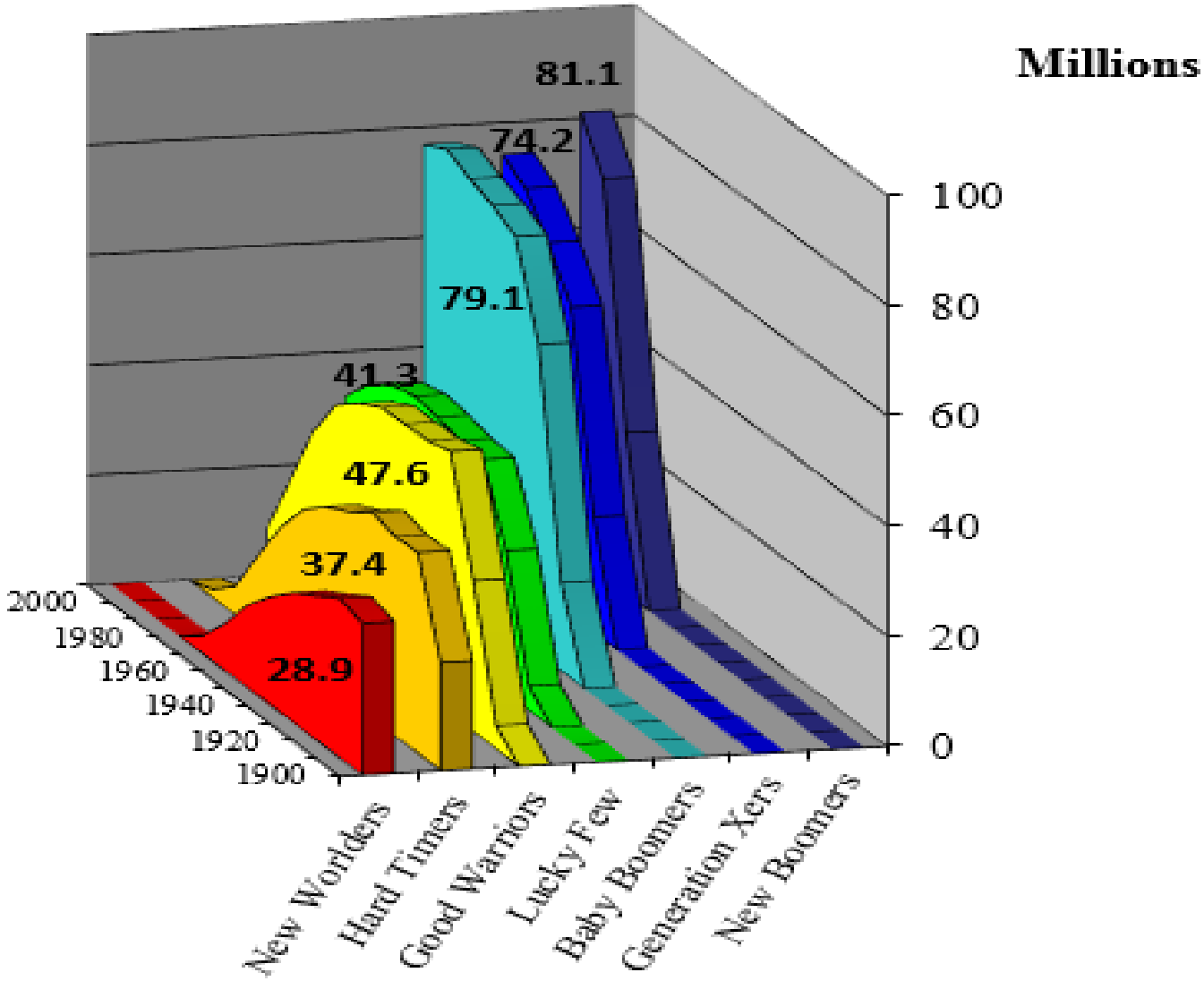
- The smaller size of the Lucky Few has enabled them to experience
  - Higher employment rates
  - Greater variety of social opportunities than members in the preceding or following cohorts

Eight US birth cohorts

Birth cohort	Years of birth	Age range in 2020	Number born in the U.S., total	Alive in 2019 (include immigrants)	Number born in the U.S., per year
New Worlders	1871–1889	None living	~ 30 million	None	1.6 million
Hard Timers	1890–1908	None living	~ 25 million	None	1.3 million
Good Warriors	1909–1928	92–111	57.6 million	1.7 million	2.8 million
Lucky Few	1929–1945	75–91	44.1 million	20.9 million	2.5 million
Baby Boomers	1946–1964	56–74	75.8 million	69.9 million	4 million
Generation X	1965–1982	38–55	62.2 million	73.9 million	3.4 million
Millennials	1983–2001	19–37	74.5 million	84.9 million	3.9 million
Generation Z	2002–present	0–18	72.4 million	77.3 million	4 million

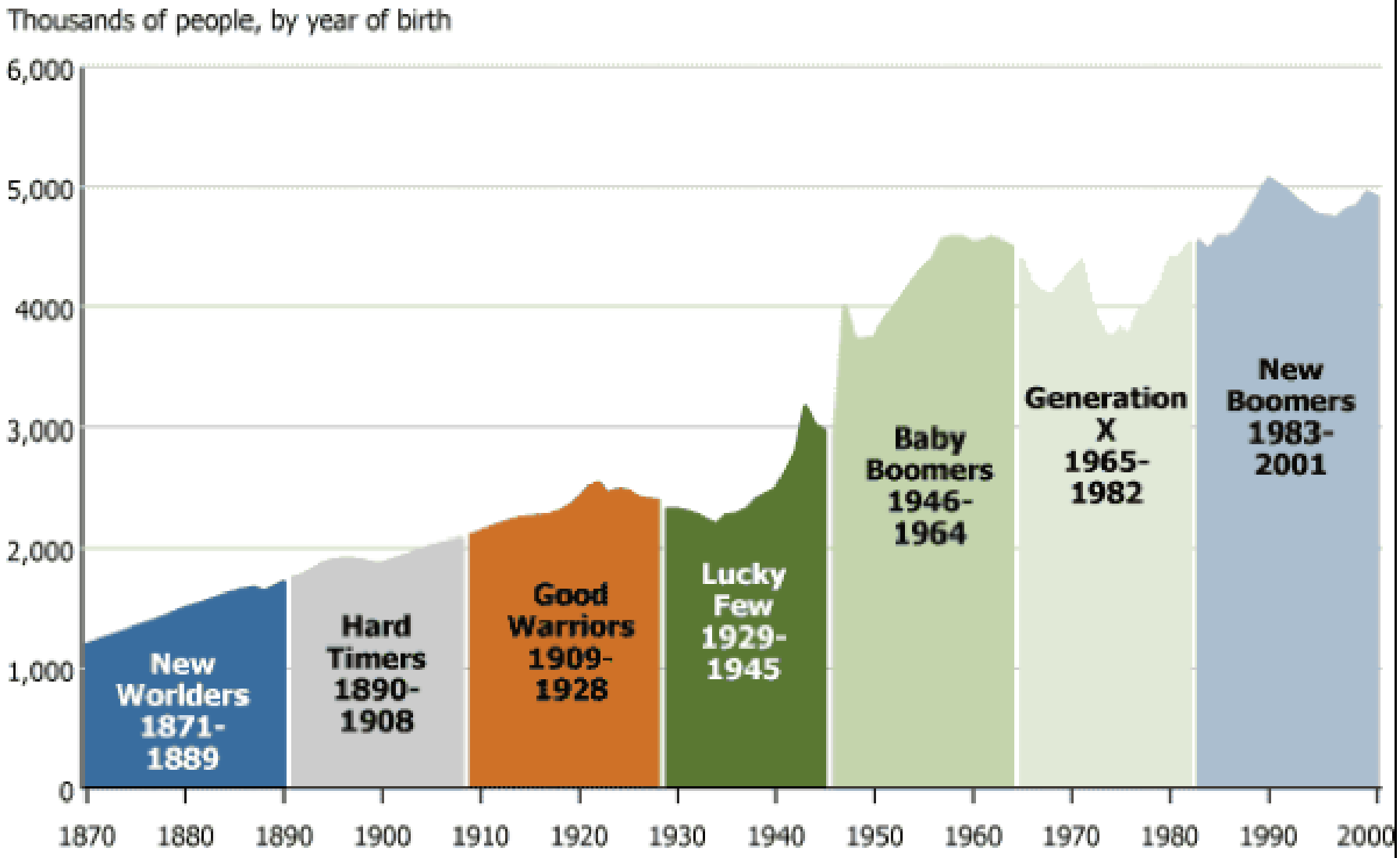
Source: Poston D. 2020. "I'm a 'Lucky Few': How About You?" Life @ The Dominion, September, p.61.

Seven US birth cohorts by size, 1900–2010

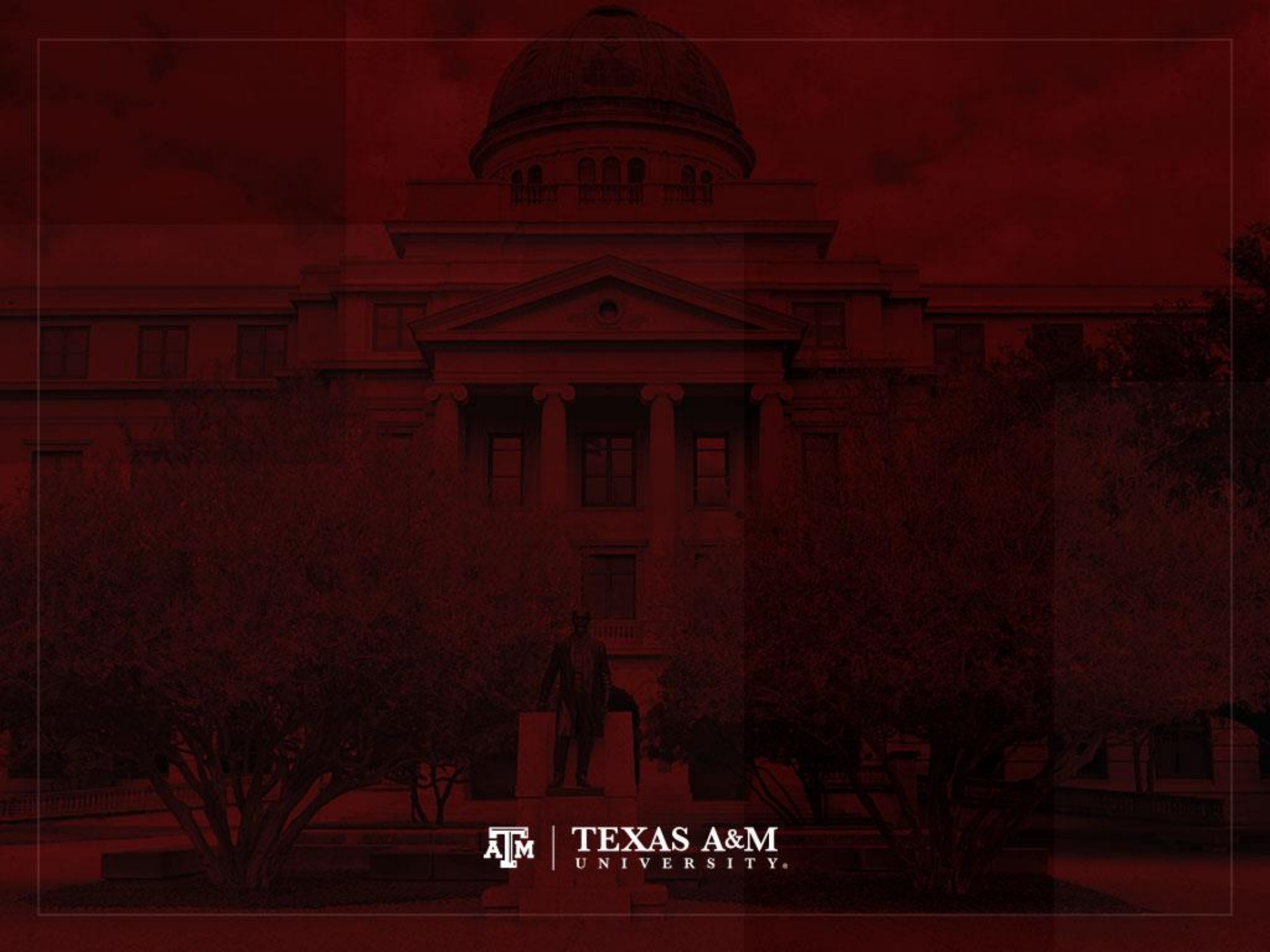


Source: Poston, Bouvier (2017).

US birth cohorts



Source: Professor Dudley Poston.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Age-sex structure

- Age and sex are the most important and relevant characteristics of populations for demographers
  - They tell us about population structure
  - They are known as the demographic characteristics

- Age and sex are tied in with the three demographic processes
  - Fertility, mortality, migration
  - These components produce the population's age and sex structure, which in turn influences the demographic processes

Concepts of age and sex

- Age is an ascribed and changeable characteristic
  - In population censuses, it is usually defined in terms of the age of a person at his/her last birthday
  - UN definition: estimated or calculated interval of time between the date of birth and the date of the census, expressed in complete solar years

- Sex is an ascribed characteristic and, for most people, unchangeable
  - For most people, sex is fixed at birth, but there are some who do change their sex

Sex versus gender

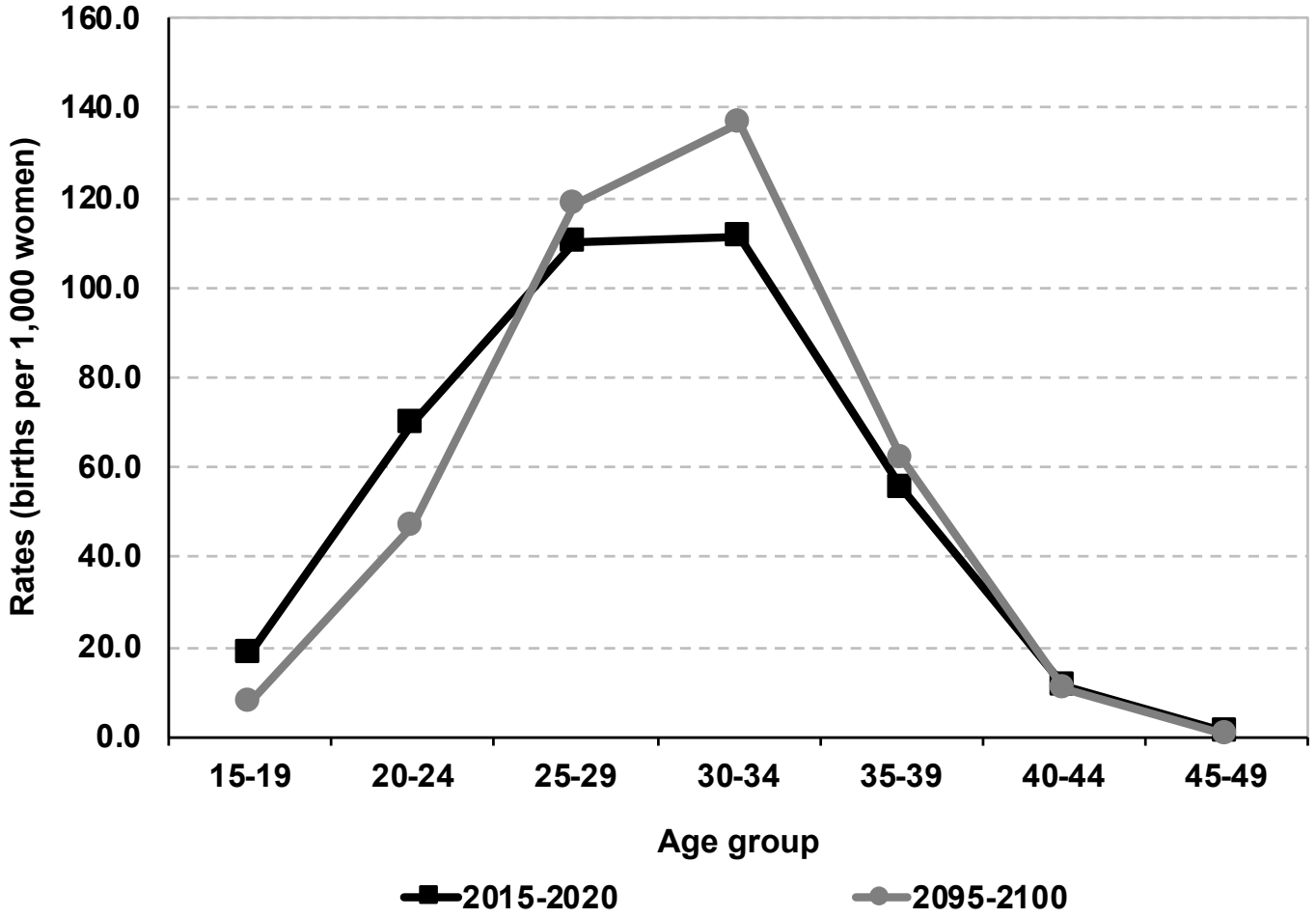
- Sex
  - For the most part though not always, is an ascribed variable whose designation is based on biology
- Gender
  - It is more often used when discussing nonbiological differences between males and females
  - For example, differences between males and females in migration, marriage, divorce, and labor force participation
- Demographers
  - Tend to use the term sex when discussing both biological and nonbiological differences

Fertility varies by sex and age

- 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 sex

- Females have lower death rates than males at every age of life
  - This differential has been observed through the centuries and may be attributed to both behavioral and genetic causes
  - Males are more prone than females to engage in health or life risk-taking behaviors, such as cigarette smoking
  - Estrogen (female's primary hormone) protects the heart and blood vessels
  - Testosterone, in contrast, tends to promote higher blood pressure, suppress the effectiveness of the immune system, and increase thrombosis

Source: Poston, Bouvier, 2017.

Mortality varies by age

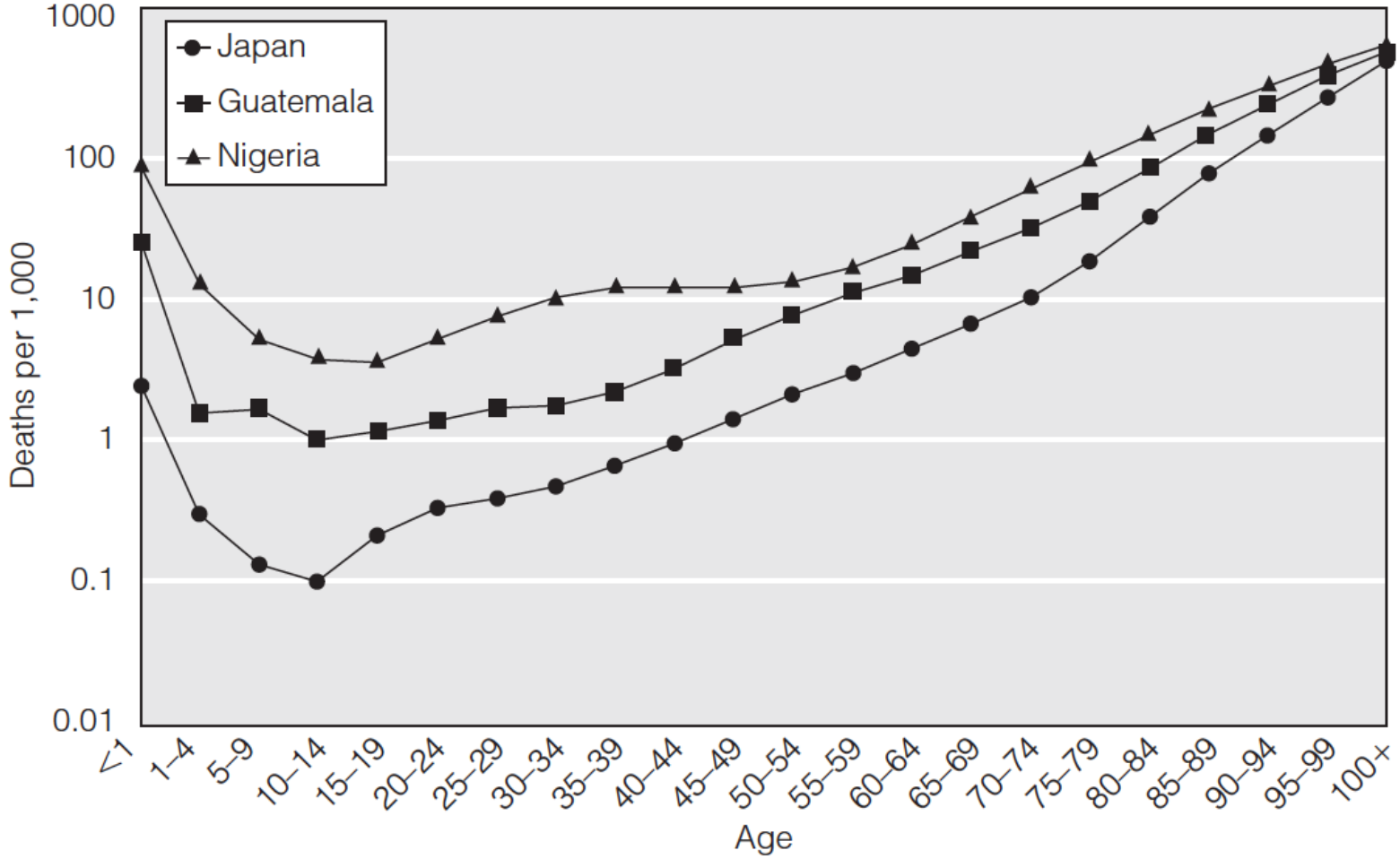
- Death rates are high in the first year of life and then drop to very low levels

- 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

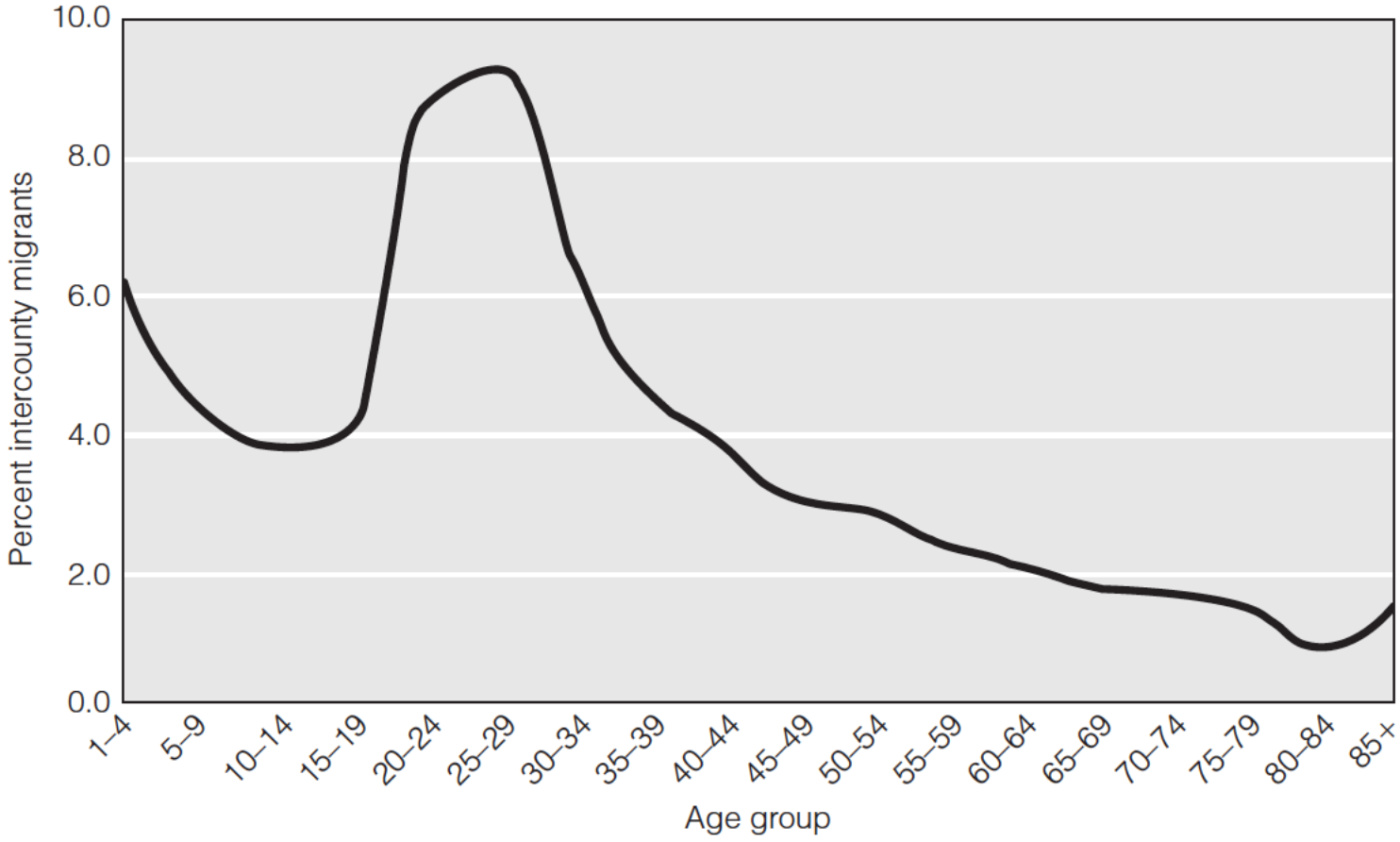


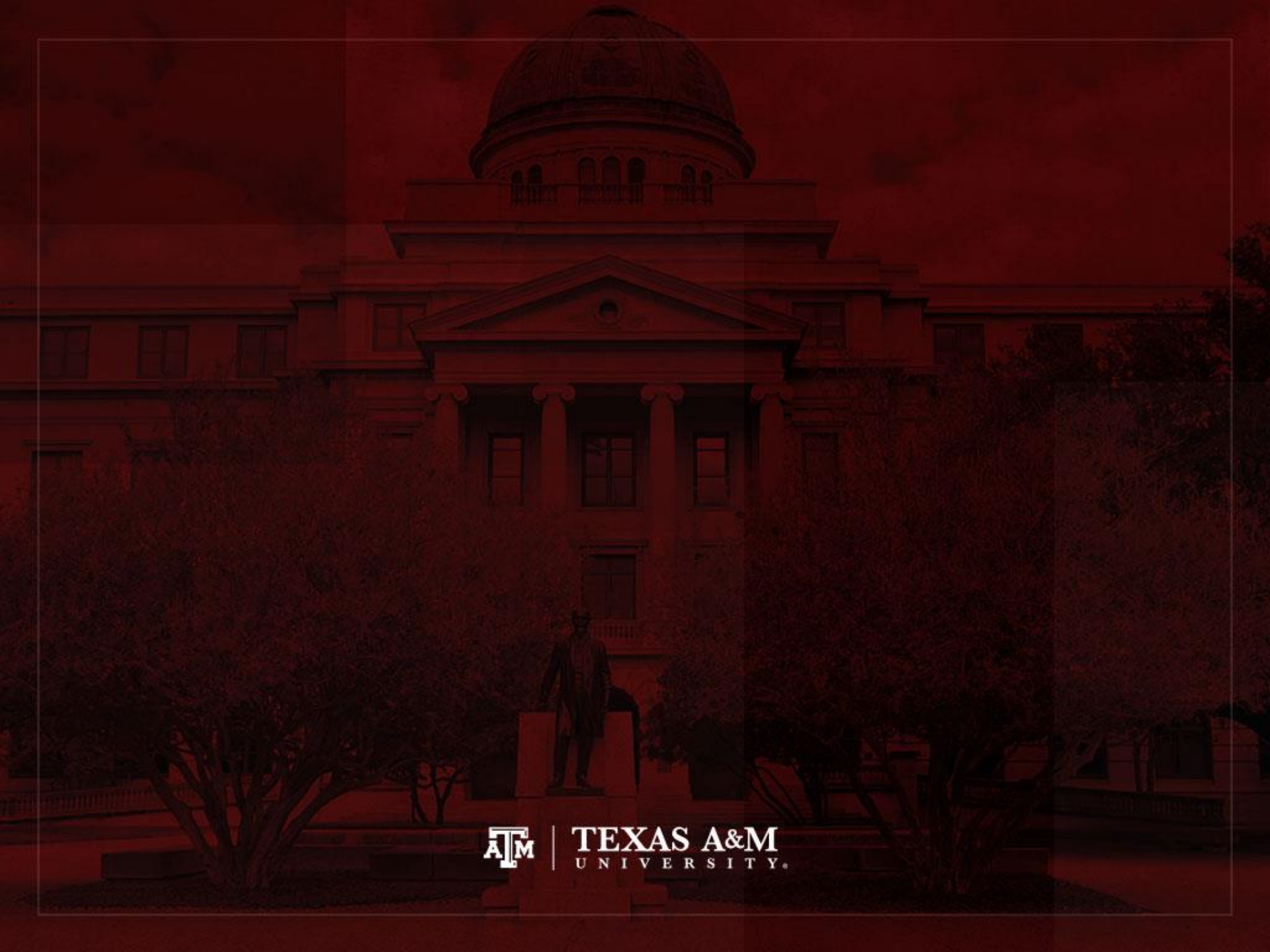
Migration varies by sex and age

- Especially in developing countries, 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
- Migration is age-selective
  - The largest numbers of migrants found among young adults

Source: Poston, Bouvier, 2017.

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

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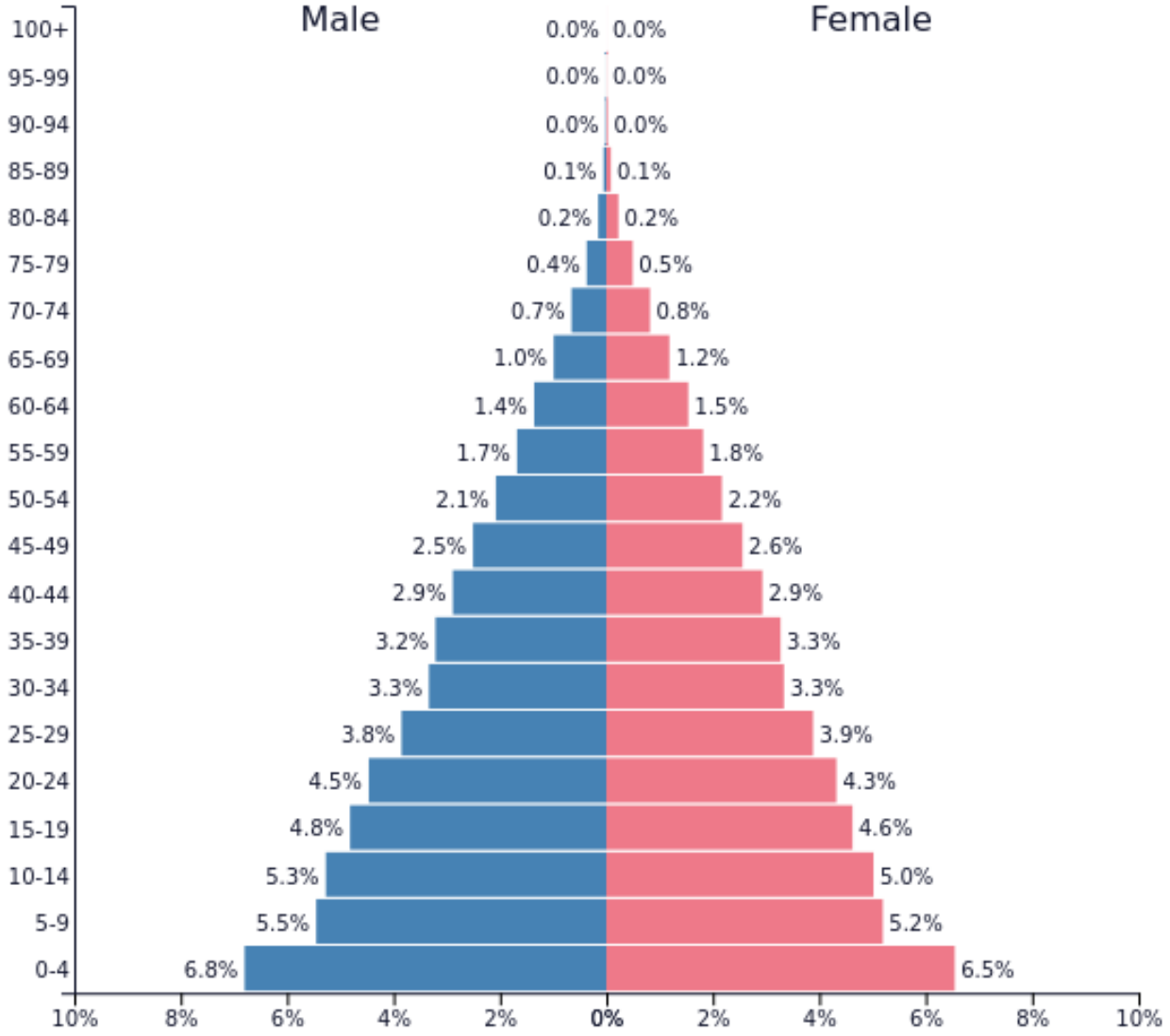
Population pyramid

- A population pyramid
  - It is a graphic representation of the age/sex structure of the population
  - It is also called “age/sex pyramid”
  - Due to changes in the shape of population distributions, it has been simply called “age/sex structure”

- A population pyramid is nothing more than two ordinary histograms (bar graphs)
  - They represent male and female populations
  - Usually, demographers use 1- or 5-year age categories

- A main characteristic of age transitions is a change from very young to older populations



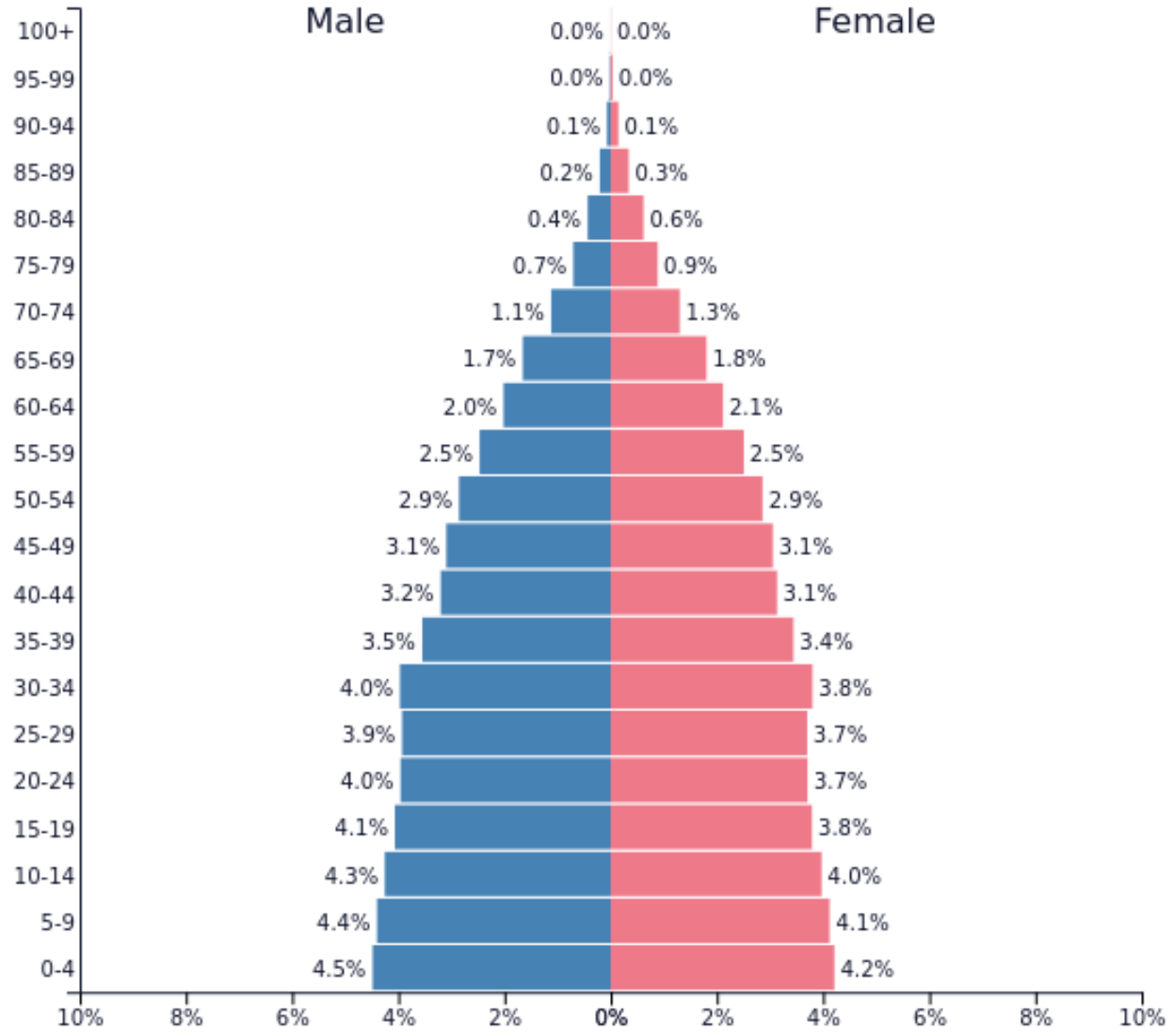
PopulationPyramid.net

WORLD - 1950

Population: **2,536,431,017**

PopulationPyramid.net

WORLD - 2000
Population: **6,143,493,805**



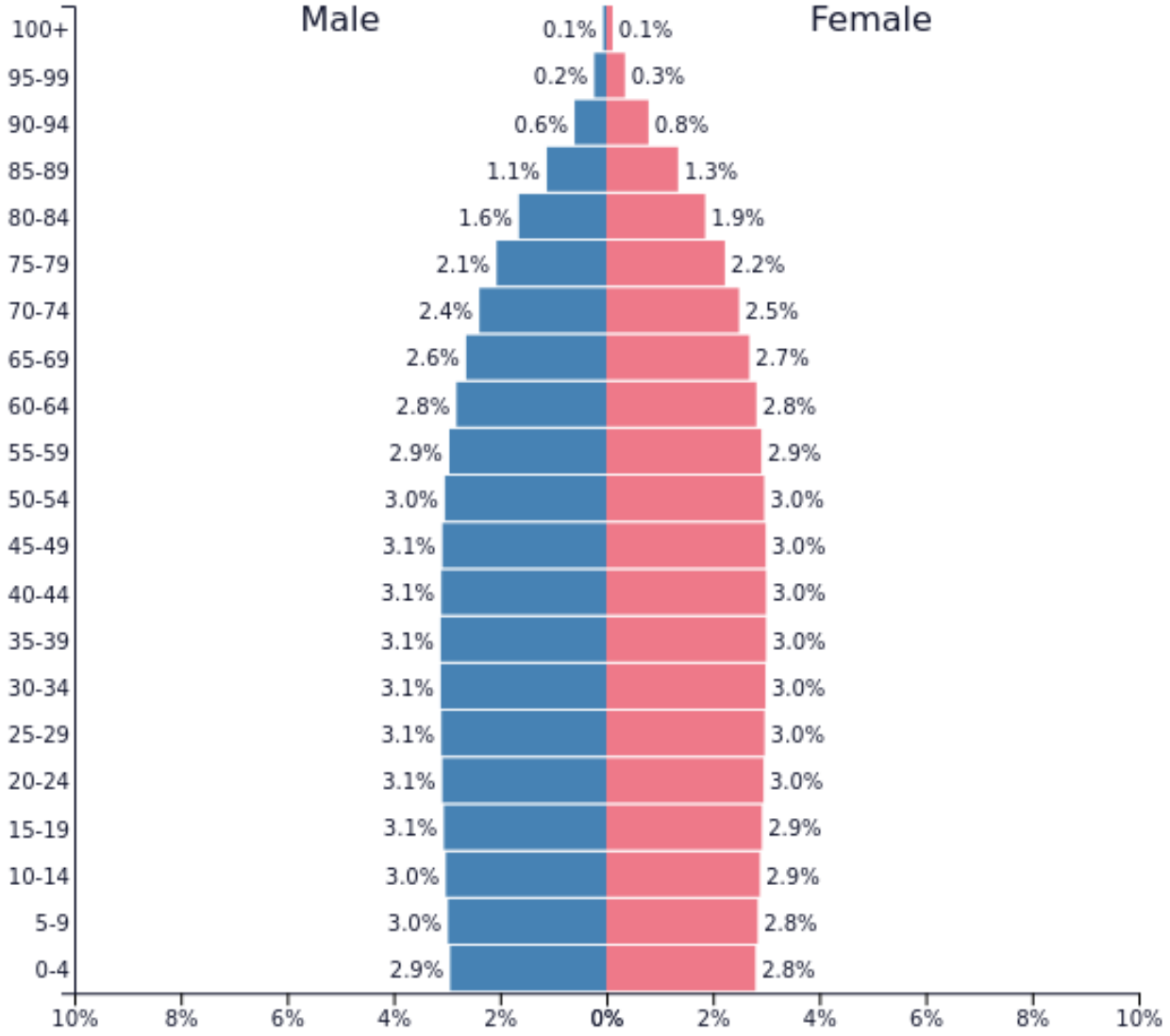
PopulationPyramid.net

WORLD - 2020
Population: **7,794,798,729**

PopulationPyramid.net

WORLD - 2050

Population: **9,735,033,899**



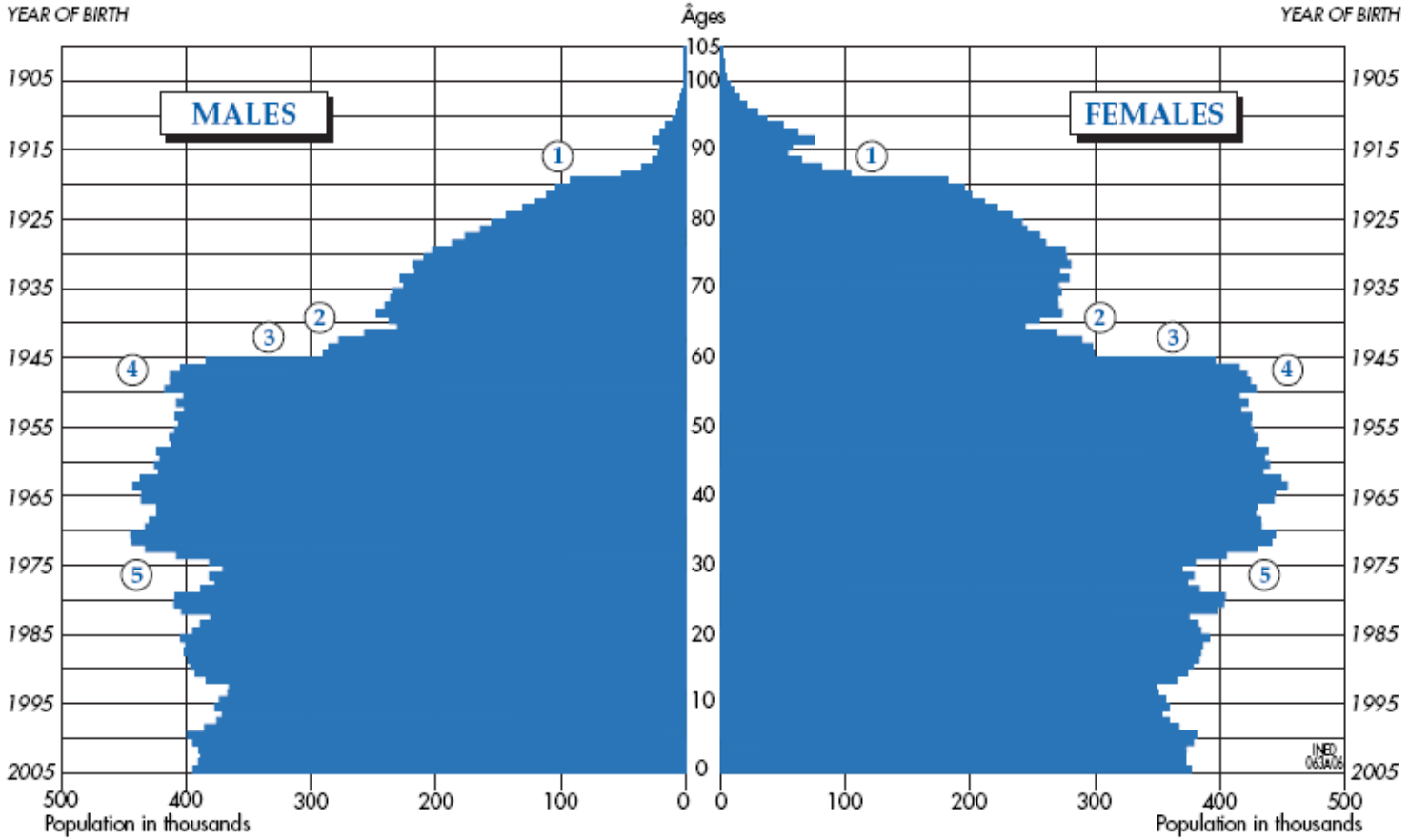
PopulationPyramid.net

WORLD - 2100

Population: **10,875,393,719**

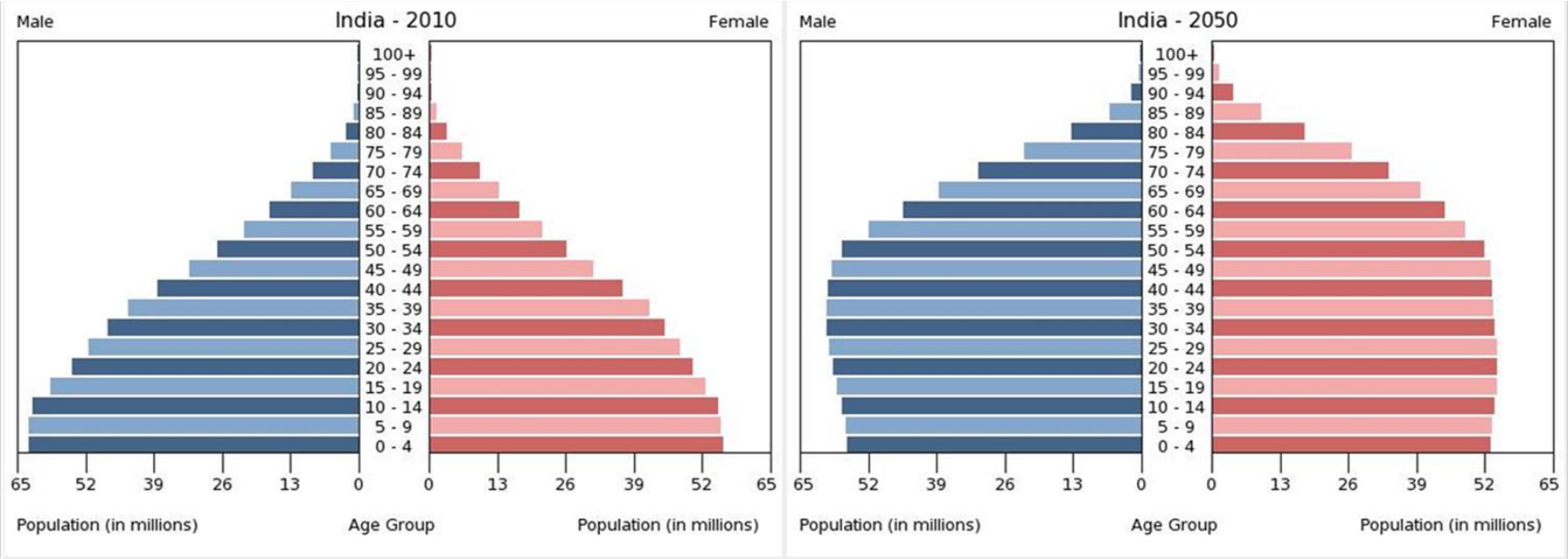
POPULATION OF FRANCE

PROVISIONAL ESTIMATE ON 1 JANUARY 2006



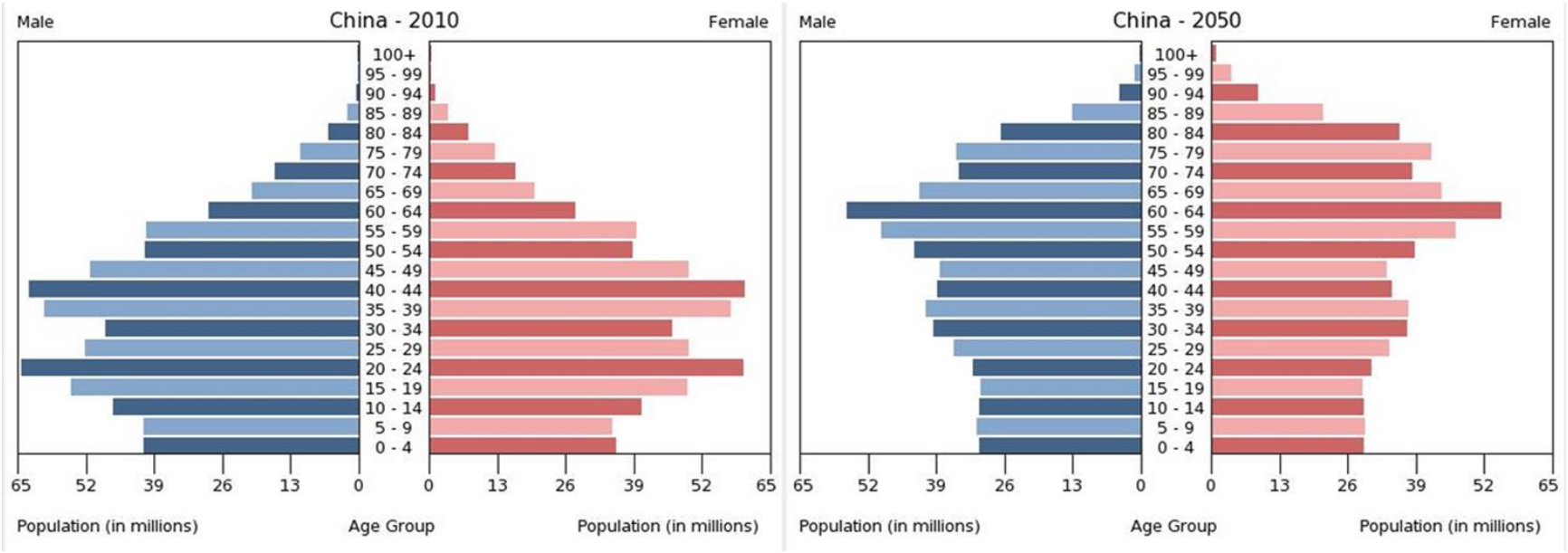
Source: Pison, 2006: 3, reprinted with permission of Institut National d'études Démographiques (INED).

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



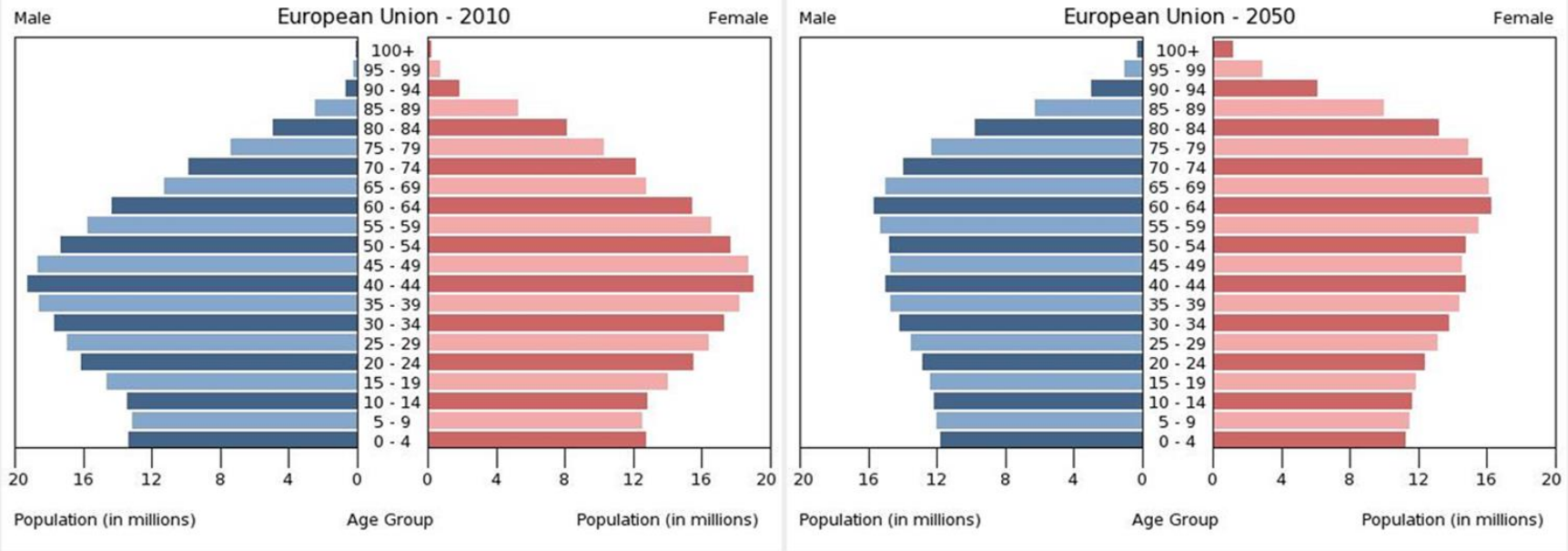
Source: http://www.fdbetancor.com/wp-content/uploads/2012/10/demochallenge2.png

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



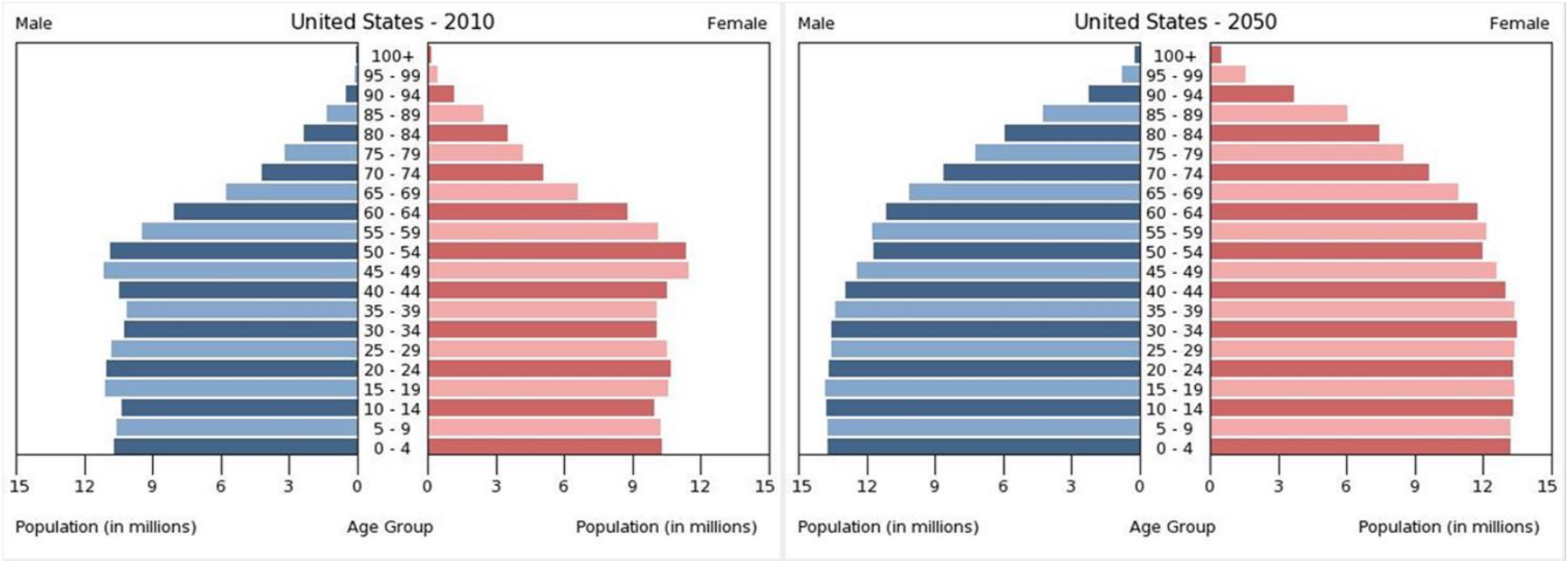
Source: http://www.fdbetancor.com/wp-content/uploads/2012/10/demochallenge2.png

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



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

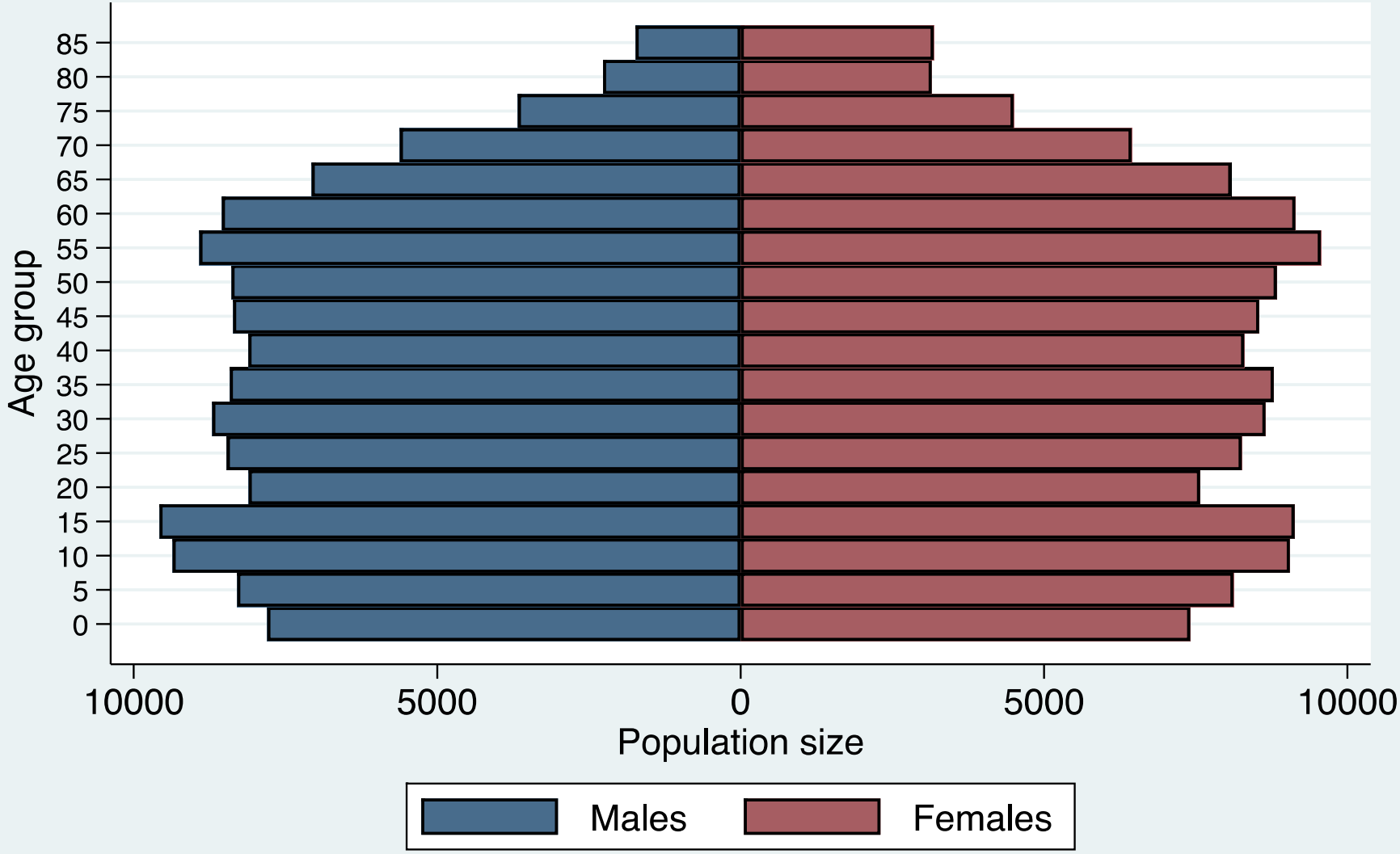
Population structure by age and sex, United States, 2010–2050



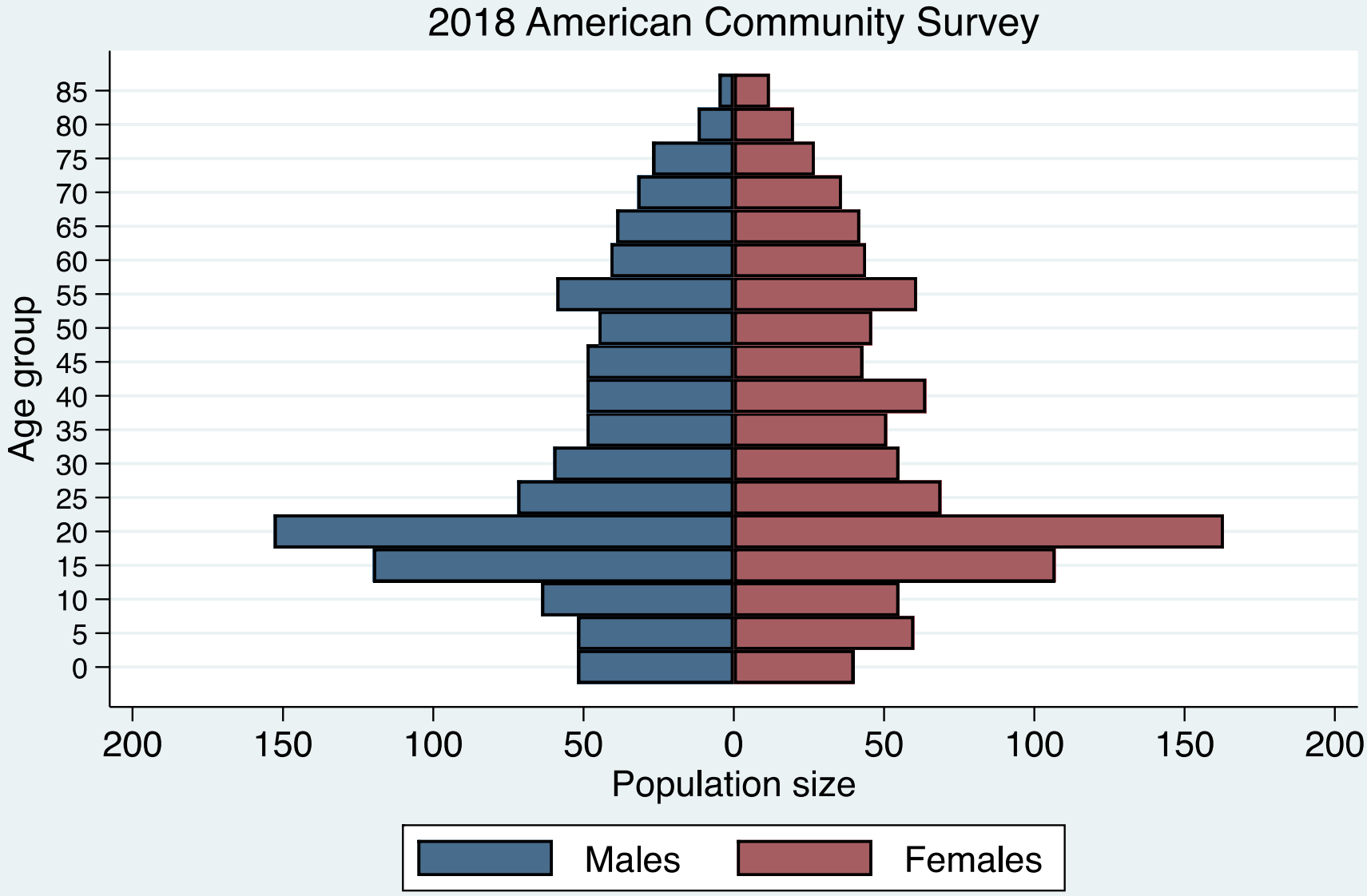
Source: http://www.fdbetancor.com/wp-content/uploads/2012/10/demochallenge2.png

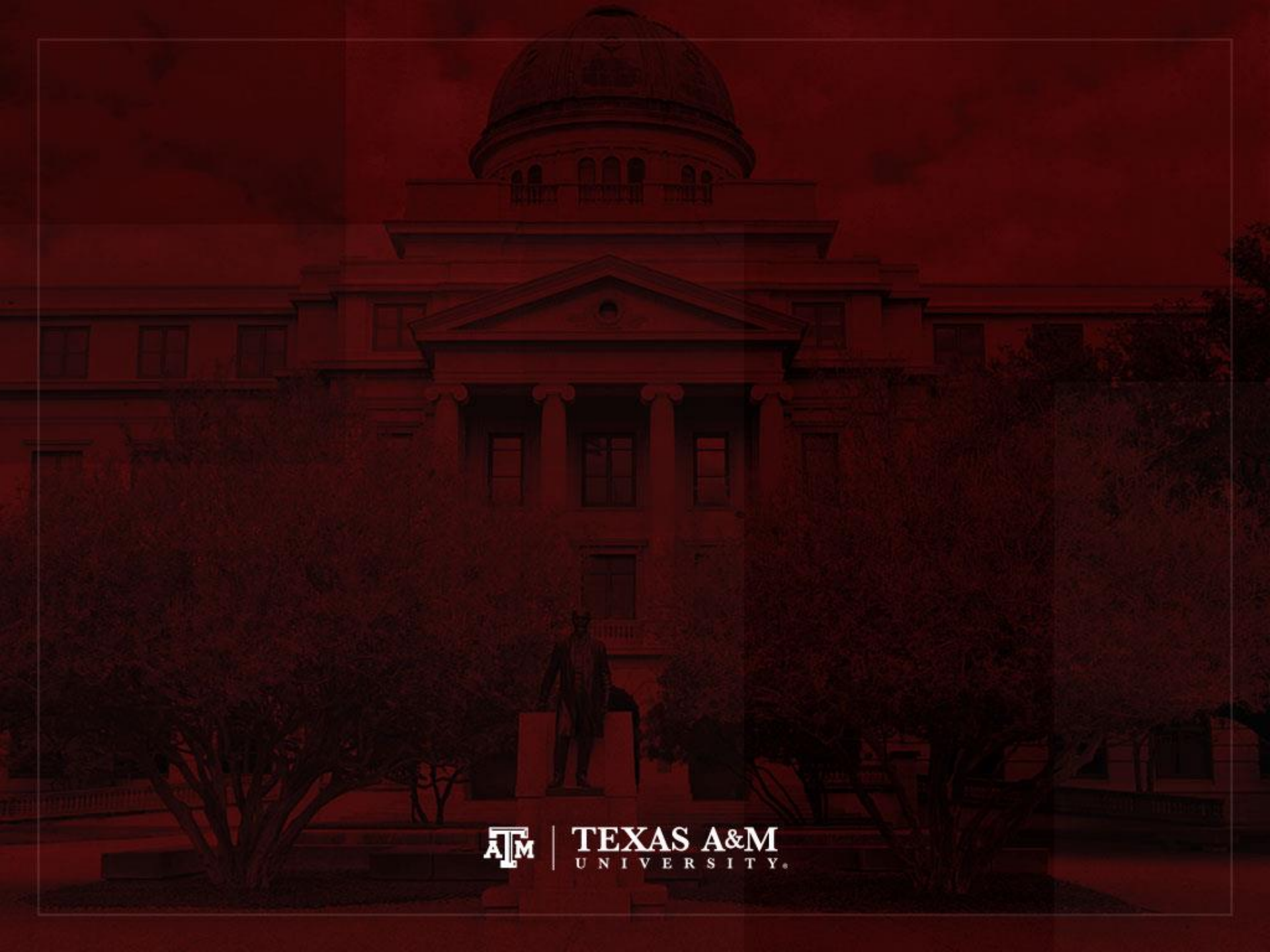
Age-sex structure, Texas

2018 American Community Survey



Age-sex structure, Brazos county

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Age dependency

- Total dependency ratio (TDR)
  - It is the ratio of the dependent-age population
    - Young (persons 0–14 years old) + Old (persons 65+ years old)
  - To the working-age population
    - Persons 15–64 years old
  - It is usually multiplied by a constant of 100

$$Total\ dependency\ ratio = \frac{Pop.\ children\ (0\ to\ 14)\ +\ Elderly\ pop.\ (65+)}{Working\ age\ population\ (15\ to\ 64)} * 100$$

- The higher the ratio
  - The more people each worker has to support
- The lower the ratio
  - The fewer the number of dependents

YDR and ADR

- Demographers usually split dependency ratio into
  - Youth-dependency ratio (YDR or Youth-DR)

$$Youth\ dependency\ ratio = \frac{Pop.\ children\ (0\ to\ 14)}{Working\ age\ population\ (15\ to\ 64)} * 100$$

  - Old-age dependency ratio (Old Age-DR), also known as the aged-dependency ratio (ADR or Aged-DR)

$$Old\ age\ dependency\ ratio = \frac{Elderly\ pop.\ (65+)}{Working\ age\ population\ (15\ to\ 64)} * 100$$

- TDR = YDR + ADR

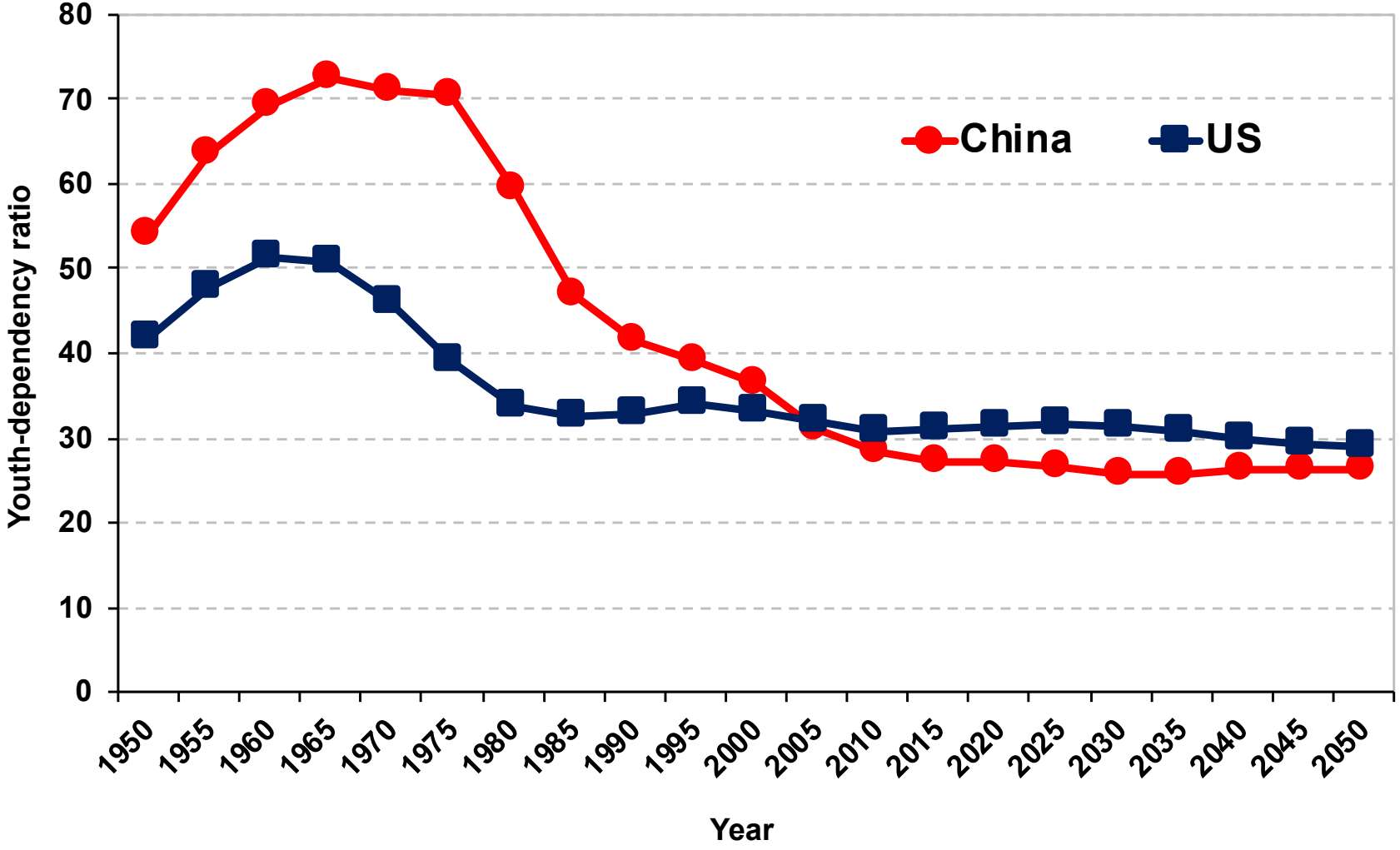
Age dependency

Values of Youth-Dependency Ratio, Old-Age-Dependency Ratio, and Total Dependency Ratio, Selected Countries of the World, 2014

Country	Youth-DR	Old-Age-DR	Total DR
Macao	13.6	9.9	23.5
South Korea	21.6	13.5	35.1
China	20.5	16.4	36.9
Russia	22.5	18.3	40.8
Spain	22.4	26.9	49.3
United States	28.4	20.9	49.3
Mexico	42.4	9.1	51.5
Italy	21.5	32.3	53.8
Japan	21.3	42.6	63.9
Nigeria	83.0	5.7	88.7
Gambia	88.5	3.8	92.3
Uganda	96.0	4.0	100.0
Chad	100.0	4.1	104.1
Niger	106.4	6.4	112.8

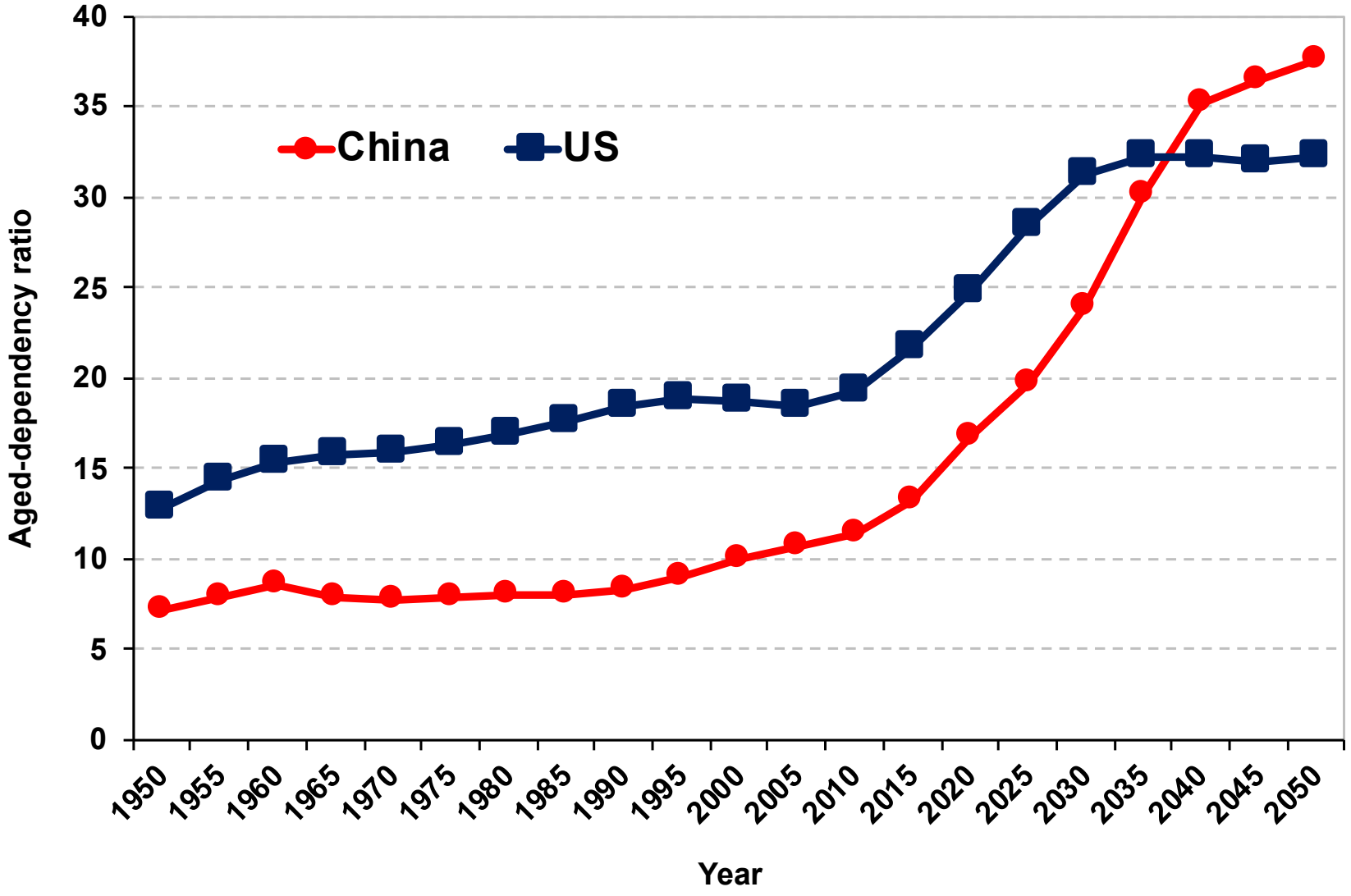
Source of Data: Population Reference Bureau, 2014

Youth-dependency ratios, China and the United States, 1950–2050



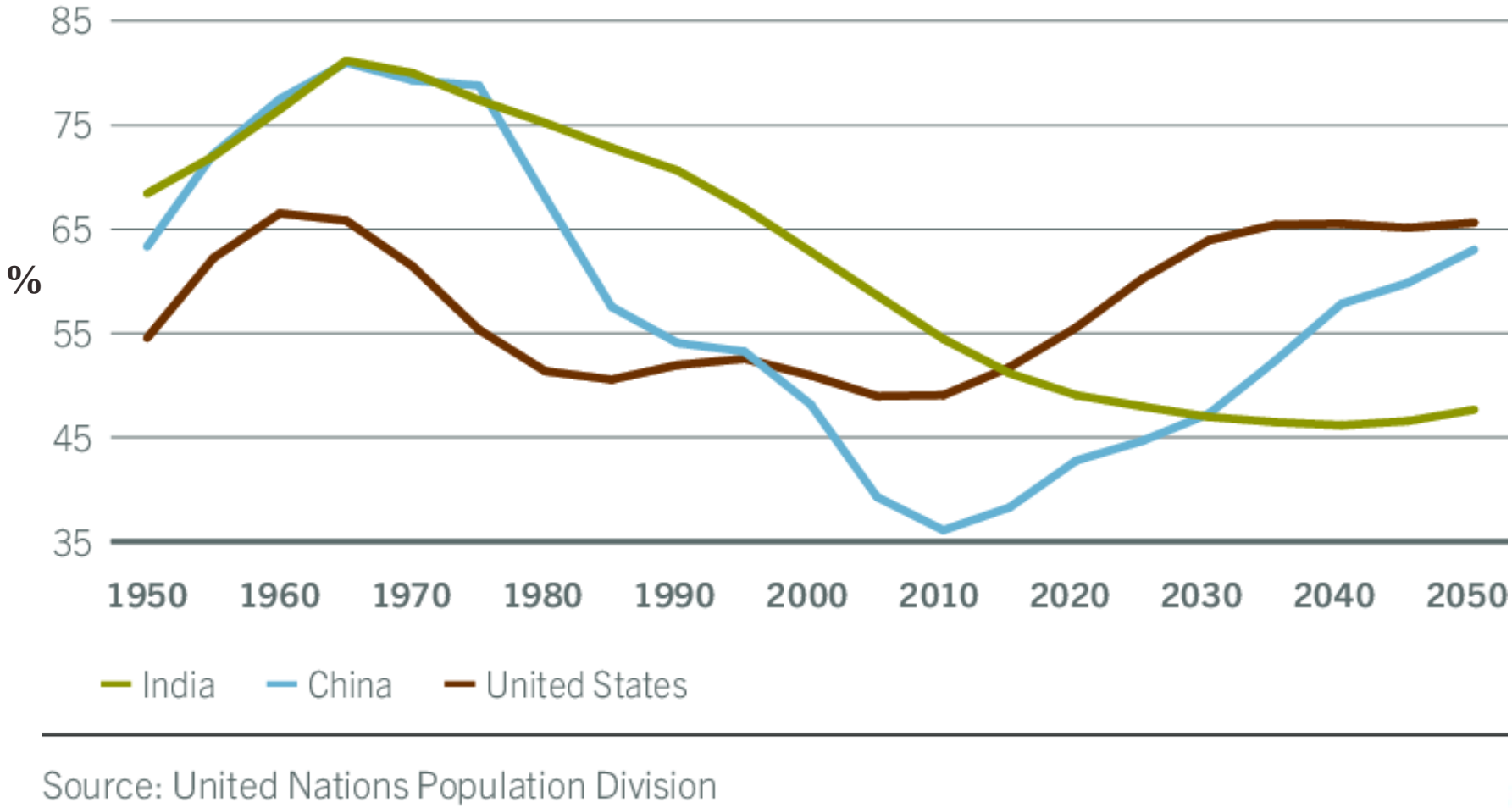
Source: Poston, Bouvier (2017).

Aged-dependency ratios, China and the United States, 1950–2050



Source: Poston, Bouvier (2017).

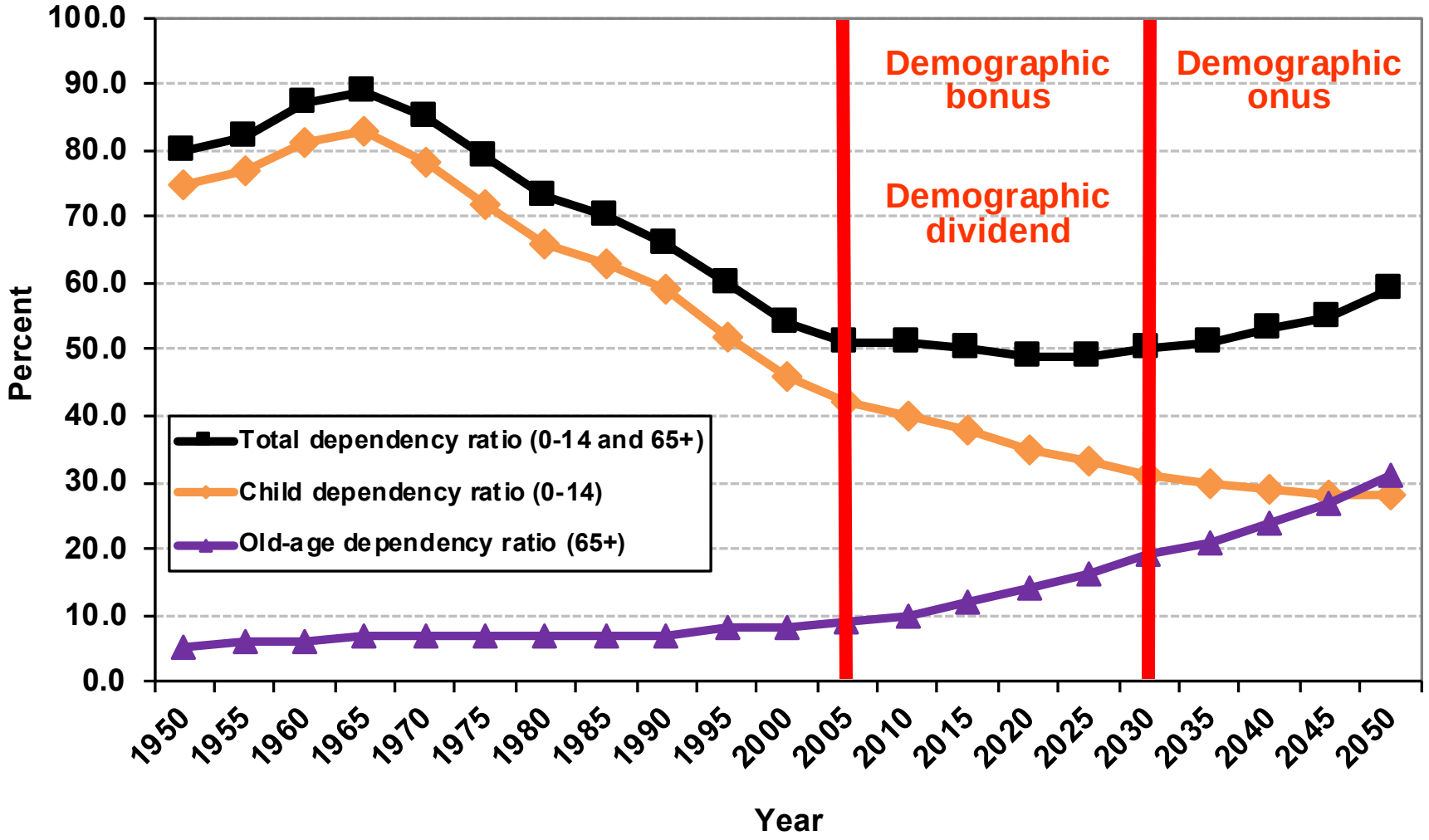
Total dependency ratios, India, China, United States



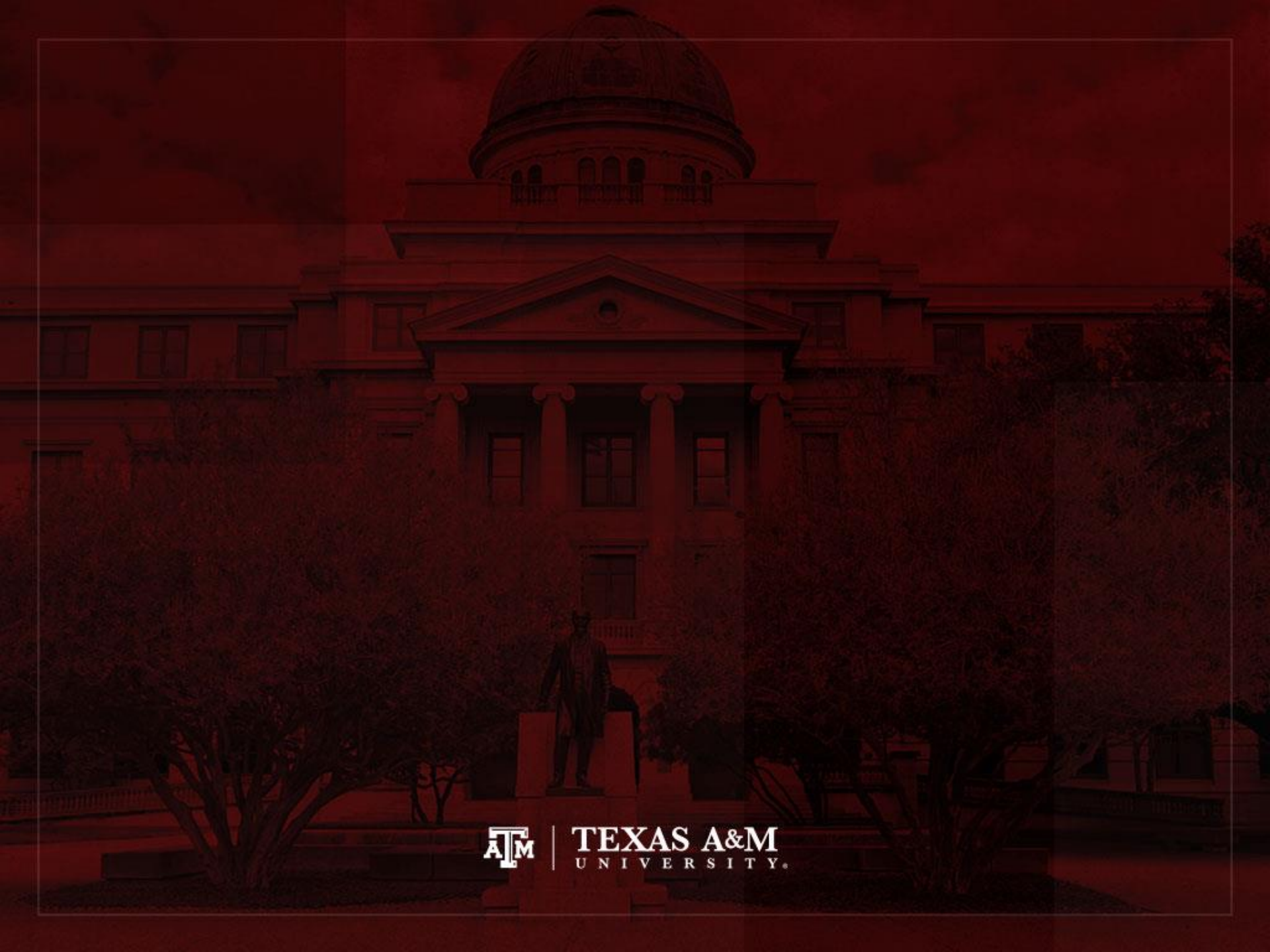
Source: United Nations Population Division

Source: https://www.researchgate.net/figure/Total-dependency-ratios-of-China-India-and-the-US-In_fig3_275071394.

Dependency ratios, Brazil 1950–2050



Source: United Nations - http://esa.un.org/unpp (medium variant).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Age heaping

- Demographers use data from single years of age to determine whether there are irregularities or inconsistencies in the data

- **Age heaping** happens if a population tends to report certain ages (e.g., those ending in 0 or 5) at the expense of other ages

- Age heaping tends to be more pronounced among populations or population subgroups with low levels of education

Examples of age heaping

- In some cultures, certain numbers and digits are avoided
- For example, “13” is frequently avoided in the West because it is considered unlucky
  - Hotels in the US and in some Western countries sometimes do not have floors designated as 13
- The numeral “4” is avoided in Korea and China, since it has the same sound as the word/character for “death”
  - Many hotels in China, South Korea, and some other East Asian countries do not have floors designated as 4

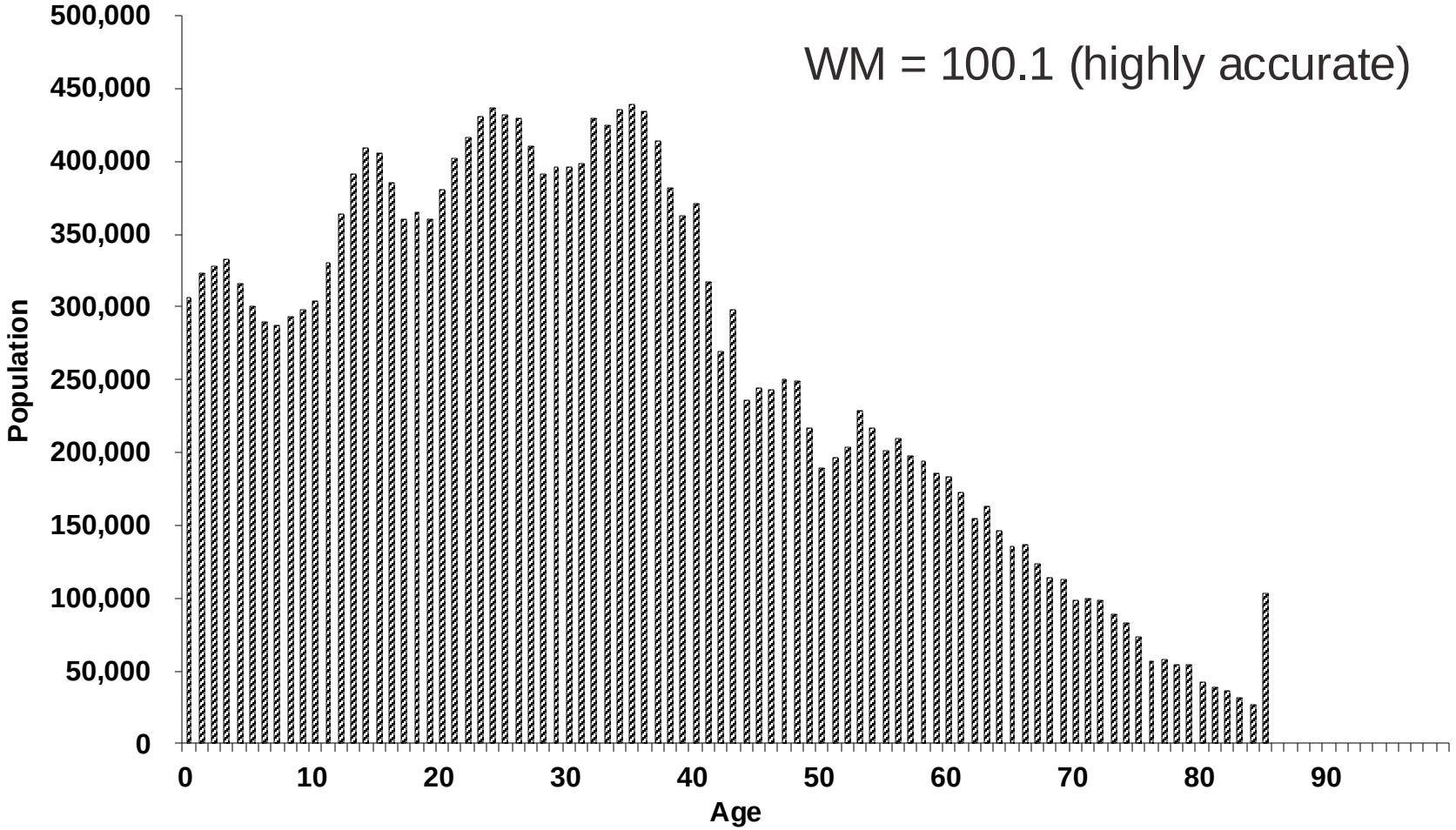
Whipple's Method (WM)

- WM measures preference for the terminal digits of "0" and "5", usually in the age range of 23 to 62

$$WM = \frac{\sum(P_{25} + P_{30} + \cdots + P_{55} + P_{60})}{\sum(P_{23} + P_{24} + P_{25} + \cdots + P_{60} + P_{61} + P_{62})} * 5 * 100$$

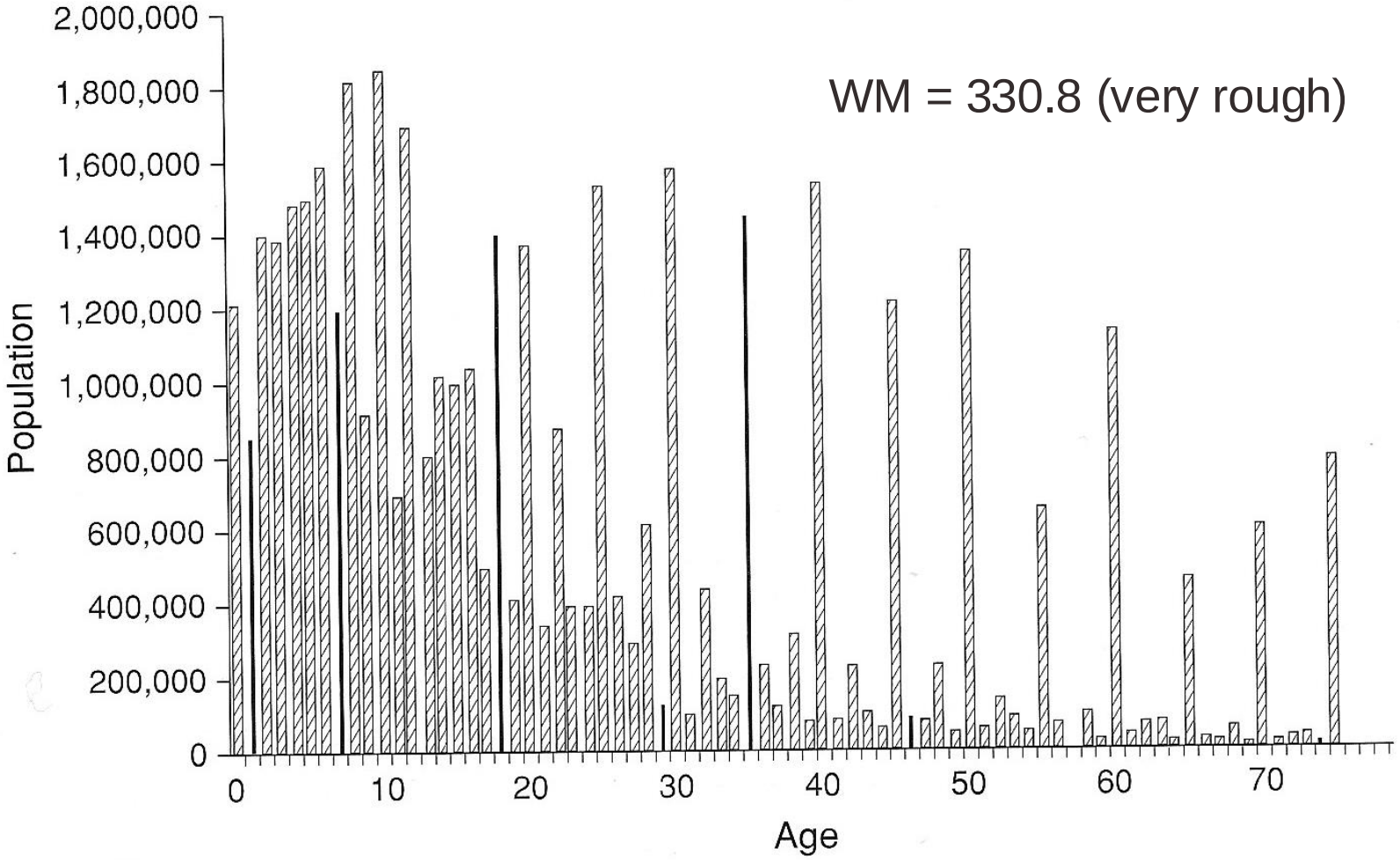
  - Technically, WM could have the following values
    - 0, when the digits 0 and 5 are not reported
    - 100, when there is no preference for 0 or 5
    - 500, when only digits 0 and 5 are reported
  - Based on real data about age distribution
    - <105, highly accurate
    - 105–109.9, fairly accurate
    - 110–124.9, approximate
    - 125–174.9, rough
    - 175+, very rough

Single years of age, female population, Republic of Korea, 1995

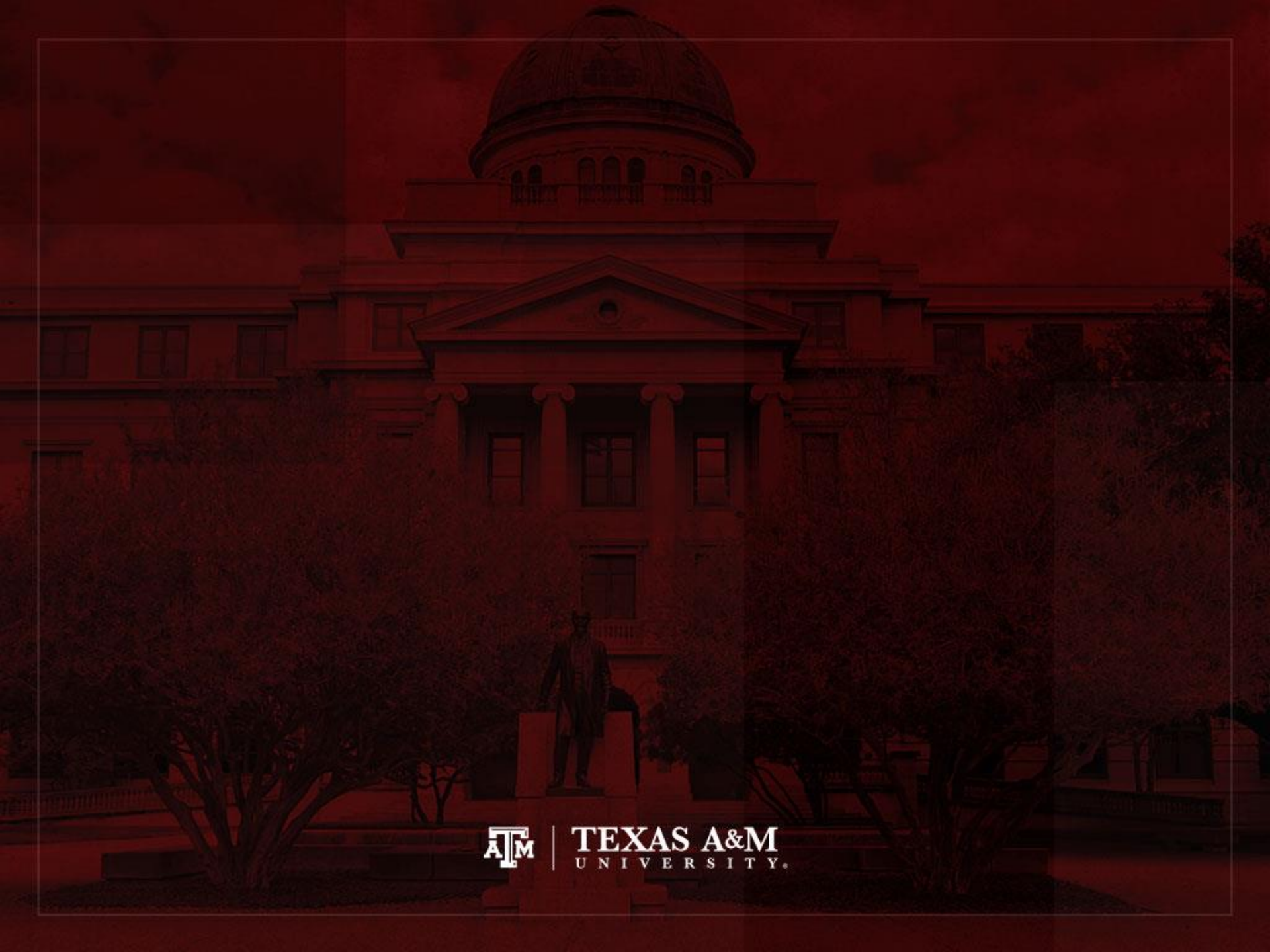


Source: Population Reference Bureau, 2014

Single years of age, male population, Pakistan, 1981



Source: U.S. Bureau of the Census, International Data Base. Figure prepared by Dudley L. Poston.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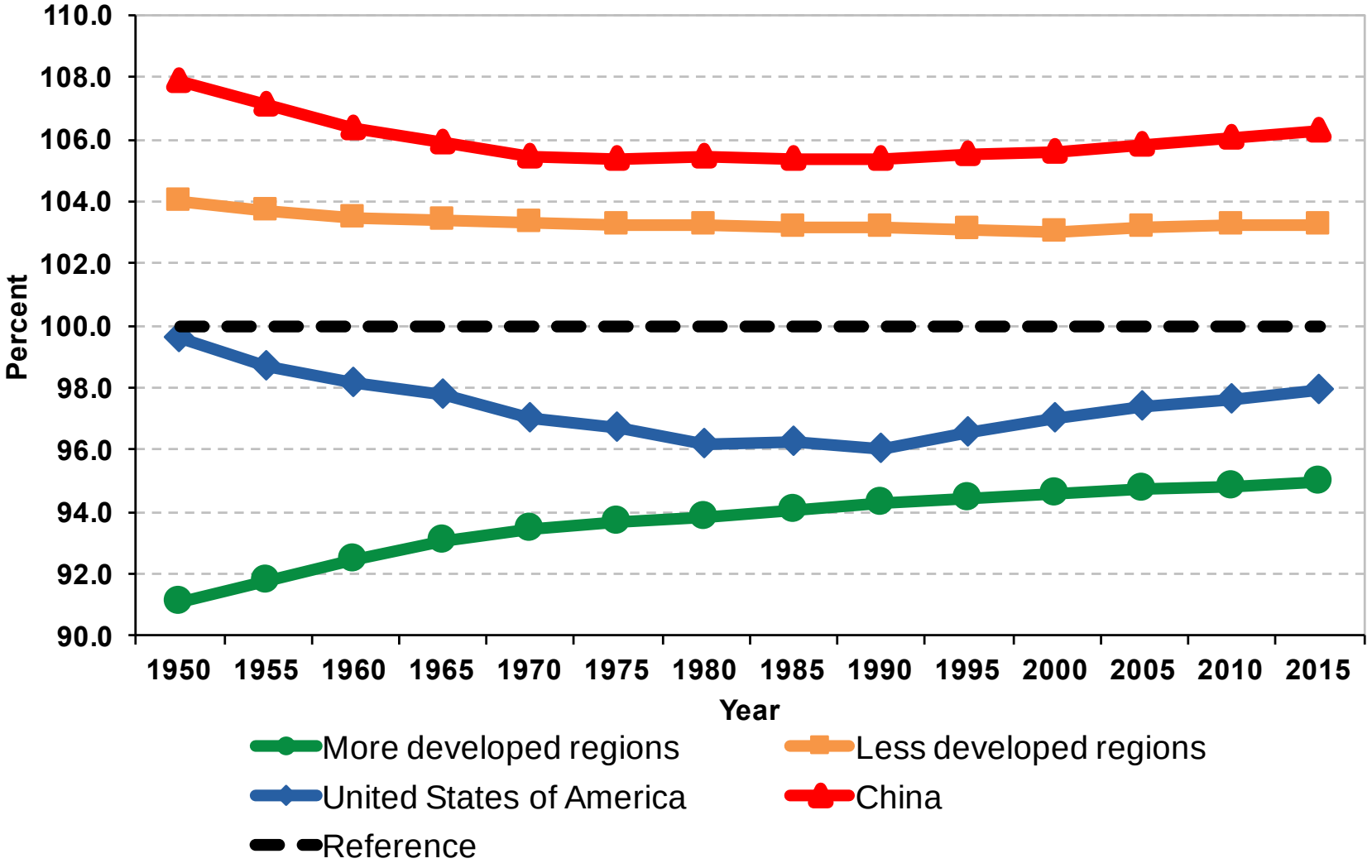
Sex structure

- The sex ratio (SR) is the most popular index of sex composition in demographic analyses
  - It is defined as the number of males per 100 females
  - SR above 100 indicates an excess of males
  - SR below 100 indicates an excess of females

$$Sex\ ratio = \frac{Population\ of\ males}{Population\ of\ females} * 100$$

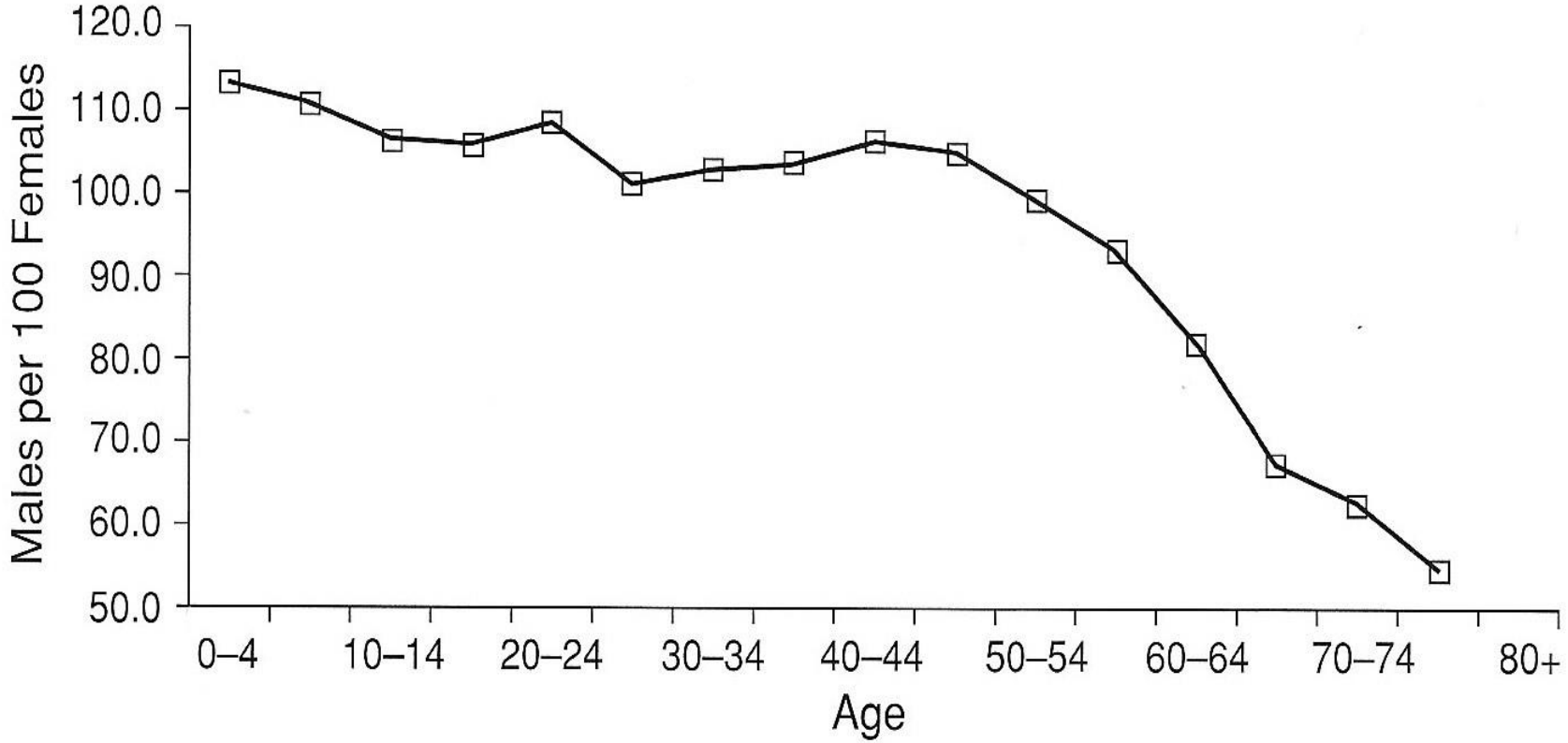
- In general, national sex ratios tend to fall in the narrow range from about 95 to 102
  - National sex ratios outside the range of 90 to 105 should be viewed as extreme

Sex ratios, 1950–2015



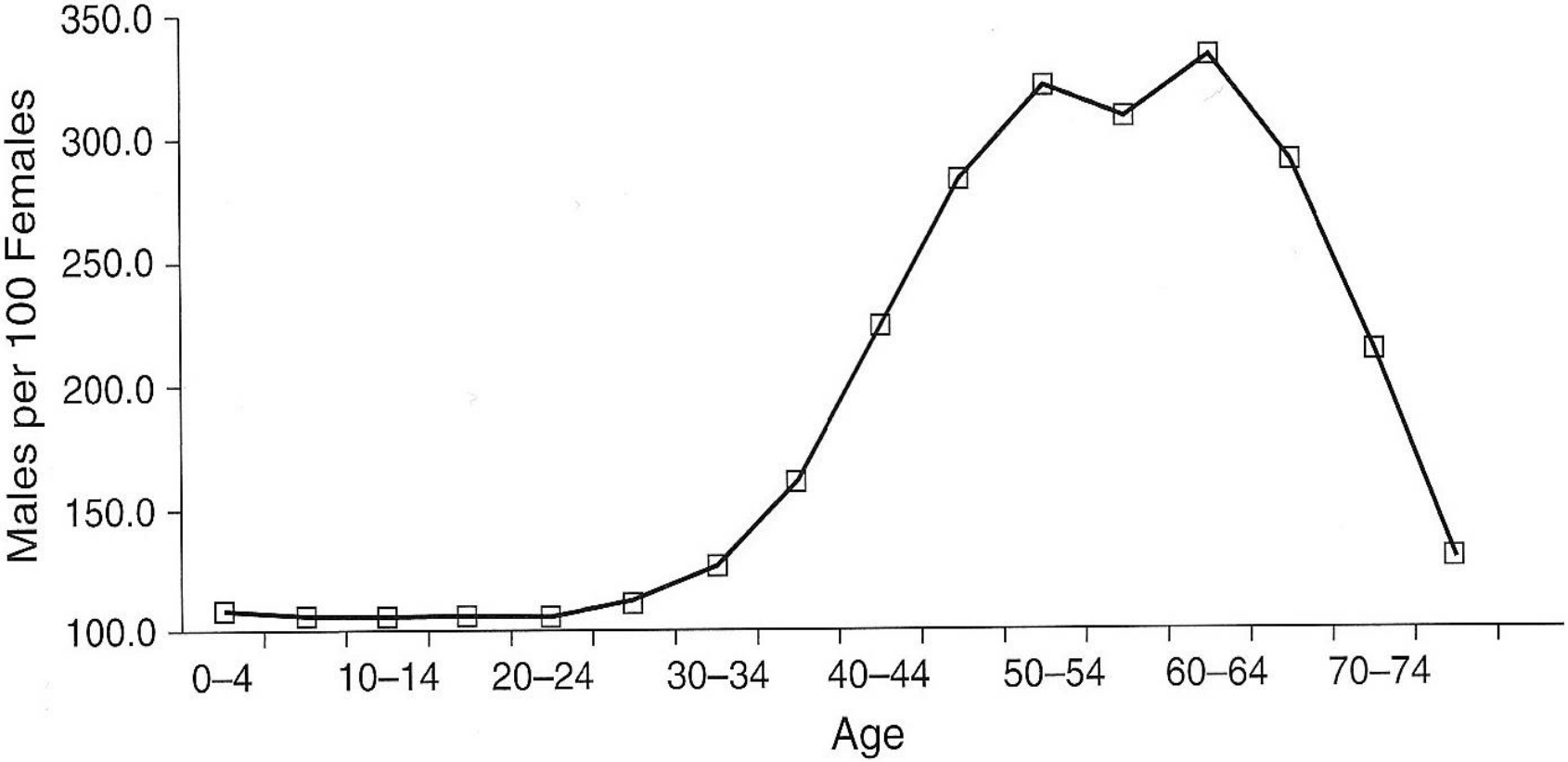
Source: United Nations, World Population Prospects 2017
https://esa.un.org/unpd/wpp/Download/Standard/Population/

Sex ratios by age group, Republic of Korea, 1995

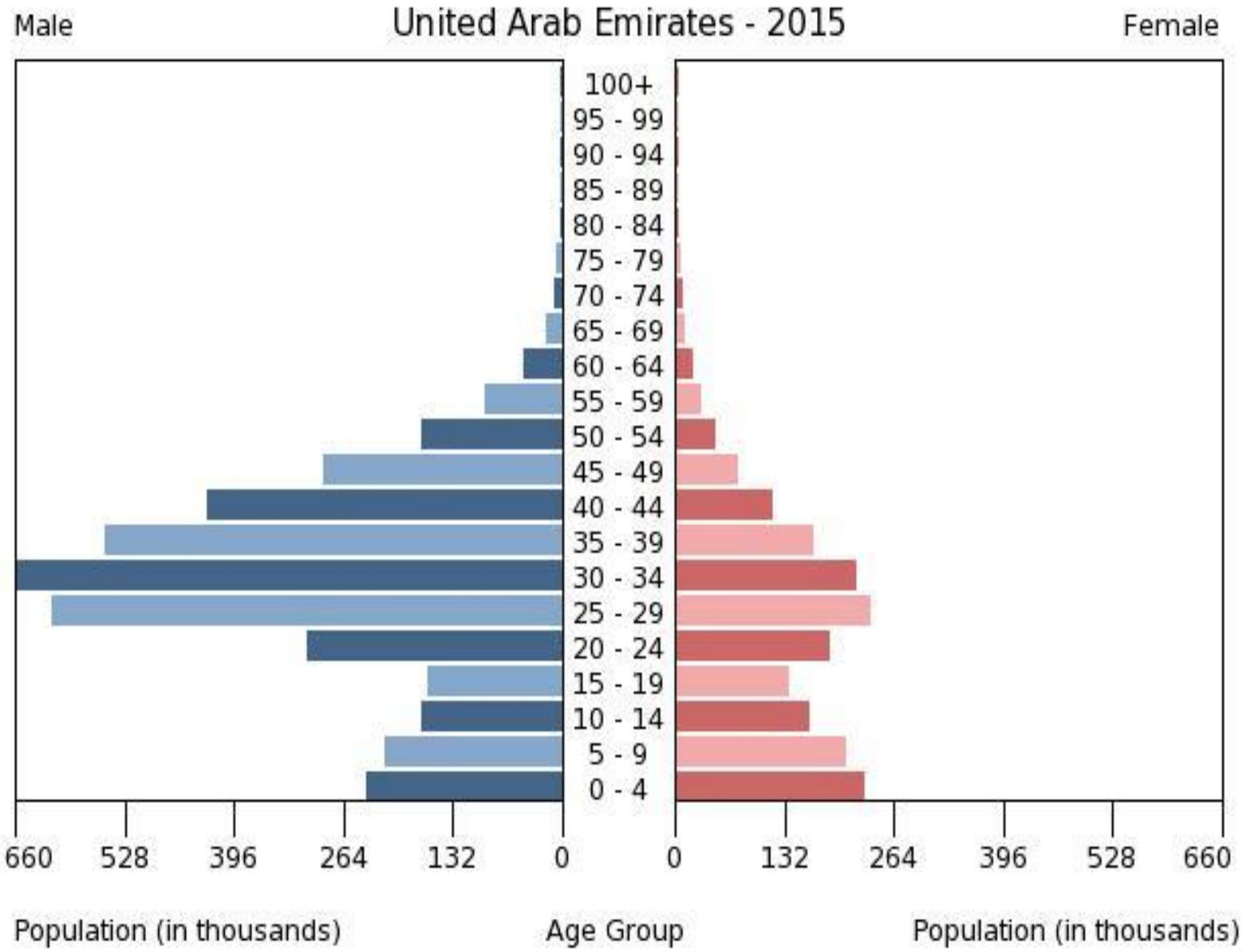


Source: U.S. Bureau of the Census, International Data Base. Figure prepared by Dudley L. Poston.

Sex ratios by age group, United Arab Emirates, 2000



Source: U.S. Bureau of the Census, International Data Base. Figure prepared by Dudley L. Poston.



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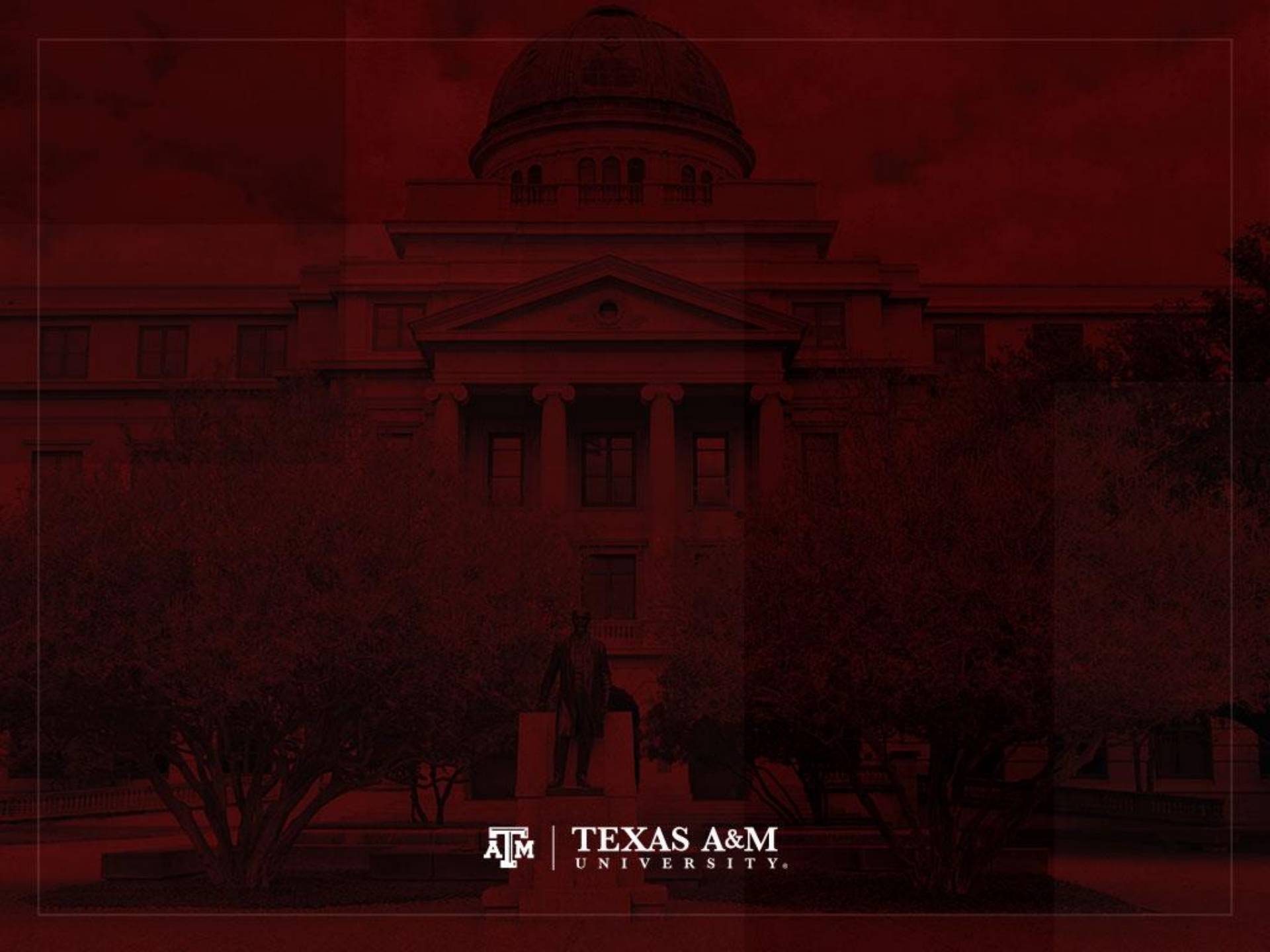
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Sex ratio at birth

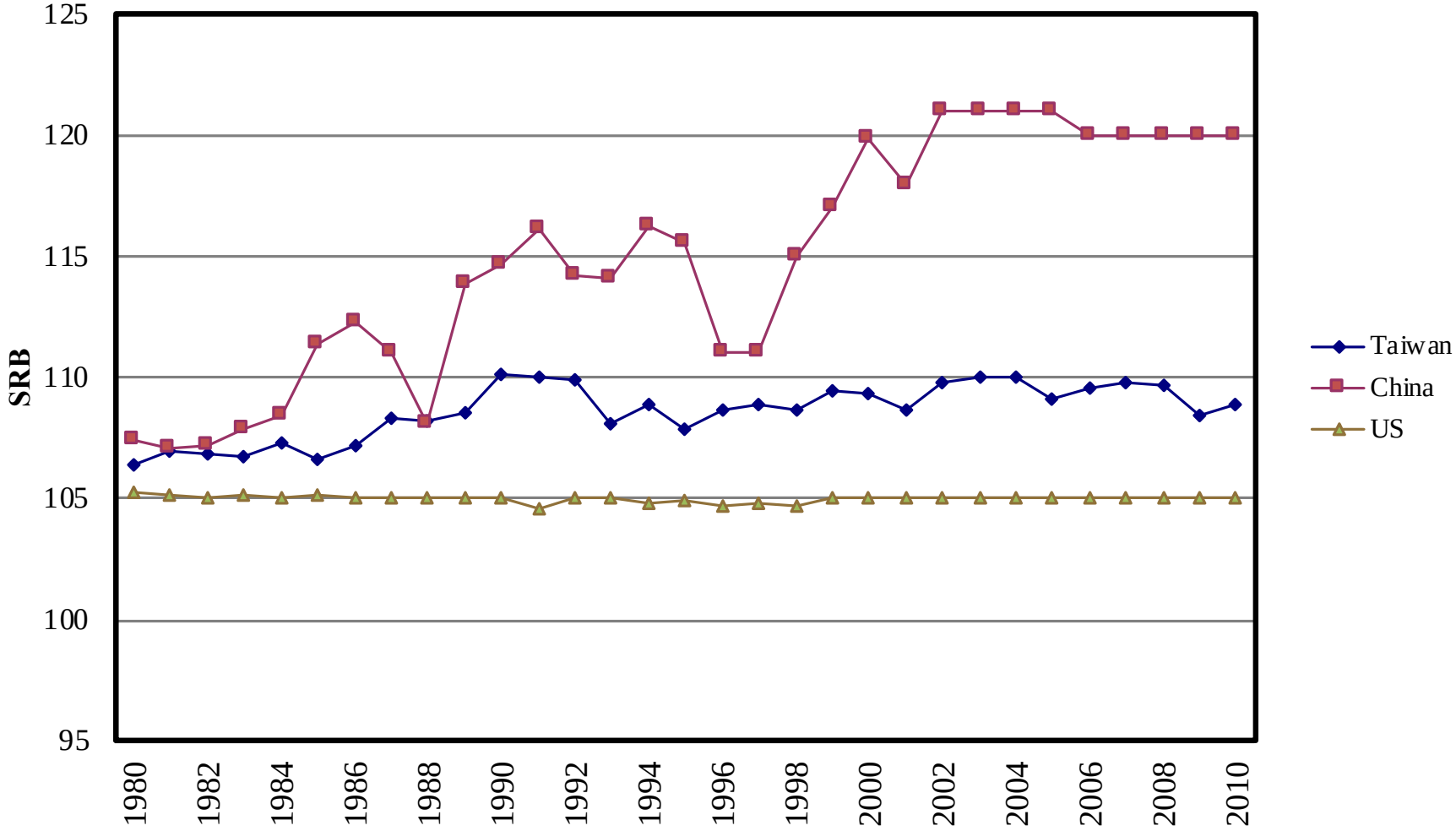
- Most societies have sex ratios at birth (SRBs) of around 105
  - 105 boys are born for every 100 girls

- But China, Taiwan, South Korea, India, and several other Asian countries have been reporting abnormally high SRBs since the 1980s
  - A main intervention is prenatal sex identification followed by gender-specific abortion

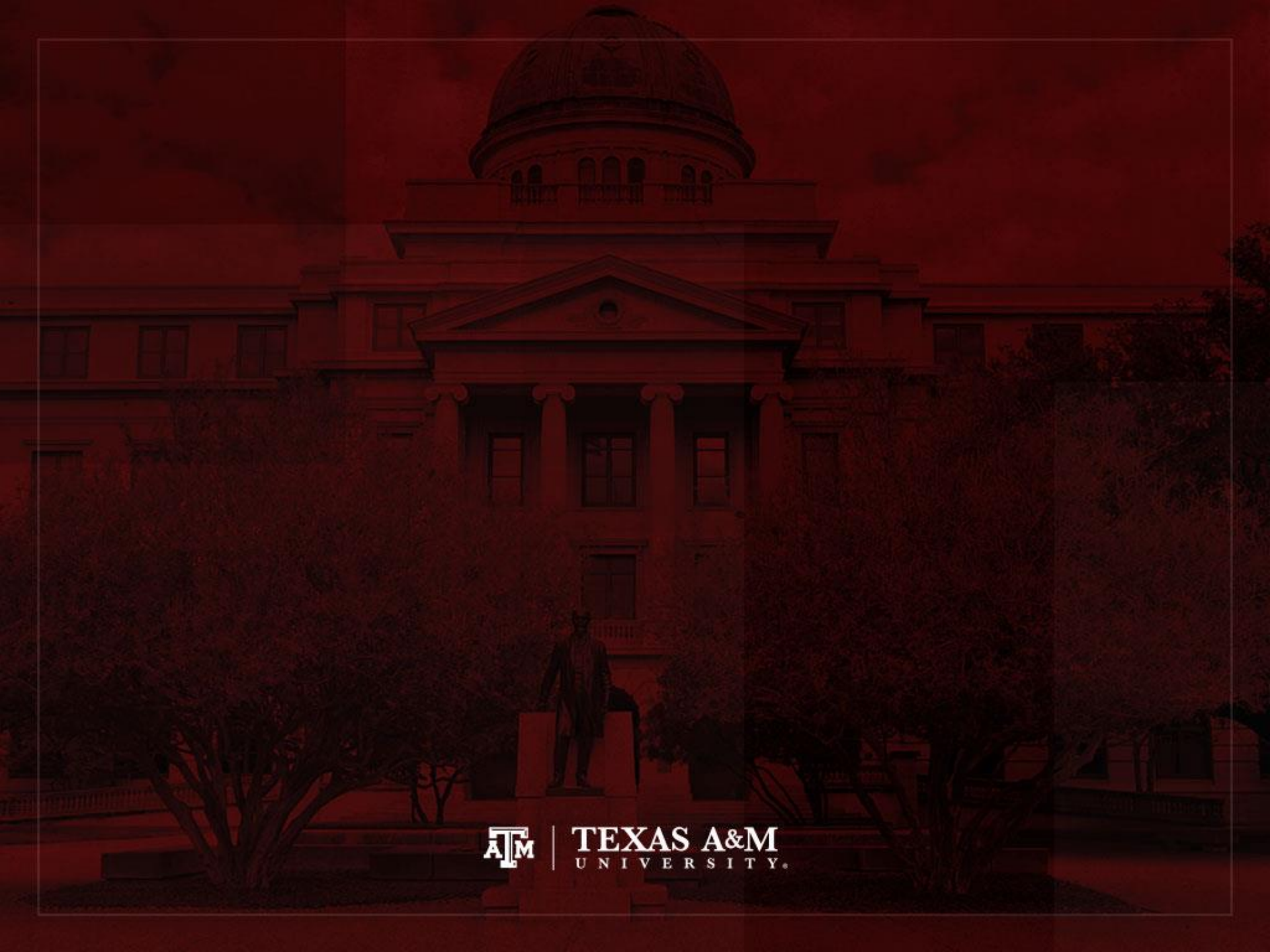
China and Taiwan

- China and Taiwan have a Confucian patriarchal tradition where son preference is strong and pervasive
- Birth-planning policies, socioeconomic changes, and industrial transformations have been responsible for the rapid decline in fertility
- Ultrasound technology enables the prenatal determination of sex

Sex ratios at birth, Taiwan, China, U.S., 1980–2010



Source: Poston, Bouvier (2017).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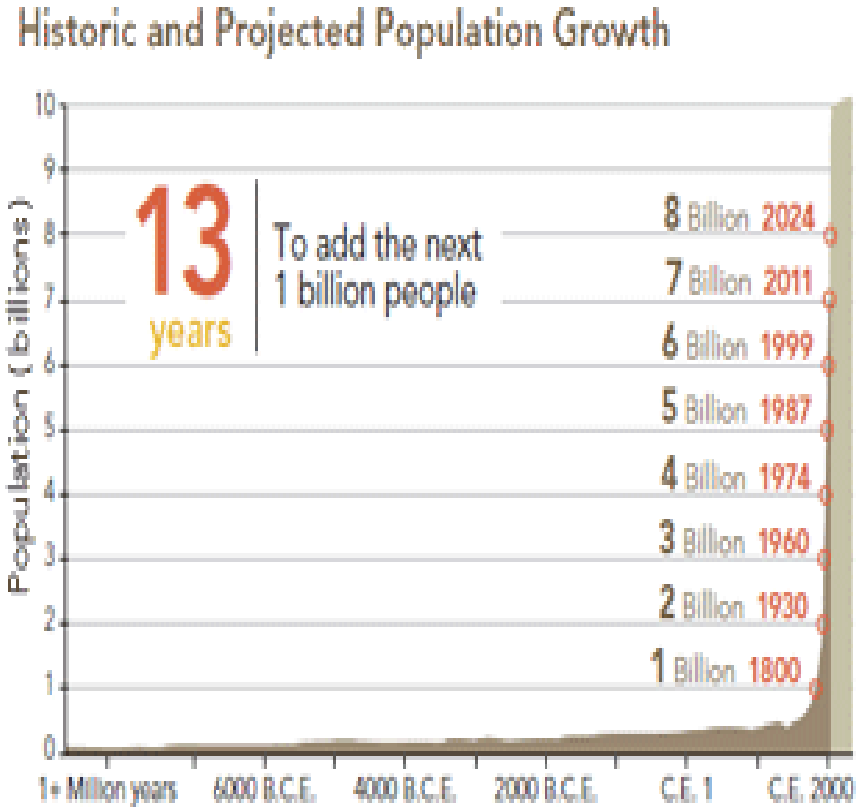
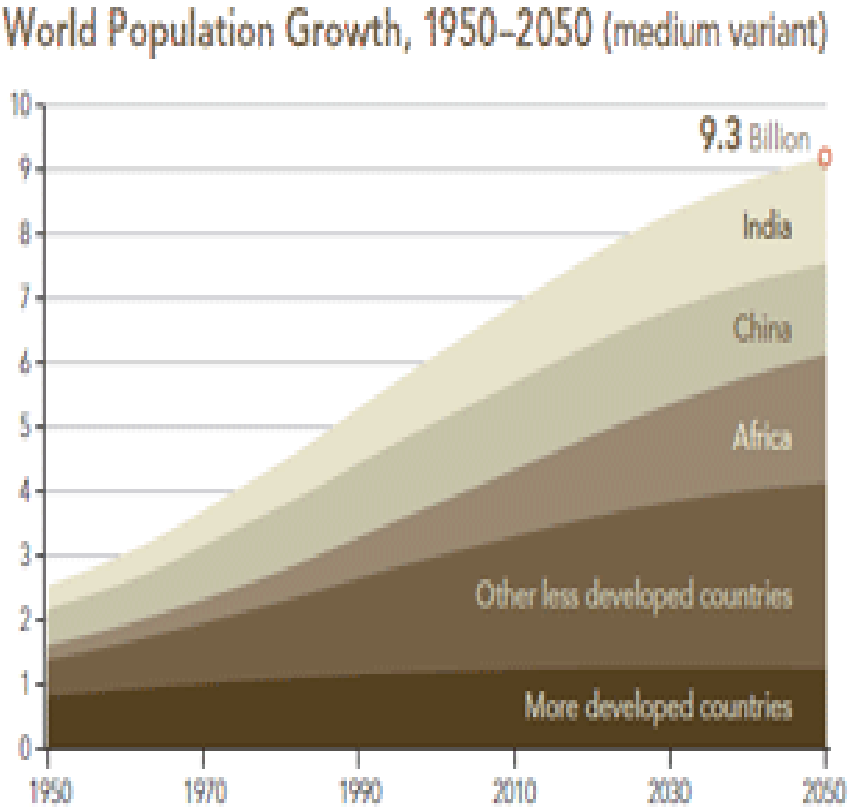
Five contemporary aspects of importance of demography

1. The greatest demographic change in human history
2. Spectacular gains in life expectancy
3. Below replacement fertility
4. Unbalanced sex ratios at birth
5. Population aging

Source: Poston, Bouvier, 2017.

1. The greatest demographic change in human history





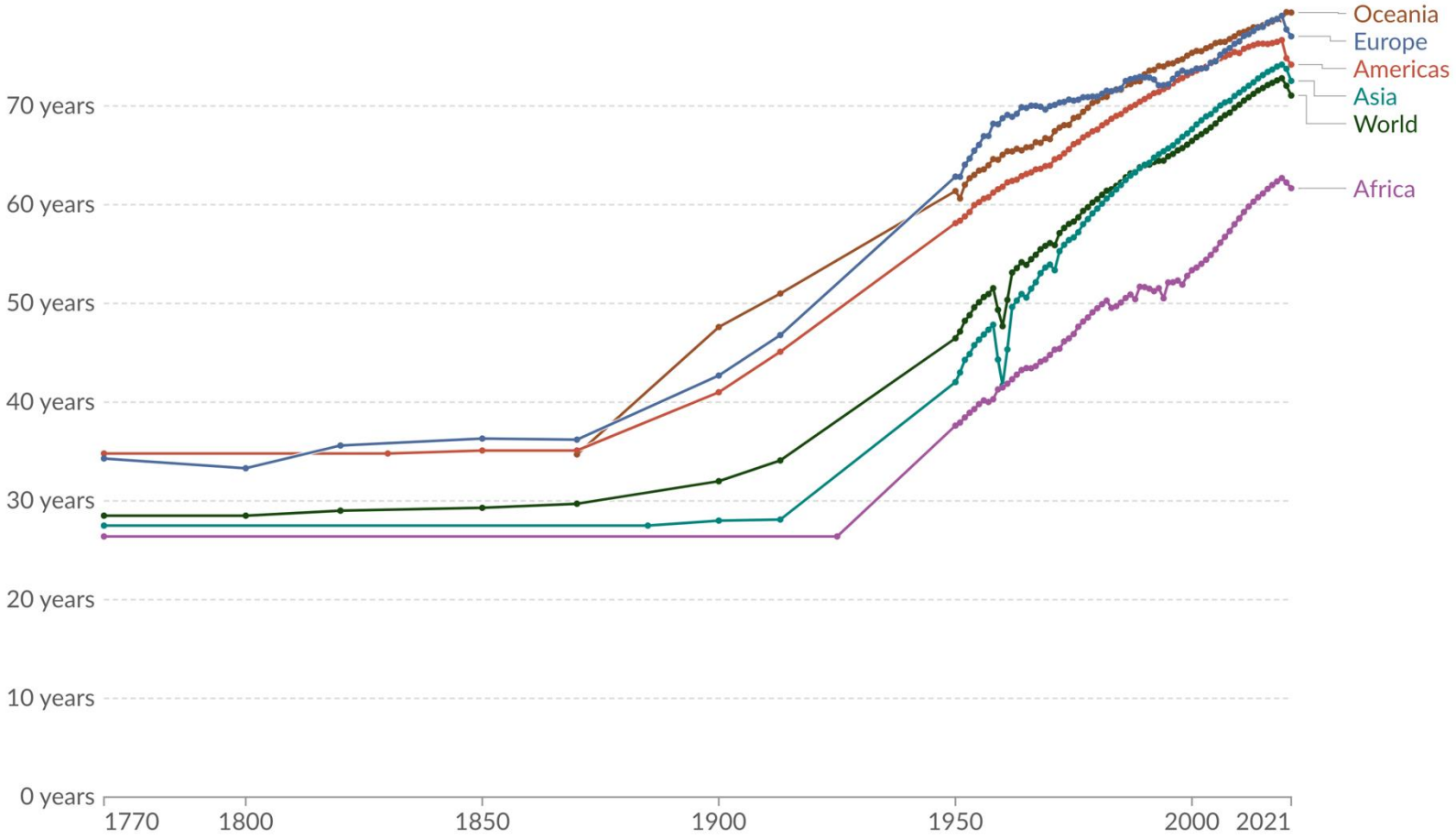
Source: Poston, Bouvier, 2017.

2. Spectacular gains in life expectancy

- Significant decline in mortality over the past two centuries
- Particularly since the end of World War II
- One of the most important developments in human history
- Both a consequence and driver of a new worldview
- The resulting transitions have been profoundly transformative

Life expectancy

The period life expectancy[1] at birth, in a given year.



Data source: UN WPP (2022); HMD (2023); Zijdeman et al. (2015); Riley (2005)

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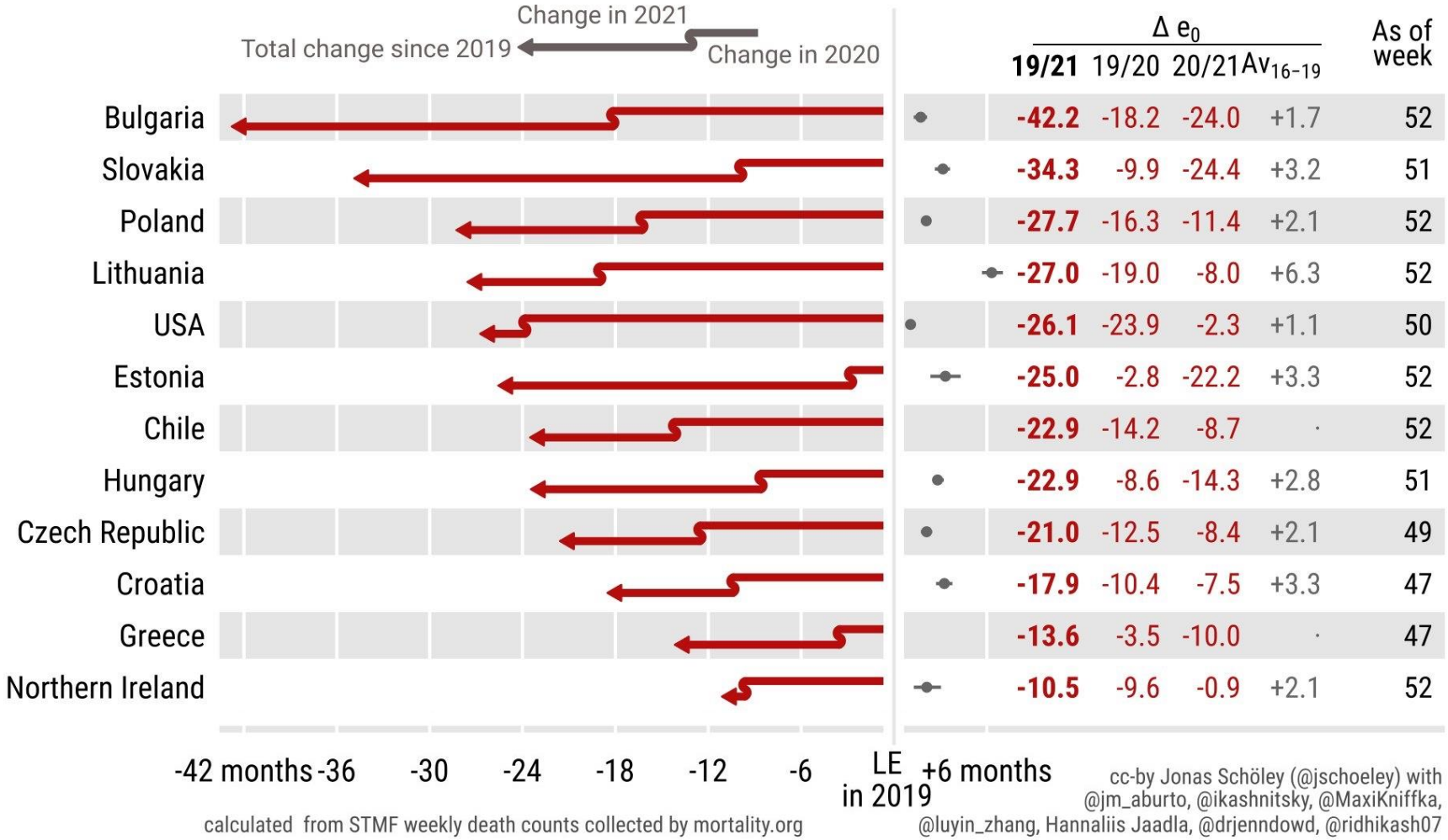
1. Period life expectancy: Period life expectancy is a metric that summarizes death rates across all age groups in one particular year. For a given year, it represents the average lifespan for a hypothetical group of people, if they experienced the same age-specific death rates throughout their whole lives as the age-specific death rates seen in that particular year. Learn more in our article: "Life expectancy" – What does this actually mean?

Life expectancy bounce-backs amid continued losses

Life expectancy changes since the start of the COVID-19 pandemic

Estimates for 2021 are adjusted for the weeks with missing data
Grey dots mark the average annual life expectancy change 2016 to 2019



calculated from STMF weekly death counts collected by mortality.org

Life expectancy bounce-backs amid continued losses

Life expectancy changes since the start of the COVID-19 pandemic

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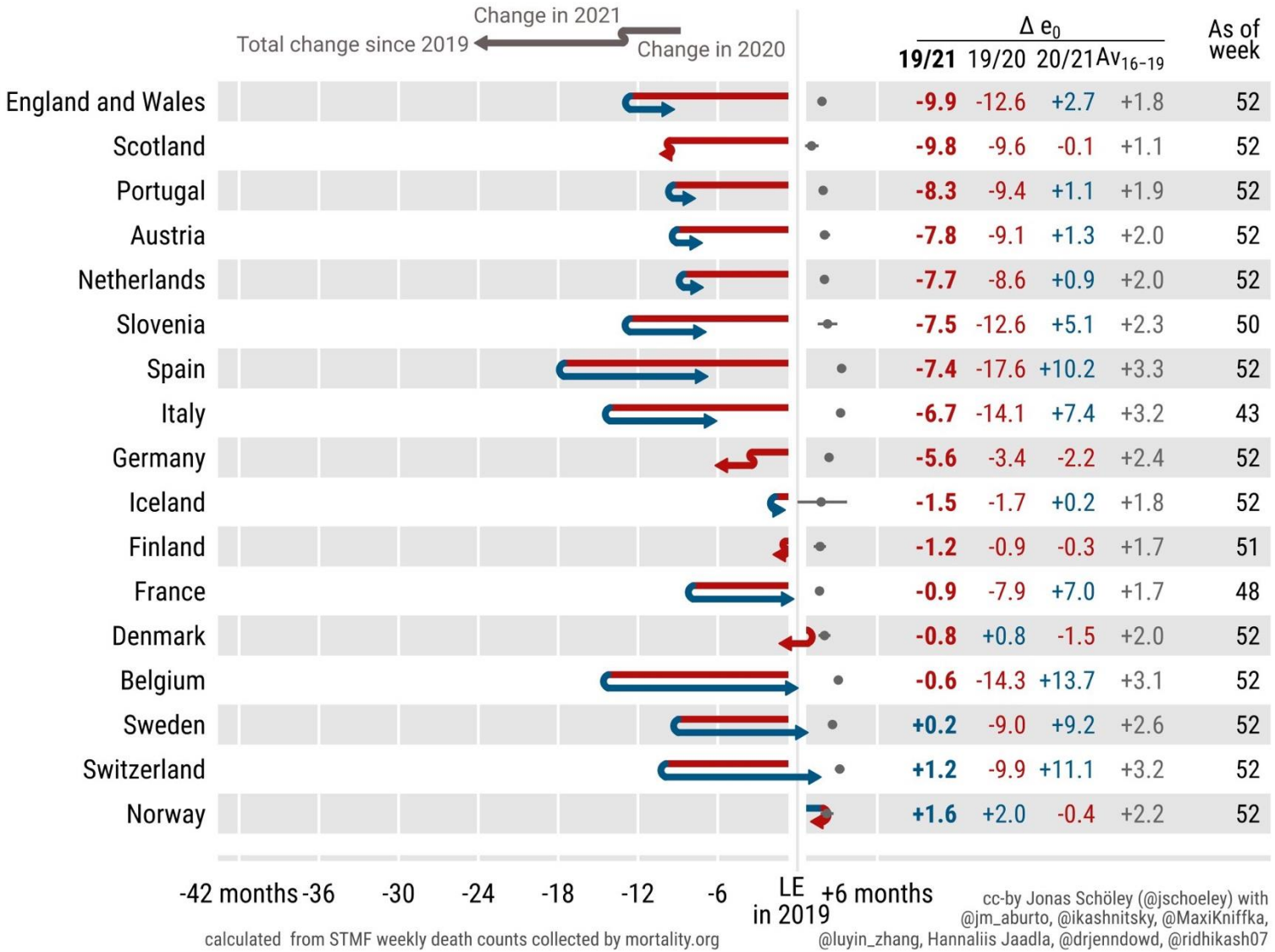
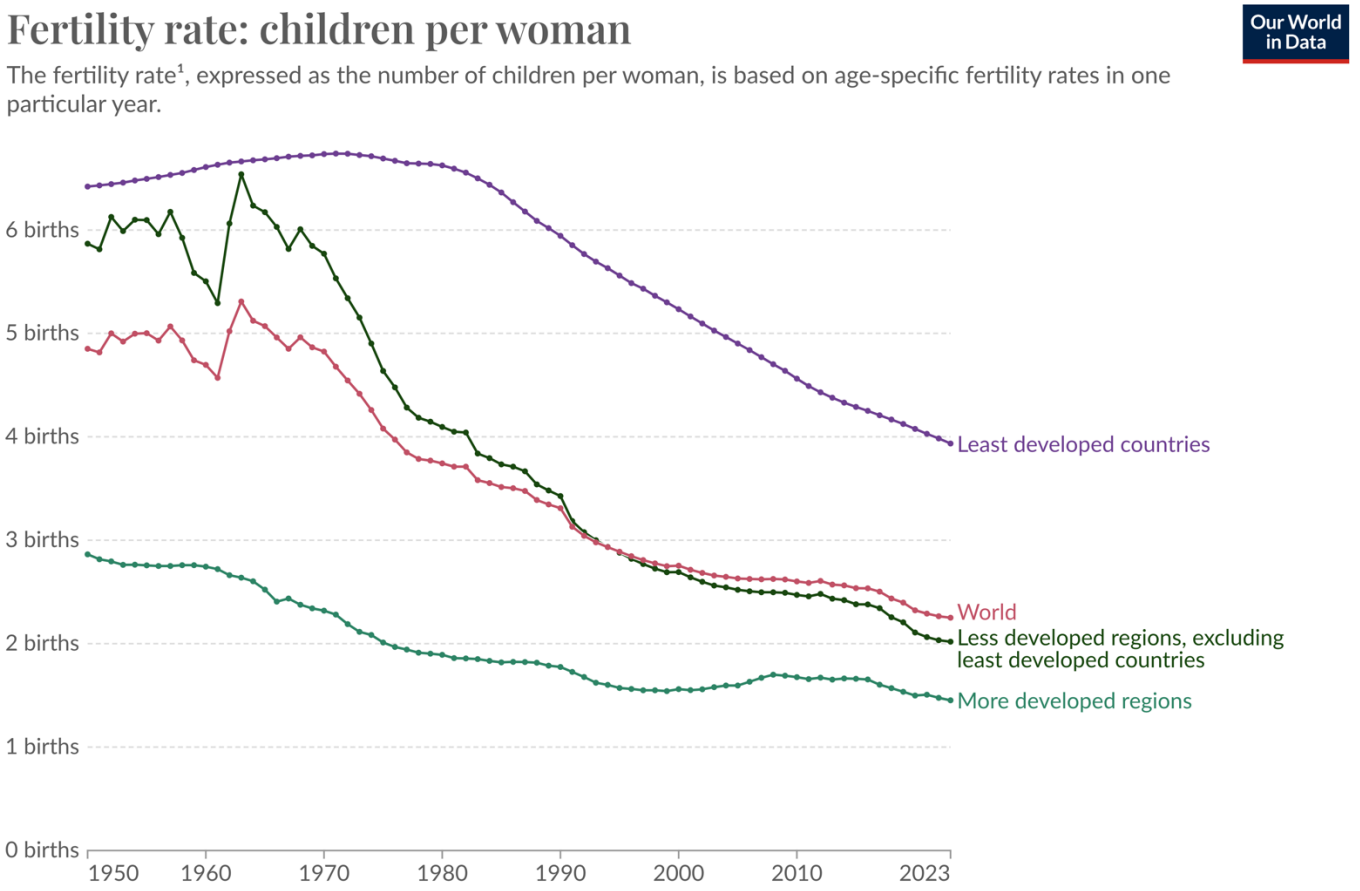


	Δ e_0 19/21	19/20	20/21	Av$_{16-19}$	As of week
England and Wales	**-9.9**	-12.6	+2.7	+1.8	52
Scotland	**-9.8**	-9.6	-0.1	+1.1	52
Portugal	**-8.3**	-9.4	+1.1	+1.9	52
Austria	**-7.8**	-9.1	+1.3	+2.0	52
Netherlands	**-7.7**	-8.6	+0.9	+2.0	52
Slovenia	**-7.5**	-12.6	+5.1	+2.3	50
Spain	**-7.4**	-17.6	+10.2	+3.3	52
Italy	**-6.7**	-14.1	+7.4	+3.2	43
Germany	**-5.6**	-3.4	-2.2	+2.4	52
Iceland	**-1.5**	-1.7	+0.2	+1.8	52
Finland	**-1.2**	-0.9	-0.3	+1.7	51
France	**-0.9**	-7.9	+7.0	+1.7	48
Denmark	**-0.8**	+0.8	-1.5	+2.0	52
Belgium	**-0.6**	-14.3	+13.7	+3.1	52
Sweden	**+0.2**	-9.0	+9.2	+2.6	52
Switzerland	**+1.2**	-9.9	+11.1	+3.2	52
Norway	**+1.6**	+2.0	-0.4	+2.2	52

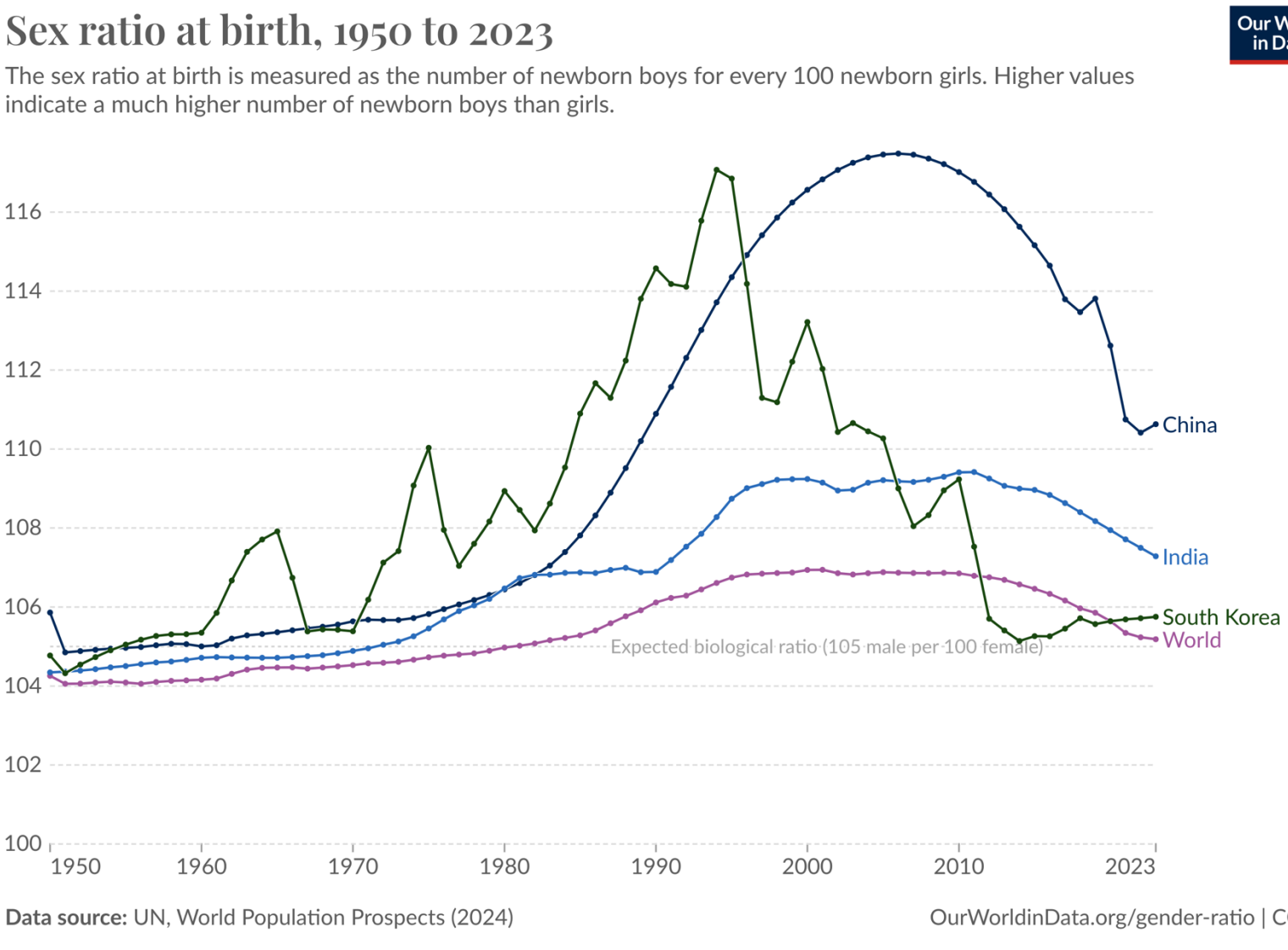
calculated from STMF weekly death counts collected by mortality.org

3. Below replacement fertility



1. Fertility rate: The total fertility rate is a period metric. It summarizes fertility rates across all age groups in one particular year. For a given year, the total fertility rate represents the average number of children that would be born to a hypothetical woman if she (1) lived to the end of her childbearing years, and (2) experienced the same age-specific fertility rates throughout her whole reproductive life as the age-specific fertility rates seen in that particular year. It is different from the actual average number of children that women have. The fertility rate should not be confused with biological fertility, which is about the ability of a person to conceive. Read more: Fertility rate

4. Unbalanced sex ratios at birth



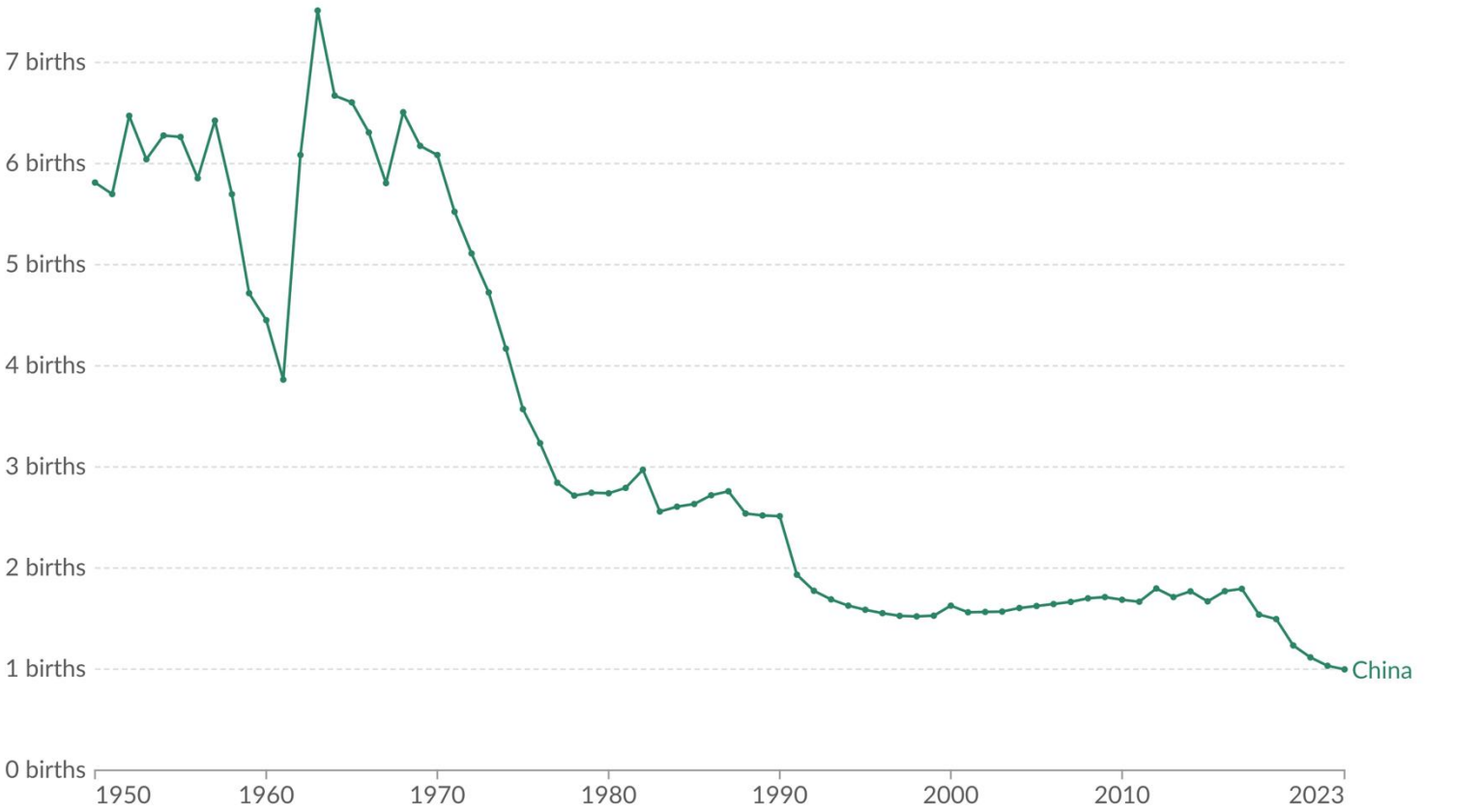
Sex ratio at birth in China

- Biologically normal level of sex ratio at birth
  - Around 105 males for every 100 females
- Several societies have much higher SRBs
  - Rapid fertility transition
  - Son preference
  - Available technology to determine sex of the fetus
  - Ease of access to abortion

Source: Poston, Bouvier, 2017.

Fertility rate: children per woman

The fertility rate[1], expressed as the number of children per woman, is based on age-specific fertility rates in one particular year.



Data source: UN, World Population Prospects (2024)

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The destiny of China is already set

- Why does China have high SRBs?
  - Pre-natal sex identification via sonar technology, followed by female-specific abortion
- What will be the result of the high SRBs?
  - Between 1983 and 2010 over 41 million extra boys were born than girls
  - Larger number of bachelors in China than the total population of California in 2010 (37 million) or Texas (25 million)

Source: Poston, Bouvier, 2017.

What might happen if boys don't marry?

- Most men unable to find sex partners will be poor, uneducated, unemployed, and migrate from rural to urban areas

- Some likely consequences
  - Increase in crime, violence
  - Increase prostitution
  - Increase of STDs mainly among unmarried men
  - Unprecedented spread of HIV

Source: Poston, Bouvier, 2017.

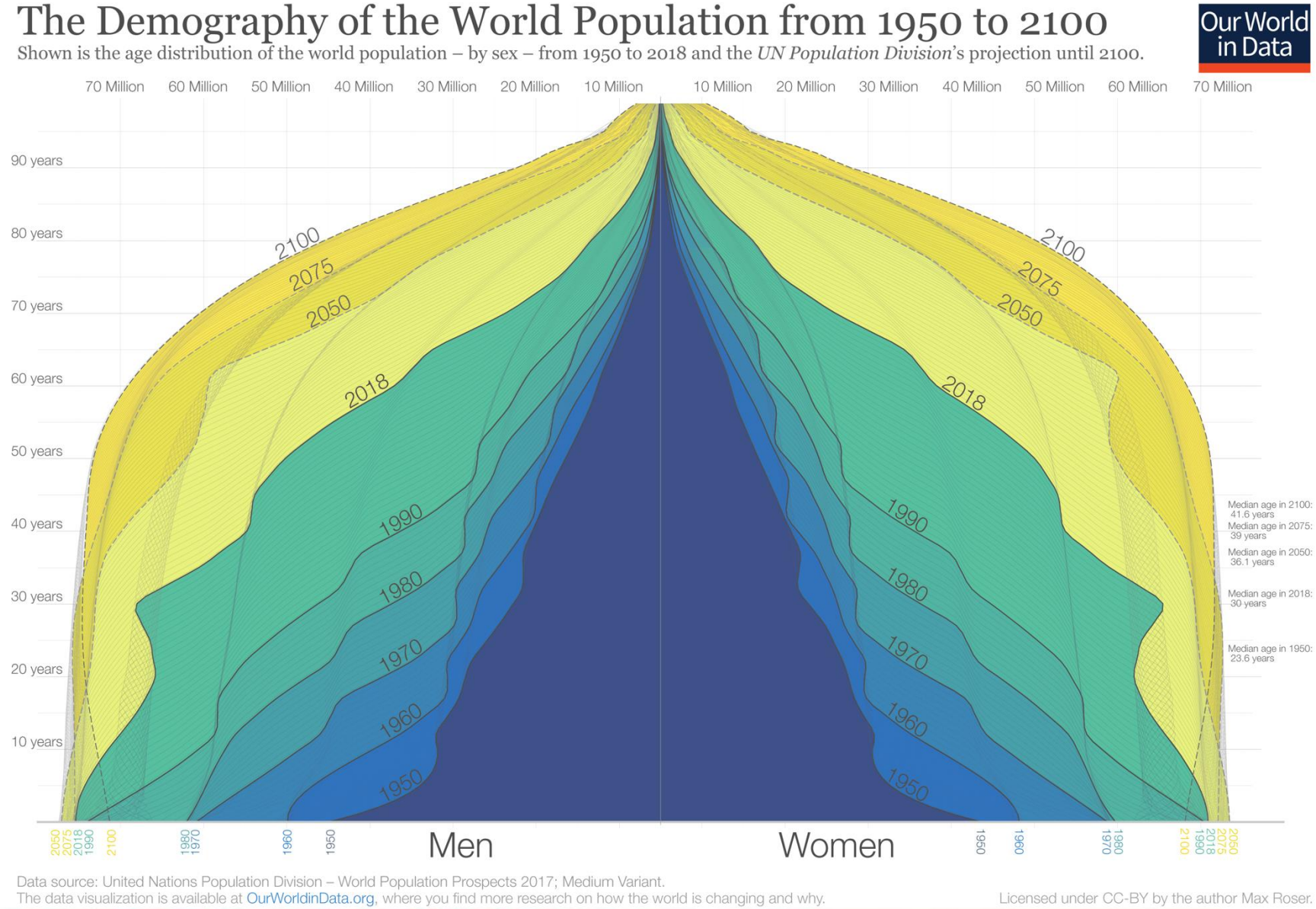
HIV

- In sub-Saharan Africa
  - In 2013, 24.7 million adults infected with HIV
    - This is almost 71% of adult infections worldwide
  - In 2010
    - Around 1.2 million people died from AIDS
    - 1.9 million people became infected with HIV

- China could equal or exceed these numbers by 2020–2030
  - The country is beginning to take seriously the issue of HIV/AIDS and a possible epidemic

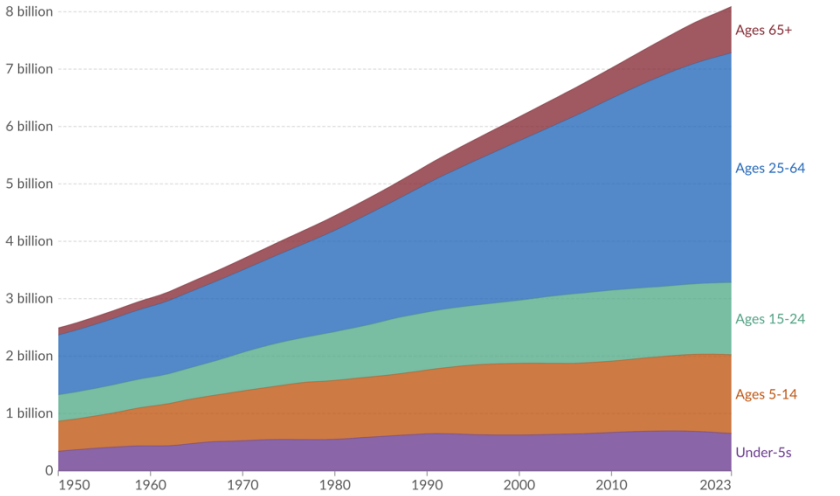
Source: Poston, Bouvier, 2017.

5. Population aging



Source: Poston, Bouvier, 2017.

Population by age group, World



Data source: UN, World Population Prospects (2024)

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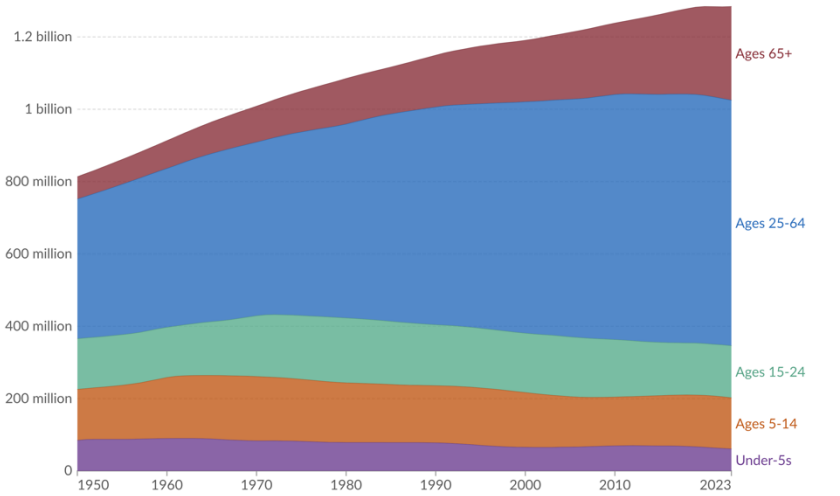
Population by age group, More developed regions



Data source: UN, World Population Prospects (2024)

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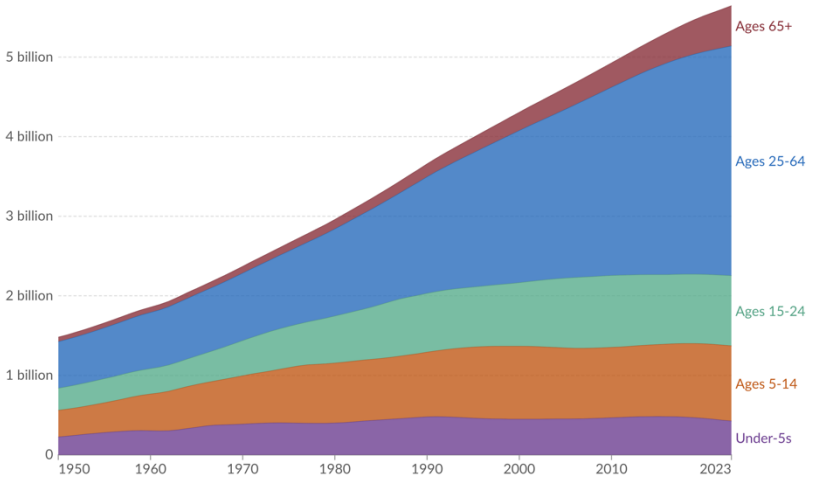
Population by age group, Less developed regions, excluding least developed countries



Data source: UN, World Population Prospects (2024)

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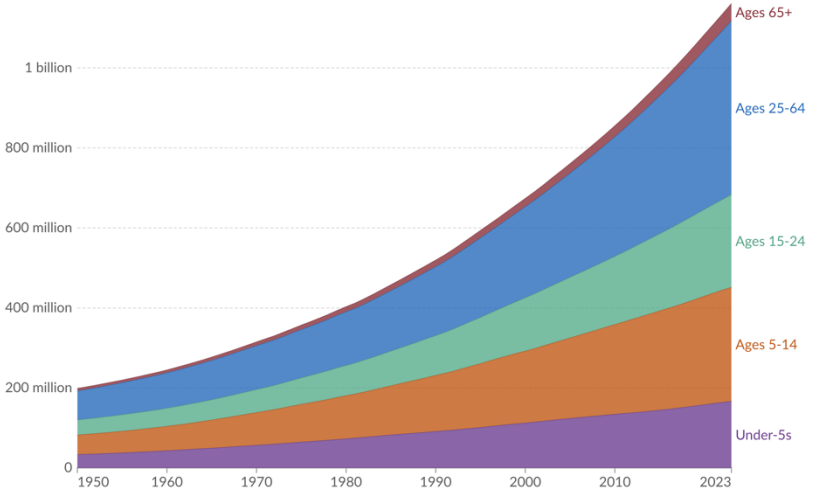
Population by age group, Least developed countries



Data source: UN, World Population Prospects (2024)

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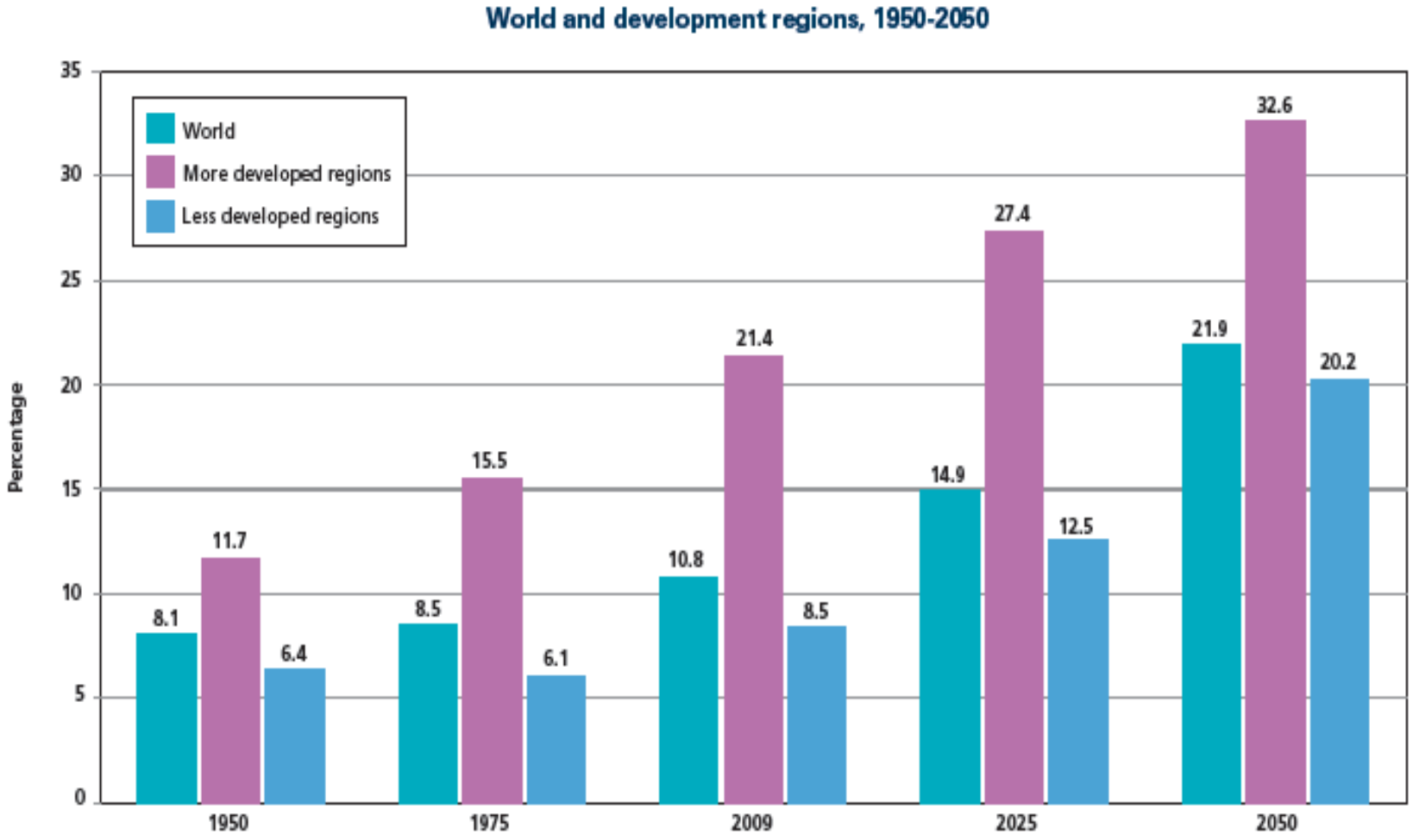
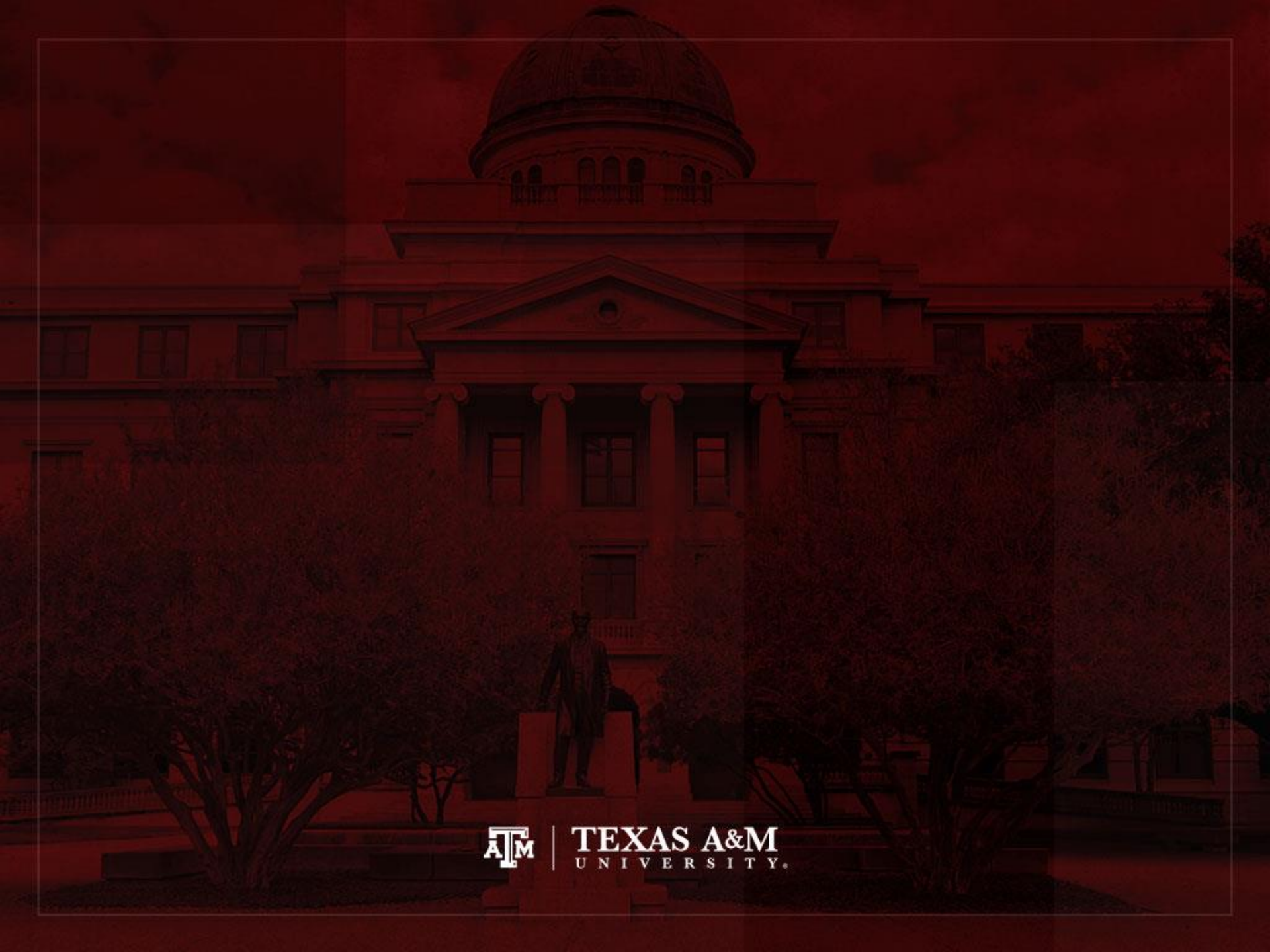
Percentage of population aged 60 or over



Source: Poston, Bouvier, 2017.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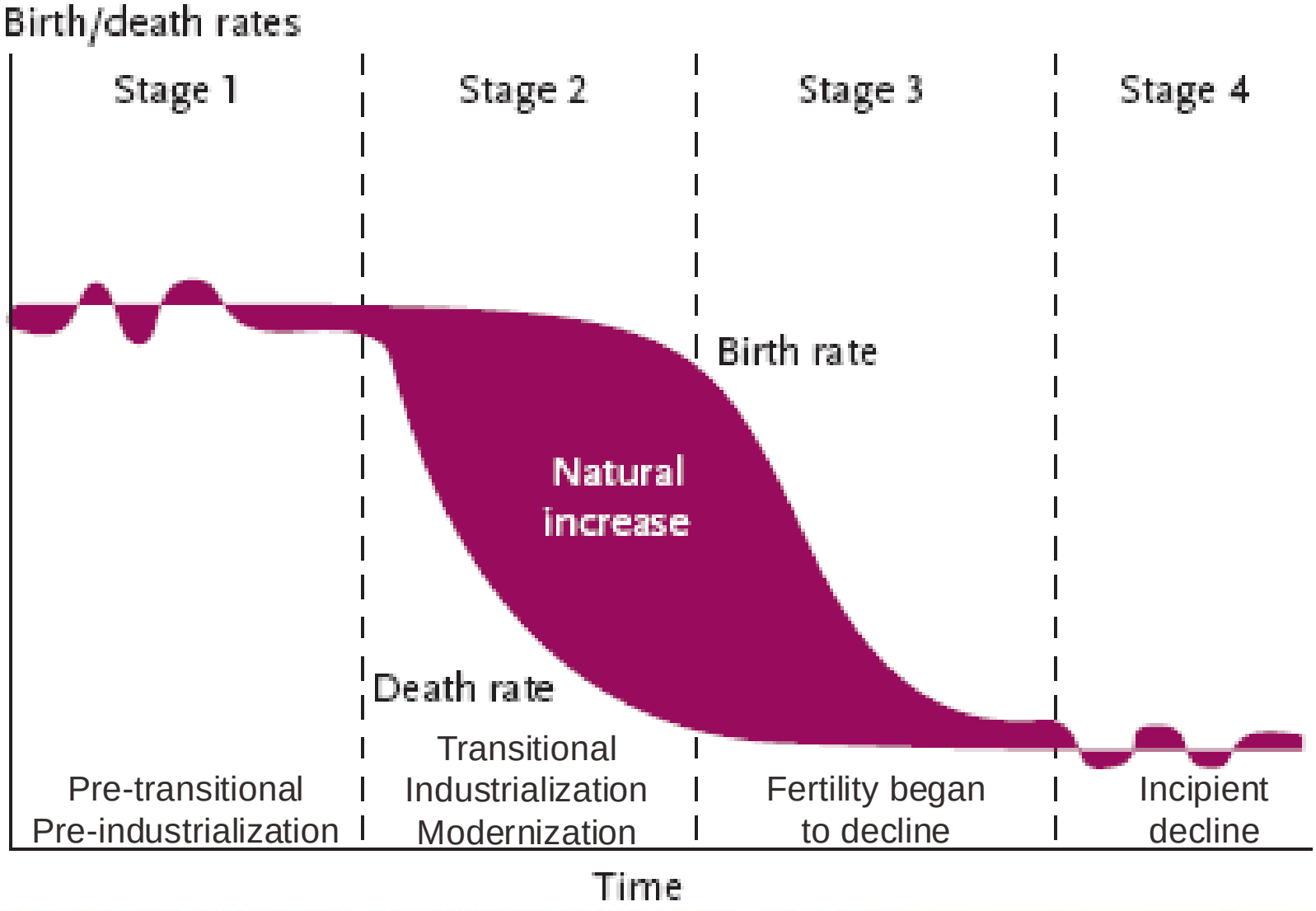
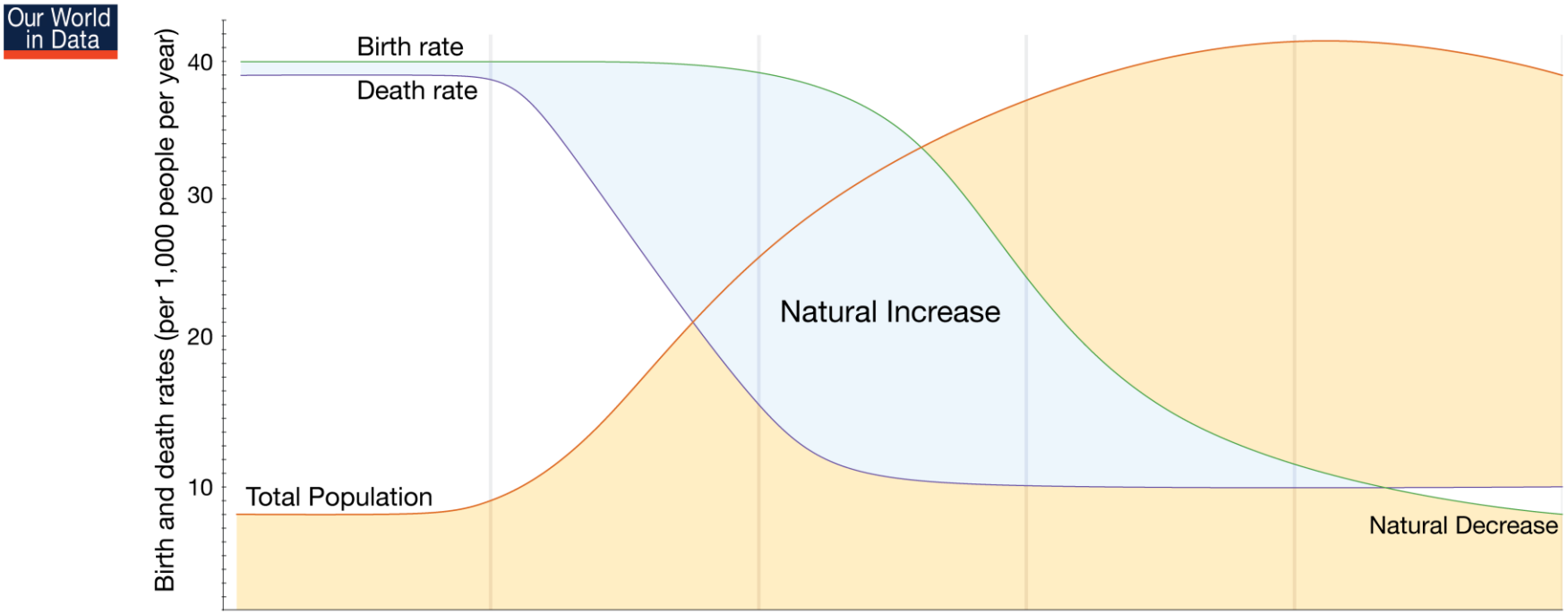
Demographic transition



Source: Poston, Bouvier, 2017.

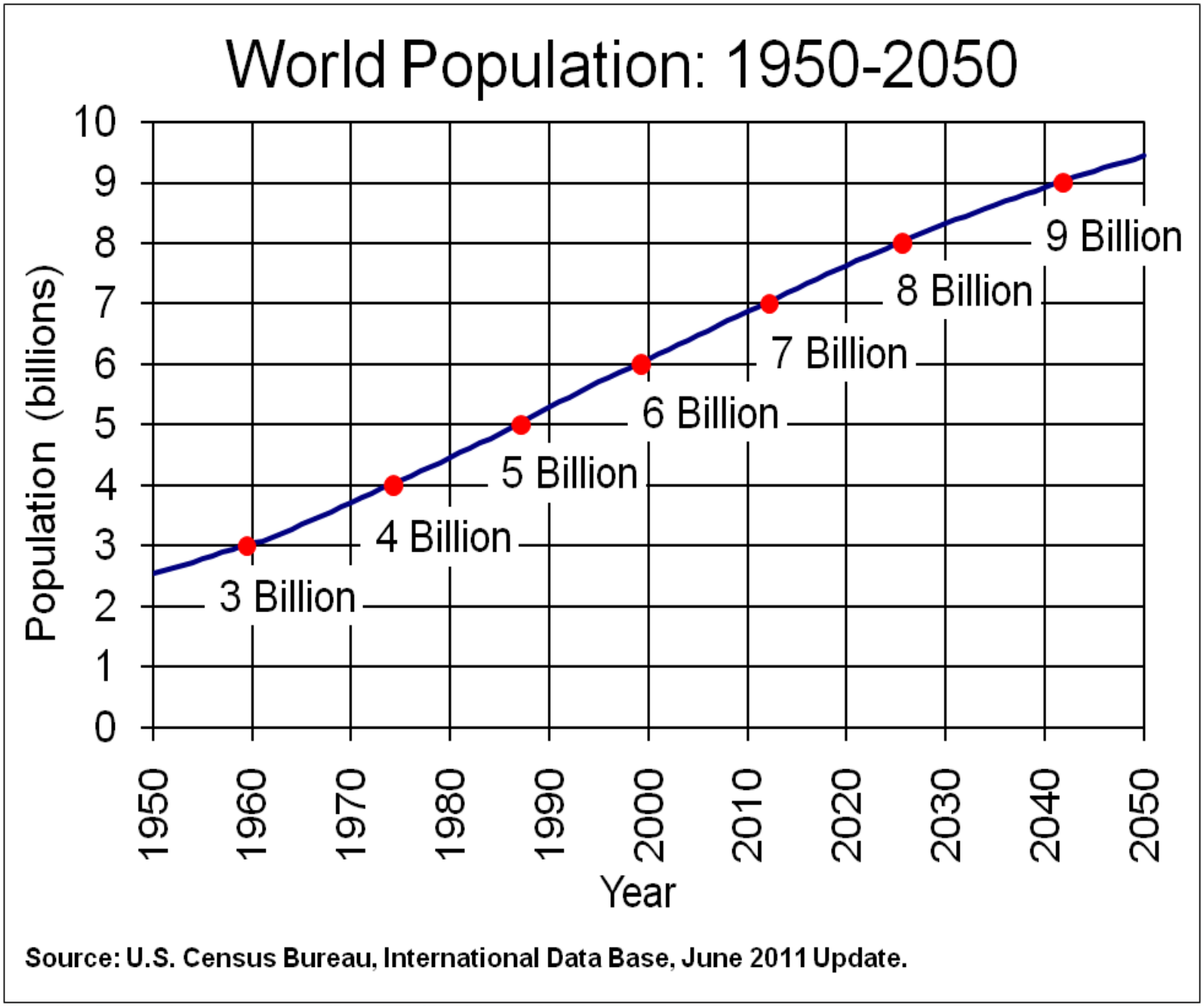
Demographic transition



	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*

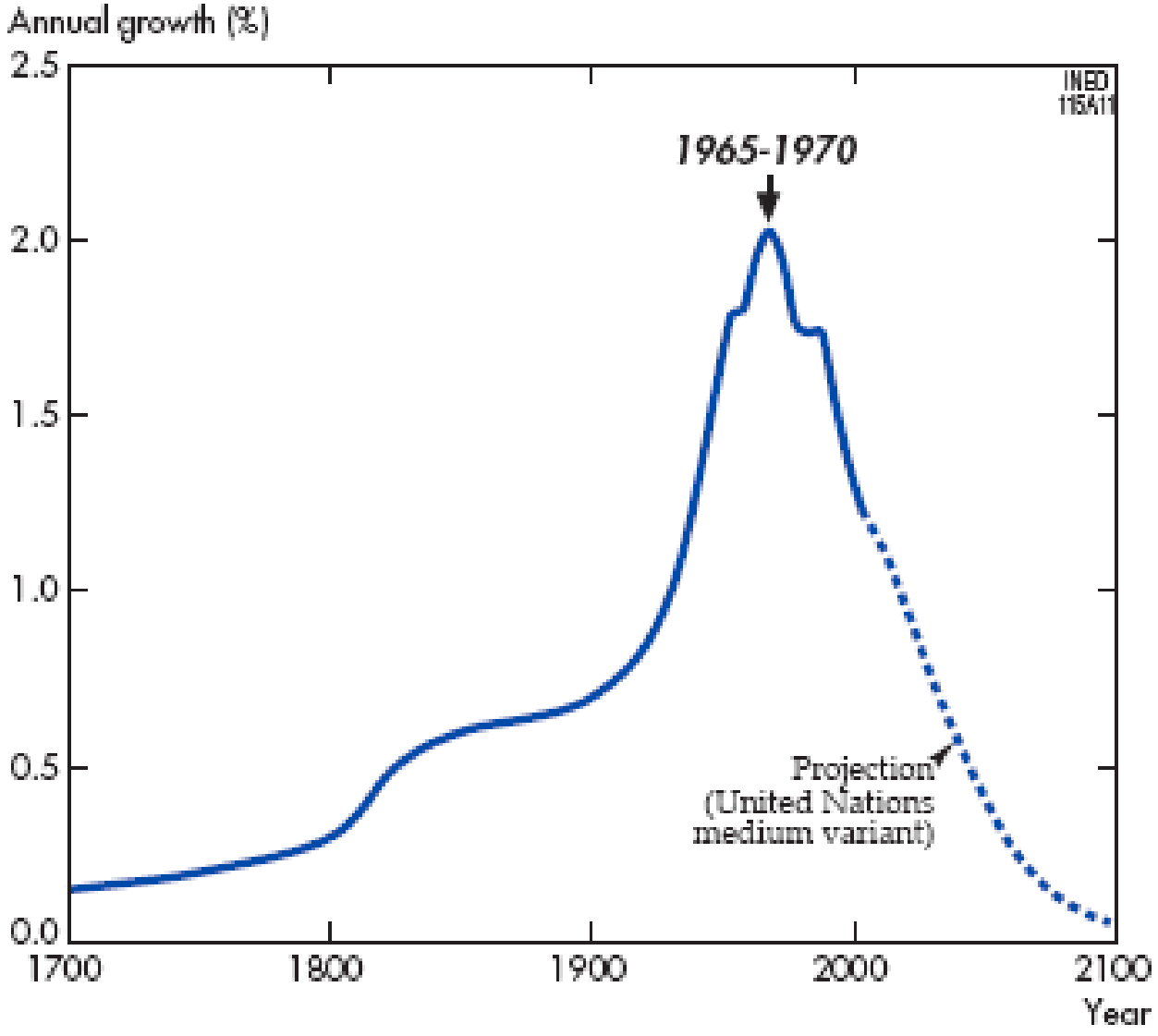
Population storm

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



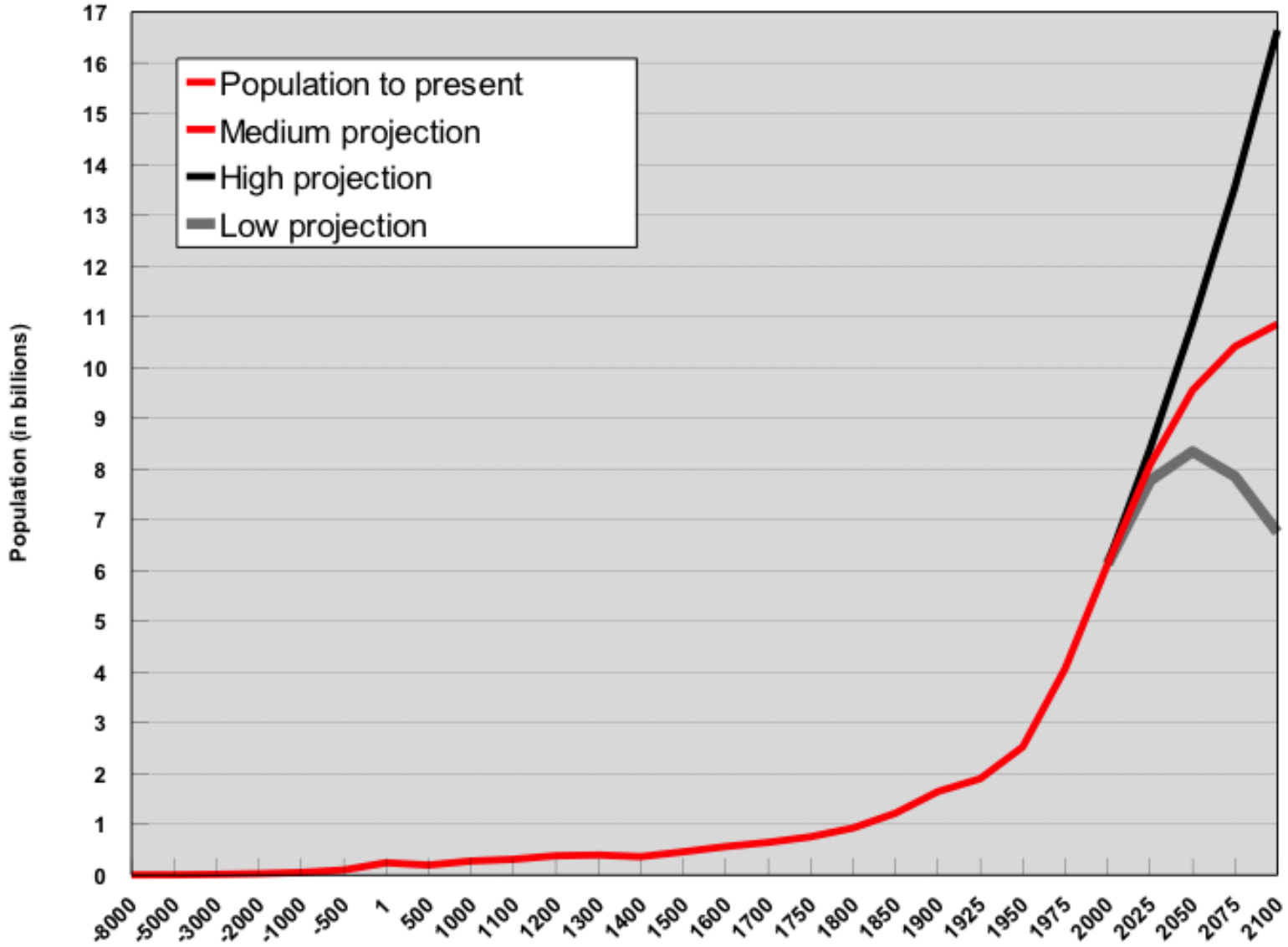
Source: Poston, Bouvier, 2017.

World population growth rates

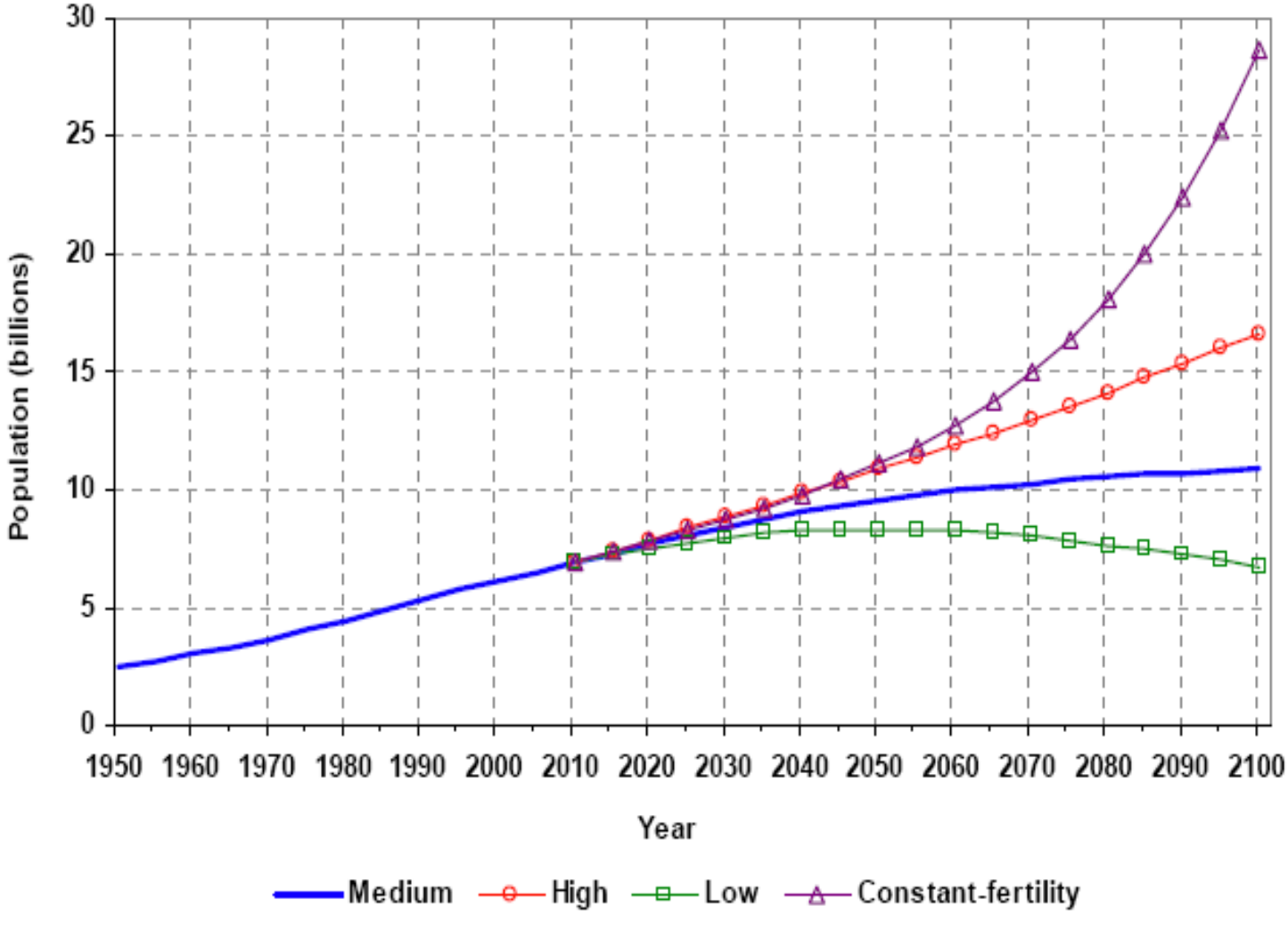


Source: Poston, Bouvier, 2017.

World's population exploded in size



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

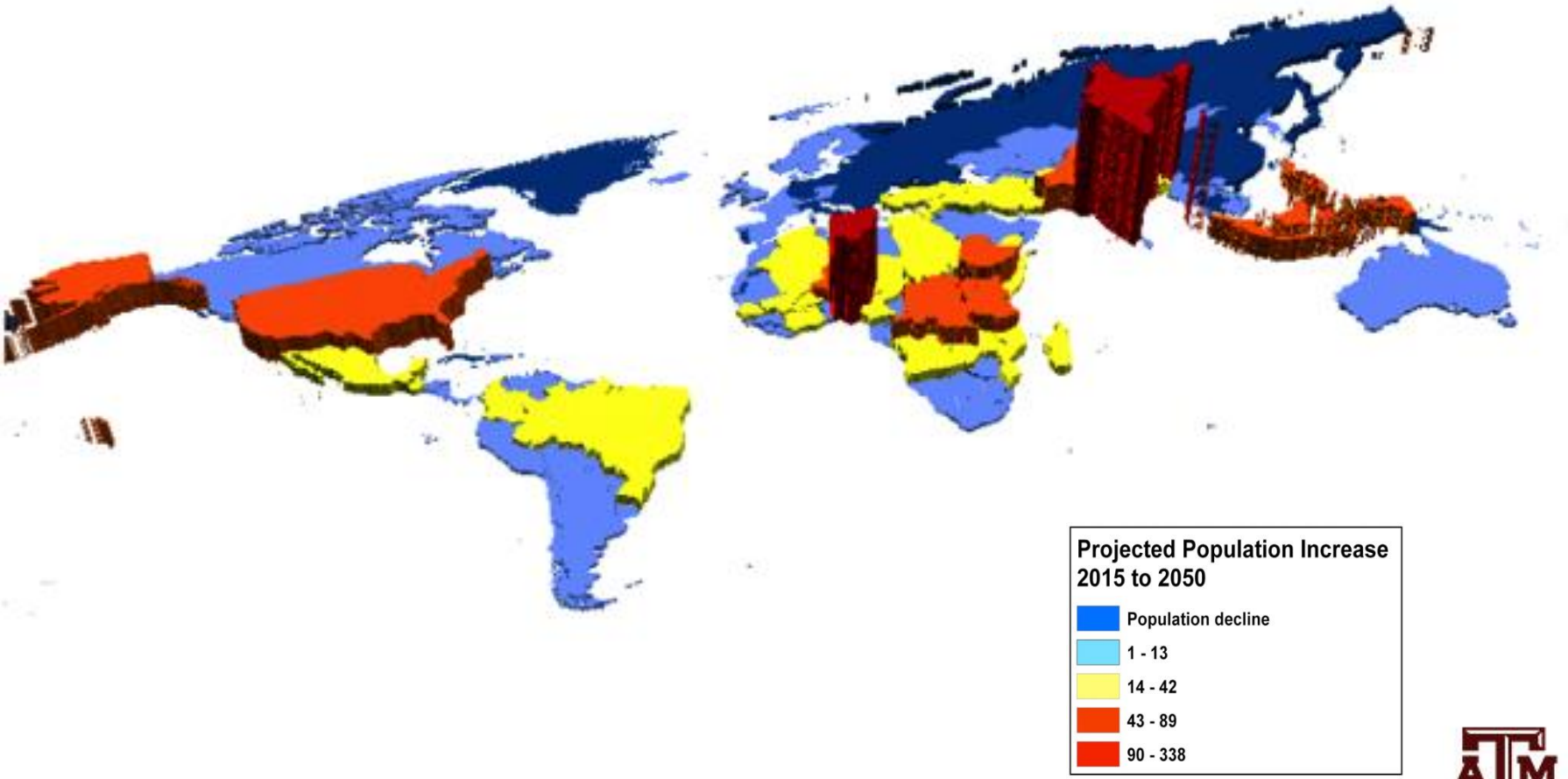
Age group	2013	2024	2050	2100
75+				1
60–74	1	1	1	2
45–59	1	1	2	2
30–44	1	2	2	2
15–29	2	2	2	2
0–14	2	2	2	2
Total	**7**	**8**	**9**	**11**

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

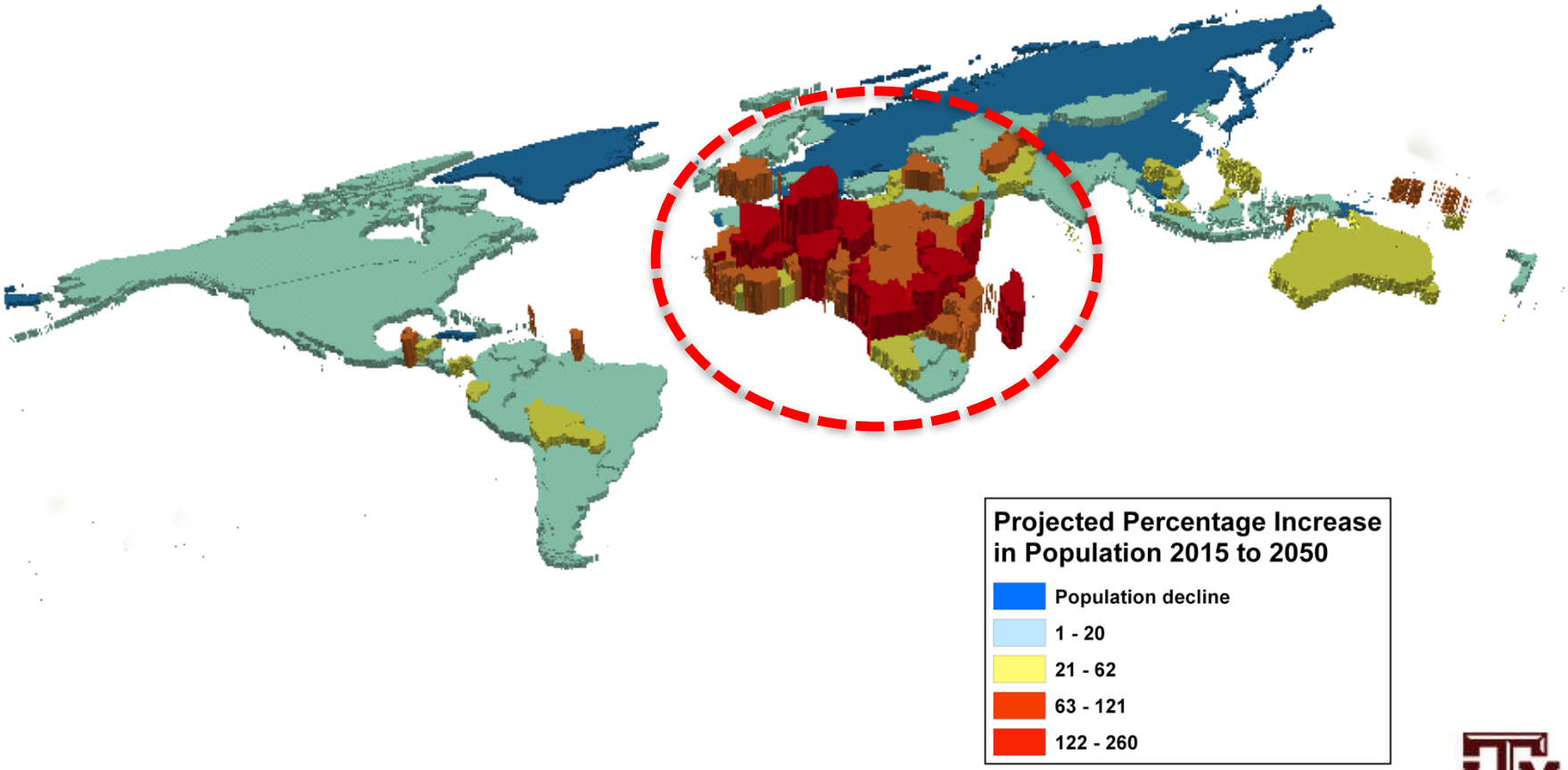
Population growth

- 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

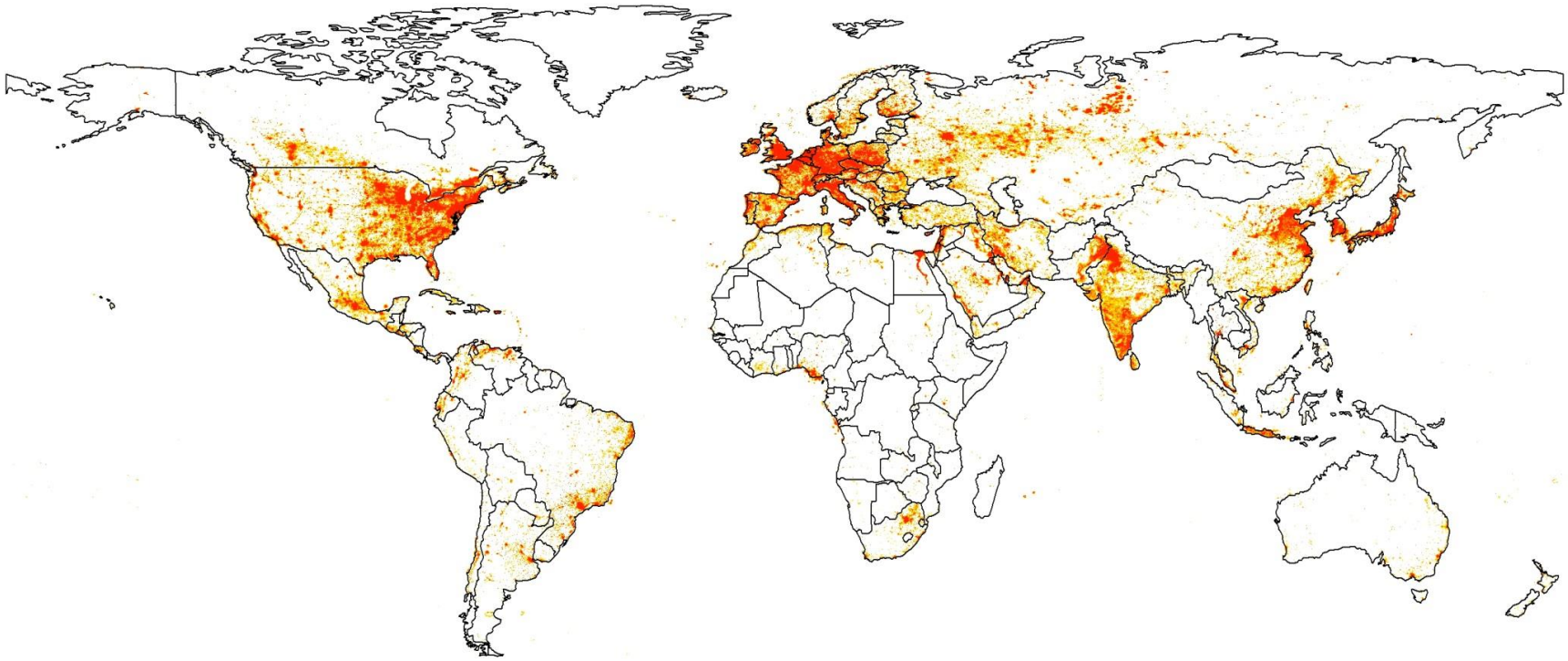
Population increase 2015–2050



Percentage population increase 2015–2050



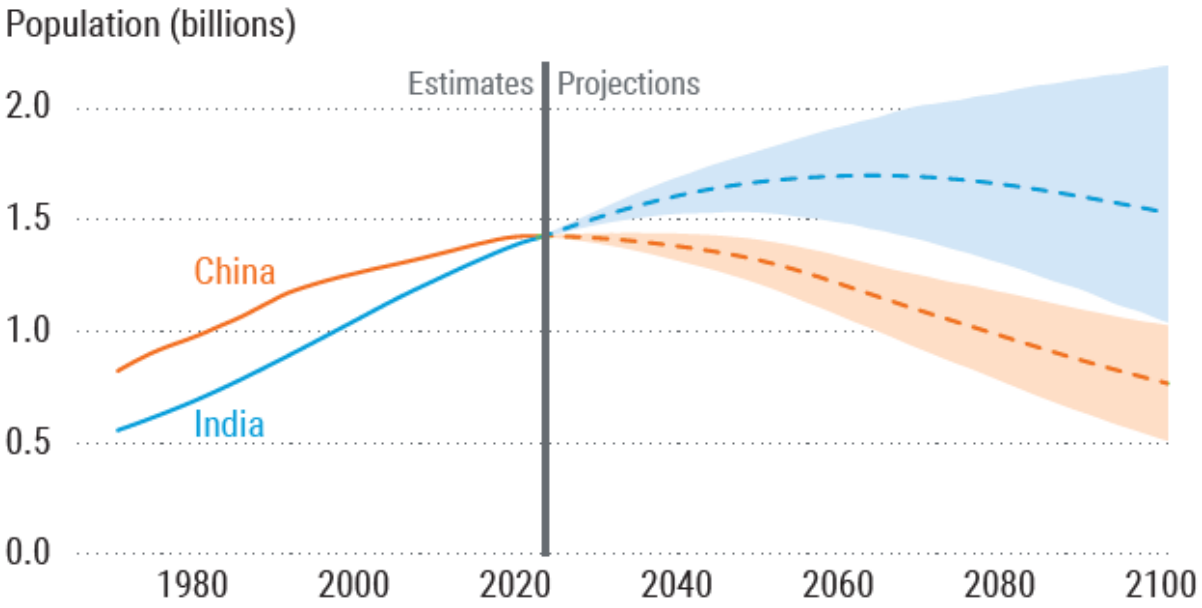
Geographic distribution of world's population, 2015



In April 2023, India's population surpassed the population of mainland China

Figure 1

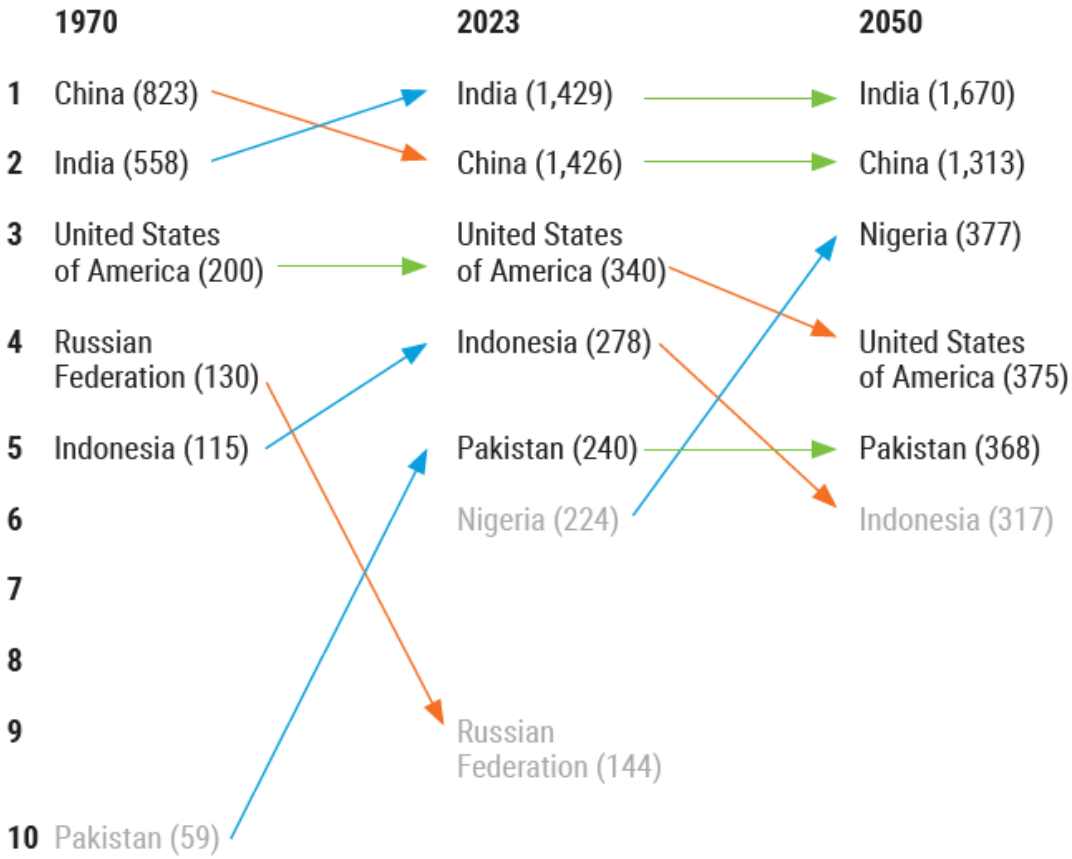
Trends in total population for China and India, estimates for 1970-2022 and projections for 2023-2100
(*with 95 per cent prediction intervals*)



Data source: United Nations, *World Population Prospects 2022*, https://population.un.org/wpp/.

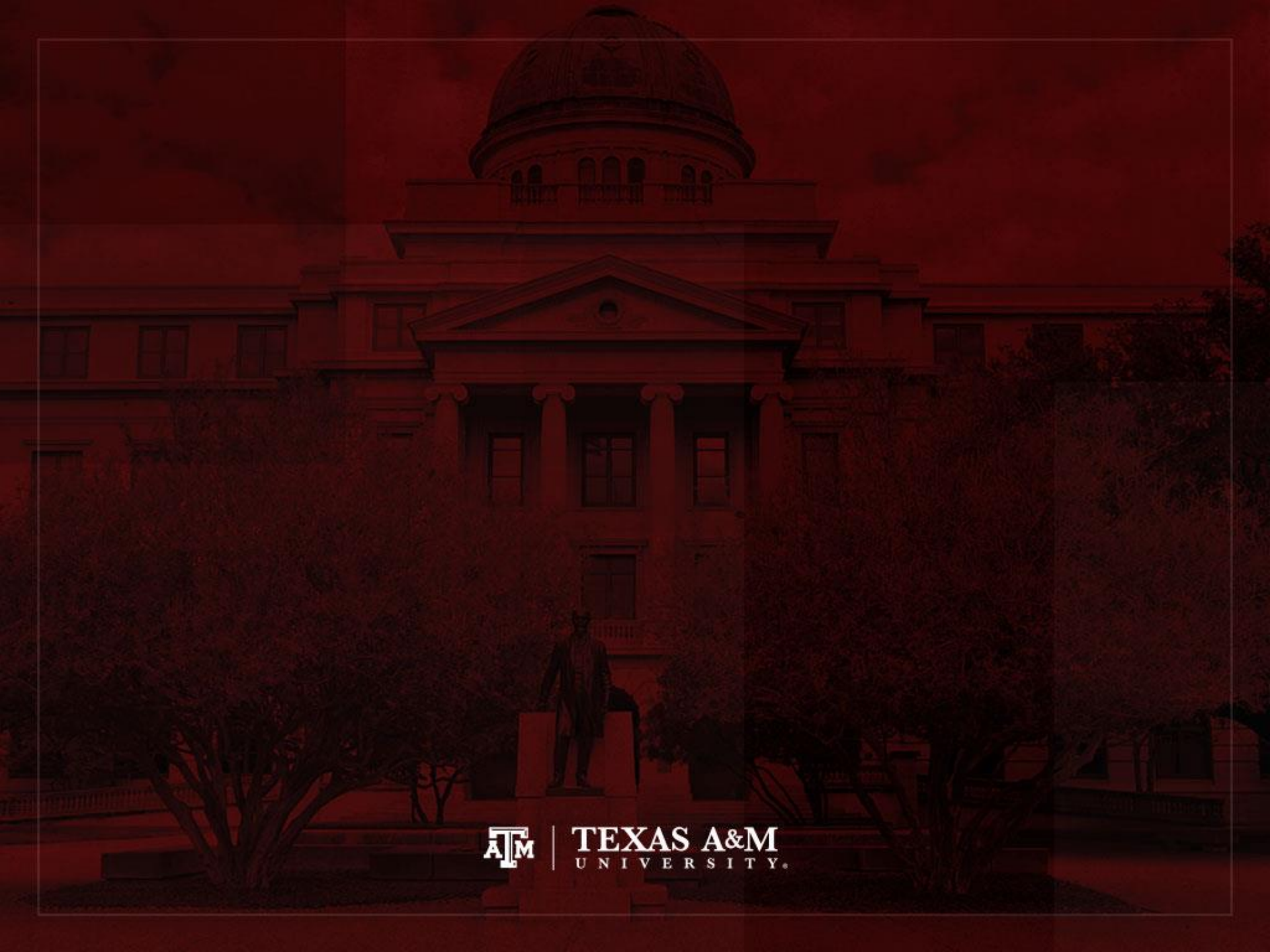
Figure 2

Top five most populous countries, estimates for 1970 and projections for 2023 and 2050



Note: Numbers in parentheses refer to total population (in millions) on 1 July of the referenced year.

Data source: United Nations, *World Population Prospects 2022*, https://population.un.org/wpp/.


TEXAS A&M
UNIVERSITY

Coronavirus pandemic, August 24, 2020

#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
	World	23,809,061	+6,189	817,005	+431	16,358,235	6,633,821	61,715	3,054	104.8			
1	USA	5,915,630		181,114		3,217,981	2,516,535	16,483	17,856	547	76,883,479	232,071	331,293,410
2	Brazil	3,627,217		115,451		2,778,709	733,057	8,318	17,046	543	14,144,344	66,473	212,784,888
3	Mexico	563,705	+3,541	60,800	+320	389,124	113,781	3,346	4,365	471	1,263,835	9,787	129,132,739
4	India	3,164,881		58,546		2,403,101	703,234	8,944	2,290	42	35,902,137	25,978	1,382,011,722
5	UK	326,614		41,433		N/A	N/A	72	4,807	610	15,177,265	223,394	67,939,531
6	Italy	260,298		35,441		205,662	19,195	65	4,306	586	8,053,551	133,231	60,448,212
7	France	244,854		30,528		85,199	129,127	399	3,750	468	6,000,000	91,890	65,295,389
8	Spain	420,809		28,872		N/A	N/A	658	9,000	617	8,517,446	182,162	46,757,536
9	Peru	600,438		27,813		407,301	165,324	1,525	18,174	842	3,006,993	91,014	33,038,913
10	Iran	361,150		20,776		311,365	29,009	3,848	4,292	247	3,062,422	36,392	84,150,494
11	Colombia	551,696		17,612		384,171	149,913	1,493	10,825	346	2,508,972	49,231	50,962,919
12	Russia	961,493		16,448		773,095	171,950	2,300	6,588	113	34,600,000	237,077	145,943,991
13	South Africa	611,450		13,159		516,494	81,797	539	10,291	221	3,564,065	59,983	59,418,339
14	Chile	399,568		10,916		372,464	16,188	1,014	20,875	570	2,231,463	116,583	19,140,575
15	Belgium	82,092	+156	9,996	+4	18,242	53,854	89	7,079	862	2,144,563	184,921	11,597,214
16	Germany	236,117		9,336		209,600	17,181	245	2,817	111	10,197,366	121,652	83,824,401
17	Canada	125,647		9,083		111,694	4,870	62	3,325	240	5,169,166	136,782	37,791,278
18	Argentina	350,867		7,366		256,789	86,712	1,960	7,753	163	1,105,878	24,435	45,257,261
19	Indonesia	155,412		6,759		111,060	37,593		567	25	2,056,166	7,506	273,950,524
20	Iraq	207,985		6,519		150,389	51,077	661	5,154	162	1,457,665	36,125	40,350,522

Source: https://www.worldometers.info/coronavirus/.

Coronavirus pandemic, August 31, 2021

#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	New Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
	World	218,171,757	+278,500	4,527,970	+4,700	195,040,717	+304,214	18,603,070	113,811	27,989	580.9			
1	USA	39,953,651	+6,943	656,482	+89	30,945,115	+650	8,352,054	25,541	119,888	1,970	582,550,800	1,748,051	333,257,237
2	Brazil	20,752,281		579,643		19,692,898		479,740	8,318	96,831	2,705	56,897,224	265,485	214,314,149
3	India	32,808,018	+40,198	438,962	+370	31,982,180	+29,967	386,876	8,944	23,506	314	521,541,098	373,663	1,395,753,675
4	Mexico	3,341,264	+5,564	258,491	+326	2,686,568	+16,627	396,205	4,798	25,603	1,981	9,723,416	74,506	130,505,007
5	Peru	2,149,591		198,263		N/A	N/A	N/A	1,333	64,158	5,917	16,733,426	499,437	33,504,611
6	Russia	6,918,965	+17,813	183,224	+795	6,181,054	+18,624	554,687	2,300	47,388	1,255	178,700,000	1,223,912	146,007,206
7	Indonesia	4,089,801	+10,534	133,023	+532	3,760,497	+16,781	196,281		14,771	480	32,216,075	116,354	276,880,593
8	UK	6,757,650		132,485		5,427,062		1,198,103	982	98,940	1,940	266,714,771	3,905,032	68,300,272
9	Italy	4,534,499		129,146		4,263,960		141,393	548	75,126	2,140	83,728,076	1,387,181	60,358,447
10	Colombia	4,907,264		124,883		4,737,467		44,914	8,155	95,264	2,424	24,121,717	468,271	51,512,348
11	France	6,746,283		114,308		*6,225,201*		406,774	2,270	103,089	1,747	124,769,146	1,906,579	65,441,374
12	Argentina	5,178,889		111,607		4,869,104		198,178	2,713	113,380	2,443	22,017,526	482,024	45,677,243
13	Iran	4,992,063	+31,319	107,794	+643	4,205,927	+30,522	678,342	7,879	58,565	1,265	28,213,229	330,985	85,240,218
14	Germany	3,950,247	+3,231	92,682	+11	3,738,000	+6,100	119,565	1,096	46,973	1,102	68,329,706	812,527	84,095,254
15	Spain	4,847,298		84,146		4,338,145		425,007	1,685	103,628	1,799	60,618,810	1,295,943	46,775,830
16	South Africa	2,770,575		81,830		2,533,956		154,789	546	46,041	1,360	16,426,011	272,965	60,176,262
17	Poland	2,888,670	+285	75,345	+5	2,657,084	+30	156,241	60	76,423	1,993	19,778,356	523,259	37,798,415
18	Turkey	6,366,438		56,458		5,823,111		486,869	633	74,555	661	76,140,298	891,652	85,392,352
19	Ukraine	2,286,296	+1,356	53,789	+51	2,207,940	+1,257	24,567	177	52,646	1,239	11,980,323	275,866	43,428,075
20	Chile	1,638,675	+345	36,937	+14	1,595,747	+577	5,991	687	84,876	1,913	20,276,691	1,050,240	19,306,720

Source: https://www.worldometers.info/coronavirus/.

Coronavirus pandemic, January 17, 2022

#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	New Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
	World	331,459,057	+138,304	5,563,652	+219	269,090,164	+64,428	56,805,241	97,247	42,523	713.8			
1	USA	67,631,191		874,321		43,165,667		23,591,203	25,869	202,490	2,618	862,458,737	2,582,225	333,998,303
2	Brazil	23,083,297		621,261		21,710,831		751,205	8,318	107,419	2,891	63,776,166	296,783	214,891,229
3	India	37,618,271		486,784		35,394,882		1,736,605	8,944	26,852	347	705,411,425	503,527	1,400,939,318
4	Russia	10,834,260		321,990		9,878,371		633,899	2,300	74,191	2,205	246,800,000	1,690,051	146,031,061
5	Mexico	4,385,415	+17,101	301,469	+59	3,478,130	+34,246	605,816	4,798	33,471	2,301	13,163,932	100,471	131,022,844
6	Peru	2,606,126		203,464		N/A	N/A	N/A	1,038	77,378	6,041	23,289,858	691,497	33,680,346
7	UK	15,305,410		152,075		11,497,602		3,655,733	746	223,644	2,222	434,073,111	6,342,723	68,436,401
8	Indonesia	4,272,421		144,174		4,119,472		8,775		15,369	519	67,715,434	243,593	277,986,279
9	Italy	8,790,302		141,391		6,093,633		2,555,278	1,717	145,717	2,344	156,338,495	2,591,622	60,324,574
10	Iran	6,224,196		132,095		6,066,819		25,282	1,313	72,669	1,542	42,908,102	500,962	85,651,435
11	Colombia	5,568,068		131,130		5,258,204		178,734	342	107,659	2,535	31,171,683	602,704	51,719,680
12	France	14,274,528		127,263		*9,198,995*		4,948,270	3,895	217,943	1,943	211,520,605	3,229,497	65,496,464
13	Argentina	7,197,323		118,231		6,193,473		885,619	2,099	157,024	2,579	30,753,911	670,959	45,835,727
14	Germany	8,045,348		116,411		7,000,000		928,937	3,212	95,553	1,383	89,622,218	1,064,429	84,197,463
15	Poland	4,323,482		102,309		3,800,051		421,122	1,519	114,430	2,708	28,591,765	756,744	37,782,620
16	Ukraine	3,759,530		98,361		3,556,162		105,007	177	86,769	2,270	17,182,817	396,574	43,328,102
17	South Africa	3,560,921		93,451		3,375,859		91,611	546	58,895	1,546	21,815,463	360,811	60,462,270
18	Spain	8,424,503		90,993		5,331,175		3,002,335	2,251	180,077	1,945	66,213,858	1,415,348	46,782,734
19	Turkey	10,522,099		84,920		9,737,610		699,569	1,128	122,722	990	125,433,490	1,462,964	85,739,301
20	Romania	1,911,546		59,257		1,776,122		76,167	485	100,399	3,112	17,974,573	944,065	19,039,551

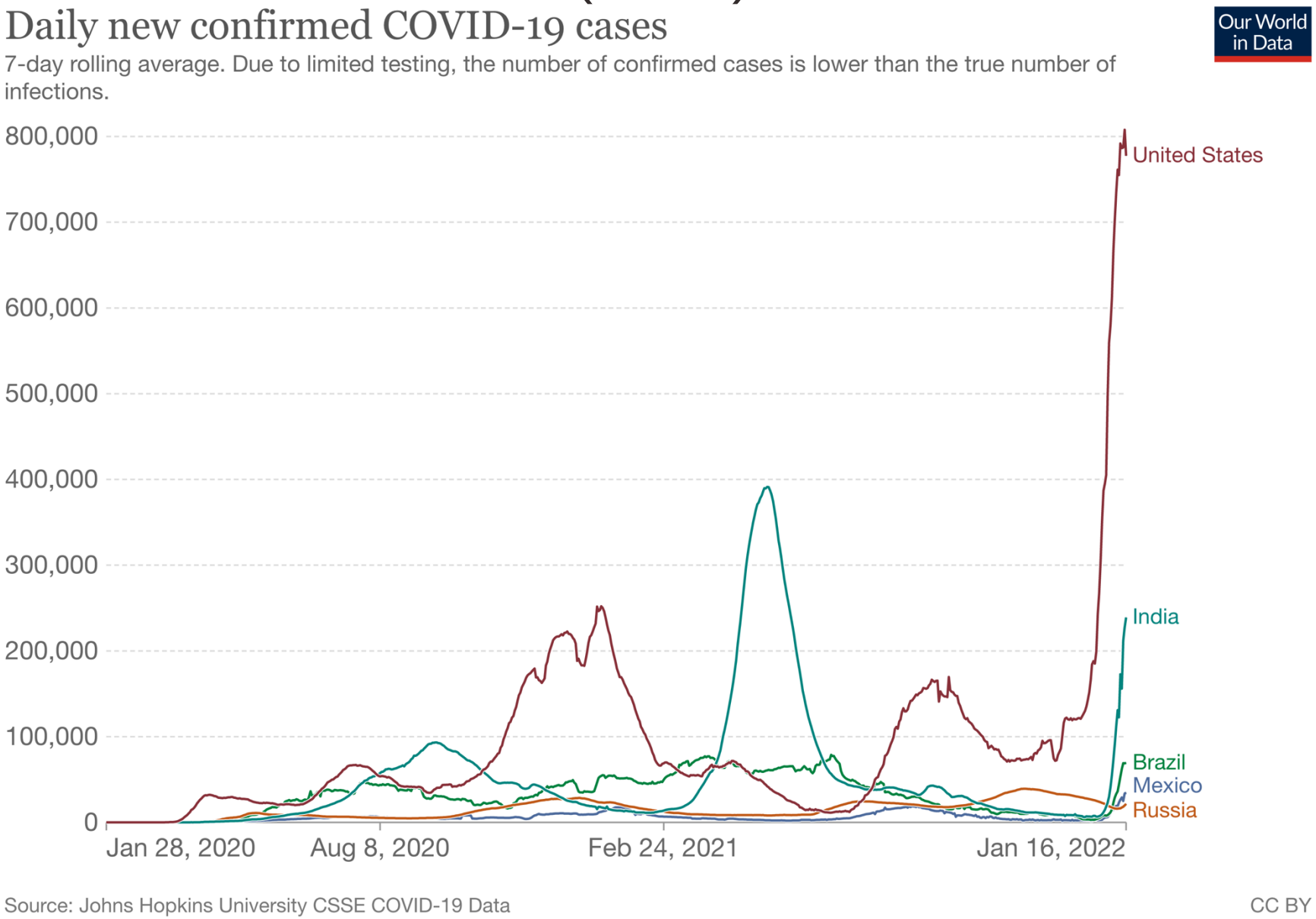
Source: https://www.worldometers.info/coronavirus/.

Coronavirus pandemic, January 17, 2023

#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	New Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
	World	671,760,988	+198,796	6,732,661	+547	643,130,485	+191,195	21,897,842	45,494	86,181	863.7			
1	USA	103,583,983		1,125,558		100,449,206		2,009,219	4,454	309,386	3,362	1,157,800,576	3,458,131	334,805,269
2	Brazil	36,661,526		695,461		35,580,516		385,549	8,318	170,239	3,229	63,776,166	296,146	215,353,593
3	India	44,681,884		530,726		44,148,472		2,686	698	31,765	377	913,255,016	649,250	1,406,631,776
4	Russia	21,864,944	+4,042	394,483	+45	21,283,039	+4,933	187,422	2,300	149,959	2,706	273,400,000	1,875,095	145,805,947
5	Mexico	7,314,891		331,595		6,544,815		438,481	4,798	55,600	2,520	19,198,152	145,924	131,562,772
6	Peru	4,475,610		218,547		*4,245,094*	+2,474	11,969	77	132,870	6,488	37,578,799	1,115,621	33,684,208
7	UK	24,243,393		202,157		*23,935,279*	+8,569	105,957	146	353,929	2,951	522,526,476	7,628,357	68,497,907
8	Italy	25,363,742		185,993		24,824,106		353,643	310	420,886	3,086	264,182,282	4,383,839	60,262,770
9	Germany	37,622,357		163,965		37,104,300	+40,500	354,092	1,281	448,507	1,955	122,332,384	1,458,359	83,883,596
10	France	39,453,006		163,463		*39,056,393*		233,150	869	601,560	2,492	271,490,188	4,139,547	65,584,518
11	Indonesia	6,726,668	+357	160,746	+7	6,559,303	+572	6,619	2,771	24,098	576	114,158,919	408,975	279,134,505
12	Iran	7,562,755		144,727		7,336,791		81,237	188	87,916	1,682	54,420,785	632,632	86,022,837
13	Colombia	6,349,971		142,259		6,170,360		37,352	342	123,270	2,762	36,951,507	717,327	51,512,762
14	Argentina	10,024,095		130,338		*9,760,801*		132,956	402	217,867	2,833	35,716,069	776,264	46,010,234
15	Poland	6,373,880	+514	118,660	+9	5,335,940		919,280	1,101	168,890	3,144	38,060,816	1,008,506	37,739,785
16	Spain	13,711,251		117,759		13,522,850		70,642	231	293,483	2,521	471,036,328	10,082,298	46,719,142
17	Ukraine	5,364,322		110,920		*5,246,563*	+457	6,839		124,197	2,568	32,603,805	754,855	43,192,122
18	South Africa	4,051,891		102,568		3,912,506		36,817	192	66,691	1,688	26,473,049	435,726	60,756,135
19	Turkey	17,042,722		101,492		N/A	N/A	N/A		199,186	1,186	162,743,369	1,902,052	85,561,976
20	Romania	3,319,680		67,504		*3,240,976*		11,200	118	174,432	3,547	26,244,526	1,379,017	19,031,335

Source: https://www.worldometers.info/coronavirus/.

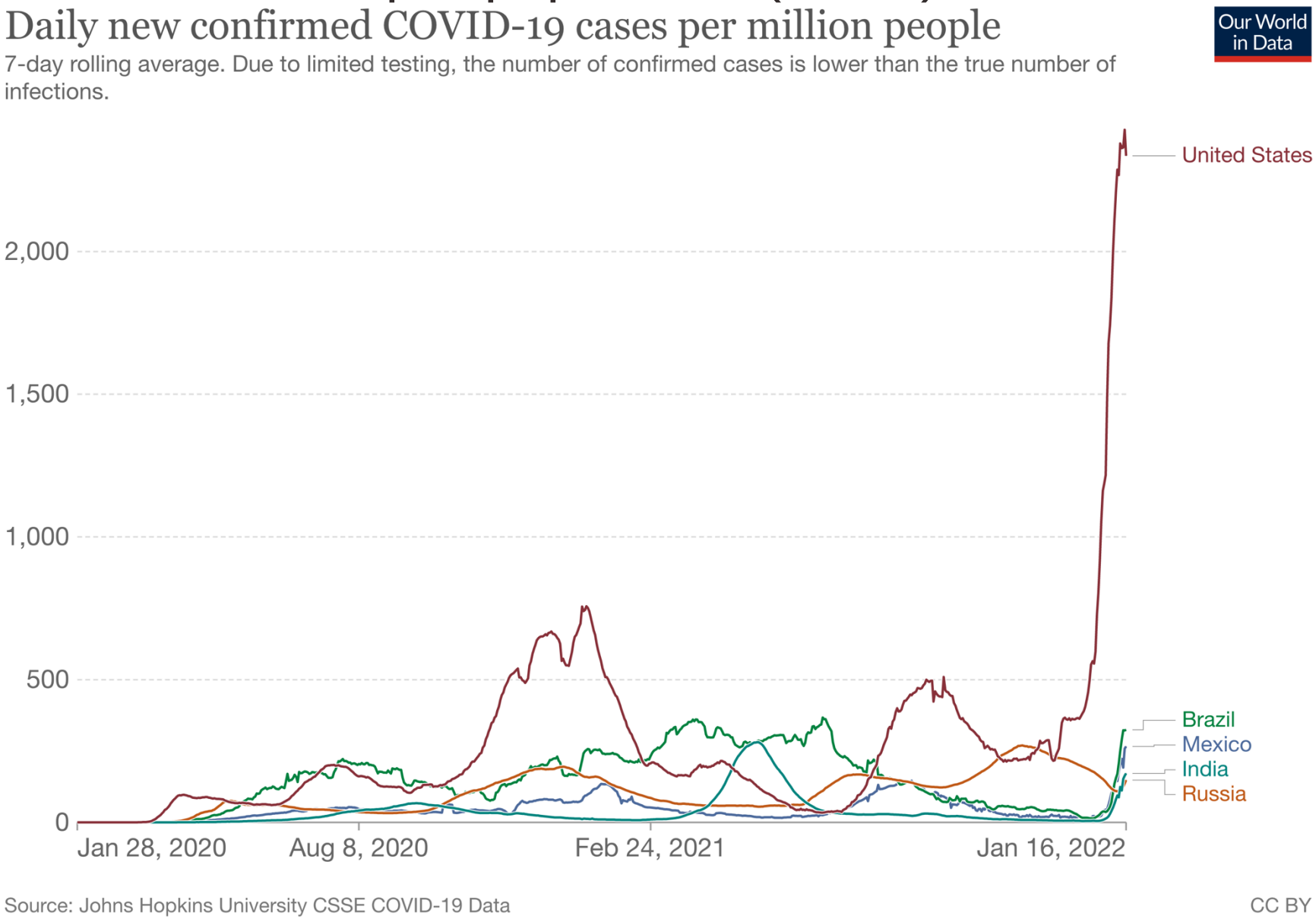
New cases (linear), 1/17/2022



Note: Five countries with more deaths (United States, Brazil, India, Russia, Mexico).

Source: https://ourworldindata.org/coronavirus.

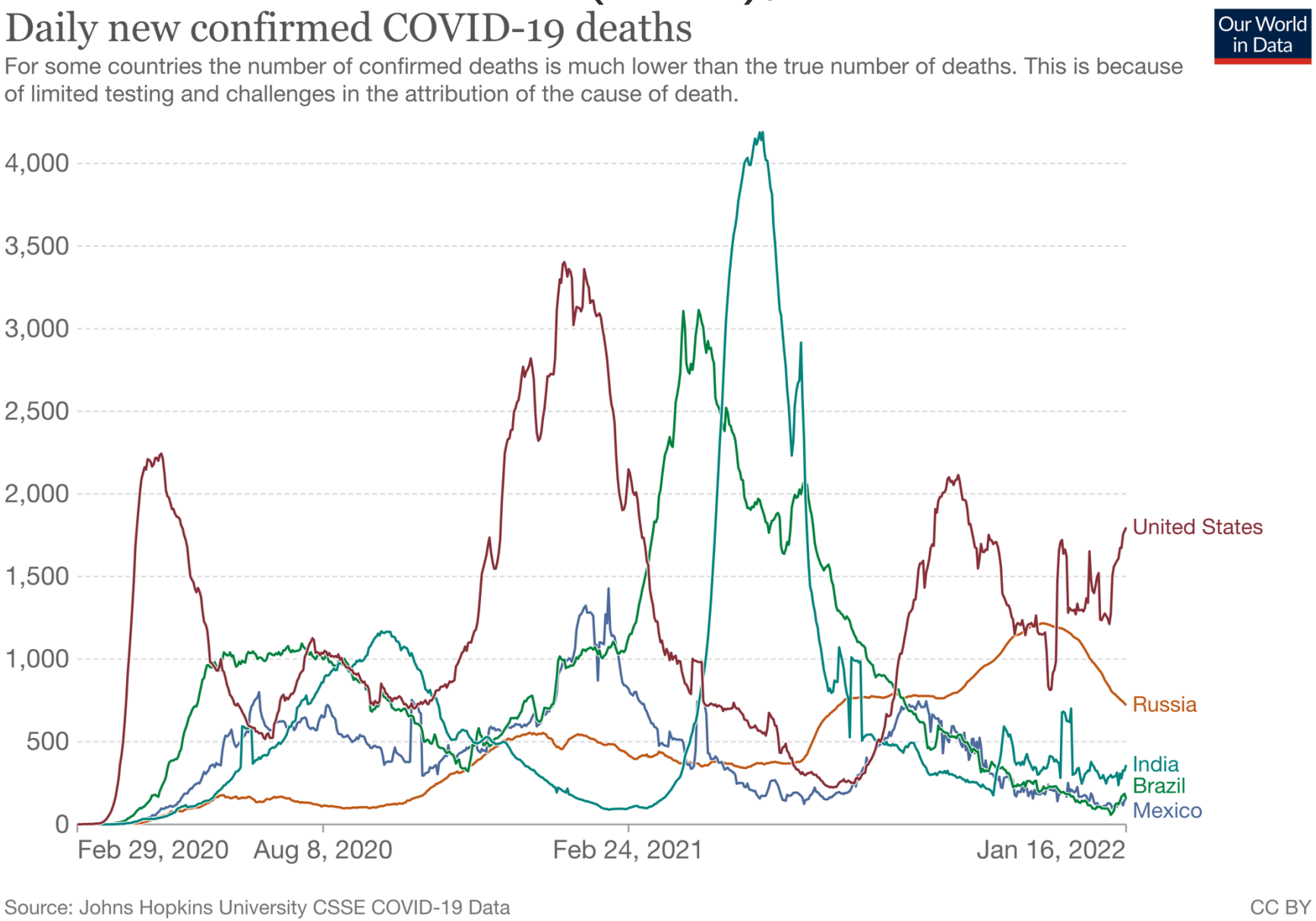
New cases per population (linear), 1/17/2022



Note: Five countries with more deaths (United States, Brazil, India, Russia, Mexico).

Source: https://ourworldindata.org/coronavirus.

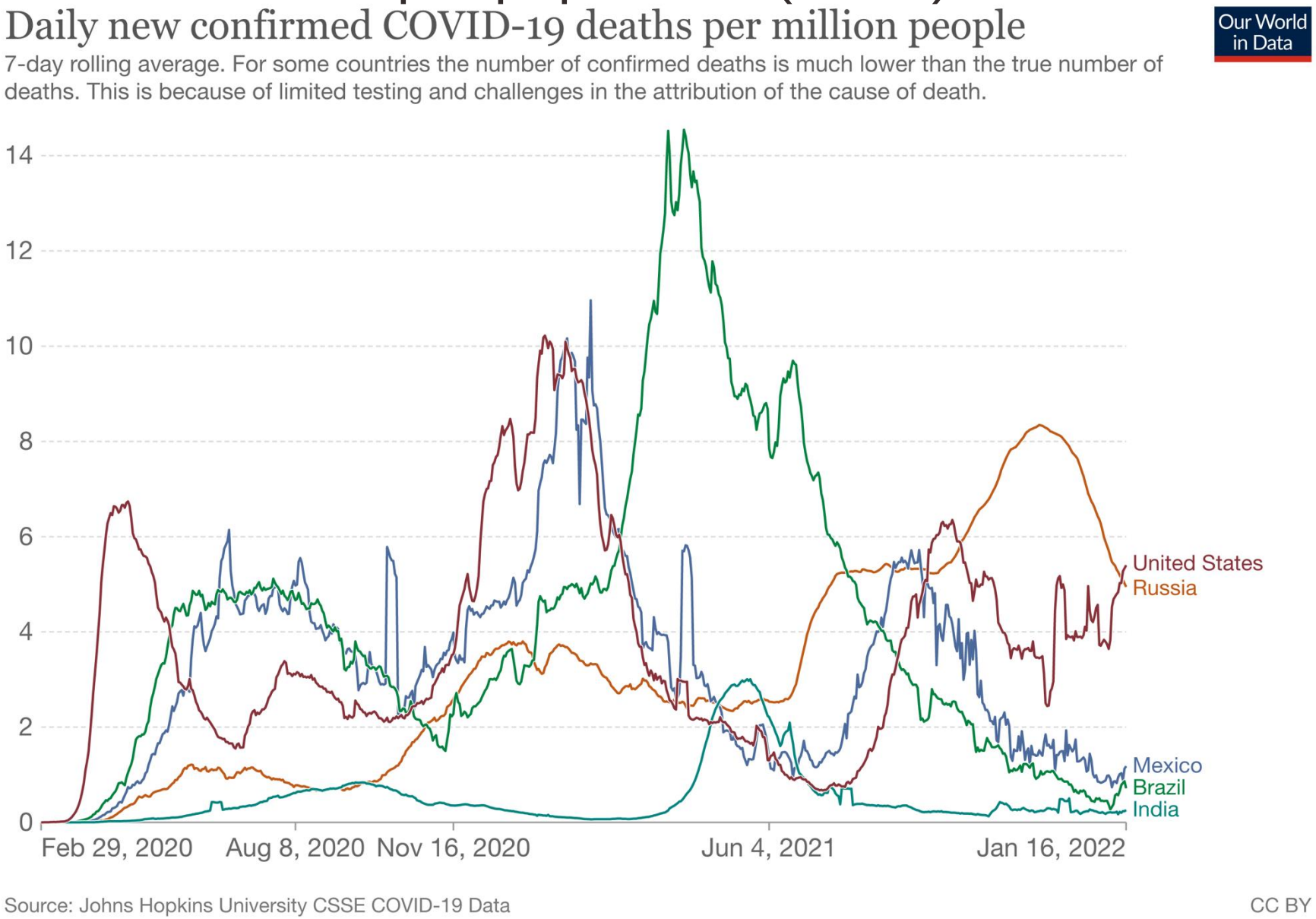
New deaths (linear), 1/17/2022



Note: Five countries with more deaths (United States, Brazil, India, Russia, Mexico).

Source: https://ourworldindata.org/coronavirus.

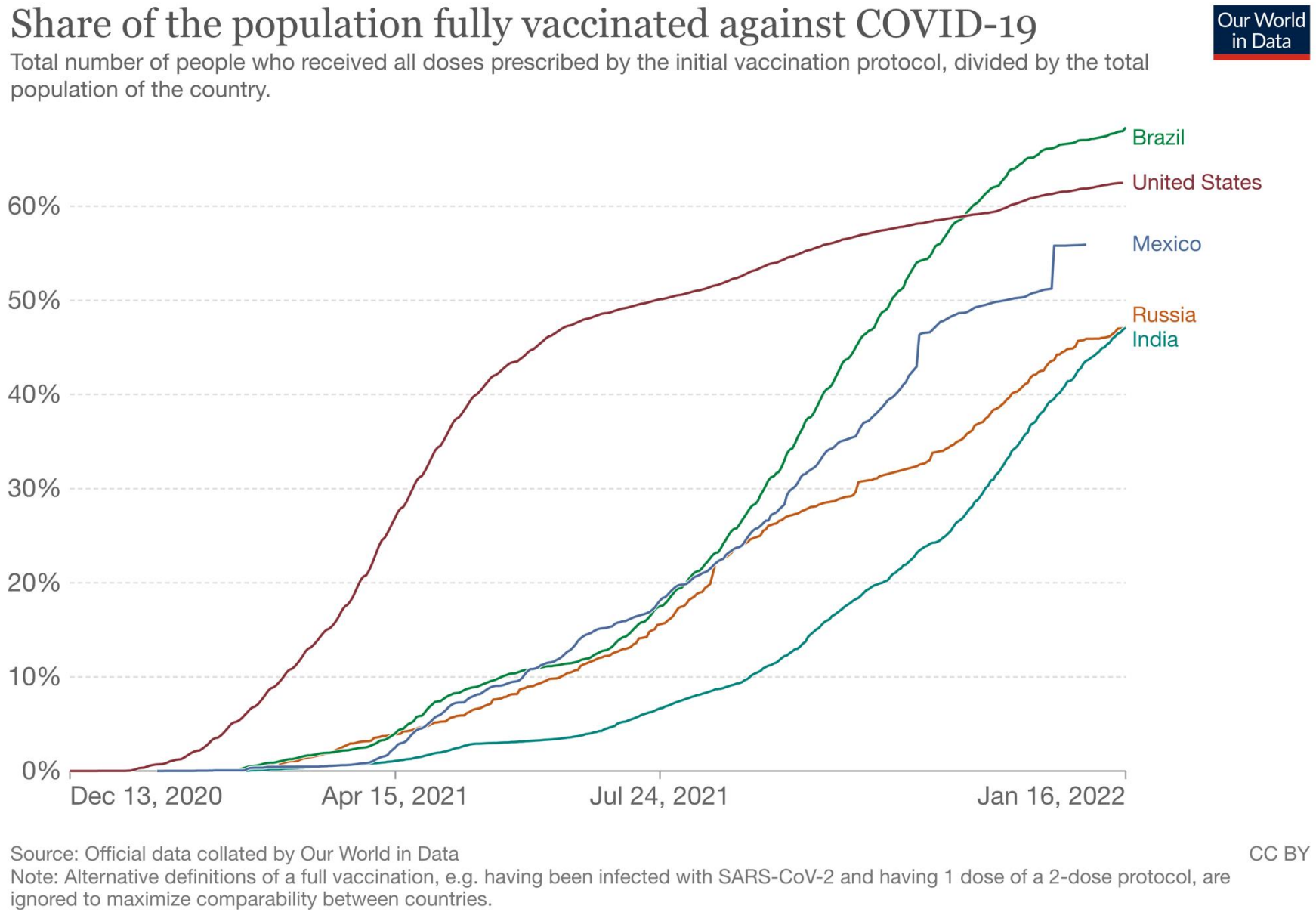
New deaths per population (linear), 1/17/2022



Note: Five countries with more deaths (United States, Brazil, India, Russia, Mexico).

Source: https://ourworldindata.org/coronavirus.

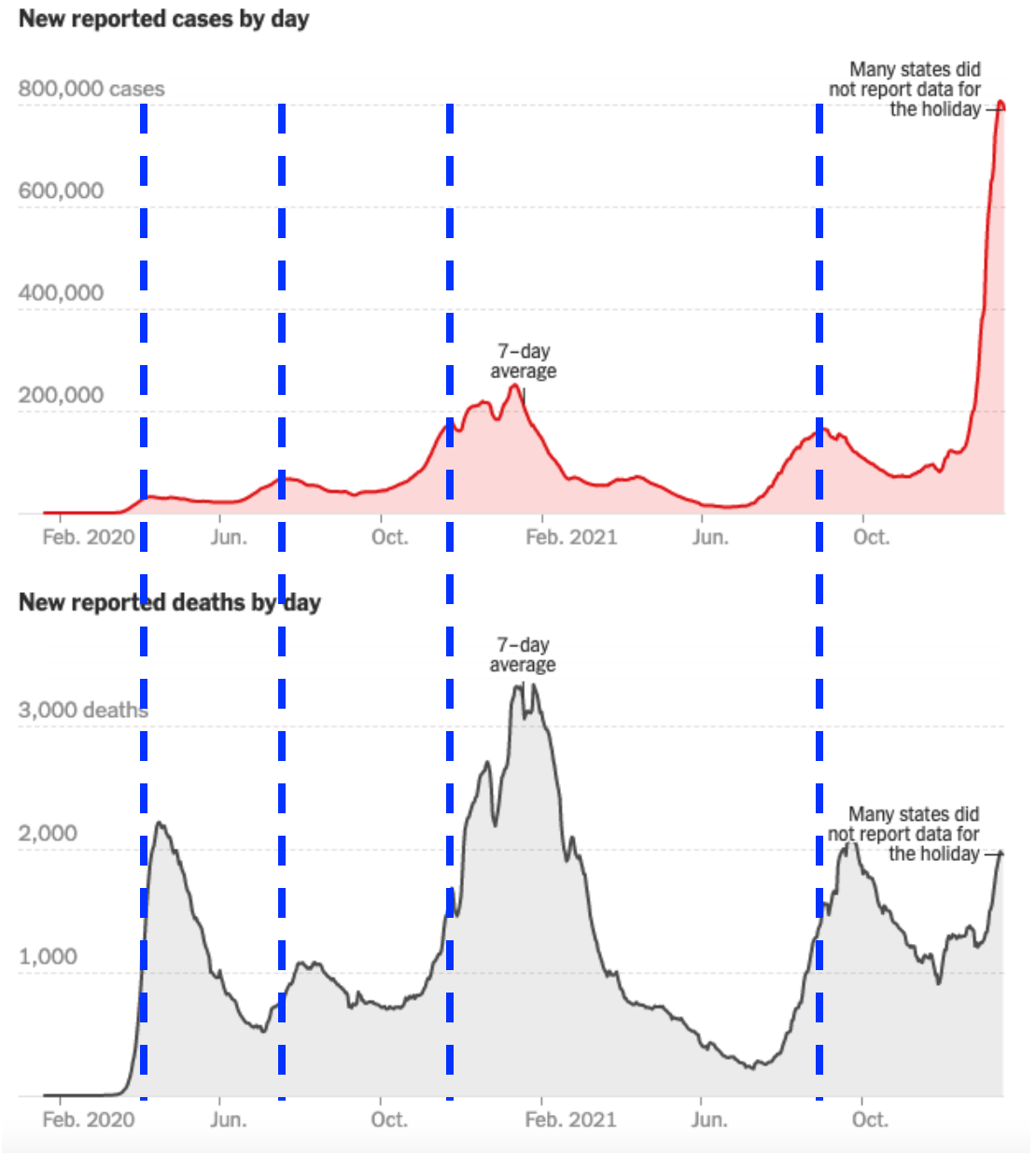
Percentage fully vaccinated, 1/17/2022



Note: Five countries with more deaths (United States, Brazil, India, Russia, Mexico).

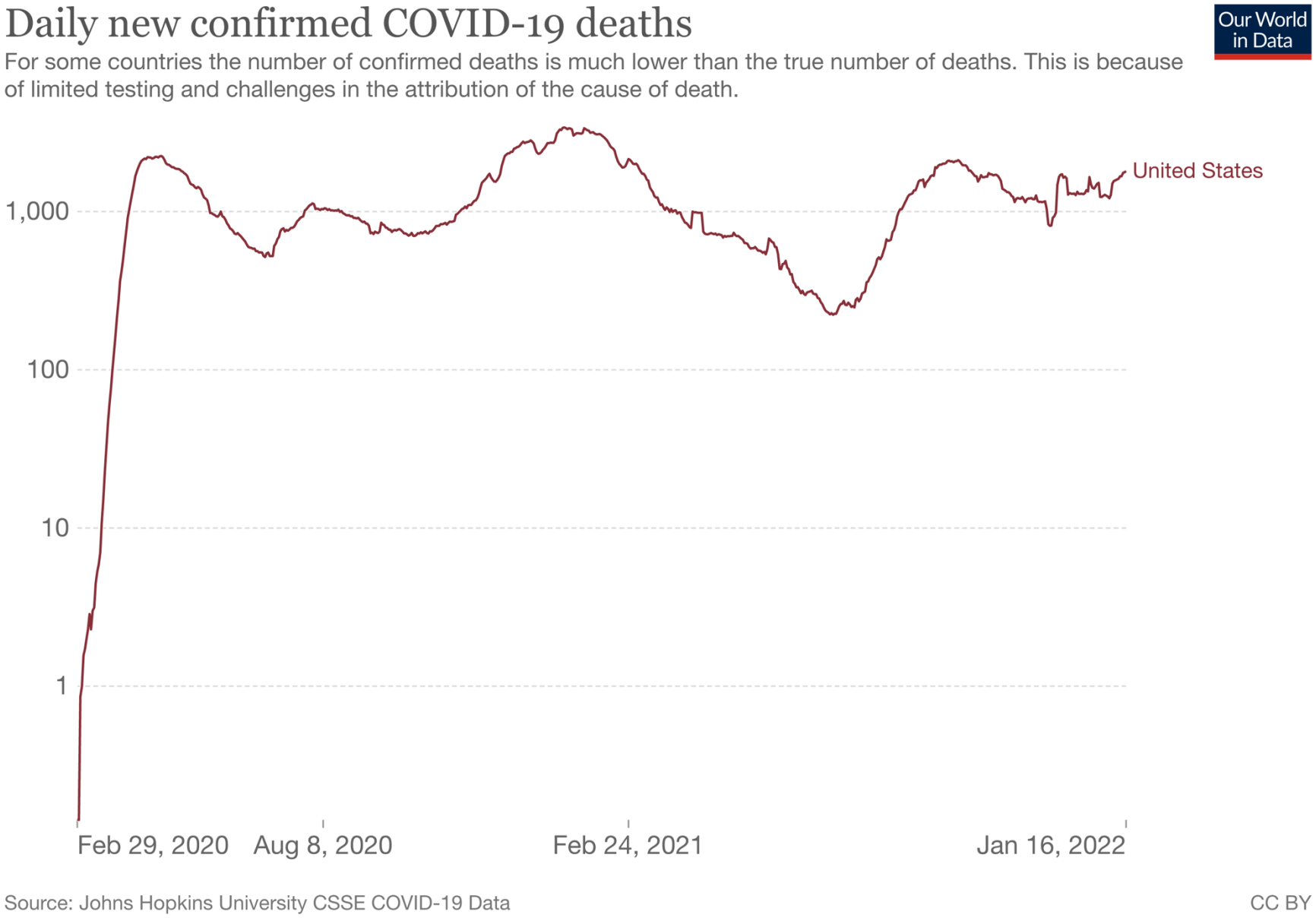
Source: https://ourworldindata.org/coronavirus.

United States
1/17/2022



Source: https://www.nytimes.com/interactive/2021/us/covid-cases.html.

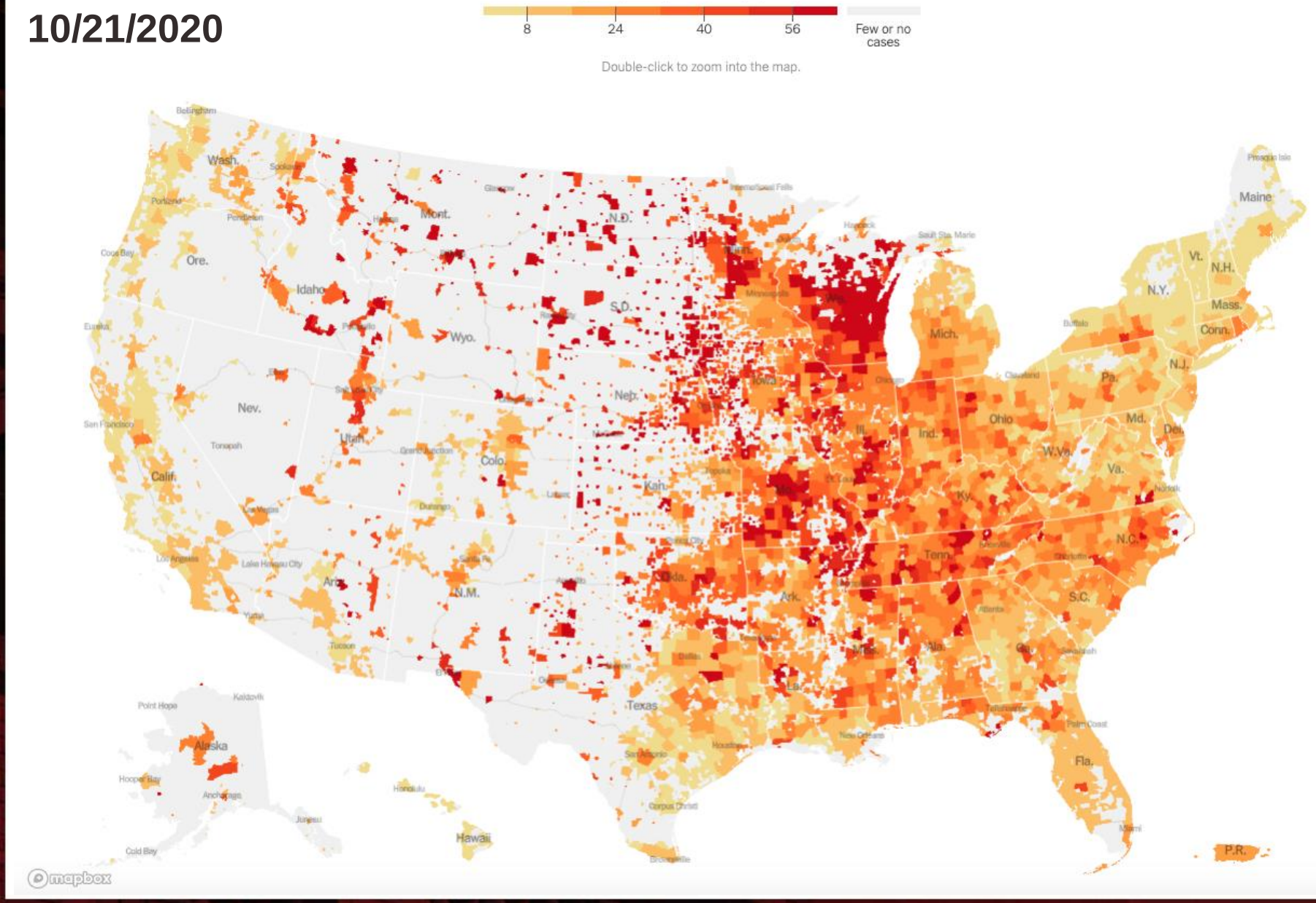
New cases (log), flattening the curve, 1/17/2022



Source: https://ourworldindata.org/coronavirus.

Average daily cases per 100,000 people in past week

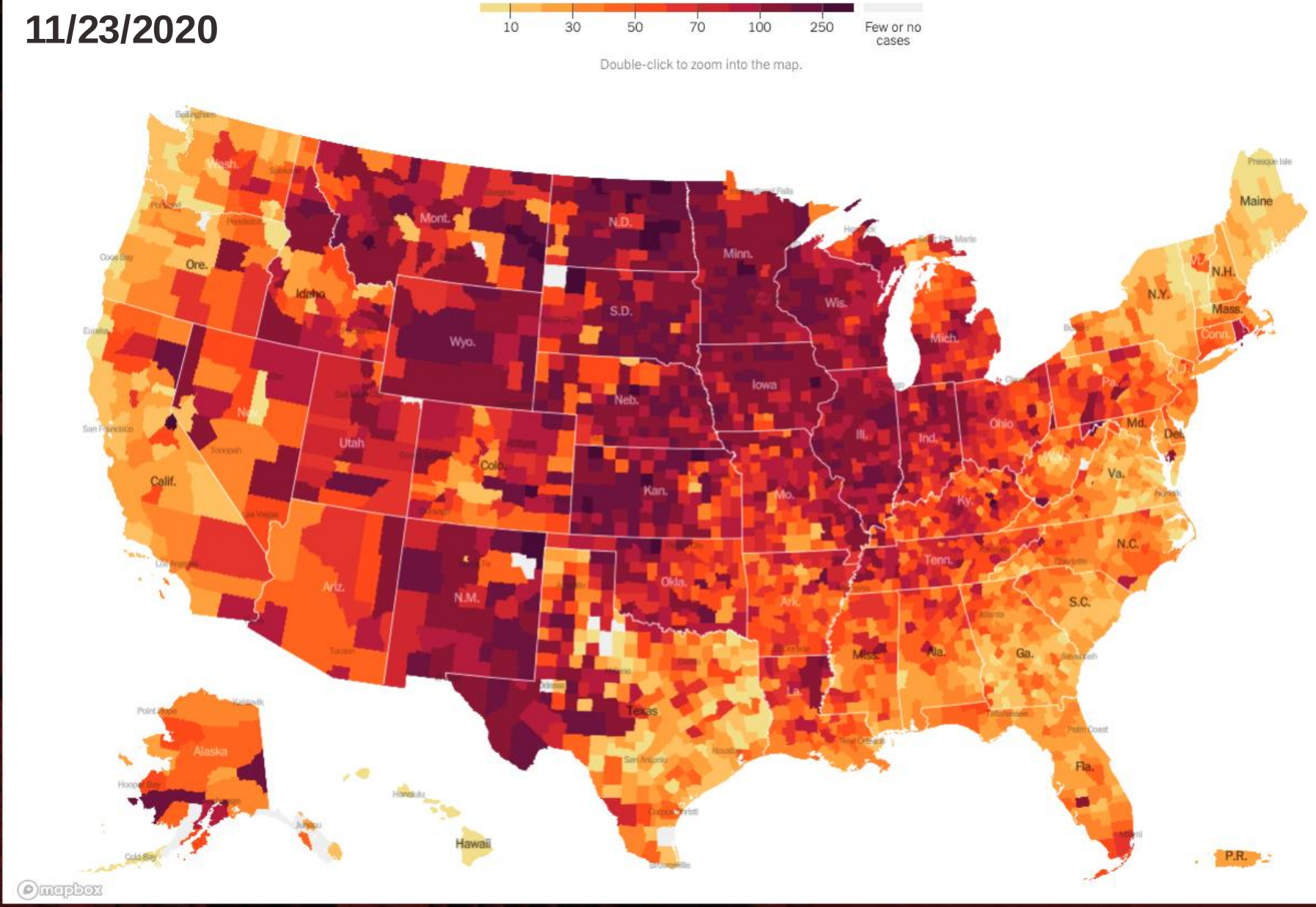
10/21/2020



Source: https://www.nytimes.com/interactive/2020/us/coronavirus-us-cases.html.

Average daily cases per 100,000 people in past week

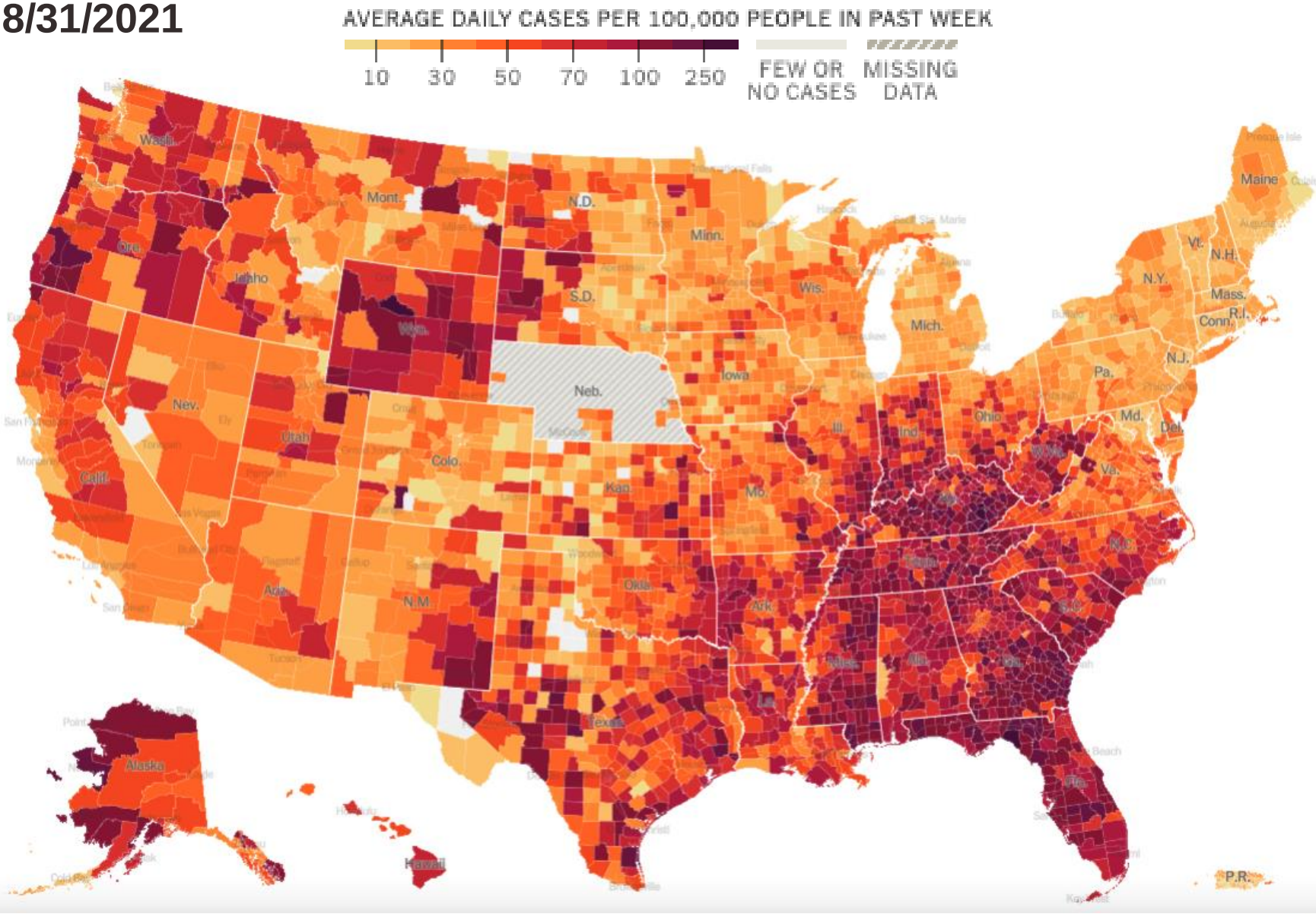
11/23/2020



Source: https://www.nytimes.com/interactive/2021/us/covid-cases.html.

Average daily cases per 100,000 people in past week

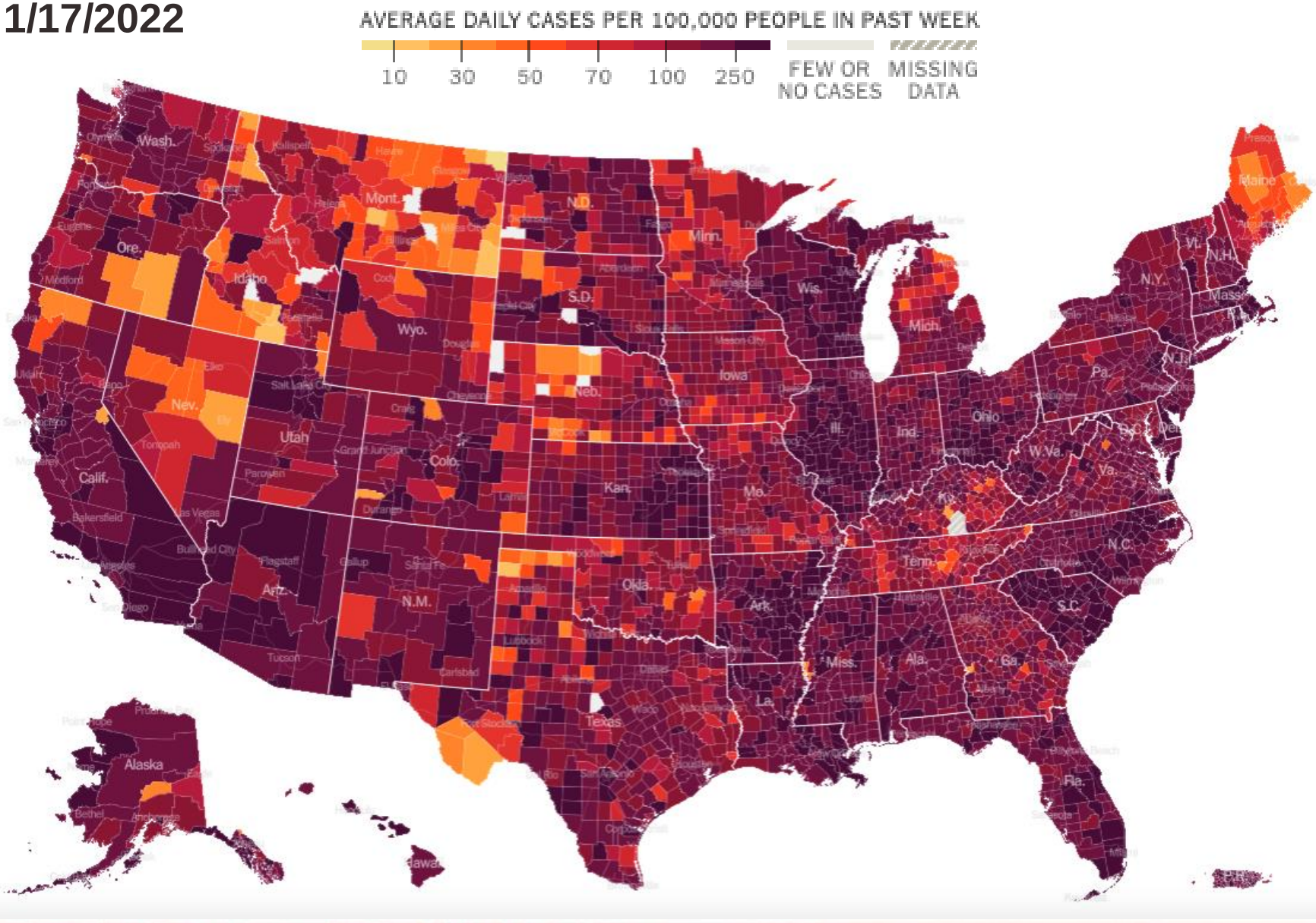
8/31/2021



Source: https://www.nytimes.com/interactive/2021/us/covid-cases.html.

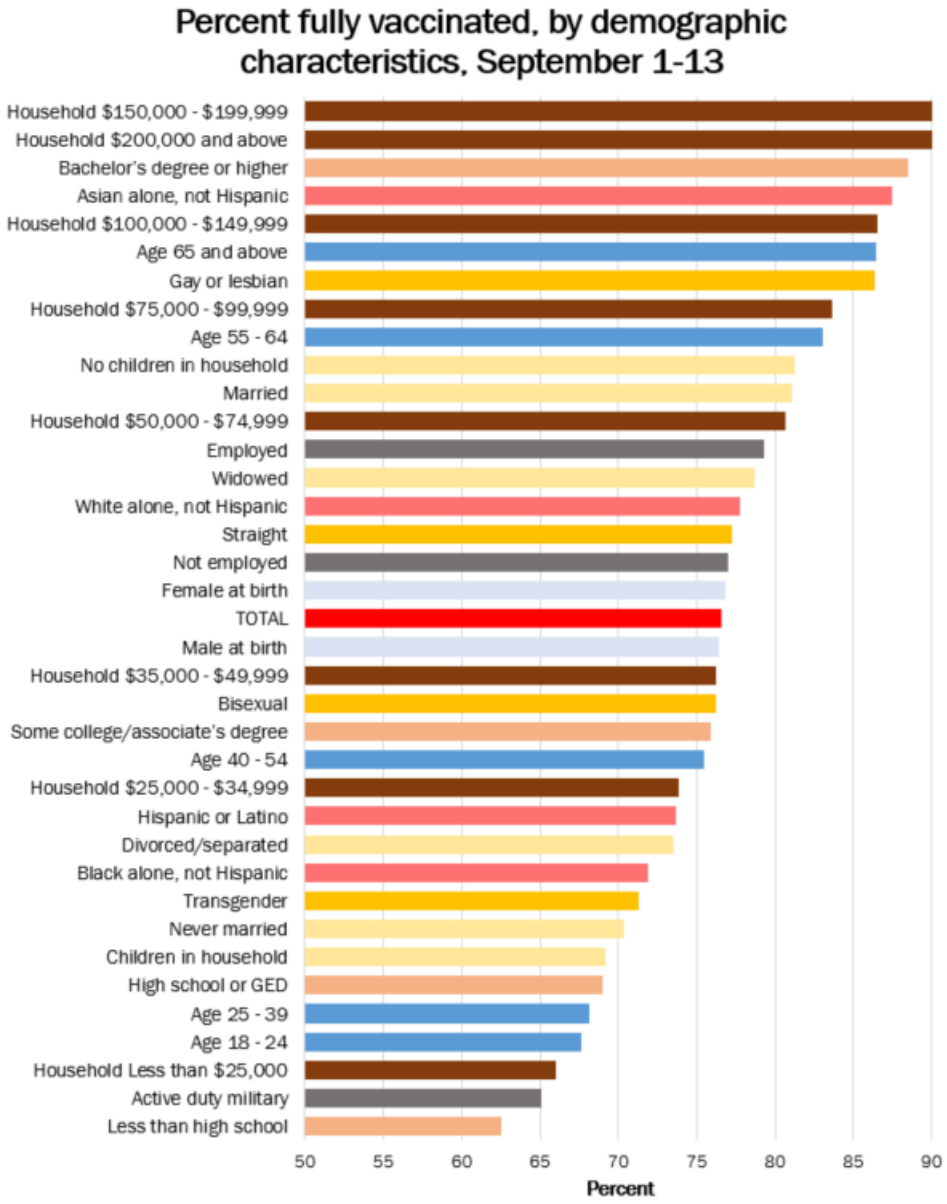
Average daily cases per 100,000 people in past week

1/17/2022



Source: https://www.nytimes.com/interactive/2021/us/covid-cases.html.

United States



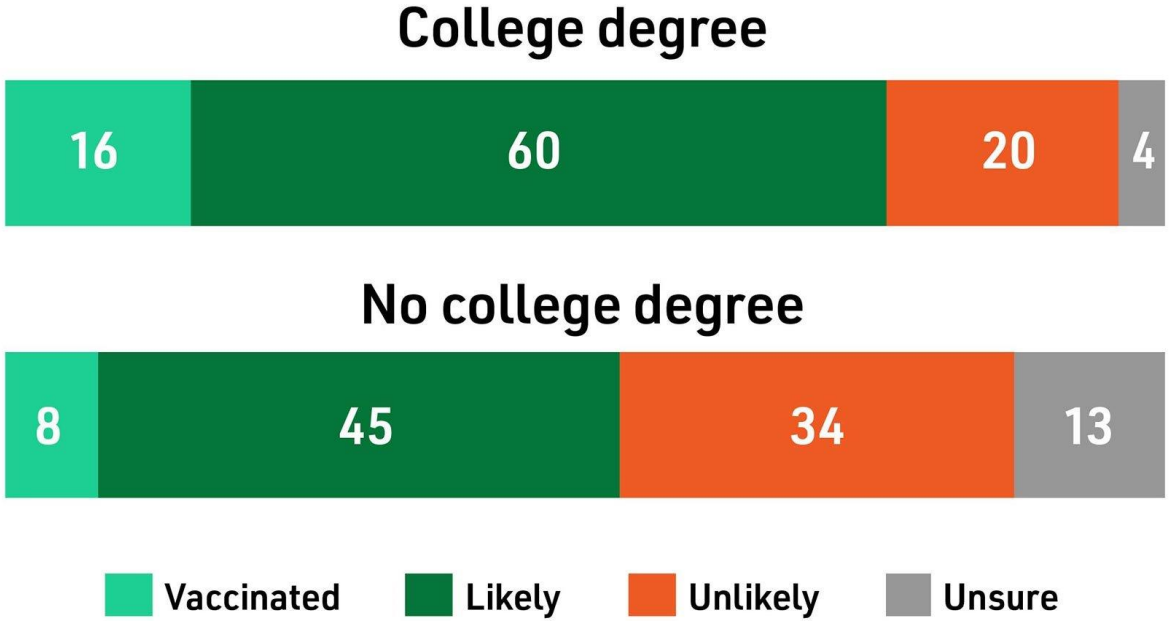
PN Cohen figure from US Census Bureau Household Pulse Survey data, Sep 1-13, 2021 (Week 37)

Source: Professor Philip N. Cohen, Department of Sociology, University of Maryland.

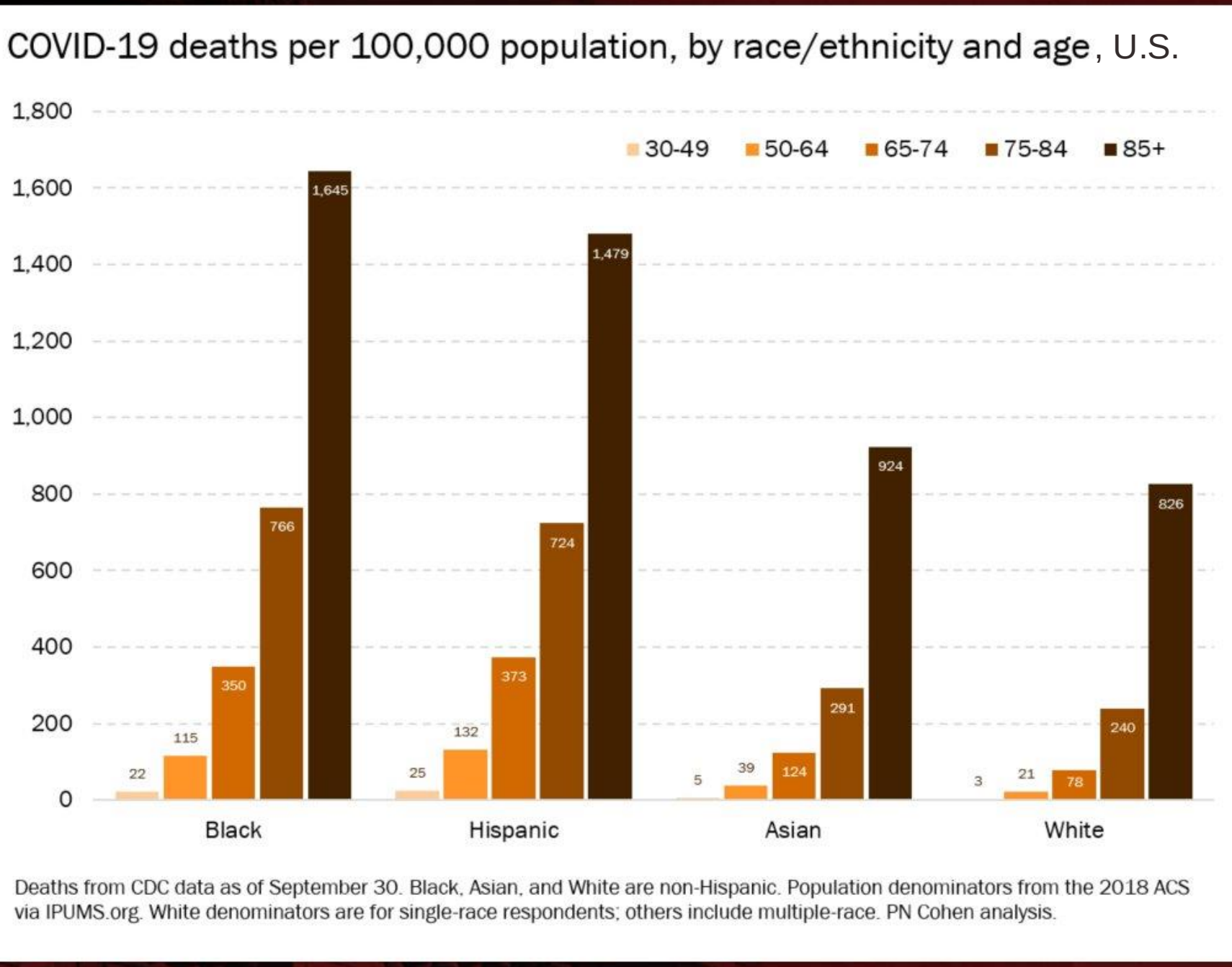
Understanding Coronavirus in America

USC Dornsife Center for Economic and Social Research

Likelihood of getting COVID-19 vaccine, by education

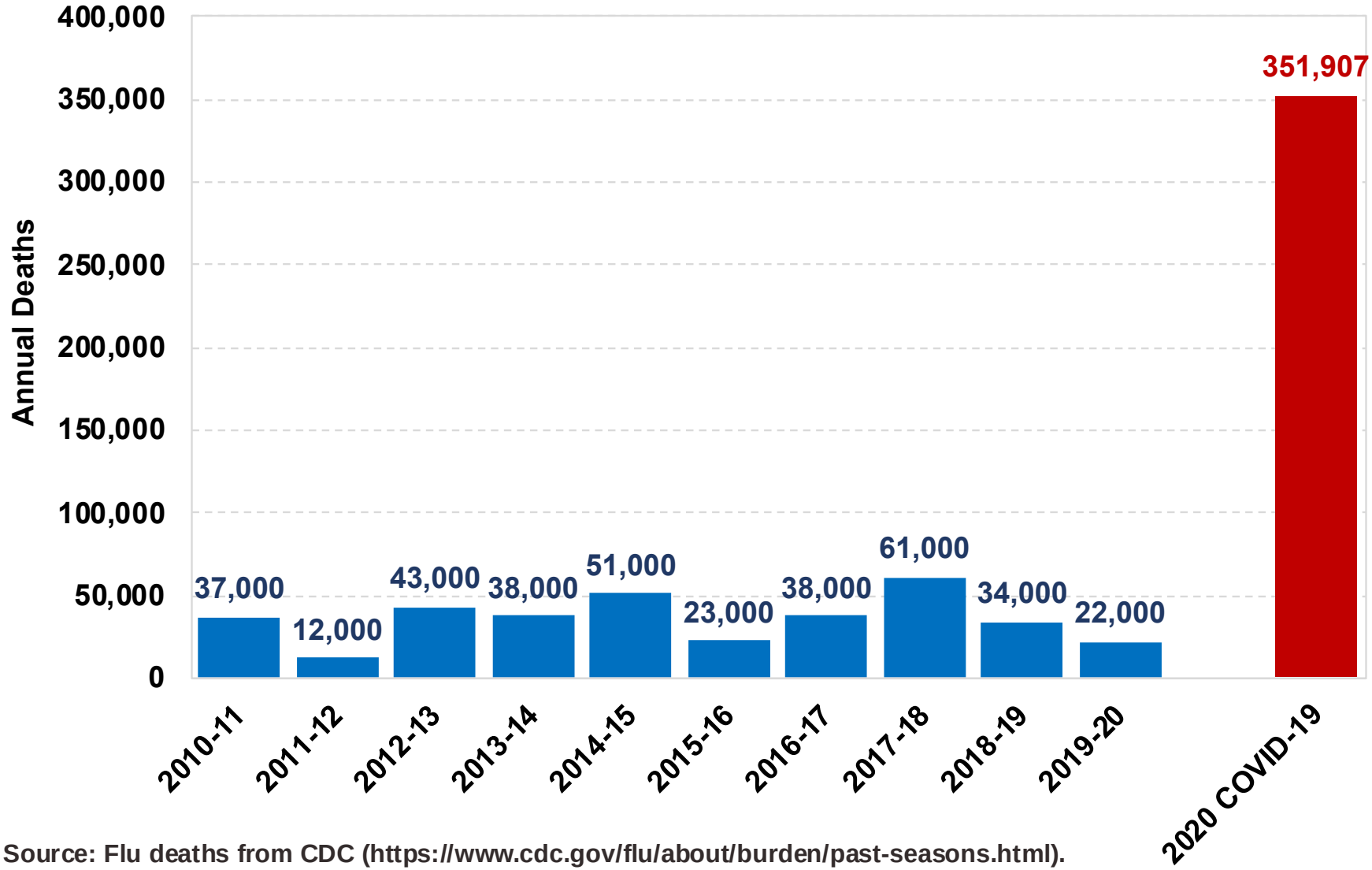


Findings are based on 6,231 participants who responded between January 20, 2021 and February 16, 2021. Margin of sampling error is +/-1 percentage point for all U.S. residents, and +/- 2 percentage points for educational attainment subgroups. "College degree" includes bachelor's degree or higher. More information at covid19pulse.usc.edu



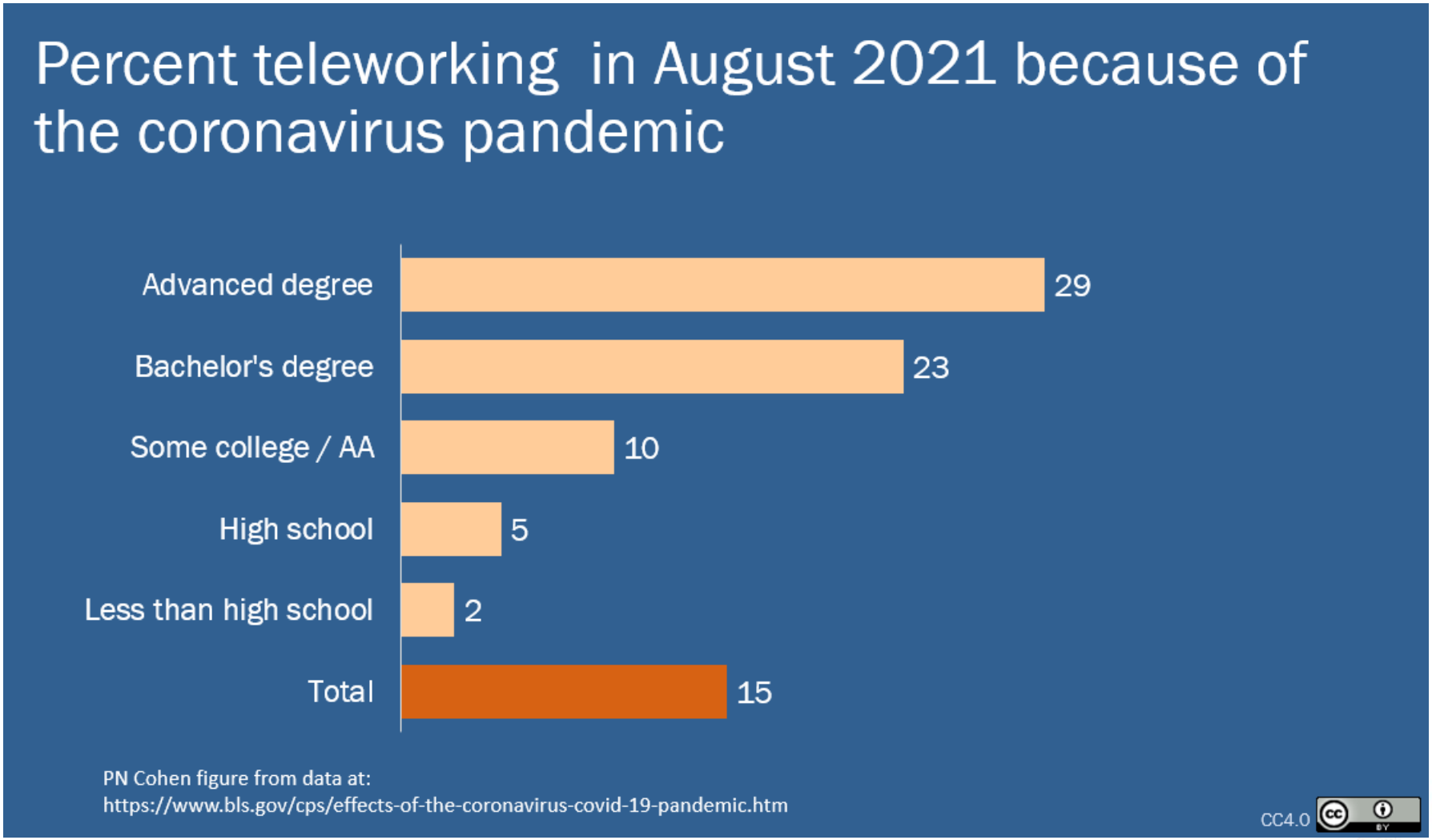
Source: Professor Philip N. Cohen, Department of Sociology, University of Maryland.

Annual flu deaths (2010–2020) and COVID-19 deaths (2020), United States



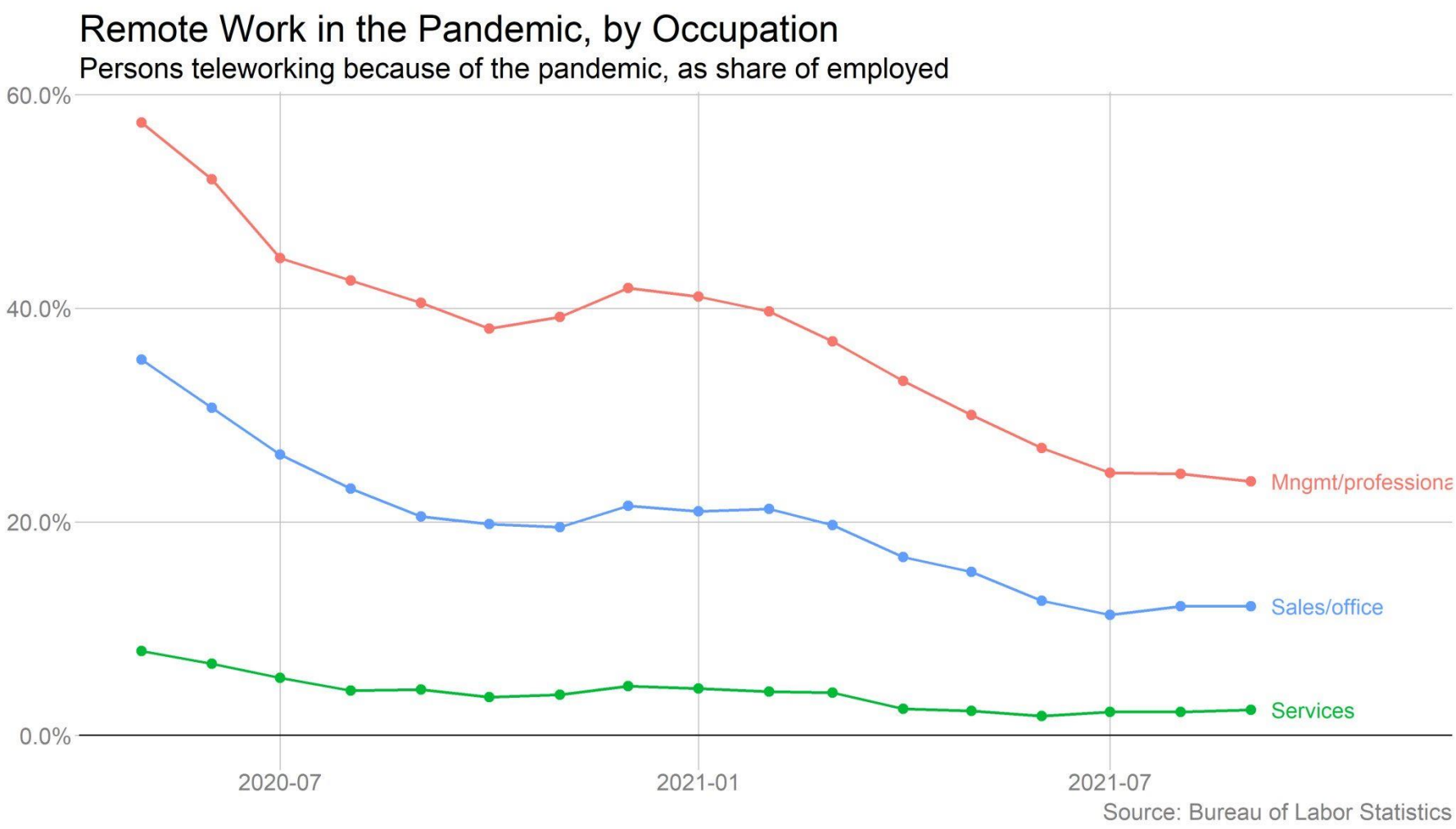
Source: Flu deaths from CDC (https://www.cdc.gov/flu/about/burden/past-seasons.html).
COVID-19 deaths from Our World in Data (https://ourworldindata.org).

United States



Source: Professor Philip N. Cohen, Department of Sociology, University of Maryland.

United States



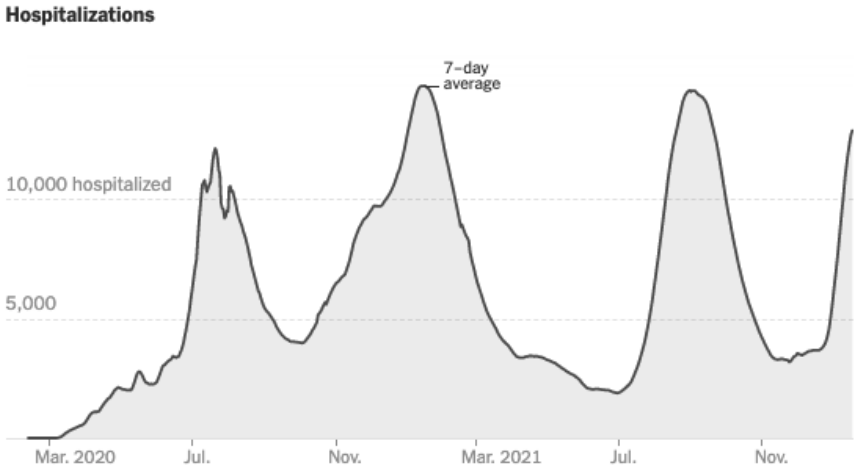
Source: Professor Philip N. Cohen, Department of Sociology, University of Maryland.

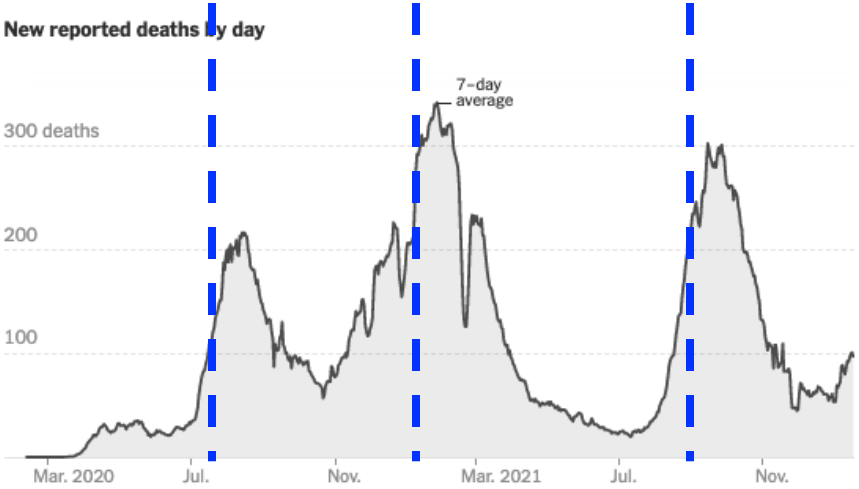
United States

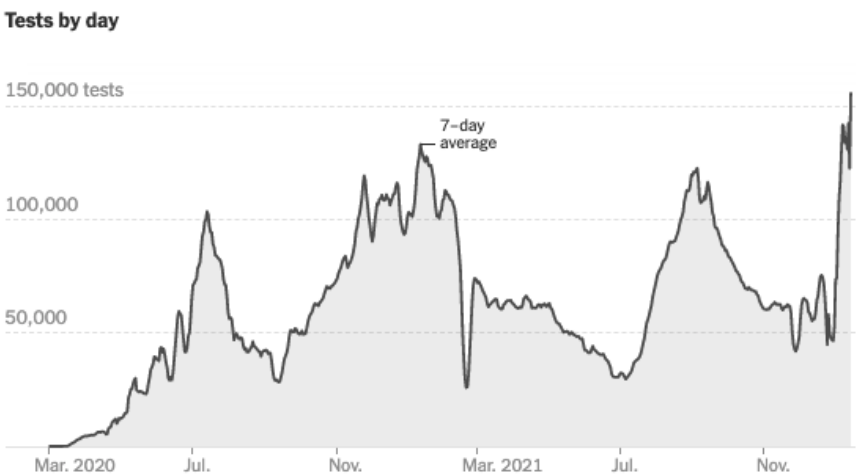
Linear fit weighted by industry size. PN Cohen figure from 2019 Bureau of Labor Statistics data.

Source: Professor Philip N. Cohen, Department of Sociology, University of Maryland.

Coronavirus in Texas, 1/17/2022







Source: https://www.nytimes.com/interactive/2021/us/texas-covid-cases.html.

Colleges in Texas

Outbreak clusters

In the first year of the pandemic, The Times tracked cases in the types of places with some of the worst outbreaks, like nursing homes, food processing plants and correctional facilities.

Nursing homes | Prisons | **Colleges** | Food processing plants | Other clusters

CASES CONNECTED TO	LOCATION	CASES
Texas A&M University	College Station, Texas	5,576
Baylor University	Waco, Texas	4,065
University of Texas at Austin	Austin, Texas	3,989
Texas Tech University	Lubbock, Texas	3,443
Texas State University	San Marcos, Texas	2,715
Texas Christian University	Fort Worth, Texas	2,087
University of North Texas	Denton, Texas	1,791
University of Texas at El Paso	El Paso, Texas	1,765
University of Texas Medical Branch at Galveston	Galveston, Texas	1,634
Southern Methodist University	Dallas, Texas	1,550
Sam Houston State University	Huntsville, Texas	1,366
University of Texas Southwestern Medical Center	Dallas, Texas	1,163
University of Houston	Houston, Texas	1,051
West Texas A&M University	Canyon, Texas	941
Texas Tech University Health Sciences Center	Lubbock, Texas	883
Stephen F. Austin State University	Nacogdoches, Texas	836

Source: https://www.nytimes.com/interactive/2021/us/texas-covid-cases.html.

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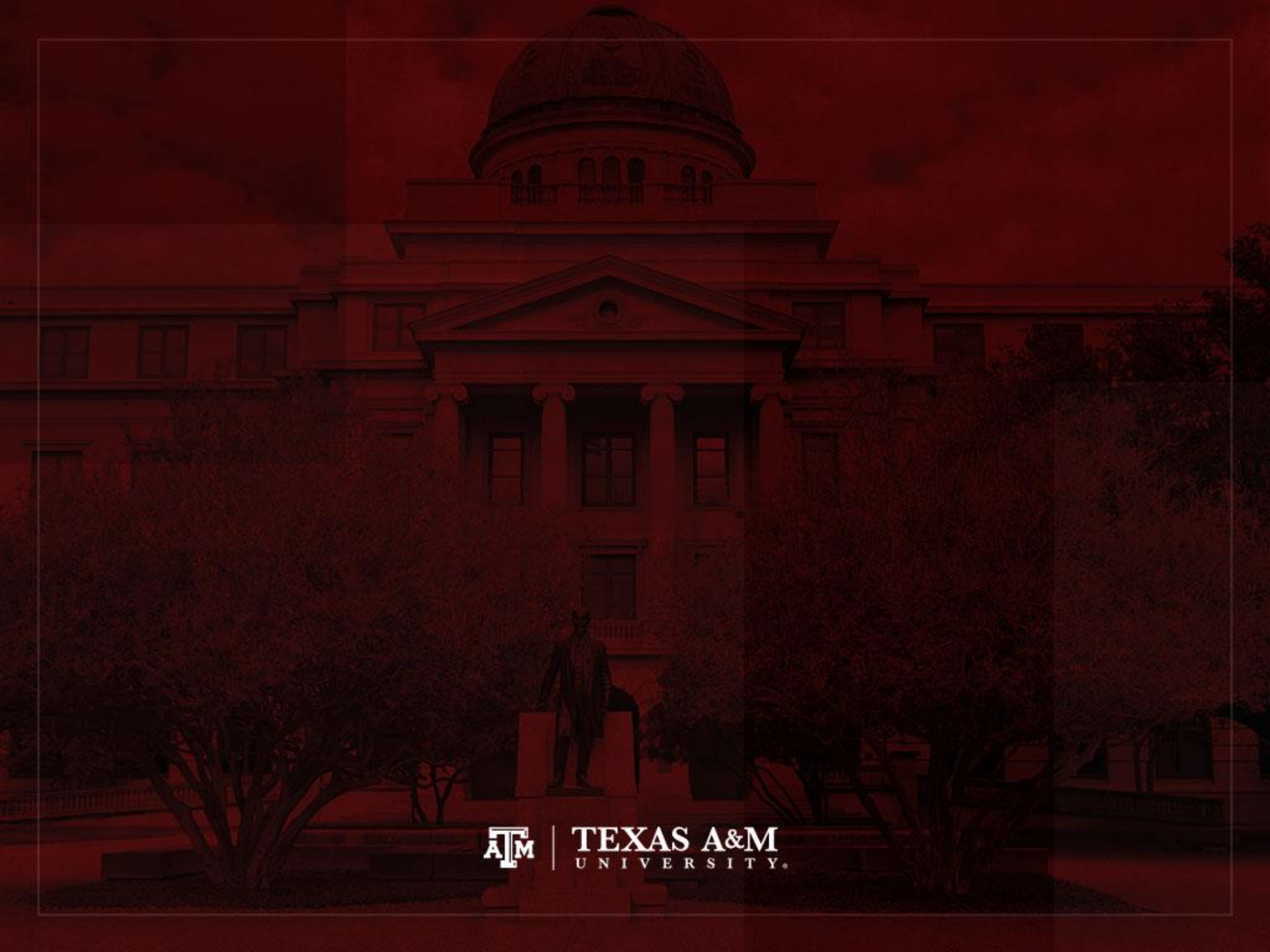
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