

# An introduction to demography

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# Outline

- Definition of demography
- Demographic equation
- Variables and observations
- Demographic models
- Why is demography important?

# 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*



# 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



# 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



# 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?



# Answers to these questions

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

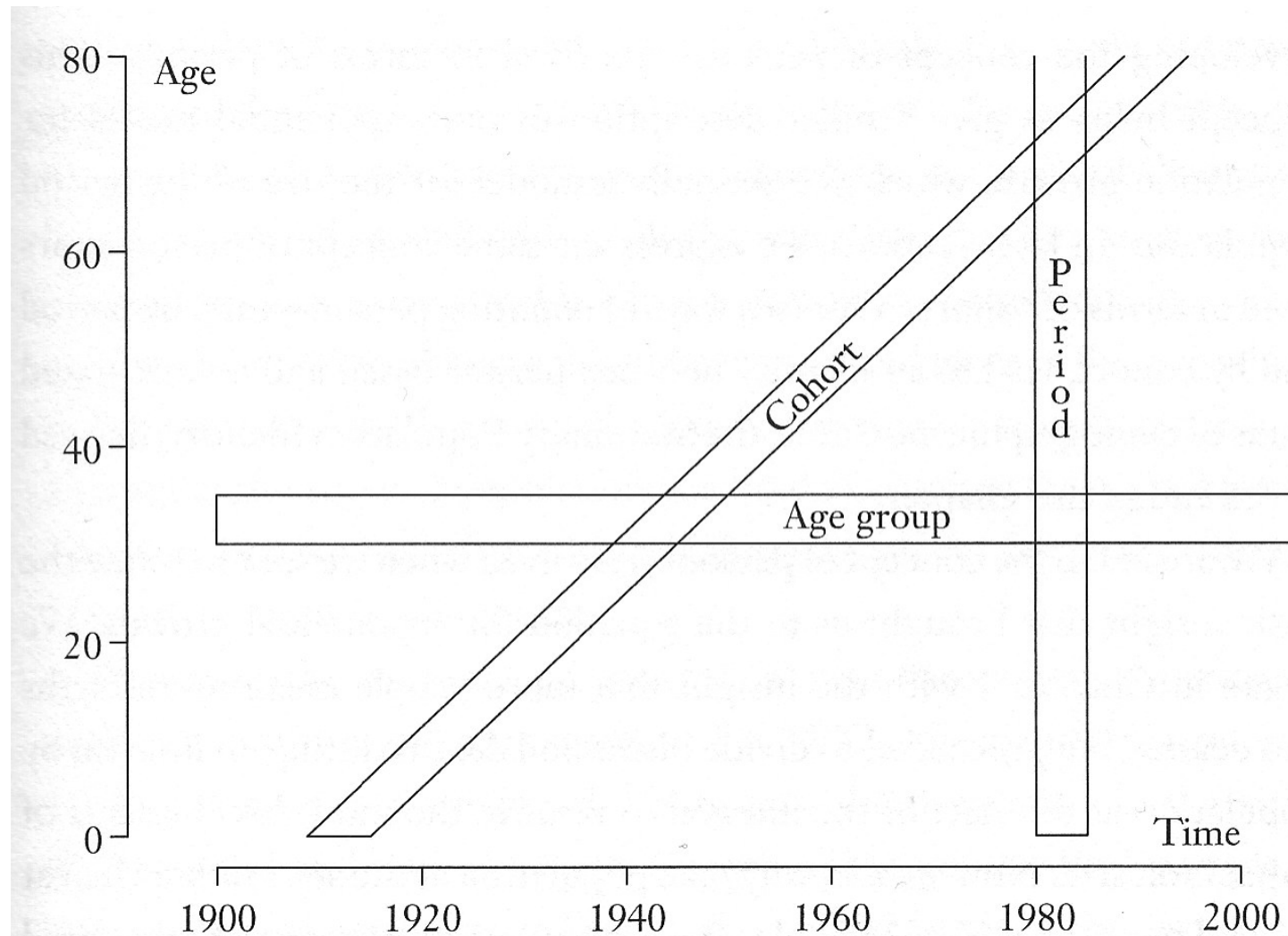


# Cohort

- 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)



# Lexis diagram: Age, period, cohort



# Game of pretend

- When we calculate a period measure, we pretend that age-specific rates we see today for different age groups continue unchanged into the future
- We are creating an imaginary cohort whose life experience is pieced together from the experiences of different people found at different ages in one period of time

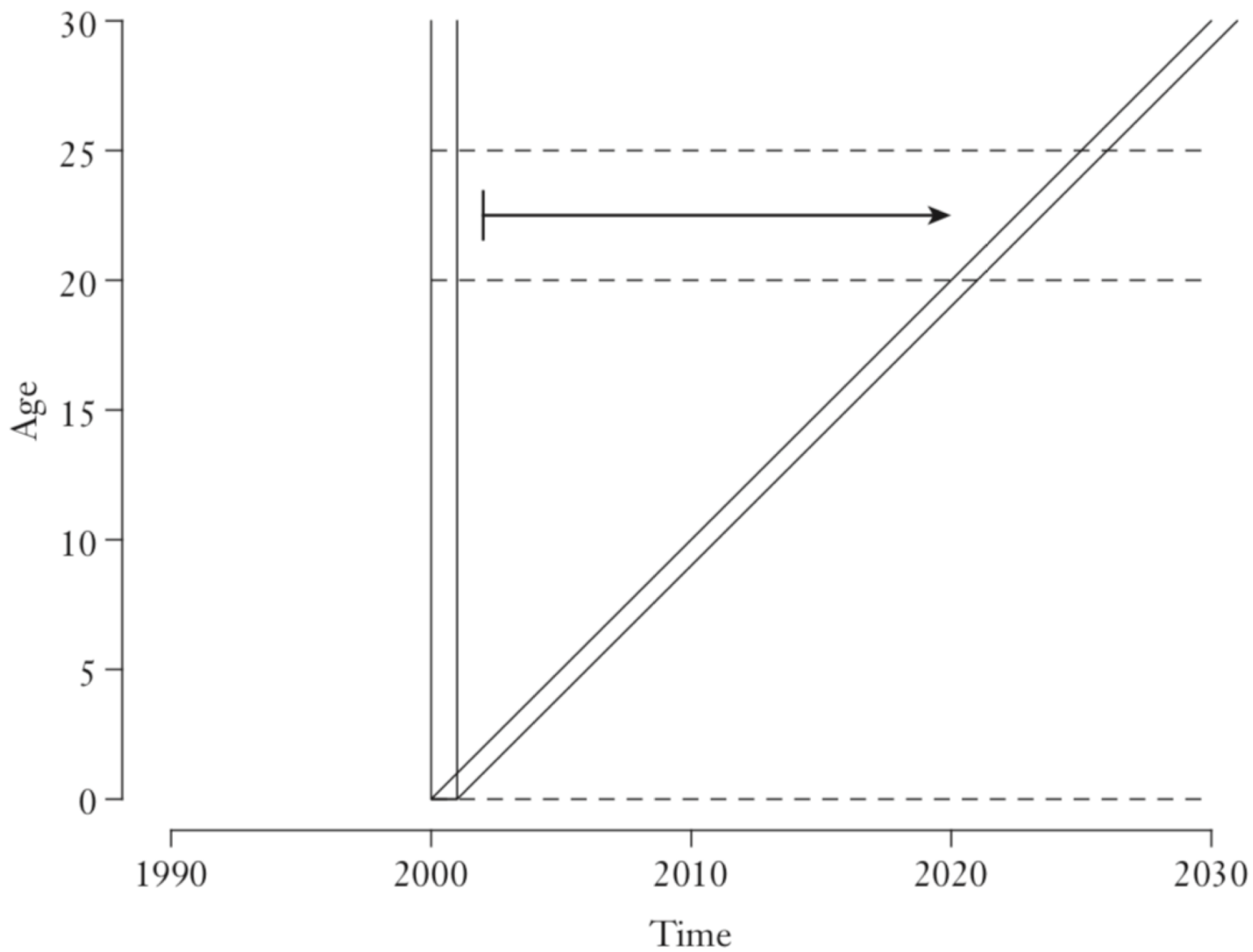


Figure 6.1 From period to cohort on a Lexis diagram





# Synthetic cohort

- We call this imaginary cohort the synthetic cohort
  - *syn*: “together”
  - *thetic*: “pieced”
  - *synthetic*: “pieced together”
- Age-specific cohort rates of the synthetic cohort are the age-specific period rates of the period population
- The concept of a synthetic cohort is central to demography

# Our course

- A great deal that we will learn in this class has a special relevance and importance for society and the world
- A great deal of demography is more than academic exercise
- Demographic concepts, theories, data, and results have tremendous practical importance and policy implications





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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



# 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  $t+1$



# Components of equation

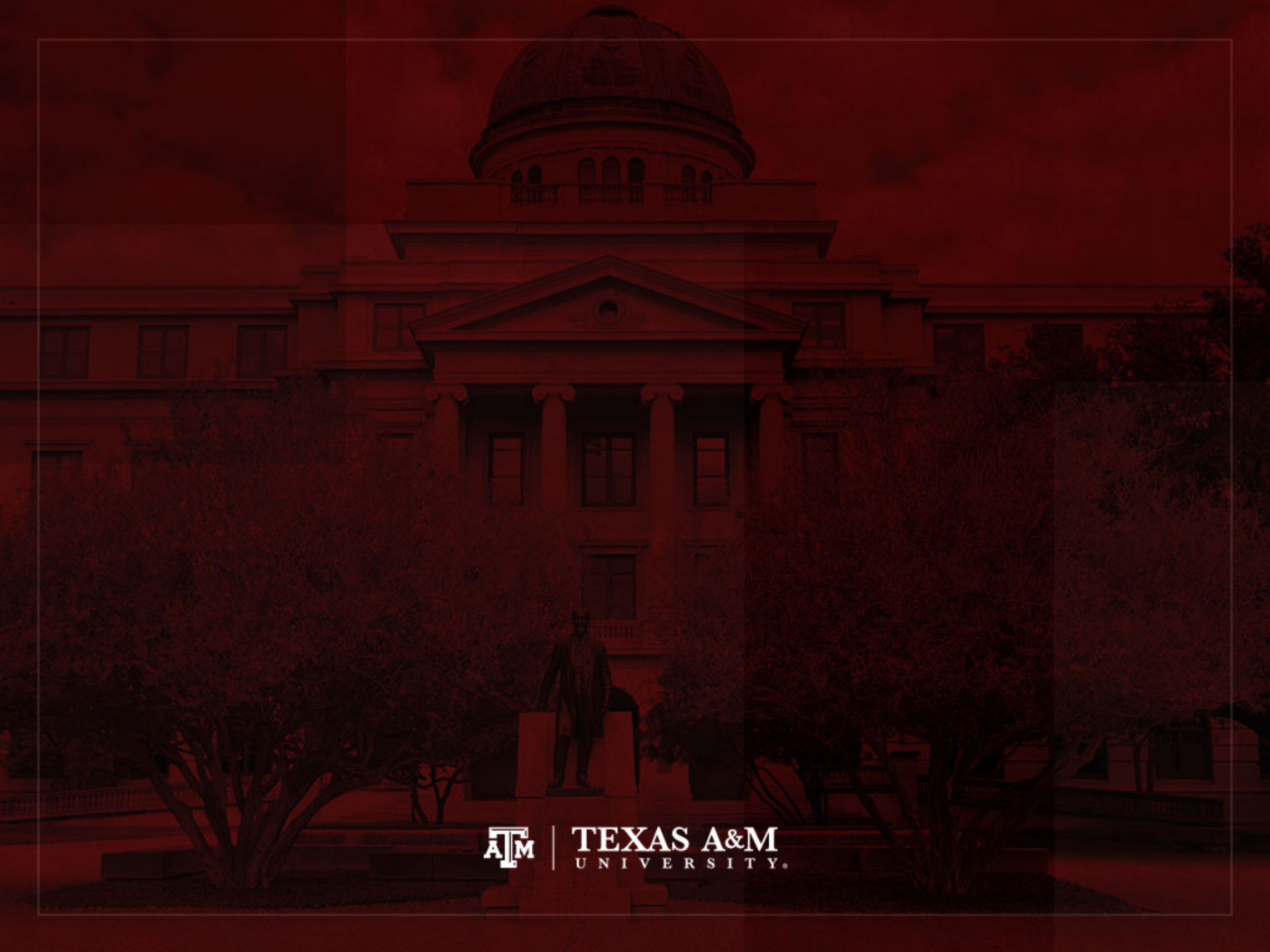
- $P_{t+1} = P_t + B_{t \text{ to } t+1} - D_{t \text{ to } t+1} + I_{t \text{ to } t+1} - E_{t \text{ to } t+1}$
- Natural increase:  $B_{t \text{ to } t+1} > D_{t \text{ to } t+1}$
- Natural decrease:  $B_{t \text{ to } t+1} < D_{t \text{ to } t+1}$ 
  - Negative natural increase



# 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)





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# Variables and observations

- **Variables**

- Characteristics that can change values from case to case
- E.g. gender, age, income, political party affiliation...

- **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

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



# 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





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# Demographic models

- Formal demography
- Population studies I
- Population studies II



# Formal demography

## Independent variable

Demographic

## Dependent variable

→ 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





# Population studies I (social demography)

## Independent variable

Non-demographic

## Dependent variable

→ 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



# Population studies II (social demography)

## Independent variable

Demographic

## Dependent variable

→ 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)





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# Why is demography important?

- Demography helps understand what the past says about the future, given expected population changes
  - Population change is a prime force behind social and technological change, because societies must adjust to demographic change
  - Population change is often provocative, bursting other dilemmas that face human society



# Population and earth's resources

- How will we feed an even larger population than we currently have?
- Will we have enough fresh water?
- Where will we get energy to sustain our lifestyle?
- Who will build housing and infrastructure for an increasing urban population?
- How do we minimize the environmental impact?



# Populations and women's rights

- Women live longer than men, unless society intervenes
- Getting pregnant was the most dangerous thing a woman could do until very recently
- Women are capable of the same levels of education and occupation as men
  - Many societies still do not provide these opportunities
- Status of women underlies many conflicts in the world and influences demographic trends

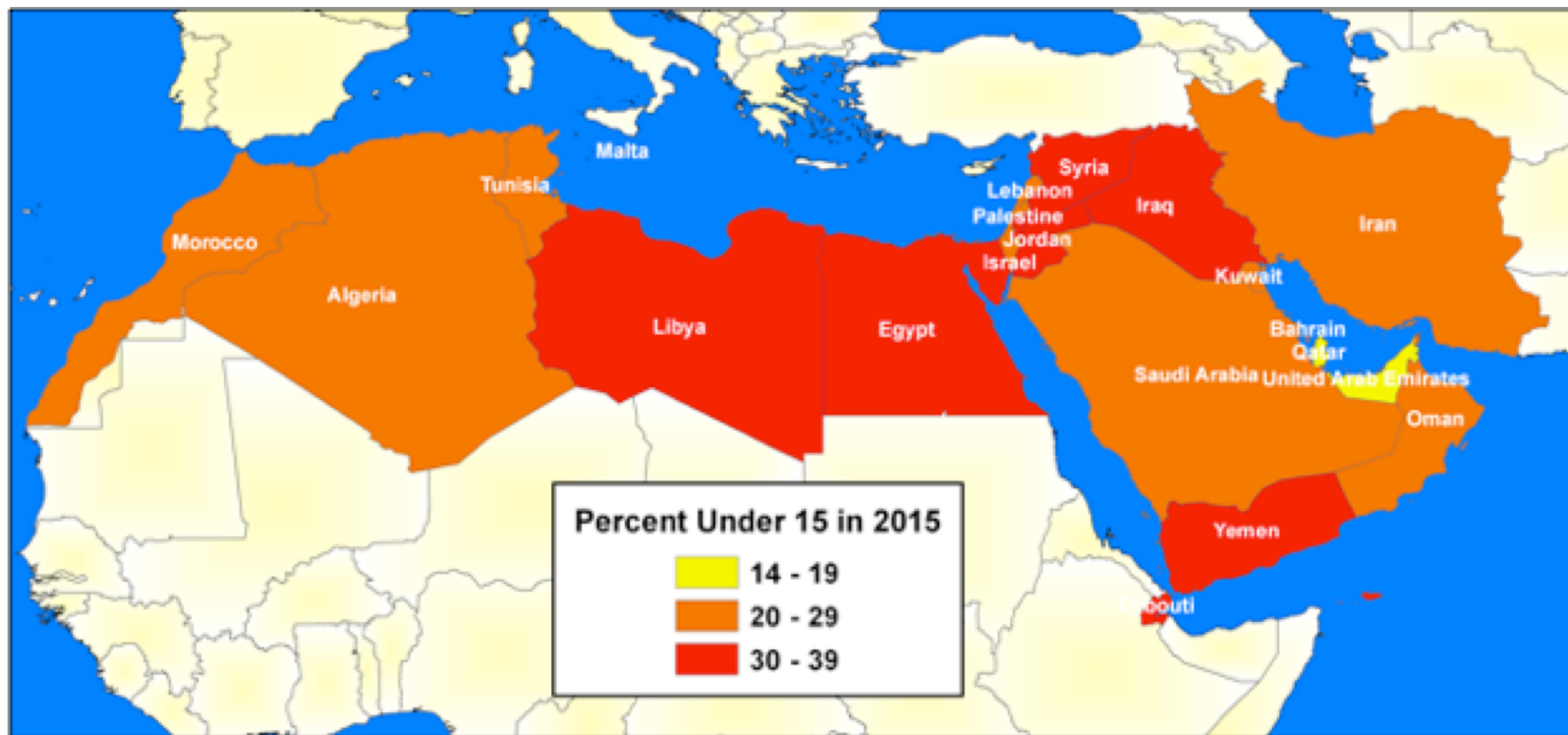


# Population and social and political dynamics

- Globalization is related to search for cheap labor
- Backlash against immigrants is aggravated by xenophobia in the face of the need for workers in the richer, aging countries
- Regional conflict is aggravated by population growth and especially by youth bulges in the Middle East and South Asia



# Middle East and North Africa (MENA) Region





Country	Population (millions)			Ratio		% Pop < 15 in 2015
	1950	2015	2050	2015/1950	2050/2015	
MENA	81	418	604	5.1	1.4	29
Iraq	6	36	71	6.0	2.0	39
Syria	3	22	37	7.3	1.7	35
U.S.	103	325	401	3.2	1.2	19
Germany	70	83	73	1.2	0.9	13
Japan	82	127	108	1.5	0.9	13

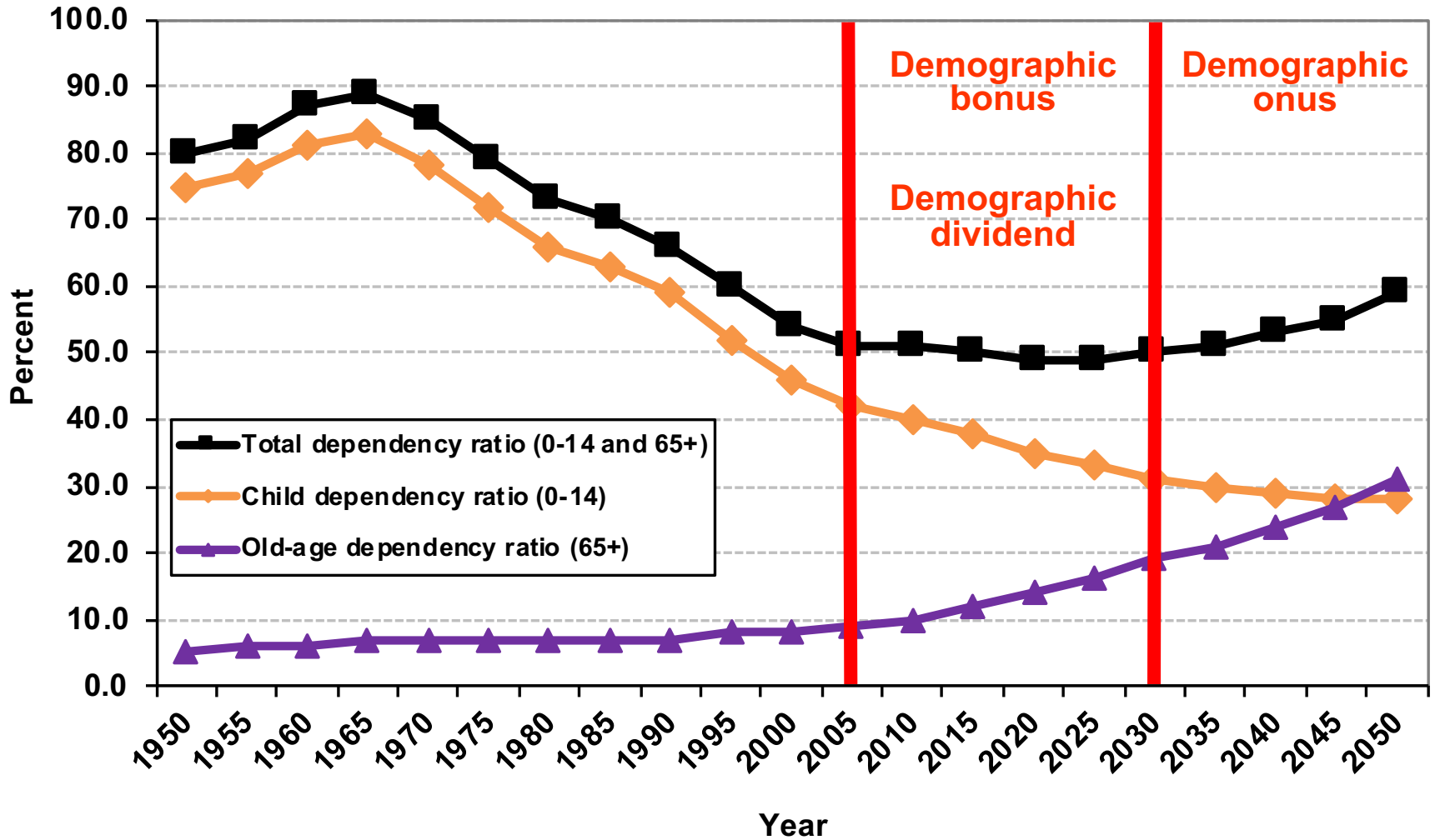


# Impact of population change

- Less about population growth *per se*
- More about population growth in different age groups and places over time, affecting
  - Education
  - Health
  - Crime
  - Consumer desires and fashions
  - Economic opportunities



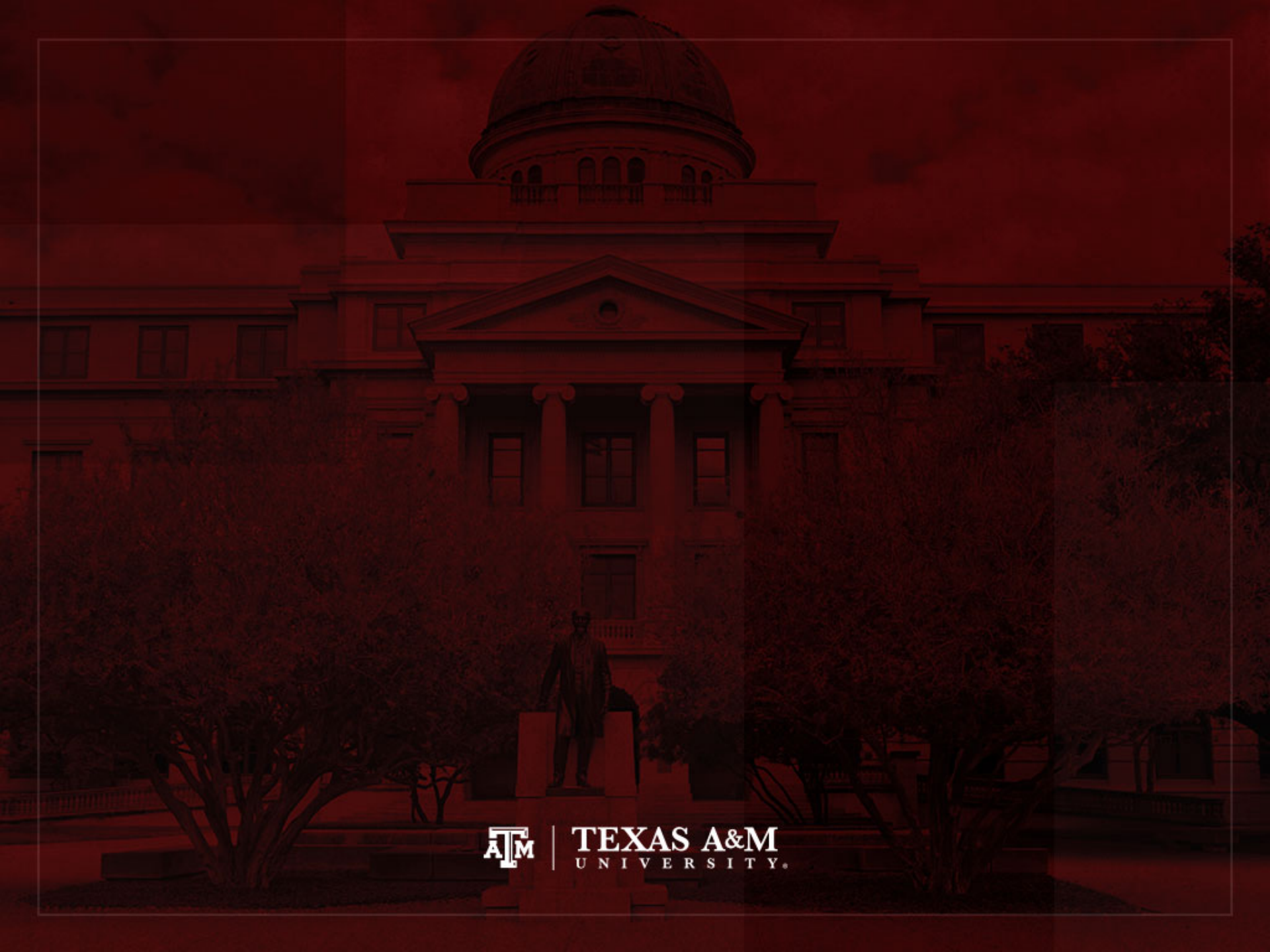
# Dependency ratios, Brazil 1950–2050



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