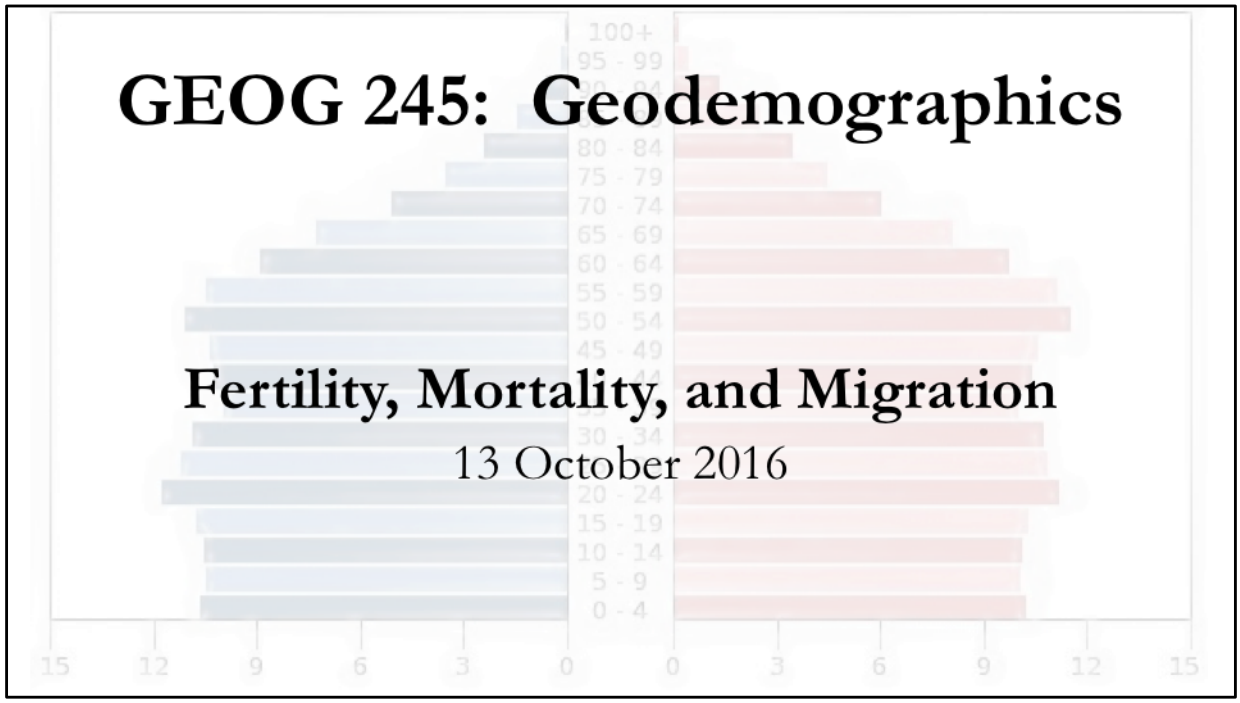


GEOG 245: Geodemographics

Fertility, Mortality, and Migration

13 October 2016

Announcements

- Assignment 1
  - I am NOT asking you to examine the political campaigns of any of the presidential candidates, but rather to use the demographic data from the census and model from FiveThirtyEight.com to make a prediction.
    - I don't want to see commentary on the debates, statements by the candidates, etc.
    - All claims should be backed up with demographic data!
- I have shifted a few things in the calendar…

Plan for the next three weeks

- Today: Fertility, Mortality, and Migration
- Week 4:
  - Tuesday: Race, Ethnicity & Diversity
  - Thursday: Segregation in the United States
- Week 5:
  - Tuesday: Guest Lecture (*Rebecca Stubbs*)
  - Thursday: Morbidity, Population Health & HIV/AIDS
- Week 6: Midterm (November 1st)

Note that the guest lecture will not be recorded as some of the data that will be presented has not yet been published (you are getting a sneak peak!).

Plan for Today

- Fertility
- Mortality
- Migration
- Putting it All Together

As I mentioned on the first day of class, Fertility, Mortality, and Migration are the three things that demographers are most concerned with as they are the three most important indicators of population.

We are going to try to get through the basics of all three today. We will be talking about migration more later in the quarter.

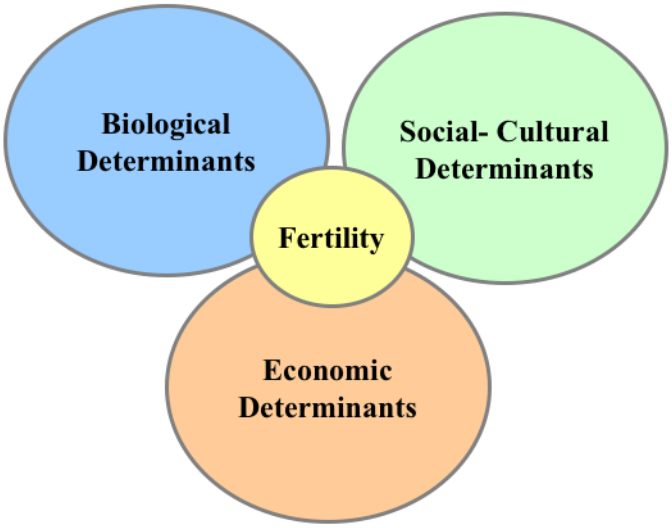
What is Fertility?

What is Fertility?

The capacity to produce offspring

What factors affect fertility?

Factors Affecting Fertility Rate



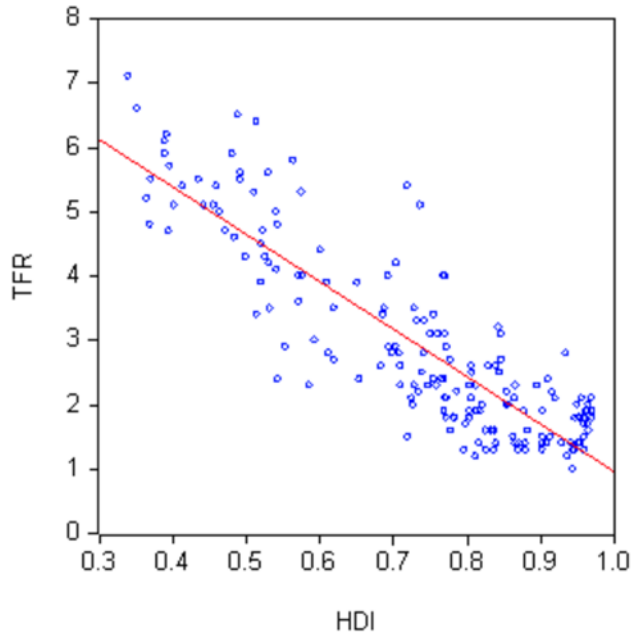
Biological Determinants

- Biological determinants
  - Age:
    - Reproductive age of women ranges from 15-44 or from 15-49.
    - Men: 13-??
  - Health and nutrition:
    - Poor health and/or nutrition can reduce fertility.
    - Linked with underweight children.
    - Linked with child mortality rates.
  - Environment:
    - Represents an undocumented impacts on fertility.
    - Stressed populations tend to have less males than females.
    - Possible correlation between sperm count and pollution.

Social Determinants

- Social determinants
  - The social norms and acceptance of practices affecting fertility.
  - Differ from society to society.
  - Marriage:
    - Particularly the average age of marriage.
    - The percentage of people never married varies spatially and affects fertility rates.
    - Late marriage age generally involves less children.
  - Contraception:
    - Used by 30-50% of all married couples.
    - Availability of contraceptive devices and social attitudes toward their use affect fertility rates.
    - Sharp differences exist between Global North and Global South.
    - Some notable exceptions, such as China and Cuba.

Correlation between fertility and Human Development Index



What is the HDI?
Human Development Index is a measure of the overall quality of life in a country based on life expectancy, education, and income per capita.

Social Determinants (Continued)

- Abortion:
  - Last resort measure when contraception failed (or was not used).
  - Its legality is not universal and under challenge in some countries where it is permitted.
  - Global figures:
    - Approximately 22% of all pregnancies end up in a abortion.
    - About half of them are obtained legally.
  - Illegal abortions are common in most societies, even where it is prohibited.
  - Culture plays an important determining role in the impact of abortion.
  - United States: 49% all pregnancies unwanted and about half of unwanted pregnancies ended in abortion (1.4 million abortions per year).

Economic Determinants

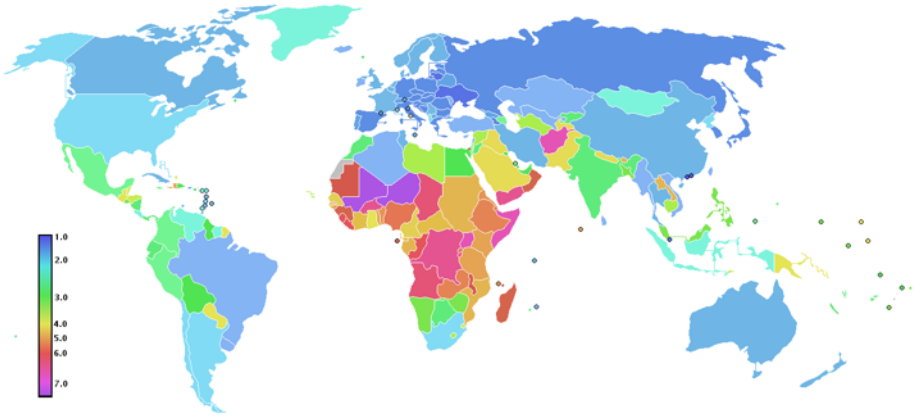
- The role of children, or their "value" affects fertility.
- Inverse relationships:
  - Fertility and income per capita.
  - Fertility and urbanization.
- Traditional rural societies:
  - Children still play an important economic role and contribute to family wealth,
  - Fertility is likely to remain higher.
- Industrial and post-industrial societies:
  - Costs tend to increase with the development level of the society. Deflate the fertility rate since parents must consider the direct and opportunity costs of bearing additional children.

Factors Affecting Fertility Rate

- Status of Women
- Level of education
- Employment opportunities
- Type of residence
- Religion of parents
- Level of available health care
- Machismo
- Perceived cost of having children
- Pressure from the government

World Fertility Rate

Strongly correlated with level of economic development



Spatial distribution Fertility

Questions?

So how is fertility calculated?

So how is fertility calculated?

- Lots of options:
  - Period Measures:
    - Crude Birth Rate (CBR)
    - General Fertility Rate (GFR)
    - Child-Woman Ratio (CWR)
  - Cohort Measures:
    - Age-Specific Fertility Rate (ASFR)
    - Total Fertility Rate (TFR)
    - Gross Reproduction Rate (GRR)
    - Net Reproduction Rate (NRR)

The primary way we group fertility measures together is by period or cohort measures. What do we mean by period and cohort measures?

Period Measures

- Any measure that examines a cross-section of the population in a given year

Cohort Measures

- Any measure that follows the same people over a period of time

Crude Birth Rate

$$\text{CBR} = \frac{\text{Number of Live Births}}{\text{Total Population}} * K$$

- The CBR is generally calculated for a given year (using mid-year population)
- The CBR is often multiplied by a constant 1,000 and expressed per 1,000 in the population

It is a period measure because it is a snapshot at a given time.

K=a constant, almost always 1000

Crude Birth Rate

$$CBR = \frac{\text{Number of Live Births}}{\text{Total Population}} * K$$

- Example:
- According to the CDC, 3,932,181 people were born in the US in 2015.
- In 2015, the US (mid-year) population was 321,418,820.

So what is the CBR?

Crude Birth Rate

$$CBR = \frac{\text{Number of Live Births}}{\text{Total Population}} * K$$

- Example:
- According to the CDC, 3,932,181 people were born in the US in 2015.
- In 2015, the US (mid-year) population was 321,418,820.

- (3,932,181/321,418,820) * 1000 = **12.23 births per 1000 population**

Remember to always include a unit!

Crude Birth Rate Pros and Cons

What are some of the benefits of CBR?

Crude Birth Rate Pros and Cons

- Pros
  - Easy to calculate
  - Data is usually available

What are some of the problems with CBR?

Crude Birth Rate Pros and Cons

- Pros
  - Easy to calculate
  - Data is usually available
- Cons
  - Doesn't consider the age/sex structure of the population
    - Not everyone in the denominator can have children
    - Isn't good for comparing between populations

General Fertility Rate

$$GFR = \frac{\text{Number of Live Births}}{\text{Population of Women of Childbearing Age}} * K$$

- The GFR is also generally calculated for a given year (using mid-year population)
- The GFR is also often multiplied by a constant 1,000 and expressed per 1,000 in the population
- Women of Childbearing Age is usually considered either 15-49 or 15-44

Essentially it is the same as the CBR, but using population of childbearing years as the denominator rather than the total population. This addresses the cons of the CBR. But what if this data isn't available…

Child-Woman Ratio

$$CWR = \frac{\text{Number of Children Under 5}}{\text{Population of Women of Childbearing Age}} * K$$

- The CWR is also generally calculated for a given year (using mid-year population)
- The CWR is also often multiplied by a constant 1,000 and expressed per 1,000 in the population
- Women of Childbearing Age is usually considered either 15-49 or 15-44

Essentially it is substituting births in a five year period for births in a single year period.

This measure is primarily used in situations where births are not well documented (very rural or resource poor settings) and thus we can get a better sense of what is going on from a more accurate count of children under the age of 5. This measure can be calculated from national censuses or survey data, thereby providing fertility data where birth statistics may not otherwise be available.

Questions?

Age-Specific Fertility Rates

$$\text{ASFR} = \frac{\text{Number of Live Births to Women of a Particular Age}}{\text{Total Population of Women of that Age}} * K$$

- Usually calculated for 5 year increments (women aged 15-19, 20-24, etc.)
- Separates out fertility measures by age group (also called cohort)
- The ASFR is also generally calculated for a given year (using mid-year population)
- The ASFR is also often multiplied by a constant 1,000 and expressed per 1,000 in the population

This is a cohort measure because it is concerned with a particular cohort (subsection) of society.

Age-Specific Fertility Rates

$$\text{ASFR} = \frac{\text{Number of Live Births to Women of a Particular Age}}{\text{Total Population of Women of that Age}}$$

Age	Number of Women	Births	ASFR
15-19	100,000	20,000	0.200
20-24	120,000	40,000	0.333
25-29	90,000	50,000	0.556
30-34	100,000	20,000	0.200
35-39	80,000	8,000	0.100
40-45	95,000	1,000	0.011

Why measure age-specific fertility rates?

Why measure age-specific fertility rates?

- For comparisons in fertility behavior at different ages
- For comparison of fertility at different ages over time

Total Fertility Rate

$$ASFR_1 + ASFR_2 + ASFR_3 + ASFR_4 + ASFR_5\ldots$$

- The sum of all age-specific fertility rates
  - Functionally only those of reproductive age women because all others will be zero
- The average number of children that would be born to a woman by the time she ended childbearing if she were to pass through all her childbearing years conforming to the age-specific fertility rates of a given year.

Total Fertility Rate

$$ASFR_1 + ASFR_2 + ASFR_3 + ASFR_4 + ASFR_5 \ldots$$

Age	Number of Women	Births	ASFR
15-19	100,000	20,000	0.200
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30-34	100,000	20,000	0.200
35-39	80,000	8,000	0.100
40-45	95,000	1,000	0.011

ASFR
0.200
0.333
0.556
0.200
0.100
0.011
1.399
x 5 yrs
TFR=6.997

Note that in calculating it we multiply our figure by 5. This is because each ASFR is for 5 years of a woman's life.

Note: This does not predict the number of children the average woman will have, as this number will change over the course of her reproductive years. It is purely a hypothetical measure.

Total Fertility Rate Pros and Cons

- Pros
  - Independent of the age/sex structure of the population
    - Makes it easy to compare between populations
- Cons
  - Relies on a lot of specific data
  - Is only an abstract measure
  - Ignores life expectancy

Total Fertility Rate and Crude Birth Rate are the two figures we see most often in demography.

Gross Reproduction Rate

- The total number of female births an average woman would have if she lived through the end of her reproductive years at today's ASFR.
- Exactly like TFR, but only counting female children born.

Valuable because it gives a clearer indication of population growth.

Net Reproduction Rate

- The average number of daughters that female members of a birth cohort would bear during their reproductive life span if they were subject to the observed age-specific fertility rates and mortality rates through their lifetimes.
- The same as GRR, but also considers mortality rates.
- NRR is always lower than GRR, because it takes into account the fact that some women will die before entering and completing their child-bearing years.

GRR and NRR will be very close in countries where mortality rates are relatively low.

Questions?

Other Useful Measures

- **Parity** = Number of children born alive to a woman in her lifetime
  - Also called Children Ever Born or CEB
  - If only considering women over the age of 49, it is sometimes called the Completed Fertility Rate or CFR.
- **Gravidity** = Number of pregnancies a woman has had whether or not they produce a live birth

Why is calculating fertility so complex?

Why is calculating fertility so complex?

- Involves 2 individuals of opposite sex
- Risk is not universal in female population
  - Fecundity
  - Sexual activity
  - Contraception/abortion
- Repeatable event

Risk being likelihood of bearing children.
What is fecundity?

Fecundity

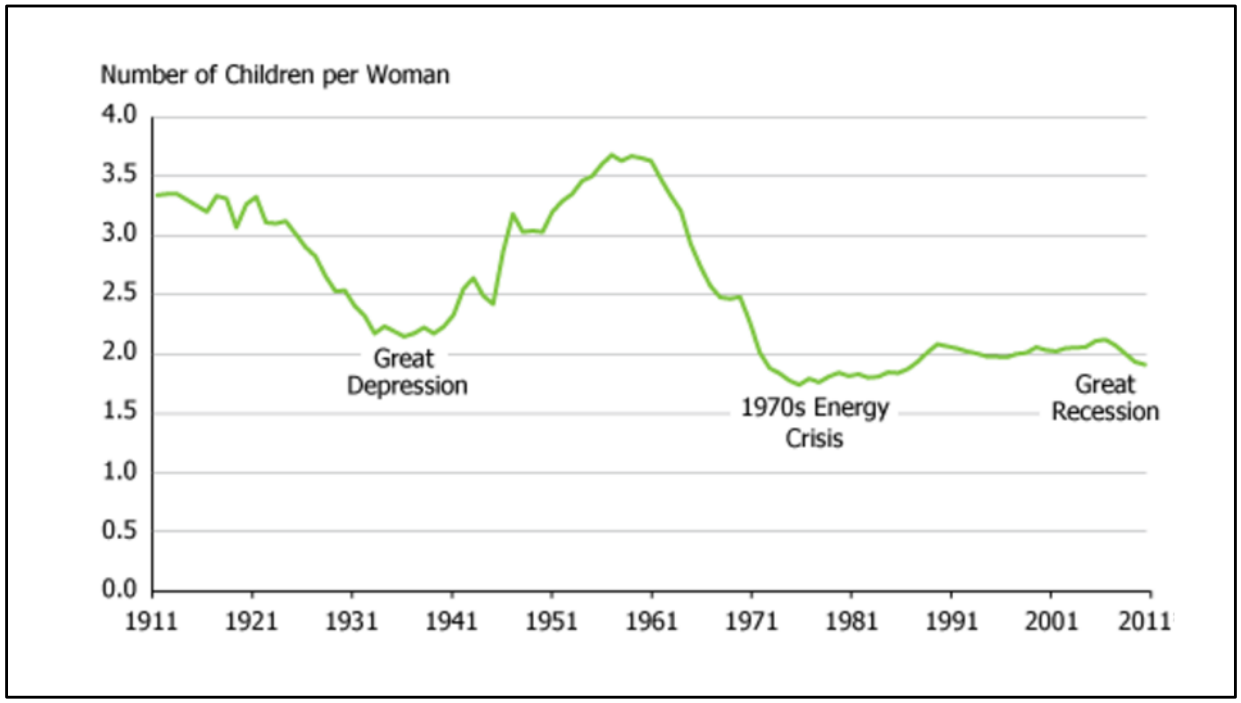
- The natural capacity to bear children
- In other words, the physiological capacity to have children

How is this different from fertility?

Why is calculating fertility so complex?

- Involves 2 individuals of opposite sex
- Risk is not universal in female population
  - Fecundity
  - Sexual activity
  - Contraception/abortion
- Repeatable event

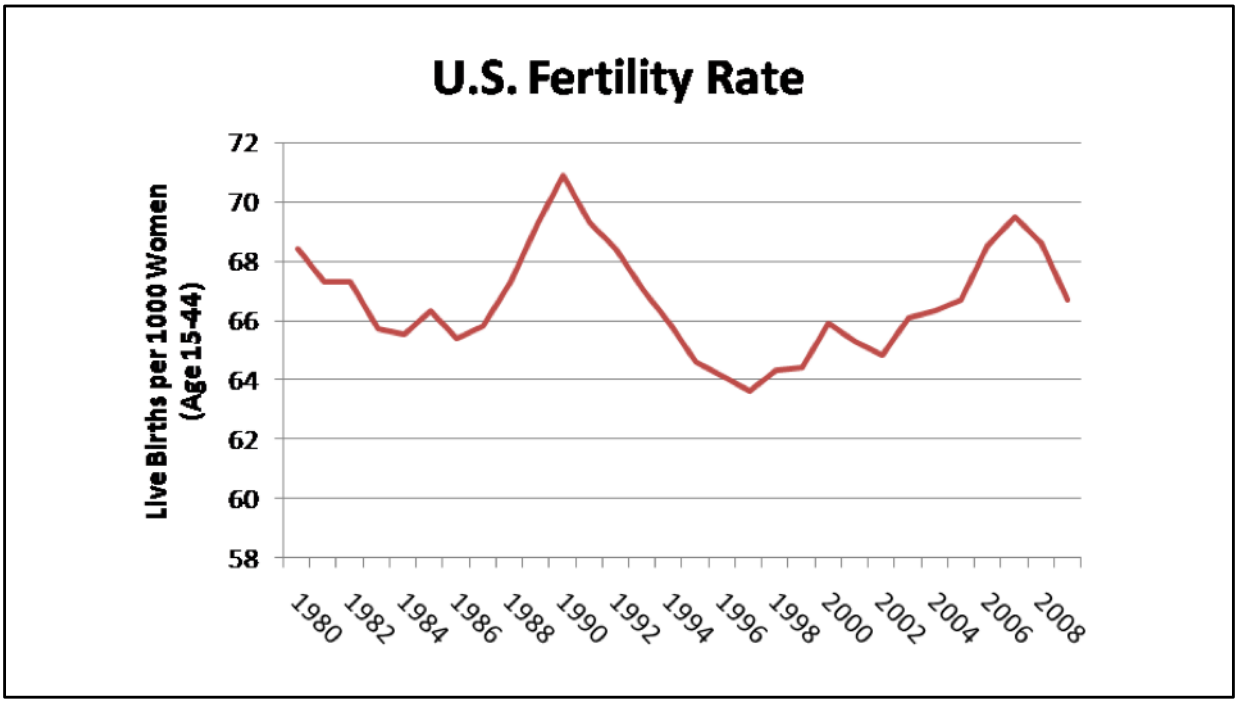
What does fertility in the US look like?



What measure is this most likely using?

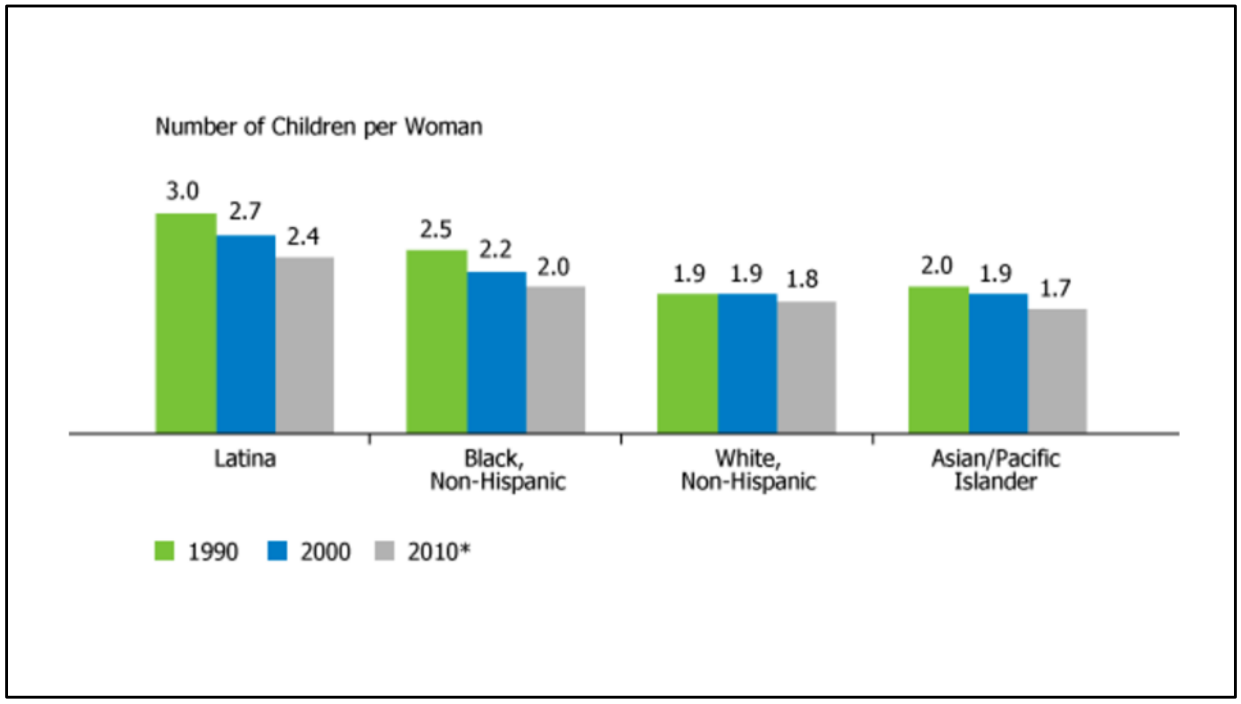
Total Fertility Rate

Note that in periods of economic recession, fertility rates decrease.

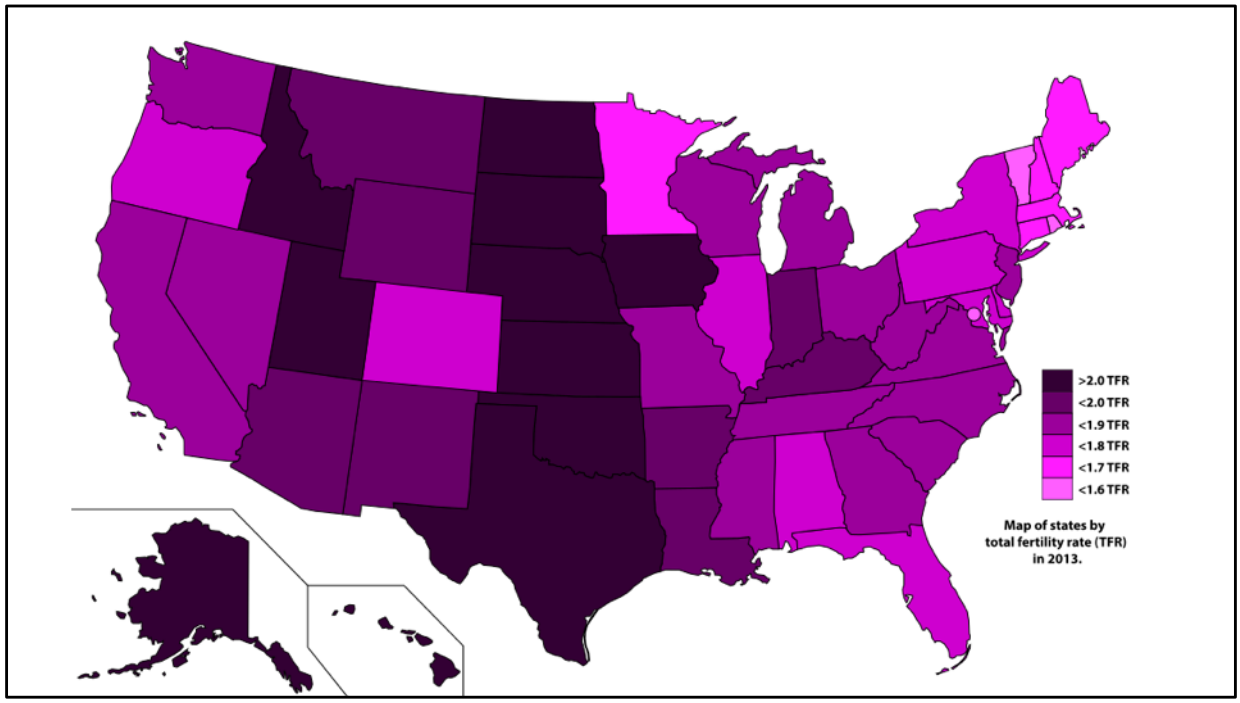


What measure is this most likely using?

General Fertility Rate



- on 2010 means that it is preliminary data.



Does this surprise you? What might be going on to produce this pattern?

Reminder: Where do we get fertility data?

- Censuses
- Vital registration systems
- Nationally representative sample surveys

As we discussed last week…
These are three of the most common places to get fertility data.

Questions?

Plan for Today

- Fertility
- Mortality
- Migration
- Putting it All Together

What is Mortality?

What is Mortality?

Death

So how is mortality calculated?

- Lots of options:
  - Crude Death Rate (CDR)
  - Life Expectancy
  - Cause Specific Death Rate
    - Maternal Mortality Rate
    - Case Fatality Rate
  - Age-Specific Mortality Rates
    - Neonatal Mortality Rate
    - Infant Mortality Rate

Like fertility, there are many ways of measuring mortality.

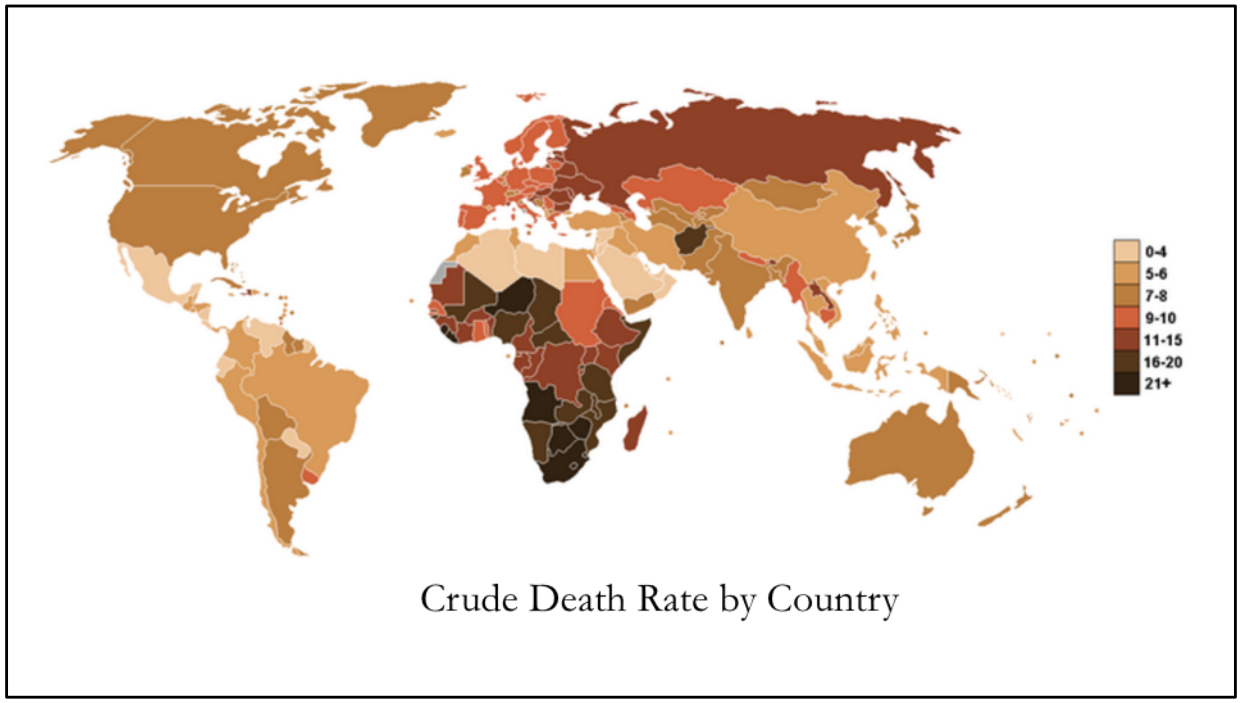
Crude Death Rate

$$\text{CDR} = \frac{\text{Number of Deaths}}{\text{Total Population}} * K$$

- The CDR is generally calculated for a given year (using mid-year population)
  - Sometimes called the annual death rate
- The CDR is often multiplied by a constant 1,000 and expressed per 1,000 in the population

It is a period measure because it is a snapshot at a given time.

K=a constant, usually 1,000, sometimes 100,000



Crude Death Rate by Country

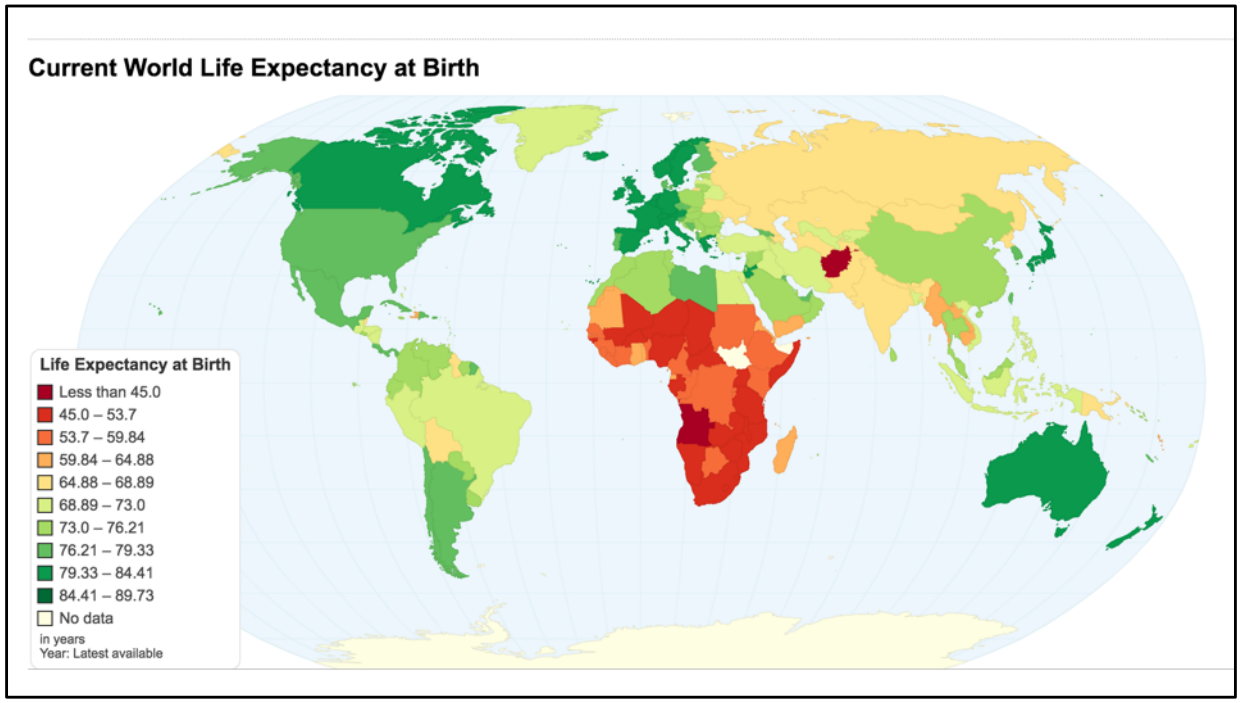
Does this look as you would expect? Why is Europe's crude death rate so high? (aging population)

CDR does not account for differences in age/sex structures of populations

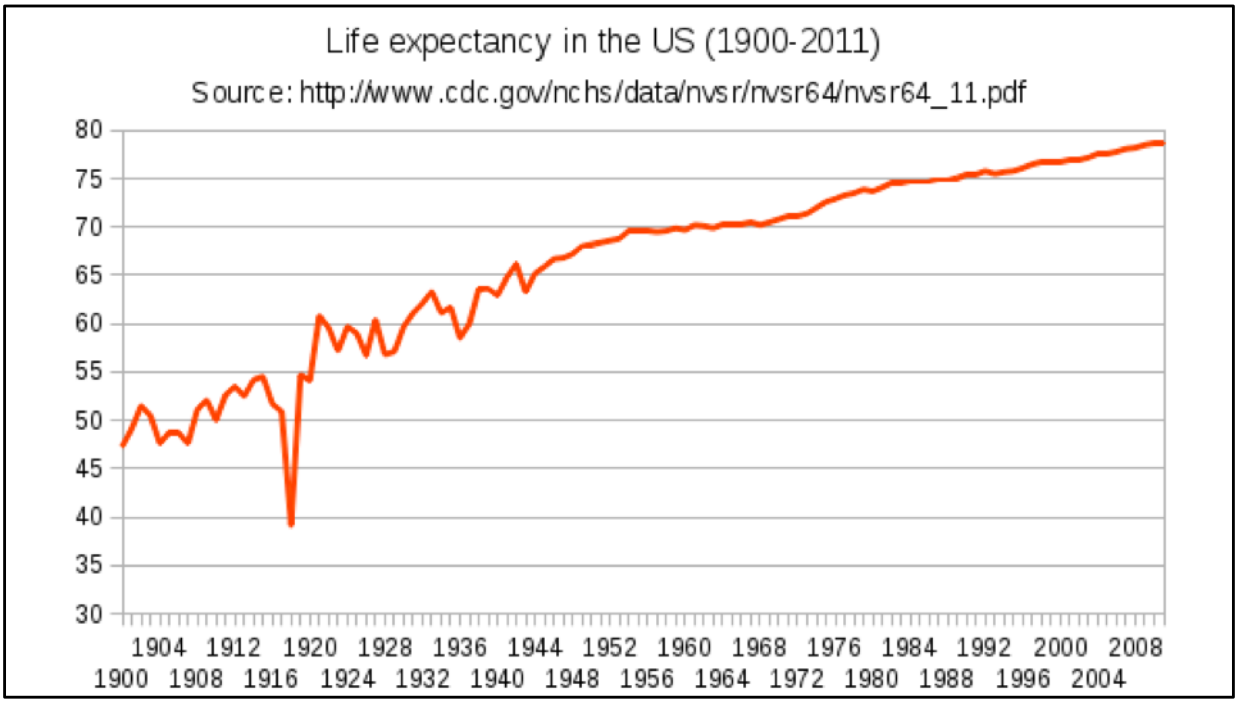
Life Expectancy

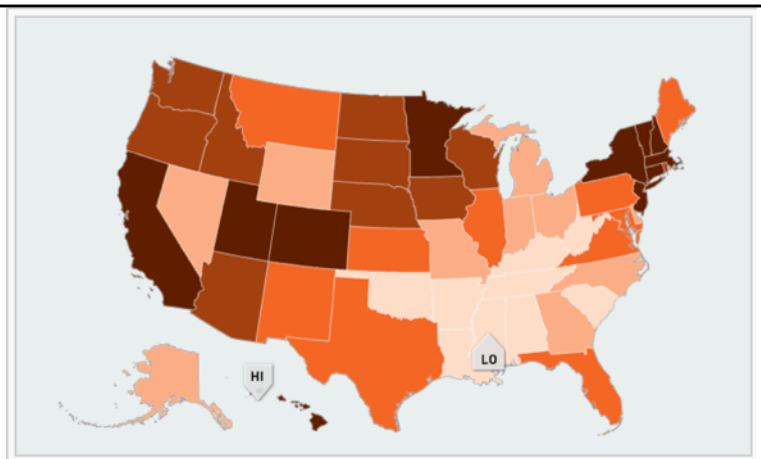
- The average time someone is expected to live
  - Usually measured in years
  - Usually implied from birth (sometimes you see life expectancy at age 5)

Why would you see life expectancy at age 5? (excludes infant/child mortality)



This looks more like the figures we are used to seeing.


Life expectancy in the US (1900-2011)
Source: http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_11.pdf
80
75
70
65
60
55
50
45
40
35
30
1900 1904 1908 1912 1916 1920 1924 1928 1932 1936 1940 1944 1948 1952 1956 1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008



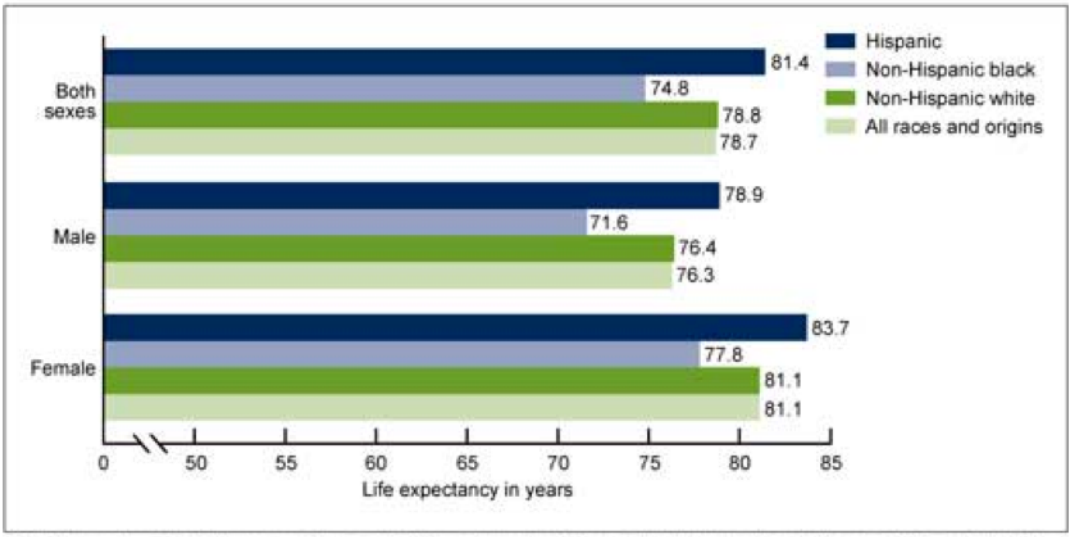
Map of US states by life expectancy at birth (years)

Legend:

- 80–81.3
- 79.5–80.0
- 78.4–79.5
- 77.2–78.4
- 75.0–77.2

What accounts for this pattern?

Figure 1. U.S. Life Expectancy by Gender and Race/Ethnicity: Preliminary 2011



NOTE: Life expectancies for the Hispanic population are adjusted for underreporting of Hispanic ethnicity but are not adjusted to account for the potential effects of reverse migration.
SOURCE: National Vital Statistics System, Mortality.

What can we tell from this chart?

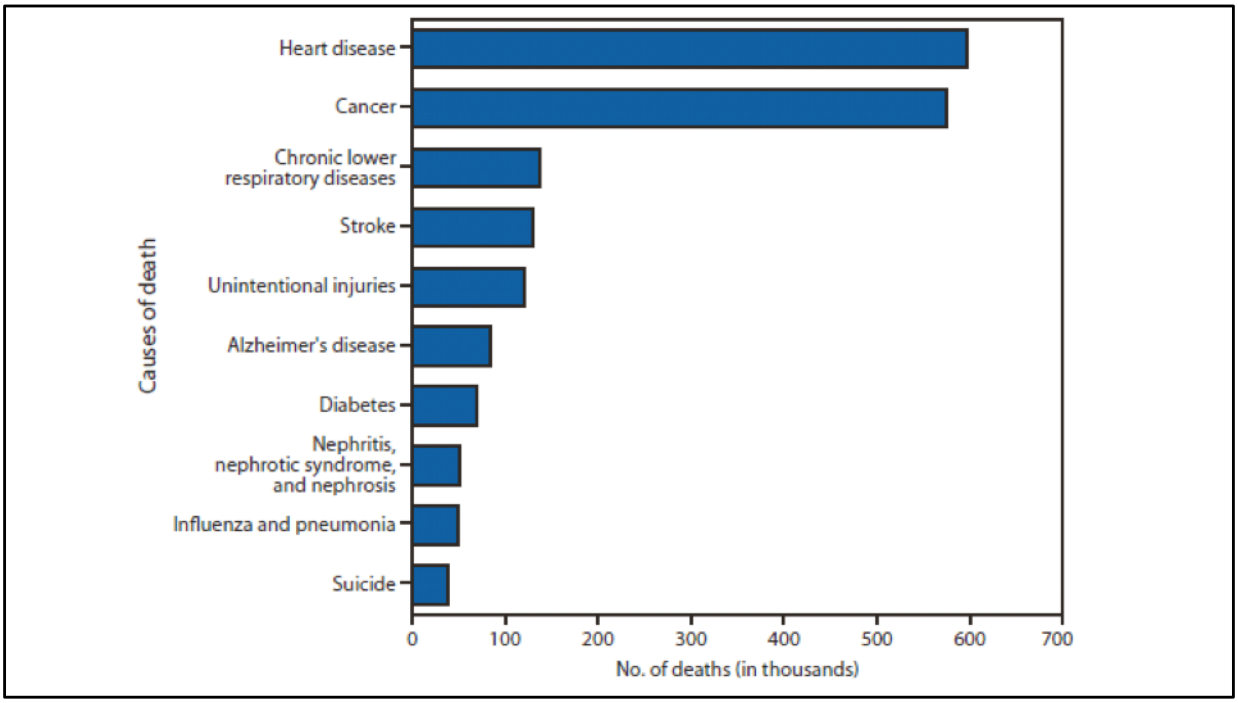
Questions?

Cause Specific Death Rate

$$\text{CSDR} = \frac{\text{Number of Deaths from a Specific Cause}}{\text{Total Population}} * K$$

- The CSDR is generally calculated for a given year (using mid-year population)
- The CSDR is often multiplied by a constant 100,000 and expressed per 100,000 in the population

Note, K is usually 100,000 not 1,000

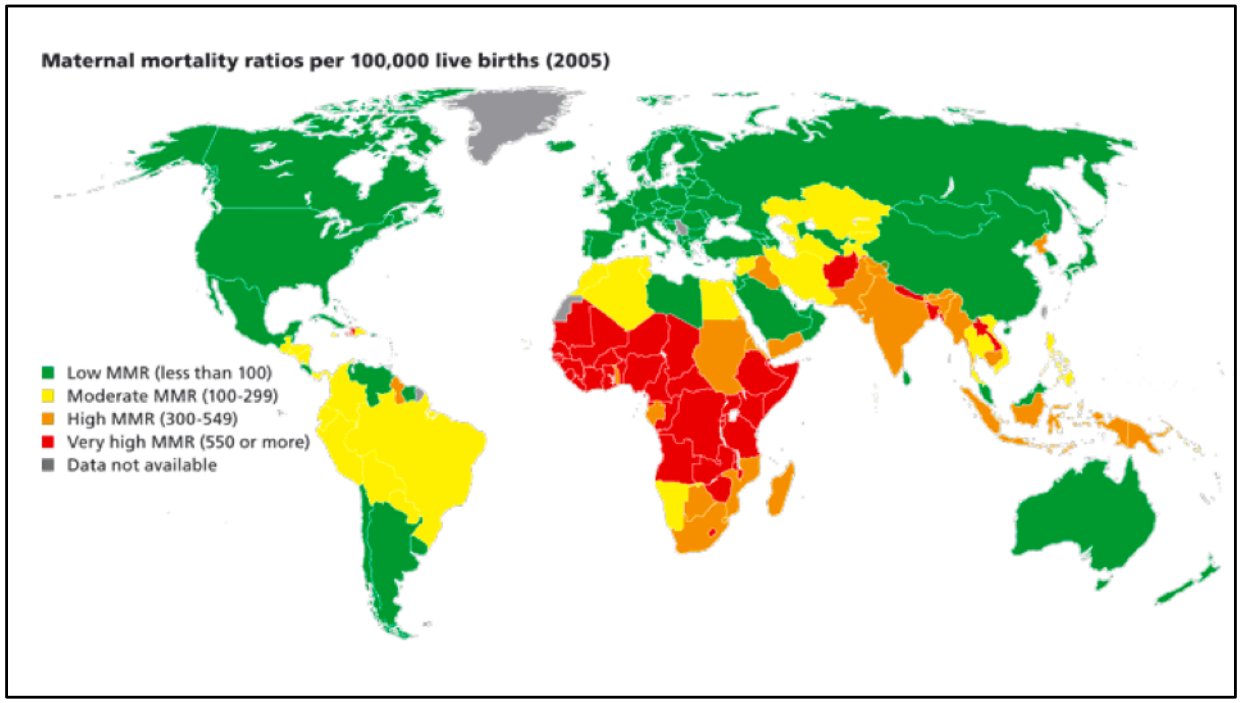

Heart disease
Cancer
Chronic lower respiratory diseases
Stroke
Unintentional injuries
Alzheimer's disease
Diabetes
Nephritis, nephrotic syndrome, and nephrosis
Influenza and pneumonia
Suicide
Causes of death
0
100
200
300
400
500
600
700
No. of deaths (in thousands)

Maternal Mortality Rate

$$MMR = \frac{\text{Number of Maternal Deaths}}{\text{Number of Live Births}} * K$$

- Generally calculated within a given year
- The MMR is often multiplied by a constant 100,000 and expressed per 100,000 live births

Maternal Deaths include all deaths related to childbirth


Maternal mortality ratios per 100,000 live births (2005)
Low MMR (less than 100)
Moderate MMR (100-299)
High MMR (300-549)
Very high MMR (550 or more)
Data not available

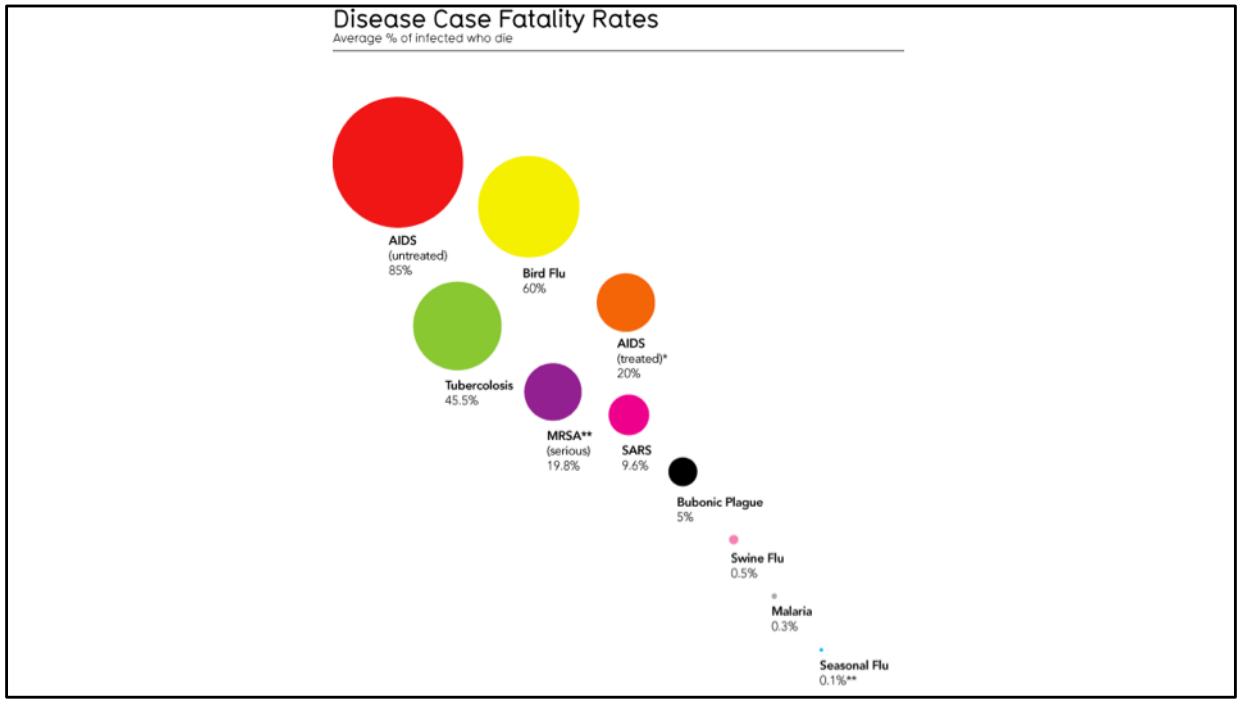
Case Fatality Rate

$$\text{CFR} = \frac{\text{Number of Deaths from Specific Cause}}{\text{Number of Cases of that Cause}} * K$$

- Generally calculated within a given year
- The CFR is often multiplied by a constant 100 and expressed per 100 cases
- Essentially, what percent of those infected will die?

Generally K is just a round number to make the number intelligible.

Ex: If 1000 people are diagnosed with a particular disease, but only three die from it, the CFR would be .3 / 100 cases.


Disease Case Fatality Rates
Average % of infected who die
AIDS
(untreated)
85%
Bird Flu
60%
AIDS
(treated)*
20%
Tubercolosis
45.5%
MRSA**
(serious)
19.8%
SARS
9.6%
Bubonic Plague
5%
Swine Flu
0.5%
Malaria
0.3%
Seasonal Flu
0.1%**

Trouble calculating case specific death rates:

- Death certificates generally completed by doctors and/or funeral directors
  - Varies by state
  - Often questions are answered based on family self-reporting
  - Causes of death are complicated
    - Often there are immediate and less immediate causes that go into one's death

For example: If you have smoked your whole life which contributed to ongoing heart disease which caused you to have a heart attack, which didn't kill you, but made it necessary for you to have surgery and then in the surgery you developed an infection that ultimately kills you, what was your cause of death?

Most states let you list multiple causes of death from most immediate to least, but these are often not reliably or consistently filled out.

Questions?

Age-Specific Death Rate

$$\text{ASDR} = \frac{\text{Number of Deaths in a Given Age Group}}{\text{Total Population in that Age Group}} * K$$

- The ASDR is generally calculated for a given year (using mid-year population)
- The constant used in ASDRs often depends on the age group

Ex: all deaths among 20 something year olds/ total population of 20 something year olds.

Neonatal Mortality Rate

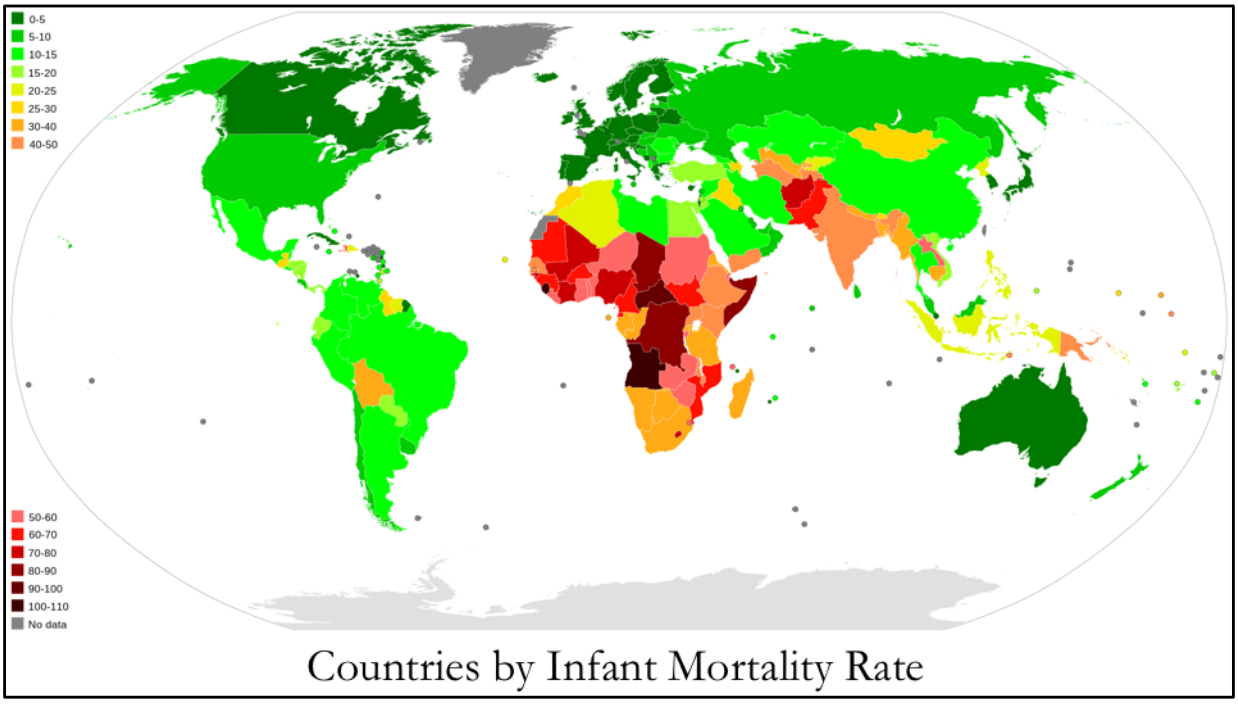
$$\text{NMR} = \frac{\text{Number of Deaths under 28 Days Old}}{\text{Number of Live Births}} * K$$

- The NMR is generally calculated for a given year (using mid-year population)
- The constant (K) is usually 1,000

Infant Mortality Rate

$$\text{IMR} = \frac{\text{Number of Deaths under 1 Year Old}}{\text{Number of Live Births}} * K$$

- The IMR is generally calculated for a given year (using mid-year population)
- The constant (K) is usually 1,000



Countries by Infant Mortality Rate

Questions?

Plan for Today

- Fertility
- Mortality
- Migration
- Putting it All Together

What is Migration?

What is Migration?

- The movement of people from one place to another

What are the two things that go into migration?

What is Migration?

- The movement of people from one place to another
  - Immigration: migration into the country
  - Emigration: migration out of the country

Note: migration refers to all sorts of movement (including within countries). Immigration and emigration refer to the movement of people at the national scale.

What is Migration?

- The movement of people from one place to another
  - Immigration: migration into the country
  - Emigration: migration out of the country

Net migration = Immigration - Emigration

Migration is commonly considered to be the result of push and pull factors…

What are push factors?

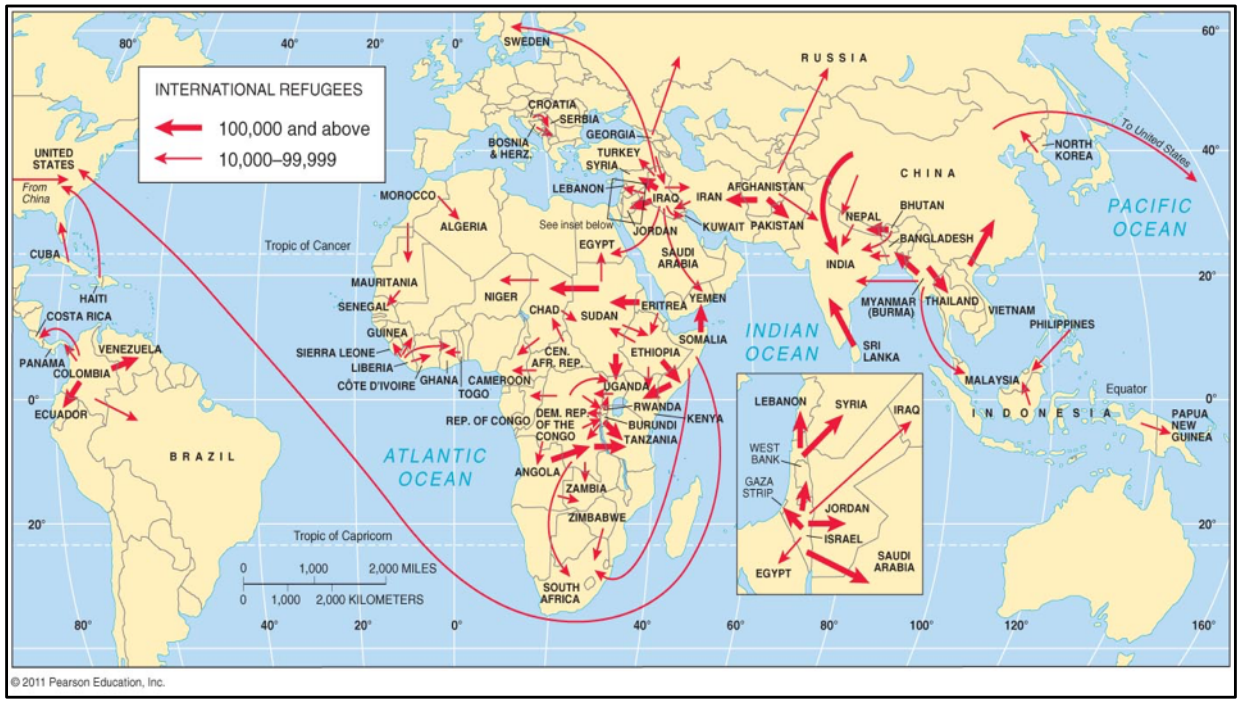
Push Factors

- Any factor that contributes to the decision of someone to leave their current home

What do these include?

Push Factors

- War
- Famine
- Disease
- Lack of Jobs
- Overpopulation
- Drought


INTERNATIONAL REFUGEES
100,000 and above
10,000–99,999
SWEDEN
RUSSIA
CROATIA
SERBIA
GEORGIA
BOSNIA & HERZ.
TURKEY
SYRIA
LEBANON
IRAQ
IRAN
AFGHANISTAN
KUWAIT
PAKISTAN
CHINA
NEPAL
BHUTAN
BANGLADESH
INDIA
NORTH KOREA
To United States
PACIFIC OCEAN
UNITED STATES
From China
CUBA
HAITI
COSTA RICA
PANAMA
COLOMBIA
VENEZUELA
ECUADOR
BRAZIL
MOROCCO
ALGERIA
See inset below
JORDAN
EGYPT
SAUDI ARABIA
Tropic of Cancer
MAURITANIA
SENEGAL
GUINEA
SIERRA LEONE
LIBERIA
CÔTE D'IVOIRE
GHANA
TOGO
CAMEROON
NIGER
CHAD
SUDAN
ERITREA
YEMEN
SOMALIA
ETHIOPIA
CEN. AFR. REP.
UGANDA
RWANDA
KENYA
BURUNDI
TANZANIA
REP. OF CONGO
DEM. REP. OF THE CONGO
ANGOLA
ZAMBIA
ZIMBABWE
SOUTH AFRICA
ATLANTIC OCEAN
INDIAN OCEAN
Tropic of Capricorn
0 1,000 2,000 MILES
0 1,000 2,000 KILOMETERS
MYANMAR (BURMA)
THAILAND
VIETNAM
PHILIPPINES
SRI LANKA
MALAYSIA
INDONESIA
Equator
PAPUA NEW GUINEA
LEBANON
SYRIA
IRAQ
WEST BANK
GAZA STRIP
JORDAN
ISRAEL
EGYPT
SAUDI ARABIA
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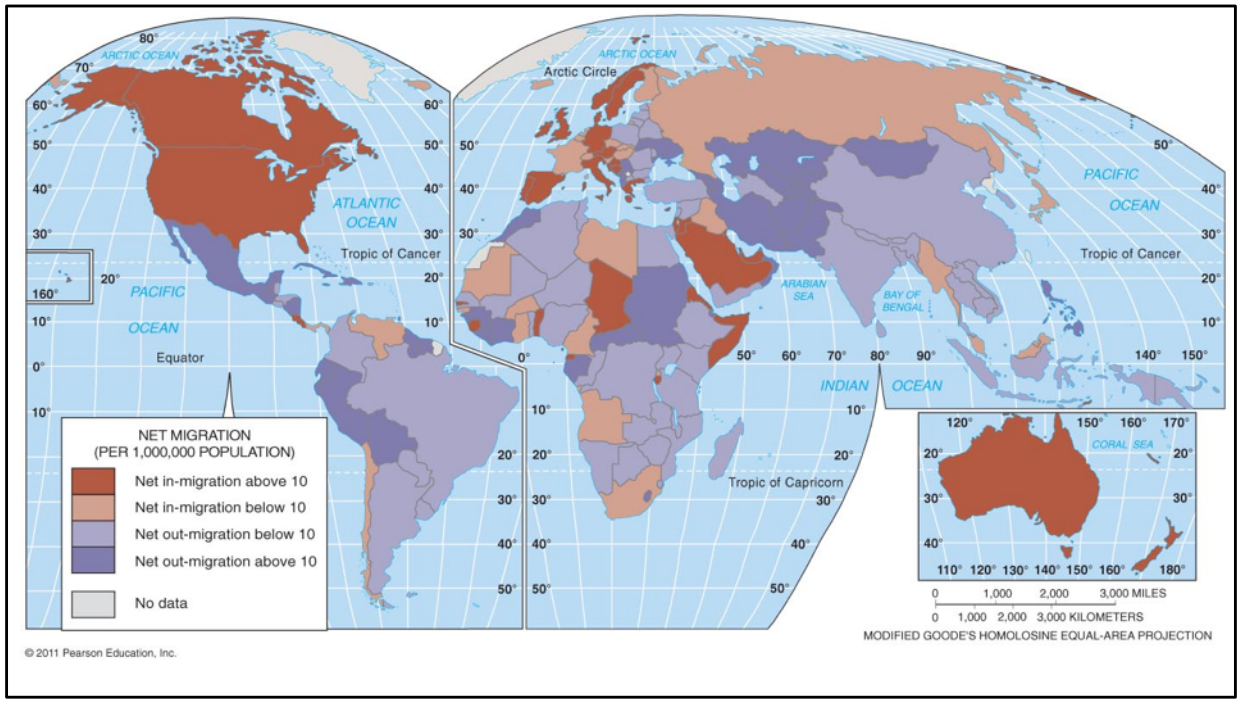
Pull Factors

- Any factor that contributes to the decision of someone to move to a new place (draws them to that place)

What do these include?

Pull Factors

- Freedom
- Jobs
- Family
- Technology
- Education
- Cost of Living
- Weather



This is where people have net gains and losses from immigration/emigration.

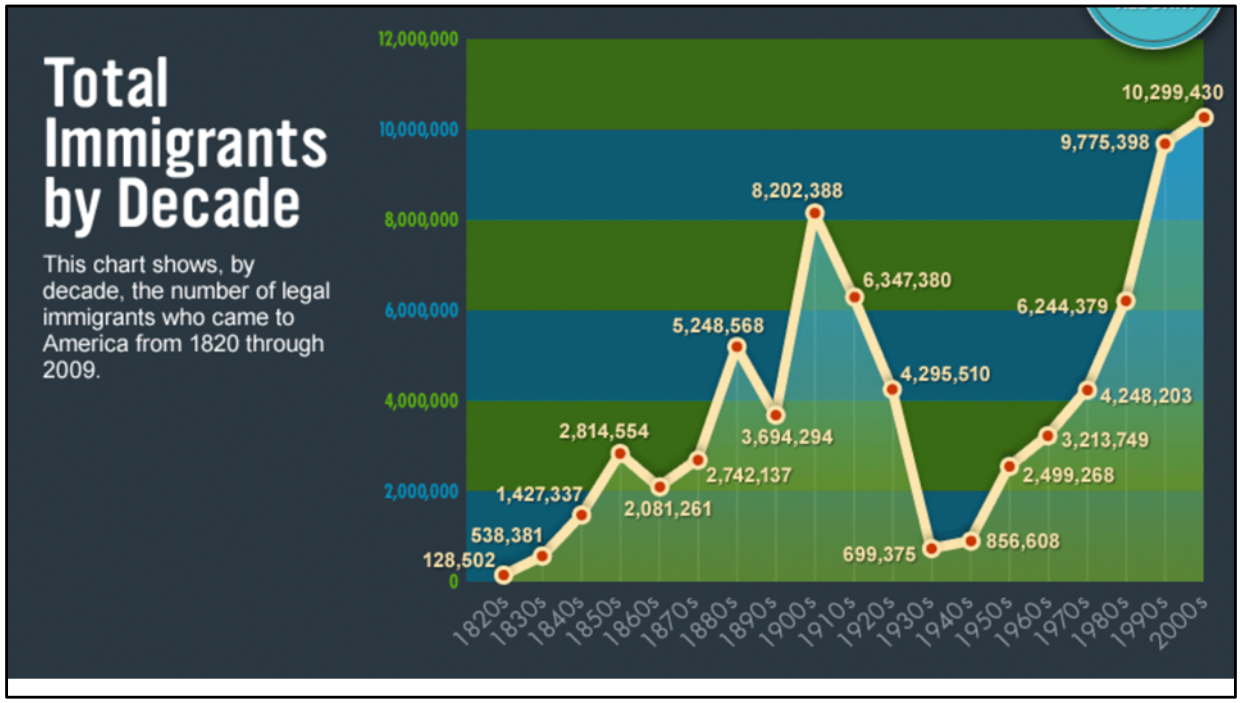
Questions?

Migration in the US

- On average, Americans move once every 6 years
- The US population is the most mobile in the world

Most of this is internal migration (migration within the US)

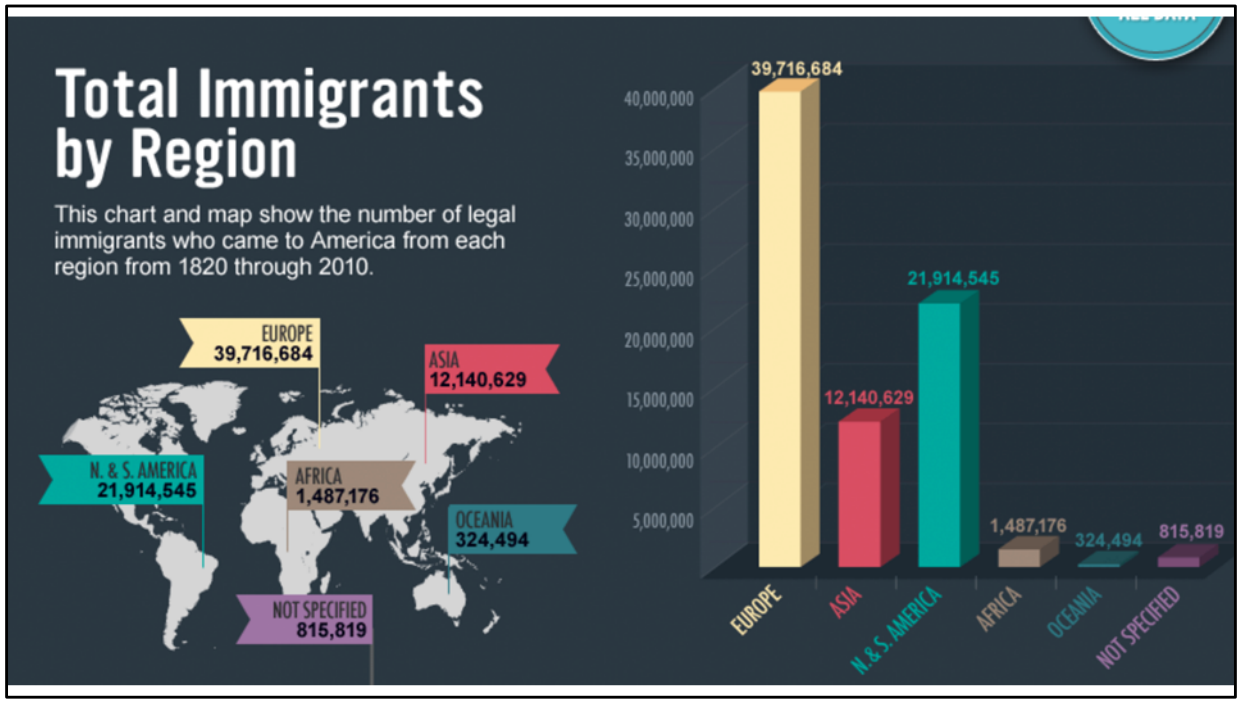
5 million people move between states each year
35 million people move within a state each year

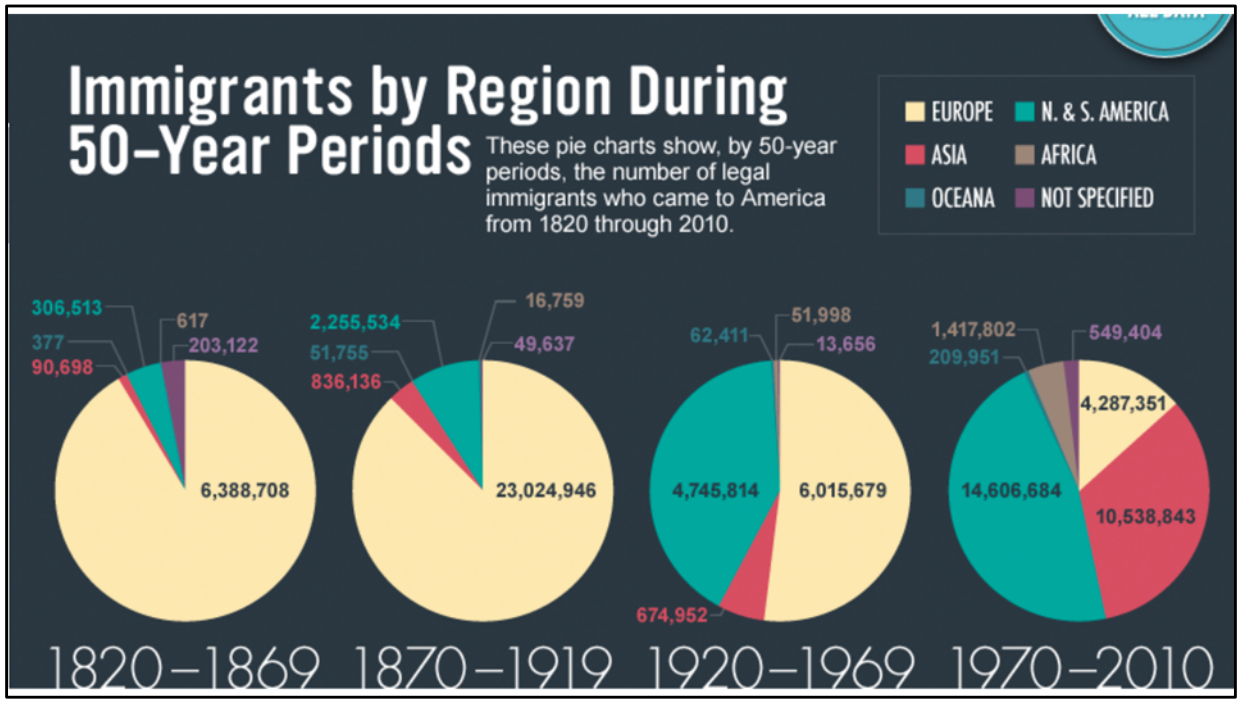

Total Immigrants by Decade
This chart shows, by decade, the number of legal immigrants who came to America from 1820 through 2009.
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
128,502
538,381
1,427,337
2,814,554
2,081,261
2,742,137
5,248,568
3,694,294
8,202,388
6,347,380
4,295,510
699,375
856,608
2,499,268
3,213,749
4,248,203
6,244,379
9,775,398
10,299,430
1820s
1830s
1840s
1850s
1860s
1870s
1880s
1890s
1900s
1910s
1920s
1930s
1940s
1950s
1960s
1970s
1980s
1990s
2000s

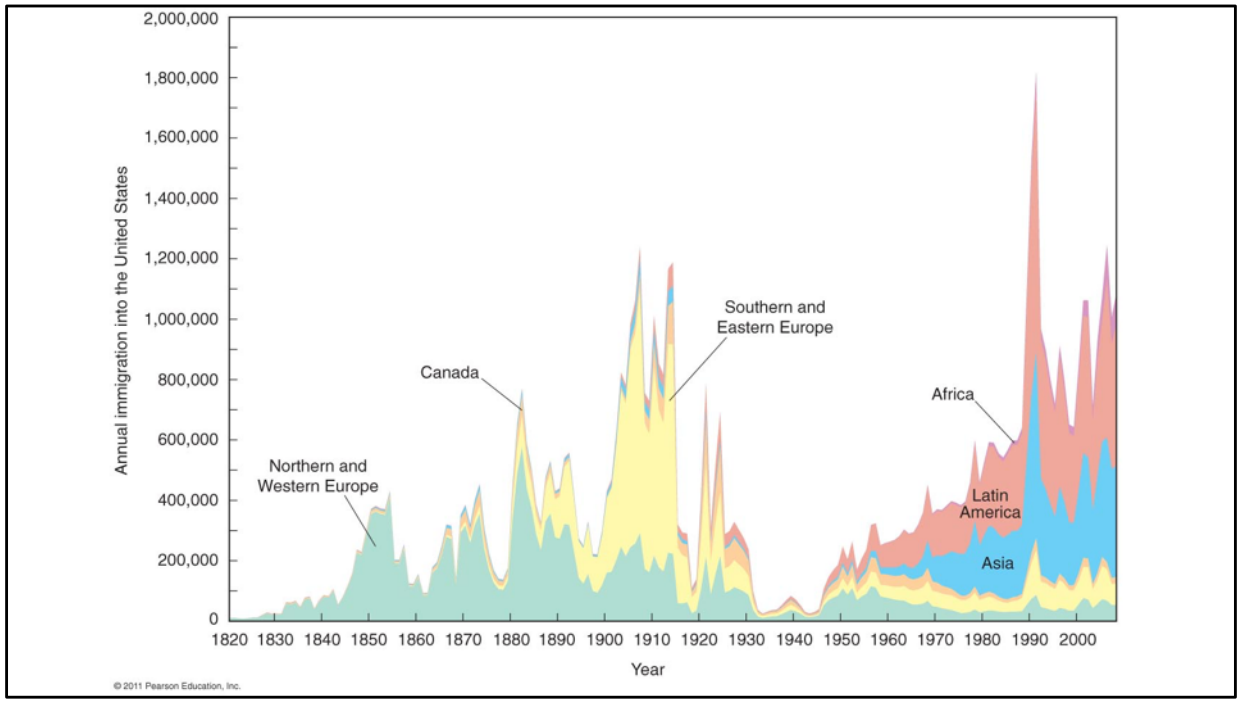
Immigration to the US: Three Eras

- Initial Settlement of Colonies (1600s-1840)
  - Immigrants from Europe and Africa
- 19th Century Immigration (1840-1930)
  - Primarily from Europe
    - 1840s and 50s: From Northern and Western Europe
    - 1880s: From Scandinavia
    - 1900s-20s: From Southern and Eastern Europe
- Recent Immigration (1930-today)
  - More than ¾ of immigrants from Asia and Latin America

5 million people move between states each year
35 million people move within a state each year


Total Immigrants by Region
This chart and map show the number of legal immigrants who came to America from each region from 1820 through 2010.
EUROPE
39,716,684
ASIA
12,140,629
N. & S. AMERICA
21,914,545
AFRICA
1,487,176
OCEANIA
324,494
NOT SPECIFIED
815,819
40,000,000
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
39,716,684
12,140,629
21,914,545
1,487,176
324,494
815,819
EUROPE
ASIA
N. & S. AMERICA
AFRICA
OCEANIA
NOT SPECIFIED


Immigrants by Region During 50-Year Periods
These pie charts show, by 50-year periods, the number of legal immigrants who came to America from 1820 through 2010.
EUROPE
N. & S. AMERICA
ASIA
AFRICA
OCEANA
NOT SPECIFIED
306,513
617
377
203,122
90,698
6,388,708
2,255,534
16,759
51,755
49,637
836,136
23,024,946
62,411
51,998
13,656
4,745,814
6,015,679
674,952
1,417,802
549,404
209,951
4,287,351
14,606,684
10,538,843
1820–1869
1870–1919
1920–1969
1970–2010


2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Annual immigration into the United States
Northern and Western Europe
Canada
Southern and Eastern Europe
Africa
Latin America
Asia
1820 1830 1840 1850 1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000
Year
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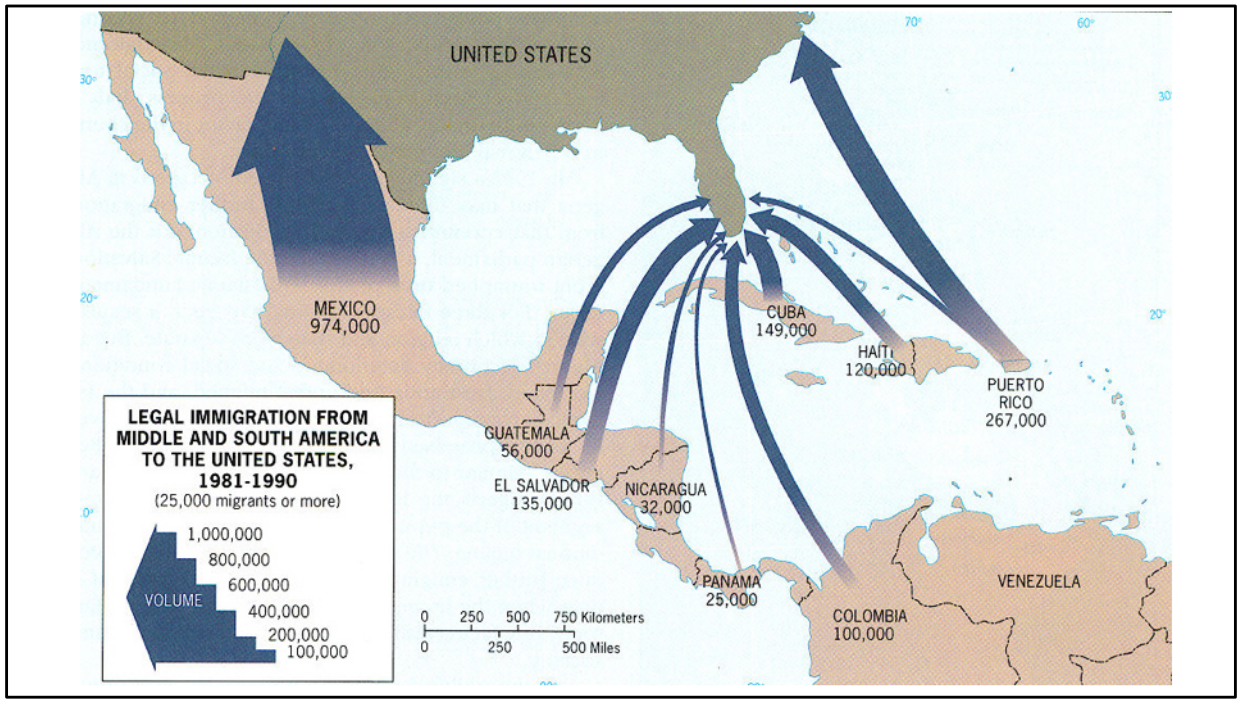
UNITED STATES
MEXICO
974,000
CUBA
149,000
HAITI
120,000
PUERTO
RICO
267,000
GUATEMALA
56,000
EL SALVADOR
135,000
NICARAGUA
32,000
PANAMA
25,000
COLOMBIA
100,000
VENEZUELA
LEGAL IMMIGRATION FROM MIDDLE AND SOUTH AMERICA TO THE UNITED STATES, 1981-1990
(25,000 migrants or more)
VOLUME
1,000,000
800,000
600,000
400,000
200,000
100,000
0 250 500 750 Kilometers
0 250 500 Miles

Questions?

Again, we will be talking more about migration later in the quarter.

Plan for Today

- Fertility
- Mortality
- Migration
- Putting it All Together

Putting it All Together

Population Change = (Births + Immigration) – (Deaths + Emigration)

http://www.census.gov/popclock/