

Demography 101

Texas Demographic
Conference

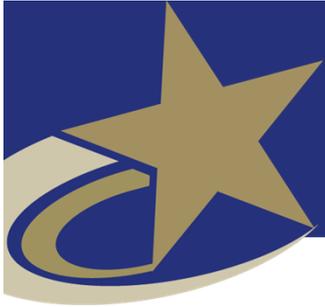
Austin, Texas

May 23, 2018

TEXAS 
DEMOGRAPHIC CENTER

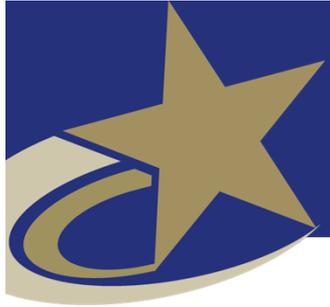


@TexasDemography



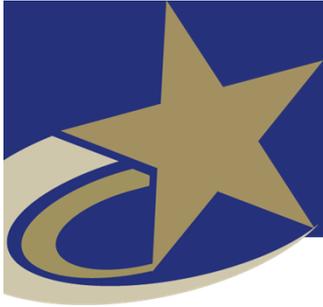
Demography

- the scientific study of human populations, primarily with respect to their size, their structure and their development' (United Nations 1958).
- the study of human population in relation to the changes brought about by the interplay of births, deaths and migration' (Pressat 1985).

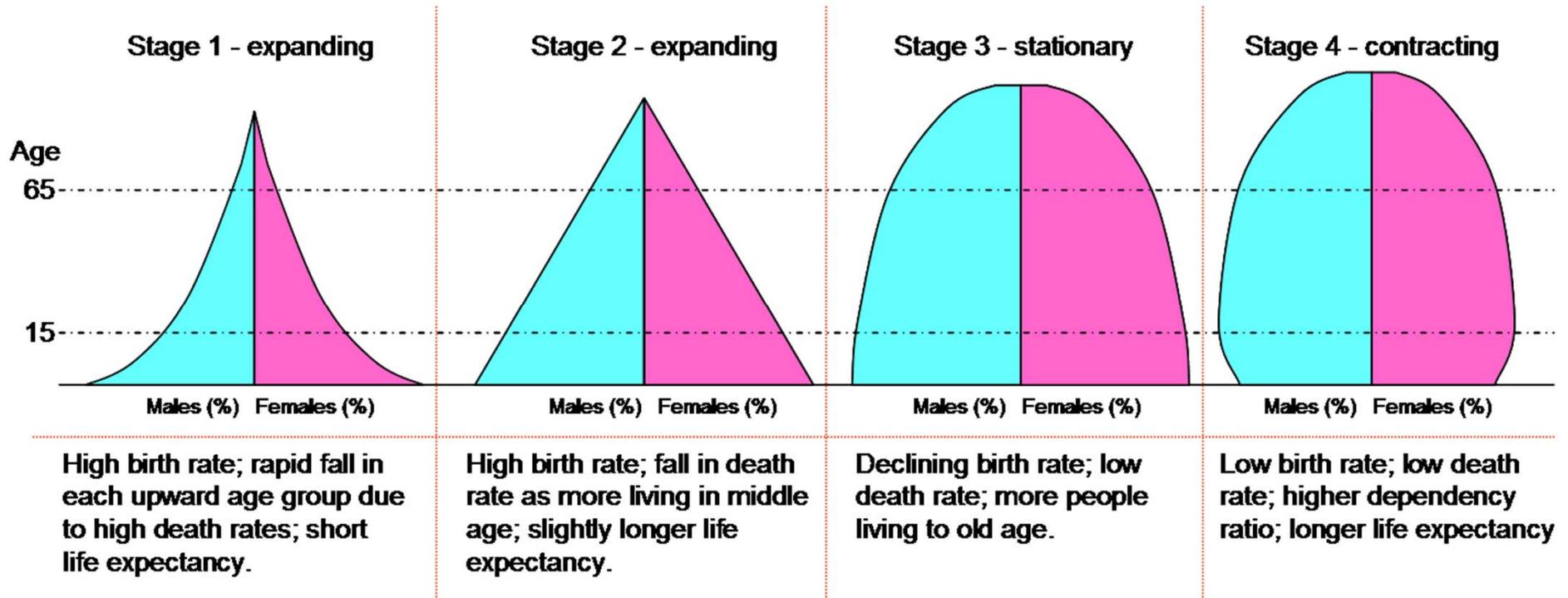


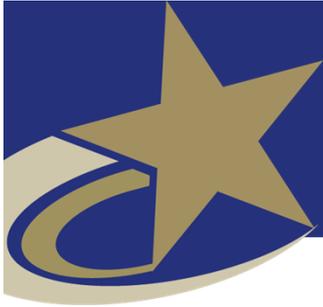
Study of population

- size
- distribution
- composition
- components of population change, and
- determinants and consequences of population change
- social and economic characteristics of population

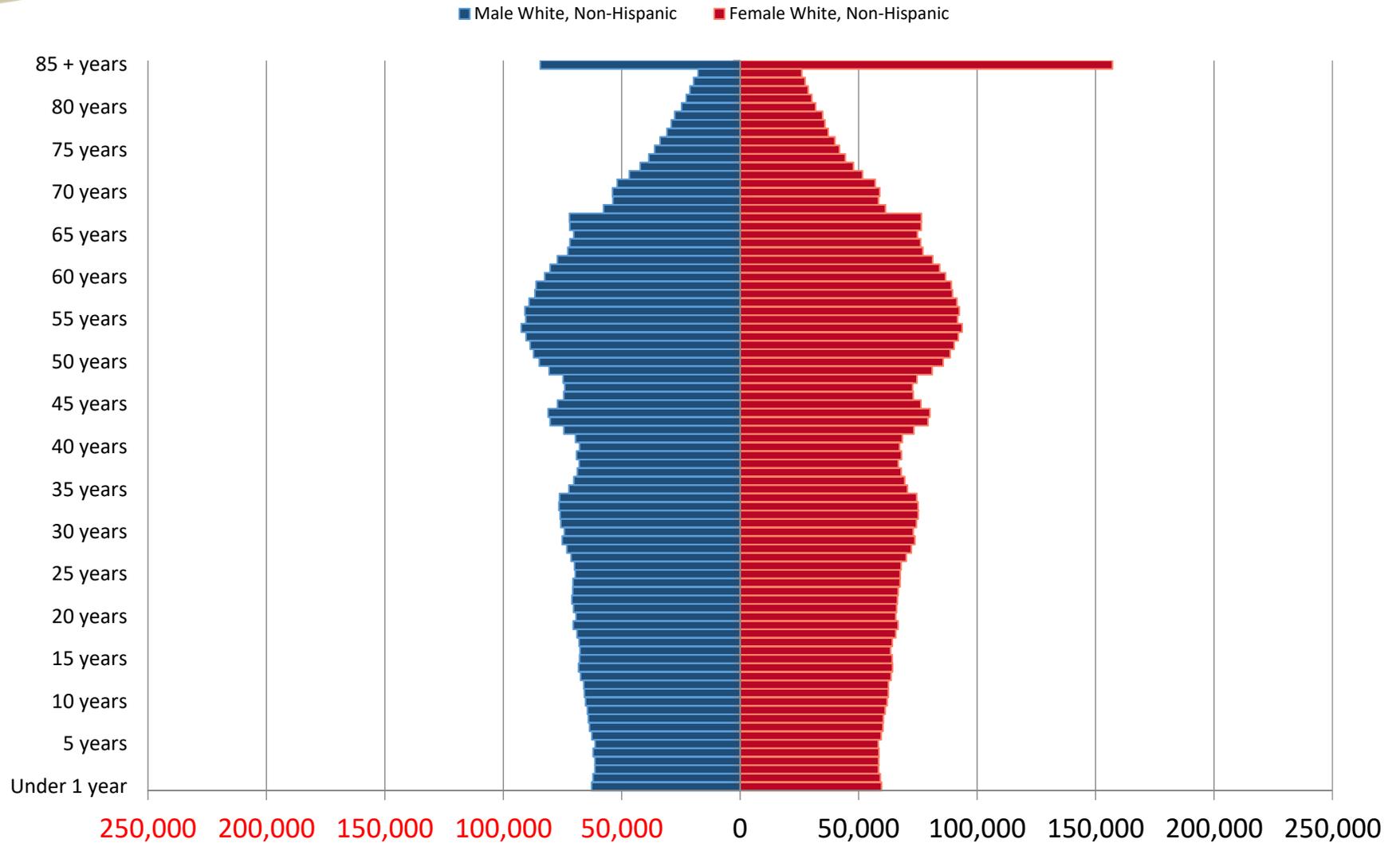


Population Pyramids for the four demographic transition phases

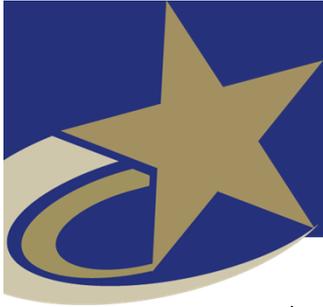




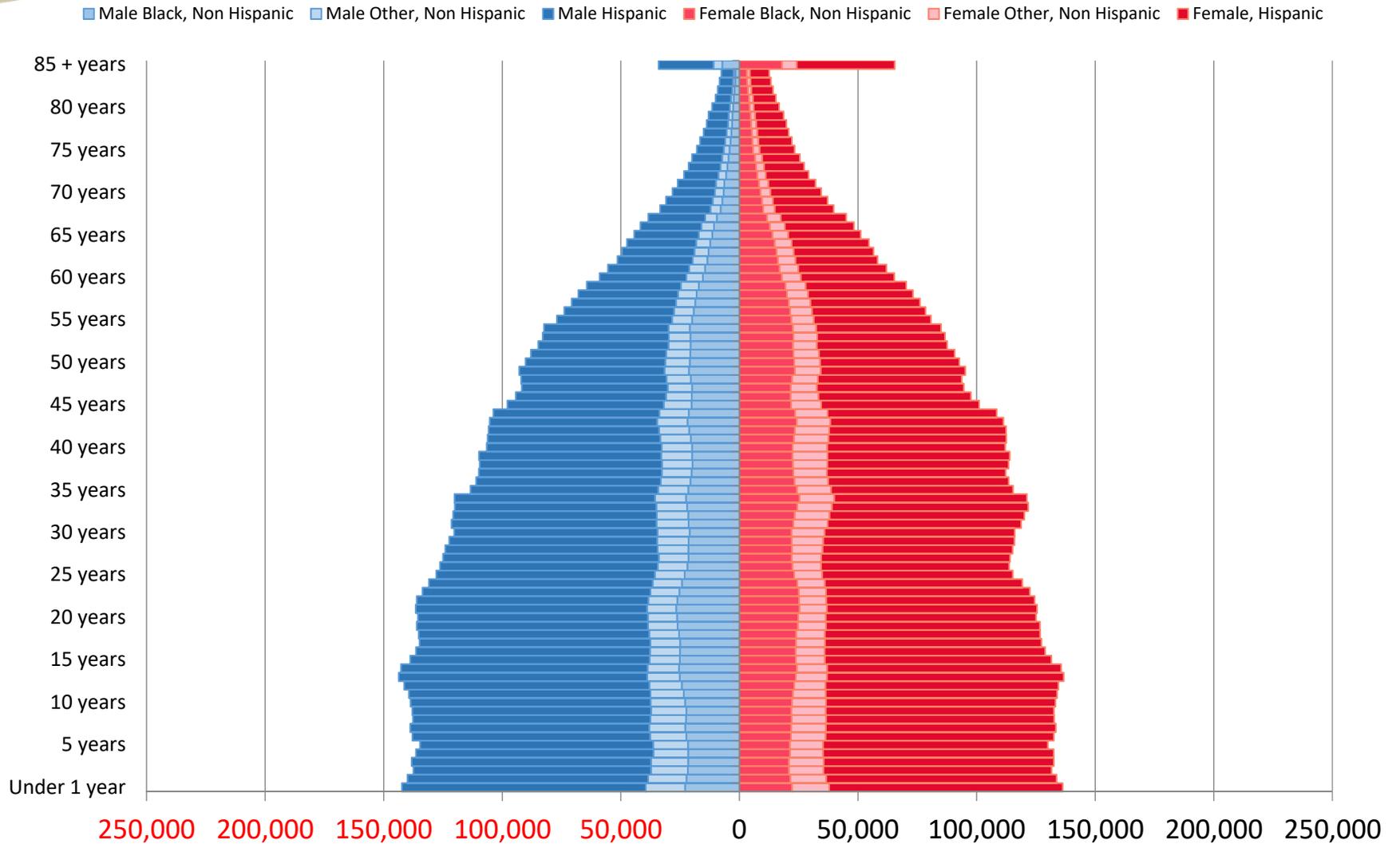
Texas Population Pyramid by Race/Ethnicity, 2014



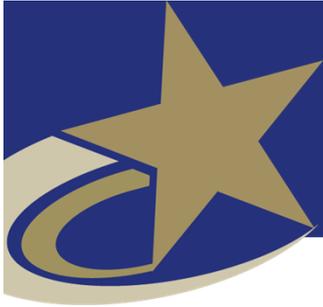
Source: Texas Demographic Center, 2014 Population Estimates



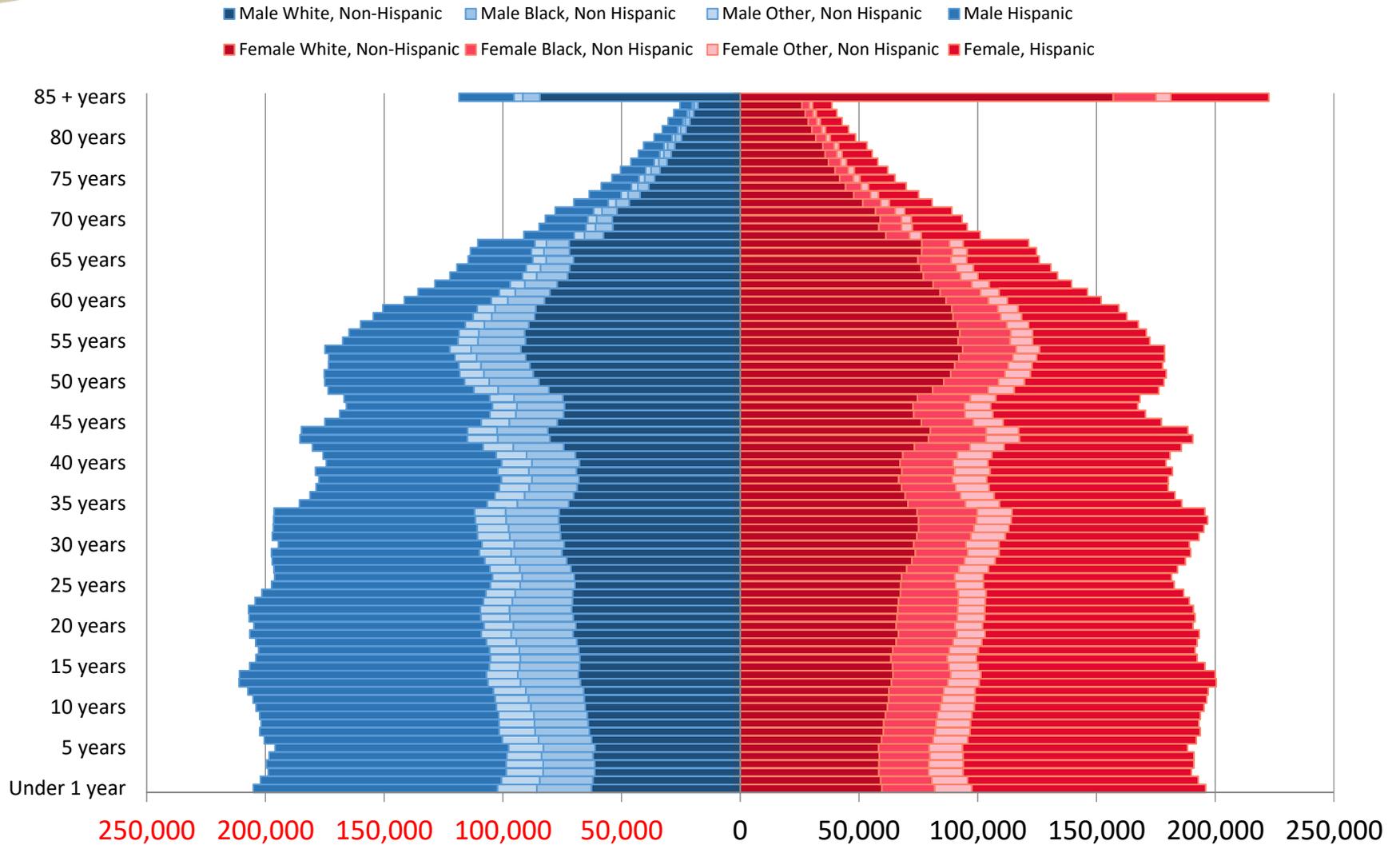
Texas Population Pyramid by Race/Ethnicity, 2014



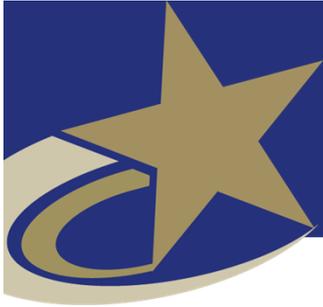
Source: Texas Demographic Center, 2014 Population Estimates



Texas Population Pyramid by Race/Ethnicity, 2014



Source: Texas Demographic Center, 2014 Population Estimates



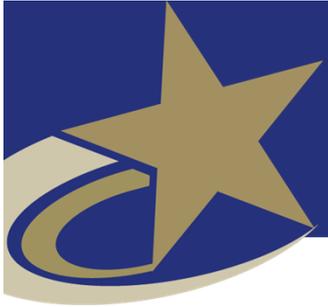
Demographic Data

- Three basic sources of demographic data
 - National censuses, registers, and surveys
- National censuses
 - Conducted on a decennial or quinquennial basis
 - A “snapshot” of the population, intended to provide a picture at one point in time of the size, characteristics and distribution of a population



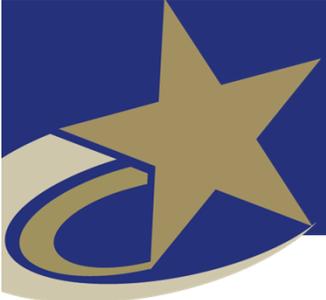
Demographic Data

- Registers
 - Gathered continuously
 - Compiled and published annually or monthly
 - Major population events, such as births, deaths, marriages, divorces, and sometimes migration
 - As a birth or death occur, it is registered with the government and thus registration occurs continuously



Demographic Information

- Censuses and registers are intended to cover the entire population
 - In the national census everyone is intended to be enumerated and all demographic events should be registered
- Surveys are by definition administered to only a fraction of the population
 - Include information typically found in censuses and registers, but also include items of interest to demographers not usually included in censuses and registers



National Census

- Decennial U.S. Census
 - Typically one person answers all questions pertaining to themselves and all individuals in the household
 - Few questions, pertaining to sex, age, Hispanic origin, household relationship, owner/renter status of residence
 - This is the 100% census form



Use a blue or black pen.

Start here

The Census must count every person living in the United States on April 1, 2010.

Before you answer Question 1, count the people living in this house, apartment, or mobile home using our guidelines.

- Count all people, including babies, who live and sleep here most of the time.

The Census Bureau also conducts counts in institutions and other places, so:

- Do not count anyone living away either at college or in the Armed Forces.
- Do not count anyone in a nursing home, jail, prison, detention facility, etc., on April 1, 2010.
- Leave these people off your form, even if they will return to live here after they leave college, the nursing home, the military, jail, etc. Otherwise, they may be counted twice.

The Census must also include people without a permanent place to stay, so:

- If someone who has no permanent place to stay is staying here on April 1, 2010, count that person. Otherwise, he or she may be missed in the census.

1. How many people were living or staying in this house, apartment, or mobile home on April 1, 2010?

Number of people =

2. Were there any additional people staying here April 1, 2010 that you did not include in Question 1?

Mark all that apply.

- Children, such as newborn babies or foster children
- Relatives, such as adult children, cousins, or in-laws
- Nonrelatives, such as roommates or live-in baby sitters
- People staying here temporarily
- No additional people

3. Is this house, apartment, or mobile home —

Mark ONE box.

- Owned by you or someone in this household with a mortgage or loan? *Include home equity loans.*
- Owned by you or someone in this household free and clear (without a mortgage or loan)?
- Rented?
- Occupied without payment of rent?

4. What is your telephone number? We may call if we don't understand an answer.

Area Code + Number

- -

OMB No. 0607-0919-C; Approval Expires 12/31/2011.

Form **D-61** (9-25-2008)

5. Please provide information for each person living here. Start with a person living here who owns or rents this house, apartment, or mobile home. If the owner or renter lives somewhere else, start with any adult living here. This will be Person 1.

What is Person 1's name? *Print name below.*

Last Name

First Name MI

6. What is Person 1's sex? Mark ONE box.

- Male Female

7. What is Person 1's age and what is Person 1's date of birth?

Please report babies as age 0 when the child is less than 1 year old.

Print numbers in boxes.

Age on April 1, 2010 Month Day Year of birth

→ NOTE: Please answer BOTH Question 8 about Hispanic origin and Question 9 about race. For this census, Hispanic origins are not races.

8. Is Person 1 of Hispanic, Latino, or Spanish origin?

- No, not of Hispanic, Latino, or Spanish origin
- Yes, Mexican, Mexican Am., Chicano
- Yes, Puerto Rican
- Yes, Cuban
- Yes, another Hispanic, Latino, or Spanish origin — *Print origin, for example Argentinian, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.*

9. What is Person 1's race? Mark one or more boxes.

- White
- Black, African Am., or Negro
- American Indian or Alaska Native — *Print race of ancestor or principal tribe.*

- Asian Indian Japanese Native Hawaiian
- Chinese Korean Guamanian or Chamorro
- Filipino Vietnamese Samoan
- Other Asian — *Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on.*
- Other Pacific Islander — *Print race, for example, Fijian, Tongan, and so on.*

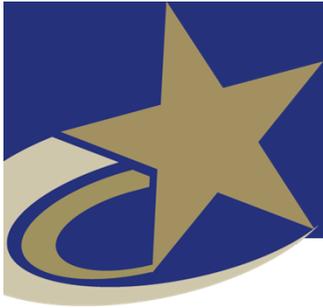
Some other race — *Print race.*

10. Does Person 1 sometimes live or stay somewhere else?

No Yes — Mark all that apply.

- In college housing For child custody
- In the military In jail or prison
- At a seasonal or second residence In a nursing home
- For another reason

→ If more people were counted in Question 1, continue with Person 2.



Use this section to complete information for the rest of the people you counted in Question 1 on the front page. We may call for additional information about them.

Person 7	Last Name	First Name	MI
Sex	Age on April 1, 2010	Date of Birth	Related to Person 1?
<input type="checkbox"/> Male <input type="checkbox"/> Female		Month Day Year	<input type="checkbox"/> Yes <input type="checkbox"/> No
Person 8	Last Name	First Name	MI
Sex	Age on April 1, 2010	Date of Birth	Related to Person 1?
<input type="checkbox"/> Male <input type="checkbox"/> Female		Month Day Year	<input type="checkbox"/> Yes <input type="checkbox"/> No
Person 9	Last Name	First Name	MI
Sex	Age on April 1, 2010	Date of Birth	Related to Person 1?
<input type="checkbox"/> Male <input type="checkbox"/> Female		Month Day Year	<input type="checkbox"/> Yes <input type="checkbox"/> No
Person 10	Last Name	First Name	MI
Sex	Age on April 1, 2010	Date of Birth	Related to Person 1?
<input type="checkbox"/> Male <input type="checkbox"/> Female		Month Day Year	<input type="checkbox"/> Yes <input type="checkbox"/> No
Person 11	Last Name	First Name	MI
Sex	Age on April 1, 2010	Date of Birth	Related to Person 1?
<input type="checkbox"/> Male <input type="checkbox"/> Female		Month Day Year	<input type="checkbox"/> Yes <input type="checkbox"/> No
Person 12	Last Name	First Name	MI
Sex	Age on April 1, 2010	Date of Birth	Related to Person 1?
<input type="checkbox"/> Male <input type="checkbox"/> Female		Month Day Year	<input type="checkbox"/> Yes <input type="checkbox"/> No

*Thank you for completing your official
2010 Census form.*

FOR OFFICIAL USE ONLY

JIC1	JIC2

1. Print name of **Person 2**

Last Name

First Name MI

2. How is this person related to Person 1? Mark ONE box.

Husband or wife Parent-in-law
 Biological son or daughter Son-in-law or daughter-in-law
 Adopted son or daughter Other relative
 Stepson or stepdaughter Roomer or boarder
 Brother or sister Housemate or roommate
 Father or mother Unmarried partner
 Grandchild Other nonrelative

3. What is this person's sex? Mark ONE box.

Male Female

4. What is this person's age and what is this person's date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age on April 1, 2010 Month Day Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this census, Hispanic origins are not races.

5. Is this person of Hispanic, Latino, or Spanish origin?

No, not of Hispanic, Latino, or Spanish origin
 Yes, Mexican, Mexican Am., Chicano
 Yes, Puerto Rican
 Yes, Cuban
 Yes, another Hispanic, Latino, or Spanish origin — Print origin, for example, Argentinian, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on. ↴

6. What is this person's race? Mark one or more boxes.

White
 Black, African Am., or Negro
 American Indian or Alaska Native — Print name of enrolled or principal tribe. ↴

Asian Indian Japanese Native Hawaiian
 Chinese Korean Guamanian or Chamorro
 Filipino Vietnamese Samoan
 Other Asian — Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on. ↴ Other Pacific Islander — Print race, for example, Fijian, Tongan, and so on. ↴

Some other race — Print race. ↴

7. Does this person sometimes live or stay somewhere else? No Yes — Mark all that apply.

In college housing For child custody
 In the military In jail or prison
 At a seasonal or second residence In a nursing home or second residence For another reason

→ If more people were counted in Question 1 on the front page, continue with Person 2.

1. Print name of **Person 3**

Last Name

First Name MI

2. How is this person related to Person 1? Mark ONE box.

Husband or wife Parent-in-law
 Biological son or daughter Son-in-law or daughter-in-law
 Adopted son or daughter Other relative
 Stepson or stepdaughter Roomer or boarder
 Brother or sister Housemate or roommate
 Father or mother Unmarried partner
 Grandchild Other nonrelative

3. What is this person's sex? Mark ONE box.

Male Female

4. What is this person's age and what is this person's date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age on April 1, 2010 Month Day Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this census, Hispanic origins are not races.

5. Is this person of Hispanic, Latino, or Spanish origin?

No, not of Hispanic, Latino, or Spanish origin
 Yes, Mexican, Mexican Am., Chicano
 Yes, Puerto Rican
 Yes, Cuban
 Yes, another Hispanic, Latino, or Spanish origin — Print origin, for example, Argentinian, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on. ↴

6. What is this person's race? Mark one or more boxes.

White
 Black, African Am., or Negro
 American Indian or Alaska Native — Print name of enrolled or principal tribe. ↴

Asian Indian Japanese Native Hawaiian
 Chinese Korean Guamanian or Chamorro
 Filipino Vietnamese Samoan
 Other Asian — Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on. ↴ Other Pacific Islander — Print race, for example, Fijian, Tongan, and so on. ↴

Some other race — Print race. ↴

7. Does this person sometimes live or stay somewhere else? No Yes — Mark all that apply.

In college housing For child custody
 In the military In jail or prison
 At a seasonal or second residence In a nursing home or second residence For another reason

→ If more people were counted in Question 1 on the front page, continue with Person 3.

1. Print name of **Person 4**

Last Name

First Name MI

2. How is this person related to Person 1? Mark ONE box.

Husband or wife Parent-in-law
 Biological son or daughter Son-in-law or daughter-in-law
 Adopted son or daughter Other relative
 Stepson or stepdaughter Roomer or boarder
 Brother or sister Housemate or roommate
 Father or mother Unmarried partner
 Grandchild Other nonrelative

3. What is this person's sex? Mark ONE box.

Male Female

4. What is this person's age and what is this person's date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age on April 1, 2010 Month Day Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this census, Hispanic origins are not races.

5. Is this person of Hispanic, Latino, or Spanish origin?

No, not of Hispanic, Latino, or Spanish origin
 Yes, Mexican, Mexican Am., Chicano
 Yes, Puerto Rican
 Yes, Cuban
 Yes, another Hispanic, Latino, or Spanish origin — Print origin, for example, Argentinian, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on. ↴

6. What is this person's race? Mark one or more boxes.

White
 Black, African Am., or Negro
 American Indian or Alaska Native — Print name of enrolled or principal tribe. ↴

Asian Indian Japanese Native Hawaiian
 Chinese Korean Guamanian or Chamorro
 Filipino Vietnamese Samoan
 Other Asian — Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on. ↴ Other Pacific Islander — Print race, for example, Fijian, Tongan, and so on. ↴

Some other race — Print race. ↴

7. Does this person sometimes live or stay somewhere else? No Yes — Mark all that apply.

In college housing For child custody
 In the military In jail or prison
 At a seasonal or second residence In a nursing home or second residence For another reason

→ If more people were counted in Question 1 on the front page, continue with Person 4.

1. Print name of **Person 5**

Last Name

First Name MI

2. How is this person related to Person 1? Mark ONE box.

Husband or wife Parent-in-law
 Biological son or daughter Son-in-law or daughter-in-law
 Adopted son or daughter Other relative
 Stepson or stepdaughter Roomer or boarder
 Brother or sister Housemate or roommate
 Father or mother Unmarried partner
 Grandchild Other nonrelative

3. What is this person's sex? Mark ONE box.

Male Female

4. What is this person's age and what is this person's date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age on April 1, 2010 Month Day Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this census, Hispanic origins are not races.

5. Is this person of Hispanic, Latino, or Spanish origin?

No, not of Hispanic, Latino, or Spanish origin
 Yes, Mexican, Mexican Am., Chicano
 Yes, Puerto Rican
 Yes, Cuban
 Yes, another Hispanic, Latino, or Spanish origin — Print origin, for example, Argentinian, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on. ↴

6. What is this person's race? Mark one or more boxes.

White
 Black, African Am., or Negro
 American Indian or Alaska Native — Print name of enrolled or principal tribe. ↴

Asian Indian Japanese Native Hawaiian
 Chinese Korean Guamanian or Chamorro
 Filipino Vietnamese Samoan
 Other Asian — Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on. ↴ Other Pacific Islander — Print race, for example, Fijian, Tongan, and so on. ↴

Some other race — Print race. ↴

7. Does this person sometimes live or stay somewhere else? No Yes — Mark all that apply.

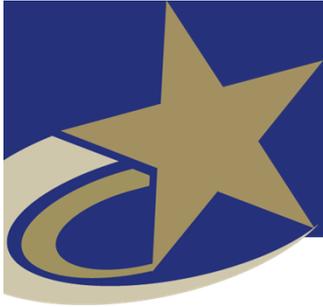
In college housing For child custody
 In the military In jail or prison
 At a seasonal or second residence In a nursing home or second residence For another reason

→ If more people were counted in Question 1 on the front page, continue with Person 5.



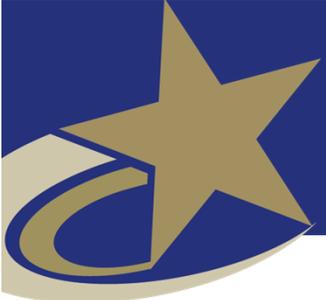
Registration Systems

- Registration systems identify the population's demographic events
- Registers are dynamic and continuous
- Principally apply to births and deaths, although some countries also register marriages, divorces, migrations and abortions



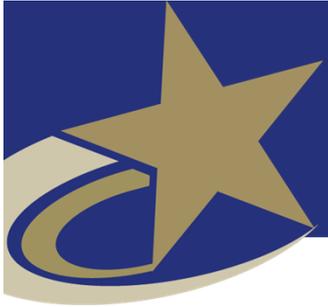
U.S. Birth and Death Certificates

- Birth certificates include data on:
 - Parents, pregnancy, method of delivery, etc
- Death certificates include data on:
 - Age, occupation, cause of death, etc
- Some information death certificates come from family or others so data can be less reliable



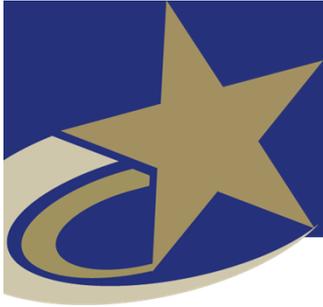
Surveys

- Demographers also rely on a third source of data—the survey
- This is so because often censuses and registration systems don't contain the extensive kinds of information needed to address some critical demographic questions
- Surveys are administered to carefully selected samples of the larger population



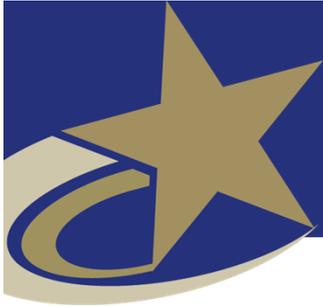
Popular Demographic Surveys

- **World Fertility Surveys**—began in the 1970s, collect data on the reproductive behavior and related social and psychological indicators. Conducted in 62 countries, representing 40 percent of the world's population
- **Demographic and Health Survey**—More than 200 sample surveys carried out in more than 75 developing countries between 1986 and now. Areas of fertility, population, health and nutrition. Nationally representative, large sample sizes, conducted every 5 years



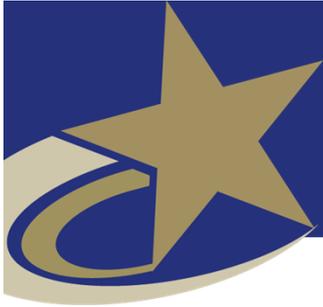
Popular Demographic Surveys

- **Other fertility studies**—less comprehensive but also widely used:
 - Indianapolis Study, Princeton Study, etc
- **Current Population Survey (CPS)**—monthly, nationwide survey conducted by the U.S. Census Bureau. Main focus is labor-force data, provides data on unemployment in the U.S. Nationally representative sample of the U.S. population



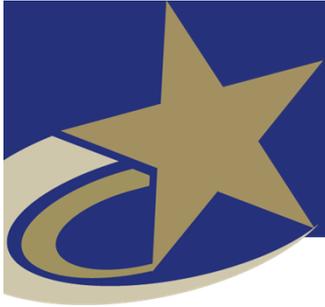
Popular Demographic Surveys

- **National Survey of Family Growth (NSFG)**—conducted by the NCHS, conducted every few years since 1973. Nationally representative sample of females (males were included since 2002 version) aged 15-44, asks about sexual and reproductive health
- **National Survey of Adolescent Health**—began in 1990's by the Carolina Population Center, covers adolescents



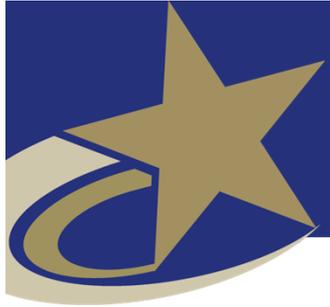
American Community Survey

- **American Community Survey (ACS)**—Redesign of the decennial census in the U.S. Replaces the long form questionnaire with a “continuous measurement” survey of the U.S. population. Started on a limited basis in 1996, in 2010 completely replaced the long form census. Data collected are be similar to the long form census.



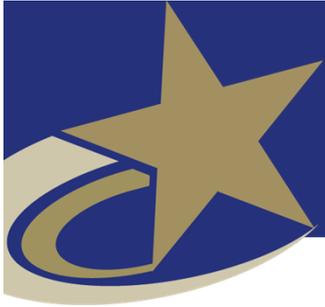
American Community Survey

- ACS data are estimates
- ACS data are not counts of the population or housing
- Population counts are produced from the decennial census
 - Counts are updated throughout the decade through the Population Estimates Program



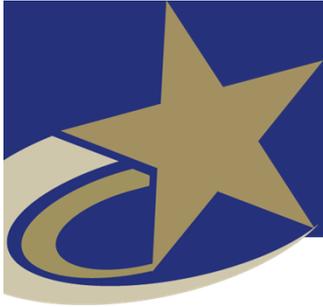
American Community Survey (cont)

- ACS estimates are period estimates
- Period estimates describe the average characteristics over a specific time period
- Contrast with point-in-time estimates that describe characteristics as of a specific date



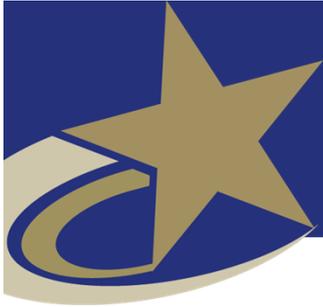
American Community Survey (cont)

- Sampling Error
 - Standard Error (SE)
 - Margin of error (MOE)
 - Confidence Interval (CI)
 - Coefficient of Variance (CV)



What is the ACS PUMS file?

- A sample of population and housing unit records from the American Community Survey
- Allows users to create custom tables that are not available through pretabulated ACS products
- The 1-year ACS PUMS file represents 1 percent of the U.S. population

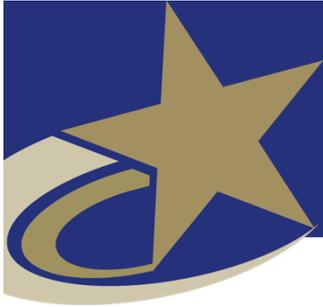


What is a Multiyear Estimate?

Definition

A period estimate that encompasses more than one calendar year

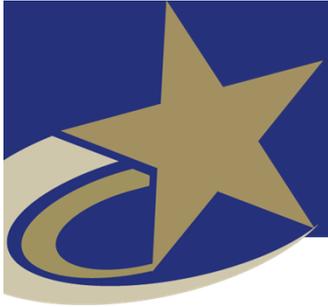
Period for ACS multiyear estimates is 5 calendar years
(used to have 3 year)



Population Thresholds for ACS Estimates

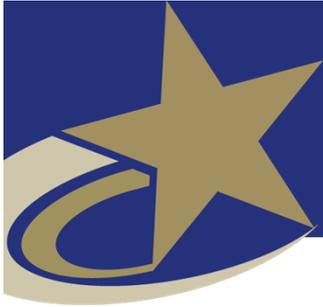
	1-year estimates	3-year estimates	5-year estimates
65,000 + people	X	X	X
20,000+ people		X	X
Less than 20,000 people			X





Measuring Population Change

- Population change is simply the difference in population between two points in time.
- Change can be expressed in Absolute or Percentage terms.
- **Absolute Change:** The simple difference between population figures. Negative values indicate a loss in population.
- **Percent Change:** The relative growth rate over a period of time calculated as a percentage using the formula: $[(\text{New} - \text{Old}) / \text{Old}] * 100$



Components of Population Change

- Demographers rely upon the “Demographic Balancing Equation” to very simply and elegantly summarize population change:

$$\text{Pop}_2 = \text{Pop}_1 + \text{B} - \text{D} + \text{IM} - \text{OM}, \text{ where}$$

Pop₂ = Population at a later time period

Pop₁ = Population at an earlier time period

B = Births

D = Deaths

IM = In-Migration

OM = Out-Migration

Migration

Mortality

Fertility

- The nature of population change is simple... changes can only occur through: 1) Births, 2) Deaths, or 3) Migration

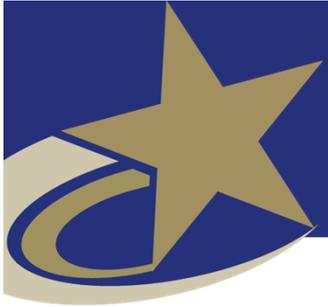


Top Counties for Numeric Growth in Texas, 2016-2017

County	U.S. Rank Population Change	Population Change	Percent of Change from Natural Increase	Percent Change from Domestic Migration	Percent Change from International Migration
Harris*	4	35,939	128.8%	-126.0%	97.2%
Tarrant	5	32,729	47.9%	29.0%	23.1%
Bexar	7	30,831	47.8%	33.4%	18.8%
Dallas	8	30,686	78.0%	-25.5%	47.6%
Denton	9	27,911	23.3%	67.0%	9.7%
Collin	10	27,150	24.4%	56.5%	19.0%
Fort Bend	14	22,870	29.4%	48.1%	22.6%
Travis	15	22,116	47.9%	22.1%	30.0%
Williamson	19	19,776	20.1%	73.5%	6.3%
Montgomery	28	16,412	22.7%	68.5%	8.8%
Hidalgo*	49	10,474	105.9%	-34.5%	28.5%

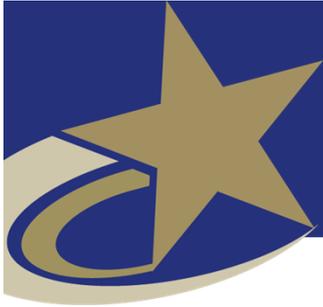
* Hidalgo and Harris Counties had negative net migration (Harris -10,322 and Hidalgo -621).

Source: U.S. Census Bureau, 2017 Vintage Population Estimates



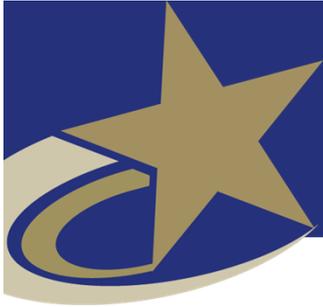
Fertility Component

- **Fertility**: The number of births that occur to an individual or in a population.
- **Fecundity**: The physiological ability of individuals or couples to have children. Maximum fecundity for a population is believed to be 15 children.
- Another key concept is the “**at-risk population**”. Only a certain subset of the population is “at-risk” for fertility → Women aged 12-50
- Factors that affect fertility include:
 - 1) Gender
 - 2) Age
 - 3) Race/Ethnicity
 - 4) Socioeconomic status
 - 5) Others → Religion, Culture, Education
- Common calculations related to fertility include:
 - 1) **Total Fertility Rate**: *Average # of children in a “synthetic” family*
 - 2) **General Fertility Rate**: *#Births per 1000 women of childbearing age*
 - 3) **Crude Birth Rate**: *# Births/Midyear Population*



Mortality Component

- Mortality: Number and causes of deaths in a population.
- Life Span: The upper limit to human lives is theorized to be somewhere around 120, although there are reports of some people living as long as 135 years.
- Factors affecting mortality include:
 - 1) Age (J-curve)
 - 2) Gender
 - 3) Socioeconomic status
 - 4) Race/Ethnicity
 - 5) Modernity
- Common calculations related to mortality include:
 - 1) **Overall Death Rate**: *Deaths per 1000 population*
 - 2) **Crude Death Rate**: *# Deaths/Midyear Population*
 - 3) **Age-Sex-Race specific survival rates**: *The likelihood that an individual with certain characteristics will survive the year*
 - 4) **Life Expectancy**: *The expected number of years an individual will live if they were to live their entire life right now.*
In 1900 → ~30 (worldwide) By 2000 → ~70 (worldwide)



Migration Component

- Migration: The movement of people into and out of a certain area.
- Migration can occur at all geographic levels.
 - 1) Neighborhood
 - 2) Within a county
 - 3) Across states: Out-migration versus In-migration
 - 4) To a different country: Emigration (out of a country) versus Immigration (into a country)
- Migration in the United States:
 - Approximately 20% of Americans move per year*
 - Americans move about 11 times over their lifetimes (on average)*
- Factors affecting migration include
 - 1) Age
 - 2) Gender
 - 3) Socioeconomic Status
 - 4) Race and Ethnicity

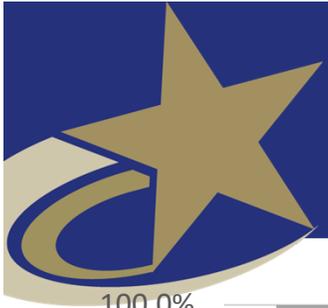


Total Population and Components of Population Change in Texas, 1950-2010

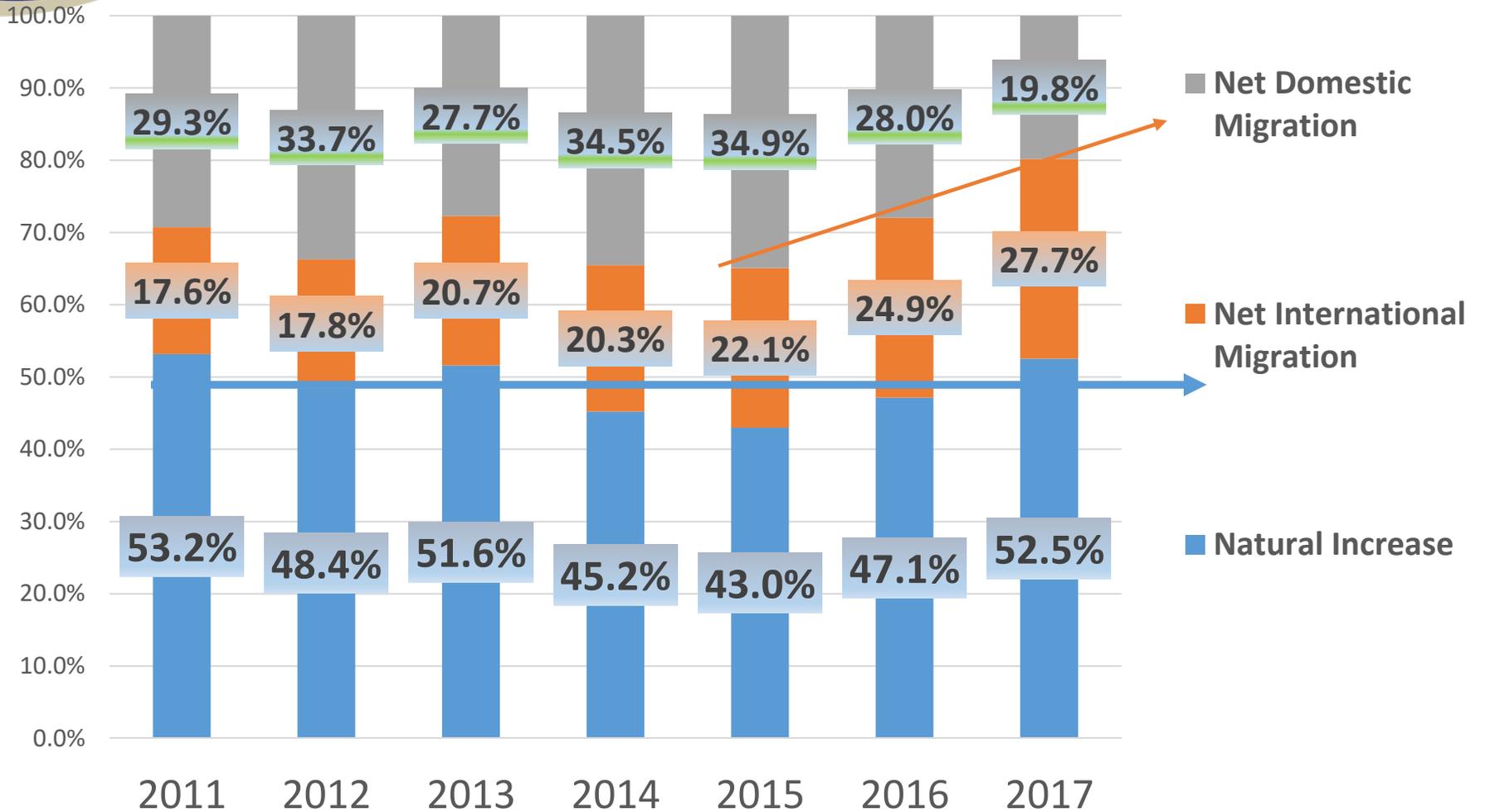
Year*	Population	Numerical Change	Percent Change	Percent Change Due to	
				Natural Increase	Net Migration
1950	7,711,194	--	--	--	--
1960	9,579,677	1,868,483	24.2	93.91	6.09
1970	11,196,730	1,617,053	16.9	86.74	13.26
1980	14,229,191	3,032,461	27.1	41.58	58.42
1990	16,986,510	2,757,319	19.9	65.85	34.15
2000	20,851,820	3,865,310	22.8	49.65	50.35
2010	25,145,561	4,293,741	20.6	54.94	45.06

* All values for the decennial dates are for April 1st of the indicated census year. Values for 2011 are for July 1 as estimated by the U.S. Census Bureau.

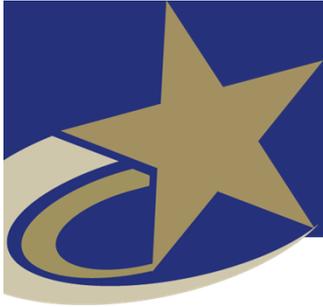
Source: Derived from U.S. Census Bureau Estimates for dates indicated by the Texas State Data Center, University of Texas at San Antonio.
 Note: Residual values are not presented in this table.



Estimates of percent components of population change, Texas, 2011-2017



Source: U.S. Census Bureau, 2017 Vintage population estimates



Comparative measures

- Population at risk
- Average over a period
- Mid-year denominator, $\frac{1}{2}$ numeric change numerator

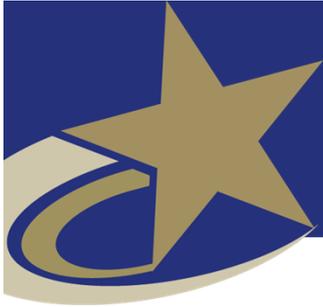
- Rate - The ratio of the number of demographic events (e.g. births) to the population at risk of experiencing the event. In mathematical demography, the denominator is the number of person years lived.

- Ratio -The size of a number relative to another convenient number.

- Proportion - A ratio in which the denominator includes the numerator.

- Percentage - A proportion multiplied by 100.

- Probability - The ratio of the number of demographic events to the initial population at risk of experiencing them. In mathematical demography, the denominator is the number of preceding events.



Basic Measures of Change

Crude Rates

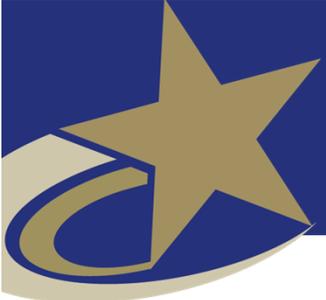
CBR = live births in a year/mid-year population * k

CDR = deaths in a year/mid-year population * k

RNI = (births-deaths)/mid-year population * k

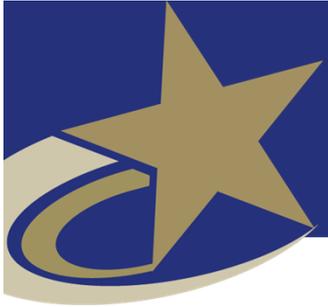
RNM = net migration in a year/mid-year population * k





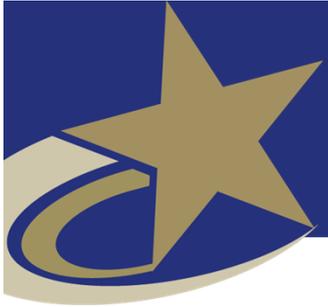
Fertility

- Fertility refers to the actual production of children, which is in the strictest sense a biological process
 - We can study fertility cross-sectionally, i.e., with period measures, or over time
 - On a *cohort* or *period* basis
 - On a *micro* or *macro* basis
-



Conceptualization and Measurement of Fertility

- There are 3 main fertility concepts:
 - **Fertility** is the actual production of male and female births; fertility refers to actual behavior.
 - **Reproduction** is also actual production, but refers to the production of only female births (there is no demographic term referring to the production of only male births).
 - **Fecundity** refers to the potential or the biological possibility of producing births.



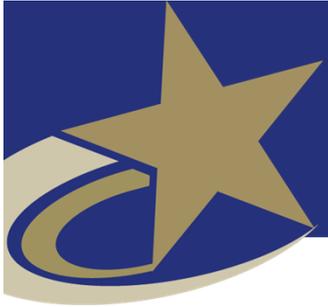
Conceptualization and Measurement of Fertility

- The Crude Birth Rate (CBR)

- A cross-sectional measure

- $$CBR = \frac{\textit{number of births}}{\textit{midyear population}^z} * 1,000$$

- In the world the CBR in 2007 ranged from a high of 38 in Africa to a low of 10 in Europe
- It is a "crude" measure because its denominator includes people who are not at the risk of childbearing (women under 15 yrs and women over 50, and men).



Conceptualization and Measurement of Fertility

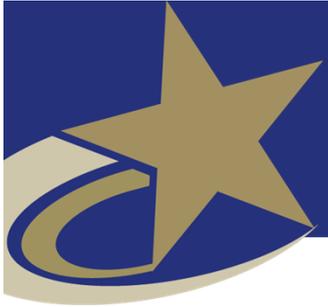
- **The General Fertility Rate (GFR)**

- Another cross-sectional measure of fertility.
- The GFR is superior to the CBR because it restricts its denominator to women of childbearing ages.

$$GFR = \frac{\text{births}}{\text{midyear population}_{f,15-49}} * 1,000$$

$$GFR = CBR * 4.5$$

- Denominator is sometimes further restricted to women aged 15-44 because of the very low fertility among women over 44 yrs
- In the U.S. more than 56 babies born in 2005 for every 1,000 women between the ages of 15 and 49



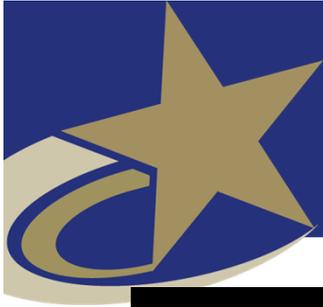
Conceptualization and Measurement of Fertility

- The **Age-specific Fertility Rate (ASFR)**

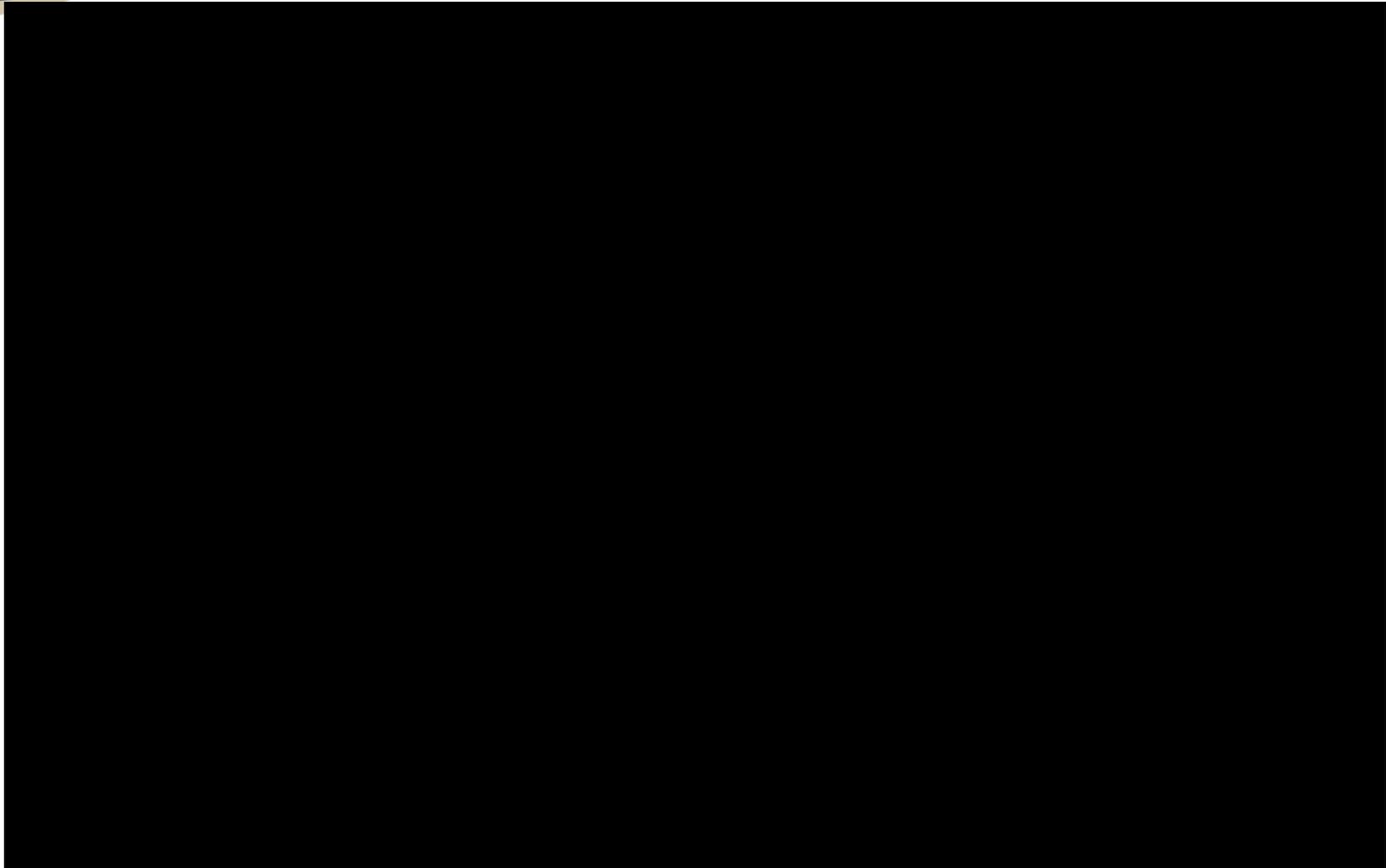
- Births to women according to their age.
- ASFRs are usually calculated for women in each of the seven 5-year age groups of 15-19,...45-49. Sometimes 35 single year age groups are used.

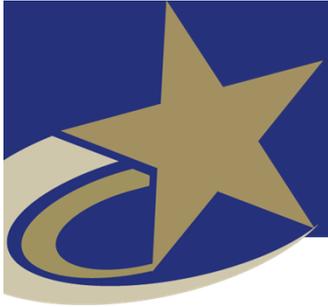
$$ASFR_{x \text{ to } x+n} = \frac{\text{births}_{x \text{ to } x+n}}{\text{females}_{x \text{ to } x+n}} * 1,000$$

- ASFRs in 1970, as well as in 2000-05, are highest in Africa and lowest in Europe and North America
- Table 3.1 shows the numbers of women in the U.S. in 2005 in each of the seven age groups and the numbers of babies born to the women in each of the age groups.



Fertility Data and Rates for the United States in 2005





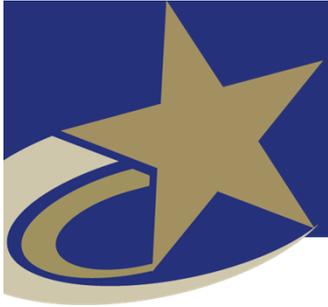
Conceptualization and Measurement of Fertility

- **The Total Fertility Rate (TFR)**

- Like the ASFR it takes into account the fact that fertility varies by age, but the TFR provides a single fertility value
- The TFR is calculated by summing the ASFRs, after multiplying each by the width of the age interval

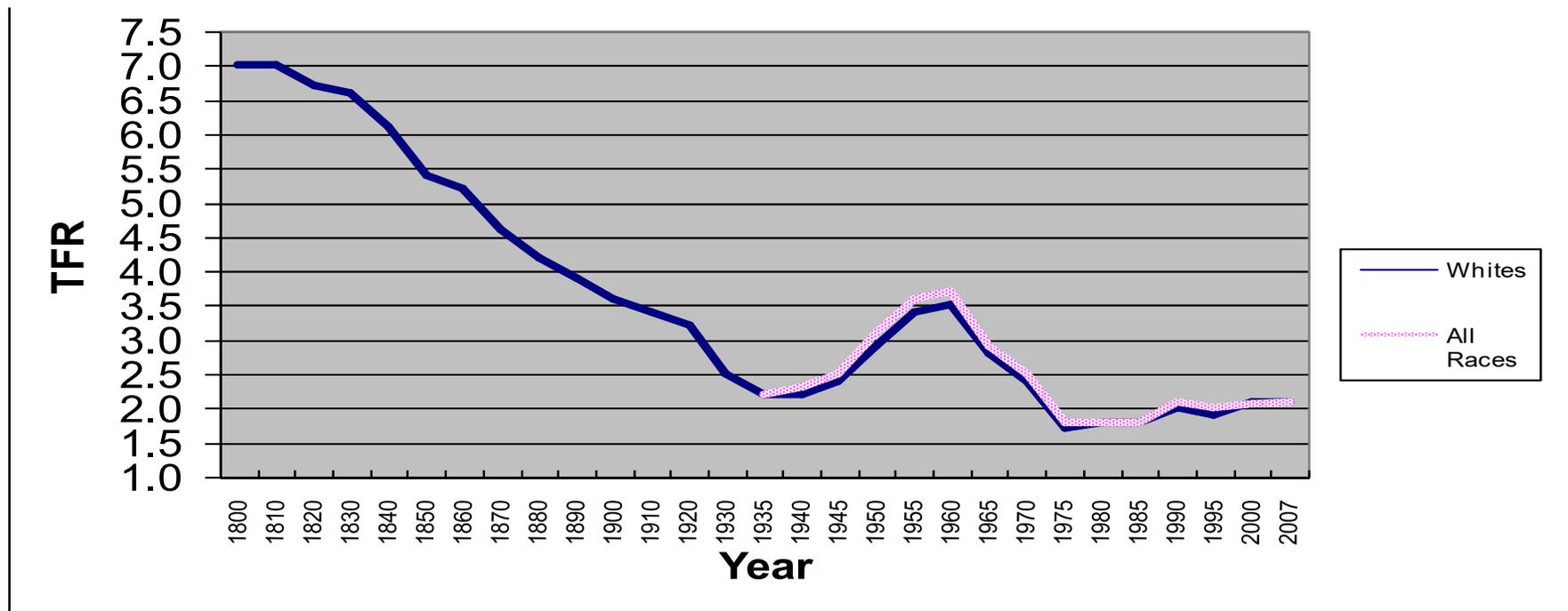
- It is a standardized rate—it is not influenced by the differences in the numbers of women in each age

$$TFR = \sum (ASFR_{x \text{ to } x+n} * i)$$

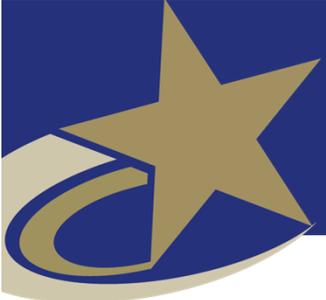


Fertility Change in the United States

- Figure 3.5 shows total fertility rates for the United States from 1800 to 2007

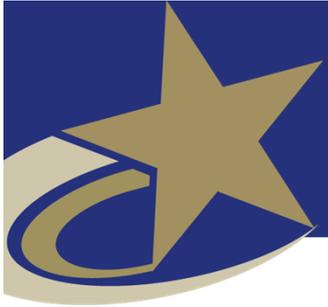






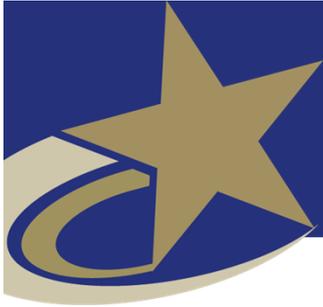
Mortality

- Everyone of us has been born, and everyone of us will die, but death does not occur to everyone at the same time
- The length of time we will live depends on many factors; over some of these factors we have no control, but over others we have a lot of control
- The impact of mortality varies significantly according to social and demographic characteristics.



Measurement of Mortality

- An exact figure for the human life span or for the life span of any species is not known
- Demographers often use the “maximum recorded age at death” as an accepted operational definition of the human life span
- The longest known and verified life span, as of 2010, is 122 years and 164 days, lived by the Frenchwoman Jeanne Louise Calment.
- The concept of life expectancy is used by demographers much more so than the concept of the life span.



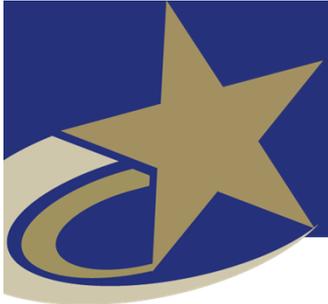
Measurement of Mortality

- **The Crude Death Rate (CDR)**

- The number of deaths in a population in a given year, per one thousand members of the population

$$CDR = \frac{\text{deaths in the year}}{\text{population at mid - year}} * 1,000$$

- In the U.S. (2004), there were just over 8 deaths for every 1,000 persons in the population.
- The CDR (2006) ranged from lows of 1 in the United Arab Emirates and 2 in Kuwait to highs of 23 in Sierra Leone, Zambia and Zimbabwe and 22 in Angola and Afghanistan
- The range of crude death rates is narrower than that of crude birth rates.



Measurement of Mortality

- **The Age-specific Death Rate (ASDR).**

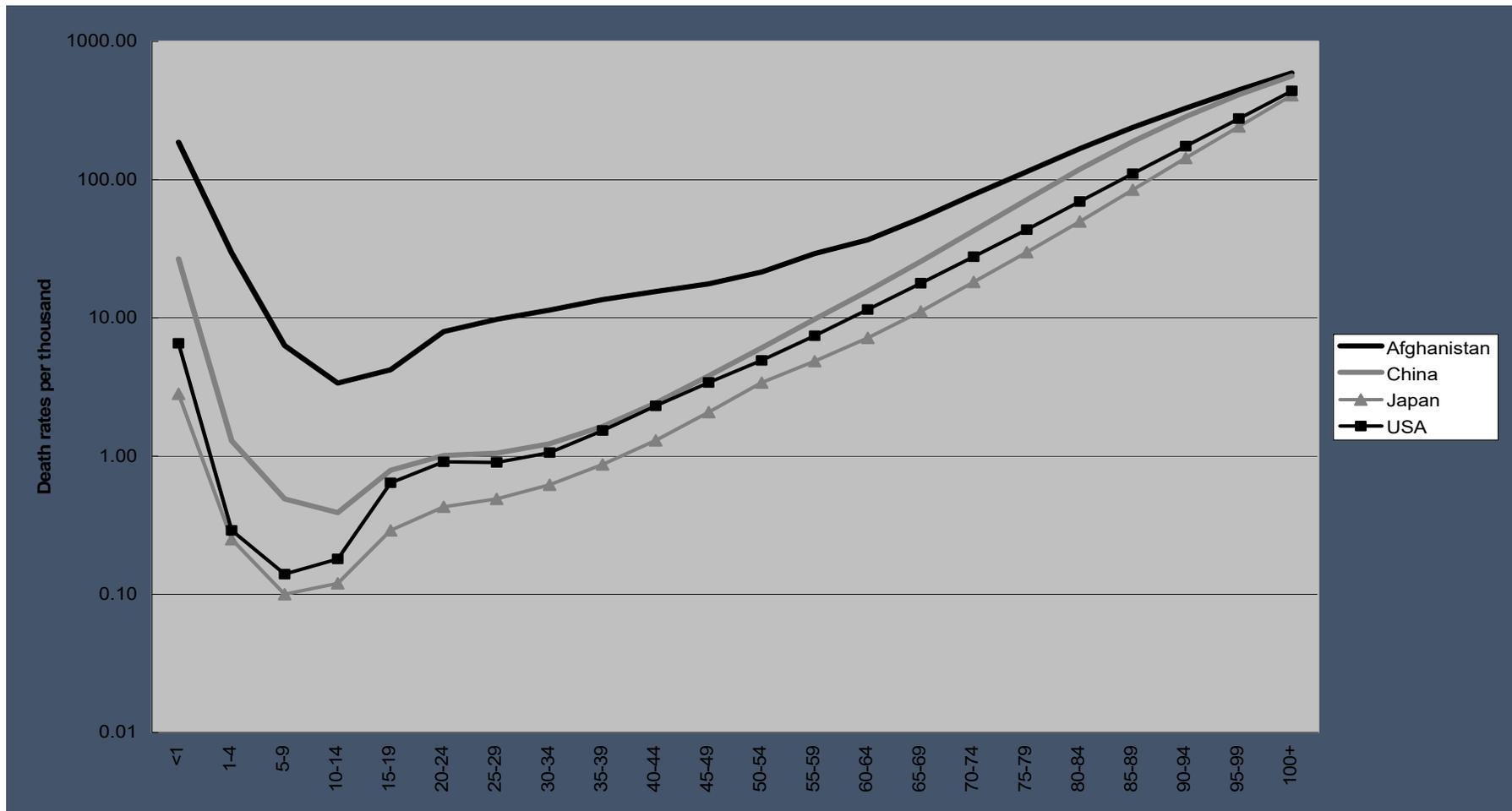
- Because death varies so considerably with age, demographers prefer to use ASDRs as a more precise measurement of mortality.

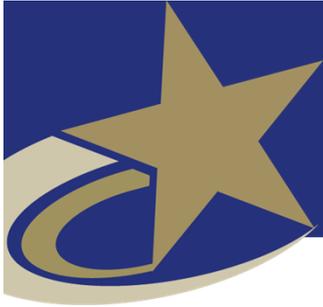
$${}_nM_x = \left(\frac{\text{Deaths to persons aged } x \text{ to } x+n}{\text{Midyear population aged } x \text{ to } x+n} \right) * 1,000$$

- where **n** is the width of the age group, and **x** is the initial year of the age group
- ASDRs are sometimes referred to as “M” rates. The ASDR, or ${}_nM_x$ is the number of deaths to persons in a specific age group per 1,000 persons in that age group.



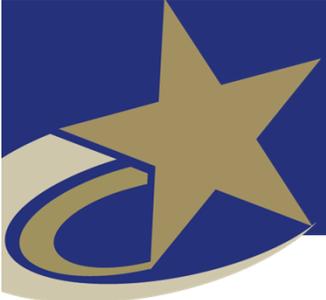
The age curve of mortality characterizes every population whether its level of mortality is high as in Afghanistan or as low as in Japan.





Measurement of Mortality

- ASDRs, and not CDRs, should be used to compare the mortality experiences of areas or populations with known differences in age composition.
- Demographers use a method called standardization to take into account age, sex, and/or racial and ethnic composition in their comparisons of the death rates among different areas.
- There are many statistical programs available that demographers use that execute the statistical calculations to standardize mortality rates for age composition

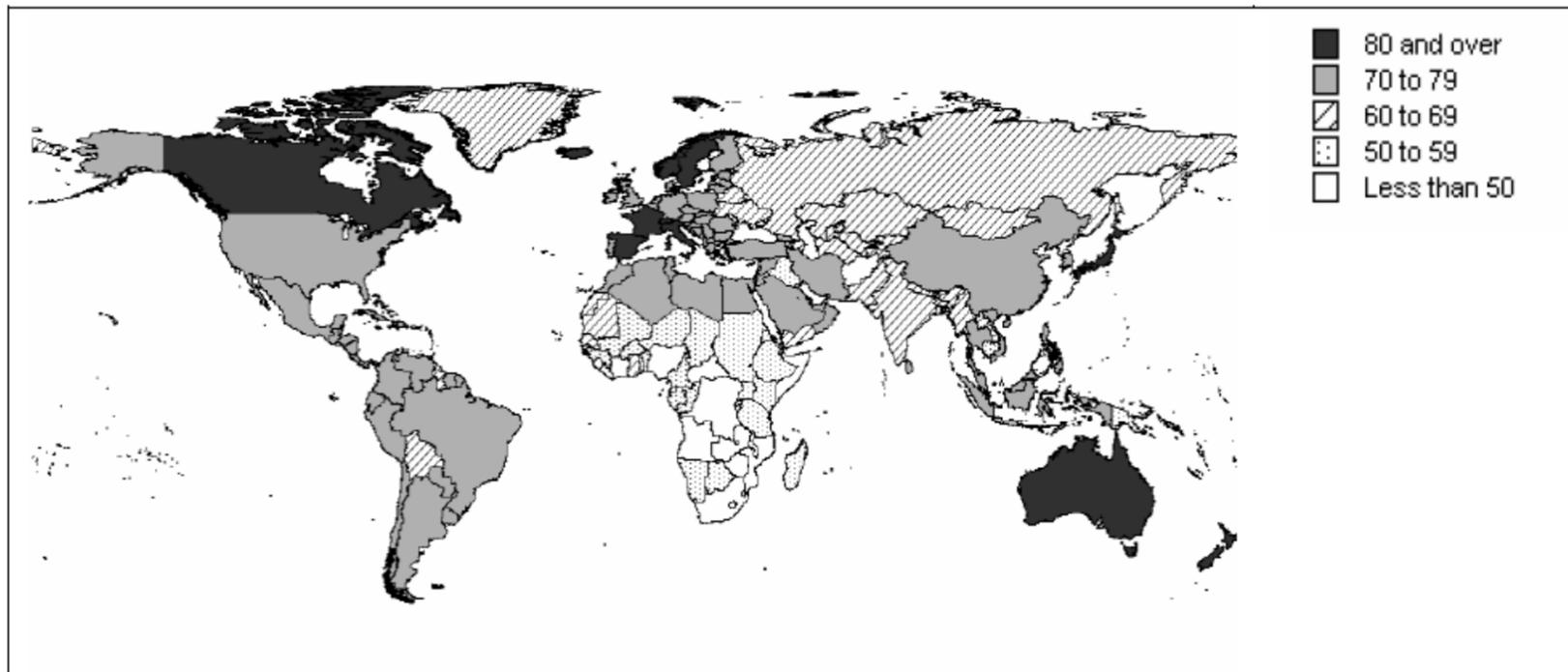


The Life Table

- The basic life table consists of eight columns including:
 - The probability of dying between age x and age $x + n$ (${}_nq_x$),
 - The number of survivors at each age x (l_x),
 - The number of deaths in each age interval (${}_nd_x$),
 - The number of years lived in each age interval (${}_nL_x$), and
 - Life expectancy at each age (e_{x0}).



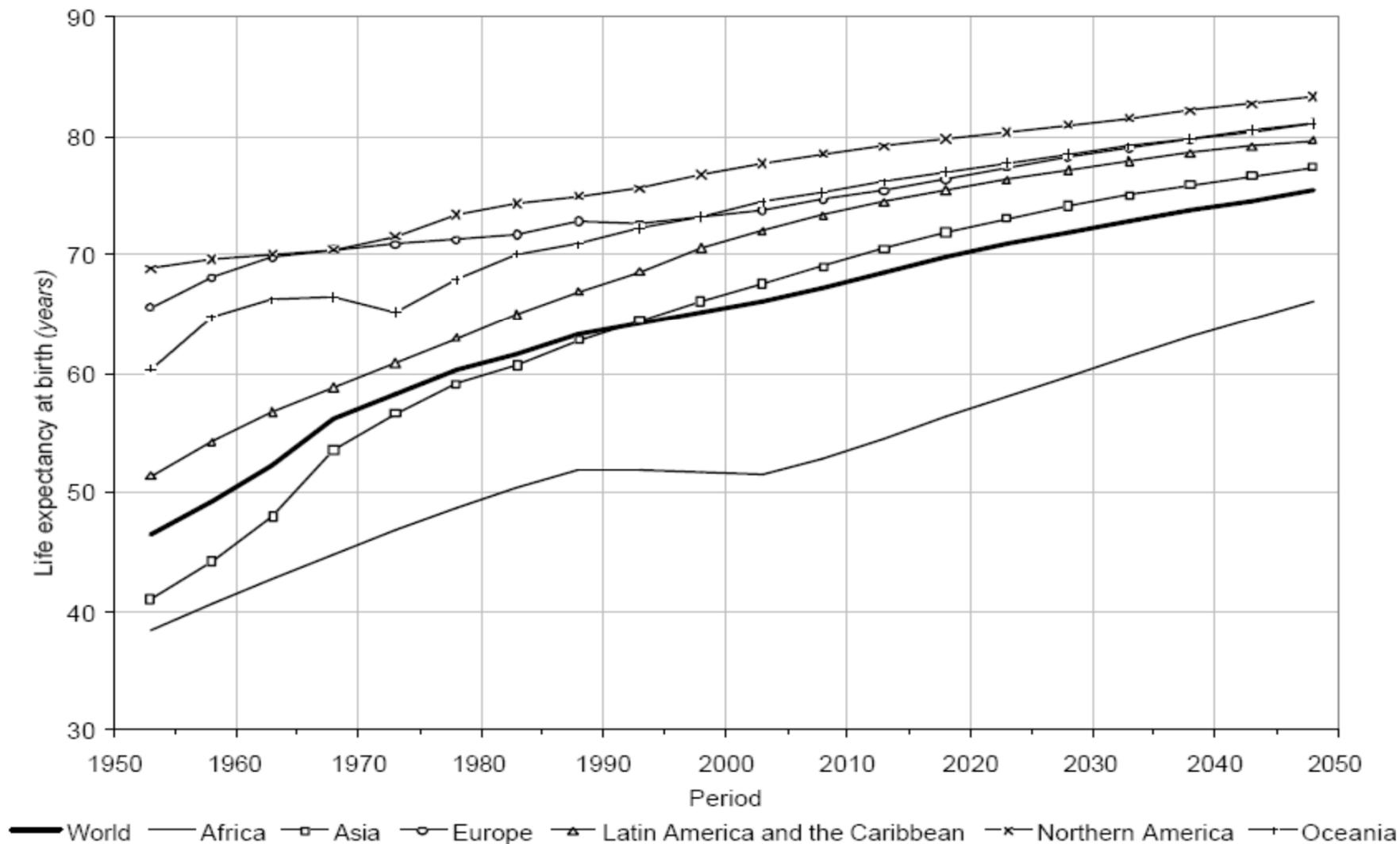
Life Expectancy at Birth, Countries of the World, 2005-2010



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2007). World Population Prospects: The 2006 Revision. Highlights. New York: United Nations.

NOTE: The boundaries shown on the present map do not imply official endorsement or acceptance by the United Nations.

Life Expectancy at Birth, World and Major Areas, 1950-2050



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2007). World Population Prospects: The 2006 Revision. Highlights. New York: United Nations.

Age Specific Mortality

$$ASMR_{t \rightarrow t+n}^i = \frac{D_{t \rightarrow t+n}^i}{\bar{P}_{t \rightarrow t+n}^i}$$

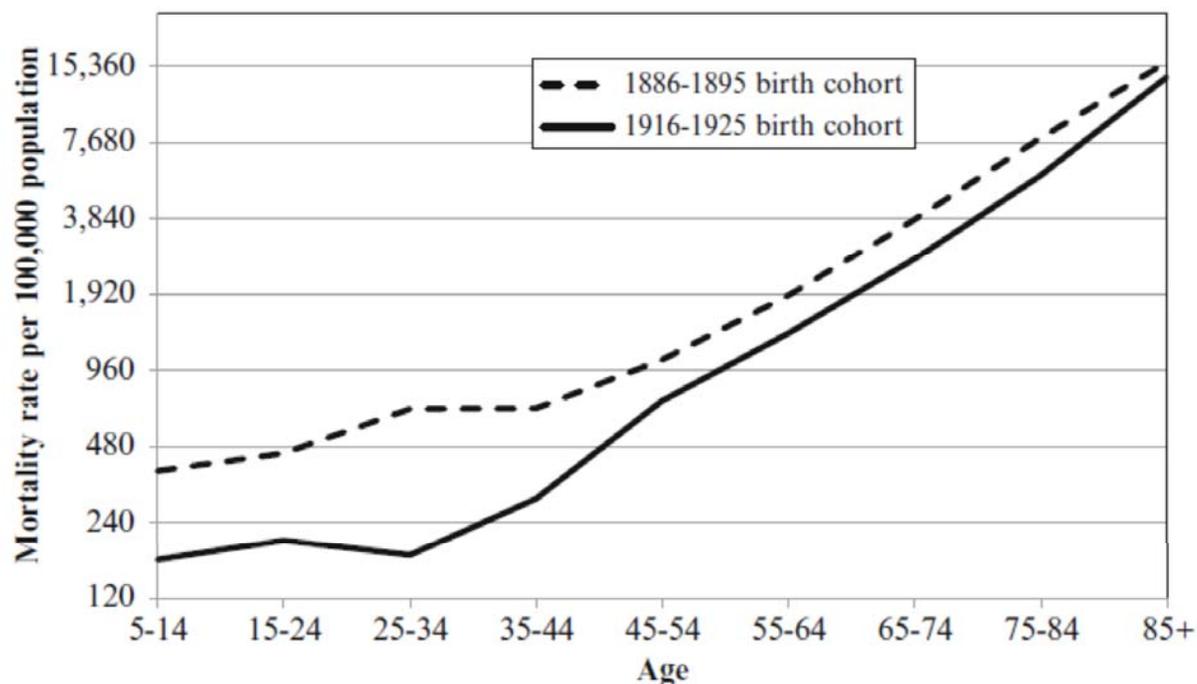


Fig. 6.3 Age-specific mortality rates per 100,000 population: United States, 1886–1895 and 1916–1925 birth cohorts (using logarithmic scale to base 2) (Source: Table 6.2)

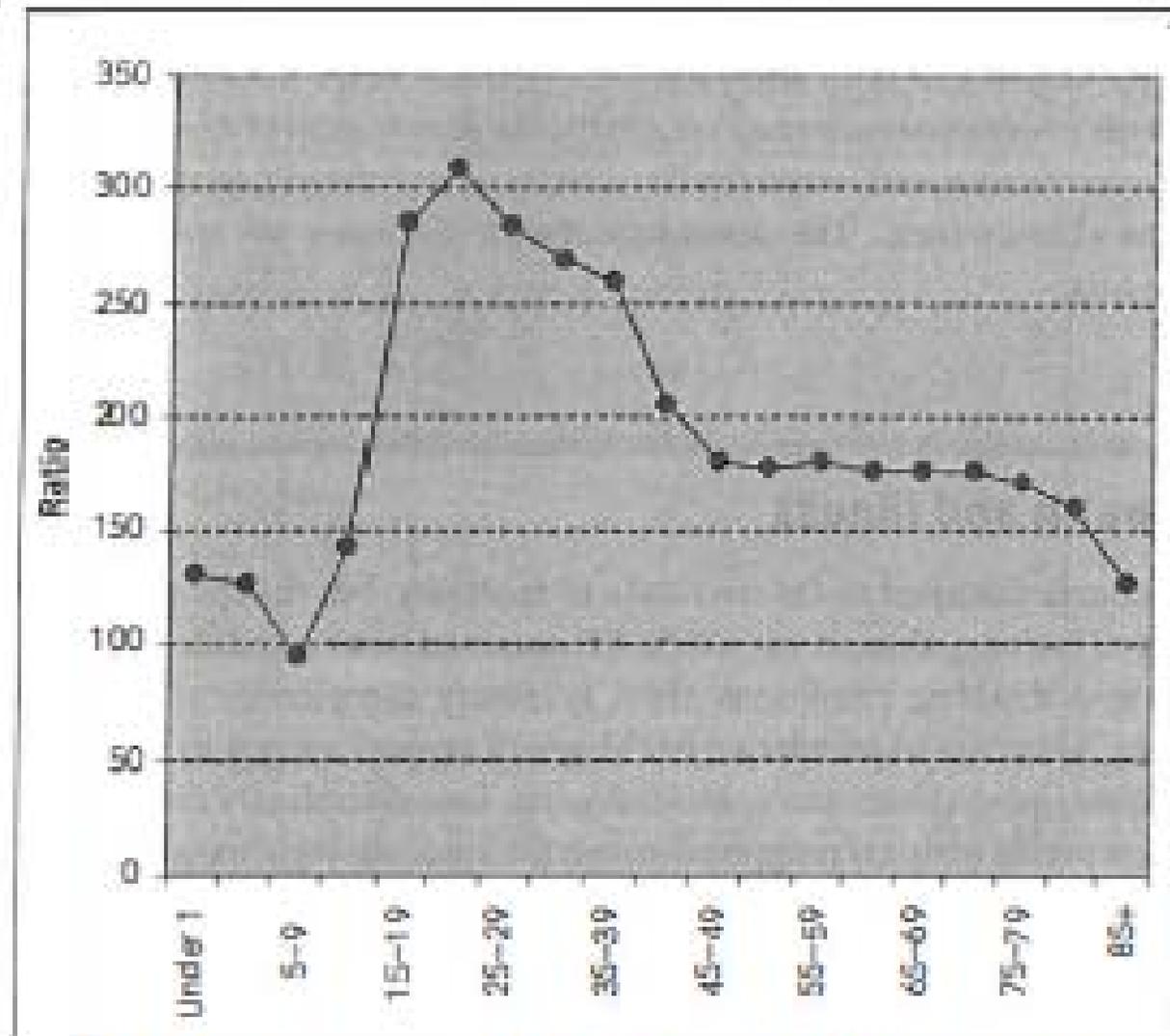
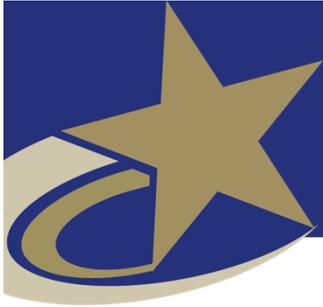
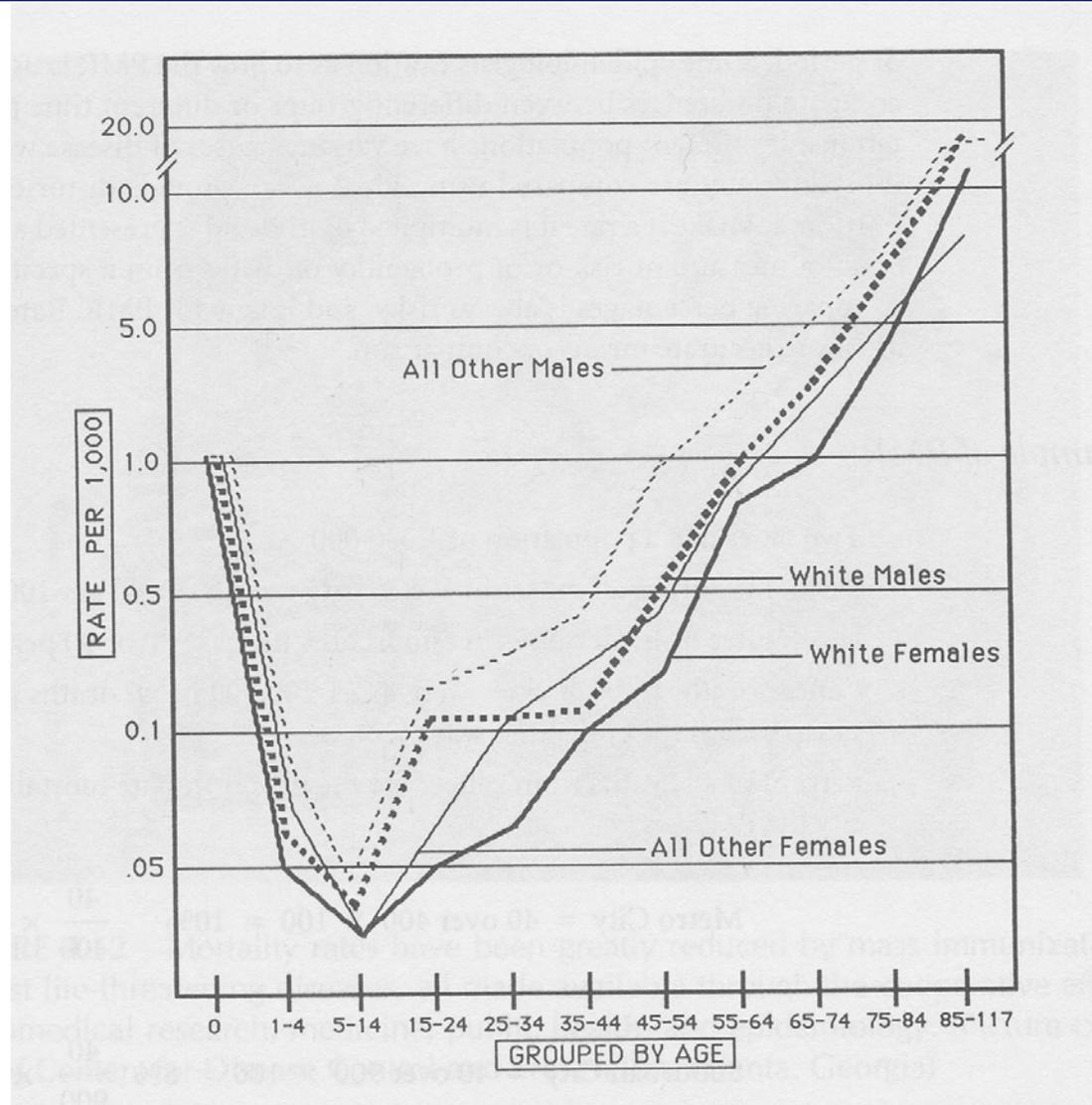


Figure 6.5 Sex ratios of age-specific death rates, United States, 1990.



Race-Sex-Age-Specific Mortality Rates



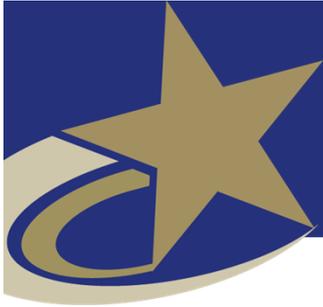
Leading Causes of Death

10 Leading Causes of Death by Age Group, United States – 2014

Rank	Age Groups										Total
	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	
1	Congenital Anomalies 4,746	Unintentional Injury 1,216	Unintentional Injury 730	Unintentional Injury 750	Unintentional Injury 11,836	Unintentional Injury 17,357	Unintentional Injury 16,048	Malignant Neoplasms 44,834	Malignant Neoplasms 115,282	Heart Disease 489,722	Heart Disease 614,348
2	Short Gestation 4,173	Congenital Anomalies 399	Malignant Neoplasms 436	Suicide 425	Suicide 5,079	Suicide 6,569	Malignant Neoplasms 11,267	Heart Disease 34,791	Heart Disease 74,473	Malignant Neoplasms 413,885	Malignant Neoplasms 591,699
3	Maternal Pregnancy Comp. 1,574	Homicide 364	Congenital Anomalies 192	Malignant Neoplasms 416	Homicide 4,144	Homicide 4,159	Heart Disease 10,368	Unintentional Injury 20,610	Unintentional Injury 18,030	Chronic Low. Respiratory Disease 124,693	Chronic Low. Respiratory Disease 147,101
4	SIDS 1,545	Malignant Neoplasms 321	Homicide 123	Congenital Anomalies 156	Malignant Neoplasms 1,569	Malignant Neoplasms 3,624	Suicide 6,706	Suicide 8,767	Chronic Low. Respiratory Disease 16,492	Cerebro-vascular 113,308	Unintentional Injury 136,053
5	Unintentional Injury 1,161	Heart Disease 149	Heart Disease 69	Homicide 156	Heart Disease 953	Heart Disease 3,341	Homicide 2,588	Liver Disease 8,627	Diabetes Mellitus 13,342	Alzheimer's Disease 92,604	Cerebro-vascular 133,103
6	Placenta Cord. Membranes 965	Influenza & Pneumonia 109	Chronic Low. Respiratory Disease 68	Heart Disease 122	Congenital Anomalies 377	Liver Disease 725	Liver Disease 2,582	Diabetes Mellitus 6,062	Liver Disease 12,792	Diabetes Mellitus 54,161	Alzheimer's Disease 93,541
7	Bacterial Sepsis 544	Chronic Low Respiratory Disease 53	Influenza & Pneumonia 57	Chronic Low Respiratory Disease 71	Influenza & Pneumonia 199	Diabetes Mellitus 709	Diabetes Mellitus 1,999	Cerebro-vascular 5,349	Cerebro-vascular 11,727	Unintentional Injury 48,295	Diabetes Mellitus 76,488
8	Respiratory Distress 460	Septicemia 53	Cerebro-vascular 45	Cerebro-vascular 43	Diabetes Mellitus 181	HIV 583	Cerebro-vascular 1,745	Chronic Low. Respiratory Disease 4,402	Suicide 7,527	Influenza & Pneumonia 44,836	Influenza & Pneumonia 55,227
9	Circulatory System Disease 444	Benign Neoplasms 38	Benign Neoplasms 36	Influenza & Pneumonia 41	Chronic Low Respiratory Disease 178	Cerebro-vascular 579	HIV 1,174	Influenza & Pneumonia 2,731	Septicemia 5,709	Nephritis 39,957	Nephritis 48,146
10	Neonatal Hemorrhage 441	Perinatal Period 38	Septicemia 33	Benign Neoplasms 38	Cerebro-vascular 177	Influenza & Pneumonia 549	Influenza & Pneumonia 1,125	Septicemia 2,514	Influenza & Pneumonia 5,390	Septicemia 29,124	Suicide 42,773

Data Source: National Vital Statistics System, National Center for Health Statistics, CDC.
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.





Specific Death Rates

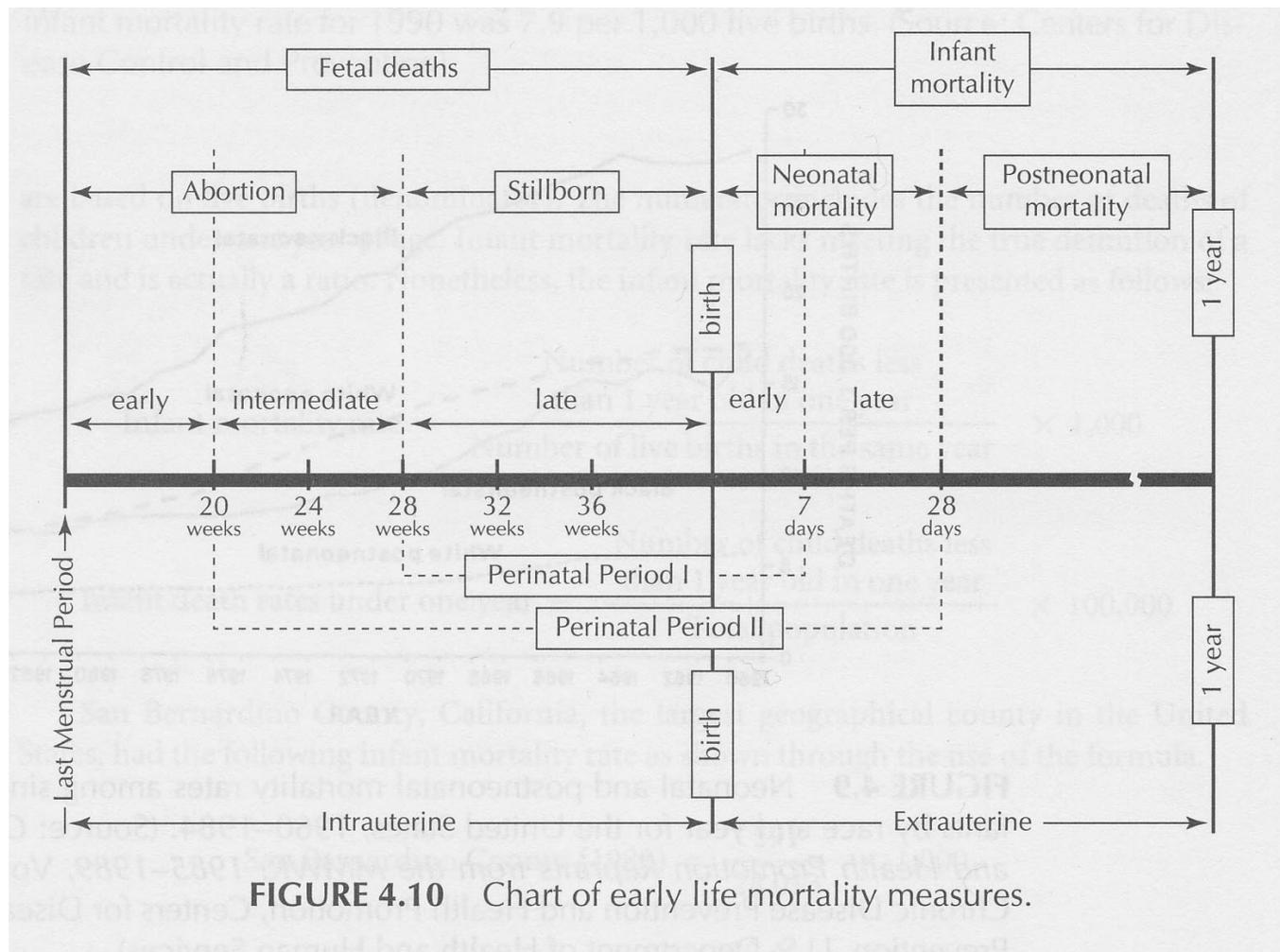
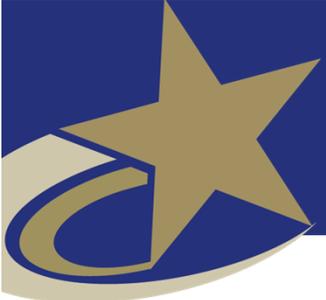


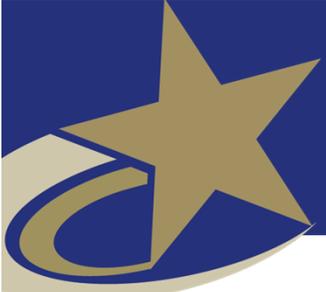
FIGURE 4.10 Chart of early life mortality measures.





Internal Migration

- Migration is the third way in which populations change their size. Migration may occur to us on multiple occasions, or we may never experience migration.
- There are two main types of migration
 - Internal migration occurs within a country
 - International migration occurs between countries
- Internal migration is the change of permanent residence within a country that involves a geographical move that crosses a political boundary, usually a county.



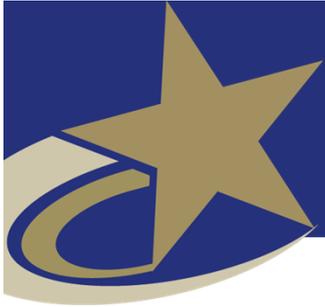
Internal Migration

- Not all changes in residence, however, are migrations.
 - A mover is anyone who changes residence regardless of distance
 - A migrant is a person whose residential move involves the crossing of a political boundary.
 - All migrants are movers, but all movers are not necessarily migrants.
- Migration is not only a significant event for persons, but for the sending and receiving community as well.
 - Migration is the major method for redistributing the population within a country



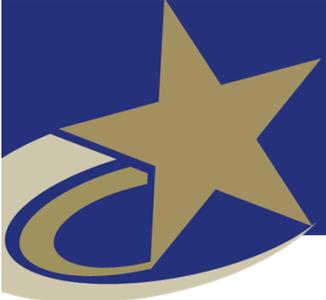
Internal Migration

- Each year about 1 in 5 Americans moves from one house to another; 1 in 14 migrates from one county to another. About half of these migrants move from one state to another.
 - Americans average about 13 changes of residence, and 4 migrations, during their lifetimes.
- The geographic mobility rates in the United States are comparable to those in Canada and Australia, but are much higher than those in many other developed countries like Sweden, Ireland, and Japan, likely due to the smaller geographic size of these countries.



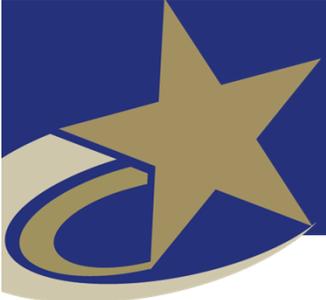
Concepts and Definitions

- Local movement is the short-distance change of residence within the same community that does not involve crossing a county jurisdictional boundary.
- Migration is the geographical movement of a permanent change of residence that involves the crossing of a county boundary.
 - A migrant leaves his/her community and moves to a new community and changes school, job, etc.
 - Local movement, usually does not involve changing the main institutions in the mover's daily life.
 - A migration, but not necessarily a local movement, is a sociological event of major magnitude.



Internal Migration

- Return migration is the migration of persons back to their area of origin at some time after their initial out-migration.
- Net migration refers to the migration balance of an area, consisting of the number of in-migrants minus the number of out-migrants;
 - The net balance may be positive (representing a net population gain to the area) or negative (representing a net loss) or, conceivably, zero.



Internal Migration

- Gross migration is the sum total of migration for an area and is comprised of the in-migration into the area plus the out-migration from the area.
- Migration efficiency is an area's net migration divided by its gross migration.
 - Little out-migration and more in-migration is positively efficient.
 - Little in-migration and a lot of out-migration is negatively efficient.



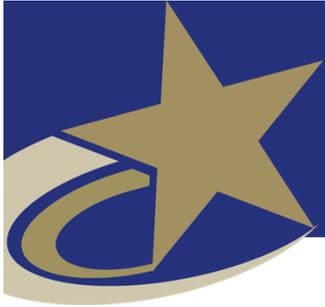
Concepts and Definitions

- Migration is not effective for an area when there are about the same numbers of persons migrating into the area as there are persons migrating out of the area
 - High negative migration efficiency characterizes areas of economic hardship, whereas high positive efficiency is often found in areas experiencing economic expansion.



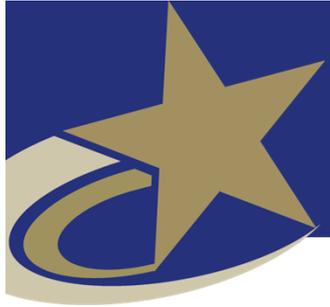
Concepts and Definitions

- A migration *stream* is a body of migrants departing from a common area of origin and arriving at a common area of destination during a specified time interval.
- A migration *counterstream* is the migration stream, smaller in size, going in the opposite direction during the same time interval.
- A migration *interval* refers to the time period during which the migration occurs.
 - Time intervals of one year, five years, or ten years, are common intervals used in demographic studies of internal migration.



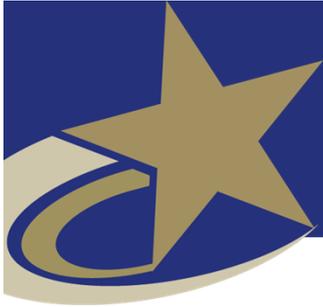
Concepts and Definitions

- *Differential migration* refers to the study of differences in migration according to the demographic, social, and economic characteristics of the population.
 - This is also known as migration selectivity and points to the fact that some persons are more likely to migrate than others.
 - The strongest selectivity factor associated with both migration and local movement is age. There is also selectivity based on level of education, and homeownership.

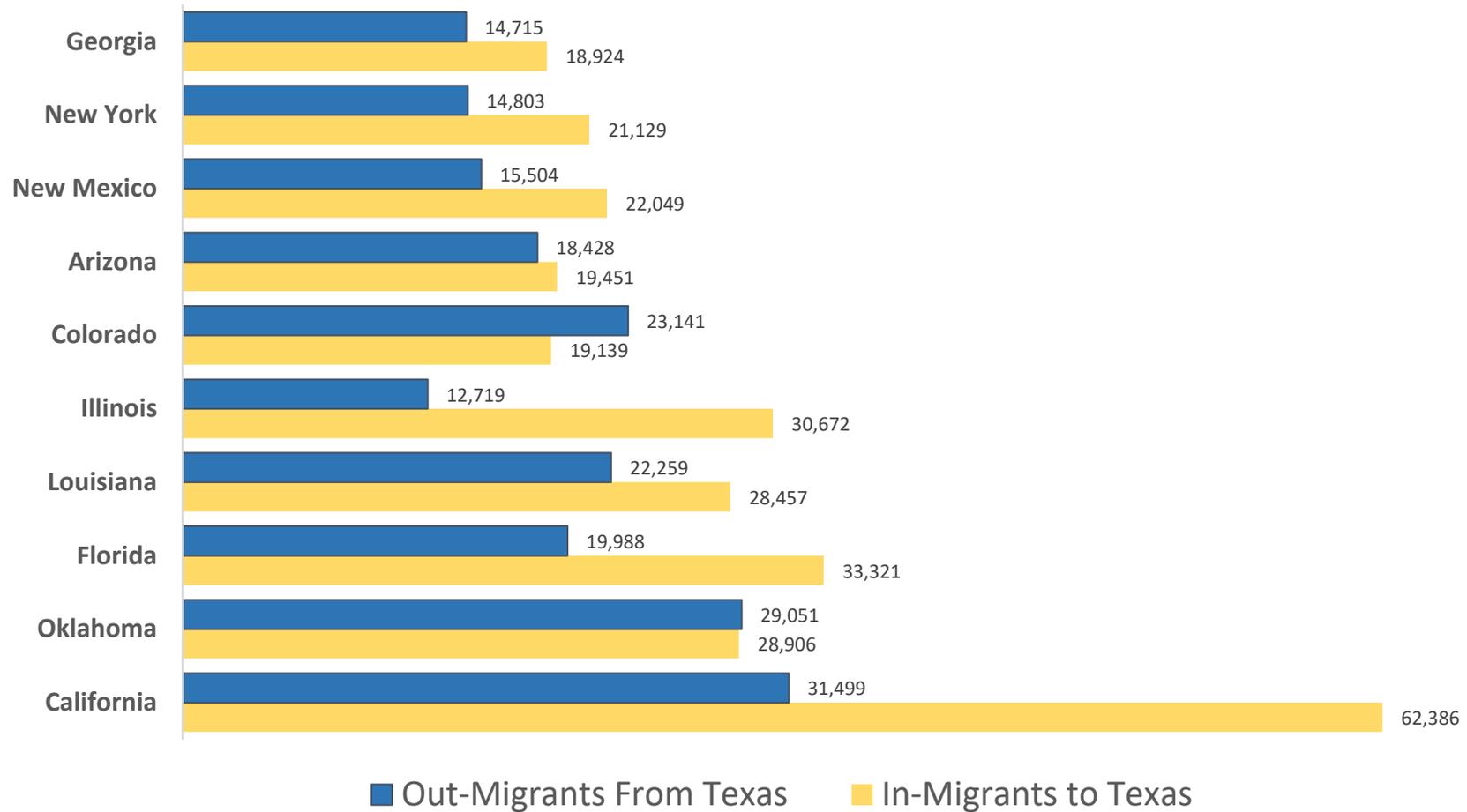


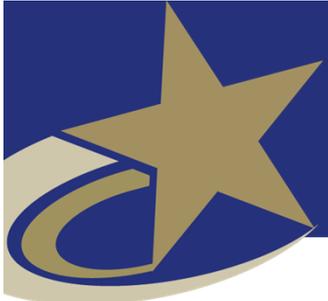
Measures of Migration

- Migration is difficult to study because of the lack of registration data in the U.S.
- The U.S. census of population contains two useful items that demographers use to measure migration:
 - State of birth, and the place of residence five years prior to the census.
- The census questions permit the distinction between nonmigrants (or natives) and lifetime migrants



Top 10 Gross Migration States for Domestic Migration to Texas, 2013



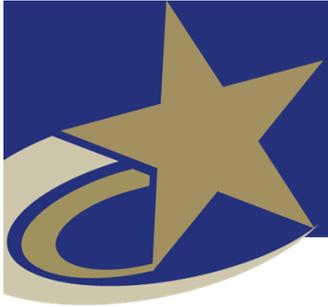


Measures of Migration

- Measures of migration are usually developed as rates that show empirically the relative frequency that a certain kind of migration occurs.
 - **In-migration Rate** = $(I / P) * 1000$
 - **Out-migration Rate** = $(O / P) * 1000$
 - **Net Migration Rate** = $[(I - O) / P] * 1000$
 - **Gross Migration Rate** = $[(I + O) / P] * 1000$
 - **Migration Efficiency Ratio** = $[(I - O) / (I + O)] * 100$

where:

- I refers to the number of in-migrants moving into an area during a certain time interval (usually 1 or 5 or 10 years);
- O refers to the number of out-migrants moving out of an area during a certain time interval; and
- P is the denominator and refers to the midyear or average size of the population of the area.



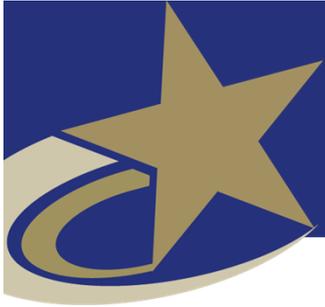
Measures of Migration

- Demographers usually use as the denominator for all migration rates the resident population of the area for which the rate is being calculated.
- Migration rates are usually multiplied by a constant of 1,000, and the migration efficiency ratio by a constant of 100.



Migration Selectivity

- Migration is very selective on the basis of age, race, sex, and socioeconomic status.
- Young adults between the ages of 20 and 29 as well between 30 and 39 were more likely to move than anyone else.
- Mobility differences between races are minor.
 - Between 2004 and 2005, about 14% of the population of the U.S. moved. Blacks were somewhat more likely to move locally than were whites.



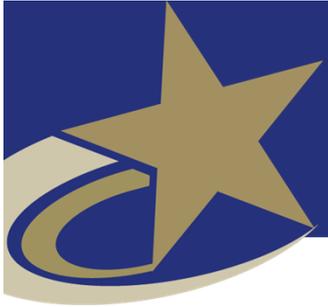
Migration Selectivity

- Generally the greater a person's education, the more likely the person will migrate, especially long distance moves.
- Manual workers are mobile, but tend to move locally.
- Farmers are the least mobile occupational group.
- People not in the labor force have high mobility.



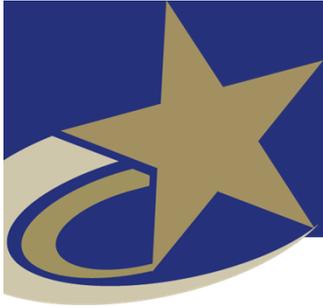
International Migration Definitions and Concepts

- Immigration refers to the movement of people to a new country for the purpose of establishing permanent residence
- An immigrant is a person who moves to a new country of permanent residence and crosses an international boundary in doing so.
- Emigration refers to the permanent departure of people from a country involving the crossing of an international boundary
- An emigrant is one who moves away from a country with the intention of establishing a permanent residence elsewhere
- In every international migration, a migrant is simultaneously an immigrant and an emigrant.



Definitions and Concepts

- Most international migration is economically motivated. Most immigration these days is to the more developed countries.
 - Of the 190 million long-term immigrants in the world in 2006, 115 million resided in more developed countries (United Nations 2006).
- Some countries, e.g., Israel, provide priorities for migrants with the same ethnic and religious origins as the majority population



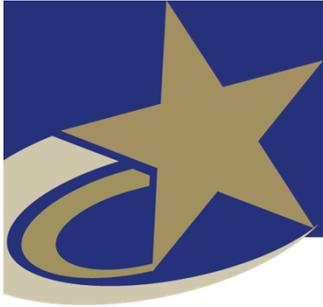
Definitions and Concepts

- Most people never engage in international migration; most people live and die near their place of birth.
- Those who do migrate internationally do so usually between countries that are geographically close together, such as the U.S. and Mexico and Central America
 - However, recently there has been migration from China to the U.S.
- The U.S. had a net gain (immigrants minus emigrants) between 2000 to 2005 of almost 6.5 million, much greater than Spain's net gain of 2.8 million (the country with the 2nd largest number of immigrants)
- Mexico had the largest net loss of international migrants between 2000-2004, with 4 million more emigrants than immigrants
- China had the second highest net loss with 1.9 million more emigrants than immigrants

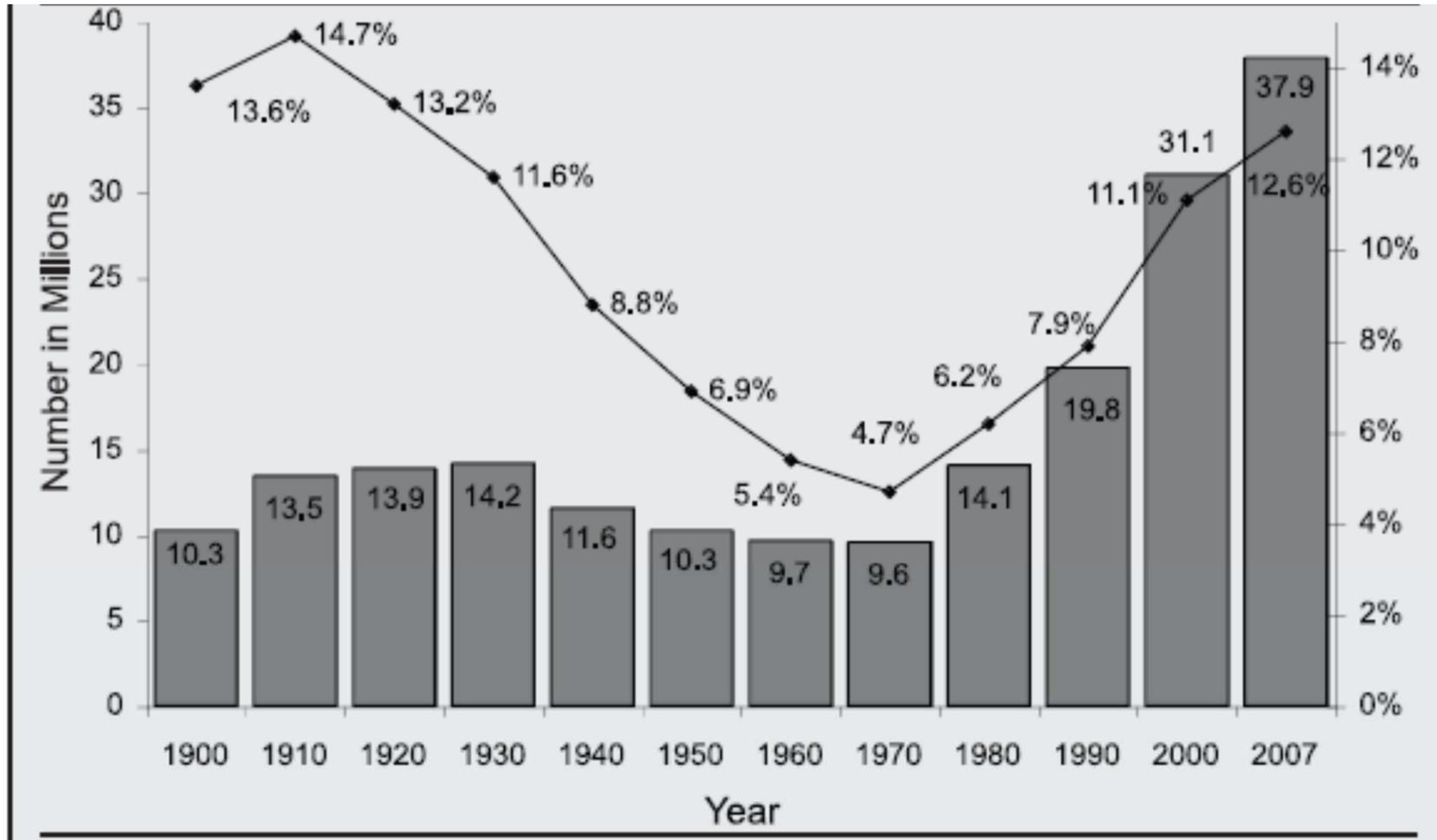


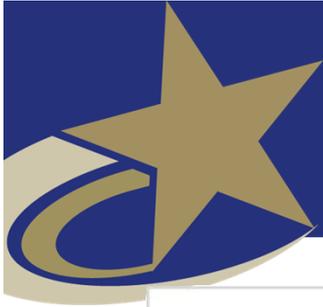
Immigration to the United States

- Only about 1.5 % of the U.S. population identify as American Indian or Alaskan Native and therefore are neither immigrants nor the descendents of immigrants.
- The U.S. is by far the most immigrant friendly country in the world, with almost 13 % of the total U.S. population being born in foreign countries (2005).
- The country with the next largest number of foreign born residents is the Russian Federation with 8.5 % of its total population.
- Migrants residing in countries with high percentages of foreign born are typically migrant workers who are seldom citizens of the host countries.

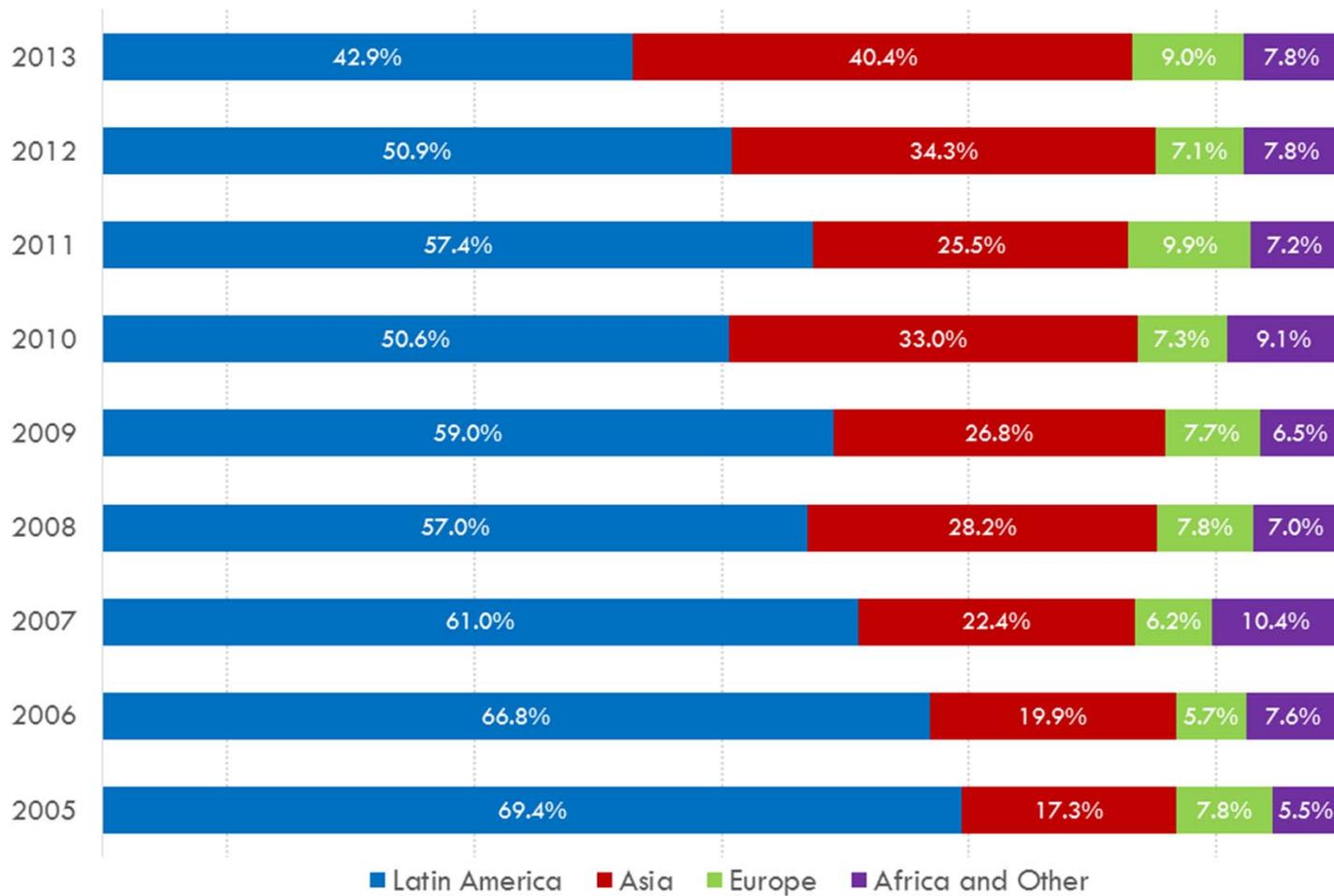


Immigration in the United States

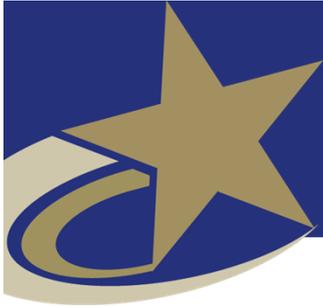




Annual Shares of Recent Non-Citizen Immigrants to Texas by World Area of Birth, 2005-2013

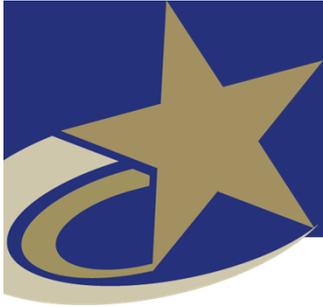


Source: 1-Year ACS PUMS 2005-2013



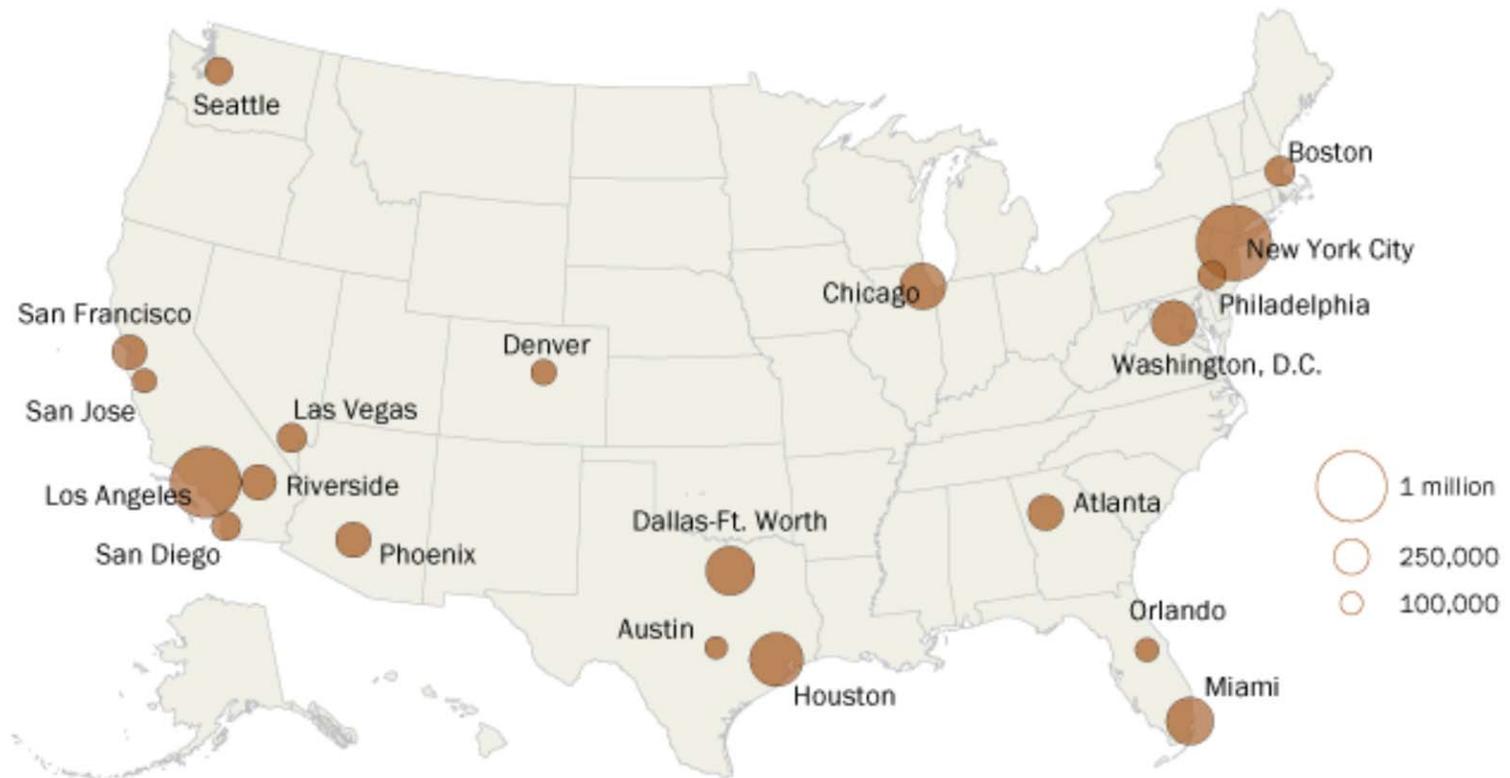
Unauthorized International Migration

- An unauthorized immigrant is a person who immigrates to a host country “through irregular or extralegal channels”
- An international migrant is classified as “unauthorized” if:
 - 1) during the process of migrating to the host country the person “avoided inspection by crossing borders clandestinely or ... traveled with fraudulent documents, e.g., a falsified visa or counterfeit passport”; such persons are referred to as “entries without inspection” (EWIs)
 - 2) the person “overstayed the time limit of a legally obtained non-immigrant temporary visa”; such persons are referred to as “visa overstayers”
 - 3) the migrant violated explicit visa conditions, e.g., obtaining employment while holding a student visa



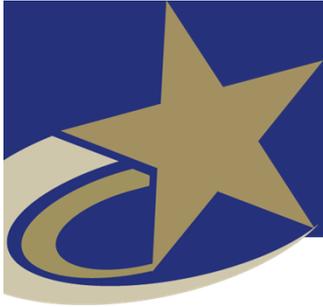
20 metropolitan areas with the largest number of unauthorized immigrants

2014 estimates



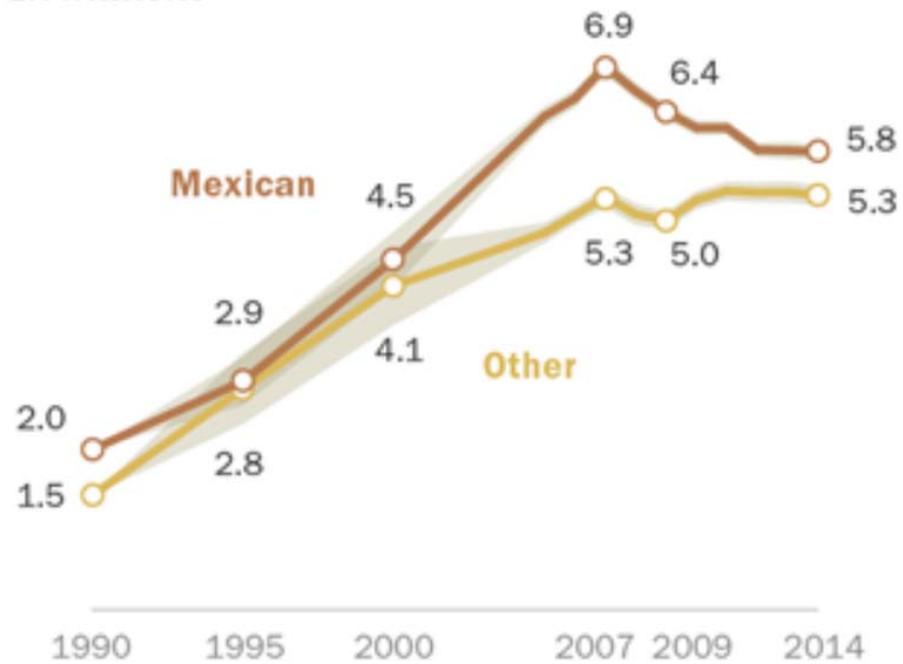
Source: Pew Research Center estimates based on augmented 2014 American Community Survey (IPUMS).

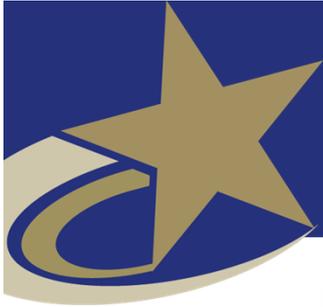
PEW RESEARCH CENTER



Among unauthorized immigrants, a decline from Mexico but rise from elsewhere since 2009

In millions





State of residence

Region/Country of birth

Texas

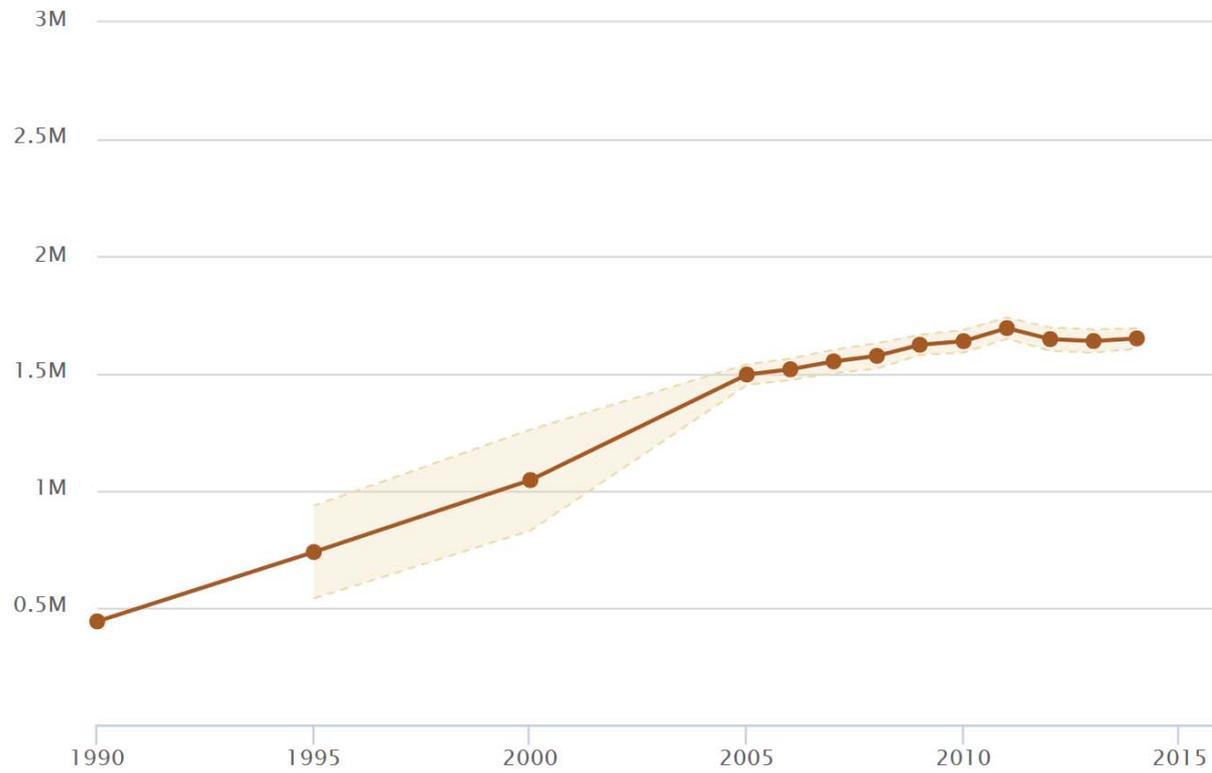
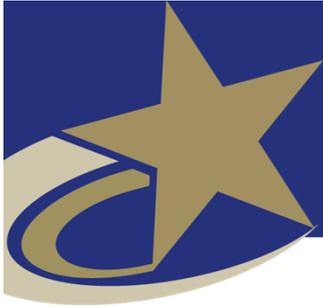


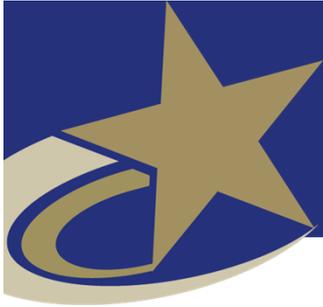
Table 12.1 Methods for population projections and estimates

Methods	Projections		Estimates	
	National	Sub-national	National	Sub-national
Cohort component	•	•	•	•
Mathematical	•	•	•	•
Model populations	•			
Ratio method		•		•
Housing unit method		•		•
Indicator methods				•
Matrix methods	•	•		
Statistical modelling	•	•	•	•



Population Estimates and Projections

- **Population estimate**
 - size of the past or current population of a specific geographic area for which census counts are not available
 - estimates calculated in lieu of an actual census count and are used to update population data gathered by the last census
- **Estimate methods closely related to methods for population projections.**
- **Projections look ahead to the future, estimates focus on the present or the recent past.**



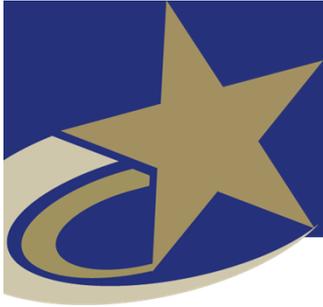
Population Estimates and Projections

- **Local and government agencies prepare estimates of the current population, to provide up-to-date information for years in which there is no census.**
- **Estimates based on observed data about population changes (births, deaths and migration)**
- **Projections refer to dates for which there are no observed data, especially future years.**



Population Estimates

- **Types of Population Estimates.**
- **Two types of estimates:**
 - Intercensal
 - Postcensal
- **Intercensal estimate refers to estimates computed between two censuses, such as 2000 and 2010;**
- **Postcensal estimate refers to those developed for dates after the most recent census.**



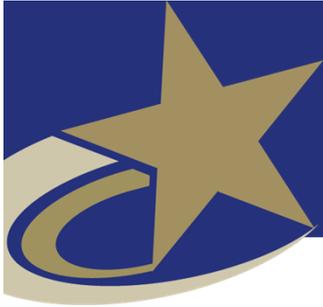
Principles of Population Estimates and Projections

An estimate or projection is as accurate as the assumptions on which it is based

No specific methodology guarantees accuracy

Estimates and Projections usually are more accurate for:

- **Areas with large populations**
- **Total population**
- **Shorter time periods**
- **Areas with slow or stable growth patterns**



Factors Limiting Estimation and Projection Procedures and Uses

- **Data Availability and Quality (Data Adjustments)**
 - **Changes in Areal Boundaries**
 - **Changes in Definitions**
 - **Coverage Errors (undercount or overcount)**
-



Estimation Methods

Extrapolative Techniques

- Arithmetic
- Geometric
- Exponential

Symptomatic Techniques

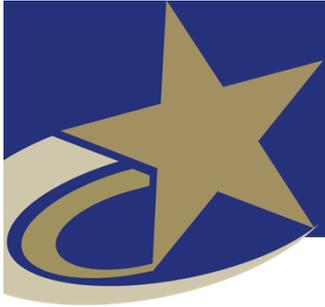
- Housing Unit Method
- Electric Meter Method
- School Enrollment Method
- Simple Ratio Method
- Vital Rates method
- Composite Method
- Proration Method

Regression-Based Techniques

- Ordinary Least Squares
- Ratio-Correlation

Component Techniques

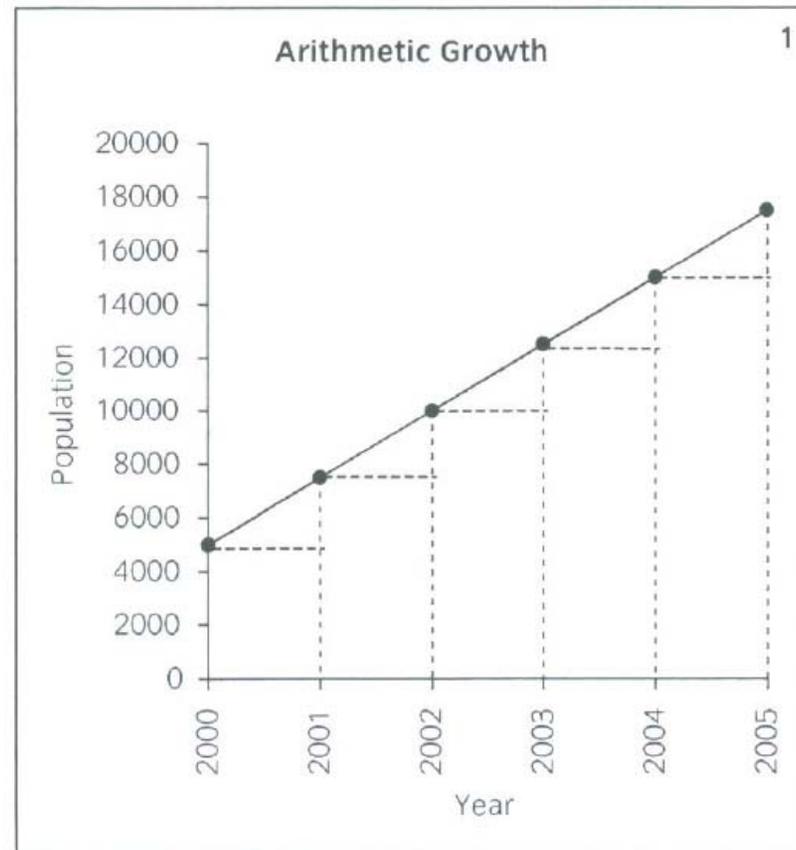
- Cohort Survival Method
- Component Method II
- Administrative Records Method



Projection Techniques

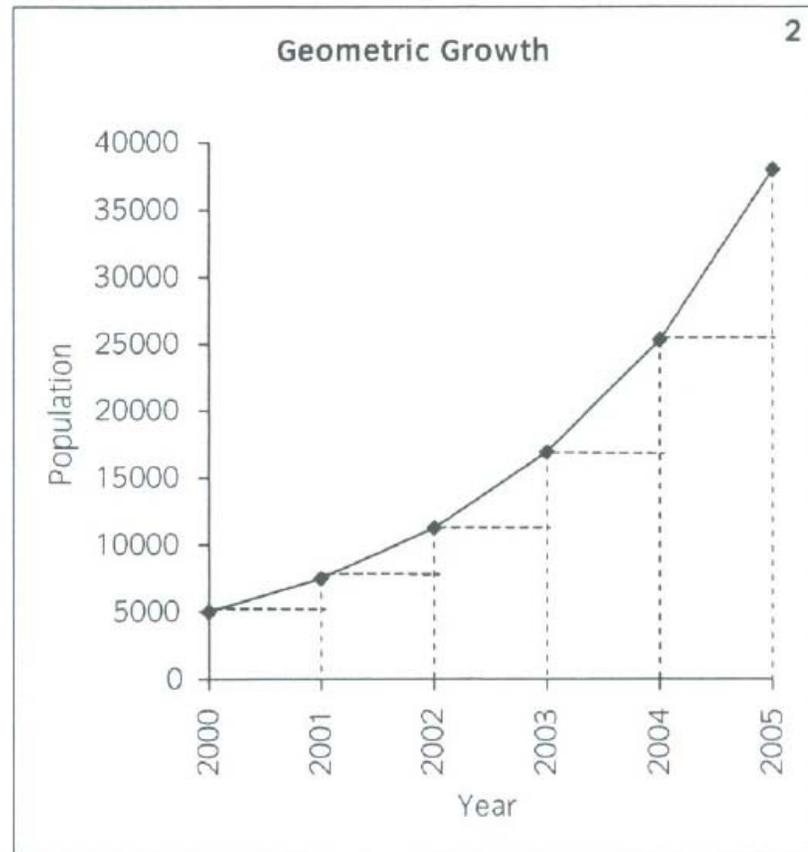
- **Trend Extrapolation or Mathematical Method**
 - **Simple extrapolation method**
 - **Complex extrapolation method**
 - **Ratio extrapolation method**
- **Land-Use Techniques**
- **Economic-Based Techniques**
- **Cohort-Component Techniques**

Arithmetic Growth



population increases by a constant number of persons for each period
arithmetic growth entails constant increments

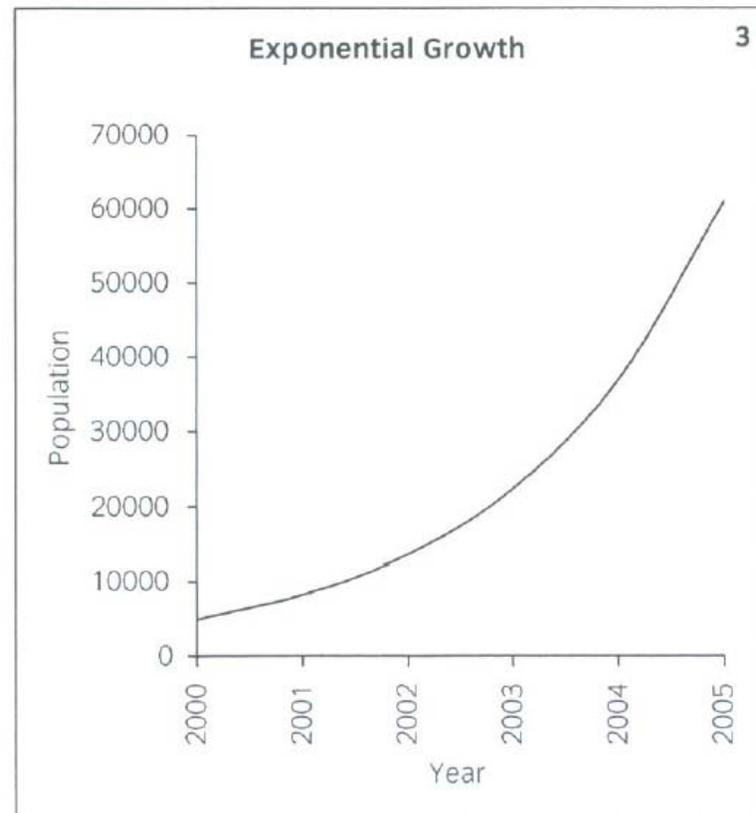
Geometric Growth



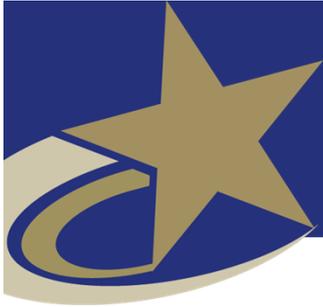
Geometric growth entails ever larger increments.

Population increments become larger because increases

Exponential Growth



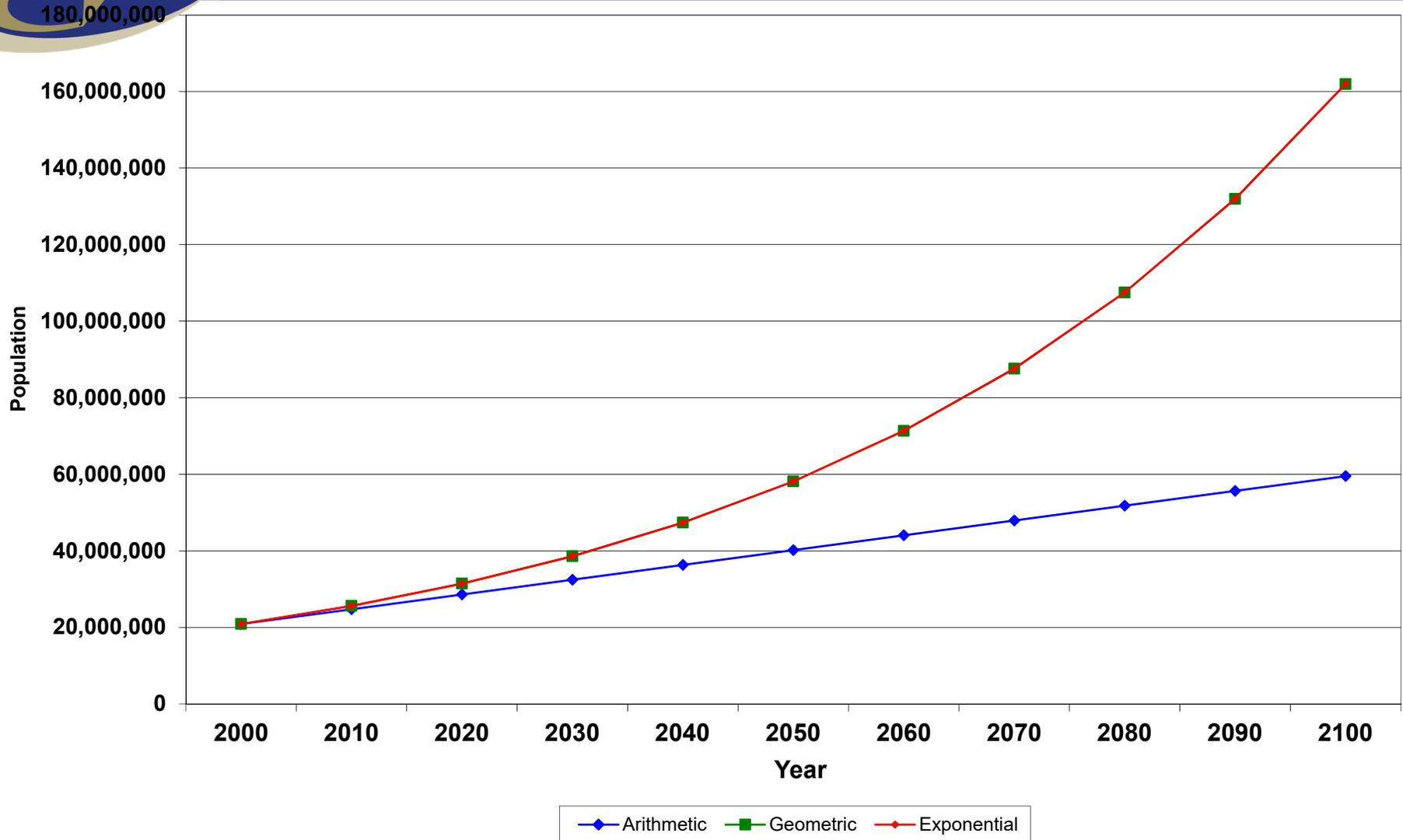
Exponential growth refers to the situation where growth compounds continuously - at every instant of time.



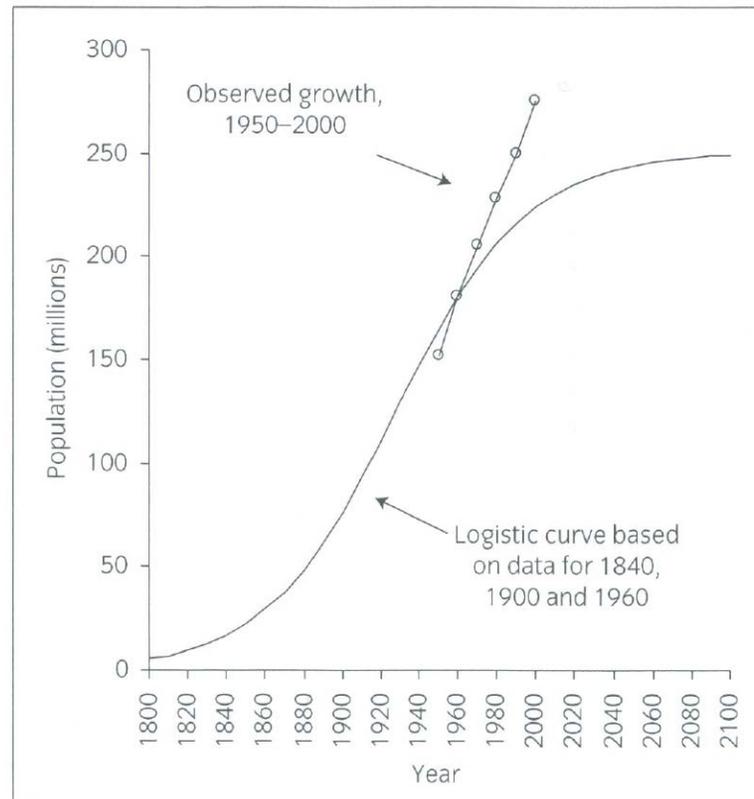
Populations Increasing at Annual Rates of 50%

Year	Type of Growth Rate		
	Arithmetic	Geometric	Exponential
A	B	C	D
Population Totals			
2000	5,000	5,000	5,000
2001	7,500	7,500	8,244
2002	10,000	11,250	13,591
2003	12,500	16,875	22,408
2004	15,000	25,313	36,945
2005	17,500	37,969	60,912
2006	20,000	56,953	100,428
2007	22,500	85,430	165,577
2008	25,000	128,145	272,991
2009	27,500	192,217	450,086
2010	30,000	288,325	742,066
Population Ratios			
$P_1 : P_2$	variable	1 : 1.500	1 : 1.649

Projected Population of Texas by Arithmetic, Geometric, and Exponential Method, 2010-2100

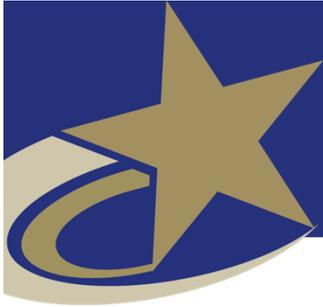


Logistic growth



“universal law of population growth”

S-shaped trend is a more realistic depiction of long-run national or global population growth than straight lines or exponential curves



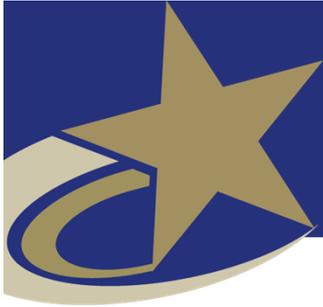
Principles of Population Projection

Population projection is as accurate as the assumptions on which it is based

No specific methodology guarantees accuracy

Projections usually are more accurate for:

- **Areas with large populations**
- **Total population**
- **Shorter time periods**
- **Areas with slow or stable growth patterns**



Component Methods

Uses Three Components of Population Change

$$P_{t_2} = P_{t_1} + B_{t_1-t_2} - D_{t_1-t_2} + NM_{t_1-t_2}$$

Where:

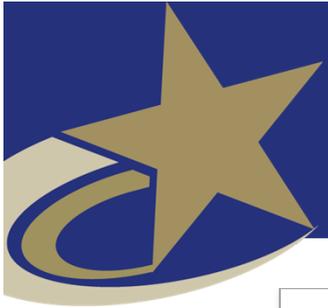
P_{t_2} = Population for estimate period

P_{t_1} = Population for base period

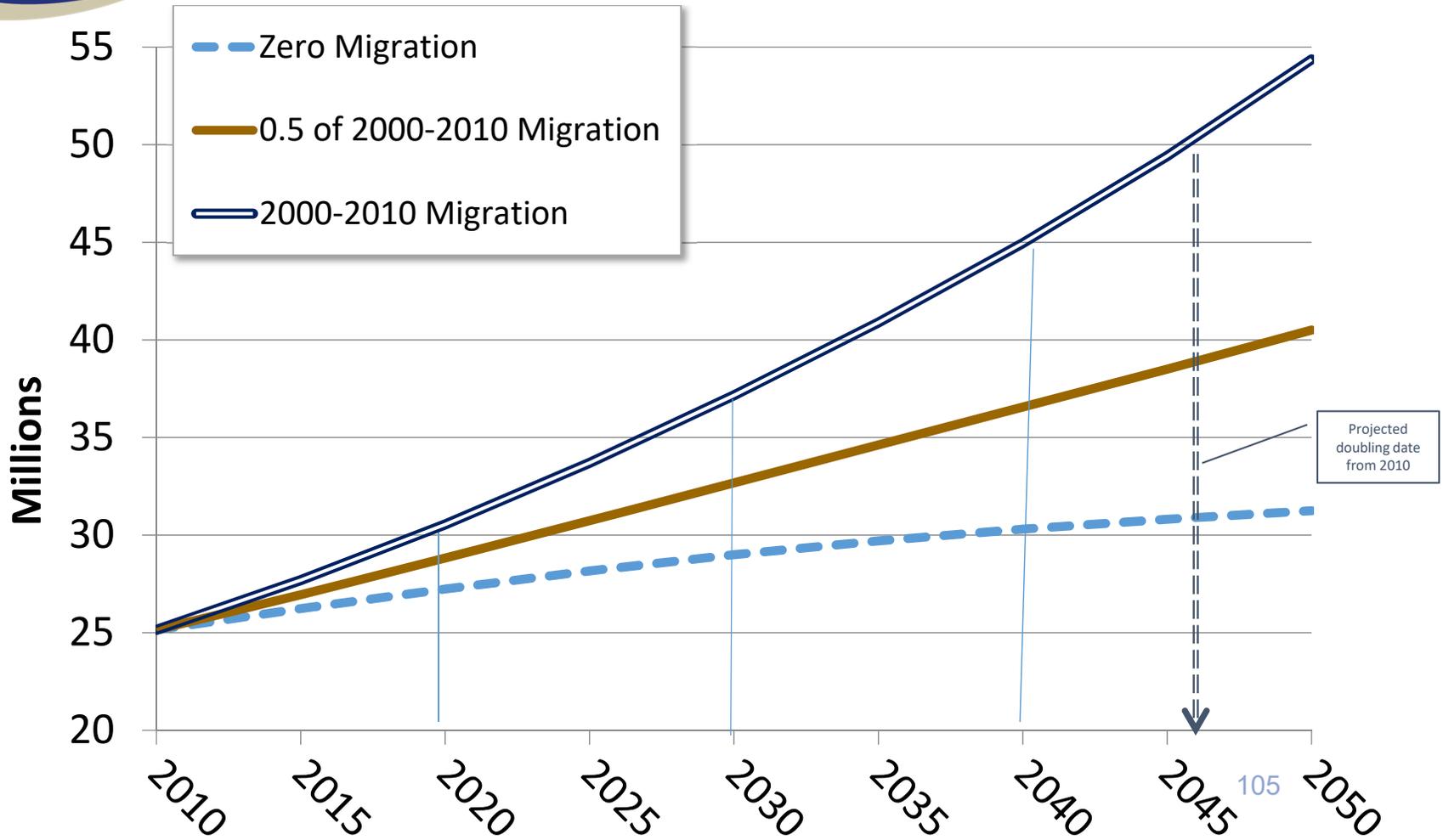
$B_{t_1-t_2}$ = Births between P_{t_1} and P_{t_2}

$D_{t_1-t_2}$ = Deaths between P_{t_1} and P_{t_2}

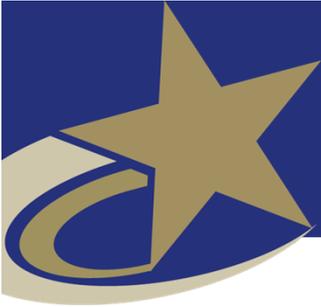
$NM_{t_1-t_2}$ = Net migration between P_{t_1} and P_{t_2}



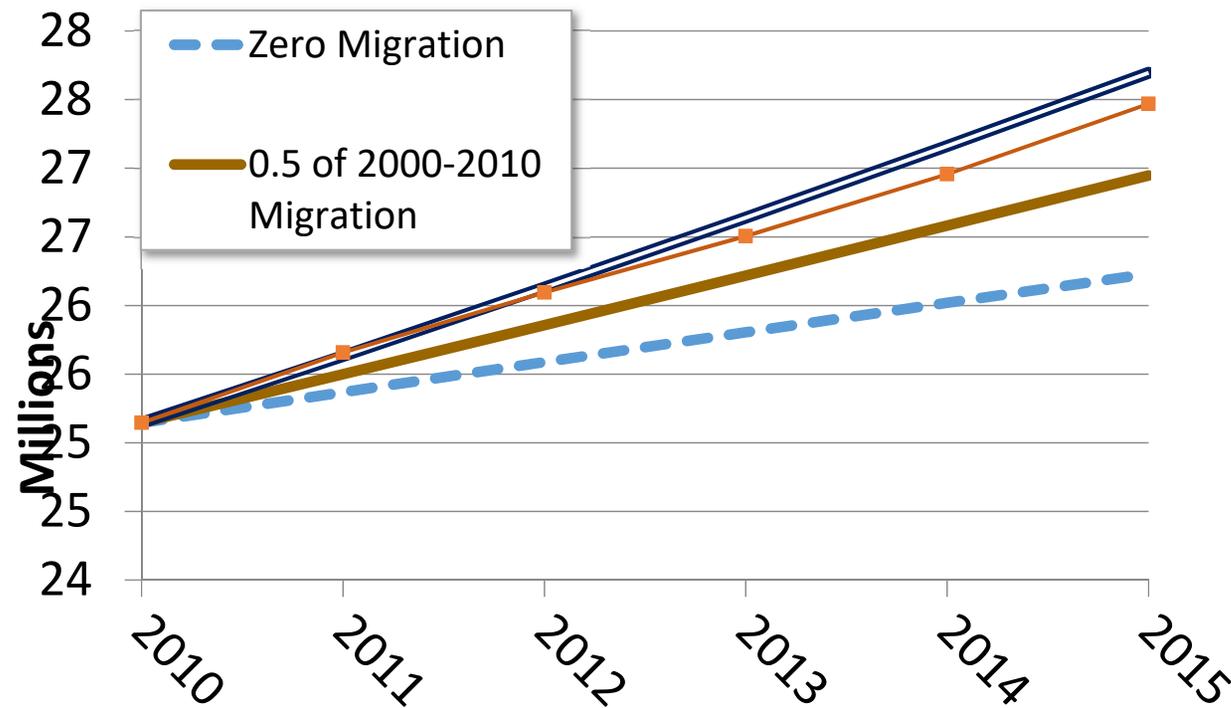
Projected Population Growth in Texas, 2010-2050



Source: Texas State Data Center 2014 Population Projections



Projected and Estimated Population Growth in Texas, 2010-2015



Source: Texas State Data Center 2014 Population Projections and U.S. Census Bureau Population Estimates