Demographic Analysis

Fertility:
Concepts and Measures

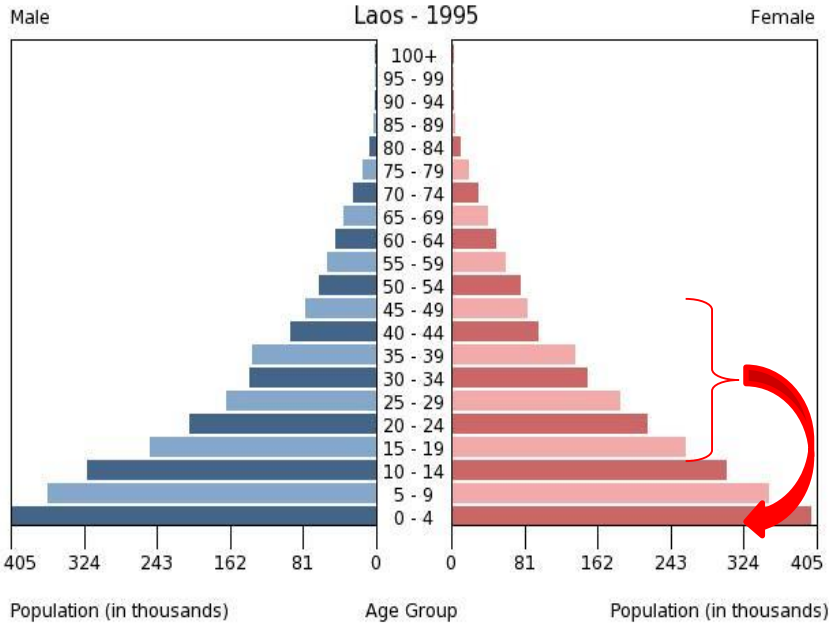
Fertility: Overview of Lesson Topics

In this lesson, we will cover:

- Sources of fertility data
- Basic concepts and measurements of fertility, including age patterns
- Direct estimation of fertility from registered births or from births reported in a census or survey
- Overview of indirect methods of fertility estimation (all related in some way to age structure)
- In following lessons, we will explore several of these methods in greater detail.

Why do we want to measure fertility?

- Fertility is the primary engine of population growth.
- Knowledge of levels and trends help us to formulate or evaluate policies related to such population growth.
- Analysis of fertility trends helps us to predict needs for maternal health facilities, teachers, new schools, etc.



Source: U.S. Census Bureau, International Database. http://www.census.gov/population/international/data/idb/region.php?N=%20Results%20&T=12&A=separate&RT=0&Y=1995&R=-1&C=LA

Fertility: Data Sources

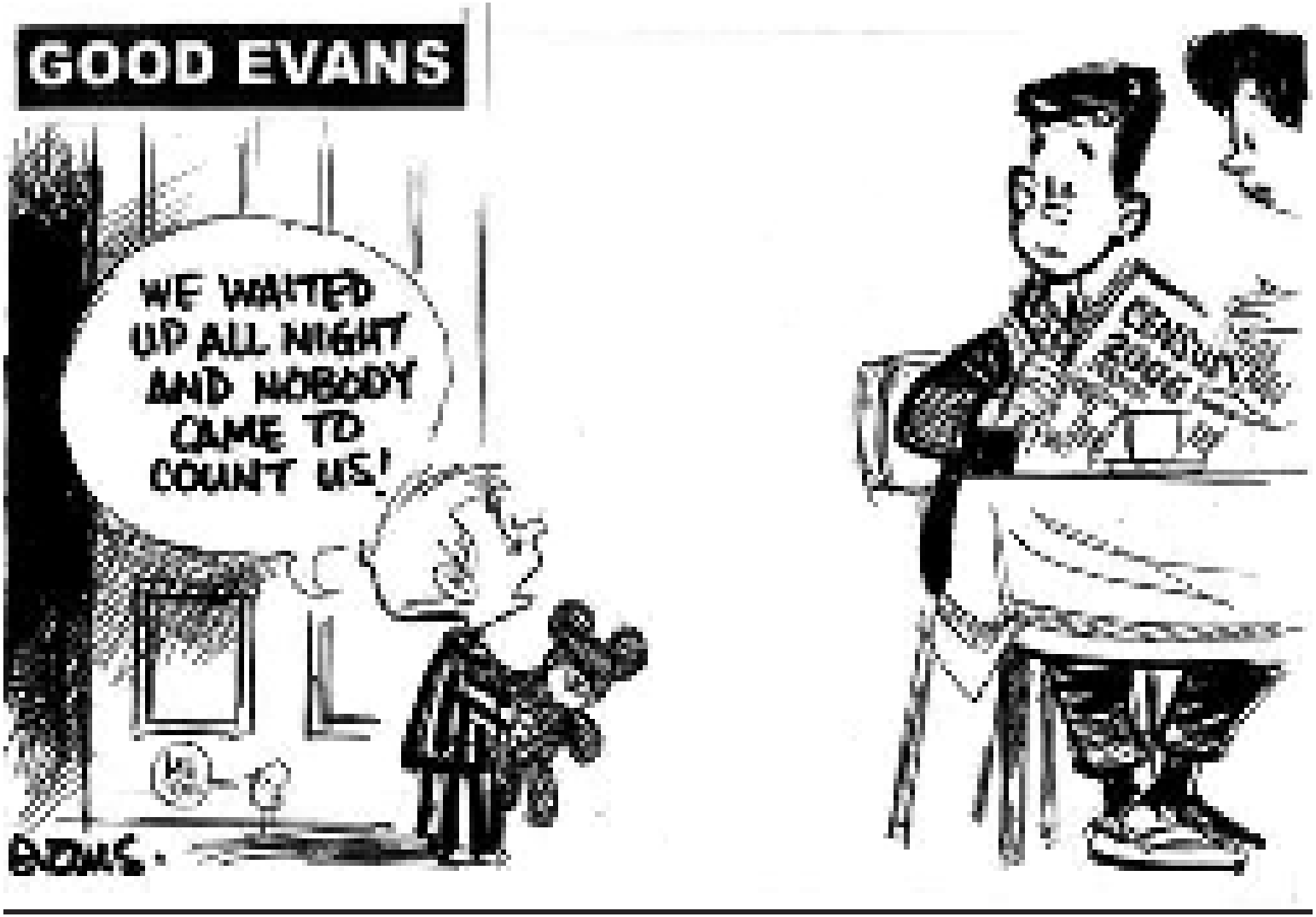
- Data sources for fertility estimates
  - Vital registration
  - Demographic surveillance system
  - Censuses
  - Surveys

Total births or births tabulated by age of mother

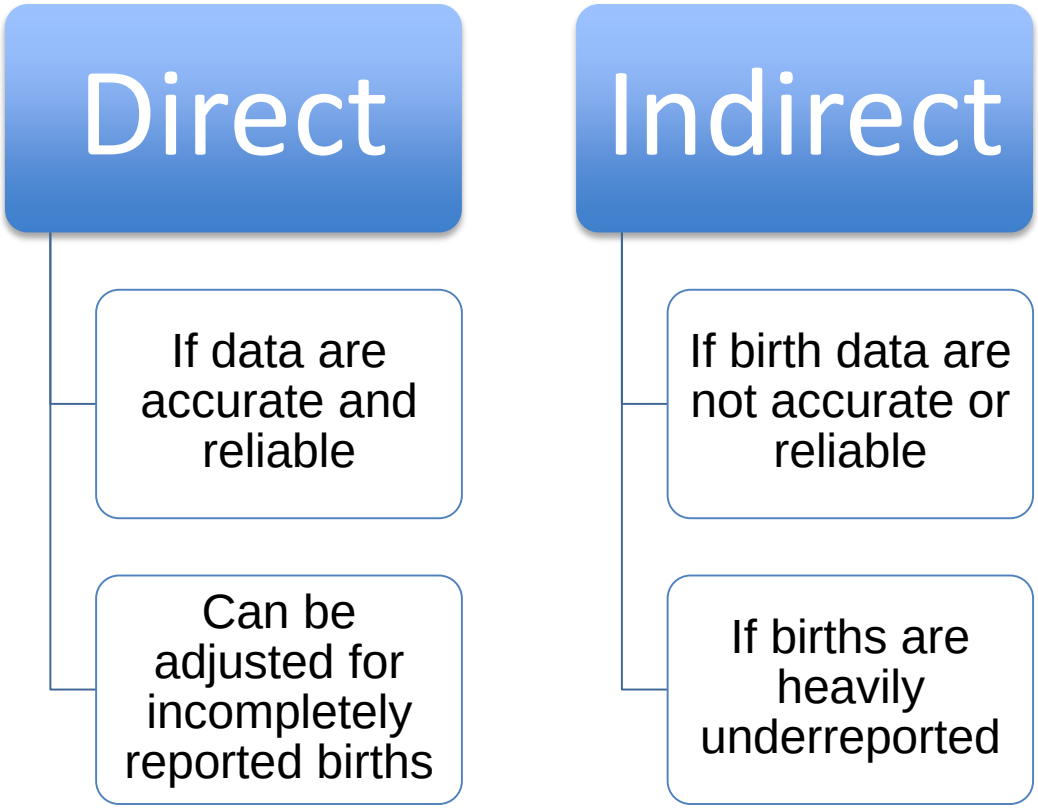
Questions about
1) lifetime fertility
2) recent fertility (usually 12 months)

Questions on Fertility from Censuses and Surveys

- Recent fertility:
  - Children born to individual women during a fixed period (typically 12 months) prior to the interview.
- Lifetime fertility (Parity):
  - Full or partial birth history for individual women (DHS)
  - Children Ever Born (CEB): A series of questions about the number of sons and daughters:
    - born alive and living with the mother
    - born alive but living elsewhere
    - born alive but now deceased


GOOD EVANS
WE WAITED UP ALL NIGHT AND NOBODY CAME TO COUNT US!
EVANS.

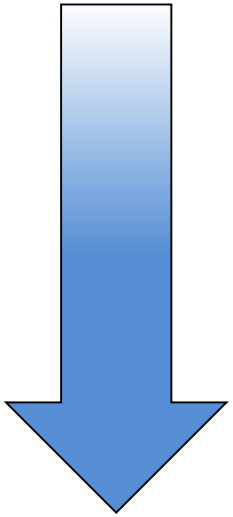
Fertility: Estimation Methods



Common Measures of Fertility

As we progress from one measure to the next, they will be less influenced by age structure and hence more accurately reflect fertility.

- Number of Births
- Crude birth rate (CBR)
- General fertility rate (GFR)
- Age-specific fertility rates (ASFRs) and
- Total fertility rate (TFR)



Measures of Fertility: Number of Births

- When would you want to use number of births?
- When would you not want to?

Measures of Fertility: Number of Births

Good for:

1) assessing absolute population growth

2) planning for school enrollments & immunizations

Number of births does not tell us anything about the fertility of the average woman

Large birth numbers may simply reflect a large population of mothers

Measures of Fertility: Crude Birth Rate

Crude birth rate (CBR) is calculated as the number of births occurring in a year divided by the population at midyear, times 1,000. (Question – why midyear?)

CBR = 1000*B / P

For example, the CBR for Hong Kong in 1987 is obtained as follows:

1,000 x 69,811 / 5,613,000 = 12.44
(births) (population)

12.4 births per 1,000 population in Hong Kong in 1987.

Which Country Has Higher Fertility?

	Country A	Country B
Births	19,898	15,438
Population (thousands)	315,968	156,207
Crude Birth Rate (per 1000)	12.6	20.4

Source: World Population Prospects 2015.
Note: Births (average annual births) and crude birth rates from 2010-2015. Population is the average de facto population between 2012 and 2013.

Measures of Fertility – Crude Birth Rate

Yet crude birth rates can be misleading due to the denominator used to calculate it:

- It includes men
- It includes women outside childbearing ages
- It includes children
- Age structure can vary among childbearing women

Implications:

- Two populations may have different crude birth rates even if fertility of women at each age is the same
- Women in one society could have a higher birth rate than another society even though the number of births could be lower at each age.

Measures of Fertility – General Fertility Rate (GFR)

General fertility rate: The number of births in a year **per 1,000 women ages 15 to 49 years as of the midyear**.

GFR for Hong Kong in 1986:

72,221 / 1,469,300 x 1000 = 49.2
(births) / (women ages 15 to 49)

There were 49 births per 1,000 women of reproductive age in Hong Kong in 1986.

Measures of Fertility – General Fertility Rate (GFR)

While improving over the crude birth rate, the general fertility rate statistic suffers from two limitations:

1. Age structure can vary among childbearing women
2. Although the statistic is clearly defined, it gives us little intuition about typical number of children per mother

Measures of Fertility – Age-Specific Fertility Rate (ASFR)

An age-specific fertility rate is calculated as the number of births in a year to mothers of a specific age per woman (or per 1,000 women) of the same age at midyear.

Measures of Fertility – Age-Specific Fertility Rate (ASFR)

Age-specific fertility rates are calculated as the number of births to mothers in a particular age group in a year per 1,000 women (or per woman) in the same age group at midyear.

In symbols:

$$ {}_nf_x^t = \frac{{}_nB_x^t}{{}_nP_x^t} \times 1{,}000 $$

Where:

${}_nf_x^t$ is the age-specific fertility rate for women between ages x and x+n for year t;

${}_nB_x^t$ is the number of births to women between ages x and x+n in year t; and

${}_nP_x^t$ is the number of women between ages x and x+n in year t.

Measures of Fertility – Age-Specific Fertility Rate (ASFR)

Not affected by differences in the age distribution among women of childbearing ages.

Difficult to use them to make comparisons among populations or within a certain population over time.

Do not easily portray the overall level of fertility.

Measures of Fertility – Total Fertility Rate (TFR)

The total fertility rate (TFR) represents the average number of children a group of women would have by the end of their reproductive years if they had children according to a set of age-specific fertility rates pertaining to a particular year.

In other words, if a group of women have been exposed to a given set of ASFR's from age 15 to age 49, the average number of children they would have by age 50 is the total fertility rate.

Measures of Fertility – Total Fertility Rate (TFR)

The TFR is derived by cumulating the age-specific fertility rates (per woman) for all ages of women.

When rates are calculated for the seven conventional 5-year age groups, the TFR is the sum of the rates for each age group, multiplied by five (the width of the age-group interval).

Deriving Total Fertility Rate (TFR) from ASFRs

Age	Births	Females	Age Specific Fertility (ASFR)
15-19	34,772	860,698	0.0404
20-24	117,697	759,335	0.1550
25-29	85,664	507,188	0.1689
30-34	56,565	422,755	0.1338
35-39	37,072	454,870	0.0815
40-44	14,448	401,344	0.0360
45-49	1,436	319,017	0.0045
			0.6201 sum of ASFRs
			3.10 Total Fertility Rate
			(sum of ASFRs * 5)

ASFR = Births/Females At Each Age

Summed ASFRs

ASFRs show expected fertility at each single year age within each interval. Thus, for a 5-year age interval, multiply sum of ASFRs by 5 to get the ***TFR, the expected births per woman's reproductive lifetime.***

Deriving TFR from ASFRs – Example from Chile

Table IV-1. Age-Specific Fertility Rates and Total Fertility Rate for Chile: 1983

Age of women	Female population	Number of births	Fertility rate
(1)	(2)	(3)	(4) = (3)/(2) x 1,000
15-19	593,262	36,784	62.0
20-24	587,076	81,213	138.3
25-29	505,362	65,236	129.1
30-34	424,186	37,506	88.4
35-39	385,749	17,532	45.4
40-44	325,105	4,929	15.2
45-49	266,575	512	1.9

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		Sum =	480.4
		Sum x 5 / 1,000 =	2.4

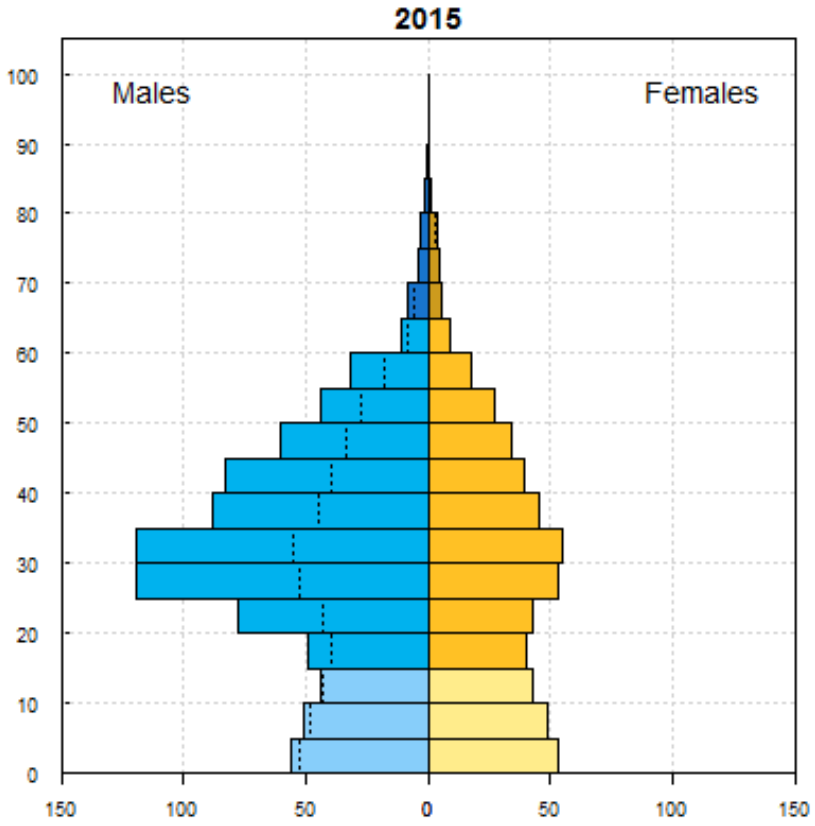
The total fertility rate in Chile in 1983 was 2.4 births per woman.

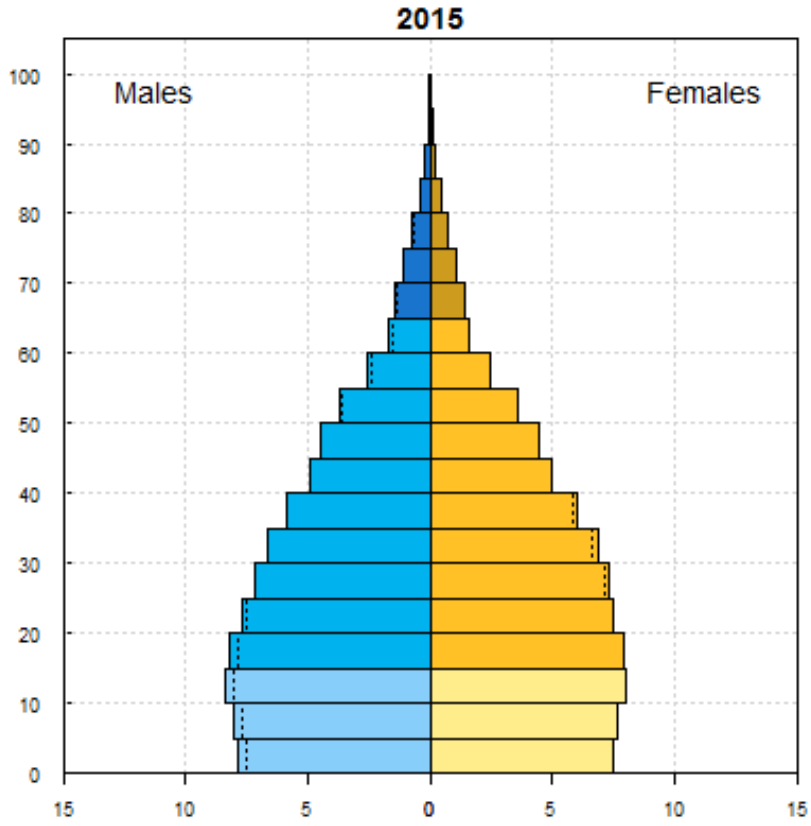
Which Country has higher fertility?

	Country A	Country B
Crude Birth Rate (per 1000)	18.2	20.4
Total Fertility Rate (per 1000)	2.25	2.23
Population (thousands)	52,544	155,222

Source: World Population Prospects 2015.
Note: Births (average annual births) and crude birth rates from 2010-2015. Population is the average de facto population between 2012 and 2013.

Why would TFR be about the same but CBR higher in one country?



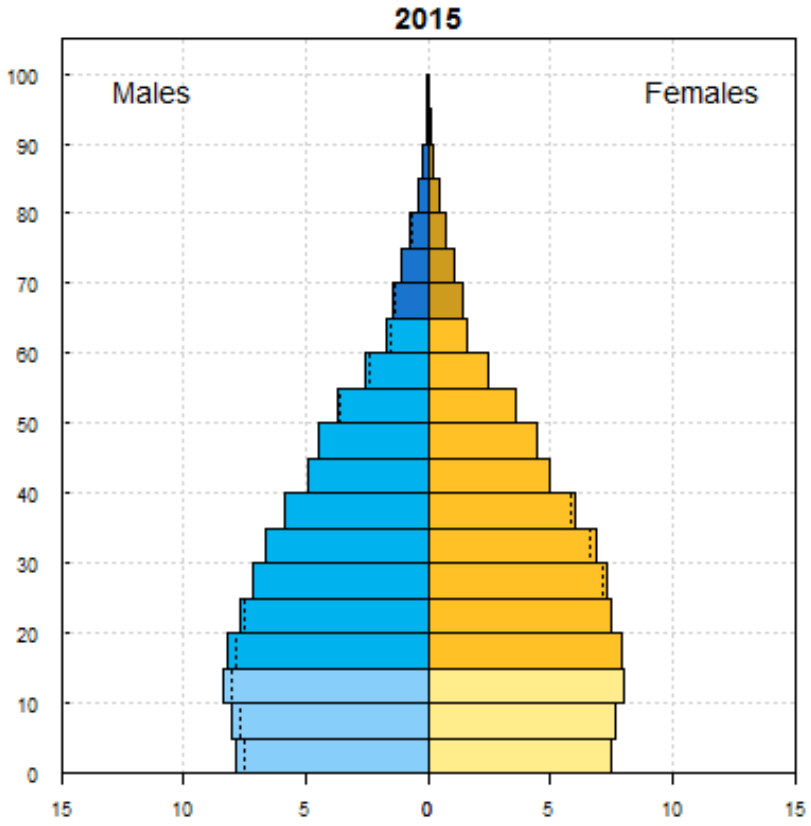


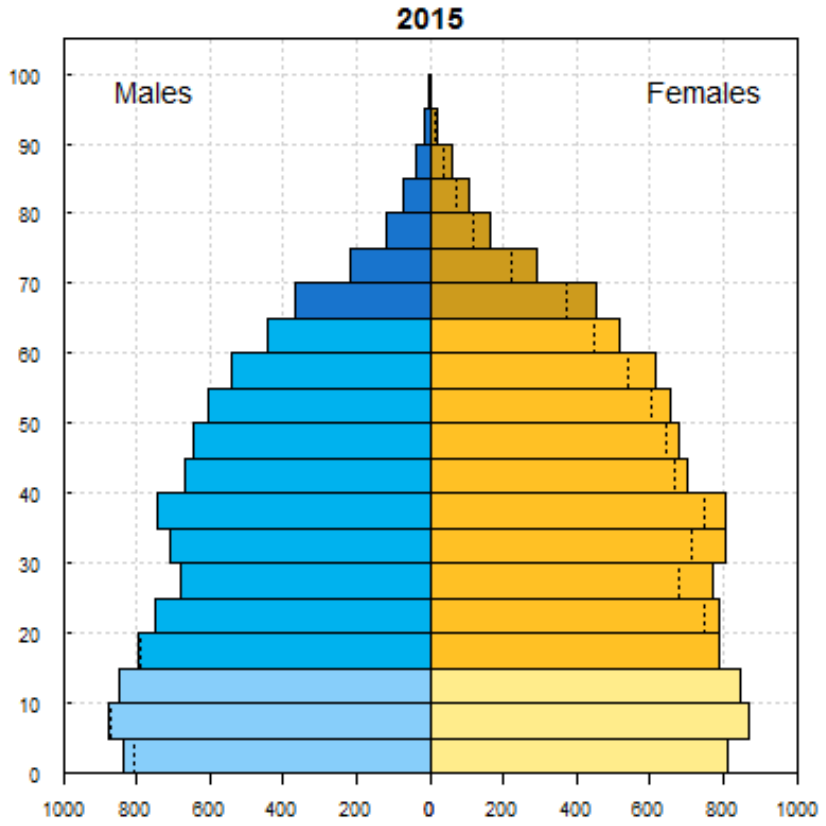
Which Country Has Higher Fertility?

	Country B	Country C
Crude Birth Rate (per 1000)	20.4	16.4
Total Fertility Rate (per 1000)	2.23	2.11
Population (thousands)	156,207	40,944

Source: World Population Prospects 2015.
Note: Births (average annual births) and crude birth rates from 2010-2015. Population is the average de facto population between 2012 and 2013.

Age Structure of Women of Childbearing Age Affects the CBR





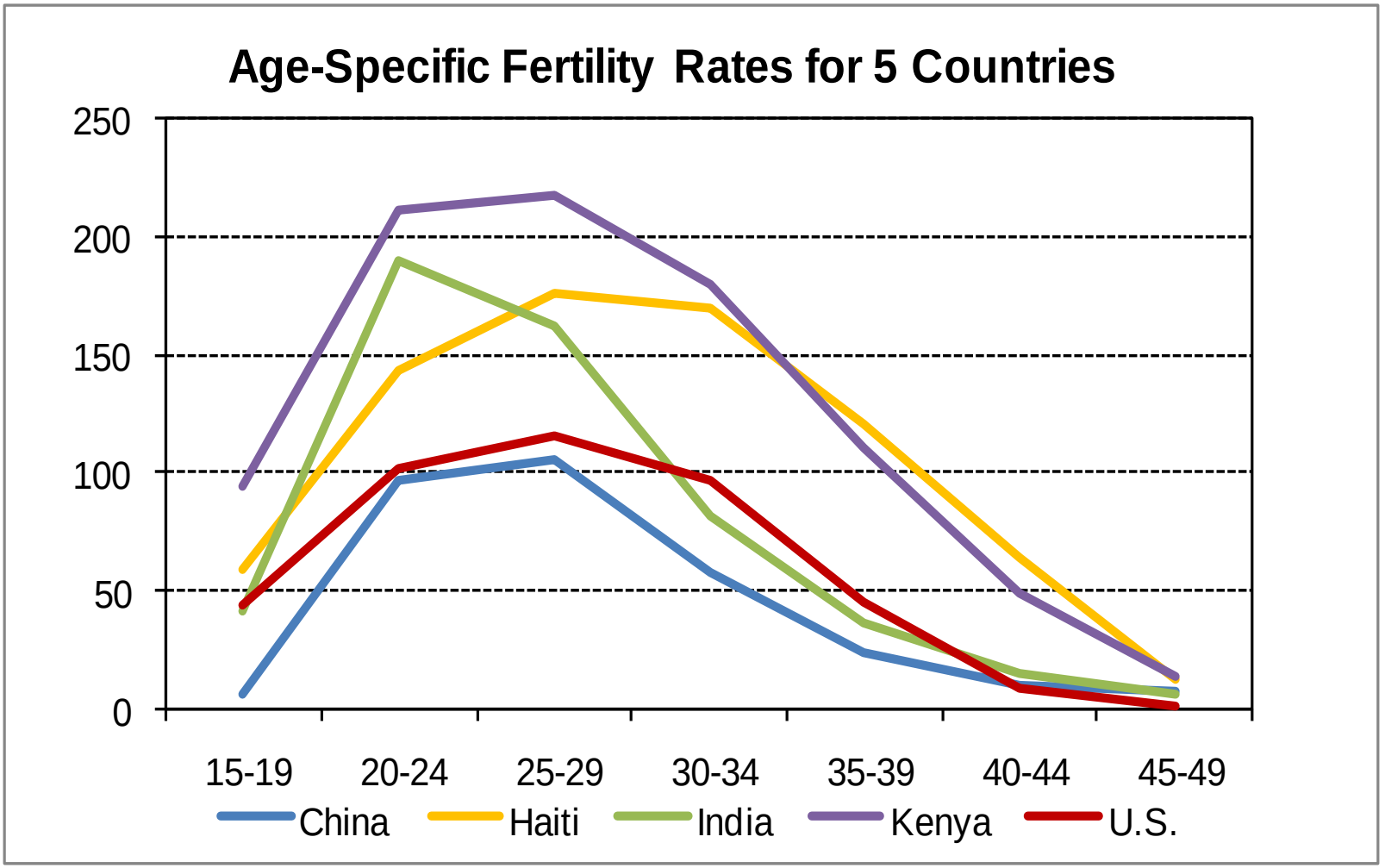
ASFR Patterns

Age-specific fertility rates (ASFRs) follow a fairly standard pattern among women in all populations

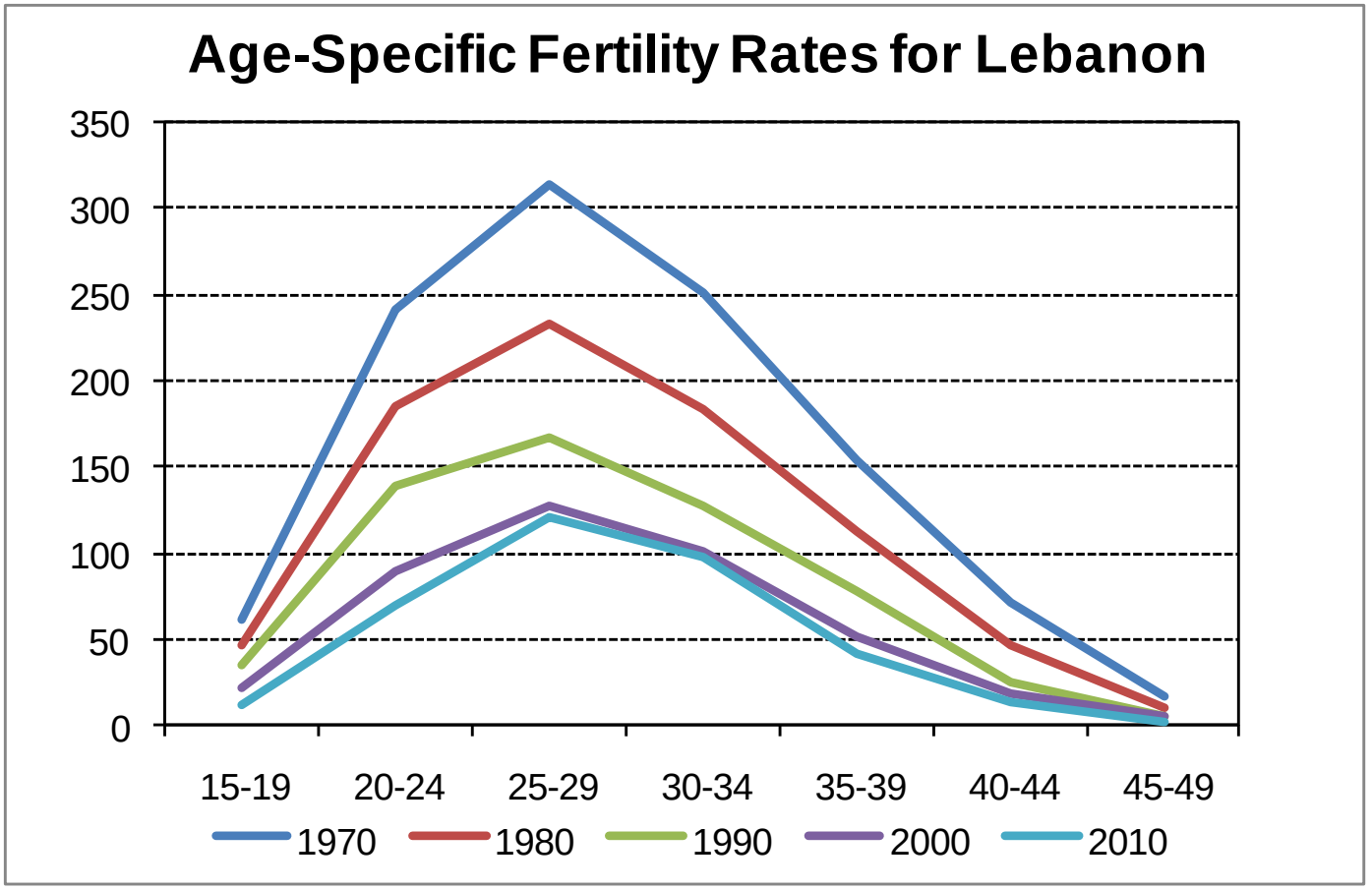
- start from zero at very young ages
- peak sometime in the twenties,
- declining gradually until again reaching zero around age 50

Slight variations to the pattern occur, depending on differences in age at marriage, on the proportion of women sexually active (mostly within marital unions), or on the desire and possibility of controlling pregnancies (mostly by using contraception).

ASFRs Share a Common Pattern



ASFRs Vary Over Time



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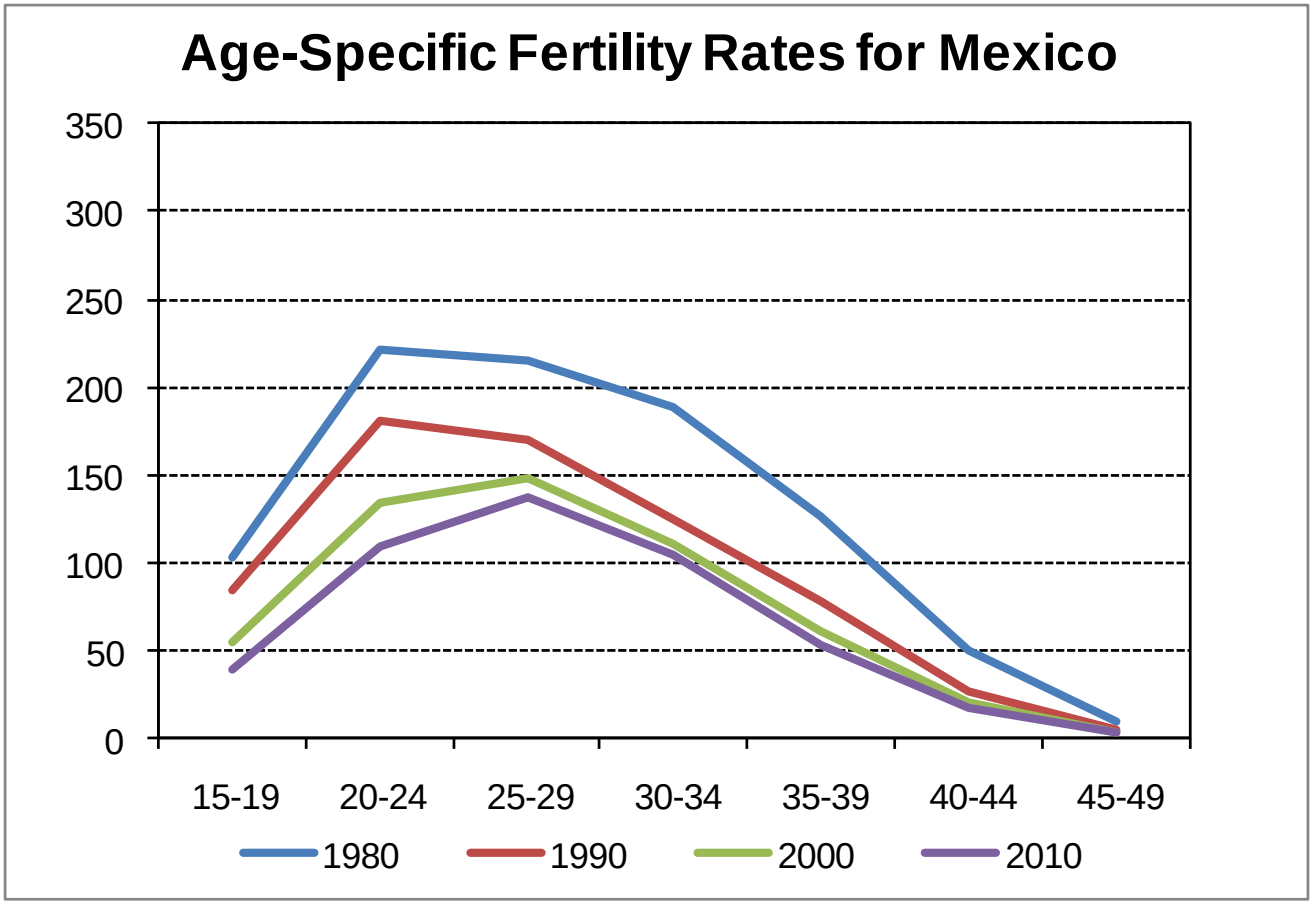

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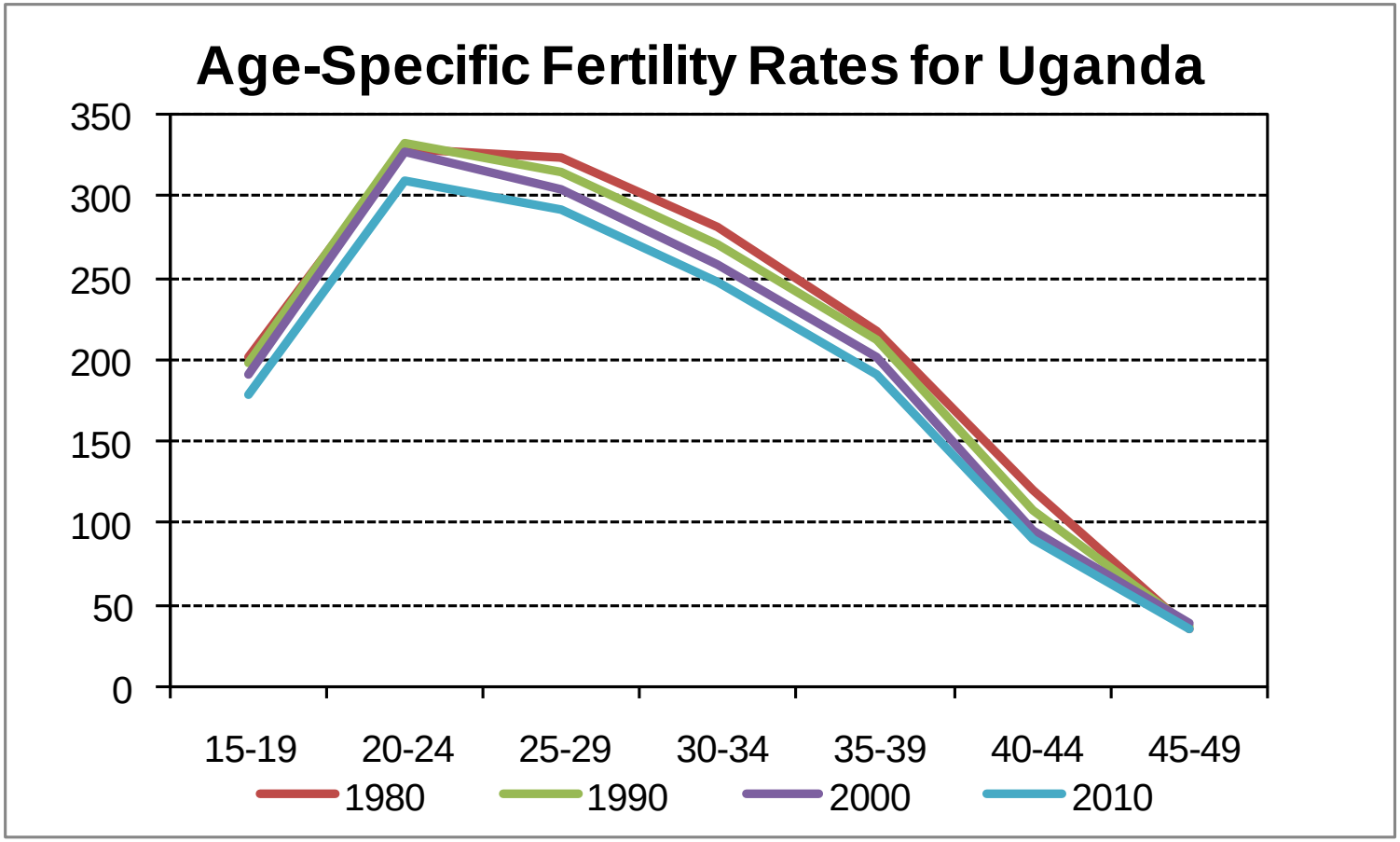


Other Fertility Measures – the Gross and Net Reproduction Rates (GRR and NRR)

Other fertility measures related to the TFR and helpful in demographic estimation and analysis include:

- The Gross Reproduction Rate (GRR): Constructed like a TFR, but ASFRs include female births only
- Net Reproduction Rate (NRR): The average number of daughters expected to survive to childbearing ages – the extent to which a generation of mothers reproduce themselves. This is like the GRR adjusted for the impact of mortality.

Other Fertility Measures – Marital Fertility Rates

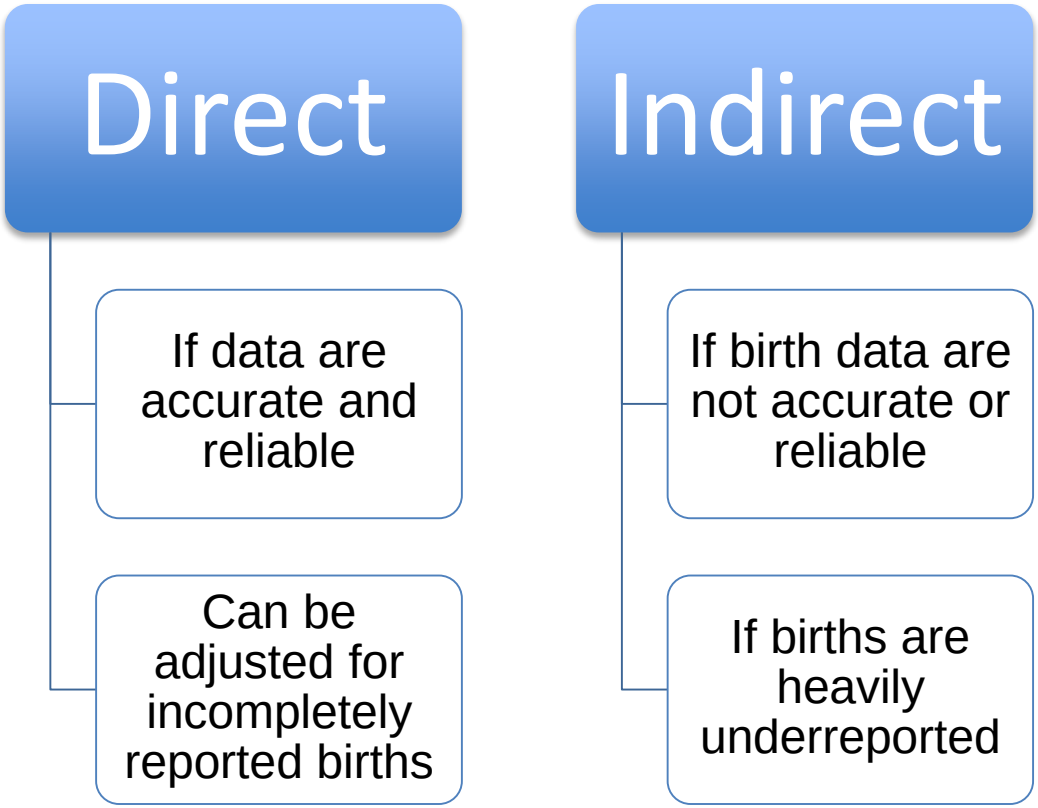
- Marital fertility rates can be computed like the measures we have studied so far. In most cases, the marital version of the measure includes births to married women in the numerator and all married women in the denominator.
- If not further specified, the Marital Fertility Rate is equivalent to the GFR for married women.
- These measures may be useful in understanding how changes in marriage affect fertility.
- These measures are difficult to interpret in cultures where many births occur outside marriage, and/or there are different types of marital status (e.g., consensual unions).

Exercises

- In your groups... For your country
- Compute the following measures of fertility:
  - CBR
  - GFR
  - ASFRs
  - TFR
- Plot the ASFRs. What is the pattern?

CALCULATING FERTILITY ESTIMATES

Fertility: Estimation Methods



Indirect Methods

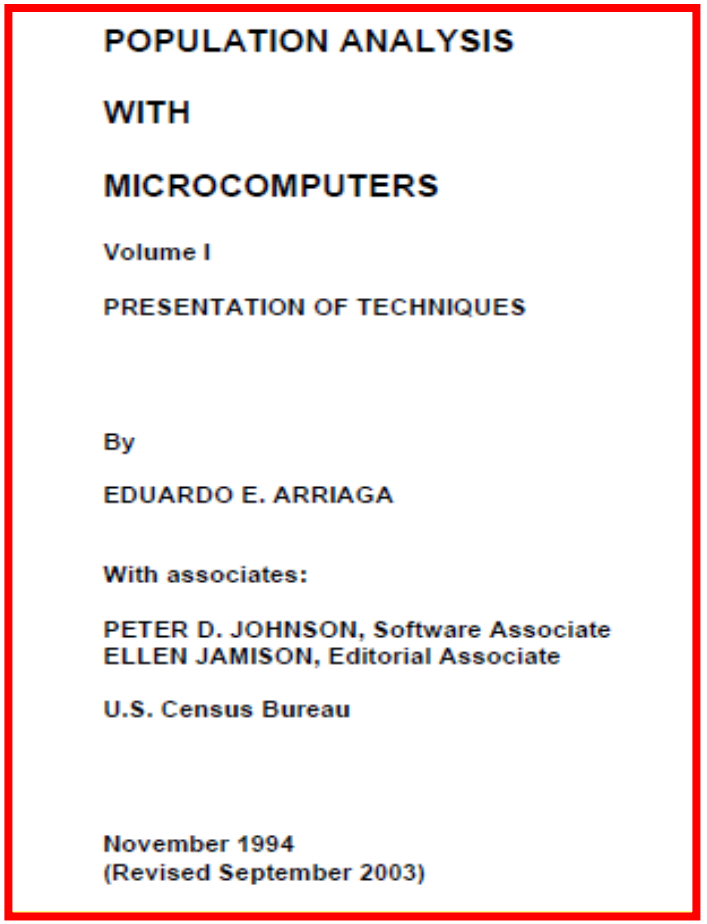
- Use population age-sex structure
  - Rele
  - Reverse survival
- Use questions on Children Ever Born
  - PFRatio

Spreadsheets:
RELE
REVCBR

Spreadsheets:
PFRATIO
REL-GMPZ
ARFE-2
ARFE-3

Fertility: For more information

The importance of fertility data, techniques for estimating fertility levels and patterns, and methods for adjusting fertility data are discussed in more detail in chapter 4 of the Census Bureau's *Population Analysis with Microcomputers*.


POPULATION ANALYSIS

WITH

MICROCOMPUTERS

Volume I

PRESENTATION OF TECHNIQUES

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