Methods - Rehearsel

Nico Keilman

Demography of developing countries ECON 3710

January 2011

Recommended

- Rowland, Donald.T (2003). *Demographic Methods and Concepts*. Oxford: Oxford University Press.

  - Sections 1.5, 1.6, 6.3, 7.3 - 7.6

- Population handbook at www.prb.org/pdf/PopHandbook_Eng.pdf

  - Chapters 2-5, 7, 8, Appendix A

Cf. handout

Stocks vs flows

Norway:

Pop	1 Jan 2006	4 640 219
	1 Jan 2007	4 681 134

Live births 2006	58 545
Deaths 2006	41 253

Stocks: one point in time (census time, 1 January etc.)

Flows: during a certain period (one year, five years, between two censuses etc.)

Flows (population) ←→ events (individuals)

e.g. birth, death, migration (total population), or marriage, divorce (sub-population)

Rates

Intensity of an event is expressed by means of a RATE

Definition: Ratio of the number of events to exposure time for population at risk

Unit: # events pr. person pr. year

Cf. Poisson rate (= exp. # events pr. unit of time)

Crude death rate (CDR)

Pop 1 Jan 2006 4 640 219

1 Jan 2007 4 681 134

Deaths 2006 41 253

Mid-year population (4640219 + 4681134)/2=

4 660 676½

CDR = 41253/4660676½ = 0.0089 or

8.9 per thousand

Mid-year population approximates exposure time

1 Jan 2006: 4 640 219 exposed to death risk

1 Jan 2007: 4 681 134 exposed to death risk

On average during the year
(4640219 + 4681134)/2= 4 660 676½ persons were exposed to death risk during one whole year

When period shorter/longer than one year: multiply ”mid-period” population by period length to find exposure time

Crude birth rate (CBR)

Pop	1 Jan 2006	4 640 219
	1 Jan 2007	4 681 134
Live births 2006		58 545

Mid-year population (4640219 + 4681134)/2= 4 660 676½

CBR = 58545/4660676½ = 0.0126 or 12.6 per thousand

Types of measures

- Rate: # events/exposure time

- Ratio: one number relative to one other number. Example: sex ratio

- Proportion (fraction, share): numerator is part of the denominator. Examples: proportion women in a population, proportion elderly

- Probability: # events in a pop/initial pop size

  - easy to compute in closed population

  - open population:

    use formula that transforms rate into probability (see Table 6.5)

Crude Death Rate too crude

Typical age pattern of mortality

→ Death rates for separate ages/age groups

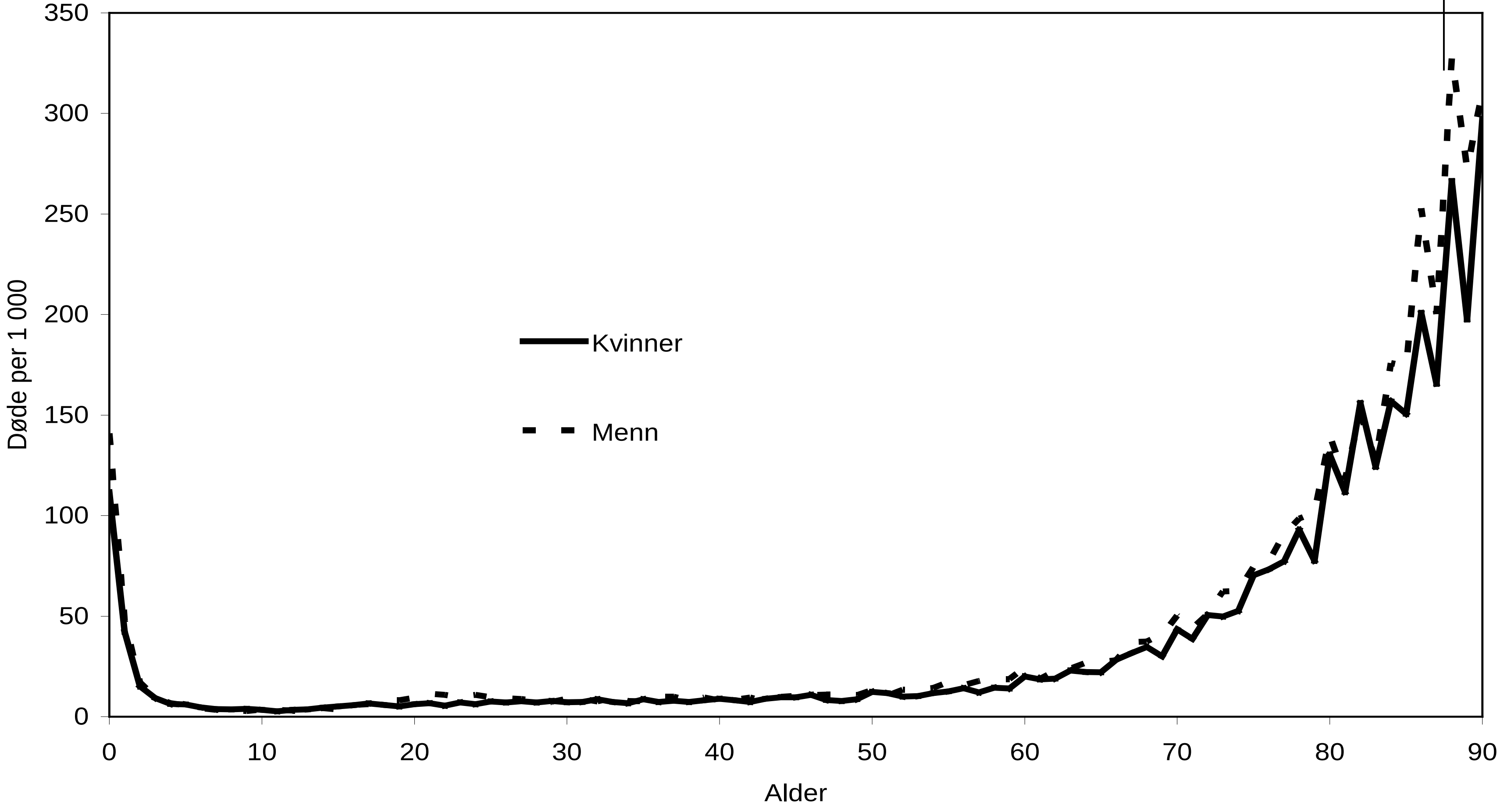
Age specific death rates (ASDR)

ASDR for age x =

deaths at age x/mid.year pop age x

0 ≤ ASDR ≤ 2!

Age specific death rates, Norway 1900



NB: Kvinner = women, Menn = men, alder = age,
Vertical scale: number of deaths per 1000 of mid-year population

Death probability (q) – Formula Table 6.5

Death probability: Probability to be no longer alive at the end of the year, given alive at the beginning of the year

One year: $q = ASDR/(1 + ½ASDR)$

n years : ${}_nq = n.ASDR/(1 + ½.n.ASDR)$

$0 \leq {}_nq \leq 1$!

Cf. Example Russian Federation in Table 6.5

Life table

Summarizes the life course of a hypothetical population from birth to death

Based on a given set of age-specific death rates/death probabilities

e.g. men, Malaysia, 1995 (handout) or women, Norway, 2007

Some die early, others die later. Life table extends until last person in hypothetical population has died.

Life table (cont.)

Series of columns, with rows representing ages / age groups cf. Handout (men in Malaysia 1995).

Important:

- ${}_nq_x$ proportion dying in the age interval

  ${}_nq_x$ column (or the death rates underlying them) is input for the life table

- l_x number alive at the beginning of age interval
- e_x years of life remaining (life expectancy) – summarizes, in one number, the whole set of rates/probabilities for 100 ages

How to compute a life table is not required reading in this course (it is in ECON 1710)

Life table (cont.)

- Ordinary life tables: one-year age groups
- Abridged life tables: five-year age groups (but 0-<1, 1-5)

- Period life table: death rates/probabilities observed for a certain period/calendar year among persons born in different years
- Cohort life table: death rates/probabilities observed for a certain fixed birth for various calendar years

Life expectancy in a period life table is NOT a reliable measure of future mortality

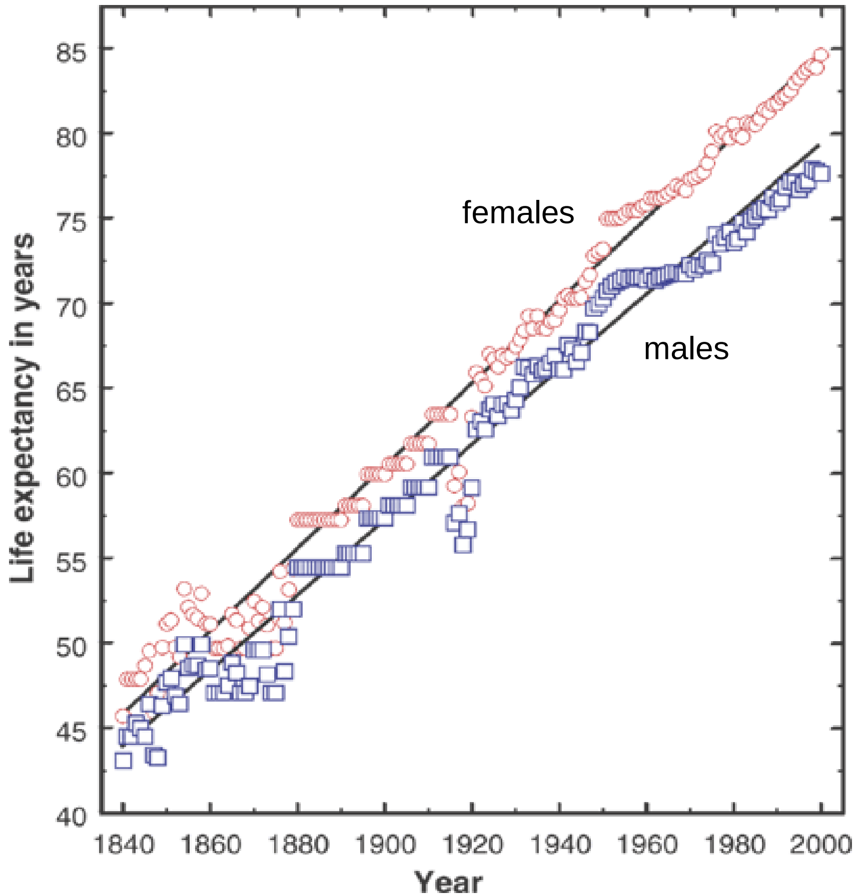
In 1949 (Nico's birth cohort) e_0 for men was 69 years; most recent life table (2009) gives 78.6 years

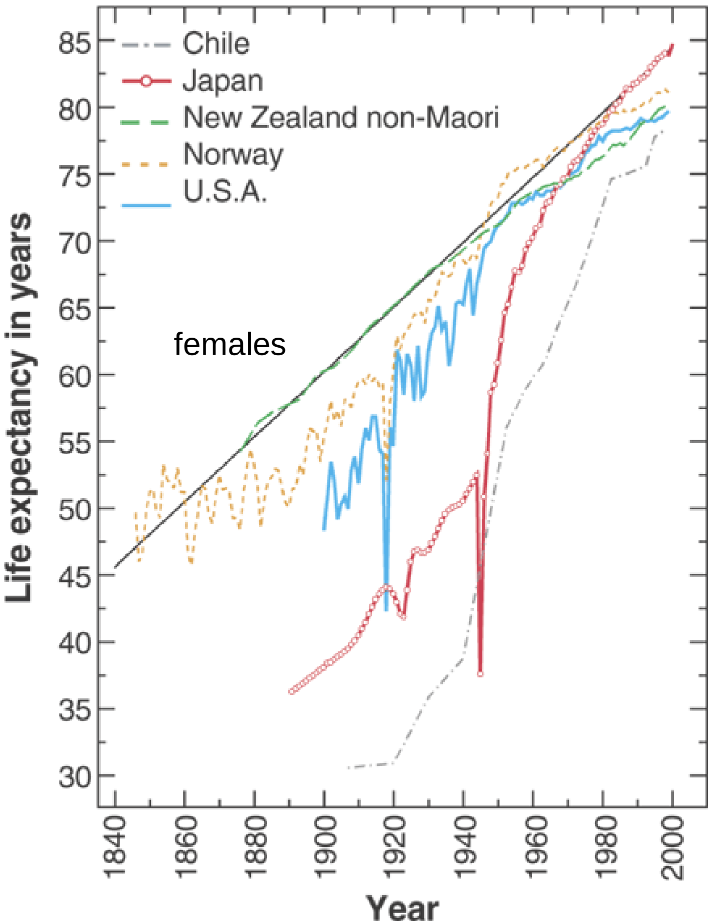
Nico's current (that is, in 2009) remaining life expectancy (e_{60}) is 21.9 years, so that he can expect to become

60+21.9 = 81.9 years old (with today's mortality)

Record life expectancy

has increased linearly in 160 years (~3 mnths. pr. year / ~2.5 years pr. decade)





Source: Oeppen and Vaupel (2002) *Science*

Crude Birth Rate too crude

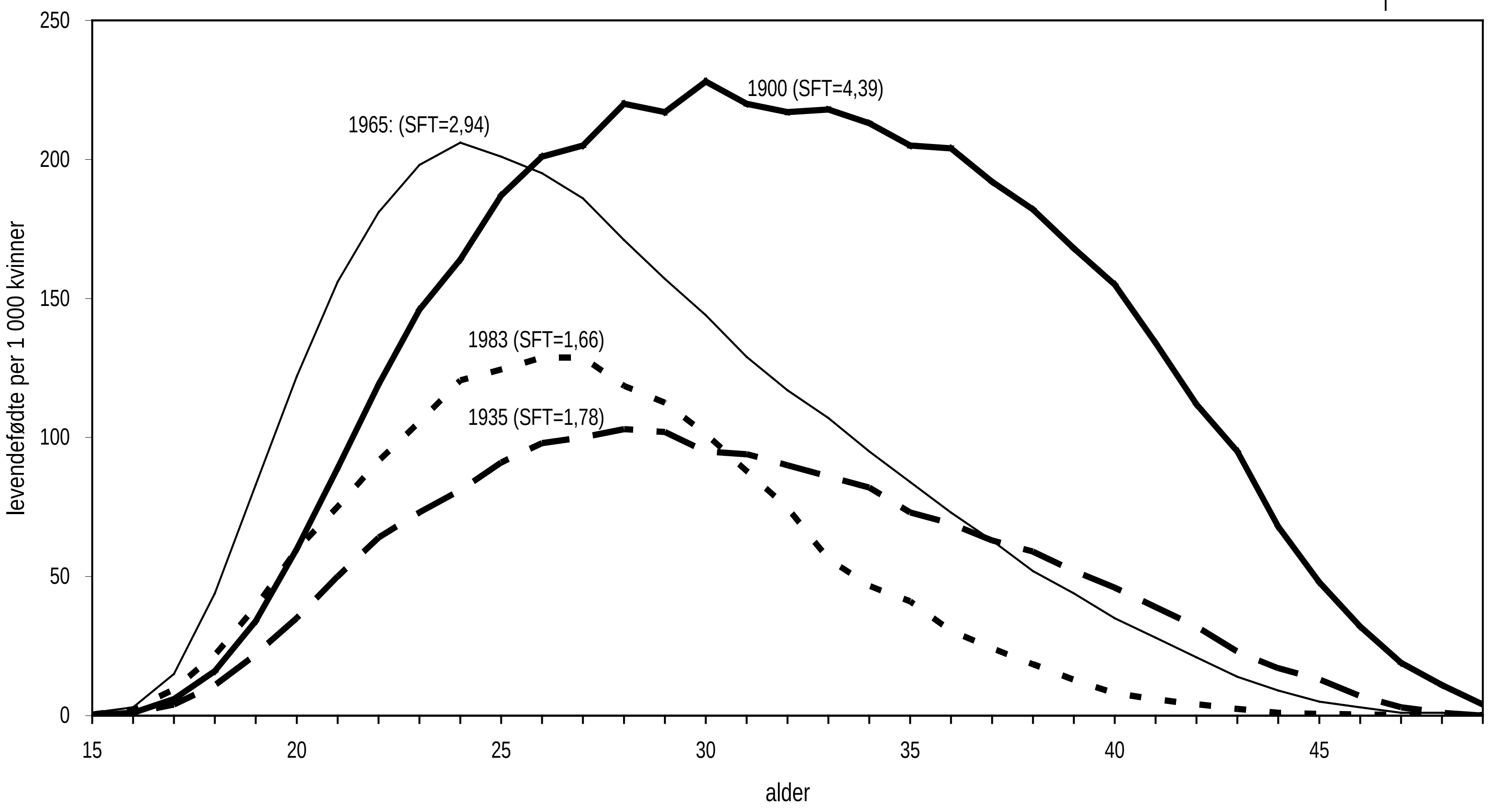
Age specific fertility rate ASFR

- one-year age groups (x,x+1) 15, 16, 17, …, 49
- five-year age groups (x,x+5) 15-19, 20-24, … 45-49

$$\text{ASFR} = \frac{\text{\# births to women in age group}}{\text{mid-year population of women in age group}} .1000$$

See example Russian Federation in Table 7.1

Age specific fertility rates, Norway, selected years



NB SFT = Total Fertility Rate ("Samlet fruktbarhetstall")
Horizontal scale: age. Vertical scale: live births per 1000 women.

Total Fertility Rate (TFR)

TFR = sum, for all ages, of ASFR/1000

Average number of children a young girl eventually will have provided that current ASFR's remain constant, no mortality

When ASFR's are given for five-year intervals:

TFR = 5 x (sum, for all ages, of ASFR/1000)

Total Fertility Rate (TFR)

Period TFR : based on ASFR's observed in one particular year/period for women born in different years → synthetic measure

Cohort TFR: based on ASFR's for women born in one particular year/period, observed in different years → actual # children

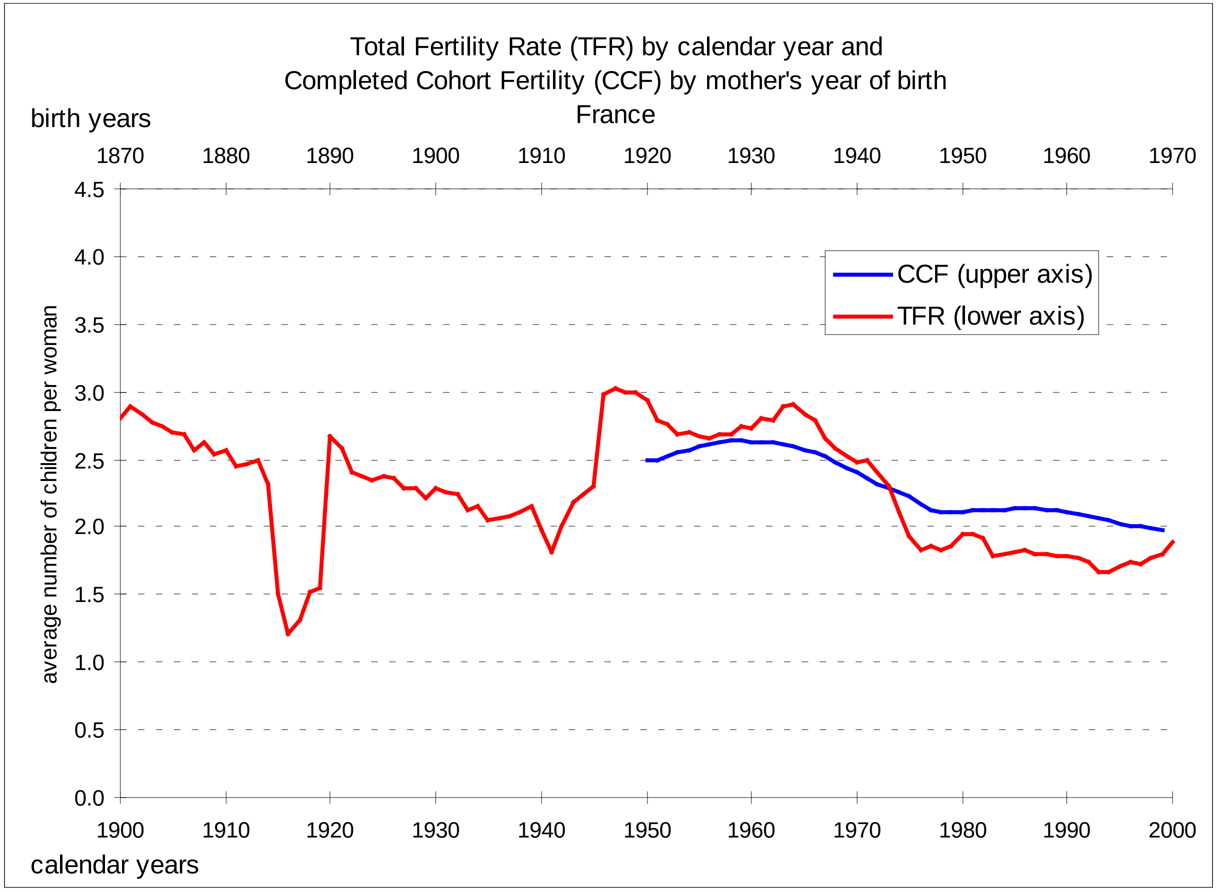
Cohort TFR also called Completed Cohort Fertility (CCF)

Period TFR synthetic measure

Period TFR's are poor predictors of the number of children a woman ultimately will have

Based on unrealistic assumption that ASFR's will remain constant over time

Period TFR influenced by postponement and catching up effects in the timing of births


Total Fertility Rate (TFR) by calendar year and
Completed Cohort Fertility (CCF) by mother's year of birth
France
birth years
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
average number of children per woman
CCF (upper axis)
TFR (lower axis)
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
calendar years

Gross Reproduction Rate (GRR)

GRR =

TFR x (proportion girls among live births)

Average number of daughters a woman will have when she experiences childbearing as given by the set of ASFR's that underly the TFR – ignoring mortality

Extent to which a group of women reproduces itself by daughters

Proportion girls among live births

Usually around 0.485 in Western countries

Lower in some developing countries

Net Reproduction Rate (NRR)

Takes mortality into account

Given: ASFR’s for one year

ASDR’s for women for one year

NRR = Average number of daughters a woman will have when she experiences childbearing and mortality as given by the set of ASFR’s and ASDR’s

Western countries: little difference between GRR and NRR

Developing countries: big differences

	GRR 1993	NRR 1993
Burkina Faso	3.50	2.41
United Kingdom	0.86	0.85

NRR = 1

Fertility is at replacement level

In the long run, population size wil become constant (ignoring migration)

NRR > 1 (< 1)

Fertility is over (under) replacement level

Long run: increasing (falling) population