1. Introduction & Crude Birth Rate

Welcome to the series of E-learning modules on Fertility, measurement of fertility-Crude Birth Rate, age-specific, general and total fertility rates.

At the end of this session, you will be able to:

- Explain the Fertility & measurement of fertility such as:
 - o Crude Birth Rate
 - Age-specific
 - General and total fertility rates

Let us start with an introduction:

In demography, the word fertility is used in relation to the actual production of children or 'occurrence of births, especially live births'.

Fertility must be distinguished from fecundity which refers to the capacity to bear children. In fact, fecundity provides an upper bound for fertility.

As a measure of the rate of growth of population, various fertility rates are computed. In the following section we shall discuss briefly some of the important rates which are usually computed to have an idea about the fertility in the relevant section of the population. Crude Birth Rate (CBR), General Fertility Rate (GFR), Specific Fertility Rate (SFR), Total Fertility Rate (TFR).

Let's discuss about the Crude Birth Rate (CBR).

The crude Birth rate method is the simplest of all the measures of fertility and consists in relating the number of live births to the total population.

This provides an index of the relative speed at which additions are being made through the child birth.

The fertility pattern of the above mentioned measure is given by Crude Birth Rate (CBR) defined as follows:

Crude Birth Rate is equal to total number of live births in the given region or locality during a given period t (Bt) divided by total population of the given region during the period t (Pt) multiplied by k a constant usually 1000.

Following are the merits:

- It is simple, easy to calculate and readily comprehensible.
- It is based only on the number of births (Bt) and the total size of the population (Pt) and does not necessitate the knowledge of these figures for different sections of the community or the population

Following are the demerits:

• The Crude Birth Rate, though simple, it is only a crude measure of fertility and is unreliable since it completely ignores the age and sex distribution of the population

- Crude Birth Rate is not a probability ratio, since the whole population cannot be regarded as exposed to the risk of producing children. It is only the female and the child bearing age group are exposed to risk and whole of the male population and female population outside the child-bearing age should be excluded from the total population.
- Due to variation in the climatic condition in various countries, the child bearing age groups are not identical in all the countries. In tropical countries, the period starts at an apparent earlier date than in countries with cold weather. Accordingly, Crude Birth Rate does not enable us to compare the fertility situations in different countries.
- Crude Birth Rate assumes that women in all the ages have the same fertility. This is an assumption which is not true since, younger women have, in general higher fertility than elderly women. Crude Birth Rate thus gives us an estimate of a heterogeneous figure and is unsuitable for comparative studies.
- The level of Crude Birth Rate is determined by a number of factors such as age and sex, distribution of population, fertility of the population, sex ratio, marriage rate, migration, family planning measures and so on. Thus, a relatively high crude birth rate may be observed in a population with a favourable age and sex structure even though fertility is low. That is, a population with large proportion of the individuals in the age-group of 15-49 years will have a high crude birth rate other things remaining same.

Note a point.

Crude Birth Rate usually lies between 10 and 55 per thousand. Since, it is only a live birth that augments the existing population only live births are considered in measuring fertility, thus excluding still births.

2. General Fertility Rate

Let us now discuss about General Fertility Rate.

This method calculates the total number of live births to the number of females in the reproductive or child bearing age and is given by the term general fertility rate.

The General Fertility Rate (GFR) is equal to number of live births occurring among the population of a given geographic area during a given period t, (Bt) divided by the total female population in the reproductive age, in the given geographical region during the same time t, (Σ fPx) into k a constant usually 1000. Thus, general fertility rate may be defined as the number of babies per k women in the reproductive age.

Following are the merits:

- General Fertility Rate is a probability rate since the denominator consists of the entire female population which is exposed to the risk of production
- General Fertility Rate reflects the extent to which the female population in the reproductive ages increases the existing population through live birth
- General Fertility Rate takes into account the sex distribution of the population and also the age structure to a certain extent

Following are the demerits:

- General Fertility rate gives a heterogeneous figure since it overlooks the age composition of the female population in the child bearing age. Hence, it suffers from the drawbacks of non-comparability in respect of time and country
- Two populations with altogether different general fertility rate may have the same fertility in each one year age group. This is due to the difference in the fecundity of the women according to the age groups since the females belonging to different child bearing age groups are not exposed to uniform risk of giving birth to babies

Note a point.

In India the fecundity of women is very low in the age group of 15-19 it increases very rapidly in the age group of 20-24 and signifies in the age group of 25-29 after which it defines. On the other hand, in USA it reaches the peak in the age group of 20-24 and thereafter declines.

Similarly, two populations with more or less the same General Fertility Rate may exhibit entirely different fertility status, since the proportion of young females in one may be quite different from the other.

3. Specific Fertility Rate

Let us discuss specific Fertility Rate.

The concept of specific fertility rate originated from the fact that fertility is affected by a number of factors such as age, marriage, migration, state or region etc. The fertility rate computed with respect to any specific factor is called specific fertility rate.

Specific fertility rate is defined as specific fertility rate is equal to number of births to the female population of the specific section in a given period divided by total number of female population in the specified section into k where k is equal to 1000 usually.

Let us now discuss about age specific fertility rate.

In order to overcome the drawback of the General fertility rate and get a better idea of the fertility situation prevailing in a community or locality it is necessary to compute the fertility rates for different age groups of reproductive age separately.

The fertility rate so computed on the basis of specification say, age is called age specific fertility rate, for its computation, the reproductive span is split into different sub groups and specific fertility rate is worked out for each sub group.

Symbolically the age specific fertility rate for the age group x to x+n is denoted by n of i of x is given by the formula age specific rate is equal to number of births to the females in age group x to x+n where in the age is greater or equal to x but less than x+n in the given geographic region during a period $({}_nB_x)$ divided by average female population of ages x to x+n in the given area during the period $({}_nfP_x)$ into k.

If we take n=1 then, we get the annual age specific rate as given Age specific rate($_ni_x$) is equal to number of births to the females in age group x to x+n where in the age is greater or equal to x but less than x+n in the given geographic region during a period (B_x)divided by average female population of ages x to x+n in the given area during the period (fP_x) into k.

Make a Note.

In computation of age specific fertility rate, the female population in the child bearing age group is placed in small age groups so as to put them in common with other as the child bearing capacity of women for different age groups have different capacity to bear children.

Fertility data for different countries show that generally specific fertility starts from a low point, rises to a peak somewhere between 20 and 29 years of age and after that decline steadily. The age specific fertility curve is therefore a highly positive skewed curve.

Following are the merits.

Age specific fertility rate is a probability rate. It removes the drawback of General fertility rate by taking into account the age composition of the women in the child bearing age group and is thus suitable for comparative studies.

Following are the demerits.

The drawback of this rate is that the age specific fertility rate will be higher for certain age group and lower for certain age groups in one region than in the other. Hence, there is difficulty in comparison between regions as the fertility may be higher or low in one region compared to the other.

4. Total Fertility Rate

Let us now discuss about Total Fertility Rate.

Age specific fertility rate is not of much practical utility for comparative purposes. In order to arrive at more practical measure of the population growth, the age specific fertility rates for different groups have to be combined together to give a single quantity.

A simple technique is to obtain standardized fertility rate.

This leads to Total Fertility Rate which can be obtained by adding the Annual Age specific fertility rate.

We can represent this by an equation as shown below,

Total Fertility Rate is equal to Summation tending from lambda 1 to lambda 2 of 'i' of x which is equal to Summation (tending from Lamba 1 to Lambda2) – (B of x) that is the number of births divided by ('f' of 'P' of 'x') that is the total of the female population multiplied by 'k' Lambda1 and Lambda2 are the lower and upper limits of the female productive period. Thus, the Total Fertility rate gives the number of children born per 'k' females in the child bearing age divided into different age groups.

Total Fertility Rate for a particular region during a given period may be regarded as an index of the overall fertility conditions operating in that region during the same period. Usually Lambda1 is equal to 15 and Lambda 2 is equal to 49.

This means that the interval between the two limits (34) is the number of age specific fertility rates that we need to calculate for obtaining the Total fertility rate.

In order to generalise the same we can define the intervals as a range from 'x' to 'x plus n' where in general 'n' is the width of interval and may vary from one group to the other. Thus, we can find the Total Fertility rate is approximately given by the below formula,

TFR is equal to Summation of 'x' of 'n' multiplied by 'n' of 'i' of 'x'. Where, the summation is taken over different age groups in the reproduction period.

If we deal with age group, i.e., n is equal to 5 for each class then,

Total Fertility Rate is equal to summation of 'x' of 5 multiplied by (5 of 'i' of 'x') which is equal to 5 multiplied by Summation of x of 5 of 'i' of 'x'.

Thus, the calculation of Total Fertility Rate based on age group requires only one fifth of the arithmetic as compared to the Total Fertility Rate based on single age groups and this method is much more accurate than other methods.

Make a note of it:

- 1. TFR is a hypothetical figure giving the number of children born to a unit of k equal to 1000 females with the following assumptions
 - > None of them die before reaching the end of the child bearing age i.e. all of them

live till at least the age of 50 years

- At each of the age group in the child bearing age, they are subject to the fertility conditions given by the observed age specific fertility rate
- 2. If the number of women at each age is decreasing and the age-specific fertility rate is increasing then the total fertility rate obtained from the data expressed in groups of five years is lower than the actual value and if the fertility rate is decreasing, the age specific resulting value of Total Fertility Rate will be higher than the actual one. This is also true for the Gross Reproduction Rate (GPR) and the Net Reproduction Rate (NPR)
- 3. 'n of 'i' of 'x' is the age specific fertility rate for the age group 'x' to 'x plus n' and it implies that 'k' females aged 'x' would by the time they reach the age 'x plus n' have born (n of I of x) multiplied by 'n' children.

The reason why we multiply by 'n' is that the specific fertility rate is a Rate per annum and by the time they reach the age 'x plus n', the women would have spent 'n' years in the age group 'x' to 'x plus n'

5. Example

Let us take an example to understand the calculation of the general fertility rate, specific fertility rate and the total fertility rate.

Compute the GFR, SFR and TFR from the data given below:

- The first column showing the age of the population in years and sub grouped as 15-19, 20-24, and so on up to 45-49
- The second column showing the number of women in each sub group
- And the third column shows the number of births in each subgroup

Age group of child bearing females	Number of women (`000)	Total Births
15 - 19	16.0	260
20 -24	16.4	2244
25 – 29	15.8	1894
30 -34	15.2	1320
35 – 39	14.8	916
40 - 44	15.0	280
45 - 49	14.5	145

Figure 1

Assume that the proportion of female births is 46.2%.

Let us look at the solution:

Let us calculate the general fertility rate first for which we will take the table and total the columns.

- The second column showing the number of women in each sub group and the total of this column comes to 1 lack, 7 thousand and 700
- > The third column shows the number of births in each subgroup with a total of 7059

Figure 2

Age group of child bearing females	Number of women (`000)	Total Births
15 – 19	16.0	260
20 -24	16.4	2244
25 – 29	15.8	1894
30 -34	15.2	1320
35 – 39	14.8	916
40 - 44	15.0	280
45 - 49	14.5	145
Total	107.7	7059

Let us calculate the general fertility rate.

The general fertility rate is equal to summation of number of birth divided by the summation of the female population into 1000 is equal to 7 thousand 59 divided by 1 lakh 7 thousand 700 is equal to 65.5,4,3 per thousand.

Next, we will calculate the age specific fertility rate.

Figure 3

Age group of child bearing females	Number of women (`000)	Total Births	Age SFR
15 – 19	16.0	260	16.25
20 -24	16.4	2244	136.83
25 – 29	15.8	1894	119.87
30 -34	15.2	1320	86.84
35 – 39	14.8	916	61.89
40 - 44	15.0	280	18.67
45 - 49	14.5	145	10.00
Total	107.7	7059	450.35

The age specific fertility rate is to equal number of births in each group divided by the total population on that specific group into 1000 which is equal to 16.25 for the first sub group 15-19,

And subsequently, 136.83, 119.87, 86.84, 61.89, 18.67, 10.00 and the summation is 450.35.

Next, we will calculate the total fertility rate.

The total fertility rate is equal to 5 into summation of the age specific rate is equal to 5 into 450.35 is equal to 2251.75 per thousand.

Here's a summary of our learning in this session, where we have understood:

- The concept of Fertility and measurement of fertility such as:
 - o Crude Birth Rate
 - Age-specific
 - General and total fertility rates