Statistical Demography

❖ **Demography**: The term demography is made up of two words: "Demos", which means "population", and "-graphy", which means "describe."

One can then say that demography is the science that researches and describes a population. The study of the components of change in the population. These components are also called population dynamics, i.e. births (الولادات), deaths (الوفيات) and migration (الهجرة).

By statistical: using the language of probability and statistical modeling for the population processes.

❖ Sources of Population Data:

Demographic data usually consist of data on age (العمر), occupation(العمر), religion(الدين), marital status (الحالة الاجتماعية), e.t.c.

The collection and analysis of demographic data is usually

1. Census (التعداد السكاني)
2. Biostatistics (الاحصاء الحيوي)
3. Civil registration (التسجيل المدني)
4. Immigration statistics (احصاء الهجرة)
5. Other sources : records of schools, universities, laboratories, and companies (مصادر اخرى مثل: المدارس والجامعات المعامل والشركات)

❖ Benefits of statistical demography (فوائد دراسة الاحصاء السكاني)

demographic statistics, plays a crucial role in understanding and analyzing the population characteristics of a given area or group. Here are some simple points highlighting the benefits of statistical demography:

1. Population Understanding: (فهم السكان)

Statistical demography helps in understanding the size, structure, and distribution of populations. This includes factors such as age, gender, ethnicity, and geographic location.

تساعد الديموغرافيا الإحصائية في فهم حجم السكان وبنيتهم وتوزيعهم. ويشمل ذلك عوامل مثل العمر والجنس والعرق والموقع الجغرافي.

2. Policy Planning: (تخطيط السياسات)

Governments and organizations use demographic data to plan and formulate policies related to healthcare, education, housing, and social services. Knowing the demographic composition helps in allocating resources effectively.

تستخدم الحكومات والمنظمات البيانات الديموغرافية لتخطيط وصياغة السياسات المتعلقة بالرعاية الصحية والتعليم والإسكان والخدمات الاجتماعية. إن معرفة التركيبة السكانية يساعد في تخصيص الموارد بشكل فعال.

3. Economic Planning: (تخطيط الاقتصادي)

Businesses and policymakers use demographic information to make informed decisions about economic development, market research, and workforce planning. It aids in identifying potential markets and understanding consumer behavior.

تستخدم الشركات وصناع السياسات المعلومات الديموغرافية لاتخاذ قرارات مستنيرة بشأن التنمية الاقتصادية وأبحاث السوق وتخطيط القوى العاملة. فهو يساعد في تحديد الأسواق المحتملة وفهم سلوك المستهلك.

4. Healthcare Planning:

Demographic data is crucial for healthcare planning, allowing for the identification of health trends, disease prevalence, and the allocation of healthcare resources based on population needs.

عد البيانات الديموغرافية أمرًا بالغ الأهمية لتخطيط الرعاية الصحية، مما يسمح بتحديد الاتجاهات الصحية وانتشار الأمراض وتخصيص موارد الرعاية الصحية بناءً على احتياجات السكان.

5. Education Planning: (تخطيط التعليم)

Educational institutions use demographic statistics to plan for future student enrollment, allocate resources, and design programs that cater to the needs of specific age groups and demographics.

تستخدم المؤسسات التعليمية الإحصاءات الديموغرافية للتخطيط لالتحاق الطلاب في المستقبل، وتخصيص الموارد، وتصميم البرامج التي تلبي احتياجات الفئات العمرية والديموغرافية المحددة.

6.Urban Planning (التخطيط العمراني)

City planners use demographic data to design and develop urban areas. This includes infrastructure planning, housing development, and transportation systems tailored to the needs of the population.

يستخدم مخططو المدن البيانات الديموغرافية لتصميم وتطوير المناطق الحضرية. ويشمل ذلك تخطيط البنية التحتية، وتطوير الإسكان، وأنظمة النقل المصممة خصيصًا لتلبية احتياجات السكان.

❖ Age, gender and economic composition of the population:
التركيب العمري والنوعي والاقتصادي

the importance of age, gender, and economic composition in understanding a population:

1. Age Composition (التركيب العمري)

The age composition of a population provides insights into the distribution of individuals across different age groups.

It helps in understanding the demographic structure and can influence social, economic, and healthcare policies.

A high proportion of young people may indicate a growing workforce, potential for economic development, and increased demand for education and family services.

An older population may require adjustments in healthcare and social security systems due to increased healthcare needs and retirement considerations.

يوفر التركيب العمري للسكان نظرة ثاقبة لتوزيع الأفراد عبر الفئات العمرية المختلفة. فهو يساعد في فهم البنية الديموغرافية ويمكن أن يؤثر على السياسات الاجتماعية والاقتصادية والرعاية الصحية.

قد تشير نسبة عالية من الشباب إلى تزايد القوى العاملة، وإمكانات التنمية الاقتصادية، وزيادة الطلب على التعليم والخدمات الأسرية.

قد تتطلب شيخوخة السكان تعديلات في أنظمة الرعاية الصحية والضمان الاجتماعي بسبب زيادة احتياجات الرعاية الصحية واعتبارات التقاعد.

2. Gender Composition : (تكوين الجنس)

Gender composition refers to the distribution of males and females within a population.

It is crucial for identifying gender-related issues and tailoring policies to address gender-specific needs.

Understanding gender distribution is essential for promoting gender equality in various sectors such as education, employment, and healthcare.

يشير التركيب الجنسي إلى توزيع الذكور والإناث ضمن السكان.

وهو أمر بالغ الأهمية لتحديد القضايا المتعلقة بالجنسين وتصميم السياسات لتلبية الاحتياجات الخاصة بالجنسين.

يعد فهم التوزيع بين الجنسين أمرًا ضروريًا لتعزيز المساواة بين الجنسين في مختلف القطاعات مثل التعليم والتوظيف والرعاية الصحية.

3. Economic Composition (التركيب الاقتصادي)

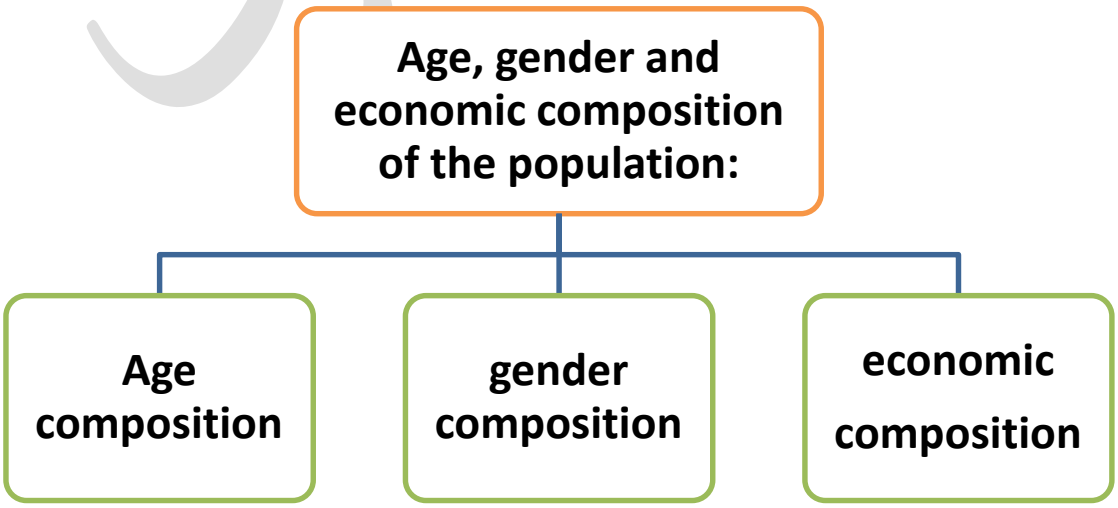
Economic composition focuses on the distribution of individuals based on their economic activities, income levels, and employment status.

It is vital for economic planning, resource allocation, and poverty reduction strategies.

يركز التكوين الاقتصادي على توزيع الأفراد على أساس أنشطتهم الاقتصادية ومستويات الدخل والوضع الوظيفي.

وهو أمر حيوي للتخطيط الاقتصادي، وتخصيص الموارد، واستراتيجيات الحد من الفقر.

What came after can be summarized in the following diagram:



❖ Population pyramid (الهرم السكاني)

It is defined as a graphic form that shows the age and gender structure of the population. Its images reflect the population at a stage in its demographic history, as it were a century ago. Through the population pyramid, the events that occurred in the population, such as disasters, wars, and economic times, leave their effects in the shape of the population pyramid, and we reflect the state of the population from a period of youth, maturity, or old age.

يعرف على انه شكل بياني يوضح التركيب العمري والنوعي للسكان ويعكس صوره المجتمع السكاني لمرحلة من تاريخة الديمغرافي كأن يكون قرن من الزمن . ومن خلال الهرم السكاني ان الاحداث التي مرت بالمجتمع السكاني من الكوارث والحروب والازمان الاقتصادية التي تترك أثارها على شكل الهرم السكاني ونعكس حالة السكان من فترة شباب أو نضج أو شيخوخة.

The population pyramid or species pyramid is usually drawn as follows:

1. Placing the male population on the left and the female population on the right.

2. The young are placed at the bottom of the population pyramid and the elderly are at the top

Population, ages can be expressed either annually or every five years. The figure (1-1) shows the population pyramid for five different years in Libya as follows:

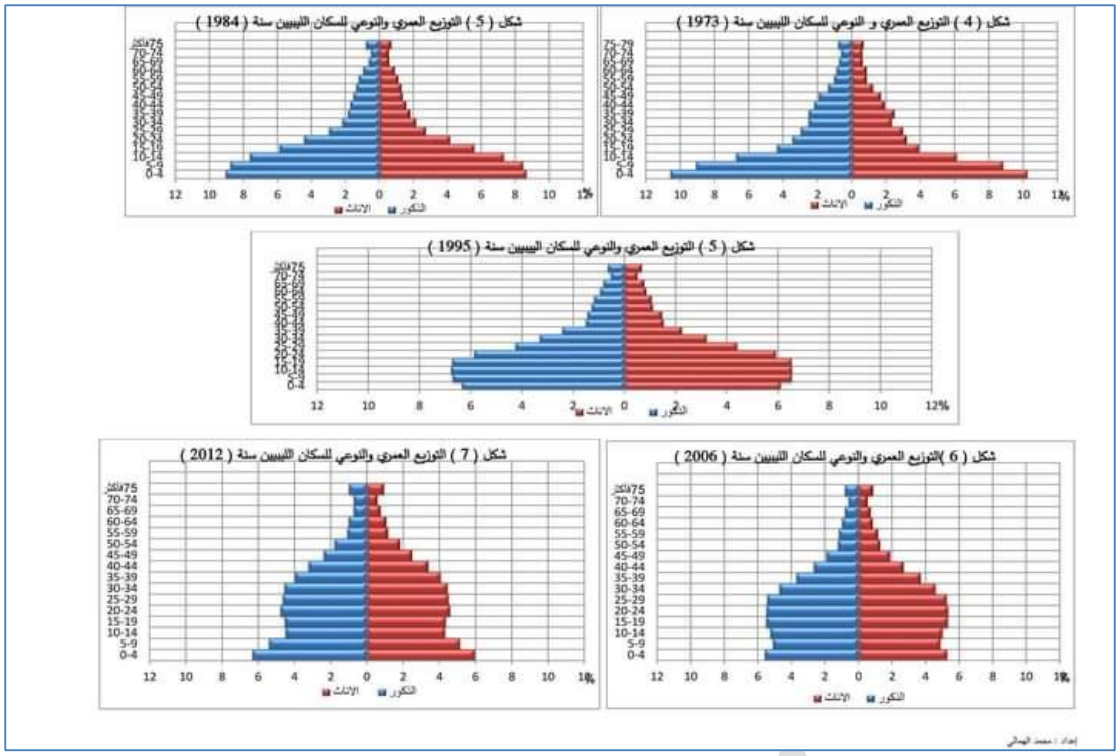


Figure (1-1) : Population pyramid for five years

By observing Figure (1-2), which expresses the population pyramid of Iraq, it indicates that the majority of the population of Iraq are children and young people between newborns - 14 years old and 15-24 years old. Together, they constitute a total of about 60% of the population of about 40 million people, and those aged 50 years and above do not exceed 12% of the total population. This means that Iraq is considered a demographically young country.

من خلال ملاحظة الشكل (١-١) والذي يعبر عن الهرم السكاني للعراق يشير إلى أن غالبية سكان العراق هم من الأطفال والشبيبة ما بين حديثي الولادة - 14 سنة و 15-24 سنة ويشكلون هؤلاء مجتمعين ما مجموعه حوالي 60 % من عدد السكان البالغ حوالي 40 مليون نسمة وأن الذين أعمارهم من 50 سنة فما فوق لا تتجاوز نسبتهم 12% من مجموع السكان. هذا يعني ان العراق يعتبر دولة فتية سكانيا .

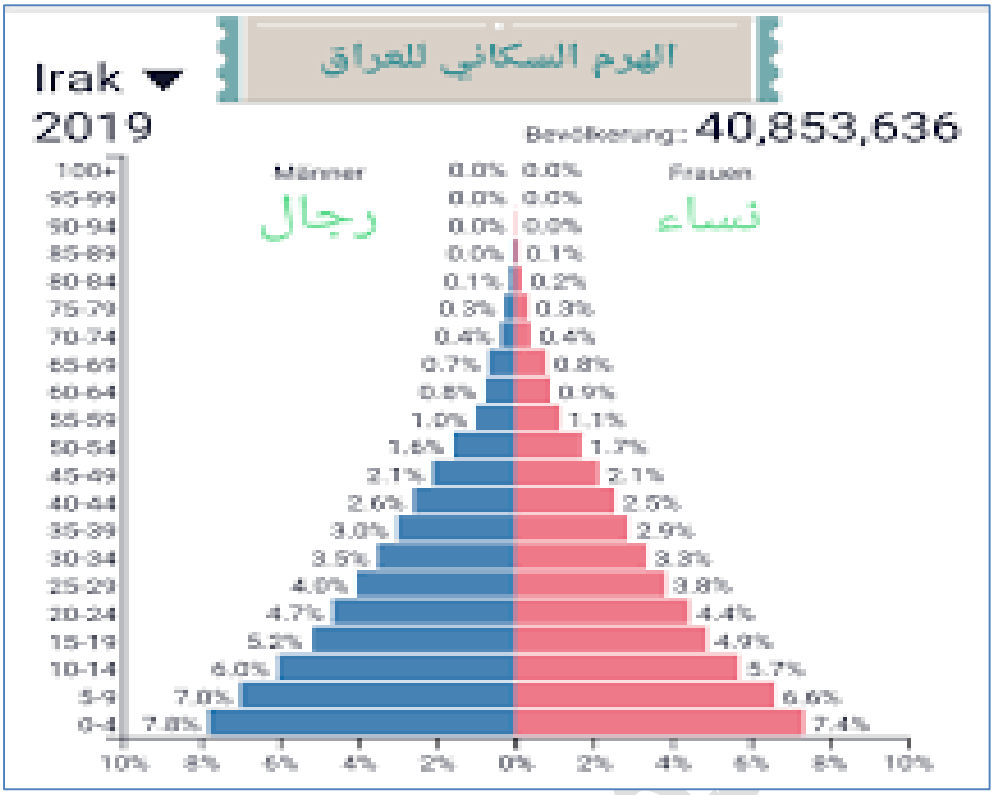


Figure (1-2): Population pyramid of Iraq

ERRORS IN DEMOGRAPHIC DATA:

The accuracy of demographic statistics varies from one country to another. That happened, because of lack of administrative machinery, individual ignorance about certain personal details

Errors in the demographic data are mainly of two types, namely, coverage and content errors.

1. **Coverage Errors** (خطأ التغطية) : are due to persons being missed, Individual of a given age may have been missed by the census officials, this type is called **under enumeration**, while the second type represents **over enumeration**, counted more than once (i.e. counted twice).
2. **Content Errors** in demographic data refer to inaccuracies arising during the reporting, tabulation, and compilation of information. The primary sources of content errors include:
   a. **The respondent** (المستجيب): Mistakes made by individuals providing information, whether intentional or unintentional.
   الأخطاء التي يرتكبها الأفراد الذين يقدمون المعلومات، سواء بقصد أو بغير قصد

b. **The enumerator** (العدّاد)- where he/she classifies a person incorrectly even though give the correct information.
حيث يقوم بتصنيف شخص ما بشكل غير صحيح على الرغم من تقديم المعلومات الصحيحة.

c. **The coding process** (خطا الترميز)- errors caused from the failure to allocate information on the census or survey schedule to the proper code.
الأخطاء الناتجة عن الفشل في تخصيص المعلومات الخاصة بجدول التعداد أو المسح بالرمز المناسب.

d. **he editing process (خطأ عملية التحرير)** : Errors introduced during the editing process, which involves reviewing and correcting data for consistency and accuracy.
الأخطاء التي تحدث أثناء عملية التحرير، والتي تتضمن مراجعة البيانات وتصحيحها للتأكد من اتساقها ودقتها.

e. **Errors may arise at all stage** of the compiling process or during tabulations.
قد تنشأ أخطاء في جميع مراحل عملية التجميع أو أثناء الجدولة.

❖ Demographic indicators:

It aims to measure the frequency of occurrence of vital events (births, deaths, marriage, divorce, migration) that are recorded in a particular society regularly throughout the year. This measurement is taken in a year for a specific period of time, which is often a year.

1. **Crude rates**:

Crude death rates can be calculated using the following formula:

$$\mu_{death} = \frac{D}{\bar{P}} * k$$

Where

$$\bar{P} = \frac{P_1 + P_2}{2}$$

μ_{death}: crude death rates
D: Death rate during the year
$\bar{P}$: number of the population in the middle of the year
k: is constant (mostly 1000)

While the crude birth rate, it can be calculated as follows:

$$\mu_{brith} = \frac{B}{\bar{P}} * k$$

Where

B: birth rate during the year

Note that this rate represents the frequency of births per person per year, and is often expressed as the number of births per 1,000 populations. Crude rates can be calculated for the population of one country or for the population of any geographic region.

By calculating the difference between the crude birth and death rates, **The Crude Rate of Natural Increase** can be obtained, as follows:

$$NI = \left(\frac{B}{\bar{P}} - \frac{D}{\bar{P}}\right) * 1000$$

$$= \frac{(B - D)}{\bar{P}} * 1000$$

2. Special rates:

It is known that the probability of death, marriage, divorce, etc. is not the same degree for all individuals in society, and these probabilities depend on a number of factors, the most important of which are age and gender.

Mortality has less impact on average work, and it is different for males than it is for females. Marriage and childbearing are related to age, and marriage divides society into homogeneous groups.

We call these rates the **special rates**. The special rates can be calculated according to the available statistics as follows:

$$\mu_x = \frac{D_x}{P_x} * k$$

μ_x: Age-specific death rate *x*

D_x: Number of deaths within the age group *x*

P_x: Population mean (population) for age group number *x*

k: is constant (mostly 1000)

We can be calculated the age specific birth rate as the same way as follows:

$$\mu_x = \frac{B_x}{P_x} * k$$

μ_x: Age-specific birth rate *x*
D_x: Number of birth within the age group *x*

3.Standard rate:

A standard rate, often used in demographic and epidemiological studies, is a rate that has been adjusted or standardized to account for differences in age, sex, or other relevant factors between populations. Standardization allows for fair comparisons between groups or populations with different demographic compositions. The two common types of standardization are:

1. Age-Standardized Rate: Adjusts for differences in age distribution between populations. This is particularly important when comparing health outcomes or mortality rates across populations with varying age structures.

لمعدل الموحد للعمر: يضبط الاختلافات في التوزيع العمري بين السكان. وهذا مهم بشكل خاص عند مقارنة النتائج الصحية أو معدلات الوفيات بين السكان ذوي الهياكل العمرية المختلفة.

2. Sex-Standardized Rate: Adjusts for differences in sex distribution when comparing rates between populations with different gender compositions.

المعدل الموحد للجنس: يضبط الاختلافات في توزيع الجنس عند مقارنة المعدلات بين السكان ذوي التركيبات الجنسية المختلفة.

The standardization process involves applying weights to different age or sex groups to create a standardized rate that reflects the hypothetical rate that would exist if the populations being compared had the same demographic structure.

تضمن عملية التوحيد تطبيق الأوزان على مجموعات عمرية أو جنسية مختلفة لإنشاء معدل موحد يعكس المعدل الافتراضي الذي قد يكون موجودًا إذا كان السكان الذين تتم مقارنتهم لديهم نفس التركيبة الديموغرافية.

There are two methods for finding standard rates:

1. **Direct method**: This method boils down to choosing one of the population communities as a standard, and considering the relative distribution by age of the population of this community as weights that outweigh the rates of the actual community.

In mortality (death) rates, for example, the standard mortality rate is extracted in the following formula:

$$R_{death} = \sum \mu_x^o w_x^s$$

And

$$w_x^s = \frac{P_x^s}{\sum P_x^s}$$

Where:

R_{death}: Direct standard death rate

μ_x^o: The death rate for the actual population

w_x^s: The weights with which the rates of the actual population are given

Example 1:

In the following table showing the death rates for the actual population and the population in the standard population for the same age groups, find the standard death rate using the direct method.

age categories	the death rates for the actual population(μ_x^o)	the population in the standard population(P_x^s)	w_x^s	$\mu_x^o w_x^s$
-35	0.0047	27242	0.355	0.0017
35-44	0.0071	23971	0.312	0.0022
45-54	0.0146	14247	0.186	0.0027
55-64	0.0285	7472	0.097	0.0028
56-	0.053	3811	0.050	0.027
Sum.		76743		0.0364

Solution:

$$w_x^s = \frac{P_x^s}{\sum P_x^s}$$

$$w_{35}^s = \frac{P_{35}^s}{\sum P_{35}^s} = \frac{27242}{76743} = 0.355$$

$$w_{44}^s = \frac{P_{44}^s}{\sum P_{44}^s} = 0.312$$

:

Then

$R_{death} = \sum \mu_x^o w_x^s = 0.0364$

2. **Indirect method (rate):** This method is used when the gender and age distribution and the total vital events of the population in the actual community match. This method is summed up by obtaining the estimated number of vital events prevailing in the standard community E^s, by summing the result of multiplying the total age population in the actual community P_x^o by the corresponding standard rates μ_x^s , i.e.

$$E^s = \sum P_x^o \, \mu_x^s$$

By dividing the total number of events that actually took place in the actual society E^o by the estimated number of these events E^s, we obtain an indicator *(I)* that expresses the difference between the demographic experience in the actual and standard societies, which is due to age or something else.

$$I = \frac{E^o}{E^s} = \frac{\sum P_x^o \mu_x^o}{\sum P_x^s \mu_x^s}$$

By multiplying this indicator by the standard raw rate, we obtain the standard rate by the indirect method

$$Ri_{death} = I * \mu^s$$

$$= \frac{E^o}{E^s} * \mu^s$$

$$Ri_{death} = \frac{\sum P_x^o \mu_x^o}{\sum P_x^s \mu_x^s} * \mu^s$$

Where:

E^o: the number of events in actual population

E^s: the estimated number of events in standard population

μ^s: the crude rate in standard population

Example 2:

The following table shows the distribution of the population in the actual population and the standard death rates by age groups. If you assume that the number of actual deaths in the actual population E^o= 1055 and the crude death rate in the standard country μ^s= 0.0091 , find the standard death rate using the Standard indirect method.

age categories	the population in the standard population(P_x^s)	the death rates for the actual population(μ_x^o)	$E^s = \sum P_x^o \mu_x^s$
-35	7068	0.0021	14.84
35-44	9614	0.0032	30.76
45-54	9537	0.0076	72.48
55-64	7453	0.0219	163.22
56-	4242	0.0777	329.60
Sum			610.9129

$$Ri_{death} = \frac{\sum P_x^o \mu_x^o}{\sum P_x^s \mu_x^s} * \mu^s$$

$$= \frac{1055}{610.9129} * 0.0091 = 0.0157$$

❖ **Measures of the gender and age composition of the population**

Measures of the gender and age composition of the population

1. The ratio of gender

There are three types of this ratio:

a. The ratio of males:

$$R_m = \frac{P_m}{P} * 100$$

b. The ratio of females:

$$R_f = \frac{P_f}{P} * 100$$

c. The ratio of the gender as a whole:

$$R = \frac{P_m}{P_f} * 100$$

2. The ratio of age:

This ratio is considered one of the basic indicators that can be calculated based on the type of population by age and gender, and is calculated as follows:

$$A_x = \frac{P_x}{\frac{1}{2}\left[P_{(x+n)} + P_{(x-n)}\right]} * 100$$

Where **n** is the length of class (category)

3. Dependency ratio:

The dependency ratio for any society depends on the fact that every member of society is a consumer of its material goods, but only a part of it contributes to the production of these goods.

The proportion of countries in which the proportion of the population that participates in the production of goods and services is high is better off from an economic standpoint than the other country in which this proportion is lower.

In agricultural societies, workers are widespread at an early age, and in other societies, the elderly contribute to production, while in some countries the elderly are not allowed to work, and therefore demographers have suggested expressing the population between the ages of 15 - 59 as the working age.

ان نسبة الاعالة لأي مجتمع تعتمد على حقيقة ان كل فد في المجتمع مستهلك لخيراته المادية، ولكن جزء منه فقط يساهم في انتاج هذه الخيرات. ان نسبة البلاد التي ترتفع فيه نسبة السكان الذين يشاركون في انتاج السلع والخدمات هم افضل حالا من الناحية الاقتصادية من البلد الاخر تقل فيه هذه النسبة.

ففي المجتمعات الزراعية ينتشر فيها العمال في سن مبكر، وفي مجتمعات اخرى يساهم كبار السن في الانتاج، بينما في بعض البلدان لا يسمح لكبار السن بالعمل، ولذلك فقد اقترح الديمغرافيين بالتعبير عن السكان من سن 15-59 بسن العمر.

There are three types of dependency ratios:

1. Total dependency ratio

$$Total\ dependency\ ratio = \frac{Number\ of\ nonworking\ age\ population\ (less\ than\ 15\ +\ more\ than\ 60\ years)}{The\ number\ of\ working-age\ population\ (between\ 15-59)\ years} * 100$$

2. Dependency ratio for the children

$$Dependency\ ratio\ for\ the\ children = \frac{Number\ of\ children\ under\ 15\ years\ of\ age}{The\ number\ of\ working-age\ population\ (between\ 15-59) years} * 100$$

3. Dependency ratio for the elderly

$$Dependency\ ratio\ for\ the\ elderly = \frac{Population\ aged\ 60\ years\ and\ older}{the\ number\ of\ working-age\ population\ (between\ 15-59) years} * 100$$

Example 3:

The following table shows the number of males and the number of females in a population, according to age groups, find:

1. The ratio of gender
2. Dependency ratio

age categories	No. male	No. female
0-4	5420	4420
5-9	3790	3800
10-14	5320	5430
15-19	2240	2800
20-24	3925	3950
25-29	3540	3640
30-34	3990	4000
35-39	4540	4670
40-44	5500	5800
45-49	5600	5730
50-54	5420	5600
55-59	5320	5475
60-	4990	5040
sum	59595	60355

Sol.

1. The ratio of gender

The total numbers of the population = No. male + no. female

Total = 59595 + 60355

= 119950

a. The ratio of males:

$$R_m = \frac{P_m}{P} * 100$$

$$= \frac{59595}{119950} * 100 = 49.6832\%$$

b. The ratio of females:

$$R_f = \frac{P_f}{P} * 100 = \frac{60355}{119950} * 100 = 50.3168\%$$

c. The ratio of the gender as a whole:

$$R = \frac{P_m}{P_f} * 100 = \frac{59595}{60355} * 100 = 98.74078\%$$

2. Dependency ratio

a. Total dependency ratio

$$total = \frac{less\ than\ 15 + greater\ than\ 60}{The\ number\ of\ working - age\ population\ (between\ 15 - 59)\ years}$$

$$= \frac{5420 + 3490 + 5320 + 4990 + 4420 + 3800 + 5430 + 5240}{2240 + 3925 + \cdots + 5320 + 2800 + 3950 + .. + 5475} * 100$$

$$= \frac{33410}{76700} * 100 = 43.55932\%$$

b. Dependency ratio for the children **(homework)**

$$Dependency\ ratio\ for\ the\ children = \frac{Number\ of\ children\ under\ 15\ years\ of\ age}{The\ number\ of\ working-age\ population\ (between\ 15-59)years} * 100$$

$$= \frac{5420 + 3790 + 5320 + 4420 + 3800 + 5430}{79254} * 100$$

$$= \frac{28180}{79264} * 100 = 35.5\%$$

c. Dependency ratio for the elderly **(homework)**

$$Dependency\ ratio\ for\ the\ elderly = \frac{Population\ aged\ 60\ years\ and\ older}{the\ number\ of\ working-age\ population\ (between\ 15-59)years} * 100$$

$$= \frac{4990 + 5040}{79264} * 100 = 12.65\%$$

❖ Demographic error measures:

It was mentioned previously that some age errors are due to some individuals, preference for ages ending in certain numbers over others, such as zero and five, and also even numbers, which leads to a concentration of the population at these preferred ages.
Consequently, this leads to errors in the age distribution, and some methods have been proposed to measure this bias, including the following:

1. Whipple's Index of Digit Preference

This index is limited to measuring the degree of preference for ages that end in zero or five, in the age range from 23 to 62. The formula of the scale is:

we obtain this number by dividing the total number of people with ages ending in one of the numbers 0 or 5 by (1/ the ratio is the preferred numbers) of the total number of people from the ages of 23 to 62.

$$Weibull\ measurement = \frac{The\ total\ population\ with\ ages\ ending\ at\ 0-5\ in\ the\ range}{1/\text{ratio} * The\ total\ population\ in\ the\ age\ range(23-62)} * 100$$

The value of the Weibull scale ranges from 100 to 500. If the value is 100 as a minimum (then there is unbiased (no focus) on ages ending in 0 or 5, and a maximum of 500 (then there is a complete bias for ages ending in 0 or 5)

In general, the following division reveals the extent of accuracy in:
Provide a statement of age:
Less than 105 very accurate

- 105-109.9 accurate
- 110-124.9 is almost correct
- 125-174.9 is inaccurate
- more than 175 is completely inaccurate

The Weibull number is considered an effective measure of the accuracy of ages, as it enables us to reveal the preference of some numbers and is easily calculated, but the main flaw in this indicator is that it only measures the preference of numbers, and it only reveals preference for the numbers 0 and 5.

Note: if we want to count the 0 and 5, then the ratio is 1/5, but 0 only or 5 only , then it is 1/10

Example:

Using age distribution data for a West African country (1960), determine the extent of heaping on

(a) Digit '0' and '5'.

(b) Digit '0' only

(c) Digit '5' only.

age	population	age	population
23	38687	45	44654
24	51289	46-49	77102
25	77141	50	52024
26-29	201450	51-54	44751
30	110379	55	14024
31-34	132136	56-59	45283
35	64091	60	38377
36-39	134140	61	4779
40	81515	62	7866
41-44	84422	sum	1304110

Solution:

This table has the numbers of the favorite age 0 or 5 as follows:

Age	Population
25	77141
30	110379
35	64091
40	81515
45	44654
50	52024
55	14024
60	38377
Sum	482205

Weibull measurement

$$= \frac{The\ total\ population\ with\ ages\ ending\ at\ 0-5\ in\ the\ range}{1/\text{ratio} * The\ total\ population\ in\ the\ age\ range(23-62)} * 100$$

a. Digit ‘0’ and ‘5’.

$$= \frac{482205}{\frac{1}{5} * \ 1304110} * 100 = 185.1$$

The measurement is completely inaccurate

b. Digit '0' only

$$= \frac{282295}{\frac{1}{10} * 1304110} * 100 = 216.5$$

The measurement is completely inaccurate

c. Digit '5' only.

$$= \frac{199910}{\frac{1}{10} * 1304110} * 100 = 153.3$$

The measurement is inaccurate

2. Myer's Blended Index of Digit Preference

This index is used for evaluating single - year age - sex data. It can give the extent of digit preference for all the digits 0, 1, 2, 3... 9. It can be used to report errors for all ages 10 – 99 years.

The underlying assumption of the method is that in the absence of systematic irregularities in the reporting of age, the blended sum at each terminal digit should be approximately equal to 10% of the total blended population.

If the sum at any given digit exceeds 10% of the total blended population, it indicates over selection of ages ending in that digit (i.e. digit preference).

On the other hand, a negative deviation or sum that is less than 10% of the total blended population indicates an under selection of the ages ending in that digit (i.e. digit avoidances).

If age heaping is non-existent, the index would be approximately zero.

Example

Use the Myer's blended index to assess the quality of age data given below:

Digit	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
0	386	417	307	190	89	80	50	40	10
1	133	93	90	89	41	35	33	10	2
2	341	227	100	40	30	25	15	6	4
3	223	160	90	46	28	22	8	5	1
4	201	138	50	38	25	10	8	5	3
5	298	238	201	154	148	65	25	2	3
6	198	105	70	49	31	18	12	6	4
7	166	86	50	45	25	9	5	4	2
8	255	100	90	40	28	10	5	5	2
9	132	85	40	20	8	6	2	2	2

1. Sum all the populations ending in each digit over the whole range i.e. 10-99
2. Sum figures between ages 20-99.
3. Multiply the sums in (1) by coefficients; 1, 2, 3,4,5,6,7,8,9 and 10.
4. Multiply the sums in (2) by coefficients from 9 descending to 0 i.e. 9 ,8 ,7, 6, 5 ,4 ,3 ,2 ,1 ,0.
5. Add the product of (3) and (4), to obtain the blended sum
6. Add up the blended sum in (5).
7. Find the percent (%) of the total blended sum at different digit ends.
8. Take the deviations of each % in (7) from 10.0. This result indicates the extent of concentration or avoidance of a particular digit.

Digit	Sum (10 – 99	Coef-ficient	Product	Sum (20-99)	Coef-ficient	Product	Blended sum	Percent dist	Dev from 10%	Remark
0	1569	1	1569	1183	9	10647	12216	21.7	11.7	Preference
1	526	2	1052	393	8	3144	4196	7.5	-2.5	Avoidance
2	788	3	2364	447	7	3129	5493	9.8	-0.2	Avoidance
3	583	4	2332	360	6	2160	4492	8.0	-2.0	Avoidance
4	478	5	2390	277	5	1385	3775	6.7	-3.3	Avoidance
5	1134	6	6804	836	4	3344	10148	18.0	8.0	Preference
6	493	7	3451	295	3	885	4336	7.7	-2.3	Avoidance
7	392	8	3136	226	2	452	3588	6.4	-3.6	Avoidance
8	535	9	4815	280	1	280	5095	9.0	-1.0	Avoidance
9	297	10	2970	165	0	0	2970	5.3	-4.7	Avoidance

3. **United Nations Age-gender Accuracy Index**

This index which was proposed by the United Nation is used for evaluation of five-year age- gender data. The index is also referred to as **Joint Score**. It has three components;

a. **Average gender ratio score (S)**: This score is obtained by fist calculating the gender ratio at each age group. Successive differences irrespective of sign are added and averaged.

$$Age-specific\ gender\ ratio(S) = \frac{P_m}{P_f} * 100$$

b. **Average male age ratio score (M):** For each age group for males, calculate the age ratios computed as:

$$age\ ratio(M) = \frac{P_{(m)x}}{{}^1/_2\,(P_{(m)x-5} + P_{(m)x+5})} * 100$$

The deviations from unity irrespective (بغض النظر) of sign are added and averaged (M).

c. **Average female age ratio score (F)**: For each age group for females, the age ratios are calculated using the same formulae as for males. The deviations from unity irrespective of sign are added and averaged (F).

$$age\ ratio(M) = \frac{P_{(f)x}}{{}^1/_2\,(P_{(f)x-5} + P_{(f)x+5})} * 100$$

d. The index is then computed as: UNAI = 3(S) + M + F

The reported age-sex data for a given population is presumed to be accurate if:

- the age-gender accuracy index is between 0 and 19.9,
- inaccurate if the index is between 20 and 39.9,
- and highly inaccurate if the index is above 40.