COURSE CODE: STS 242

COURSE TITLE: SOCIO – ECONOMICS STATISTICS

NUMBER OF UNIT: 2 UNITS

COURSE DURATION: TWO HOURS PER WEEK.

COURSE COORDINATOR: Mrs. F.S. Apantaku / Mr G.A. Daudu

LECTURER OFFICE LOCATION: A101, AMREC

COURSE CONTENT:

Operations and publications of official statistical organizations in Nigeria, Designs for data collection (sample census and administrative data), Index numbers, Design of questionnaires and Time series analysis.

COURSE REQUIREMENTS:

This is a compulsory course for all statistics students. Students are expected to have a minimum of 75% attendance to be able to write the final examination.

READING LIST:

1.) Francia, A. (1993). Business Mathematics and Statistics. (Third Edition). London : DP Publications Ltd.
2.) Kpedekpo, G.M.C & Arya. P.L (1981). Social and Economic statistics for Africa. London : George Allen & Unwin.
3.) Federal Republic of Nigeria. Official Gazette, The statistics Act, 2007, Vol 94. No 60.
4.) National Bureau of Statistics (2007). History, Operation and Activities. Abuja: NBS.

LECTURE NOTES

OPERATIONS AND PUBLICATIONS OF OFFICIAL STATISTICAL ORGANIZATIONS IN NIGERIA.
Official Statistics is the totality of the statistics produced by public statistical agencies of a country. It covers economic statistics including statistics of industrial production, services, prices and institutional sector, and social statistics encompassing population, and demography, housing, education, employment, health, nutrition, income and expenditure, public order and safety, social security and welfare, leisure and cultural activities.

Official statistics are produced within the framework of national statistical system. A **statistical system** consists of the people, procedure, data and equipment for data processing and dissemination. If the system is organised on a national basis, it is called a national statistical system.

Types of National Statistical System (NSS)

A. Centralised National Statistical System is one where the whole process of data production and dissemination to the governments and other users of statistics is carried out by an organ of the government.

B. Decentralised National Statistical System whereby there is division of responsibility between various data collection agencies at different tiers of government and the different agencies are free to collect data to satisfy their respective needs.

Nigeria National Statistical System

The Nigerian National Statistical System is a decentralised system. In its current form, it was established by the Statistics Act of 2007.

Elements of Nigeria National Statistical System

A. The producers of statistics including the National Bureau of Statistics (NBS) as the coordinating agency of the system, federal ministries, public agencies, state statistical agencies and local government statistics units.

B. Data user, including key users such as policy and decision makers.

C. Data supplier, including establishment and households.

D. Research and Training institution including higher education institutions.

Objectives of Nigeria National Statistical System

A. To raise public awareness about the importance and role of statistical information to society

B. To collect, process, analyses and disseminate quality statistical data.

C. To promote the use of best practice and international standards in statistical production, management and dissemination.

D. To promote the use of statistical data and information at individual, institutional, local government area, national and international levels, especially for evidence based policy design and decision making.

E. To build sustainable capacity for the production and use of statistical data and information in the country for planning purpose.

Coordination of Nigeria National Statistical System

A. The national statistical system is coordinated by the governing board of the NBS. The board take policy decision and monitor coordination of the system.

B. National consultative committee on statistics is another mechanism for coordinating the system. The committee is headed by the Statistician General (i.e CEO of the NBS).

Functions of Coordinating Agencies

A. To examine the statistical programmes of the various agencies annually in order to achieve greater coordination and avoid unnecessary duplication of efforts and evolve a national statistical programme for the approval of the NBS board.

B. To examine the Statistics Act and recommend to the board any necessary changes as the need arises.

C. To develop strategies which shall ensure uniform standard and methodologies amongst the various agencies with a view to improving on the quality comparability and timeliness of their statistics output.

Nature of Socio – Economic Statistics

Economic statistics may be defined as an historical record of economic activity which is capable of guilding the understanding of an economic system and at the same time capable of guilding the formulation of policy within the system. Quantitative information on manpower, production, distribution, transport, foreign trade, prices, employment, investments, national income and expenditures are examples of economic statistics.

Social statistics refers to data generated on the condition and quality of life of the people. Statistical information on household, education, health, public safety and population are examples of social statistics.

Major Producers of Socio - Economic Statistics in Nigeria

National Bureau of statistics (NBS)

The NBS is the main national agency responsible for the development and management of official statistics in the country. It is the authoritative source and custodian of official statistics in the country. The statistics Acts of 2007 outlined NBS key functions.

Functions of National Bureau of Statistics

1. To coordinate the National Statistical System.

2. To advise the federal, state and local government on all matters related to statistical and development.

3. To develop and promote use of statistical standards and appropriate methodologies in the system.

4. To collect, compile, analyze, interpret, publish and disseminate statistical information alone or in collaboration with other agencies, both governmental non-governmental agencies

5. To develop and maintain a comprehensive national data bank by encouraging unit of line ministries and agencies develop their sectoral data bank and forward to the bureau.

6. To provide a focal point of contact with international agencies on statistical matters.

7. To carry out all other functions relating to statistics as the federal government only assign to the bureau.

Historical Development and Antecedent of National Bureau of Statistics

1. In 1928, a Statistics Unit was established in the office of the colonial secretary in the cabinet secretariat of the British colonial administration.

2. In 1947, the Statistics Unit became Department of Statistics. In 1949, the department's responsibilities were expanded to form the nucleus of a centralised national statistics office for the country.

3. 1957, the Statistics Act was enacted, and a decentralised national statistical system (NSS) was adopted for the country.

4. In 1960, the Department of Statistics was moved from Customs and Excise to the ministry of finance and later federal ministry of economic development, with the name changed to the **Federal Office of Statistics**, (FOS).

5. The FOS was merged with the national data bank (NDB) in 2004. The merger of FOS and NDB led to the establishment of the National Bureau of Statistics (NBS).
6. The Statistics Act of 1957 was repealed and the Statistics Act of 2007 was enacted.

Statistical Activities of the National Bureau of Statistics

1. **National Integrated Survey of Household (NISH)**
- General Household Survey
- National Agricultural Sample Census
- Rural Agricultural Sample Survey
- Labour Force Survey
- Survey of Internal Migration
- Survey of Household Enterprise
- National Food Consumption Survey
- National Consumer Expenditure Survey
- Survey of Housing Status
- Health Interview Survey
- Family Planning Survey

2. **National Integrated Survey of Establishments (NISE)**
- National Census of industries and business
- Annual survey of establishment
- Quarterly survey of establishment
- Survey of public enterprises
- Transportation survey
- Monthly retail prices survey
- Survey of modern agricultural holdings

3. **Administrative Statistics Programme**
- Foreign Trade
- Local government information system
- Government Accounts programme
- Vehicle registration and relicensing statistics
- Agricultural administrative statistics

4. **Analytical programme**
- National Accounts Statistics
- Social Reporting Service
- Environmental Statistics

Publications of National Bureau of Statistics

1. Annual Abstract of Statistics
2. Nigeria Trade Summary
3. Review of External Trade
4. Report of building and construction
5. Distribution Survey of Nigeria
6. Industrial Survey of Nigeria
7. Consumer price index
8. National Accounts of Nigeria
9. Digest of statistics

10. The economic indicators, etc.

National Population Commission of Nigeria

The National Population Commission of Nigeria (formerly National Population Commission) was first established as the National Census Board in 1972. The legal institutions creating it, Decree no 23 of 1989 charge the commission with the following responsibilities;

1. To undertake the enumeration of the population of Nigeria periodically through censuses and sample surveys.

2. To establish and maintain a machinery for continuous and universal registration of births and deaths throughout the country.

3. To prepare and maintain a national framework for the delineation exercise for censuses and sample surveys

4. To collect, collect and publish data on migration statistics.

5. To conduct researches, monitor the national population policy and set up a national population information data bank

6. To provide information and data on population for purpose of facilitation of national planning and economic development.

7. To advise the federal government on any population and related matters and problems.

8. To disseminate information and educate the general public about the activities of the commission, and

9. To arrange for the appointment and training of enumerators and all other categories of staff of the commission.

Central Bank of Nigeria

The central bank of Nigeria publishes banking, financial, agricultural and foreign trade statistics through its

1. Annual Report and Statement of Account

2. Economic and Financial Review.

3. Monthly Report .

4. Nigeria principal economic and financial indicators.

5. Statistical Bulletins, e.t.c.

Sources of Economic and Social Statistics

Published National Sources

1. Statistical Abstracts, bulletins and reports issued by government departments such as NBS, POPCOM, CBN, NNPC, e.t.c

2. Miscellaneous report of government and non government agencies such as NEIC, INEC, PPFN, NACA, e.t.c

3. Research Report and publications in learned journals such as NISER, NIPSS, ASCON, IITA, e.t.c

4. Daily Newspapers Magazines and Miscellaneous periodicals.

Published International Sources

1. Publication of international institutions such as IBRD, IMF, ECA, AU, INHO, ILO, e.t.c

2. The Internet i.e. www.nigerianstat.gov.ng; www.npc.gov.ng; www.population.gov.ng; www.cenbank.org

Administrative Statistics

This source of data refers to the raw data which exist in their original form but in the files, books, and on various forms of government and NGOS. Such data if obtained could be adequately used as checks on published data. The process of obtaining data from this source is normally hindered by poor storage of the data and partly because of bureaucratic bottlenecks.

Uses of Economic and Social Statistics
1. Planning for national development
2. Construction of systems of national accounts
3. Construction of Economic Models
4. Policy formulation and decision making

Problem of Collecting Economic and Social Statistics in Nigeria
1. Conceptual problem
2. Problem in the statistical system
- Shortage of well-qualified statistical manpower
- Inadequate coordination, cooperation and collaboration among major producers of statistics in the country
- Inadequate funding of the statistical agencies
- Administrative bureaucracy and red tapism
3. Problem in Society
- Lack of statistical awareness
- Illiteracy/ innumeracy
- Cultural /religious problems
- Language problem
- Poor social facilities

DESIGNS FOR DATA COLLECTION

The raw material for socio economic investigation and analysis is data. The type of data collected for a given purpose may be primary or secondary, internal or external.

Primary Data

This is data collected at first hand for a specific purpose. The basic sources of primary data are censuses, sample surveys, and administrative processes. Primary data are collected where

    a. The needed information does not exist elsewhere

    b. The needed information exist but is not reliable

    c. Collecting the information at first hand is only way such information can be obtained

Secondary Data

These are data which already exist and may be adapted for use in the current survey. Such data are collected originally for another purpose. Secondary data can be sourced from publications and records of governments and non government organisations, journals of universities and research institutes, media, organization and administrative records.

For secondary data to be used with reasonable degree of confidence, the validity of such data must be assessed. This involves checking for the following;

    a. The source of the data

    b. The purpose of which it was collected

    c. The method of data collection used

    d. Definition of terms used

    e. Coverage and changes overtime, if any

    f. Method of analysis

Internal Data

This is data collected by one's own organization. Such data may be extracted from records such as the ledger, personnel records, sales records, stock records e.t.c.

External Data

This is data collected by one organization and being used by another organization data from external sources are either primary in nature or secondary in nature.

METHODS OF COLLECTING QUANTITATIVE PRIMARY DATA

    1. INTERVIEW METHOD

    a. Personal interview- collected face to face

    b. Telephone interview-conducted over a telephone system

    c. Computer assisted interview

    2. EXPERIMENTAL METHOD

        Refers to data collected through laboratory tests and direct measurement of variables

    3. OBSERVATION METHOD

        Is the method used when the investigator visit the location of the event or individual being studies, and he directly or indirectly observe, and record data on the required variables

    4. QUESTIONNAIRE METHOD

This is by far the most popular and widely used method. It's the process of collecting data by sending a set of questions printed on paper-called questionnaire to the respondent either by hand or by post

METHOD OF COLLECTING QUALITATIVE PRIMARY DATA
a. In-depth interviews - permits greater depth of meaning, and open ended responses to questions.
b. Focus Group Discussion - brings respondents together in discussion group that focus on a particular topic

ADMINISTRATIVE DATA
These are data that are routinely collected as a by-product of daily administration. Administrative statistics are compile from administrative records.
Administrative statistics are being used:
a. For the constructions of frames, such frames may be subject to errors
b. Supplementing data collected through surveys and census
c. For evaluating results of statistical studies or exercises check on the coverage of the survey Administrative source may be the only reliable means of collected data on a particular subject e.g. arrival/departure from a country

LIMITATIONS OF ADMINISTRATIVE DATA
1. Concepts, definitions and classifications used may not be suitable for statistical purpose
2. Coverage may be deficient in the sense that it may be incomplete or inaccurate
3. It may be difficult to gain access to administrative data for the following reasons:
a. Users may not be aware that such data exist
b. Producer may not consider it necessary to release the information to the public
c. Poor storage may make access difficult or impossible
d. The pledge of confidentiality by compiling agency may make access impossible.

DESIGN OF QUESTIONAIRES

A questionnaire is a document or form which contains questions designed to collect statistical information from the respondents for the purpose of statistical enquiry.

Objectives of questionnaire design

    A.   To collect the information required.

    B. To facilitate interviewing or responses.

    C. To facilitate data processing.

Basic steps in questionnaire design

    1.   Identify the type of data required from the population of interest or target population.

    2.   The type of information required showed be specified.

    3.   Write up a first draft.

    4.   Re - examine and revise the draft.

    5.   Pre test the draft.

    6.   Re - edit and produce final draft.

In questionnaire design, decisions are taken in the various component of questionnaire. Decisions are taken in the following areas of questionnaire design:

    A. Forms of the questions

    B. Question order.

    C. Question content.

    D. Question wording

    E. Question type.

Types of Questions in Questionnaire design

Factual questions straight forward types usually requiring sample and straight forward response sometimes in the form of yes or no.

Memory questions those requiring efforts on the part of respondents to remember past happenings.

Opinion questions those that seek views or opinion of respondents on certain issues.

Structured questions those in which the respondents are guided as to the kind of response expected.

Open ended questions those in which the respondents are allowed to respond in their own words.

Decisions on Forms of question

    1.   A questionnaire should be attractive especially if respondent have to answer unaided.

    2.   Preferable short questions should be asked.

    3.   The questions should be clear and simple.

    4.   There are five major divisions in the construction. However, three are more important;

        A Identification of the respondent is the first division.

        B It is then followed by classificatory information.

    C. Topics of the survey.

    D. Decisions on request for extra comments.

    E. Acknowledgement.

Decision on Question order

1. General questions should be asked first.
2. Followed by more specific questions.
3. Ask very intimate or personal information at the very end.

Decision on Question Content
1. Ask only necessary questions.
2. Sub divides questions into simple ones.
3. Sub divides questions into sections or parts.
4. Questions should be within the experience and competence of the respondents.
5. Questions should not be loaded in one direction.

Decision on question wording
Questions should be:
1. Simple and framed in a way to be interpreted in the same manner by all respondents.
2. Avoid ambiguous statement, terminologies, or technical languages
3. Clear frame of reference is important to make it better understood.

Decision on question type
There are two types;
   A. Closed or fixed response questions.

These are well structured or complete statements with their response categories. These types of questions can be; dichotomous e.g. yes or no, scale with various grades e.g. 10-19, 20-29, e.t.c.
   B. Open ended questions.

This is an unstructured or incomplete statement in which response is recorded directly from the respondents.
However, closed or fixed response questions are preferred because it has a number of advantages over open ended responses.
Advantages of Structured Questions
1. It facilitates coding or processing.
2. Interviewing is faster, it saves time.
3. It saves space.
4. Response is fast.

INDEX NUMBERS

An index number which is always expressed in terms of a base of 100, is statistical devise used to measure changes in price, quantity or value of a group of related items over a period of time. In order to bring in the idea of time, the following standard convention is used

P_o, Q_o, V_o for price, quantity, or value at base time point

P_n, Q_n, V_n for price, quantity or value at some other time point

In selecting the base period for a particular index, two rules should be observed:

   a. The period selected should as much as possible be one of economic normalcy or stability-relative stability.
   b. The base period should be recent so that comparisons will not be unduly affected by changing technology, product, quantity, e.t.c. – recent period.

CONSTRUCTION/TYPES OF PRICE INDICES
INDEX RELATIVES OR SIMPLE INDEX NUMBER

An index relative is the name given to an index number which measures the changes in a distinct commodity i.e.

Ip = Pn/Po x 100, Iq = qn/qo x 100

EXAMPLE

The prices and quantities of some household items sold by a supermarket over two years are as follows;

	2007		2008	
Item	Price	quantity	Price	quantity
Milk	250	500	300	450
Soap	1000	1000	1500	800
Matches	400	600	500	630

Determine the price and quantity relatives for these items for the period of 2008 (2007=100)

Milk => Ip = Pn/Po = 300/250 x 100 = 120

Soap => Ip = 1500/1000 x 100 = 150

Matches => Ip = 500/400 x 100 = 125

Milk => Iq = 450/500 x 100 = 90

Matches = 360/600 x 100 = 105

Soap => Iq = 800/1000 x 100 = 80

TIME SERIES OF RELATIVES

It is usually necessary to see how the values of an index relative change over time. Given the values of some commodity over time, there are two distinct ways in which relatives can be calculated:

   a. **Fixed - base relatives** these are found by calculating relatives for each value of time series based on the same fixed time point
   b. **Chain – base relatives** these are found by calculating relatives for each value of a time series based on the immediately preceding time point.

EXAMPLE

Given the prices of a commodity for six years, calculate fixed based and chain based indices. (2002=100)

Year	Prices
2002	4563
2003	4245
2004	4841
2005	4644
2006	4290
2007	5166

a. Fixed - base (2002 = 100)

2003 => 4245/4563 x 100   = 93.0

2004 => 4841/4563 x 100 = 106.1
2005 => 4644/4563 x 100 = 101.8
2006 => 5290/4563 x 100 = 109.3
2007 => 5166/4563 x 100 = 106.7

b. Chain-base

2003 => 4245/4563 x 100 = 93.0
2004 => 4841/4245 x 100 = 114.0
2005 => 4644/4841 x 100 = 95.9
2006 => 5290/4644 x 100 = 113.9
2007 => 5166/5290 x 100 = 97.7

C0MPOSITE INDICES

A composite index number is an index number which is obtained by combining the information from a set of economic commodities of like kind. Such a composite index number normally requires that each component be weighted. Composite indices are of two types namely weighted and un weighted indices.

   a. Un weighted index numbers
     (i) Simple aggregate index
     (ii) Mean of price relatives

Simple Aggregate Index

$SAI = \sum Pn / \sum Po$ X 100   for prices

Year	A	B	C	TOTAL
2000	11.4	18.5	11.7	41.6
2002	14.8	19.7	15.2	49.7
2004	16.8	18.7	14.4	50.4

If 2000 =100
SAI 2002 = 49.7/41.6 x 100 = 119.5
SAI 2004 = 50.4/41.6 x 100 = 121.2
Mean of Price Relatives

$\Pi = (\sum(Pn/Po) \times 100)/k$
Where k = number of items

Item	2007		2008		
	Price	Qty	Price	Qty	Ip
Milk	250	500	300 120	450	
Soap	1000	1000	1500 150	800	
Matches	400	600	500 125	630	

$\Pi = 395/3 = 131.66$

    b.   weigh

Weighted index numbers

    (i)   weighted average of relatives

    (ii) weighted aggregate index

Variants of weighted aggregate indices are:

    1.   Laspeyres index

    2.   Paasche index

    3.   Fishers ideal index

    4.   Marshal - Edgeworth index

Weighted Average of Relatives
This method involves calculating index relatives for each of the given components , then using the given weights to obtain a weighted average of the relatives. It is computed as;

$$I = \frac{\sum WI}{\sum W}$$

Example

Components Of mix	Prices		Standard quantity (W)	(I)	WI
	2007	2008			
A	1.50	3.00	8	200	1600
B	3.40	4.25	3	125	375
C	10.40	8.84	1	85	85
			12		2060

Ip, A $= 3.00 \times 100 = 200$

    B $= 4.25 \times 100 = 125$

    C $= 8.84 \times 100 = 85$

    $I_{AG} = 2060/12 = 171.7$

Weighted Aggregate Index
This method involves multiplying each component value by its corresponding weight and adding these products to form an aggregate. It is computed as:

$I_{AG} = \sum WVn \times 100$

$\sum WVo$

Example

Items	Prices 2007	2008	weight W	WVo	WVn
A	1.50	3.00	8	12.00	24.00
B	3.40	4.25	3	10.20	12.75
C	10.40	8.84	1	<u>10.40</u>	<u>8.84</u>
				32.60	45.59

$I_{AG} = 45.59/32.60 \times 100 = 139.8$

Laspeyres indices
A Laspeyres index is a special case of a weighted aggregate index which always uses base time period weights. It is most commonly associated with price and quantity indices. It is computed as follows:

$Lp = \dfrac{\sum q_o p_n}{\sum q_o p_o} \times 100$

$Lq = \dfrac{\sum p_o q_n}{\sum q_o p_o} \times 100$

Paasche indices
A paasche index is a weighted aggregate index which uses current time period as weights. It is computed as;

$Pp = \dfrac{\sum qn p_n}{\sum qn p_o} \times 100$

$Pq = \dfrac{\sum pn q_n}{\sum pn q_o} \times 100$

Example
The following data relate to a set of commodities used in a particular process.

Item	2007 price	Qty	2008 price	Qty
A	36	100	40	95
B	80	12	90	10
C	45	16	41	18
D	5	1100	6	1200

Calculate Laspeyres and Paasche price indices for 2008.

	Laspeyres			Paasche	
Item	qopn	poqo		qnpn	qnpo
A	4000	3600		3800	3420
B	1080	960		900	800
C	656	720		738	810
D	6600	5500		7200	6000
	12336	10780		12638	11030

Lp = 12336/10780 x 100 = 114.4

Pp = 12638/11030 x 100 = 114.6

Fisher's ideal index

This is simply the geometric mean of the Laspeyre's and Paasche's indices. It is defined as follows;

Fp = √Lp x Pp

Fq = √Lq x Pq

Fisher's ideal index represents a compromise between the Laspeyre's and Paasche indices.

Note that whereas a Laspeyre's index tends to overestimate changes during period of inflation, a Paasche's index tends to under estimate changes. Therefore, as an average between the two, a Fisher's index is expected to more precisely reflect the current position than either of the two.

Example from our last exercise,

Fp = √114.4 x 114.6 = 114.5

Marshal Edgeworth's index

This is an alternative to the Laspeyre's and Paasche's indices, it uses the arithmetic mean of the quantities or price of the current and base time points as weighting factors. It is computed as follows:

$$Mp = \frac{\sum Pn\,(qo + qn)}{\sum Po\,(qo + qn)} \times 100$$

$$Mq = \frac{\sum Qn\,(po + pn)}{\sum Qo\,(po + pn)} \times 100$$

Example

The prices and quantity demmded of commodities A, B, and C in the current and base year are given below (1990 = 100).

	1990			2000	
Commodity	price	qty		price	qty
A	4	50		10	40
B	3	10		9	2
C	2	5		4	2

Construct Marshal Edgeworth price and quantity indices.

Item	pn	qo + qn	pn (qo + qn)	po	po (qo+qn)
A	10	90	900	4	360

B	9	12	108	3	36
C	4	7	28	2	14
			1036		410

Mp = 1036/410 x 100 = 252.

Item	qn	po + pn	qn (po + pn)	qo	qo (po + pn)
A	40	14	560	50	700
B	2	12	24	10	120
C	2	6	12	5	30
			596		850

Mq = 596/850 x 100 = 70.1

Uses of index numbers
1. To show relative changes in an economic variable e.g prices, costs, income, wages, e.t.c. over

time.
2. To reflect general economic condition e.g. cost of living, standard of living ,e.t.c.
3. It provides useful inputs for planning, budgeting and making economic forecasts.
4. Trade unions often use price indices to support negotiation for better wage.
5. It is useful for comparing performance, economic conditions, productivity e.t.c. overtime and among towns, industries, cities, countries, e.t.c.
6. Governments use various types of indices as input when formulating economic policies.

Limitations to the use of indices
1. They indicate general (aggregate) rather than specific changes.
2. They may be misinterpreted i.e CPI in Nigeria may not show differences in cost of living of rural/urban dwellers.
3. The weighting factor may become out of date.
4. Where sampling is involved in the collection of the required data, they may not be accurate.
5. Organisations entrusted with the publication of certain indices may not be reliable i.e NBS & CBN usual conflict on inflation rate.

Problems of index number construction
1. Different indices may have to be constructed for different purposes as an index that is useful for one purpose may not be appropriate for another.
2. The required data may not be available or they may be very expensive to collect.
3. There may be difficulty choosing items to be included in an index e.g CPI
4. There is problem of choosing appropriate weighting factor.
5. The choice of the base period may be arbitrary.

Real Vs Nominal changes in value
One important use of index number is for deflating monetary values of important economic variables such as wages, national income, export, import, e.t.c. in such a way as to enable us show real changes as against nominal changes in values assumed over time.

The formular for determing the real value at a given base period prices is follows:

RVn.o = NVn x Io/ In

Rvn = current time's real value at base periods prices.

Nvn = current time point nominal value

Io = base period's price index

In = current time points price index

Example

The table shows the average monthly wages received by registered nurse in a west African country and the consumer price index (1980 = 100):

Year	Wages (#)	CPI
1980	1100	100.0
1985	3900	103
1990	7500	122
1995	18000	125
2000	32000	130
2005	65,000	136
2008	80,000	131

Determine the real wages in 2000, 2005 and 2008.

Rv 2000 = 32,000 x 100/130 = 24, 615.4

Rv 2005 = 65,000 x 100/136 = 47,794.1

Rv 2008 = 80000 x 100/131 = 61,068.7

Exercises

1. The table below shows the average prices and quantities of some household commodities demanded daily in a town for 2006 and 2008:

Commodity	Prices 2006	Prices 2008	quantities 2006	quantities 2008
Rice (kg)	50	60	800	700
Yam (1tubar)	30	32	600	630
Gari (1kg)	25	30	1000	1200
Beans (1kg)	60	80	600	400

Determine (2006 =100).

(a) The simple aggregate index for 2008

(b) Mean of price relatives for 2008

(c) Weighted average of price relatives for 2008

(d) Laspeyres andPaasche's price indices for 2008

(e) Marshal Edgeworth's quantity inder for 2008.

2. The table below shows Nigeria GDP (in #b) at current factor cost and price indices (1985=100) between 1980 and 1989.

Year	GDP	Index
1981	50.5	51.2

1982	51.6	55.1
1983	56.8	67.9
1984	63.0	94.8
1985	71.4	100
1986	72.1	105.4
1987	106.9	116.1
1988	142.7	181.2
1989	222.5	272.7

Determine the real GDP at 1985 constant factor cost.

TIME SERIES ANALYSIS

Statistical data which are collected at regular intervals over a period of time are called Time Series Data. Common example include annual population figures, annual rainfall, weekly sales figures, monthly production figures, e.t.c. each of which were recorded over a number such period.

Time series are studied with a view to detect the pattern of changes in the value of the variable of interest over time. Such knowledge is useful in predicting the likely future occurrence, and for planning and budgeting.

Components of Time series

These refer to the various types of movement or variation that may be observed in a time series data. They are:

A Secular or long Term Trend

B Seasonal variation

C Cyclical variation or movement.

D Irregular or erratic variation.

Long Term Trend

This refers to the smooth or regular movement of the series over a fairly long period of time.

Generally, three types of trend may be observed in a time series;

(a) Upward Trend characterised by a general increase in the values of the series over time.

(b) Downward Trend characterised by a general decline in the values of the series over time.

(c) Constant Trend in this case, despite periodic fluctuations in the value of the time series, the overall or average figure trends to be constant.

Seasonal variation

This describes any kind of movement or variation which is of periodic nature, and for which the period does not extend beyond a year. It consists of regular repeating pattern.

Cyclical variation

This refers to a recurrent up and down movement, or long term oscillation, in a statistical data from some sort of statistical trend or normal.

  Irregular variation

It refers to variations which are completely unpredictable or are caused by such isolated special occurrence as good or bad news, bank failure, election, war, flood e.t.c.

Models of a Time series

Two model are appropriate for associating the components of a time series.

A Addictive model i.e. $Y = t + s + c + i$

B Multiplicative Model i.e. $Y = tsci$

In both cases

Y = observed data.

T = trend values

S =seasonal variation

C = cyclical variation

I = irregular variation

Estimation of components

Long Term Trend

Given a time series data, there are four methods that may be used to determine the general trend in its long term movement. They are:

A Freehand method

B Method of semi averages

C Method of moving averages

D Least squares method

Least squares method

This is similar to the least squares regression techniques. The dependent variable in the case of time series analysis is the value of the series (Vt), while the period of time (t) is the explanatory or independent variable. The least square trend equation is written as;

$Vt = a + bt$

where $b = \sum Vt / \sum t^2$, and $a = \sum v / N$

The trend values for each period are estimated using the trend equation

$Vt = a + bt$.

Example

The table below shows the profit made by a company between 2001 and 2009

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Profit (#m)	10.0	12.7	12.4	11.9	12.5	13.0	14.9	16.5	18.7

Using the least square method, obtain the trend values. Estimate profit for 2010.

Year	V	t	v.t	t2	trend value
2001	10.0	-4	-4.0	16	10.13
2002	12.7	-3	-38.7	9	11.00
2003	12.4	-2	-24.8	4	11.88
2004	11.9	-1	11.9	1	12.75
2005	12.5	0	0	0	13.62
2006	13.0	1	13	1	14.49
2007	14.9	2	29.8	4	15.36
2008	16.5	3	49.5	9	16.24
2009	18.7	4	74.8	16	17.11
	122.6		52.8	60	

Method of Moving Average

This method involves obtaining a new series of k - period's moving averages. If a set of n values of a time series is arranged chronologically as V1, V2, V3, ... Vn, and we obtain a set of averages.

Y1=V1 + V2 +.. Yk/K

Y2 = V2 + V3 + ... Vk + Yk + 1/K

Y3 = V3 + V4 + ...+ Vk + Yk + 1 + Vk + 2/K

These averages are called k- point moving averages. The k - point is to show that k observation are used in the averages. The averages are moving because they are the averages of successive k observations.

Example The turnover of a business conglomerate in #m between 1983 and 1996 are given below

Year	Amount	year	Amount

1983	23489	1990	52883
1984	25276	1991	55016
1985	30827	1992	56998
1986	36375	1993	64287
1987	45635	1994	74012
1988	47648	1995	83485
1989	51678	1996	89658

Obtain 3 - year moving averages.
Solution
A calculate 3 – year moving total
B calculate 3 - year moving average

Year	Amount	Moving total	moving average
1983	23489	-	-
1984	25276	79592	26530.7
1985	30827	92478	30826
1986	36375	112837	37612.3
1987	45635	129658	43219.3
1988	47648	144961	483203.3
1989	51678	152209	50736.3
1990	52883	159577	53192.3
1991	55016	164897	54965.7
1992	56998	176301	58767
1993	64287	195297	65099
1994	74012	221784	73928
1995	83485	247155	82385
1996	89658	-	-

If for practical purposes, an even numbered period has to be used, as it applies to 12 - month moving averages, 4 – quarter moving averages, e.t.c, than we make the trend value to correspond to true median period by calculating what is called centred moving averages. The moving averages are central by summing up values of two adjacent moving totals, and dividing the resulting values by 2k, (where k is the number of periods in each moving totals).

Example
The consumer price indices for food between 1994 and 1996 are given on quarterly base in the table below:

Year	Q1	Q2	Q3	Q4
1994	119	127	127	116
1995	123	142	133	127
1996	146	185	181	161

Using yearly (i.e. 4 – quarterly centred) moving averages, obtain the trend in the food price index.

Solution

A 4 – quarter moving total i.e. 11+127 +127 +116 =489

127 +127 +116 +123 493

B centred moving total = 489 + 493 = 982

493 +508 =1001

C centred moving average = 982/2(4) = 122.75

Year/ Quater		price index	4 - Qtr moving	centred moving total	centred moving average
1994	Q1	119			
					-
	2	127			
			489		
					-
	3	127		982	
					123
			493		
	4	116		1001	
					125
			508		
1995	Q1	123		1022	
					128
			514		
	2	142		1039	
					130
			525		
	3	133		1073	
					134
			548		
	4	127		1139	
					142
			591		
1996	Q1	146		1230	
					154
			638		
	2	185		1312	
					164
			673		
	3	181			
					-
	4	161			
					-

Seasonal variation indices

The purpose of determining the seasonal component of a time series is that of removing the effects of the other components - trend, cyclical and irregular. Once these other components have been eliminated, we calculate, in index form, a measure of seasonal variation which is called the seasonal variation index.

Seasonal variation indices of a time series may be determine using any one of four methods, they are:

A Average percentage method

B Ratio – to – trend method

C Ratio – to – moving average method

D Link relative method

The percentage Average Method

This method is based on the assumption that an additive relationship exists between the components of a time series i.e $V = T + S + C + I$.

Steps

1. Average the figures of each of the corresponding time points.

2a Fit a least square trend line to the averages obtained in step1 to determine the incremental rate 'm' as we move from one seasonal time point to another.

Convention for assigning value of 't' odd number time point

a. median period is assigned a value of zero (t = 0).

b. Subsequent time points are assigned values of t = 1, 2, 3, while preceding time points are assigned values of t = -1,- 2,- 3, ...downward.

Even number time point

a. the two periods at the centre are assigned values of -1 and 1

b.   subsequent time periods are assigned values of t = 3,5,7, e.t.c. while periods prior to the base are assigned values of t = -3, -5, -7, ...downward.

 2b. Following the convention for assigning values of **t** the incremental rate **m** is the slope parameter **b** if we have odd number of time points; and **2b** if there are even number of time points.

3. Obtain and estimate of the expected increase in the value of the series along the trend line, by assigning zero to the first seasonal period and m, 2m, 3m,... e.t.c. to the subsequently periods.

4. Deduct the estimate of the incremental trend value of each seasonal period from the corresponding seasonal period average to elimate the effects of trend.

5. Obtain the seasonal indices by expressing each of the seasonal values as a percentage of their average.

Example

Year	Q1	Q2	Q3	Q4
2004	119	127	127	116
2005	123	142	133	127
2006	146	185	181	161

Determine the seasonal variation indices.

Step1 - Average of each quarters figures

Year	1	2	3	4
2004	119	127	127	116
2005	123	142	133	127
2006	146	185	181	161
Ave	129.3	151.3	147	134.7

Step 2 & 3 – estimation of trend line of the averages, and the quarterly trend incremental rate

Q	v	t	Vt	t2	trend increment
1	129.3	-3	-387.9	9	0
2	151.3	-1	-151.3	1	1.19
3	147	1	147	1	2.38
4	134.7	3	404.1	9	3.57
			11.9	20	

b = 11.9/20 = 0.595
2 x b = m, 2 x .595 = 1.19

Step 4 & 5 – Removing the effects of trend, and calculating seasonal indices

Q	Qtr Ave	Trend interment	seasonal value	seasonal index
1	129.3	0	129.3	93.16
2	151.3	1.19	150.11	108.16
3	147	2.38	144.62	104.20
4	134.7	3.57	131.13	94.48
	Total		555.16	400
	Average		138.79	100

Interpretation

Q1 = a typical first quarter's sale is 93.16% of an average quarterly sale

Q2 = a typical second quarter's sales is 108.16% of an average quarterly sale e.t.c.

Ratio to Trend Method

This method is an improvement over the average percentage method. It assumes a multiplicative relationship between the components of the time series i.e.

V = T x S x C x I

Steps

1. Estimate a least square trend line of the series, and use the trend equation to estimate the trend values for each of the time points.
2. Obtain percentage of trend values
3. Obtain the average for each of the different seasonal periods, using mean or median
4. Obtain the seasonal indices.

Example

Year	1	2	3	4
2004	119	127	127	116
2005	123	142	133	127
2006	146	185	181	161

Year	Q	V	t	Vt	t2	trend value	% of trend
2004	1	119	-11	-1309	121	111.60	106.63

	2	127	-9	-1143	81	116.87	108.67
	3	127	-7	-889	49	122.14	103.98
	4	116	-5	-580	25	127.41	91.04
2005	1	123	-3	-369	9	132.68	92.70
	2	142	-1	-142	1	137.95	102.94
	3	133	1	133	1	143.22	92.86
	4	127	3	381	9	148.49	85.53
2006	1	146	5	730	25	153.76	94.95
	2	185	7	1295	49	159.03	116.33
	3	181	9	1629	81	164.30	110.16
	4	161	11	1771	121	169.57	94.95
		1687		1507	572		

$b = 1507/572 = 2.6346$, $a = 1687/12 = 140.58$, $V = 140.58 + 2.6346t$

Quarter's

Year	1	2	3	4	Total
2004	106.63	108.67	103.98	91.04	
2005	92.7	102.94	92.86	85.53	
2006	9495	116.33	110.16	94.95	
Ave	98.09	109.31	102.33	90.51	400.24
Index	98.03	109.25	102.27	90.46	400.01

Exercises

1. The profit before tax (#m) made by a company for the period 1993 -2002 are as follows

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Profit	85	82	83.5	84	86.5	81.5	86	85	89	92

Fit a least square trend line to this data, and estimate expected profit in 2006.

2. The following table summarizes the quarterly turnover (#'000) of a company between 2005 and 2008

Year	quarter's			
	1	2	3	4
2005	50	31	46	63
2006	58	34	38	65
2007	63	39	44	76
2008	65	45	52	70

Calculate 4 - quarter centred moving averages of the series.

3. The table below shows the quarterly export of an agricultural firm (in million of naira)over five year period;

Quarters

Year	Q1	Q2	Q3	Q4
2000	58	61	71	66
2001	64	63	68	68
2002	76	73	76	71
2003	60	63	69	58

2004   56   54   61   58

Obtain the seasonal indices using;

A The percentage average method

B Ratio – to – trend method