Param Pujya Dr. Babasaheb Ambedkar Smarak Samiti's
Dr. Ambedkar Institute of Management Studies & Research
Deeksha Bhoomi, Nagpur - 440010 (Maharashtra State) INDIA
NAAC Accredited with 'A' Grade
Tel: +91 712 6521204, 6521203 ,6501379
Email: info@daimsr.in

UNIT II

TIME SERIES & FORECASTING.

Programme Educational Objectives

Our program will create graduates who:

1. *Will be recognized as a creative and an enterprising team leader.*
2. *Will be a flexible, adaptable and an ethical individual.*
3. *Will have a holistic approach to problem solving in the dynamic business environment.*

Research Methodology & Quantitative Techniques Course Outcomes

- CO1-Given a managerial problem and associated frequency distribution data, the student manager will be able to apply descriptive and inferential statistics to facilitate quick and rationale managerial decision making.

- CO2-Given the data for two or more variables, the student manager will be able to estimate the strength of the relationship between two variables using ‘Karl Pearson’ and ‘Spearman’s Rank’ correlation coefficient.

- CO3-Given the data for two or more variables, the student manager will be able to predict / forecast using as moving averages, regression and time series analysis.

- CO4-Given a managerial problem, the student manager will be able to formulate it as ‘research problem’ and also will be able to suggest suitable research methodology to identify workable solutions.

- CO5-Given a business Problem/situation, the student manager will be able to develop methods and instruments (questionnaire/ interview schedule) for collection and measurement of qualitative as well as quantitative data using primary and secondary sources from a given sampling framework.

- CO6-Given the sample statistics, the student manager will be able to apply Z, t and Chi-square tests to accept or reject the stated hypotheses for making sound decisions.

Learning Objectives

Given the past values of a variable in chronological order, the student should be able to obtain the trend and forecast the value for future.

- Components of Time Series.
- Trend - Moving averages, semi-averages and least-squares.
- Seasonal variation, cyclic variation and irregular variation.
- Index numbers, calculation of seasonal indices.
- Additive and multiplicative models.
- Forecasting, Non linear trend – second degree parabolic trends

TIME SERIES.

A Time Series is a set of observations taken at specified times, usually at equal intervals.

Mathematically, a time series is defined by values Y1, Y2, … of a variable at times t1, t2,… Thus Y is a function of t symbolized by $Y = F(t)$.

UTILITY OF TIME SERIES ANALYSIS.

- Helps in understanding past behaviour.
- Helps in planning future operations.
- Helps in evaluating current accomplishments.
- Facilitates comparison.

COMPONENTS OF A TIME SERIES.

Secular Trend	T
Seasonal Variations	S
Cyclical Variations	C
Irregular Variations	I

$Y = T+S+C+I$ or $Y = TxSxCxI$

Additive Model Multiplicative Model

Measurement of Trend

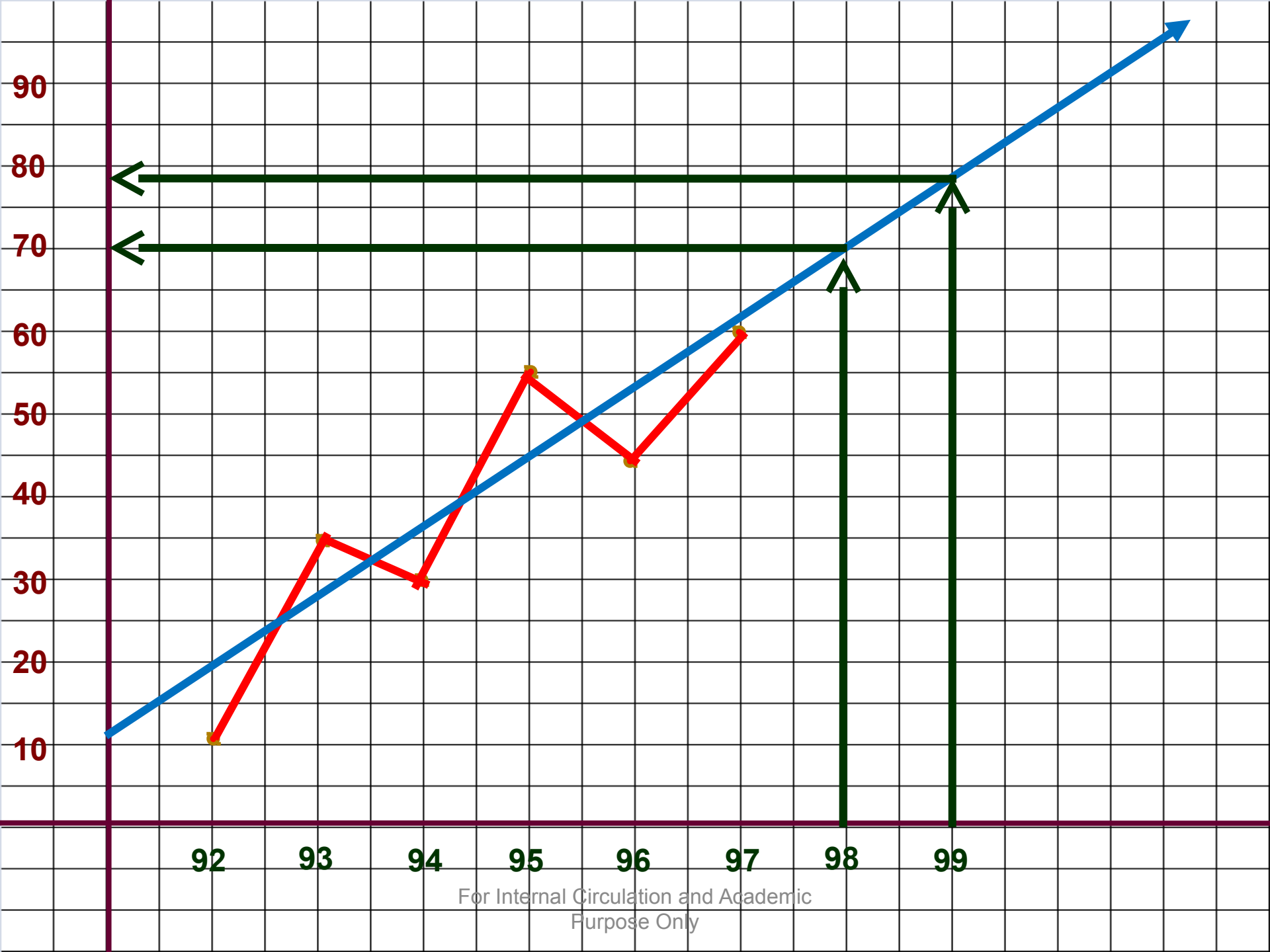
- Freehand or Graphical method
- Semi-average method
- Moving average method
- Least squares method.

Freehand or Graphical method

1. Plot the time series on a graph paper.
2. Examine carefully the direction of dots.
3. Draw a straight line according to personal judgement.

Fit a trend line to the following data using the Freehand method and predict values for 1998 & 1999.

YEAR	SUGAR PRODUCTION (Million Tonnes)
1992	10
1993	35
1994	30
1995	55
1996	45
1997	60



Fit a trend line to the following data using the Freehand method and predict values for 2009 & 2010.

YEAR	Sales (Millions)
2001	5
2002	15
2003	10
2004	25
2005	30
2006	20
2007	35
2008	45

Method of SEMI AVERAGES

1. Divide the data in two equal parts. In case of odd years, omit the middle year.
2. Obtain the average of each part.
3. Plot the two points against the midpoint of class interval on a graph.
4. Joint the two points to get a trend line.

Fit a trend line to the following data using the semi averages method and predict values for 2009 & 2010.

YEAR	Sales (Millions)
1993	102
1994	105
1995	114
1996	110
1997	108
1998	116
1999	112

Method of MOVING AVERAGES

There can be two ways to calculate moving averages.

1. 3 year, 5 year or 7 year moving averages. These are called odd year moving averages.

Or

2. 2 year, 4 year, 6 year or 8 year moving averages.

There is a slight difference in these two ways.

Calculate the 3 year moving averages of the production figures given below.

YEAR	PRODUCTION	YEAR	PRODUCTION
1985	15	1993	63
1986	21	1994	70
1987	30	1995	74
1988	36	1996	82
1989	42	1997	90
1990	46	1998	95
1991	50	1999	102
1992	56		

Construct 5 year moving averages of the number of students studying in a college.

YEAR	No. of students	YEAR	No. of students
1990	332	1995	405
1991	317	1996	410
1992	357	1997	427
1993	392	1998	405
1994	402	1999	438

Calculate the trend values by taking 4 year moving averages.

YEAR	VALUE	YEAR	VALUE
1984	12	1991	100
1985	25	1992	82
1986	39	1993	65
1987	54	1994	49
1988	70	1995	34
1989	87	1996	20
1990	105	1997	7

WEIGHTED MOVING AVERAGES

Generally weighted moving average is used to forecast trend figures.

WMA gives higher weightage to recent figures.

Calculate the trend values using 3 year WMA for the following data. Weights are to be assigned in order 1, 2, 3.

YEAR	SALES	YEAR	SALES
2001	10	2008	18
2002	12	2009	20
2003	12	2010	18
2004	14	2011	24
2005	16	2012	28
2006	18		
2007	22		

Year	Sales	WT	Wtd Sales	3 Y WMT	3 Y WMA
01	10	1	10	----	----
02	12	2	24	70	11.66
03	12	3	36	74	12.33
04	14	1	14	82	13.66
05	16	2	32	100	16.66
06	18	3	54	108	18
07	22	1	22	112	18.66
08	18	2	36	118	19.66
09	20	3	60	114	19
10	18	1	18	126	21
11	24	2	48	150	25
12	28	3	84	----	----

Calculate the trend values using 5 year WMA for the following data. Weights are to be assigned in order 1, 2, 2, 3, 3.

YEAR	SALES	YEAR	SALES
1990	18	1997	32
1991	20	1998	28
1992	21	1999	36
1993	26	2000	34
1994	22	2001	35
1995	24	2002	44
1996	30	2003	46
		2004	42

LEAST SQUARES METHOD

EQUATION OF SRTAIGHT TREND LINE

$$Y = a + b X$$

Normal Equations for obtaining the values of a and b are as follows

$$(i) \sum Y = Na + b \sum X$$

$$(ii) \sum XY = a \sum X + b \sum X^2$$

N = Number of years,
X = Converted value for years.

(i)$\sum Y = Na + b \sum X$

(ii)$\sum XY = a \sum X + b \sum X^2$

If we take the middle year as year of origin then $\sum X = 0$.

Then $a = (\sum Y / N)$ = Mean of Y

AND

Putting the value of $\sum X = 0$ in equation (ii).

Then $b = (\sum XY / \sum X^2)$

Fit a straight line trend for the following series and Estimate the values for 1997

YEAR	Production
1990	60
1991	72
1992	75
1993	65
1994	80
1995	85
1996	95

$Y = 76 + 4.857\ X$

$Y_{1997} = 95.428$

Fit a straight line trend for the following series and Estimate the values for 1998

YEAR	Production
1989	38
1990	40
1991	65
1992	72
1993	69
1994	60
1995	87
1996	95

$$Y = 65.75 + 3.667\,X$$

$$Y_{1997} = 106.087$$

CALCULATION OF SEASONAL INDEX

There are 4 methods of computing seasonal component of time series:

1. Simple Average Method
2. Ratio to Trend Method
3. Ration to Moving Average Method
4. Link Relative Method

We will study only the first method…

Simple Average Method

1. Find the Quarterly totals.
2. Find Quarterly averages for each quarter.
3. Find grand average of quarterly averages.
4. Find the seasonal index of each quarter by dividing its quarterly average by grand average.

The given table shows trend free figures of quarterly sales made by a mega mall. Find the seasonal indices.

YEAR	I	II	III	IV
2003	39	20	60	85
2004	45	23	62	90
2005	60	32	76	100
2006	47	35	65	85

The following time series data on consumption of cold drinks contains only seasonal and irregular variations. Construct indices for seasonal variations using simple arithmetic mean.

YEAR	I	II	III	IV
2003	39	20	60	85
2004	45	23	62	90
2005	60	32	76	100
2006	47	35	65	85

Following data gives monthly production figures. Find monthly seasonal indices.

Yr	01	02	03	04	05
Jan	31	34	36	39	42
Feb	28	30	32	34	37
Mar	27	29	28	34	37
Apr	25	26	26	31	33
May	23	24	25	29	31
Jun	21	23	25	27	29
Jul	22	24	28	28	30
Aug	24	26	30	30	33
Sep	26	28	34	32	35
Oct	30	32	36	36	39
Nov	32	34	39	38	42
Dec	34	36	40	41	45

References and Suggested Readings

Fundamentals of Statistics by S.C. Gupta

Statistics Methods by S.P.Gupta