# MAR GREGORIOS COLLEGE OF ARTS & SCIENCE

Block No.8, College Road, Mogappair West, Chennai – 37

Affiliated to the University of Madras
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An ISO 9001:2015 Certified Institution

# DEPARTMENT OF COMMERCE

# (ACCOUNTING & FINANCE)

**SUBJECT NAME: BUSINESS STATISTICS**

**SEMESTER: III**

**PREPARED BY: PROF.M.PARTHIBAN**

# BUSINESSSTATISTICSSYLLABUS

OBJECTIVES

To Facilitate Understanding Relevance and Need Of Statistics in Current Scenario

- To Customize the Importance of Business Statistics for the Commerce Students

**UNIT-I** Introduction Meaning and Definition of Statistics- Collection and Tabulation of Statistical DataPresentation of Statistical Data-Graphs and Diagrams

**UNIT-II** Measures of Central Tendency and Measures of Variation Measures of Central Tendency- Arithmetic Mean, Median, Mode, Harmonic Mean and Geometric Mean. Measures of Variation- Standard Deviation -Mean Deviation-Quartile Deviation-Skeweness and Kurtosis- Lorenz Curve

**UNIT-III** Correlation and Regression Analysis Simple Correlation-Scatter Diagram- Karl Pearson's Correlation-Spearman's Rank Correlation- Regression- Meaning-Linear Regression.

**UNIT- IV** Time Series Analysis of Time Series-Causes of Variation in Time Series Data -Components of Time Series-Additive and Multiplicative Models- Determination of Trend By Semi Average, Moving Average and Least Square( Linear Second Degree And Exponential) MethodsComputation of Seasonal Indices By Simple Average, Ratio to Moving Average, Ratio to Trend and Link Relative Methods

**UNIT-V**Index Numbers Meaning and Types of Index Numbers-Problems in Construction of Index NumbersMethods of Construction of Price and Quantity Indices- Test of Adequacy- Errors in Index Numbers- Chain Base Index Numbers-Base Shifting -Splicing -Deflation -Customer Price Index and Its Uses- Statistical Quality Control SUGGESTED READINGS

1. Dhingra IC & MP Gupta, Lectures In Business Statistics, Sultan chand and Sons, New Delhi 2009

2. Gupta SP and ArchanaAgarwal, Business Statistics (Statistical Methods) Sultan chand and Sons, New Delhi, 9th Edition 2013

3. Gupta SC, Fundamentals of Statistics, Himalaya Publishing House

4. Richard Levin and David Rubin, Statistics for Management, Prentice Hall Of India, New Delhi, 2011,7th Edition

5. Sharma J K,Fundamentals of Business Statistics, Second Edition, Vikas Publishing House Private Limited,2013

6. Siegel, Andrew, Practical Business Statistics, Irwin Mcgraw Hill International Edition 4th

7. Rajagopalan SP and Sattanathan R B Business Statistics and Operations Research, Vijay Nicole

UNIT-1

IntroductionofStatistics

## INTRODUCTION

The word 'Statistics ' is derived from a Latin term "Status' or Italian term 'Statistics' or the Germanterm 'Statistick' is the French term 'Statistique' each of which means a political state. The termstatistics was applied to mean facts and figures and figures which were needed the state in respect ofthedivision ofthestate, theirrespectivepopulation birthrate, incomeandthelike.

**Statistics-Meaning:**

Theterm'Statistics'isconveyedtotwodifferentthings,Inthepluraluse,statisticsmeanssomesystematiccollectionofnumericaldataaboutsomeparticular topic.

In the singular use, it means the science of statistics. In the general practice, statistics isusedtomeanthescienceofstatistics anddata orstatisticaldataused forthenumericalvariables.

**Statistics–Definition**

''Statisticsarenumericalstatementoffactsinanydepartmentofenquiryplacedinrelationtoeachother''. **– A.I.Bowley.**

"Statistics may be defined as the science of collections presentation, analysis and interpretationofnumericaldata".-**CroxtonandCowden.**

**Characteristics of statisticsAggregateof fact's**

Statistical enquiry is to get information from a mass of observation with regards to thegroup behavior of individual items. For example, the aggregate of figures related to production,saleandprofitoverdifferenttimesis calledstatistics.

**Numericallyexpressed**

Numerical expression of the observed fact in terms of quantitative standards of particularscorescould beregarded asstatistics.

**Estimated**

Thenumericaldatapertainingbyfieldofenquirycanbeobservedeitherbyenumerating orbyestimation.Enumerationisusedforsellfieldofenquirywhileestimationisusedforwideandlargefield of enquiry.

**StandardofAccuracy**

Incaseofenumerationandestimation,itisessentialtofixthedesiredstandardofaccuracybeforehand.

**Predeterminedpurpose**

Thepurposeofenquiryisspecificallystated,andthenthedatashouldbecollectedinasystematicmannerthroughsomesuitableplan,soastomakethefiguresfreefrombiasanderrors.

**Comparability**

Theultimateaimofstatisticaldatais,forthepurposeofthecomparativeorrelativestudy.Therefore,itishomogeneousto makevalidcomparison.

## Objectiveofstatistics

- Toimprovetheunknownandtocastlightuponthestatisticsoutoffacts andfigures
- Toenablecomparisontobemakebetweenpastandpresent
- Tothrow lightonthereasonsofchanges,effectsofchangesandplansforfuture
- Tohandleanalyzeanddrawvalidinferences.
- Tohelptodrawingconclusionfromfactseffectedbyamultiplicityofcauses

## Importance/ScopeofStatistics/ApplicationofStatisticsinvariousfields in States

Statisticswasregardedasthe“ScienceofKings”.Itsuppliestheessential informationtorunthegovernment;Policiesareadopted bythegovernmentwith thehelpof statistics.

## Ineconomics

In economics, the problems are studied by the use of statistical methods economic lossisbasedonthestudyofcollectedstatisticaldata.Thelosseconomicsrefertostatisticstoprovetheiraccuracy.Statisticsineconomics asgivenbirthtoanewdisciplinecalledeconometrics.

## InBusiness

In the competitive business, the business people face some likeshortageis overstocking,uneconomic crisis etc., which can be solved through statistical analysis. To a greater extentstatisticshelpthebusinessman maximizetheirprofit.

## InEducation

Statistics is widely used in education for research purpose. It is used to test the pastknowledgeandevolvednewknowledge.

## InAstronomy

Astronauts study the eclipse and astronocal issues by applying statistics. They rely onestimation inmany casesand itwascorrectedwiththe helpof statistics.

## Inaccounting

In accounting correlation analysis between profit and sales is widely used. In auditing,Samplingtechniquesarecommonlyfollowed.

## InBanking

In this past developing technology, the banking sectorneeds a lot of information about thepresentand futurebusinessdevelopment.

## InInvestmentDecision

Statistics helps an investors in selecting securities, which are safe, yielding a good returnanappreciation in themarketprice.

## InInsurance

Statistics is extensively used in the field of Insurance. Actuarial statistics is must oftheinsurancecompany throughfixthepremiumrelateswhichisbasedonthemortalitytables.

Marketresearcherslargelydependsuponstatisticalmethodsindrawingconclusion

## Inmanagement

Statisticaltoolsareusedwidelybybusinessenterprisesforthepromotionofnewbusiness.

It also helps in the assessment of quantum of product to be manufactured, the amount ofrawmaterial,laborneeded,marketingavenuesfortheproductandthecompetitiveproductsinthemarket and so on.

## InIndustry

In Industry statics is used in quality control through control charge which has its basis onthe theory of probability, normal distribution andinspection, which are based on samplingtechniques

## InMedicalsciences

In medical sciences, the test of significance by student T –test for testing the efficiency ofnew drug, injection for controlling and curing specific ailments is done carried out by statistics.Comparative study for the effectiveness of different medicine by different concerns can also bealsobemadeby statistical techniquesof T&Ftestof significance

## InWar

Thetheoryofdecisionfunctionspropoundedby A.Waldcanbeofgreatassistancetothe military and technical personnel to plan maximum destruction with minimum effort. Moreover, thestatistical data obtained in the post war period reveal some useful information for planning futuremilitarystrategies.

## FunctionsofStatistics

- Itpreventsfacts inadefinitenumericalform
- Itsimplifiesthe complexityofthedata
- Itprovides atechniqueofcomparison
- Ithelpsinformulationandtestinghypothesis
- Ithelps inforecastingoffuturetrendsandtendencies
- Itstudiesrelationship
- Ithelpsthegovernment

## Limitationofstatistics

- Statisticscannotbeappliedtoindividualterm
- Statisticalstudyqualitativephenomenainindirectform
- Statisticallawarenotexact
- Statisticalresultsareuncertain
- Statisticsisnotsimple
- Statisticaldatamaybeincomparable
- Statisticsisliabletobemisused
-

CollectionofDataMeaning

DataCollectionmeanstheassemblingforthepurposeofaparticularinvestigationofentirelynew data,presumably noravailableinpublishedsources

## Data:meaning

Datarefertothefacts,figures orinformation collectedforaspecificpurpose

## TypesofData

Primarydata&Secondarydata

## Choicebetween Primaryand SecondaryData

- Natureand scopeoftheenquiry
- Availabilityoffinancialresources
- Availabilityoftime
- Degreeofaccuracydesigned
- Collectingagency
- PrimaryData
- Primarydataarenewandoriginalinnaturewhicharefirsthandinformationgeneratedtoachievet hepurposeof theresearch

## AdvantagesofPrimarydata

- Firstandnewinformation
- Morereliable
- Formulatedinsuchamanner,which bestsuits thepurpose

## Methodsofcollection ofPrimaryDataExperimentMethod

Heretheresearcherexaminesthetruthcontainedinhishypothesesbyconductingexperiments,through whichthedatearecollected.

## SurveyMethod

Underthis method,datacanbecollectedbyanyoneormoreofthefollowingways:

### A) Observationmethod

Thismethodreferstothecollectionofinformationbywayofinvestigator'sownobservationwith outinterviewingtherespondents.

### B) InterviewMethod

In the interviewmethod,a lot of questions relationto the proposedstudy is preparedandtheanswer for thesequestionnairesobtainedfromtherespondents.

### C) MailedQuestionnairemethod

Underthismethod,thequestionnaireissenttotherespondentswithacoveringlettertofillup thequestionnaireand sendback within aspecified time.

### D) ThroughSchedules

Underthismethod,enumeratorsareappointedandtrained.Whowilltakethequestionnairetothere spondentsandfilltheanswertothequestions,obtainedfromtherespondents

## Secondarydata

Secondarydataarenotnewandoriginalinnaturewhichareobtainedfrompublishedandorunpublis hedsources

## SourcesofSecondaryData

- **PublishedSources**
- **UnpublishedSources**

## Classificationand tabulation

### Meaning

Classificationistheprocessofarrangingthedataundervariousunderstandablehomogeneousgr oupsforthepurposeofconvenientinterpretation.Thegroupingofdataismakingonthebasisof common characteristics

## Definition

Theprocessofgroupingalargenumberofindividualfactsorobservationsonthebasisofsimilari tyamongtheitemsiscalledclassification. -Stactor and Clark

## Characteristicsofclassification

- Allfactscanbearrangedintohomogeneousgroups
- Classificationmaybeaccordingtotheirresemblancesandaffinities
- Classificationmaybemadeoneitheractualityornationality
- Goingexpressiontotheunityofattributes
- Itshouldbeflexibletoaccommodateadjustment

## Objectivesofclassification

- Tofacilitatecomparison
- Tostudytherelationship
- Totracelocationofimportantfacts ataglance
- Toeliminateunnecessarydetails
- Toeffectstatisticaltreatmentofthecollecteddata
- Tofacilitateeasyinterpretation

## Significanceofclassification

- Itishelpfultotabulation
- Itleadstoavalidresult
- Itmakesinterpretationclearandmeaningful

TypesofClassificationGeographicalClassification

Inthistypethedataareclassifiedonthebasisofgeographicallocationaldifferencesamongvariousitems onthebasisofstatesdistricts, cities, regions,and thelike

## ChronologicalClassification

Underthistypedataareclassifiedinthembasisofdifferencesintimeorperiodsuchasrainfallfor12 months.

## QualitativeClassification

In this classification, data are classified on the basis of some attributes or qualitativephenomenasuchasreligion,sex, maritalstatus,literacy,occupation and thelike.

## QuantitativeClassification

Underthistypedataareclassifiedaccordingtosomequantitativephenomenacapableofquantitativemea surementsuchas age,experience,income,prices,production,sales andthelike

## FrequencyDistribution

Frequencydistributionistheprocessormethodinsimplifymassofdataintogroupedformof classes andthememberof itemsinsuch class isrecorded

a. UnivaraiteFrequencyDistribution
b. BivariateFrequencyDistribution

### a. UnivariateFrequencydistribution

Itisonewayfrequencysinglevariabledistributionandfurtherclassificationinto

- IndividualObservation
- DiscreteFrequencyDistribution
- ContinuousFrequencyDistribution

### b. BivariateFrequencyDistribution

BivariateFrequencyDistributionisatwowayFrequencydistribution,wheretwovariables aremeasuredinthesamesetofitems through crossdistribution

## Tabulation

Tribulationis asystematicarrangementofraw datainacompactformofhistoricalRowsand verticalcolumn

## Usesoftables

- Itsimplifiesthepresentation
- Itfacilitatescomparison
- Itiseasiertodistendtherequiredinformation
- Itreflectsthetrendsandtendencies

## Partsoftables

- TableNumber
- Titleofthetable
- HeadNote
- Caption
- Bodyofthetable
- SourceNote
- FootNote

DiagrammaticandGraphicPresentationDiagramsandGraphs

Diagramsandgraphsareeasymethodsofunderstandingofdataastheyareavisualformofpresentation of presentation of statistical data.

Diagrams and attractive and useful to find out the result. Data should be simplified beforepresenting in the diagram. Two or more sets of data can be compared with the help of diagrams.Diagramsprovidemoiréinformation thanthetable.

## MethodsofDiagrams

Points,lines,bars,squares,rectangles,circlescubeandsoon.

## TypesofCharts

- Charts,picturesMapsandthelike
- Advantagesofdiagrams
- VisualformofpresentationProvideattractiveandImpressiveview
- Savetimeandlabour
- MadeComparisonEasy
- Usefulforproduction
- Providemoreinformation

## LimitationsofDiagramsandCharts

- Furtheranalysisisnotpossible
- Theyshowonlyapproximatevalues
- Alldetailscannotbepresenteddiagrammaticallyandorgraphically
- Constructionofdiagramsandgraphsrequiresomeskill
- Itis complementary inthetablebutnotanalternativetoit

## TypesofDiagrams

- Onedimensionaldiagram
- Twodimensionaldiagram

- Threedimensionaldiagram
- Pictogram
- Cartograms

## Bar Diagrams

Barisathickwideline.Statisticaldatapresentedintheformofbariscalledbardiagram.Simplebut diagramiscommonly usedin business

## Typesofbardiagram

- Simplebardiagram
- Percentagebardiagram
- Bilateraldeviationbardiagram
- Multiplebardiagram
- SubdividedbarDiagram

Unit-2

MeasuresofCentral Tendency and MeasuresofVariation

**MEASURESOFCENTRALTENDENCY**

AverageMeaning

Averageisasinglevaluethatrepresentsgroupof values

## Definition

AnAverageis avaluewhichatypicalorrepresentativeofanetofdata

## CharacteristicsofaGoodAverage

- Itshouldbedefinedclearandunambiguoussothatitleadstooneandonlyoneinterpreta tion by differentpersons
- Itshouldbeeasytounderstandandsimpletocomputeandshouldnotinvolveheavyarithmetical calculations
- Itshouldbebasedonalltheitemsofthegivensetofdatais computetheaverage.
- Itshouldbesuitableforfurtheralgebrasmathematicaltreatmentandcapableofbeingusedisfu rther statistical computations

## UsesofAverage

- Itisusefultodescribethedistributioninaconcisemanner
- Itisusefultocomparedifferentdistributions
- Itisusefultocomparevariousstatisticalmeasuressuchasdispersion,skewness,kurtosisand soon

## FunctionsorAnaverage

- TofacilitateQuickunderstandingofcomplexdata
- TofacilitateComparison
- Itestablishesmathematicalrelationship
- Capableoffurtherstatistical comparison

## TypesofAverage

- MathematicalAverage
- LocationAverage
- CommercialAverage

## Objectivesofan Average

- Togetasinglevaluethatdescribethefeatures oftheentiregroup
- Toprovidegroundforbettercomparison
- Toprovidegroundforfurtherstatisticalcomputationandanalysis

## ArithmeticMean

The arithmetic mean of a series of items is the sum of the values of all items divided bythat total number. It is a multinational average and it is the most popular measure of centraltendency

## MeritsofAntiemeticMean

- Easytocalculateandunderstand
- Itisaperfectaverage, affectbythevalueofeveryitemintheseries
- Itiscalculatedvalueandnotbasedonpositionintheseries
- Itisdeterminedbyarigidformula.Hence,everyonewhocomputestheaveragegetsthesamean swer
- Itisusedinfurthercalculation
- Itgives agoodbaseforcomparison

## DemeritsofArithmeticMean

- Themeanisundulyaffectedbytheextremeitems
- ItisunreliableItmayleadtoafalseconclusion
- Itisnotusefulforthestudyofqualities
- Itcannotbelocatedbythegraphicmethod

ArithmeticMeanIndividualSeries

Findourmeanfromthefollowingdata

| RollNo | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Marks | 21 | 30 | 28 | 40 | 26 | 34 | 40 | 9 | 15 | 17 |

Solution:

| RollNo | Marks(X) |
|---|---|

| | |
|---|---|
| 1 | 21 |
| 2 | 30 |
| 3 | 28 |
| 4 | 40 |
| 5 | 26 |
| 6 | 34 |
| 7 | 40 |
| 8 | 9 |
| 9 | 15 |
| 10 | 17 |
| N=10 | ∑X =300 |

Formula=X=∑X/NX=300/10=30.The mean marks =30

## DiscreteSeries

**Calculatethearithmeticmeanforthewagesofworkersina Factory**

| WagesinRs. | 4 | 6 | 8 | 10 | 15 | 16 |
|---|---|---|---|---|---|---|
| Workers | 5 | 15 | 6 | 7 | 8 | 2 |

## Solution

| Wages inRs. | Workers f | fx |
|---|---|---|
| 4 | 5 | 4x5=20 |
| 6 | 15 | 6x15=96 |
| 8 | 6 | 8x6=48 |
| 10 | 7 | 10x7=70 |
| 15 | 8 | 15x8=120 |
| 16 | 2 | 16x2=32 |
| | N=∑f=43 | ∑fx=380 |

X = ∑fx/N=380,N=43
= 380 /43 =8.837
Theaveragewageofworkers =Rs.8.84

ContinuousSeries CalculateArithmeticMean

| **Class Intervals** | **0-10** | **10-20** | **20-30** | **30-40** | **40-50** |
|---|---|---|---|---|---|
| **Frequency** | **6** | **5** | **8** | **15** | **7** |

| ClassIntervals | Mid-point | Frequency | fm |
|---|---|---|---|
| 0-10 | 5 | 6 | 30 |
| 10-20 | 15 | 5 | 75 |
| 20-30 | 25 | 8 | 200 |
| 30-40 | 35 | 15 | 525 |
| 40-50 | 45 | 7 | 315 |
| | | N=∑f=41 | N=∑fm=1145 |

ArithmeticMean=X
==∑fm/NTheArithmeticmean=27
.92

## Median

Median is the value of the middle item of a series arranged in ascending or descendingorder of magnitude. Hence it is the "Middle most" or "Most central" value of a set of number.Itdividetheseriesintotwoequalpart,onepartcontainingvaluesgreaterandtheotherwithvalues lessthan themedian.

## Meaning

Thenumberisthatvalueofthevariablewhichdividesthegroupintotwoequalparts, onepartcomprisingallvalues greaterandtheother,allvalueslessthanmedian.

## MeritsofMedian:

- Itiseasytocomputeandunderstand
- Iteliminatestheeffectofextremeitem
- Thevalueofmediancanbelocatedgraphically
- DemeritsofMedian
- Thecalculatingmedia,itisnecessarytoarrangethedataotheraveragesdonotneedanarrange ment
- Itisaffectedmorebyfluctuationofsamplingthanthe arithmeticmean.
- Itis notbased onalltheitemsoftheseries

## IndividualSeries

**Arrangethedataeitherascendingordescendingorder**

Median–Sizeof N+1

.....

.....th

Item2

Findoutthemedianfromthefollowing

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 57 | 58 | 61 | 42 | 38 | 65 | 72 | 66 | 80 |

## Solution

| Sl.No | Dataarrangedinascendingorder |
|---|---|
| 1 | 38 |
| 2 | 42 |
| 3 | 57 |
| 4 | 58 |
| 5 | 62 |
| 6 | 65 |
| 7 | 66 |
| 8 | 72 |
| 9 | 80 |

Median=–Sizeof N+1

.....th

Item2

- =Sizeof9+1
- ----------theitem
-
- 2
- =10/2=5$^{th}$item

Median=62

## DiscreteSeries

Computethemedian forthefollowingdistributionofweeks ofwagers of65employeesofthexyzcompany

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Weekly wages inRs | 55 | 65 | 785 | 85 | 95 | 105 | 115 |
| Numberof employees | 8 | 10 | 16 | 14 | 10 | 5 | 2 |

Solution

| WeeklywagesinRs | NoofEmployees | Cumulativefrequency(cf) |
|---|---|---|

| | | |
|---|---|---|
| 55 | 8 | 8 |
| 65 | 10 | 18 |
| 75 | 16 | 34 |
| 85 | 14 | 48 |
| 95 | 10 | 58 |
| 105 | 5 | 63 |
| 115 | 2 | 65 |

Median=–Sizeof N+1
.....thItem
2
= sizeof 65 +1
....
.....th
Item2

=33'whichisnearerto34
Cf of34= 75
Medianweeklywages=75

## ContinuousSeries

Calculatethemedianformthefollowingdata

| Marks | 0-20 | 20-40 | 40-60 | 60-80 | 80-100 |
|---|---|---|---|---|---|
| NoofStudents | 5 | 15 | 30 | 8 | 2 |

## Solution

| Marks | Noofstudents | Cumulativefrequency |
|---|---|---|
| 0-20 | 5 | 5 |
| 20-40 | 15 | 20 |
| 40-60 | 30 | 50 |
| 60-80 | 8 | 58 |
| 80-100 | 2 | 60 |

Median=–izeof N
----------thItemcsizeof60/2thItem2
N /2-cf

=sizeofL+.....XC
f

30- 20
=40+ ----------x 20= 46.47
2
Medianmarks=46.676

## Mode

Modeisthemodalvalueinthevalueofthevariablewhichoccursmorenumberof timesormostfrequentlyis adistribution.Modeisthevaluewhichoccurswiththegreatestnumberof frequency in aseries

## Types of modal

### I. Uni-model

Ifthereisonlyonemodeinseries is calleduni-model

### II. Bi-Modal

Iftherearetwomodesintheseries,itiscalledbi-model

### III. Tri-Modal

Iftheyarethreemodesin theseries,itisRelationshipbetweendifferentAveragesSymmetricaliscalledTri-model.

### IV. Multimodal

Iftherearemorethanthreemodesintheseriesitiscalledmulti-mode.Relationship among mean, median andmode

The three averages are identical, when the distribution is symmetrical. In an asymmetricaldistribution,thevaluesof mean,medianandmodearenotequal.

Median = 1/3 (Mean - mode )Mode =2median-2mode

Median=Mode*2/3(Mean–Mode)

## IndividualSeries

Calculatethemodeformthefollowingdataofthemarks obtainby10students

| SerialNo | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Marks obtained | 60 | 77 | 74 | 62 | 77 | 77 | 70 | 68 | 65 | 80 |

Solution

Marksobtainedby10studentsishere77isrepeatedthreetimesTheref oretheModemark is 77

## DiscreteSeries

Calculatethemodeformthefollowingdataofthewagesofworkers ofareestablishment.Findthemodalwages

| Daily wagesin Rs | 3 | 4 | 6 | 7 | 9 | 10 | 12 | 13 | 15 |
|---|---|---|---|---|---|---|---|---|---|
| Noof wagee arners | 2 | 3 | 2 | 6 | 10 | 11 | 12 | 5 | 1 |

SolutionGroupingTable

| Daily Wages is Rs. | FrequencyofWages Earners | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | 2 | 5 | | 7 | | |
| 4 | 3 | | 5 | | 11 | |
| 6 | 2 | 8 | | | | 18 |
| 7 | 6 | | 16 | **27** | | |
| 9 | 10 | **21** | | | **33** | |
| 10 | 11 | | **23** | | | **28** |
| 12 | **12** | 17 | | 18 | | |
| 13 | 5 | | 6 | | | |
| 15 | 1 | | | | | |

AnalysisTable:

| **Column** | **Sizeof Item** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **4** | **6** | **7** | **9** | **10** | **12** | **15** |
| **1** | | | | | | **I** | |
| **2** | | | | **I** | **I** | **I** | |
| **3** | | | | | **I** | **I** | |
| **4** | | | **I** | **I** | **I** | | |
| **5** | | | | **I** | **I** | **I** | |
| **6** | | | | | **I** | **I** | **I** |
| | | | **I** | **3** | **5** | **4** | **1** |

Fromtheanalysistableitisknownthatsize10has beenrepeatedthemaximumnumberoftimes,thusis, sothemodalwagesRs10

## Continuousseries

Findoutthemodefromthefollowingseries

| X | 0-5 | 5-10 | 10-15 | 15-20 | 20-25 | 25-30 | 30-35 |
|---|---|---|---|---|---|---|---|
| frequency | 1 | 2 | 5 | 14 | 10 | 9 | 2 |

**Modalvaluelies in15-20asitoccursmostfrequently**

$$\text{Mode}(Z) = L + \frac{f1 - f0}{2\,f1 - f0 - f2} \times C$$

$$\text{Mode}(z) = 154 + \frac{14 - 5}{2(14) - 5 - 10} \times 5$$

$$= 15 + 9/13 \times 5 = 15 + 45/13$$

$$= 15 + 3.46$$

Mode= 18.46

## GeometricMean

MeritsofgeometricMean

- Everyiteminthedistributionisincludedinthecalculation
- Itcanbecalculatedwithmathematicalexactness,providedthatallthequalitiesaregreater thanzeroand positive
- Largeitemshavelesseffectonitthanintherithmeticaverage.
- Itisamenabletofurtheralgebraicmanipulation

## DemeritsofGeometricmean

- Itisverydifficulttocalculate
- Itisimpossibletouseitwhenanyitemiszeroornegative
- Thevalueofthegeometricmeanmaynotcorrespondwithanyactualvalueinthedistribut ion

## UsesofGeometricmean

- Thisaverageisoften usedtoconstructindexnumbers,wherewearechieflyconcernedwithrelativechangesoverap eriod oftime
- Itistheonlyusefulaveragethatcanbeemployed toindicaterateofhave

## Individualseries

$$G.M = \text{Antilog of} \frac{\sum \log X}{N}$$

CalculateGeometricMean

| | | | | |
|---|---|---|---|---|
| 50 | 72 | 54 | 82 | 93 |

Solution

| X | LogtX |
|---|---|
| 50 | 1.6990 |
| 72 | 1.8573 |
| 54 | 1.7324 |
| 82 | 1.9238 |
| 93 | 1.9685 |

$$G.M = \text{Antilog of} \frac{\sum \log X}{N}$$

$$= \text{Antilog of} \frac{9.1710}{5} = 1.8342$$

$$= \text{Antilog of } 1.8342 = 68.26$$

## DiscreteSeries

## Calculate

**Geometricmean fromthefollowingdata**

| **Sizeof Item** | **120** | **125** | **130** | **135** | **136** | **138** | **139** | **140** | **147** |
|---|---|---|---|---|---|---|---|---|---|
| **Frequency** | **2** | **3** | **3** | **1** | **1** | **7** | **4** | **2** | **8** |

Solution:

| **SizeofItem( X)** | **Frequency (f)** | **LogX** | **Flogx** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 120 | 2 | 2.0792 | 4.1584 |
| 125 | 3 | 2.0969 | 6.2907 |
| 1360 | 3 | 2.1139 | 6.3417 |
| 135 | 1 | 2.1303 | 2.1303 |
| 136 | 2 | 2.1335 | 4.2670 |
| 138 | 7 | 2.1399 | 14.9793 |
| 139 | 4 | 2.1430 | 8.5720 |
| 140 | 2 | 2.1461 | 4.2922 |
| 147 | 8 | 2.1673 | 17.3384 |
| | **N=∑f=32** | | **N==∑flogx= 68.3700** |

$$G.M = \text{Antilingof}\frac{\sum \log X}{N} = \text{Antilogof}\frac{68.375}{32}$$

**=Antilogof2.1366= 137Therefore G.M=137**

**Continuousseries**

**Geometricmeanfromthefollowingdata**

| **Yieldof wheat** | **7.54-10.5** | **10.5-13.5** | **13.5 -16.5** | **16.5-19.5** | **19.5-22.5** | **22.5-25.5** | **25.5-28.5** |
|---|---|---|---|---|---|---|---|
| **No of forms** | **5** | **9** | **19** | **23** | **7** | **4** | **1** |

Solution:

| **Yieldofwheat** | **MidValue** | **LogM** | **No. of Forms** | **flogm** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 7.54-10.5 | 9 | 0.9542 | 5 | 4.7710 |
| 10.5-13.5 | 12 | 1.0792 | 9 | 9.7128 |
| 13.5 -16.5 | 15 | 1.1761 | 19 | 22.3459 |
| 16.5-19.5 | 18 | 1.2553 | 23 | 28.8719 |
| 19.5-22.5 | 21 | 1.3222 | 7 | 9.2554 |
| 22.5-25.5 | 24 | 1.3802 | 4 | 5.5208 |
| 25.5-28.5 | 27 | 1.4314 | 1 | 1.4314 |
| | | | **N=68** | **∑flogm=81.9092** |

**G.M=Antilogof∑flogm**

**----------**

**N**

**= 81.9092/68= 1.204547**

**=Antilogof 1.204547=16.02G.M=16.02**

## HarmonicMean

## Meaning

HarmonicMeanisthereciprocalofthearithmeticaverageofthereciprocalofvaluesofvariousite min theinvariable

## MeritsofHarmonicMean

- Itutilizesallvaluesofavariable
- Itisvery importanttosmallvalues
- Itisamenabletofurtheralgebraicmanipulation
- Itprovidesconsistentresultsinproblemsrelatingtotimeandratesthansimilaraverag es

## DemeritsofHarmonicMean

- Itisnotveryeasytounderstand
- Themethodofcalculationisdifficult
- Thepresenceofbothpositiveandnegativeitemsinaseriesmakes itimpossibletocomputeitsvalue.Thesamedifficultyisfeltifoneormoreitemsarezero
- Itisonlyasummaryfigure andmaynotbetheactualitemintheseries.

## IndividualSeries

**N**

**H.M= -------**

**∑1/x**

## FindouttheHarmonicmean

| **Family** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Income** | 85 | 70 | 10 | 75 | 500 | 8 | 42 | 250 | 40 | 36 |

**Solution**

## ComputationofHarmonicMean

| **Family** | **Income (X)** | **1/x** |
|---|---|---|
| 1 | 85 | 0.01176 |
| 2 | 70 | 0.01429 |
| 3 | 10 | 0.10000 |
| 4 | 75 | 0.01333 |
| 5 | 500 | 0.00200 |
| 6 | 8 | 0.12500 |
| 7 | 42 | 0.02381 |
| 8 | 250 | 0.00400 |
| 9 | 40 | 0.02500 |
| 10 | 36 | 0.02778 |
| **N =10** | | **∑1/x =0.34697** |

**N**

H.M = -------

∑1/x

=10/0.34697 =28.82H.M= 28.82

## DiscreteSeries

| **SizeofItem** | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|
| **Frequency** | 4 | 6 | 9 | 5 | 2 | 8 |

Solution:

| **SizeofItem X** | **Frequency f** | **1/x** | **F1/x** |
|---|---|---|---|
| 6 | 4 | 0.1667 | 0.6668 |

| | | | |
|---|---|---|---|
| 7<br>8<br>9<br>10<br>11 | 6<br>9<br>5<br>2<br>8 | 0.1429<br>0.1250<br>0.1111<br>0.1000<br>0.0909 | 0.8574<br>1.1250<br>0.5555<br>0.20000.7272 |
| | N=∑f=34 | | ∑fl/x=<br>4.1319 |

$$H.M = \frac{N}{\sum fl/x} = \frac{34}{4.1319} = 8.23$$

**ContinuousSeries**

ComputeHarmonicMean

| **Size** | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 |
|---|---|---|---|---|---|
| **Frequency** | 5 | 8 | 12 | 6 | 4 |

**Solution**

| **Size** | **Frequencyf** | **Midvalue** | **reciprocal** | **F(1/m)** |
|---|---|---|---|---|
| 0-10<br>10-20<br>20-30<br>-30-40<br>40-50 | 5<br>8<br>12<br>6<br>4 | 5<br>15<br>25<br>35<br>45 | 0.20000<br>0.06667<br>0.04000<br>0.02857<br>0.02222 | 1.00000<br>0.53336<br>0.48000<br>0.17142<br>0.08888 |
| | **∑f=35** | | | **∑fl/m=2<br>.27366** |

$$H.M = \frac{N}{\sum fl/m} = \frac{35}{2.27366} = 15.393682$$

## MeasuresofVariationorDispersion Meaning

Dispersionisthestudyofscatternessaroundanaverage

## Definition

Dispersionisthemeasures ofthevariationoftheitems ---A.L.Bowley

Dispersionisameasureofextenttowhichtheindividualitems vary ----------L.R.Connor

## Importanceofmeasuringvariationordispersion

- TestingtheReliabilityoftheMeasuresofCentralTendency
- Comparingtwoormoreseriesonthebasisoftheirvariability
- Enablingtocontrolthevariability
- Facilitatingas aBasisforfurtherstatisticalAnalysis

## CharacteristicsofaMeasureofVariation

- Itiseasytounderstandand simpletocalculate
- Itshouldberigidlydefined
- Itshould bebased on allobservationsand itshould notbeaffected byextremeobservations
- Itshouldbeamenabletofurtheralgebraictreatment
- Itshouldhavesamplingstability

## MethodsofMeasuringDispersion

- Range
- InterQuartilerange
- QuartileDeviation
- MeanDeviation
- StandardDeviation
- LorenzCurve

## Range

Rangeisthedifferencebetweenthelargestandthesmallestvalueinthedistribution.It isthesimplestandcrudestmeasureofdispersion

## UsesofRange

- Itisusedinindustries forthestatisticalqualitycontroloftheminfected product
- Itisusedtostudythevariationssuchasstock,sharesandothercommodities
- Itfacilitatestheuseofotherstatisticalmeasures

## AdvantagesofRange

- Itisthesimplestmethodofstudyingvariation
- Itiseasytounderstandandtheeasiesttocompute
- Ittakesminimumtimetocalculate
- Itisaccurate

## DisadvantagesofRange

- Rangeis completelydependedonthetwoextremevalues
- Itissubjecttofluctuationsofconsiderablemagnitudefromsampletosample
- Itisnotsuitableformathematicaltreatment
- Itcannotbeappliedtoopenandclasses
- Rangecannottellusanythingaboutthecharacter ofthedistribution

## Quartiledeviation

Quartile deviation is an absolute measure of dispersion. It is calculated on the basis ofthedifferenceof upper quartileand thelowerQuartiledivided by 2.

In the series, four quartiles are there. By eliminating the lowest (25%) items and thehighest(25%)itemsofaseries,wecanobtainameasureofdispersion andcanfindouthalfthedistancebetweenthefirstandthethird quartiles.

Q3-Q1

$$\text{QuartileDeviation (Q.D)} = \frac{}{2}$$

$$\text{Co-efficientof Q.D} = \frac{Q3 - Q1}{Q3 + Q1}$$

## MeritsofQuartileDeviation

- Itissimpletocalculateandeasytounderstand
- Risk of extreme item variance is eliminated, as it depend upon the central 50 per centitems
- Itcanbeappliedtoopenandclasses

## DemeritsofquartileDeviation

- Itemsbelow Q1andaboveQ3areignored
- Itisnotcapableoffurthermathematicaltreatment
- Itisaffectedmuchbythefluctuationsofsampling
- Itisnotcalculatedfromacomputedaverage,butfromapositionalaverage.

## Meandeviation

Mean deviation is the average difference between the items in a distribution computedfromthemean,medianormodeofthatseriescountingallsuchdeviationaspositive.Themeandeviationisalso known as theaveragedeviation

$$\text{Meandeviation} = \frac{\sum IDI}{N}$$

**Co–efficientofMean Deviation(M.D)=MD/Meanor Median**

**MeritsofMeanDeviation**

- Itisclearandeasytounderstand
- Itis basedoneachandeveryitemofthedataItcanbecalculatedfromanymeasureofcentraltendency and as such asflexibletoo.

## DemeritsofmeanDeviation

- **It**isnotsuitableforfurthermathematicalprocessing
- Itisrarelyusedinsociologicalstudies
- Itismathematicallyunsoundandillogical,because thesignsareignoredinthecalculation of mean deviation

## Standarddeviation

Standard deviation is the square root of the means of the stranded deviation from theArithmeticmean.
So,itisalsoknownasRootMeanSquareDeviationanAverageofSecondorder. Standard deviation is denoted by the small Greek letter 'σ' the concept of standarddeviationisintroduced by KarlPearsonin 1893.

**UsesofStandarddeviation**

- Itisusedinstatistics becauseitpossessesmustofthecharacteristicsofanidealmeasureof dispersion.
- Itiswidely usedinsamplingtheoryandbybiologists.
- Itisappliedinco-efficientofcorrelationandinthestudyofsymmetricalfrequencydistribution

**Advantagesofstandarddeviation**

- Itisrigidlydefineddeterminate
- Itisbasedonalltheobservations ofaseries
- Itislessaffectedbyfluctuations ofsamplingandhencestable
- Itisamenabletoalgebraic treatmentandislessaffectedbyfluctuationsofsamplingmostothermeasuresofdispersion
- The standard deviation is more appropriate mathematically than the mean deviation,sincethenegativesignsareremovedbysquaringthe deviationsratherthanbyignoring

## SKEWNESS

**Introduction**

Theterm'Skewness'referstolackofsymmetry,thatis,whenadistributionistosymmetrical it is called a skewed distribution. It the curve us normal or the data distributedsymmetrically or uniformly. Spread will be the same on both sides of the cent repoint and themeansmedian andmodewillallhavethesamevalue.

## Definition

'Skewnessorsymmetryistheattributeofafrequencydistributionthatextendsfurtheron onesideoftheclass withthehighestfrequencyontheother---**SimpsonandKafka**

Whenaseriesisnotsymmetricalitissaidtobeasymmetricalorskewed-**CroxtonandcowdenSkewness ofa**

**Distribution**

Whenadistributionisnotsymmetricalitiscalledaskewed Distribution.
Theanalysis ofpresenceofskewnessinadistributionimpliestwomaintasks.Theyare

I. Determinationofthesignofskewnessandtestingofskewnessand
II. Determinationoftheextentofskewness

## Absolutemeasuresofskewness

i) TheKarlPeason'sCoefficientofSkewness
ii) TheBowley's CoefficientofSkewness
iii) TheKelly'sCoefficientofSkewness
iv) MeasureofSkewnessbasedonmoments

## KarlPearson'sCo-efficientofSkewness

Thismethodisbaseduponthedifferencebetweenmeanandmodeandthedifferenceisdividedby standarddeviation to givearelativemeasures.

## Bowley'sCoefficientofSkewness

Bowelysmeasureisbasedonquartiles,inasymmetricaldistributionfirstandthirdquartiles areequidistantfromthemedian

## ObjectivesofSkewness

I) Tofindoutthedirectionandextentofasymmetryinaseries.
II) Tocomparetwoormoreserieswithregardstoskewness.
III) Tostudythenatureofvariationoftheitemsaboutthecentralvalue.

**Graphic method ofdispersionLorenzCurve**

Lorenz Curve is a device used to show the measurement of economic inequalities as inthedistributionofincomeandwealth.Itcanalsobeusedinbusinesstostudythedisparitiesofdistribution of profit,wages,turnover,production andthelike.

Unit-3

CorrelationandRegression Analysis

**CorrelationandRegressionAnalysis**

Meaning:

Correlation is the study of the natural relationship between two or more variables. Hence, it should be notedthat the detection and analysis of correlation between two statistical variables requires relationship of some sort whichassociatestheobservation inpairseach ofwhichisavalueof thetwo variables

Definition

Therelationshipthatexistsbetweentwovariables --- SmithCorrelationanalysis dealswiththeassociationbetweentwoormorevariables ----Tuite

## UsesofCorrelation

I) Correlationisveryusefulinphysicalandsocialsciences.Businessandeconomics
II) Correlationanalysisisveryusefulineconomicstostudytherelationshipbetweenpriceanddem and
III) Itisalsousefulinbusinesstoestimatescosts,value,priceandotherrelatedvariables
IV) Correlationisthebasis oftheconceptofregression
V) Correlationanalysishelpincalculationthesamplingonce.

## TypesofCorrelation

- Positivecorrelation
- NegativeCorrelation
- SimpleCorrelation
- MultipleCorrelations
- PartialCorrelation
- LinearCorrelation
- Non–LinearCorrelation

## PositiveCorrelation

Correlation is said to be positive when the values of two variables move in the samedirection, so that an increase in the value of one variable is accompanied by an increase in thevalue of the other variable or a decrease in the value of one variable is followed by a decreaseinthevalueof theother variable

## NegativeCorrelation

Correlation is said to be negative when the values of two variables move in oppositedirection,sothatanincreaseinthevalues ofonevariableisfollowedbyadecreaseinthevalueoftheother and vice-versa.

## SimpleCorrelation

Whenonlytwovariablesarestated,itissaidtobesimplecorrelation

## MultipleCorrelations

Whenmorethantwovariables arestatedsimultaneously, thecorrelationis saidtobemultiple

## PartialCorrelation

Partialcorrelationcoefficientprovidesameasureofrelationshipbetweenadependentvariablea ndaparticularindependentvariablewhenallothervariablesinvolvedarekeptconstantanalysistoyieldan drainfall;itbecomesaproblemrelating tosimplecorrelationLinearCorrelation

Thecorrelation issaidto belinear,iftheamountofchangeisonevariabletendsto bearaconstantratio to theamountofchangeintheother

## NonLinearCorrelation

Thecorrelationisnonlinear,iftheamountofchangeinonevariabledoesnotbearaconstantratioto theamountofchangein theother related variable.

## Methodsofstudyingcorrelation

## Graphicalmethod

- Scatterdiagram
- Simplegraphmethod

## MathematicalMethods

- KarlPearson'sCo-efficientofcorrelation
- Spearman'sRankCorrelationcoefficient
- Concurrentdeviationmethod
- Methodofleastsquare

## Scatterdiagrammethod

It is a method of studying correlation between two related variables. The two variablesXand Y will be taken upon the X and Y axes of a graph paper. For each part of X and Y values, wemarkadotandwego asmany pointsasthenumbersof observation.

## Graphicalmethod

In this method curves are drawn for separate series on a graph paper. By examining thedirectionandclosenessofthetwocurveswecanofferwhetherpromptvariancesarerelated. Ifboththe curves are moving in the same direction correlation is said to be positive. On the contrary, ifthecurvesaremovingin theoppositedirectionsis said tobenegative.

## KarlPearson'sCo-efficientofcorrelation

Karl Pearson, a great statistician introduced a mathematical method for measuring themagnitude of relationship between two variables.This method. Known as Pearson Coefficient ofcorrelationiswidelyused.Itis denoted by thesymbol"r'

## Spearman'sRankCorrelationCo-efficient

In1904,afamousBritishpsychologistCharlesEdwardSpearmanfoundoutthemethodofCo-efficient of correlation of rank. Rank correlation is applicable to individual observation. Thismeasure is useful in dealing with qualitative characteristics. The result, by using ranking method,is only approximate.

## Regression

## AnalysisMeaning

Thestatisticalmethodemployedtoestimatetheunknownvaluedofonevariablefromtheknown valueof therelatedvariablesiscalled regression

## Definition

Regressionisthe measureoftheaverage relationshipbetweentwoormorevariablesintermsof theoriginalunitsof thedata- Blair

RegressionanalysisMeaningregressionanalysisisstatisticaldevicewithwhichweestimatoror predicttheunknownvaluesofonevariablefromknownvalueofanothervariable

## Regressionanalysisdefinition

Oneofthemostfrequentlyusedtechniquesineconomicsandbusinessresearch,topfindarelation betweentwoormorevariablesthatarerelatedcausally,isregressionanalysis.
- TaroFamane

## Usesofregressionanalysis

- Itisusefultoestimatetherelationshipbetweentwovariables
- Itis usefulforproductionofunknownvalue
- Itiswidelyusedinsocialscienceslikeeconomics,Naturalandphysicalsciences
- Itisusefultoforecastthebusinesssituation
- Itisusefultocalculatecorrelationco-efficientandco-efficientofdeterminations

## MethodsofstudyingRegression

- Graphicmethod
- Algebraicmethod

## Graphicmethod

Under the method the dots are plotted on a graph paper representing pair of values of thegivenvariableshavingalinearrelationshiptheindependentvariableistakenintheXaxisandthedepen dent variable taken on Y axis. The regression line of X on Y provides the most probablevalue of X given the most probable valueof Y when the exact value of X is known. Thus we gettworegressionlines.

## Regressionlines

I) RegressionofXonY
II) Regressionof Y onX

Unit-4TimeSeries

## TimeseriesAnalysis

- Timeseriesanalysisistheanalysisofidentifyingdifferentcomponentssuchastrend,seasonal, cyclicalandirregularinagiventimeseriesdata.

## Definition

Atimeseriesisasetofobservationarrangedinchronologicalorder.MorrisHambergrequirement of a time series Data must be available for a long period of time. Data must consist of ahomogeneous set of values belonging to different time periods. The time gap between the variables orcompositeof variablesmustbeasFor Possible equal.

## CausesofvariationinTimeSeriesData

- Socialcustoms,festivalsetc.Seasons
- Thefourphaseofbusiness:prosperity,decline,depression,recovery
- Naturalcalamities:earthquake,epidemic,flood,droughtetc.Political movements/changes,waretc.

ComponentsofTimeseries;Additiveandmultiplicativemodels

### ComponentsofTimeSeries

1. SecularTrend
2. SeasonalVariation
3. CyclicalVariations
4. Irregularvariation

### 1. SecularTrend

Asecular trendorlong-termtrendreferstothemovementsoftheseriesreflectingcontinuous growth or decline over a long period of time. There are many types of trend. Sometrendsriseupwardand somefalldownward

### 2. SeasonalVariation

Is that periodic investment in business activities within the year recurring periodicallyyearafter year**?**
Generally,seasonalvariationappearatweekly,monthlyorquarterlyintervals

### 3. CyclicalVariation

Upanddownmovementsaredifferentfromseasonal fluctuations,inthattheyextendoverlongerperiodoftime–usuallytwoormoreyears.Businesstimeseries isinfluencedbythewave-likechangesof prosperity anddepression.

### 4. IrregularVariation

Irregular variations or random variations constitute one of four components of a time series.Theycorrespondtothemovementsthatappearirregularlyandgenerally during shortperiods.Irregularvariationsdo notfollowaparticularmodelandarenotpredictable.

## MathematicalModelforaTimeSeries

Inclassicalanalysis,itisassumedthatsometypesofrelationshipexistamongthefourcomponentsof timeseries

### AdditiveModel

Accordingtothismodel,thetimeseriesisexpressedasY=
T+S+C+ I
Y=thevalueoforiginaltimeseri
esT=TimeValue
S =
SeasonalvariationC =
CyclicalVariation
Irregularfluctuation

MultiplicativeModel

Accordingthismodel,thetimeseriesisexpressedasY=
Y XSXC XI

DeterminationofTrend

MeasurementsofTrends

Followingarethemethodsbywhichwecan measurethetrend.

(i) FreehandorGraphicMethod.

(ii) MethodofSemi-Averages.

(iii) MethodofMovingAverages.

(iv) MethodofLeastSquares.

FreehandGraphicMethod

Inthismethodwemustplottheoriginaldataonthegraph.Drawasmoothcurvecarefullywhich will show the direction of the trend. The time is taken on the horizontalaxis I(X) and the valueofthevariableon theverticalaxis(Y)

## Semi– AverageMethod

In this method the original data are divided into two equal parts and average are calculated forboth the parts. These averages are called semi average. Trend line is drawn withthe help of the semiaverages

Fitatrendlinebythemethodofsemi-averagesforthegivendata.

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|
| Production | 105 | 115 | 120 | 100 | 110 | 125 | 135 |

***Solution:***

Sincethenumberofyearsisodd(seven),wewillleavethemiddleyear'sproductionvalueandobtaint heaverages offirstthreeyearsandlastthreeyears.

| Year | Production | Average |
|---|---|---|
| 2000 | 105 | |
| 2001 | 115 | $\frac{105+115+120}{3}=113.33$ |
| 2002 | 120 | |
| 2003 | 100 (leftout) | |
| 2004 | 110 | $\frac{110}{3}\ \frac{+125+135}{3}=123.33$ |

## Movingaveragemethod

In this method, the average value of a number of years or months or weeks is taken intoaccount and placed it at the Centre of the time span and it is is the normal or trend value forthemiddleperiod.

Calculatethree-yearlymovingaveragesofnumberofstudentsstudyinginahighersecondaryschoolinaparticularvillagefromthefollowingdata.

| Year | Numberofstudents |
|---|---|
| 1995 | 332 |
| 1996 | 317 |
| 1997 | 357 |
| 1998 | 392 |
| 1999 | 402 |
| 2000 | 405 |
| 2001 | 410 |
| 2002 | 427 |
| 2003 | 435 |
| 2004 | 438 |

Solution:

Computationothree-yearlymovingaverages.

| Year | Numberofstudents | 3-yearlymovingTotal | 3-yearlymovingAverages |
|---|---|---|---|
| 1995 | 332 | --- | --- |
| 1996 | 317 | 1006 | 335.33 |
| 1997 | 357 | 1066 | 355.33 |
| 1998 | 392 | 1151 | 383.67 |
| 1999 | 402 | 1199 | 399.67 |
| 2000 | 405 | 1217 | 405.67 |
| 2001 | 410 | 1242 | 414.00 |
| 2002 | 427 | 1272 | 424.00 |
| 2003 | 435 | 1300 | 433.33 |
| 2004 | 438 | --- | --- |

### MethodofLeastSquares

The line of best fit is a line from which the sum of the deviations of various points is zero. This is the best methodforobtainingthetrendvalues.Itgivesaconvenientbasisforcalculatingthelineofbestfitforthetimeseries.Itisamathematicalmethodformeasuringtrend. Further the sum of the squares of thesedeviationswouldbe least whencomparedwithotherfittingmethods.

Fitastraightlinetrendbythemethodofleast squaresandtabulatethetrendvalues.

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|
| Prod. ofSugarcane | 40 | 45 | 46 | 42 | 47 | 50 | 46 |

***Solution:***

Computationoftrendvaluesbythemethodofleastsquares(ODDYears).

| Year ($x$) | Production ofSugarcane ($Y$) | $X=(x-2003)$ | $X^2$ | $XY$ | Trend values ($Yt$) |
|---|---|---|---|---|---|
| 2000 | 40 | −3 | 9 | −120 | 42.04 |
| 2001 | 45 | −2 | 4 | −90 | 43.07 |
| 2002 | 46 | −1 | 1 | −46 | 44.11 |
| 2003 | 42 | 0 | 0 | 0 | 45.14 |
| 2004 | 47 | 1 | 1 | 47 | 46.18 |
| 2005 | 50 | 2 | 4 | 100 | 47.22 |
| 2006 | 46 | 3 | 9 | 138 | 48.25 |
| $N=7$ | $\Sigma Y=316$ | $\Sigma X=0$ | $\Sigma X^2=28$ | $\Sigma XY=29$ | $\Sigma Yt=316$ |

Therefore,therequiredequationofthestraightlinetrendisgivenby

$Y=a+bX$

$Y=45.143+1.036(x-2003)$

Thetrendvaluescanbeobtainedby

When$X=2000$,
$Yt=45.143+1.036(2000-2003)=42.035$When$X=2001$,
$Yt=45.143+1.036(2001-2003)=43.071$,
similarlyothervaluescanbeobtained.

ComputationofSeasonalindicesbySimpleaverage

SeasonalVariationscanbemeasuredbythemethodofsimpleaverage.Thedatashouldbe

availableinseasonwiselikelyweeks,months,quarters.

### MethodofSimpleAverages:

Thisisthesimplestand easiestmethodforstudyingSeasonalVariations.

### Ratios-to-moving-averagemethod

Ordinarily does not fluctuate so much as the index based on straight-line trends. This is because the12-month**moving average**followsthecyclicalcourseof theactualdataquiteclosely.

### Ratio-to-trendMethod

- Theratio-to-trend methodissimilartoratio-to-moving-averagemethod
- Theonlydifferenceisthewayofobtainingthe trendvalues
- Whereasintheratio-to-moving-averagemethod,thetrendvaluesareobtainedbythemethodofmovingaverages, in the ratio-to-trendmethod

### Linkrelative'smethod:

Link relatives methodare calculatedby dividingthe figure ofeachseason* by the figure ofimmediately preceding season and multiplying it by 100. These percentages are called link relatives sincetheylinkeachmonth (orquarter orothertimeperiod) to thepreceding one.

## Unit-5

## IndexNumbers

### MeaningandofIndexnumber

Asindexnumberisaspecializedaveragedesignedtomeasurethechangeinagroupofrelatedvariableover aperiod oftime.Itwasfirstconstructed in theyear

### Concept

Inits simplestformonIndexnumberis aRatiooftwonumbersexpressedas percent.

### Definition

Indexnumberdevicesformeasuringdifferenceinthemagnitudeofagroupofrelatedvariables

**----CroxtonandCowden**

## Types ofIndex Numbers

- PriceIndex
- QuantityIndex
- ValueIndex

ProblemsinConstructionofIndexnumbers

### SimpleAggregativeMethod:

In this method, the index number is equal to the sum of prices for the year for which index number is to befounddivided by thesumof actualpricesfor thebaseyear.

$$P_{01} = \frac{\Sigma P_1}{\Sigma P_0} \times 100$$

Where $P_{01}$ Stands for the index number

$\Sigma P_1$ Stands for the sum of the prices for the year for which index number is to be found :

$\Sigma P_0$ Stands for the sum of prices for the base year.

| Commodity | Prices in Base Year 1980 (in Rs.) $P_o$ | Prices in current Year 1988 (in Rs.) $P_1$ |
|---|---|---|
| A | 10 | 20 |
| B | 15 | 25 |
| C | 40 | 60 |
| D | 25 | 40 |
| Total | $\Sigma P_0 = 90$ | $\Sigma P_1 = 145$ |

Index Number $(P_{01}) = \frac{\Sigma P_1}{\Sigma P_0} \times 100$ ; $P_{01} = \frac{145}{90} \times 100$ ; $P_{01} = 161.11$

### WeightedAggregative Method:

In this method, different weights are assigned to the items according to their relative importance.Weights used are the quantity weights. Many formulae have been developed to estimate index numbers onthebasisof quantity weights.

(*i*) **Laspeyre's Formula.** In this formula, the quantities of base year are accepted as weights.

$$P_{01} = \frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times 100$$

Where $P_1$ is the price in the current year ; $P_0$ is the price in the base year ; and $q_0$ is the quantity in the base year.

(*ii*) **Paasche's Formula.** In this formula, the quantities of the current year are accepted as weights.

$$P_{01} = \frac{\Sigma P_1 q_1}{\Sigma P_0 q_1} \times 100$$

Where $q_1$ is the quantity in the current year.

(*iii*) **Dorbish and Bowley's Formula.** Dorbish and Bowley's formula for estimating weighted index number is as follows :

$$P_{01} = \frac{\frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} + \frac{\Sigma P_1 q_1}{\Sigma P_0 q_1}}{2} \times 100 \quad \text{or} \quad p_{01} = \frac{L + P}{2}$$

Where L is Laspeyre's index and P is paasche's Index.

(*iv*) **Fisher's Ideal Formula.** In this formula, the geometric mean of two indices (i.e., Laspeyre's Index and paasche's Index) is taken :

$$p_{01} = \sqrt{\frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times \frac{\Sigma P_1 q_1}{\Sigma P_0 q_1}} \times 100 \quad \text{or} \quad P_{01} = \sqrt{L \times P} \times 100$$

where L is Lespeyre's Index and P is paasche's Index.

**Example**

| Comm-odity | Base Year | | Current Year | | $P_0q_0$ | $P_1q_0$ | $P_0q_1$ | $P_1q_1$ |
|---|---|---|---|---|---|---|---|---|
| | $P_0$ | $q_0$ | $P_1$ | $q_1$ | | | | |
| A | 10 | 5 | 20 | 2 | 50 | 100 | 20 | 40 |
| B | 15 | 4 | 25 | 8 | 60 | 100 | 120 | 200 |
| C | 40 | 2 | 60 | 6 | 80 | 120 | 240 | 360 |
| D | 25 | 3 | 40 | 4 | 75 | 120 | 100 | 160 |
| Total | | | | | 265 $\Sigma P_0q_0$ | 440 $\Sigma P_1q_0$ | 480 $\Sigma P_0q_1$ | 760 $\Sigma P_1q_1$ |

(*i*) Laspeyre's Formula :

$$p_{01} = \frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times 100$$

$$p_{01} = \frac{440}{265} \times 100 = 166.04$$

## Testofadequacy foran IndexNumber

- Indexnumbersarestudiedtoknowtherelativechangesinpriceandquantityforanytwoyears compared.
- FactorReversal**Test**.
- Thecriterionforagoodindexnumberis tosatisfytheabovetwo**tests**.
- Fisher'sindexnumberformulasatisfiestheaboverelationship.

## ChainIndexNumbers

Under this method, firstly we express the figures for each year as a percentage of the preceding year.Theseareknownas LinkRelatives.Wethenneedtochainthemtogetherbysuccessivemultiplicationtoformachainindex.

### StepsintheconstructionofChainIndexNumbers

1. Calculatethelinkrelativesbyexpressingthefiguresasthepercentageoftheprecedingyear.Thus,

   LinkRelativesofcurrentyear=price ofcurrentyear/priceofpreviousyear×100

2. Calculatethechainindexbyapplyingthefollowingformula:
   ChainIndex=Currentyearrelative×Previousyearlinkrelative/100

### BaseShifting

Foravarietyofreasons,itfrequentlybecomes necessarytochangethereferencebaseofanindexnumber series from one time to another without returning to the original raw data and recomposing theentireseries.This changeofreferencebaseperiodisusuallyreferredtoas “shiftingthebase”.

## Splicing

The process of combining two or more index numbers covering different bases into a single series iscalled splicing. Example the following are two series A and B of the index numbers of a commodity taking1991and 1994 asthebaseyears.

## Deflating

Deflating means making allowances for the effect of changing price levels. The process of adjustinga series of salary or wages or income according to current price changes to find out the level of real salarywages or incomeiscalleddeflatingofindex numbers.

## ConsumerPriceIndex

The Consumer Price Index (CPI) measures the average price change of a set of consumer goods andservices. CPIs can be calculated for single items or a predetermined group of items. All of these items aredefinedas"household goodsand services."

## UsesofConsumerPriceIndex

Theconsumerpriceindexismainlyusedtomeasureinflationoveragivenperiodoftime.Itcanalsobeleveraged to determinethecostof living.

CPI is mainly used to determine the efficacy of economic policies. Inflation indicates the health (orlack thereof) of an economy, so tracking it and responding to it appropriately is important for policymakers.When inflation sharply increases or decreases, the CPI provides economists and policymakers insight intohow agovernment'seconomicpolicyaffects themarket.

## Statisticalqualitycontrol

The use of statistical methods in the monitoring and maintaining of the quality of products andservices.Onemethod,referredtoas acceptancesampling,canbeusedwhenadecisionmustbemadetoacceptor rejectagroup of parts or itemsbasedon thequalityfound in asample