Business Mathematics & Statistics (MTH 302)

Lesson 1 :COURSE OVERVIEW	3
Lesson 2 :APPLICATION OF BASIC MATHEMATICS	
Lesson 3 :APPLICATION OF BASIC MATHEMATICS	
Lesson 4 :APPLICATION OF BASIC MATHEMATICS	
Lesson 5 :APPLICATION OF BASIC MATHEMATICS	
Lesson 6 :APPLICATION OF BASIC MATHEMATICS	
Lesson 7 :APPLICATION OF BASIC MATHEMATICS	
Lesson 8 :COMPOUND INTEREST	
Lesson 9 :COMPOUND INTEREST	
Lesson 10:MATRICES	
Lesson 11: MATRICES	
Lesson 12 :RATIO AND PROPORTION	
Lesson 13 :MATHEMATICS OF MERCHANDISING	
Lesson 14 :MATHEMATICS OF MERCHANDISING	
Lesson 15 :MATHEMATICS OF MERCHANDISING	
Lesson 16 :MATHEMATICS OF MERCHANDISING	
Lesson 17 :MATHEMATICS FINANCIAL MATHEMATICS	
Lesson 18 :MATHEMATICS FINANCIAL MATHEMATICS	
Lesson 19 :PERFORM BREAK-EVEN ANALYSIS	117
Lesson 20 :PERFORM BREAK-EVEN ANALYSIS	
Lesson 21 :PERFORM LINEAR COST-VOLUME PROFIT AND BREAK-EVEN ANALYSIS	
Lesson 22 :PERFORM LINEAR COST-VOLUME PROFIT AND BREAK-EVEN ANALYSIS	
Lesson 23 :STATISTICAL DATA REPRESENTATION.	
Lesson 24 :STATISTICAL REPRESENTATION	
Lesson 25 :STATISTICAL REPRESENTATION	
Lesson 26 :STATISTICAL REPRESENTATION	
Lesson 27 :STATISTICAL REPRESENTATION	
Lesson 28 :MEASURES OF DISPERSION	
Lesson 29 :MEASURES OF DISPERSION	
Lesson 30 :MEASURE OF DISPERASION	
Lesson 31 :LINE FITTING	201
Lesson 32 :TIME SERIES AND	212
Lesson 33 :TIME SERIES AND EXPONENTIAL SMOOTHING	224
Lesson 34 :FACTORIALS	
Lesson 35 :COMBINATIONS	
Lesson 36 :ELEMENTARY PROBABILITY	
Lesson 37:PATTERNS OF PROBABILITY: BINOMIAL, POISSON AND NORMAL DISTRIB	
Lesson 38:PATTERNS OF PROBABILITY: BINOMIAL, POISSON AND NORMAL DISTRIB	
Lesson 39:PATTERNS OF PROBABILITY: BINOMIAL, POISSON AND NORMAL DISTRIB	
Lesson 40:PATTERNS OF PROBABILITY: BINOMIAL, POISSON AND NORMAL DISTRIB	UTIONS
Lesson 41: ESTIMATING FROM SAMPLES: INFERENCE	
Lesson 42 :ESTIMATING FROM SAMPLE : INFERENCE	
Lesson 43 :HYPOTHESIS TESTING: CHI-SQUARE DISTRIBUTION	
Lesson 44 :HYPOTHESIS TESTING : CHI-SQUARE DISTRIBUTION	
Lesson 45 :PLANNING PRODUCTION LEVELS: LINEAR PROGRAMMING	

MTH 302 LECTURE 1 COURSE OVERVIEW

COURSE TITLE

The title of this course is "BUSINESS MATHEMATICS AND STATISTICS".

Instructor's Resume

The instructor of the course is Dr. Zahir Fikri who holds a Ph.D. in Electric Power Systems Engineering from the Royal Institute of Technology, Stockholm, Sweden. The title of Dr. Fikri's thesis was "Statistical Load Forecasting for Distribution Network Planning".

<u>Objective</u>

The purpose of the course is to provide the student with a mathematical basis for personal and business financial decisions through eight instructional modules.

The course stresses business applications using arithmetic, algebra, and ratio-proportion and graphing.

Applications include payroll, cost-volume-profit analysis and merchandising mathematics. The course also includes Statistical Representation of Data, Correlation, Time Series and Exponential Smoothing, Elementary Probability and Probability Distributions.

This course stresses logical reasoning and problem solving skills.

Access to **Microsoft Excel** software is required for the course.

Course Outcomes

Successful completion of this course will enable the student to:

- 1. Apply arithmetic and algebraic skills to everyday business problems.
- 2. Use ratio, proportion and percent in the solution of business problems.
- 3. Solve business problems involving commercial discount, markup and markdown.
- 4. Solve systems of linear equations graphically and algebraically and apply to cost volumeprofit analysis.
- 5. Apply Statistical Representation of Data, Correlation, Time Series and Exponential Smoothing methods in business decision making
- 6. Use elementary probability theory and knowledge about probability distributions in developing profitable business strategies.

Unit Outcomes Resources/Tests/Assignments

Successful completion of the following units will enable the student to apply mathematical methods to business problems solving.

Required Student Resources (Including textbooks and workbooks)

Text: Selected books on Business Mathematics and Statistics.

Optional Resources

Handouts supplied by the professor.

Instructor's Slides Online or CD based learning materials.

Prerequisites

The students are not required to have any mathematical skills. Basic knowledge of Microsoft Excel will be an advantage but not a requirement.

Evaluation

In order to successfully complete this course, the student is required to meet the following evaluation criteria:

Full participation is expected for this course

All assignments must be completed by the closing date.

Overall grade will be based on VU existing Grading Rules.

All requirements must be met in order to pass the course.

VU

The following are the main modules of this course: **Module 1**

- Overview (Lecture 1)
- Perform arithmetic operations in their proper order (Lecture 2)
- Convert fractions their percent and decimal equivalents. (Lecture 2)
- Solve for any one of percent, portion or base, given the other two quantities. (Lecture 2)
- Using Microsoft Excel (Lecture 2) Calculate the gross earnings of employees paid a salary, an hourly wage or commissions. (Lecture 3)
- Calculate the simple average or weighted average given a set of values.
 - (Lecture 4)

Perform basic calculations of the percentages, averages, commission, brokerage and discount (Lecture 5)

- Simple and compound interest (Lecture 6)
- Average due date, interest on drawings and calendar (Lecture 6)

Module 2

- Exponents and radicals (Lecture 7)
- Solve linear equations in one variable (Lecture 7)
- Rearrange formulas to solve for any of its contained variables (Lecture 7)
- Solve problems involving a series of compounding percent changes (Lecture 8)
- Calculate returns from investments (Lecture 8)
- Calculate a single percent change equivalent to a series of percent changes (Lecture 8)
- Matrices (Lecture 9)
- Ratios and Proportions (Lecture10)
- Set up and manipulate ratios (Lecture11)
- Allocate an amount on a prorata basis using proportions (Lecture11)
- Assignment Module 1-2

Module 3

- Discounts (Lectures 12)
- Mathematics of Merchandising (Lectures 13-16)

Module 4

- Applications of Linear Equations (Lecture 17-18)
- Break-even Analysis (Lecture 19-22)
- Assignment Module 3-4
- Mid-Term Examination

Module 5

- Statistical data (Lectures 23)
- Measures of central tendency (Lectures 24-25)
- Measures of dispersion and skewness (Lectures 26-27)

Module 6

- Correlation (Lectures 28-29)
- Line Fitting (Lectures 30-31)
- Time Series and Exponential Smoothing (Lectures 31-33)
- Assignment Module 5-6

Module 7

- Factorials (Lecture 34)
- Permutations and Combinations (Lecture 34)
- Elementary Probability (Lectures 35-36)
- Patterns of probability: Binomial, Poisson and Normal Distributions (Lecture 37-40)

Module 8

- Estimating from Samples: Inference (Lectures 41-42)
- Hypothesis testing : Chi-Square Distribution (Lectures 43-44)
- Planning Production Levels: Linear Programming (Lecture 45)

Assignment Module 7-8 End-Term Examination •

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Note: The course modules are subject to change.

MARKING SCHEME

As per VU Rules DESCRIPTION OF TOPICS

NO.	MAIN TOPIC	LECTURE	TOPICS	RECOMMENDED READING
Module 1	1.0 Applications of Basic Mathematics (Lectures 1-6)	1	• Overviewew (Lecture 1)	Reference 1
Module 1		2	 Course Overview Arithmetic Operations & Using Microsoft Excel 	Reference 2, Lecture 2 Tool: Microsoft Excel
Module 1		3	 Calculate Gross Earnings Using Microsoft Excel 	Reference 2, Lecture 3 Tool: Microsoft Excel
Module 1		4	 Calculating simple or weighted averages Using Microsoft Excel 	Reference 2, Lecture 4 Tool: Microsoft Excel Reference 6
Module 1		5	 Basic calculations of percentages, averages, commission, brokerage and discount using Microsoft Excel 	Reference 2, Lecture 5 Reference 3, Ch 3 Tool: Microsoft Excel
Module 1		6	 Simple and compound interest Average due date, interest on drawings and calendar 	Reference 2, Lecture 6 Reference 3, Ch 3 Tool: Microsoft Excel
Module 2	2.0 Applications of Basic Algebra (Lectures 7-9)	7	 Exponents and radicals Simplify algebraic expressions Solve linear equations in one variable Rearrange formulas to solve for any of its contained variables 	Reference 2, Lecture 7 Reference 3, Ch 2 Tool: Microsoft Excel

		8	 Calculate returns from investments Problems involving a series of compounding percent changes Single percent change equivalent to a series of percent changes 	Reference 2, Lecture 8 Reference 3, Ch 3 Tool: Microsoft Excel
		9	• Matrices	Reference 2, Lecture 9 Reference 3, Ch 4 Tool: Microsoft Excel
Module 2	3.0 Applications of Ratio and Proportion (Lectures 10- 11)	10	 Set up and manipulate ratios. Set up and solve proportions. Express percent differences using proportions. Allocate an amount on a prorata basis using proportions. 	Reference 2, Lecture 10 Reference 3, Ch 3 Tool: Microsoft Excel
Module 2		11	 Set up and manipulate ratios. Allocate an amount on a prorata basis using proportions 	Reference 2, Lecture 11 Reference 3, Ch 3 Tool: Microsoft Excel
Module 3	4.0 Merchandising and Financial Mathematics (Lectures 12- 16)	12	 Calculate the net price of an item after single or multiple trade discounts. Calculate an equivalent single discount rate given a series of discounts. 	Reference 2, Lecture 12 Reference 3, Ch 3 Tool: Microsoft Excel
Module 3		13	• Solve merchandising pricing problems involving markup and markdown.	Reference 2, Lecture 13 Reference 3, Ch 3 Tool: Microsoft Excel
Module 3		14	• Financial Mathematics Part 1	Reference 2, Lecture 14 Reference 3, Ch 3 Reference 5, Ch 16 Tool: Microsoft Excel
Module 3		15	• Financial Mathematics Part 2	Reference 2, Lecture 15

				Reference 3, Ch 3 Reference 5, Ch 16 Tool: Microsoft Excel
Module 3		16	• Financial Mathematics Part 3	Reference 2, Lecture 16 Reference 3, Ch 3 Reference 5, Ch 16 Tool: Microsoft Excel
Module 4	5.0 Break-Even Analysis (Lectures 17- 22)	17	• Graph a linear equation in two variables.	Reference 2, Lecture 17 Reference 3, Ch 3 Reference 5, Ch 16 & 18 Tool: Microsoft Excel
Module 4		18	• Solve two linear equations with two unknowns	Reference 2, Lecture 18 Reference 3, Ch 2 Reference 5, Ch 1 Tool: Microsoft Excel
Module 4		19	 Perform linear cost-volume profit and break-even analysis. Using a break-even chart 	Reference 2, Lecture 19 Tool: Microsoft Excel
Module 4		20	 Perform linear cost-volume profit and break-even analysis. Using the algebraic approach of solving the cost and revenue functions 	Reference 2, Lecture 20 Tool: Microsoft Excel
Module 4		21	 Perform linear cost-volume profit and break-even analysis. Using the contribution margin approach 	Reference 2, Lecture 21 Tool: Microsoft Excel
Module 4		22	 Perform linear cost-volume profit and break-even analysis. Using Microsoft Excel Assignment Module 3-4 Mid-Term Examination 	Reference 2, Lecture 22 Tool: Microsoft Excel
Module 5	6. Statistical Representation of Data (Lectures 23-	23	Statistical Data	Reference 2, Lecture 23 Reference 5, Ch 5 Tool: Microsoft

	27)			Excel
Module 5		24	• Statistical Representation Measures of Central Tendency Part 1	Reference 2, Lecture 24 Reference 4, Ch 3 Reference 5, Ch 6 Tool: Microsoft Excel
Module 5		25	 Statistical Representation Measures of Central Tendency Part 2 	Reference 2, Lecture 25 Reference 4, Ch 3 Reference 5, Ch 6 Tool: Microsoft Excel
Module 5		26	• Measures of Dispersion and Skewness Part 1	Reference 2, Lecture 26 Reference 4, Ch 4 Reference 5, Ch 6 Tool: Microsoft Excel
Module 5		27	• Measures of Dispersion and Skewness Part 2	Reference 2, Lecture 27 Reference 4, Ch 4 Reference 5, Ch 6 Tool: Microsoft Excel
Module 6	7. Correlation, Time Series and Exponential Smoothing (Lectures 28- 33)	28	• Correlation Part 1	Reference 2, Lecture 28 Reference 5, Ch 13 Tool: Microsoft Excel
		29	• Correlation Part 2	Reference 2, Lecture 29 Reference 5, Ch 13 Tool: Microsoft Excel
		30	• Line Fitting Part 1	Reference 2, Lecture 30 Reference 5, Ch 14 Tool: Microsoft Excel

		31	• Line Fitting Part 2	Reference 2, Lecture 31 Tool: Microsoft Excel
		32	 Time Series and Exponential Smoothing Part 1 	Reference 2, Lecture 32 Reference 5, Ch 15 Tool: Microsoft Excel
		33	 Time Series and Exponential Smoothing Part 2 Assignment Module 5-6 	Reference 2, Lecture 33 Reference 5, Ch 15 Tool: Microsoft Excel
Module 7	7. Elementary Probability (Lectures 34- 38)	34	 Factorials Permutations and Combinations 	Reference 2, Lecture 34 Reference 3, Ch 2 Tool: Microsoft Excel
Module 7		35	• Elementary Probability Part 1	Reference 2, Lecture 35 Reference 5, Ch 8 Tool: Microsoft Excel
Module 7		36	• Elementary Probability Part 2	Reference 2, Lecture 36 Reference 5, Ch 8 Tool: Microsoft Excel
Module 7		37	• Patterns of probability: Binomial, Poisson and Normal Distributions Part 1	Reference 2, Lecture 39 Reference 5, Ch 9 Tool: Microsoft Excel
Module 7		38	• Patterns of probability: Binomial, Poisson and Normal Distributions Part 2	Reference 2, Lecture 40 Reference 5, Ch 9 Tool: Microsoft Excel

Module 7		39	• Patterns of probability: Binomial, Poisson and Normal Distributions Part 3	Reference 2, Lecture 41 Reference 5, Ch 9 Tool: Microsoft Excel
Module 7		40	• Patterns of probability: Binomial, Poisson and Normal Distributions Part 4	Reference 2, Lecture 41 Reference 5, Ch 9 Tool: Microsoft Excel
Module 8	 8. Probability Distributions (Lectures 39- 44) 9. Linear Programming (Lecture 45) 	41	• Estimating from Samples: Inference Part 1	Reference 2, Lecture 42 Reference 5, Ch 10 Tool: Microsoft Excel
Module 8		42	• Estimating from Samples: Inference Part 2	Reference 2, Lecture 43 Reference 5, Ch 10 Tool: Microsoft Excel
Module 8		43	• Hypothesis testing : Chi- Square Distribution Part 1	Reference 2, Lecture 44 Reference 5, Ch 11 Tool: Microsoft Excel
Module 8		44	• Hypothesis testing : Chi- Square Distribution Part 2	Reference 2, Lecture 45 Reference 5, Ch 11 Tool: Microsoft Excel
Module 8		45	 Production Planning: Linear Programming Assignment Module 7-8 End Term Examination 	Reference 2, Lecture 45 Reference 5, Ch 18 Tool: Microsoft Excel

<u>Methodology</u>

There will be 45 lectures each of 50 minutes duration as indicated above. The lectures will be delivered in a mixture of Urdu and English. The lectures will be heavily supported by slide presentations. The slides for a lecture will be made available on the VU website for the course a few days before the actual lecture is televised. This will allow students to carry out preparatory reading before the lecture. The course will be provided its own page on the VU's web site. This will be used to

provide lecture and other supporting material from the course to the students. The page will have a link to a web-based discussion and bulletin board for the students. Teaching assistants will be assigned by VU to provide various forms of assistance such as grading, answering questions posted by students and preparation of slides.

Grading

There will be a term exam and one final examination. There will also be 4 assignments each covering two modules. The final exam will be comprehensive. These will contribute the following percentages to the final grade:

Mid Term Exam	35%
Final	50%
4 Assignments	15%

Text and Reference Material

The course is based on material from different sources. Topics for reading will be indicated on course web site and in professor's handouts, also to be posted on the course web site. A list of reference books will also be posted and updated on the course web site.

The following material will be used by the students as reference:

- Reference 1: Course Outline
 - 2: Instructor's Power Point Slides
 - 3: Business Mathematics & Statistics by Prof. Miraj Din Mirza
 - 4: Elements of statistics & Probability by Shahid Jamal
 - 5: Quantitative Approaches in Business studies by Clare Morris
 - 6: Microsoft Excel Help File

Schedule of Lectures

Given above is the tentative schedule of topics to be covered. Minor changes may occur but these will be announced well in advance.

LECTURE 2 Applications of Basic Mathematics Part 1

OBJECTIVES

The objectives of the lecture are to learn about:

- Different course modules
- Basic Arithmetic Operations
- Starting Microsoft (MS) Excel
- Using MS Excel to carry out arithmetic operations

COURSE MODULES

This course comprises 8 modules as under:

- Modules 1-4: Mathematics
- Modules 5-8: Statistics

Details of modules are given in handout for lecture 01.

BASIC ARITHMETIC OPERATIONS

Five arithmetic operations provide the foundation for all mathematical operations. These are:

- Addition
- Subtraction
- Multiplication
- Division
- Exponents

Example- Addition

12 + 5 = 17

Example- Subtraction

12 - 5 = 7

Example- Multiplication

12 x 5 = 60

Example- Exponent

 $(4)^{2} = 16$ $(4)^{1/2} = 2$ $(4)^{-1/2} = 1/(4)^{1/2} = \frac{1}{2} = 0.5$

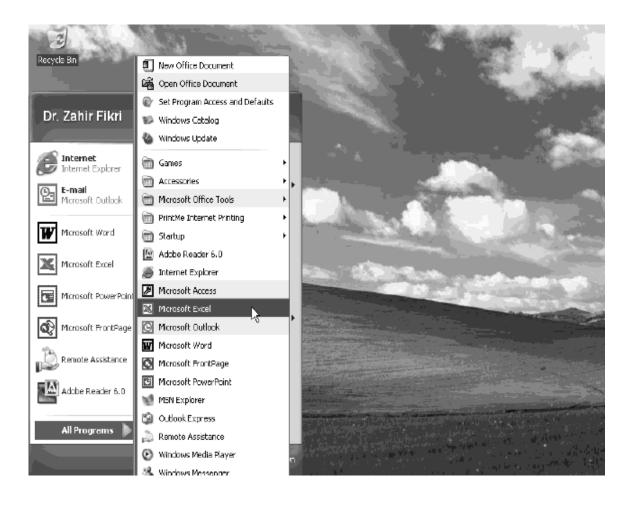
MICROSOFT EXCEL IN BUSINESS MATHEMATICS & STATISTICS

Microsoft Corporation's Spreadsheet software **Excel** is widely used in business mathematics and statistical applications. The latest version of this software is **EXCEL 2002 XP**. This course is based on wide applications of **EXCEL 2002**. It is recommended that you install **EXCEL 2002 XP** software on your computer. If your computer has **Windows 2000** and **EXCEL 2000** even that version of EXCEL can be used as the applications we intend to learn can be done using the earlier version of **EXCEL**. Those of you who are still working with Windows 98 and have **EXCEL 97** installed are encouraged to migrate to newer version of **EXCEL** software.

EXCEL 2000 XP can be started by going through the following steps:

- 1. Click **Start** on your computer
- 2. Click All Programs
- 3. Click Microsoft Excel

The following slides show the operations:



The EXCEL window opens and a blank worksheet becomes available as shown below:

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The slide shows a Workbook by the name book1 with three sheets: Sheet1, Sheet2 and Sheet3. The Excel Window has Column numbers starting from A and row numbers starting from 1. the intersection of a row and column is called a **Cell**. The first cell is A1 which is the intersection of column A and row 1. All cells in a Sheet are referenced by a combination of Column name and row number.

Example 1: B15 means cell in column B and row 15.

Example 2: A cell in row 12 and column C has reference C12.

A **Range** defines all cells starting from the leftmost corner where the range starts to the rightmost corner in the last row. The Range is specified by the starting cell, a colon and the ending cell.

Example 3: A **Range** which starts from A1 and ends at D15 is referenced by A1:D15 and has all the cells in columns A to D up to and including row 15.

A value can be entered into a cell by clicking that cell. The mouse pointer which is a rectangle moves to the selected cell. Simply enter the value followed by the **Enter** key. The mouse pointer moves to the cell below.

If you make a mistake while entering the value select the cell again (by clicking it). Enter the new value. The old value is replaced by the new value.

If only one or more digits are to be changed then select the cell. Then double click the mouse. The blinking cursor appears. Either move the arrow key to move to the digit to be

changed or move the cursor to the desired position. Enter the new value and delete the undesired value by using the **Del** key.

I suggest that you learn the basic operations of entering, deleting and changing data in a worksheet.

About calculation operators in Excel

In Excel there are four different types of operators:

- 1. **Arithmetic operators**
- 2. **Comparison operators**
- Text concatenation operator 3.
- **Reference operators** 4.

The following descriptions are reproduced from Excel's Help file for your ready reference. In the present lecture you are directly concerned with arithmetic operators. However, it is important to learn that the comparison operators are used where calculations are made on the basis of comparisons. The text concatenation operator is used to combine two text strings. The reference operators include ":" and "," or ; as the case maybe. We shall learn the use of these operators in different worksheets. You should look through the Excel Help file to see examples of these functions. Selected material from Excel Help File relating to arithmetic operations is given in in a separate file.

The Excel arithmetic operators are as follows:

- Addition. Symbol: + 1. (Example: =5+4 Result: 9)
- Subtraction. Symbol: -2. (Example: =5-4 Result: 1) (Example: =5*4 Result: 20)
- 3. Multiplication. Symbol: *
- Division. Symbol: / 4.
- Percent. Symbol: % 5.
- Exponentiation: ^ 6.

(Example: =5² Result: 25)

(Example: =20% Result: 0.2)

(Example: =12/4 Result: 3)

Excel Formulas for Addition

All calculations in Excel are made through formulas which are written in cells where result is required.

Let us do addition of two numbers 5 and 10.

We wish to calculate the addition of two numbers 10 and 5. Let us see how we can add these two numbers in Excel.

- 1. Open a blank worksheet.
- Click on a cell where you would like to enter the number 10. Say cell A15. 2.
- 3. Enter 10 in cell A15.
- 4. Click cell where you would like to enter the number 5. Say cell B15.
- Click cell where you would like to get the sum of 10 and 5. Say cell C15. 5.
- 6. Start the formula. Write equal sign = in cell C15.
- After =, write "(" (left bracket) in cell C15. 7.
- Move mouse and left click on value 10 which is in cell A15. In cell C15, the cell 8. reference A15 is written.
- Write "+" after "A15" in cell C15. 9.
- Move mouse and left click on value 5 which is in cell B15. In cell C15, the cell 10. reference B15 is written.
- 11. Write ") " (right bracket) in cell C15.
- Press Enter key 12.
- The answer 15 is shown in cell C15.

If you click on cell C15, the formula "=A15+B15" is displayed the formula bar to the right of fx in the Toolbar.

The main steps along with the entries are shown in the slide below. The worksheet MTH302-lec-02 contains the actual entries.

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C15 ▼ f₂ =A15+B15
A B C D E F G H I J K L
2 ADDING TWO NUMBERS 5 and 10
3 STEPS:
4 1 Enter 5 in cell A15
5 2 Enter 10 in cell B15
6 3 Write = sign in Cell C15
7 4 Place mouse on cell A15
8 6 type + sign
9 7 Go to cell B15
10 8 Press Enter key
11 Result Shown in Cell C15
12 9 Click on Cell C15
13 Result Formula =A15+B15 is shown in formula bar
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The next slide shows addition of 6 numbers 5, 10, 15, 20, 30 and 40. The entries were made in row 34. The values were entered as follows:

Cell A34: 5

Cell B34: 10

Cell C34: 15

Cell D34: 20

Cell E34: 30

Cell F34: 40

The formula was written in cell G34. The formula was:

=5+10+15+20+30+40

The answer was 120.

You can use an Excel function SUM along with the cell range A34:F34 to calculate the sum of the above numbers. The formula in such a case will be: =SUM(A34:F34)

You enter "=" followed by SUM, followed by "(". Click on the cell with value 5(reference: A34). Drag the mouse to cell with value 40(reference: F34) and drop the mouse. Enter ")" and then press the Enter key.

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In the above two examples you learnt how formulas for addition are written in Excel.

Excel Formula for Subtraction

Excel formulas for subtraction are similar to those of addition but with the minus sign. Let us go through the steps for subtracting 15 from 25. Enter values in row 50 as follows:

Cell A50: 25 Cell B50: 15

Write the formula in cell C50 as follows: =A50-B50

To write this formula, click cell C50, where you want the result. Enter "=". Click on cell with value 25 (reference:A50). Enter "-"(minus sign). Click on cell with value 15 (reference B50). Press enter key.

If you enter 15 first and 25 later, then the question will be to find result of subtraction 15-25.

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Excel Formula for Multiplication

Excel formula for multiplication is also similar to the formula for addition. Only the sign of multiplication will be used. The Excel multiplication operator is *.

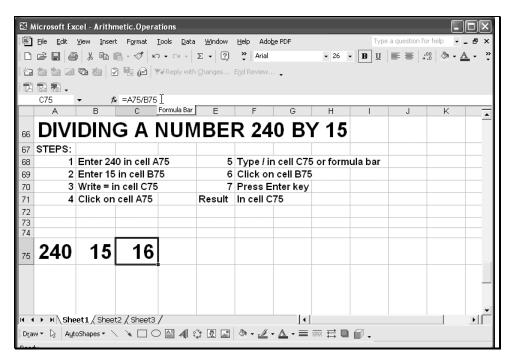
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Let us look at the multiplication of two numbers 25 and 15. The entries will be made in row 60. Enter values as under:

Cell A50: 25 Cell B50: 15 The formula for multiplication is: =A50*B50 Click on cell C50 to write the formula in that cell. Enter "=". Click on cell with number 25 (reference: A50). Enter "*". Click on cell with number 15 (reference: B50). Press Enter key. The answer is 375 in cell C50.

Excel Formula for Division

The formula for division is similar to that of multiplication with the difference that the division sign "/" will be used.



Let us divide 240 by 15using Excel formula for division. Let us enter numbers in row 75 as follows:

Cell A75: 240 Cell B75: 15

The formula for division will be written in cell C75 as under: =A75/B75

The steps are as follows: Click the cell A75. Enter 240 in cell A75. Click cell B75. Enter 15. Click cell C75. Enter "=". Click on cell with value 240 (reference: A75). Enter "/". Click cell with number 15 (reference: B75). Press enter key. The answer 16 will be displayed in cell C75.

Excel Formula for Percent

The formula for converting percent to fraction uses the symbol %. To convert 20% to fraction the formula is as under:

=20%

If you enter 20 in cell A99, you can write formula for conversion to fraction by doing the following:

Enter 20 in cell A99. In cell B99 enter "=". Click on cell A99. Enter"%". Press Enter key. The answer 0.2 is given in cell B99.

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Excel Formula for Exponentiation

The symbol for exponentiation is ^. The formula for calculating exponents is similar to multiplication with the difference that the carat symbol ^ will be used. Let us calculate 16 raised to the power 2 by Excel formula for exponentiation. The values will be entered in row 85. The steps are: Select Cell A85. Enter 16 in this cell. Select cell B85 Enter 2 in this cell. Select cell C85. Enter"=". Select cell with value 16 (reference:A85). Enter "^". Select number 2 (reference: B85) Press Enter key.

The result 256 is displayed in cell C85.

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Recommended Homework

Download worksheet MTH302-lec-02.xls from the course web site.

- Change values to see change in results.
- Set up new worksheets for each Excel operator with different values.
- Set up worksheets with combinations of operations.

LECTURE 3 Applications of Basic Mathematics Part 2

OBJECTIVES

The objectives of the lecture are to learn about:

- Evaluations
- Calculate Gross Earnings
- Using Microsoft Excel

Evaluation

In order to successfully complete this course, the student is required to meet the evaluation criteria:

- Evaluation Criterion 1
- Full participation is expected for this course
- Evaluation Criterion 2
- All assignments must be completed by the closing date
- Evaluation Criterion 3
- Overall grade will be based on VU existing Grading Rules
- Evaluation Criterion 4
- All requirements must be met in order to pass the course

<u>Grading</u>

There will be a term exam and one final exam; there will also be 4 assignments. The final exam will be comprehensive. These will contribute the following percentages to the final grade: Mid Term Exam 35% Final 50% 4 Assignments 15%

Collaboration

The students are encouraged to develop collaboration in studying this course. You are advised to carry out discussions with other students on different topics. It will be in your own interest to prepare your own solutions to Assignments. You are advised to make your original original submissions as copying other students' assignments will have negative impact on your studies.

<u>ETHICS</u>

Be advised that as good students your motto should be:

- No copying
- No cheating
- No short cuts

Methodology

There will be 45 lectures each of 50 minutes duration. The lectures will be delivered in a mixture of Urdu and Englis.

The lectures will be heavily supported by slide presentations.

The slides available on the VU website before the actual lecture is televised. Students are encouraged to carry out preparatory reading before the lecture.

This course has its own page on the VU's web site.

There are lecture slides as well as other supporting material available on the web site. Links to a web-based discussion and bulletin board will also been provided.

Teaching assistants will be assigned by VU to provide various forms of assistance such as grading, answering questions posted by students and preparation of slides

Text and Reference Material

This course is based on material from different sources. Topics for reading will be indicated on course web site and in professor's handouts. A list of reference books to be posted and updated on course web site. You are encouraged to regularly visit the course web site for latest guidelines for text and reference material.

PROBLEMS

If you have any problems with understanding of the course please contact: bizmath@vu.edu.pk

GROSS EARNINGS

There may be three types of employees in a company:

- Regular employees drawing a monthly salary
- Part time employees paid on hourly basis
- Payments on per piece basis

To be able to understand how calculations of gross earnings are done, it is important to understand what gross earnings include.

Gross remuneration can include the following:

- Salary
- Provident Fund
- Gratuity Fund
- Social Charges

SALARY

Gross salary includes the following:

- Basic salary
- Allowances
- Provident Fund
- Gratuity
- Social Charges

Gross salary includes:

- Basic salary
- House Rent
- Conveyance allowance
- Utilities allowance

Accordance to the taxation rules if allowances are 50% of basic salary, the amount is treated as tax free. Any allowances that exceed this amount, are considered taxable both for the employee as well as the company.

Example 1

The salary of an employee is as follows: Basic salary = 10,000 Rs. Allowances = 5,000 Rs. What is the taxable income of employee? Is any add back to the income of the company? % Allowances = (5000/10000) x 100 =50% Hence allowances are not taxable. Total taxable income = 10,000 Rs. Add back to the income of the company = 0

Example 2

The salary of an employee is as follows: Basic salary = 10,000 Rs. Allowances = 7,000 Rs. What is the taxable income of employee? Is any add back to the income of the company? % Allowances = $(7000/10000) \times 100 = 70\%$ Allowed non-taxable allowances = $50\% = 0.5 \times 10000 = 5,000$ Rs. Taxable allowances = 70% - 50% = 7000 - 5000 = 2,000 Rs. Hence 2000 Rs. of allowances are taxable. Total taxable income = 10,000 + 2000 = 12,000 Rs. Add back to the income of the company = 20% allowances = 2,000 Rs.

Structure of Allowances

The common structure of allowances is as under:

- House Rent = 45 %
- Conveyance allowance = 2.5 %
- Utilities allowance = 2.5 %

Example 3

The salary of an employee is as follows: Basic salary = 10,000 Rs. Allowances = 5,000 Rs. What is the amount of allowances if House Rent = 45 %, Conveyance allowance = 2.5 % and Utilities allowance = 2.5 %? House rent allowances = $0.45 \times 10000 = 4,500$ Rs. Conveyance allowance = $0.025 \times 10000 = 250$ Rs. Utilities allowance = $0.025 \times 10000 = 250$ Rs.

Provident Fund

According to local laws, a company can establish a Provident Trust Fund for the benefit of the employees. By law, 1/11th of Basic Salary per month is deducted by the company from the gross earnings of the employee. An equal amount, i.e 1/11th of basic salary per month, is contributed by the company to the Provident Fund to the account of the employee. Thus there is an investment of 2/11th of basic salary on behalf of the employee in Provident Fund. The company can invest the savings in Provident Fund in Government Approved securities such as defence saving Certificates. Interest earned on investments in Provident Fund is credited to the account of the employees in proportion to their share in the Provident Fund.

Example 4

The salary of an employee is as follows: Basic salary = 10,000 Rs. Allowances = 5,000 Rs. What is the amount of deduction on account of contribution to the Provident Trust Fund? What is the contribution of the company? What is the total saving of the employee per month on account of Provident Trust Fund? Employee contribution to Provident Fund = $1/11 \times 10000 = 909.1$ Rs. Company contribution to Provident Fund = $1/11 \times 10000 = 909.1$ Rs. Total savings of employee in Provident Fund = 909.1 + 909.1 = 1,818.2 Rs.

Gratuity Fund

According to local laws, a company can establish a Gratuity Trust Fund for the benefit of the employees. By law, 1/11th of Basic Salary per month is contributed by the company to the Gratuity Fund to the account of the employee. Thus there is a saving of 1/11th of basic salary on behalf of the employee in Gratuity Fund. The company can invest the savings in Gratuity Fund in Government Approved securities such as defence saving Certificates. Interest earned on investments in Gratuity Fund is credited to the account of the employees in proportion to their share in the Gratuity Fund.

Example 5

The salary of an employee is as follows: Basic salary = 10,000 Rs. Allowances = 5,000 Rs. What is the contribution of the company on account of gratuity to the Gratuity Trust Fund? Company contribution to Gratuity Fund = Total savings of employee in Gratuity Fund = 1/11 x 10000 = 909.1 Rs.

Leaves

All companies have a clear leaves policy. The number of leaves allowed varies from company to company. Typical leaves allowed may be as under:

- Casual Leave = 18 Days
- Earned Leave = 18 Days
- Sick Leave = 12 Days

Example 6

The salary of an employee is as follows: Basic salary = 10,000 Rs. Allowances = 5,000 Rs. **What is the cost on account of casual, earned and sick leaves per year if normal working days per month is 22? What are leaves as percent of gross salary?** Gross salary = 10000 + 5000 = 15,000 Rs. Casual leaves = $(18/22) \times 15000 = 12,272.7 \text{ Rs.}$ Earned leaves = $(18/22) \times 15000 = 12,272.7 \text{ Rs}$ Sick leaves = $(12/22) \times 15000 = 8,181.8 \text{ Rs}$ Total cost of leaves per year = 12272.7 + 12272.7 + 8181.8 = 32,727.3 Rs.Total leaves as percent of gross salary = $(32727.3/(12 \times 15000)) \times 100 = 18.2\%$

Social Charges

Social charges comprise leaves, group insurance and medical. Typical medical/group insurance is about 5% of gross salary. Other social benefits may include contribution to

employees children's education, club membership, leave fare assistance etc. Such benefits may be about 5.8%.

Total social charges may therefore may be = 18.2 + 5 + 5.8 = 29%. Other companies may have more social benefits. The 29% social charges are quite common.

Example 7

The salary of an employee is as follows: Basic salary = 10,000 Rs. Allowances = 5,000 Rs. What is the cost of the company on account of leaves (18.2%), group insurance/medical (5%) and other social benefits(5.8%)?

Leaves cost = 0.182 x 15000 = 2,730 Rs. Group insurance/medical = 0.05 x 15000 = 750 Rs. Other social benefits = 0.058 x 15000 = 870 Rs. Total social charges = 2730 + 750 + 870 = 4,350 Rs.

Gross Earnings

Summary of different components of salary is as follows:

- Basic salary 100 %
- Allowances 50 %
- Gratuity 9.99 %
- Provident Fund 9.99 %
- Social Charges 29 %

Example 8

The salary of an employee is as follows: Basic salary = 6,000 Rs.

The calculations are shown in the slide below.

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Percent from Fraction

Calculate % by multiplying fraction by 100. **Percent = Fraction X 100**

Example 9

Convert 0.1 to %. 0.1 X 100= 10%

Common Fraction

Example 10

¹⁄₂ = 0.5 10/100=0.1 Common Fraction 10/100=1/10 Converting % into Common Fraction <u>Example 11</u> 20%= 20/100= 0.2

Percent

Percent or Fraction Earnings 20% or 20/100=0.2

Base and Rate Percent of the Base Example 12 20% of 120? In 20% of 120: 120 is Base 20% is Rate Percentage

Percentage = Base x Rate Example 13 20% x 120? 20/100 x 120 Or 0.2 X 120 = 24

Example 14

What Percentage is 6 % of 40? Percentage = Rate X Base = 0.06 X 40 = 24

<u>Base</u>

Base = Percentage/Rate

Example 15

Rate = 24.0 % Percentage = 96 Base= 96/0.24=400 Part 3

OBJECTIVES

The objectives of the lecture are to learn about: Review Lecture 3 Calculating simple or weighted averages Using Microsoft Excel

Gross Remuneration

The following slide shows worksheet calculation of Gross remuneration on the basis of 6000 Rs. Basic salary.

As explained earlier, basic salary is 45% of basic salary. Conveyance and Ultilities Allowance are both 2.5% of basic salary. Both Gratuity and Provident fund are 1/11th of basic salary.

The arithmetic formulas are as follows: Excel forluas are within brackets. Basic salary = 6000 Rs. House rent = $0.45 \times 6000 = 2700 \text{ Rs}$. (Excel formula: =\$B\$93*0.45) Conveyance Allowance = $0.025 \times 6000 = 150 \text{ Rs}$. (Excel formula: =\$B\$93*0.025) Utilities allowance = $0.025 \times 6000 = 150 \text{ Rs}$. (Excel formula: =\$B\$93*0.025) Gross salary = 6000 + 2700 + 150 + 150 = 9000 Rs. (Excel formula: =SUM(B93:B96) Gratuity = $1/11 \times 6000 = 545$ (Excel formula: =ROUND((1/11)*\$B\$93;0)

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96	Utilities	150		
97	Total salary	9000		
98	Gratuity	545		
99	P. Fund	545		
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In the Excel formulas the \$ sign is used before the row and column reference to fix the location of the cell. \$B\$93 fixes the location of cell B93.

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98	Gratuity	545										
99	P. Fund	545										
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In Gratuity and provident calculations the function ROUND is used to round off values to desired number of decimals. In our case we used the value after the semicolon to indicate that no decimal is required. If you want 1 decimal use the value 1. for 2 decimals use 2 as the second parameter to the ROUND function. The first parameter is the expression for calculation 1/11*\$B\$93.

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In the calculation for social charges the formula is B93*(29/100). Here 29/100 means 29% social charges. The \$ sign was not used here. If the formula was to be copied urther then \$ sign would be needed to fix the value of basic salary.

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99	P. Fund	545					
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Average (Arithmetic Mean) = Sum /N Sum= Total of numbers N= Number of numbers EXAMPLE 1 Numbers: 10, 7, 9, 27, 2 Sum: = 10+7+9+27+2 = 55Numbers = 5Average = 55/5 = 11 ADDING NUMBERS USING MICROSOFT EXCEL Add numbers as you type them Add all numbers in a contiguous row or column Add numbers that are not in a contiguous row or column Add numbers based on one condition Add numbers based on multiple conditions Add numbers based on criteria stored in a separate range Add numbers based on multiple conditions with the Conditional Sum Wizard Add numbers Add numbers as you type them Type =5+10 in a cell Result 15. See Example 2

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Add all numbers in a contiguous row or column Click a cell below the column of numbers or to the right of the row of numbers Click AutoSum Press ENTER

See Example 2

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Add numbers that are not in a contiguous row or column Use the SUM function See Example 3

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Add numbers based on multiple conditions Use the IF and SUM functions to do this task

See Example /

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Add numbers based on criteria stored in a separate range

Use the DSUM function

to do this task

Study DSUM Example

DSUM

Adds the numbers in a column of a list or database that match conditions you specify. Syntax

DSUM(database,field,criteria)

Database is the range of cells that makes up the list or database.

Field indicates which column is used in the function.

Criteria is the range of cells that contains the conditions you specify. DSUM

EXAMPLE

=DSUM(A4:E10;"Profit";A1:F2)

The total profit from apple trees with a height between 10 and 16 (75)

AVERAGE USING MICROSOFT EXCEL

Calculate the average of numbers in a contiguous row or column

Calculate the average of numbers not in a contiguous row or column

AVERAGE

Returns the average (arithmetic mean) of the arguments.

Syntax

AVERAGE(number1,number2,...)

Number1, number2, ... are 1 to 30 numeric arguments for which you want the average.

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LECTURE 5 Applications of Basic Mathematics Part 4

OBJECTIVES

The objectives of the lecture are to learn about:

- Review of Lecture 4
- Basic calculations of percentages, salaries and investments using Microsoft Excel

PERCENTAGE CHANGE

Monday's Sales were Rs.1000 and grew to Rs. 2500 the next day. Find the percent change.

METHOD

Change = Final value – initial value Percentage change = (Change/initial value) x 100%

CALCULATION

Initial value =1000 Final value = 2500 Change = 1500 % Change = (1500/1000) x 100 = 150% The calculations using Excel are given below. First the entries of data were made as follows: Cell C4 = 1000 Cell C5 = 2500 In cell C6 the formula for increase was: =C4-C5 The result was 1500. In cell C7 the formula for percentage change was: = C6/C4*100 The result 150 is shown in the next slide.

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EXAMPLE 1

How many Percent is Next Day's sale with reference to Monday's Sale? Monday's sale= 1000 Next day's sale= 2500 Next day's sale as % = 2500/1000 x 100 = 250 % = Two and a half times

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EXAMPLE 2

In the making of dried fruit, 15kg. of fruit shrinks to 3 kg Find the percent change.

Calculation

Original fruit = 15 kg Final fruit = 3 kg Change = 3-15 = -12 % change = - 12/15 x 100 = - 80 % Size was reduced by 80%

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20 Final fruit	+	kg		
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Calculations in Excel were done as follows:

Data entry Cell D19: 15 Cell D20: 3

<u>Formulas</u>

Formula for change in Cell D21: =D19-D20 Formula for %change in Cell D22: = D21/D19*100

<u>Results</u>

Cell D21 = -12 kg Cell D22 = -80 %

EXAMPLE 3

After mixing with water the weight of cotton increased from 3 kg to 15 kg. Find the percent change.

CALCULATION

Original weight = 3 kg Final weight = 15 kg Change = 15-3= 12 % change = 12/3 x 100 = 400 % Weight increased by 400%

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25			
26 Original weight of cotton	3	kg	
27 Final weight of cotton	15	kg	
28 Change in weight	12	kg	
29 % change	400	%	
30 31			
51			

Calculations in Excel were done as follows:

Data entry Cell D26: 3 Cell D27: 15

<u>Formulas</u> Formula for change in Cell D28: =D26-D27 Formula for %change in Cell D29: = D28/D26*100

<u>Results</u>

Cell D28 = 12 kg Cell D29 = 400 %

EXAMPLE 4

A union signed a three year collective agreement that provided for wage increases of 3%, 2%, and 1% in successive years

An employee is currently earning 5000 rupees per month What will be the salary per month at the end of the term of the contract?

Calculation

- = 5000(1 + 3%)(1 + 2%)(1 + 1%)
- = 5000 x 1.03 x 1.02 x 1.01

= 5306 Rs.

Calculations using Excel are shown in the following slides.

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35	Salary year 1	5000	Rs.		
36	Increase year 1	3	%		
37	Salary year 2	=ROUND	C35*	(1+C3	36/
38		100);0)			
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37Salary year 25150 Rs.38Increase year 22 %	35	Salary year 1	5000	Rs.		
38 Increase year 2 2 %	36	Increase year 1	3	%		
	37	Salary year 2	5150	Rs.		
	38	Increase year 2	2	%		
³⁹ Salary year 3 5253 Rs.	39	Salary year 3	5253	Rs.		
40 Increase year 3 1 %	40	Increase year 3	1	%		
41 Salary end of year =ROUND(C39*(1+C40/	41	Salary end of year	=ROUND	(C39*	(1+C4	0/
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35	Salary year 1	5000	Rs.		
36	Increase year 1	3	%		
37	Salary year 2	5150	Rs.		
38	Increase year 2	2	%		
39	Salary year 3	5253	Rs.		
40	Increase year 3	1	%		
41	Salary end of year	5306	Rs.		
42					
43					

Calculations in Excel were done as follows:

Data entry

Cell C35: 5000

Cell C36: 3 Cell C38: 2 Cell C40: 1

<u>Formulas</u>

Formula for salary in year 2 in Cell C37: =ROUND(C35*(1+C36/100);0) Formula for salary year 3 in Cell C39: =ROUND(C35*(1+C38/100);0) Formula for salary end of year 3 in Cell C39: =ROUND(C35*(1+C39/100);0)

<u>Results</u> Cell C37 = 5150 Rs. Cell C39 = 5253 Rs. Cell D22 = 5306 Rs.

EXAMPLE 5

An investment has been made for a period of 4 years.

Rates of return for each year are 4%, 8%, -10% and 9% respectively. If you invested Rs. 100,000 at the beginning of the term, how much will you have at the end of the last year?

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45 INVESTMENT AT 1		_
⁴⁶ Investment year 1	100000 Rs.	
47 Increase year 1	4 %	
48 Value in year 2	=ROUND(C46*(1+C47/
⁴⁹ Increase year 2	100);0)	
50 Value in year 3	112320 Rs.	
51 Increase year 3	-10 %	
52 Value in year 3	101088 Rs.	
53 Increase year 4	9 %	
54 Value end year 4	110186 Rs.	

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46	Investment year 1	100000	Rs.		
47	Increase year 1	4	%		
48	Value in year 2	104000	Rs.		
49	Increase year 2	8	%		
50	Value in year 3	112320	Rs.		
51	Increase year 3	-10	%		
52	Value in year 3	101088	Rs.		
53	Increase year 4	9	%		
54	Value end vear 4	110186	Rs.		

Calculations in Excel were done as follows:

Data entry

Cell C46: 100000 Cell C47: 4 Cell C49: 8 Cell C51: -10 Cell C53: 9

<u>Formulas</u>

Formula for value in year 2 in Cell C48: = ROUND(C46*(1+C47/100);0) Formula for value in year 3 in Cell C50: = ROUND(C48*(1+C49/100);0) Formula for value in year 4 in Cell C52: = ROUND(C50*(1+C51/100);0) Formula for salary end of year 4 in Cell C54: = ROUND(C52*(1+C53/100);0)

<u>Results</u> Cell C48 = 104000 Rs. Cell C50 = 112320 Rs. Cell C52 = 101088 Rs. Cell C54 = 110186Rs.

LECTURE 6 Applications of Basic Mathematics Part 5

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 5
- Discount
- Simple and compound interest
- Average due date, interest on drawings and calendar

REVISION LECTURE 5

A chartered bank is lowering the interest rate on its loans from

9% to 7%.

What will be the percent decrease in the interest rate on a given balance?

A chartered bank is increasing the interest rate on its loans from 7% to

9%

What will be the percent increase in the interest rate on a given

balance?

As we learnt in lecture 5, the calculation will be as follows:

Decrease in interest rate = 7-9 = -2 %

% decrease = -2/9 x 100 = -22.2 %

Increase in interest rate = 9-7 = 2 %

% decrease = 2/7 x 100 = 28.6 %

The calculations in Excel are shown in the following slides:

DECREASE IN RATE

Data entry Cell F4 = 9 Cell F5 = 7

<u>Formulas</u> Formula for decrease in Cell F6: = =F5-F4 Formula for % decrease in Cell F7: =F6/F4*100

<u>Results</u> Cell F6 = -2% Cell F5 = -22.2%

INCREASE IN RATE Data entry Cell F14 = 7 Cell F15 = 9

Formulas Formula for increase in Cell F16: =F15-F14 Formula for % increase in Cell F17: =F16/F14*100

<u>Results</u> Cell F6 = -2% Cell F5 = -22.2%

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BUYING SHARES

If you buy 100 shares at Rs. 62.50 per share with a 2% commission, calculate your total cost.

Calculation

100 * Rs. 62.50 = Rs. 6,250 .02 * Rs. 6,250 = <u>125</u>

Rs. 6,375

RETURN ON INVESTMENT

Suppose you bought 100 shares at Rs. 52.25 and sold them 1 year later at Rs. 68. With a 1% commission rate buying <u>and</u> selling the stock and a current Rs 10 dividend per share in effect, what was your return on investment?

Bought

100 shares at Rs. 52.25 = 5,225.00 Commission at 1% = 52.25 Total Costs = 5,277.25 Sold 100 shares at Rs. 68 = 6,800.00 Commission at 1% = - 68.00 Total Costs = 6,732.00Gain Net receipts = 6,732.00 Total cost = - 5,277.25 = 1,454.75 Net Gain Dividends (100*1) = 100.00 Total Gain = 1.454.75Return on investment = 1,454.75/5277.25*100 27.57 % = The calculations using Excel were made as follows:

BOUGHT

Data entry Cell B21: 100 Cell B22: 52.25

Formulas

Formula for Cost of 100 shares at Rs. 52.25 in Cell B23: =B21*B22 Formula for Commission at 1% in Cell B24: =B23*0.01 Formula for Total Costs in Cell B25: =B23+B24

<u>Results</u>

Cell B23 = 5225 Cell B24 = 52.25 Cell B25 = 5277.25

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A	В
20 Bought	
21 Shares	100
22 Rate	52.25
23 Cost of 100 shares at Rs. 52.25	5225
24 Commission at 1%	52.25
25 Total Costs	5277.25
26	

SOLD Data entry

Cell B28: 68

Formulas Formula for sale of 100 shares at Rs. 68 in Cell B29: =B21*B28 Formula for Commission at 1% in Cell B30: =B29*0.01 Formula for Total Sale in Cell B31: =B29-B30

<u>Results</u> Cell B29 = 6800 Cell B30 = 68 Cell B31 = 6732

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A	В	С					
27 Sold							
28 Rate	68						
²⁹ 100 shares at Rs. 68	6800						
30 Commission at 1%	68						
31 Total Sale	6732						
32							

GAIN Formulas Formula for Net receipts in Cell B34: =B31 Formula for Total cost in Cell B35: =B25 Formula for Net Gain in Cell B36: =B31-B25 Formula for % Gain in Cell B37: =B36/B35*100

<u>Results</u> Cell B34 = 6732 Cell B35 = 5277.25 Cell B36 = 1454.75 Cell B37 = 27.57

DISCOUNT

Discount is Rebate or reduction in price. Discount is expressed as % of list price.

Example List price = 2200 Discount Rate = 15% Discount? = 2200 x 0.15= 330 Calculation using Excel along with formula is given in the following slide:

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		COUNT								
39	List	price	2200	Rs.						
40	Disc	count Rate	15	%						
41	Disc	count	330	330 Formula: =B39*B40/100						
42										
43										

<u>NET COST PRICE</u> Net Cost Price = List price - Discount

Example List price = 4,500 Rs. Discount = 20 % Net cost price? Net cost price = 4,500 - 20 % of 4,500 = 4,500 - 0.2 x4,500 =4,500 - 900 = 3,600 Rs.

Calculation using Excel along with formula is given in the following slide:

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45 NET COST PRICE									
46									
47 List price	4500	Rs.							
48 % Discount cost p	20	%							
49 Net Cost Price	3600	Rs.							
50									
51 Formula Cell B49: =B47-B47*(B48/100)									
52									

SIMPLE INTEREST

P = Principal R = Rate percent per annum T = Time in years I = Simple interest then I = P. R. T / 100

<u>Example</u>

P = Rs. 500 T = 4 years R = 11%Find interest $I = P \times T \times R / 100$ $= 500 \times 4 \times 11 / 100$ = Rs. 220Calculation using Excel along with formula is given in the following slide:

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56 SIMPLE INTEREST				
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58 Principal P	500	Rs.		
59 Time period T	4	Year		
60 Rate R	11	%		
61 Interest	220	Rs.		
62				
63 Formula in Cell B6	61: =B 5	8*B5	9* B 60)/100
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COMPOUND INTEREST

Compound Interest also attracts interest.

<u>Example</u>

P = 800Interest year 1= 0.1 x 800= 80 New P = 800 + 80 = 880 Interest on 880 = 0.1 X 880 = 88 New P = 880 + 88 = 968 Calculation using Excel along with formula is given in the following slide:

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69 Interest	10	%					
70 Interest year 1	80	Rs.	Forn	nula :	=B68	* B 69/	100
71 New P	880	Rs.	Forn	nula :	=B68	+B70	
72 Interest on 880	88	Rs.	Forn	nula	: = B71 [:]	* B 69/	100
73 New P	968		Forn	nula	=B71	+B 72	
74							С

mpound Interest Formula

- S = Money accrued after n years
- P = Principal
- r = Rate

n = Number of years

 $S = P(1 + r/100)^{\wedge} n$

Example

Calculate interest on Rs. 750 invested at 12% per annum for 8 years.

 $S = P(1+r/100)^8$

 $= 750(1+12/100)^{8}$

= 1957

Calculation using Excel along with formula is given in the following slide

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84	Forn	nul	a: =	RO	UNE)(B7	9*(1 + B8	0/10	0)^B8	(1;0)
85												

LECTURE 7 Applications of Basic Mathematics

OBJECTIVES

The objectives of the lecture are to learn about:

- Scope of Module 2
- Review of lecture 6
- Annuity
- Accumulated value
- Accumulation Factor
- Discount Factor
- Discounted value
- Algebraic operations
- Exponents
- Solving Linear equations

Module 2

Module 2 covers the following lectures:

- Linear Equations (Lectures 7)
- Investments (Lectures 8)
- Matrices (Lecture 9)
- Ratios & Proportions and Index Numbers (Lecture 10)

<u>Annuity</u>

Let us look at an example to understand what is annuity. Suppose that you want to buy electric equipment on installments. The value of the equipment is Rs. 4,000. The company informs you that you must pay Rs. 1,000 at the time of purchase (down payment = 1,000). The rest of the payments are to be made in 20 installments of 200 rupees each. You are wondering about the total number and sequence of periodic payments. The sequence of payments at equal interval of time is called Annuity. The time between payments is called the Time Interval.

NOTATIONS

The following notations are used in calculations of Annuity:

- R = Amount of annuity
- N = Number of payments
- I = Interest rater per conversion period
- S = Accumulated value

A = Discounted or present worth of an annuity

ACCUMULATED VALUE

The accumulated value S of an annuity is the total payment made including the interest. The formula for Accumulated Value S is as follows:

S = r ((1+i)^n – 1)/i

It may be seen that:

Accumulated value = Payment x Accumulation factor

The discounted or present worth of an annuity is the value in today's rupee value. As an example if we deposit 100 rupees and get 110 rupees (100×1.1) after one year, the Present Worth or 110 rupees will be 100. Here 110 will be future value of 100 at the end of year 1. The amount 110, if invested again, can be Rs. 121 after year 2. The present value of Rs. 121, at the end of year 2, will also be 100. Thus, the total present worth of payments made in year 1 and 2 (100+110 = 210) will be 200. The Future Value of this present worth is 210. (110x1.1)

DISCOUNT FACTOR AND DISCOUNTED VALUE

When future value is converted into present worth, the rate at which the

VU

calculations are made is called Discount factor. In the previous example 10% was used to make the calculations. This rate is called Discount Rate. The present worth of future payments is called Discounted Value. The above example may be restated as follows:

The future value of Annuity in year 1 and 2 is 100 and 110 respectively. The Discount Factor is 10%. The Accumulation Factor after year 1 is 100+10/100 = 1.1. The Accumulation Factor after year 2 will be 110+11/100=1.21.

The Accumulation Factor can also be calculated by treating the value at the end of year 1 as 1 plus interest on 1. After year 1, the Accumulation Factor will be 1+0.1=1.1. Here we treated 10% of 1 as 0.1.

Obviously the Discounted Value at the beginning of year 1 can be calculated as (1+0.1)/1.1 =1. Here 1/1.1=0.9 is the Discount Factor. If you multiply the Future Value or Payment in year 2 (1.1) by the Discount Factor (0.9), you get the discounted value (1.1 x 0.9 = 1).

Thus, we can write down the formula for Discounted Value as follows: Discounted value= Payment x Discount factor The formula can be written as follows: $A = r ((1 - 1/(1 + i)^n)/i)$

EXAMPLE 1. ACCUMULATION FACTOR (AF)

Calculate Accumulation Factor and Accumulated value when: Discount rate i = 4.25 % Number of periods n = 18 Amount of Annuity R = 10,000 Rs. Accumulation Factor AF = ((1 + 0.0425)^18-1)= 26.24 Accumulated Value S = 10,000x 26.24 = 260,240

EXAMPLE 2. DISCOUNTED VALUE (DV)

In the above example calculate the value of all payments at the beginning of term of annuitv

Value of all payments at the beginning of term of Annuity = Payment x Discount Factor (DF) Formula for Discount Factor = $((1-1/(1+i)^n)/i)$ $= ((1-1/(1+0.045)^{8})/0.045)$ = 6.595

EXAMPLE 3. ACCUMULATED VALUE (S)

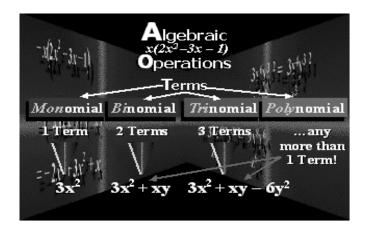
In the above example, calculate the Accumulated Value S. ACCUMULATED VALUE $= 2,000 \times ((1-1/(1+0.055)^{8})/0.055)$

= 2,000 x11.95 =23,900.77

ALGEBRAIC OPERATIONS

Algebraic Expression indicates the mathematical operations to be carried out on a combination of NUMBERS and VARIABLES.

The components of an algebraic expression are separated by Addition and Subtraction. An example is the expression in the following slide. Here the components $2x^{2}$, 3x and 1 are separated by minus "-" sign.



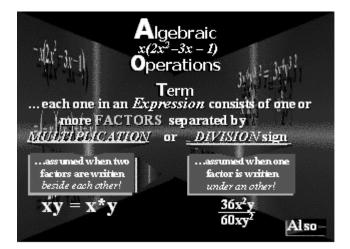
In algebraic expressions there are four types of terms:

- Monomial, i.e. 1 term (Example: 3x²)
- Binomial, i.e. 2 terms (Example: 3x²+xy)
- Trinomial, i.e. 3 terms (Example: 3x²+xy-6y²)
- Polynomial, i.e. more than 1 term (Binomial and trinomial examples are also polynomial)

Algebraic operations in an expression consist of one or more FACTORs separated by MULTIPLICATION or DIVISION sign.

Multiplication is assumed when two factors are written beside each other. Example: $xy = x^*y$

Division is assumed when one factor is written under an other. Example: $36x^2y/60xy^2$



Factors can be further subdivided into NUMERICAL and LITERAL coefficients.

VU

Algebraic $x(2x^2-3x-1)$ Operations $x(3x^2-3x-1)$
Algebraic Expression
=[+ht]+[+] Terms
Monomial Binomial Trinomial Polynomial
=-h ⁺ +h ⁺ FACTORS Numerical Coefficient

There are two steps for Division by a monomial.

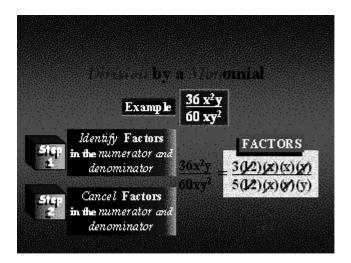
- 1. Identify factors in the numerator and denominator
- 2. Cancel factors in the numerator and denominator

Example:

 $\overline{36x^2y/60xy^2}$ 36 can be factored as 3 x 12. 60 can be factored as 5 x 12 x^2y can be factored as (x)(x)(y)

 xy^2 can be factored as (x)(y)(y)

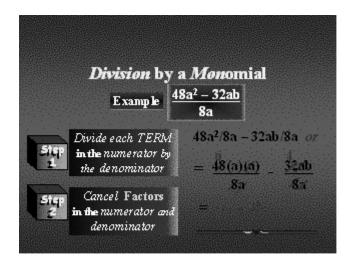
Thus the expression is converted to: $3 \times 12(x)(x)(y)/5 \times 12(x)(y)(y)$ 12x(x)(y) in both numerator and denominator cancel each other. The result is: 3(x)/5(y)



Another example of division by a monomial is (48a^2 – 32ab)/8a. Here the steps are:

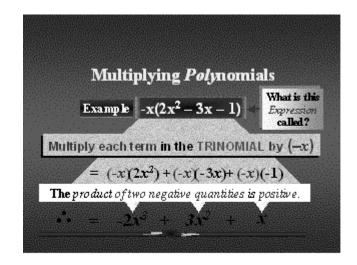
VU

1. Divide each term in the numerator by the denominator 2. Cancel factors in the numerator and denominator $48a^2/8a = 8x6(a)(a)/8a = 6(a)$ 32(a)(b)/8(a) = 4x8(a)(b)/8(a) = 4(b)The answer is 6(a) - 4(b).



How to multiply polynomials? Look at the example $-x(2x^2 - 3x - 1)$. Here each term in the trinomial $2x^2 - 3x - 1$ is multiplied by -x. = $(-x)(2x^2) + (-x)(-3x) + (-x)(-1)$ = $-2x^3 + 3x^2 + x$

Please note that product of two negatives is positive.



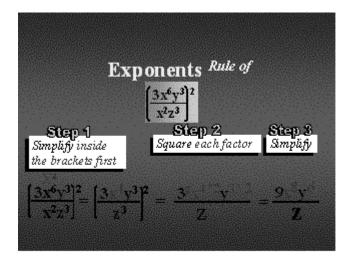
 $3x^{6}y^{3/x^{2}z^{3}}$ Exponent of a term means calculating some power of that term. In the following example we are required to work out exponent of $3x^{6}y^{3/x^{2}z^{3}}$ to the power of 2. The steps in this calculation are:

- 1. Simplify inside the brackets first.
- 2. Square each factor
- 3. Simplify

In the first step, the expression $3x^6y^3/x^2z^3$ is first simplified to $(3x^4)(y^3)/z^3$.

In the next step we take squares. The resulting expression is:

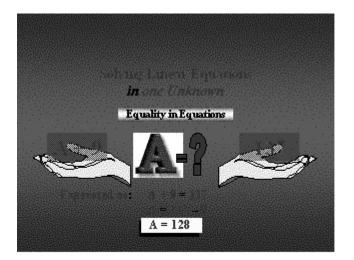
 $(3^2)(x^4*2)(y^3*2)/z^3*2 = 9x^8y^6/z^6$



LINEAR EQUATION

If there is an expression A + 9 = 137, how do we calculate the value of A? A = 137 - 9 = 128

As you see the term 9 was shifted to the right of the equality.



To solve linear equations:

- 1. Collect like terms
- 2. Divide both sides by numerical coefficient.

Step 1: x = 341.25 + 0.025x x - 0.025x = 341.25 x(1-0.025) = 341.25 0.975x = 341.25Step 2. x = 341.25/0.975 = 350

in one Unknown Solve for x from the following: $x = 341.25 \pm 0.025 x$ 99 1 Collect like Terms x = 341.25 + 0.025x x - 0.025x = 341.25\$.975x = 341.25 1 - 0.025Divide both 341.2 x = 350sides by 0.975 1975

LECTURE 8 Compound Interest Calculate returns from investments Annuities Excel Functions

OBJECTIVES

The objectives of the lecture are to learn about:

- Review of lecture 7
- Compound Interest
- Calculate returns from investments
- Annuities
- Excel Functions

CUMIPMT

Returns the cumulative interest paid on a loan between start_period and end_period. If this function is not available, and returns the #NAME? error, install and load the Analysis ToolPak add-in.

The syntax is as follows:

CUMIPMT(rate,nper,pv,start_period,end_period,type)

Rate: interest rate. Nper: total number of payment periods Pv: present value. Start_period: first period in the calculation End_period: last period in the calculation Type: timing of the payment

Туре	Timing
0 (zero)	Payment at the end of the period
1	Payment at the beginning of the period

CUMIPMT-EXAMPLE

Following is an example of CUMIPMT function. In this example, in the first case the objective is to find total interest paid in the second year of payments for periods 13 to 24. Please note there are 12 periods per year. The second case is for the first payment period.

In the first formula, the Annual interest rate 9% is cell A2 (not shown here). The Years of the loan are given in cell A3. The Present value is in cell A4. For the Start period the value 13 was entered. For the End period, the value 24 has been specified. The value of Type is 0, which means that the payment will be at the end of the period. Please note that the annual interest is first divided by 12 to arrive at monthly interest. Then the Years of the loan are multiplied by 12 to get total number of months in the Term of the loan. The answer is (-11135.23).

In the second formula, which gives Interest paid in a single payment in the first month 1 was specified as the Start period. For the End period also the value 1 was entered. This is because only 1 period is under study. All other inputs were the same. The answer is (-937.50).

64

Data Description

9% Annual interest rate

30 Years of the loan

125,000 Present value

=CUMIPMT(A2/12,A3*12,A4,13,24,0)Total interest paid in the second year of payments, periods 13 through 24 (-11135.23)

=CUMIPMT (A2/12,A3*12,A4,1,1,0)Interest paid in a single payment in the first month (-937.50)

CUMPRINC

The CUMPRINC function returns the cumulative principal paid on a loan between two periods.

The syntax is as under:

CUMPRINC(rate,nper,pv,start_period,end_period,type)

Rate: interest rate.

Nper: total number of payment periods.
Pv: present value
Start_period: period in the calculation. Payment
End_period: last period in the calculation
Type: timing of the payment (0 or 1 as above)

CUMPRINC EXAMPLE

Following is an example of CUMPRINC function. In this example, in the first case the objective is to find the total principal paid in the second year of payments, periods 13 through 24. Please note there are 12 periods per year. The second case is for the principal paid in a single payment in the first month.

In the first formula, the Interest rate per annum 9% is in cell A2 (not shown here). The Term in years (30) is given in cell A3. The Present value is in cell A4. For the Start period the value 13 was entered. For the End period, the value 24 has been specified. The value of Type is 0, which means that the payment will be at the end of the period. Please note that the interest is first divided by 12 to arrive at monthly interest. Then the years of loan are multiplied by 12 to get total number of months in the term of the loan. The answer is (-934.1071).

In the second formula, which gives the principal paid in a single payment in the first month 1 was specified as the start period. For the end period also the value 1 was entered. This is because only 1 period is under study. All other inputs were the same. The answer is (-68.27827).

EXAMPLE

Data Description

9.00% Interest rate per annum

30 Term in years

125,000 Present value

=CUMPRINC(A2/12,A3*12,A4,13,24,0)The total principal paid in the second year of payments, periods 13 through 24 (-934.1071)

=CUMPRINC(A2/12,A3*12,A4,1,1,0)The principal paid in a single payment in the first month (-68.27827)

<u>EFFECT</u>

Returns the effective annual interest rate. As you see there are only two inputs, namely, the nominal interest Nominal_rate and the number of compounding periods per year Npery.

EFFECT(nominal_rate,npery) Nominal_rate: nominal interest rate Npery: number of compounding periods per year

EFFECT-EXAMPLE

Here Nominal_rate = 5.25% in cell A2. Npery =4 in cell A3. The answer is 0.053543 or 5.3543%. You should round off the value to 2 decimals. 5.35%. 5.25% Nominal interest rate

4 Number of compounding periods per year

=EFFECT(A2,A3)

Effective interest rate with the terms above (0.053543 or 5.3543 percent) **FV**

Returns the future value of an investment. There are 5 inputs, namely, Rate the interest rate, Nper number of periods, Pmt payment per period, Pv present value and Type. **FV**(rate,nper,pmt,pv,type)

Rate: interest rate per period

Nper: total number of payment periods

Pmt: payment made each period.

Pv: present value, or the lump-sum amount

Type: number 0 or 1 due

FV-EXAMPLE 1

In the formula, there are 5 inputs, namely, Rate 6% in cell A2 as the interest rate, 10 as Nper number of periods in cell A3, -200 (notice the minus sign) as Pmt payment per period in cell A4, -500 (notice the minus sign) as Pv present value in cell A4 and 1 as Type in cell A6. The answer is (2581.40).

- Data Description EXAMPLE 1
- 6% Annual interest rate
- 10 Number of payments
- -200 Amount of the payment
- -500 Present value

P ayment is due at the beginning of the period.

=FV (A2/12, A3, A4, A5, A6) Future value of an investment with the above terms (2581.40) =FV (rate,nper,pmt,pv,type)

FV-EXAMPLE 2

In the formula, there are 3 inputs, namely, Rate 12% in cell A2 as the interest rate, 12 as Nper number of periods in cell A3, -1000 (notice the minus sign) as Pmt payment per period in cell A4. Pv present value and Type are not specified. Both are not required as we are calculating the Future value of the investment. The answer is (12682.50).

EXAMPLE 2

12% Annual interest rate 12 Number of payments -1000 Amount of the payment =FV(A2/12, A3, A4) Future value of an investment with the above terms (12,682.50) FV(rate,nper,pmt,pv,type)

FV-EXAMPLE 3

In the formula, there are 4 inputs, namely, Rate 11% in cell A2 as the interest rate, 35 as Nper number of periods in cell A3, -2000 (notice the minus sign) as Pmt payment per period in cell A4, 1as Type in cell A5. The value of Pv was omitted by entering a blank for the value (note the double commas",,". The answer is (82846.25).

EXAMPLE 3

- 11% Annual interest rate
- 35 Number of payments
- -2000 Amount of the payment
- Payment is due at the beginning of the period

=FV(A2/12, A3, A4,, A5) Future value of an investment with the above terms (82,846.25)

FV(rate,nper,pmt,pv,type)

FV SCHEDULE

Returns the future value of an initial principal after applying a series of compound interest rates. FVSCHEDULE(principal, schedule) Principal: present value Schedule: an array of interest rates to apply

FV SCHEDULE-EXAMPLE

In this example, the Principal is 1. The compound rates {0.09, 0.11,0.1} are given within curly brackets. The answer is (1.33089). FVSCHEDULE(principal,schedule) =FVSCHEDULE(1,{0.09,0.11,0.1}) Future value of 1 with compound interest rates of 0.09,0.11,0.1 (1.33089)

<u>IPMT</u>

Returns the interest payment for an investment for a given period. IPMT(rate,per,nper,pv,fv,type) Rate: interest rate per period Per: period to find the interest Nper: total number of payment periods Pv: present value, or the lump-sum amount Fv: future value, or a cash balance Type: number 0 or 1

ISPMT

Calculates the interest paid during a specific period of an investment ISPMT(rate,per,nper,pv) Rate: interest rate Per: period Nper: total number of payment periods Pv: present value. For a loan, pv is the loan amount

NOMINAL

Returns the annual nominal interest rate. NOMINAL(effect_rate,npery) Effect_rate: effective interest rate Npery: number of compounding periods per year

<u>NPER</u>

Returns the number of periods for an investment. NPER(rate, pmt, pv, fv, type) Rate: the interest rate per period. Pmt: payment made each period Pv: present value, or the lump-sum amount Fv: future value, or a cash balance Type: number 0 or 1 (due)

<u>NPV</u>

Returns the net present value of an investment based on a series of periodic cash flows and a discount rate. PV(rate,nper,pmt,fv,type) Rate: interest rate per period Nper: is the total number of payment periods Pmt: payment made each period Fv: future value, or a cash balance Type number 0 or 1 (due)

<u> PMT</u>

Returns the periodic payment for an annuity. PMT(rate,nper,pv,fv,type) Rate: interest rate Nper: total number of payments Pv: present value Fv: future value Type: number 0 (zero) or 1

PPMT

Returns the payment on the principal for an investment for a given period. PPMT(rate,per,nper,pv,fv,type) Rate: interest rate per period. Per: period and must be in the range 1 to nper Nper: total number of payment periods Pv: the present value Fv: future value (0) Type: the number 0 or 1 (due)

PV

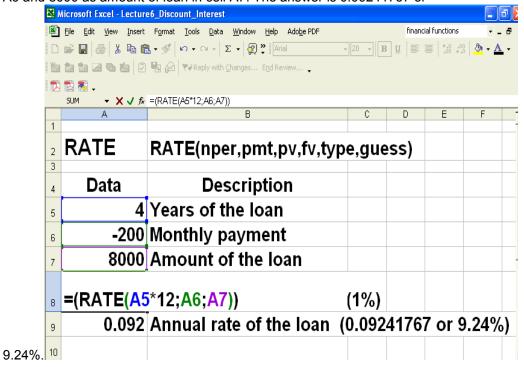
Returns the present value of an investment. PV(rate,nper,pmt,fv,type) Rate: interest rate per period Nper: total number of payment periods in an annuity Pmt: payment made each period and cannot change over the life of the annuity Fv: future value, or a cash balance Type: number 0 or 1 and indicates when payments are due

<u>RATE</u>

Returns the interest rate per period of an annuity. RATE(nper,pmt,pv,fv,type,guess) Nper: total number of payment periods Pmt: payment made each period Pv: present value Fv: future value, or a cash balance (0) Type: number 0 or 1 (due) Guess: (10%)

RATE-EXAMPLE

Three inputs are specified. 4 as years of loan in cell A5, -200 as monthly payment in cell A6 and 8000 as amount of loan in cell A7. The answer is 0.09241767 or



LECTURE 9 Compound Interest Calculate returns from investments Annuities Excel Functions

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 8
- Matrices
- Matrix Applications using Excel

QUESTIONS

Every student wonders why he or she should study matrices. Ther are mant important questions:

Where can we use Matrices? Typical applications? What is a Matrix? What are Matrix operations?

Excel Matrix Functions?

There are many applications of matrices in business and industry especially where large amounts of data are processed daily.

TYPICAL APPLICATIONS

Practical questions in modern business and economic management can be answered with the help of matrix representation in:

- Econometrics
- Network Analysis
- Decision Networks
- Optimization
- Linear Programming
- Analysis of data
- Computer graphics

WHAT IS A MATRIX?

A Matrix is a rectangular array of numbers. The plural of matrix is matrices. Matrices are usually represented with capital letters such as Matrix A, B, C. Matrices are usually represented with capital letters. Shown below are several matrices.

 $A = \begin{bmatrix} -1 & 9 \\ -3 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 47 & 62 & 70 & 56 \\ 52 & 33 & 28 & 45 \end{bmatrix} \quad C = \begin{bmatrix} 1 & -4 \\ 0 & 3 \\ 5 & -2 \end{bmatrix}$

The numbers in a matrix are often arranged in a meaningful way. For example, the order for school clothing in September is illustrated in the table, as well as in the corresponding matrix.

	Size							
	Youth	S	М	L	XL			
Sweat Pants	0	10	34	40	12			
Sweat Shirts	18	25	29	21	7			

Shorts	19	13	48	36	9
Т-	27	7	10	24	14
shirts					

The data in the above table can be entered in the shape of a matrix as follows:

Γο	10	34	40	12]	
18	10 25 13 7	29	21	7 9 14	
19	13	48	36	9	
27	7	10	24	14	

DIMENSION

Dimension or Order of a Matrix = Number of Rows x Number of Columns **Example**

Matrix T has dimensions of 2x3 or the order of matrix T is 2x3.

$$T = \begin{bmatrix} 6 & 2 & -1 \\ -4 & 0 & 7 \end{bmatrix} \leftarrow row2$$
$$\land \uparrow \land$$
$$col1 \ col2 \ col3$$

ROW, COLUMN OR SQUARE MATRIX

A matrix with dimensions 1xn is referred to as a row matrix. For example, matrix A to the right is a 1x4 row matrix. A matrix with dimensions nx1 is referred to as a column matrix. For example, matrix B to the right is a 2x1 column matrix. A matrix with dimensions nxn is referred to as a square matrix. For example, matrix C to the right is a 3x3 square matrix.

$$A = \begin{bmatrix} 12 & 17 & 10 & 9 \end{bmatrix} B = \begin{bmatrix} -2 \\ 0 \end{bmatrix} C = \begin{bmatrix} 2 & -3 & 7 \\ 6 & 8 & -1 \\ -5 & 0 & 4 \end{bmatrix}$$

ROW MATRIX

In a Row Matrix there is one row of values. Example: In Matrix A above the dimension is 1x4. In a Column Matrix there is one column of values. Example: In Matrix B above the dimension is 2x1. In a Square Matrix, there is equal number of rows and columns. Example: In Matrix C above the dimension is 3x3.

IDENTY MATRIX

An identity matrix is a square matrix with 1's on the main diagonal from the upper left to the lower right and 0's off the main diagonal. An identity matrix is denoted as I. Some examples of identity matrices are shown below. The subscript indicates the size of the

identity matrix. For example, I_n , represents an identity matrix with dimensions n×n.

$$I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad I_4 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

MULTIPLICATIVE IDENTITY

With real numbers, the number 1 is referred to as a multiplicative identity because it has the unique property that the product a real number and 1 is that real number. In other words, 1 is called a multiplicative identity because for any real number n, 1° n = n and n° 1=n. With matrices, the identity matrix shares the same unique property as the number 1. In other words, a 2×2 identity matrix is a multiplicative

inverse because for any 2×2 matrix A, $I_2 \cdot A = A$ and $A \cdot I_2 = A$ Example

Given the 2×2 matrix, A =
$$\begin{bmatrix} 2 & -1 \\ -3 & 4 \end{bmatrix}$$

 $I_2 \cdot A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 2 & -1 \\ -3 & 4 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ -3 & 4 \end{bmatrix}$
 $\begin{bmatrix} 2 & -1 \\ -3 & 4 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ -3 & 4 \end{bmatrix}$
Work
r1c1 = 1(2) + 0(-3) = 2
r2c1 = 0(2) + 1(-3) = -3
r1c1 = 2(1) + -1(0) = 2
r2c1 = -3(1) + 4(0) = -3
r1c2 = 1(-1) + 0(4) = -1
r2c2 = 0(-1) + 1(4) = 4
r1c2 = 2(0) + -1(1) = -1
r2c2 = -3(0) + 4(1) = 4

MULTIPLICATIVE INVERSES

Real Numbers

Two non-zero real numbers are multiplicative inverses of each other if their products, in both orders, is 1. Thus,

the multiplicative inverse of a real number, x is $\frac{1}{x}$ or x^{-1} since x • $\frac{1}{x} = 1$ and $\frac{1}{x} • x = 1$. **Example:**

The multiplicative inverse of 5 is 5 since

 $\frac{1}{5 \cdot 5} = 1$ and $\frac{1}{5 \cdot 5} = 1$ Matrices

Two 2^{×2} matrices are inverses of each other if their products, in both orders, is a 2^{×2} identity matrix. Thus, the multiplicative inverse of a 2^{×2} matrix, A is A^{-1} since A • A^{-1}

= I_2 and $A^{-1} \cdot A = I_2$

Example:

$$\operatorname{trix}_{\mathrm{trix}} \begin{bmatrix} 3 & -2 \\ -1 & 4 \end{bmatrix}_{\mathrm{is}} \begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix}_{\mathrm{since:}}$$

The multiplicative inverse of a matrix, \lfloor^{-1}

$$\begin{bmatrix} 3 & -2 \\ -1 & 4 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$
$$\begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix} \begin{bmatrix} 3 & -2 \\ -1 & 4 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

LECTURE 10 MATRICES

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 9
- Matrices

EXAMPLE 1

An athletic clothing company manufactures T-shirts and sweat shirts in four differents sizes, small, medium, large, and x-large. The company supplies two major universities, the U of R and the U of S. The tables below show September's clothing order for each university

University of S's September Clothing Order

	S	М	L	XL
T- shirts	100	300	500	300
sweat shirts	150	400	450	250

University of R's September Clothing Order.

	S	М	L	XL
T- shirts	60	250	400	250
sweat shirts	100	200	350	200

Matrix Representation

The above information can be given by two matrices S and R as shown below.

$$S = \begin{bmatrix} 100 & 300 & 500 & 300 \\ 150 & 400 & 450 & 250 \end{bmatrix}$$
$$R = \begin{bmatrix} 60 & 250 & 400 & 250 \\ 100 & 200 & 350 & 220 \end{bmatrix}$$

MATRIX OPERATIONS

The matrix operations can be summarized as under:

- Organize and interpret data using matrices
- Use matrices in business applications
- Add and subtract two matrices
- Multiply a matrix by a scalar

• Multiply two matrices

• Interpret the meaning of the elements within a product matrix

PRODUCTION

The clothing company production in preparation for the universities' Septmber orders is shown by the table and corresponding matrix P below.

	S	М	L	XL
T- shirts	300	700	900	500
sweat shirts	300	700	900	500

300 700 900 500 300 700 900 500

ADDITION AND SUBTRACTION OF MATRICES

The sum or difference of two matrices is calculated by adding or subtracting the corresponding elements of the matrices.

To add or subtract matrices, they must have the same dimensions.

PRODUCTION REQUIREMENT

Since the U of S ordered 100 small T-shirts and the U of R ordered 60, then althogether 160 small T-shirts are required to supply both universities. Thus, to calculate the total number of T-shirts and sweat shirts required to supply both universities, add the corresponding elements of the two order matrices as shown below.

	[10	0 30	0 500	300]	[60]	250	400	250]	
	[15	0 40	0 500 0 450	250	100	200	350	220	
[160	550	900	550]						
250	600	800	550 470						

OVERPRODUCTION

Since the company produced 300 small T-shirts and the received orders for only 160 small T-shirts, then the company produced 140 small T-shirts too many. Thus, to determine the company's over-production, subtract the corresponding elements of the total order matrix from the production matrix as shown below.

[300	700	900	500]	[160	550	900	550]	[140	150	0	-50]
300	700	900	500	250	600	800	470	50	100	100	30

MULTIPLICATION OF MATRICES

To understand the reasoning behind the definition of matrix multiplication, let us consider the following example.

Competing Companies, A and B, sell juice in 591 mL, 1 L and 2 L plastic bottles at prices of Rs.1.60, Rs.2.30 and Rs.3.10, respectively. The table below summarises the sales for the two companies during the month of July.

	591mL	1L	2L
Company A	20,000	5,500	10,600
Company B	18,250	7,000	11,000

What is total revenue of Company A?

What is total revenue of Company B?

Matrices may be used to illustrate the above information.

As shown at the right, the sales can be written as

a 2X3 matrix, S, the selling prices can be written as a column matrix, P, and the total revenue for each company can be expressed as a column matrix, R.

		Р	
S = [20,000 5,500 [18,250 7,000	10,600 11,000	1.60 2.30 3.10	R = [77,510 [79,400]

Since revenue is calculated by multiplying the number of sales by the selling price, the total revenue for each company is found by taking the product of the sales matrix and the price matrix.

_		_	[1.60]	
20,000	5,500	10,600	0.20	77,510
18 250	7 000	11 000 ×	2.30	= 79 400
L10,250	,,		3.10	= [77,510 79,400]

Consider how the first row of matrix S and the single column P lead to the first entry of R.

[20,000	5, 500	$ \begin{array}{c} 10,600\\ 11,000 \end{array} \right] \times \left[\begin{array}{c} 1.60\\ 2.30\\ 3.10 \end{array} \right] $	⇒20,000(1.60)	+5,500(2.30)+ بار	10,600(3.10) ⇒ ↓	77,510
18,250	7,000	11,000 \[2.50 \] 3.10	✓ Product of	✓ Product of	✓ Product of	79,400
			First Entries	Second Entries	Third Entries	

With the above in mind, we define the product of a row and a column to be the number obtained by multiplying corresponding entries (first by first, second by second, and so on) and adding the results.

MULTIPLICATION RULES

If matrix A is a $m^{\times}n$ matrix and matrix B is a $n^{\times}p$ matrix, then the product AB is the $m^{\times}p$ matrix whose entry in the i-th row and the j-th column is the product of the i-th row of matrix A and the j-th row of matrix B.

The product of a row and a column is the number obtained by multiplying corresponding elements (first by first, second by second, and so on).

To multiply matrices, the number of columns of A must equal the number of rows of B.

MULTIPLICATION RULES

Given the matrices below, decide if the indicated product exists. And, if the product exists, determine the dimensions of the product matrix.

A =	-5 12 7	0 3 15	4 10 -1	
B =	1 9 5	4 -1 7		
<i>C</i> =	[4 [8	-3 -5	1 - -2	.7 10
D =	[1 0	$\begin{bmatrix} -1\\ 2 \end{bmatrix}$		
<i>E</i> =	[6] 7 8 9]			

MULTIPLICATION CHECKS

The table below gives a summary whether it is possible to multiply two matrices. It may be noticed that the product of matrix A and matrix B is possible as the number of columns of A are equal to the number of rows of B. The product BA is not possible as the number of columns of b are not equal to rows of A.

Product	Dimesions of the Matrices	Does a product exist? (Is it possible to multiply the given matrices in this order?)	Dimensions of Product Matrix
AB	$A = \frac{3 \times 3}{3 \times 2} B =$ $\uparrow \qquad \uparrow$ inner dimensions	Yes, the product exists since the inner dimensions match (# of columns of A = # of rows of <i>B</i>).	3 [×] 2
ВА	$B = \frac{3 \times 2}{3 \times 3} A =$ $\uparrow \qquad \uparrow$ inner dimensions	No, the product does not exist since the inner	n/a

dimensions do not match (# of
columns of
B ≠ # of rows of A).
rows of A).

LECTURE 11 MATRICES

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 10
- Matrix functions in Excel
- Set up and manipulate ratios.
- Allocate an amount on a prorata basis using proportions.

MATRIX FUNCTIONS IN MS EXCEL

The Matrix Functions in Microsoft Excel are as follows: MDETERM Returns the matrix determinant of an array MINVERSE Returns the matrix inverse of an array MMULT Returns the matrix product of two arrays <u>MINVERSE</u> Returns the inverse matrix for the matrix stored in an array

Returns the inverse matrix for the matrix stored in an array.

Syntax MINVERSE(array)

Array is a numeric array with an equal number of rows and columns. **Remarks**

- Array can be given as a cell range, such as A1:C3; as an array constant, such as {1,2,3;4,5,6;7,8,9}; or as a name for either of these.
- If any cells in array are empty or contain text, MINVERSE returns the #VALUE! error value.
- MINVERSE also returns the #VALUE! error value if array does not have an equal number of rows and columns.
- Formulas that return arrays must be entered as array formulas.
- Inverse matrices, like determinants, are generally used for solving systems of mathematical equations involving several variables. The product of a matrix and its inverse is the identity matrix the square array in which the diagonal values equal 1, and all other values equal 0.
- As an example of how a two-row, two-column matrix is calculated, suppose that the range A1:B2 contains the letters a, b, c, and d that represent any four numbers. The following table shows the inverse of the matrix A1:B2.

	Column A	Column B
Row 1	d/(a*d-b*c)	b/(b*c-a*d)
Row 2	c/(b*c-a*d)	a/(a*d-b*c)

- MINVERSE is calculated with an accuracy of approximately 16 digits, which may lead to a small numeric error when the cancellation is not complete.
- Some square matrices cannot be inverted and will return the #NUM! error value with MINVERSE. The determinant for a noninvertable matrix is 0.

MINVERSE

MINVERSE (array) Array is a numeric array with an equal number of rows and columns Inverse of the matrix A 1:B2. Column A Column B Row 1 d/(a*d-b*c) b/(b*c-a*d) Row2 c/(b*c-a*d) a/(a*d-b*c) Array formula 1. F2 2. Enter formula 3. Ctrl + Shift + Enter

MINVERSE-EXAMPLE

The slide below shows the inversion of matrix with row 1 [4 - 1] and row 2 [2 0].

The formula in the example must be entered as an array formula. Select the range A4:B5 starting with the formula cell. Press F2, and then press CTRL+SHIFT+ENTER. If the formula is not entered as an array formula, the single result is 0.

- The process was as follows:
- 1. Enter data of array to be inverted. Cells A4:B5.
- 2. Select cells A6:B7 for the formula.
- 3. Enter the formula "=MINVERSE("
- 4. Select the range A4:B5
- 5. Enter ")"
- 6. Press CTRL+SHIFT+ENTER
- 7. Press Enter

Please note that the entry of the array Formula can be tricky. You must enter the data and formula as summarised above. If your entry is correct the curly bracket will indicate that the formula was entered as an array formula.

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	A	В	C	D						
1										
2	MINVERSE									
3	Data	Data								
4	4	-1								
5	2	0								
6	0	0.5	{=MINVERS(A	4:B5)}						
7	-1	2								
8										

Returns the matrix determinant of an array.

Syntax

MDETERM(array)

Array is a numeric array with an equal number of rows and columns.

Remarks

- Array can be given as a cell range, for example, A1:C3; as an array constant, such as {1,2,3;4,5,6;7,8,9}; or as a name to either of these.
- If any cells in array are empty or contain text, MDETERM returns the #VALUE! error value.
- MDETERM also returns #VALUE! if array does not have an equal number of rows and columns.
- The matrix determinant is a number derived from the values in array. For a threerow, three-column array, A1:C3, the determinant is defined as:

MDETERM(A1:C3) equals

A1*(B2*C3-B3*C2) + A2*(B3*C1-B1*C3) + A3*(B1*C2-B2*C1)

- Matrix determinants are generally used for solving systems of mathematical equations that involve several variables.
- MDETERM is calculated with an accuracy of approximately 16 digits, which may lead to a small numeric error when the calculation is not complete. For example, the determinant of a singular matrix may differ from zero by 1E-16.

MDETERM-EXAMPLE

The example shows an array of size 4 x 4 in cell range A14:d17. The formula was entered in cell A18. The result of this calculation is 88.

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	SUM	- - X V I	Sector A = MDETERM(A	(14:D17)			
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13	Data	à	Data	Data	Data		
14		1	3	8	5		
15		1	3	6	1		
16		1	1	1	0		
17		7	3	10	2		
18	=MD	DETER	M(A14:I	D17)			
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There are other ways of using this function. You can enter the matrix as an array constant.

=MDETERM({3,6,1;1,1,0;3,10,2})

Determinant of the

matrix as an array constant (

You can calculate the determinant of the array constant.

=MDETERM({3,6;1,1})	Determinant of the matrix in
	the array constant (-3)

Unequal number of rows and columns results in an error.

=MDETERM({1,3,8,5;1,3,6,1})

Returns an error because the array does not have an equal number of rows and columns (#VALUE!)

<u>MMULT</u>

Returns the matrix product of two arrays. The result is an array with the same number of rows as array1 and the same number of columns as array2.

Syntax

MMULT(array1,array2)

Array1, array2 are the arrays you want to multiply.

<u>Remarks</u>

- The number of columns in array1 must be the same as the number of rows in array2, and both arrays must contain only numbers.
- Array1 and array2 can be given as cell ranges, array constants, or references.
- If any cells are empty or contain text, or if the number of columns in array1 is different from the number of rows in array2, MMULT returns the #VALUE! error value.
- The matrix product array a of two arrays b and c is:

$$a_{jj} = \sum_{k=1}^{n} b_{jk} c_{kj}$$

where i is the row number, and j is the column number.

Formulas that return arrays must be entered as array formulas.

MMULT-EXAMPLE

Array1 was entered in cell range A25:B26. Array2 was entered in cell range A28:B29. The

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	SUM 🗸 🗙 🗸	/ 🖈 =MMULT(A25:B26	6;A2	,	
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23	MMULT				
24	Array 1	Array 1			
25		1	3		
26		7	2		
27	Array 2	Array 2			
28		2	0		
29		0	2	=MMULT(A25:	
30		2		B26;A28:B29)	

The formula was entered as an array formula. Cell A30 was selected for entry of the array Formula for MMULT. After entering "=MMULT(" the range A25:B26 was selected. Then ";" was entered. Next range A28:B29 was selected. Next ")" was entered. F2 was pressed to start the entry of array formula. Then the keys CTRL+SHIFT+ENTER were pressed simultaneously. The answer 2 was obtained in cell A30. The formula was also entered in cell C29 to show the syntax. RATIO

A Ratio is a comparison between things. If in a room there are 30 men and 15 women then the ratio of men to women is 2 to 1. This is written as 2:1 where the ":" is the notation for a ratio.

- The method of calculating ratios is as under:
- 1. Find the minimum value
- 2. Divide all the values by the smallest value.

In the above example, the smallest value was 15. Division gives 30/15 = 2 for men and 15/15 = 1 for women. The ratio is therefore 2:1 for men and women.

RATIO-EXAMPLE

Three friends ali, Fawad and Tanveer are doing business together. To set up the business Ali invested Rs. 7800, Fawad Rs. 5,200 and Tanveer Rs. 6,500 respectively. The question is what is the ratio of their investments.

As discussed above the smallest value is 5200. All values are divided by 5200. the results are 1.5 for Ali, 1 for Fawad and 1.25 for Tanveer. The answer is: 1.5 : 1 : 1.25.

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56				RATIO						
57	Ali	7800		1.5						
58	Fawad	5200		1						
59	Tanveer 6500 = 859/858									
60				1.25						
61										

This example was solved in Excel. The formula is as under: Cell D57: =B57/B58 Cell D58: =B58/B58 Cell D59: =B59/B58

The result for cell D59 was shown in cell D60, because the cell D59 was used to display the formula.

ESTIMATING USING RATIO

Ratio of sales of Product X to sales of Product Y is 4:3. The sales of product X is forecasted at Rs. 180,000. What should be the Sales of product Y to maintain the ratio of sales between the two products.

CALCULATION

Ratio sales X : Y = 4 : 3 Insert the value for forecasted sale for X. 180,000 : Y = 4 : 3 It can be rewritten as: 180,000/Y = 4/3Cross - multiply 180,000 x 3 = 4 x Y Rewrite to bring the unknown to the left of the equality 4 x Y = 180,000 x 3 Solve Y = (180,000 x 3)/4 Y = 135,000

Calculations using EXCEL

In cells B70 and B71 the ratios of Product X and Y were entered. The value of forecast of product X was entered in cell D70. Before writing down the formula in excel, it was derived as follows:

1 Ratio of X = (cell B70)

2	Ratio of y = (cell B71)
3	Sale of $X = (cell D70)$
4	Sale of Y = (cell D71)
Now Ra	atio X: Y = (cell B70)/ (cell B71)
Ratio	of sales = (cell D70)/ (cell D71)
Cross-	multiply.
(cell B7	70) x (cell D71) = (cell B71) x (cell D70)
Cell D7	1 is unknown. Hence:
(cell D	71) = (cell B71) x (cell D70)/ (cell B70)
Ór	
(cell D7	71) = (cell B71)/ (cell B70) * (cell D70)
Thus th	ne formula was:
=B71/E	370*D70
Please	note that actually we are using the ratio Y to

Please note that actually we are using the ratio Y to X as it is easier to think of ratio of unknown to the known.

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71	Product Y	3	=E	871/B70*D	70		
72				135000			
73							

ESTIMATING USING RATIO-EXAMPLE 2

In a 500 bed hospital there are 200 nurses and 150 other staff. If the hospital extends by a new wing for 100 beds, then what additional staff is needed? Let us 500 beds B1 and 100 beds B2. Staff nurses N1 is 200 and other staff O1 is 150. What is the value of N2 and O2 for B2.

Obviously the ratio of beds will be used. As pointed out above, think of the ratio of unknown to known. In other words ratio B2:B1 or B2/B1. Ratio of nurses would be N2/N1. Ratio of other staff would be O2/O1.

Now :

N2/N1 = B2/B1 Or N2 = (B2/B1)*N1 or N2 = (100/500)*200 = 40 Nurses O2/O1 = B2/B1 Or N2 = (B2/B1)*O1 or O2 = (100/500)*150 = 30 other staff.

Calculation

Beds	:	Nurses	:	Other staff						
500	:	200	:	150						
100	:	Χ?	:	Υ?						
Nurses										
500:200	= 10)0 : X								
500 X = 2	00 x	100								
X = (200 x	x 10	0)/500 = 4	40							
Other sta	ff	-								
Y = (150 x	Y = (150 x 100)/500 = 30									

Calculation using EXCEL

The calculation using EXCEL was done in a similar fashion as the previous example.

The calculation is self-explanatory.

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7	Ot	her s	taff	150) ?	=(D7	/D5*	E 5)	
8						30			
9									

ESTIMATING USING RATIO-EXAMPLE 3

A Fruit Punch recipe requires mango juice, apple juice and orange juice ratio of 3:2:1. To make 2 litres of punch calculate quantity of ingredient needed.

Again we shall use the raio of unknown to the unknown. The unknowns are mango and apple juice. Consider first ratio of required mango juice (3) to total quantity of punch (6). This was calculated from 3+2+1. Now the quantity of required mango for 2 litre would simply be (3/6)*2. Similarly the required quantity of apple juice is (2/6)*2.

CalculationMango juice : Apple juice : Orange juice3 : 2 : 1Total = 6X? : Y? : Z?Total = 2 litreMango juice X = (3/6)*2 = 1 litreApple juice Y = (2/6)*2 = 0.67 litreOrange juice Z = (1/6)*2 = 0.33 litre

Calculation using EXCEL

Here also the similar ratios were used. Mango = B20/B23*D23 Apple = B21/B23*D23 Orange = B22/B23*D23

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A	В	С	D	E	F	G			
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17 USING RATIO	5								
18									
19	RAT	0							
20 Mango juice	3		?	1					
21 Apple juice	2		?	0.7					
22 Orange juice	1		=B2	2/B 23	* D 23				
23 Total. Litre	6		2						
24									

LECTURE 12 RATIO AND PROPORTION MERCHANDISING

OBJECTIVES

The objectives of the lecture are to learn about:

- Module 3
- Review Lecture 11
- Ratio and Proportions
- Merchandising
- Assignment 1A and 1B

MODULE 3

Module 3 has the following content:

- Ratio and Proportions
- Merchandising
 (Lectures 12)
- Mathematics of Merchandising (Lectures 13-16)

ESTIMATING USING RATIOS-EXAMPLE 1

In the previous lecture, we studied how ratios can be used to determine unknowns. Here is another example with a slightly different approach. Here, the ratios of quantities are known. Only one quantity is known. How do we estimate the total quantity that can be made? It is the quantity of orange juice that will determine the total quantity that can be made. Again the method is to use the ratio of the unknown to the known.

Punch recipe

 Ratio of mango juice, apple juice and orange juice: 3:2:1.
 If you have 1.5 litres of orange juice, how much punch can you make?

 Calculation
 Mango juice : Apple juice : Orange juice

```
2 :
      3
              :
                               1
      Total = 6
                    Y? :
     Χ?
             :
                               Z=1.5
      Total = ? litre
Mango juice X = (3/1)^{*}1.5 = 4.5 litre
Apple juice Y = (2/1)^{*}1.5 = 3.0 litre
Orange juice Z
                          = 1.5 litre
Total = 4.5 + 3.0 + 1.5
                          = 9 litre
```

EXCEL Calculation

The method used is the same as used in previous examples.

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A	В	С	D	E	F	G		
	-							
28 USING RATIO	S							
29								
30	RAT	0						
31 Mango juice	3		?	4.5				
32 Apple juice	2		?	3				
33 Orange juice	1	I	1.5	1.5	_			
34 Total. Litre	Total. Litre 6 =B34/B33*D33							
35				9				
36								

ESTIMATING USING RATIOS-EXAMPLE 2

In this example, the ratios are the same. Quantity of orange juice is known. The quantity of mango and apple juice is to be calculated if the total requirement is 500 litre.

Punch recipe

The ratio of mango juice, apple juice and orange juice is 3 : 2 : 1.5 If you have 500 milliliters of orange juice, how much mango juice and apple juice is needed? Mango juice : Apple juice : Orange juice

: 2 : 3 1.5 Total = 6.5 X? • Y? : Z = 500 litre Total = ? litre Mango juice X = (3/1.5)*500 = 1000 litre Apple juice Y = (2/1.5)*500 = 667 litre Orange juice Z = 500 litre Total = 1000 + 667 + 500 = 2167 litre EXCEL Calculation Here also ratios were used. Mango = B45/B47*D47 Apple = B46/B47*D47Orange = D47

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46	Apple juice	2		?	667								
47	Orange juice	1.5		500	500								
48	Total. MI	6.5		?	2167								
49													

EXERCISE

In a certain class, the ratio of passing grades to failing grades is 7 to 5. How many of the 36 students failed the course? The ratio, "7 to

5" (or 7 : 5 or 7/5), tells you that, of every 7 + 5 = 12 students, five failed. That is, 5/12 of the class flunked.

(5/12)(36) = 15 students failed.

PROPORTION

a/b = c/d

...the values in the "b" and "c" positions are called the "means" of the proportion, while the values in the "a" and "d" positions are called the "extremes" of the proportion. A basic defining property of a proportion is that the product of the means is equal to the product of the extremes. In other words, given:

a/b = c/d

... it is a fact that ad = bc. **PROPORTION-EXAMPLES** Is 24/140 proportional to 30/176? Check: $140 \times 30 = 4200$ 24×176 = 4224 So the answer is that: are not proportional. **PROPORTION EXAMPLE 1** Find the unknown value in the proportion: 2: x = 3: 9. 2: x = 3: 9First, convert the colon-notation ratios to fractions: .2/x = 3/9Then solve: .2/x = 3/918 = 3x

18 = 3x6 = x

PROPORTION EXAMPLE 2

Find the unknown value in the proportion: (2x + 1) : 2 = (x + 2) : 5

They

Then

(2x + 1): 2 = (x + 2): 5First, convert the colon-notation ratios to fractions: (2x + 1)/2 = (x + 2)/5Then solve: (2x + 1)/2 = (x + 2)/5 5(2x + 1) = 2(x + 2) 10x + 5 = 2x + 4 8x = -1 x = -1/8MERCHANDISING

What does merchandising cover?

- Understand the ordinary dating notation for the terms of payment of an invoice.
- Solve merchandise pricing problems involving mark ups and markdowns.
- Calculate the net price of an item after single or multiple trade discounts.
- Calculate a single discount rate that is equivalent to a series of multiple discounts.
- Calculate the amount of the cash discount for which a payment qualifies.

STAKEHOLDERS IN Merchandising

Who are the stakeholders in merchandising? The main players are:

Manufacturer

- Middlemen
- Receive varying levels of trade discounts
- Retailer
- Consumer

There are discounts at all levels in the above chain.

Trade Discount

If L is the list price, then discount is calculated as % of this price. List price less discount is the net price. In mathematical terms, we can write:

Amount of discount = dL D = Discount L = List Price Net Price = L(1 - d) Net Price = List Price - Amount of Discount

LECTURE 13 MATHEMATICS OF MERCHANDISING

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 12
- Solve merchandising pricing problems involving markup and markdown

MARKUP

A golf shop pays its wholesaler 2 400 Rs. for a certain club, and then sells it for 4,500 Rs.

What is the markup rate?

Calculation of Markup

- 1. First, calculate the markup in absolute terms: 4500 2400 = 2100
- Then find the relative markup over the original price, or the markup rate:
 (2100) is (some percent) of (2400), or: 2100 = (x)(2400)
- 3. So the relative markup over the original price is: 2100/2400 = x = 0.875
- 4. Since x stands for a percentage, remember to convert this decimal value to a percent. The markup rate is 87.5%.

Calculation using EXCEL

Enter whole-sale price 2400 in cell B5

Enter sale price 4500 in cell B6

Enter formula for Rs. Markup (=B6-B5) in cell B7and press enter. The answer is 2100. Enter formula for % markup (=B7/B5*100) in cell B8 and press Enter. The answer is 87.5% shown in cell B9.

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6	Sale price	4500			
7	Markup Rs.	2100			
8	% Markup	=B7/B	5*10	0	
9		87.5	-		
10					

MARKUP-EXAMPLE 1

A computer software retailer used a markup rate of 40%. Find the selling price of a computer game that cost the retailer Rs. 1,500.

<u>Markup</u>

The markup is 40% of the cost, so the markup is: (0.40)(1,500) = Rs. 600

Selling Price

Then the selling price, being the cost plus markup, is: 1,500 + 600 = Rs. 2,100 The item sold for Rs. 2,100.

Calculation using EXCEL

Enter whole-sale price 1500 in cell B17.

Enter % Markup in cell B18.

Enter formula for sale price including markup (=(1+B18/100)*B17) in cell B19. Here the term 1+B18/100 is the multiplication factor. B18/100 is the markup in fraction. The result of this part of the calculation is 1.4.

The answer 2100 is shown in cell B20.

We could have calculated the multiplication factor separately. But as you see it is not necessary as the entire calculation can be done in one line

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MARKDOWN

Markdown means a reduction from the original sale price. Let us look at an example to understand how markdown is calculated.

MARKDOWN-EXAMPLE 1

An item originally priced at 3,300 Rs. is marked 25% off. What is the sale price?

<u>Markdown</u>

First, find the markdown. The markdown is 25% of the original value, so: x = (0.25)(3300) = 825

Selling Price

Then calculate the sale price, by subtracting the markdown from the original price: 3,300 - 825 = 2,475The sale price is 2,475 Rs.

Calculation using EXCEL

Enter original price 3300 in cell B28.

Enter % Markdown 25 in cell B29.

Enter formula for Rs. Markdown (=B29/100*B28) in cell B30. Here the term B29/100 is the markdown in fraction. The result of this part of the calculation is 825.

Enter formula for net sale price (=B28-B30) in cell B31. This formula is not shown in the slide.

We could have calculated the net sale price directly also by writing just one formula (=(1-B29/100)*B28). In other words the multiplication factor is calculated as 1-0.25 = 0.75 and multiplied with the original price 3300. The answer would be the same. By breaking the calculation in parts you can check the intermediate result and avoid errors. But if you become very conversant with formulas then you may wish to reduce the number of unnecessary steps in the calculations.

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31 Sale price	2475		
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DISCOUNT

Discount is a reduction in price which the seller offers to the buyer.

DISCOUNT-EXAMPLE 1

The price of office equipment is 3000. The manufacturer offers a 30% trade discount. Find the net price and the trade discount amount.

Discount Net Price = L(1 - d) = 3000(1 - .3) = 2100 Rs. Amount of discount = dL = .3* 3000 = 900 Rs.

Calculation using EXCEL

Enter price of equipment 3000 in cell B39.

Enter % trade Discount 30 in cell B40.

Enter formula for Rs. Discount (=B40/100*B3) in cell B41. Here the term B40/100 is the discount in fraction. The result of this part of the calculation is 900.

Enter formula for net price (=B39-B41) in cell B42. This formula is not shown in the slide. The result is 2100 as shown in cell B42.

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LECTURE 14 MATHEMATICS OF MERCHANDISING PART 2

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 13
- Financial Mathematics Part **1**

SERIES DISCOUNT

This refers to the giving of further discounts as incentives for more sales

TOTAL DISCOUNT

The series discount is as follows: 15% off first

Then... 10% off next Then ... 5% off next Total discount not 30%

TRADE DISCOUNT-EXAMPLE

The price of office furniture is Rs. 20,000 The series discounts are: 20%,10%, 5% What is the net price? Trade Discount N = L(1 - d)N = (1-d1) (1-d2) (1-d2)= 20,000(1-.2)(1-.10)(1-.05)= 20,000(.8)(.9)(.95)= 20,000(.6840)= 13,680 Rs.

The calculation = 20,000(1-.2)(1-.10)(1-.05) was used to write the formula for the discount. Then the discount was subtracted from the original price.

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77	Gross price Rs.	20000
78	First discount %	20
79	Next discount % on first	10
80	Next discount % on first	5
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82		100)*(1-B79/100)
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LIST PRICE

An order for power tools has a Rs. 2100 net price after a 30% trade discount. What is the list price?

Net Price

Net Price = L(1 - d)L = N/(1 - d) = 2100/(1 - .3)

= 2100 /(.7)

= 3000 Rs.

EXCEL Calculation

EXCEL formula for original price was based on the calculation = 2100/(1 - .3). The net price was entered in cell B67. % Trade discount was entered in B69.

The formula for Original price was entered in cell B71 as =B67/(1-B69/100).

The answer is shown in cell C72 as 3000.

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64	LIST PRICE			
65				
66				
67	Net price	2100		
68	-			
69	Trade discount %	30		
70				
71	=B67/(1-B6	9/100)		
72			3000	
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TRADE DISCOUNT-EXAMPLE 2

Find the single discount rate that is equivalent to the series 15%, 10% and 5%. Net Price N = L(1 - d) <u>**Trade Discount**</u> Apply the multiple discounts to a list price of Rs. 100.

Apply the multiple discounts to a list price of Rs. 100. (1-d1)(1-d2)(1-d3) 15%, 10%, 5% =100(0.85)(0.9)(0.95) = 100(0.7268) = 72.68%% Discount = 100 - 72.68% = 27.62% **EXCEL Calculation** EXCEL formula for original price was based on the calculation =100(0.85)(0.9)(0.95).

EXCEL formula for original price was based on the calculation =100(0.85)(0.9)(0.95). The formula for net price was entered in cell F8. The formula is shown in cell F8. The answer is shown in cell F12.

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In the following slide, the net price was calaculated in cell F8. Then, the discount was calculated assuming the original price was 100. This is a common method to assume 100 as the price when no price is given but you are required to calculate the net discount.

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TRADE DISCOUNT-EXAMPLE 3

The price of car parts is Rs. 20,000. The series discounts are 20%, 8%, 2%. What is the single equivalent discount rate? Trade Discount =100(0.8)(0.92)(0.98)= 100(0.7213)= 72.13% % Discount = 100 - 72.13% = 27.87% Rs. Discount = (0.2787)(20000) = 5,574 Rs. **EXCEL Calculation** EXCEL formula for net price was based on the calculation =100(0.8)(0.92)(0.98). The formula for net price was entered in cell F21. The formula is not shown. Price of car parts was entered in cell F23. Formula for discount was based on (0.2787)(20000) and is shown in cell F24. The answer is shown in cell F26 as 5574.

LECTURE 15 MATHEMATICS OF MERCHANDISING PART 3

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 14
- Financial Mathematics Part 2

PARTIAL PAYMENTS

When you buy on credit and have cash discount terms, part of the invoice may be paid within the specified time. These part payments are called Partial Payments. Let us look at an example: You owe Rs. 40,000. Your terms were 3/10 (3% discount by 10^{th day}). Within 10 days you sent in a payment of Rs. 10,000. Rs. 10,000 was a part payment.

How much is your new balance?

MARKETING TERMS

There are a number of marketing terms. First of these is the Manufacturer Cost. This is the cost of manufacturing. Next is the price charged to middlemen in 'The Distribution Chain'. The Distributor>Wholesaler>Retailer is a chain. The next term is the Selling Price. This is the price charged to Consumers by Retailers.

MARKETING, OPERATING EXPENSES AND SELLING PRICE

Gross Sales less Cost of Goods sold gives the Gross Profit. The gross Profit less the Operating Expenses gives the Net Profit.

<u>Marketing</u>

Gross Sales	Rs X	
Less: Cost of Good Sold	<u>X</u>	
Gross Profit	Х	(Margin/Markup)
Less: Operating Expenses	к X	
Net Profit (Income) Rs	s. X	

Operating Expenses

Expenses the company incurs in operating the business, e.g. rent, wages and utilities is called operating Expenses.

Selling Price

Selling Price is composed of Cost and Markup. Selling Price (S) = Cost (C) + Markup (M)

MARGIN

While determining Sale Price, a company includes the operating expenses and profit to their own cost. This amount is called the margin of the company.

Example

A computer's cost is 9000. An amount of Rs. 3,000 was added to this cost by the retailer to determine the sale price for the consumer. Thus, the selling price = 9,000 + 3,000 Rs.

= 12,000 Rs.

Rs. 3,000 is Margin available to meet Expenses and make a Profit.

MARKUP

If the Markup is to be 33% on Cost then... Selling Price (S) = Cost (C) + Markup (M) 133% = 100% + 33%Cost is 100% the Base. % Markup is the Rate. Rs. Markup is the Portion.

MARKUP-EXAMPLE

You buy candles for Rs. 10. You plan to sell them for Rs.15. What is your Rs. Markup? What is your percent Markup on cost? Selling price – Cost = 15 – 10 = Markup = Rs. 5 % Markup = 5/10*100 = 50%

SELLING PRICE

Fawad's Appliances bought a sewing machine for Rs. 1,500. To make the desired profit, he needs a 60% Markup on Cost. What is Fawad's Rs. Markup? What is his Selling price?

Selling Price

Rs. Markup = 1,500 x 0.6 = 900 Rs. Selling Price = 1,500 + 900 = 2,400 Rs. Or = 1,500 x (1+0.6) = 1,500 x 1.6 = 2,400 Rs.

EXCEL Calculation

Here 1,500 is the Sewing machine cost in cell F4 and 0.6 is the Percent Rs. Markup on cost in cell F5.

EXCEL formula in cell F6 for Rs. Markup on Cost was based on the calculation = $1,500 \times 0.6$.

The Selling price was calculated in cell F7 by using the formula =F4+F6. The answer as shown in cell F7was 2400.

RS. MARKUP AND PERCENT ON COST

Tanveer's flower business sells floral arrangements for Rs. 35. To make his desired profit, Tanveer needs a 40% Markup on cost. What do the flower arrangements cost Tanveer? What is the Rs. Markup?

Rs. Markup and Percent on Cost

Sale price S = Cost C + Markup M S = C + .40(C) 35 = 1 .40(C)C = 35/1,4 = 25 Rs. M = 25×0.4 = 10 Rs.

EXCEL Calculation

Here 35 is the Selling price-floral arrangement in cell H15. % Markup on cost is in cell H16. EXCEL formula in cell H18 for Cost was based on the calculation = 35/1,4. The Rs. Markup was calculated in cell H19 by using the formula =H18*H16/100. The answer as shown in cell H19 was 10.

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MARKUP AGAIN

You buy candles for 2 Rs. You plan to sell them for 2.50 Rs What is your Rs. Markup? What is your Percent Markup on Selling Price?

Rs. Markup

Rs. Markup = 2.5 - 2 = 0.5 Rs.

Percent Markup on Selling Price

Percent Markup on Selling Price = $(0.5/2.5) \times 100$ = 20%

EXCEL Calculation Here 2 is the Purchase price in cell E30.

Sale price is entered in cell E31.

Rs. Markup on Purchase Price was calculated by using the formula =E31-E30 in cell E32.

EXCEL formula in cell H18 for Cost was based on the calculation = 35/1,4.

The % Markup on sale price was calculated in cell E33 by using the formula =E32/E31*100.

The answer as shown in cell E35 was 10.

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36										

LLING PRICE

Fawad's Appliances bought a sewing machine for Rs. 1,500. To make the desired profit, he needs a 60% Markup on Selling price. What is Fawad's Rs. Markup? What is his Selling Price?

Selling Price

Selling Price S = 1,500 + 0.6S S - 0.6S = 1,500 Rs. Or 0.4S = 1,500 = 3,750 Rs

<u>Rs. Markup</u>

Rs. Markup = 3,750 x 0.6 = 2,250 Rs.

EXCEL Calculation

Here 1500 is the Purchase price in cell E39.

% Markup on Sale Price is entered as 60 in cell E40.

Sale Price was calculated by using the formula =E39/(1-E40/100). The result 3750 is shown in cell D41.

EXCEL formula in cell E42 for Rs. Markup was = E41-E39. The result 2250 is shown in cell E42.

Basic formula S=C+0.6S is shown in cell A44. In cell A45 it was simplified to 0.4=C. In cell A46, it is rewritten as S=C/0.4S=C/(1-mu)=C/0.4. Here mu is the Markup.

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sum ▼ X √ & =E39/(1-E40/100)												
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39	Pur	chase	e price	e	1500	Rs.						
40	% N	larku	p on s	sale price?	60	[%						
41	Sale price			3750	=E39/(1-E40/100)							
42	Rs.	Mark	up?		2250	Rs.						
43												
44	44 S=C+0.6S											
45	0.45	S=C										
46	46 S=C/0.4S=C/(1-mu) =C/0.4											
47				-								

RS. MARKUP AND PERCENT ON COST

Tanveer's flower business sells floral arrangements for Rs. 35. To make his desired profit, Tanveer needs a 40% Markup on Selling Price. What do the flower arrangements Cost Tanveer? What is the Rs. Markup?

Selling Price

Selling Price = $35 = C + 0.4x \ 35$ 35 = C + 14 C = 35 - 14 $= 21 \ Rs.$ Or $C = S - 0.4 \ S$ $= 0.6 \ S = 0.6 \ x \ 35 = 21 \ Rs.$ **Rs. Markup Rs. Markup = 35 x 0.4 = 14 \ Rs.**

EXCEL Calculation

Here 350 is the Sale price in cell E50.

% Markup on Sale Price is entered as 40 in cell E51.

Cost was calculated by using the formula =E50*(1-E51/100). The result 21 is shown in cell D52.

EXCEL formula in cell E53 for Rs. Markup was = E50-E52. The result 14 is shown in cell E53.

Basic formula S=C+0.4S is shown in cell A55. In cell A56 it was simplified to 0.6S=C=S(1-mus).

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49	Rs. MARKUP AND PERCENT ON COST										
50	Sale p	rice		35	Rs.						
51	% Mar	kup on s	sale price?	40	[%						
52	Cost?		21	=E50*(1-E)0)						
53	Rs. Ma	arkup?		14	Rs.						
54											
55	S=C+0).4S									
56	56 0.6S=C=S(1-mus)										
57											

CONVERTING MARKUPS

Converting 50% Markup (MU) on Cost = ? % MU on S

<u>Formula</u>

To convert % Markup on Selling Price (mus) to % Markup on Cost (muc): % Markup on Selling Price (mus) as % of Cost = % Markup on C/(1 + % Markup on C) mus = muc/(1+muc) = 0.5/(1+0.5) = 0.5/1.5 mus= 0.3333 = 33.33% Converting Markups Converting 33.33% MU on Sale = ? % MU on C

<u>Formula</u>

% Markup on Selling Price (mus) to % Markup on Cost (muc)= % Markup on S/1 - % Markup on S muc = mus/1-mus = 0.3333/(1 - 0.333) = 0.3333/0.6666 = 0.5 = 50%

EXCEL Calculation

Here 33.3 is the Markup on sale in cell E61. EXCEL formula in cell E62 for Markup on cost was = (E61/100)/(1-E61/100)*100. The result 50 is shown in cell E64. Basic formula muc=mus/(1-%mus/100) is shown in cell A65.

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CASH DISCOUNT A discount given for the prompt payment of an account is called Cash Discount. No Cash Discount is allowed on Invoices, Returned Goods, Freight, Sales Tax and Trade Discounts.

DISCOUNT PERIODS

Discount Periods are periods for the buyer to take advantage of Discount Terms.

CREDIT PERIODS

Credit Periods are periods for the buyers to pay invoices within specified times.

CASH DISCOUNT TERMS

Invoice was dated May 3. the Terms 2/10 mean that there is Discount 2% if invoice is paid upto 10 May. Then discount can be claimed

CASH DISCOUNT-EXAMPLE

What is the net payment for invoice value of Rs. 50,000 if paid upto 10 May?

Cash Discount

N = L(1 - d)= 50,000(1-0.02) = 50,000(0.98)

= 49,000 Rs.

EXCEL Calculation

EXCEL formula for net price was based on the calculation = 50,000(1-0.02). however, here an IF condition was applied, that means that if the payment date in cell D31 (\$ sign is put in front of row and column to fix its location) is less than or equal to 10 May then the discount will be as given in cell d30. here also \$ sign was used to fix the location of the cell.

In cell D38, the date was changed to 11 May and the same formula was applied again. The result as shown in cell D39 and D40 as 0% (% discount) and 0(Rs. Discount).

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 15
- Markup and Markdown

Financial Mathematics Part 3

MARKDOWN

Reduction from original selling Price is called Markdown.

<u>Formula</u>

%Markdown = (Rs. Markdown / Selling Price (original))*100

MARKDOWN-EXAMPLE 1

Store A marked down a Rs. 500 shirt to Rs. 360. What is the Rs. Markdown? What is the %markdown? <u>Rs. Markdown</u> Let S = Sale price Rs. Markdown = Old S - New S = Rs. 500 - Rs. 360 = Rs. 140 Markdown % Markdown = <u>Markdown</u> *100 Old S % Markdown = <u>140</u> 500 = 0.28 = 28 %

EXCEL Calculation

Here 500 is the Original price in cell E73.

Price after Markdown is entered as 360 in cell E74.

Rs. Markdown was calculated in cell E75 by using the formula =E73-E74. The result 140 is shown in cell D75.

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75	Rs.	Marko	lown	140	=E73-	E74		
76	% M	arkdo	wn?		28	%		
77								

EXCEL formula in cell E76 for % Markdown was = E75/E73*100. The result 28 is shown

MARKDOWN-EXAMPLE 2

A variety of plastic jugs that was bought for Rs. 57.75, was marked up 45% of the SellingPrice.

When the jugs went out of production, they were marked down 40%

What was the Sale Price after the 40% markdown?

Here, there are two parts to this problem. First we must find the original price so that markdown can be calculated on that price.

Original Sale Price

Selling price = 100 Markup = 45 Cost = 100 – 45 = 55 Original Sale price = (100/55) x 57.75 = 105

<u>Rs. Markdown</u>

Markdown = 40 % = 0.4Rs. Markdown = $105 \times 0.4 = 42$

Sale price after markdown

Sale price after markdown = 105 - 42 = 63 Rs.

EXCEL Calculation

Here 57.75 is the Original sale price in cell F83. Selling price is entered as 100in cell F84. Rs. Markup was calculated in cell F85 using the formula =F84-F83. The result is shown as 45 in cell F85. Original Sale Price was calculated in cell F87 by using the formula =F84/F86*F83. The result 105 is shown in cell E87. % Markdown was entered as 40 in cell F88. The Rs. Markdown was calculated using the formula =F87*F88/100 in cell F89. The result 42 is shown in cell F89. The reduced price was calculated by using the formula =F87-F89 in cell F90. The result is shown as 63 in cell F90.

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Original Sale price?	57.75 Rs.
84 Selling price	100 Rs.
85 Markup	45 Rs.
86 Cost	55 Rs.
87 Original Sale price' 1	05 =F84/F86*F83
🛚 Markdown	40 %
🐵 Rs. Markdown	42 Rs.
90 Reduced Price	63 Rs.
91	

PROJECT FINANCIAL ANALYSIS

When you carry out Project Financial analysis, a number of Financial Calculations are required. The important ones are summarized below:

- Cost estimates
- Revenue estimates
- Forecasts of costs
- Forecasts of revenues
- Net cash flows
- Benefit cost analysis
- Internal Rate of Return
- Break-Even Analysis

COST ESTIMATES

In every project you will be required to prepare a cost estimate. Generally, such cost estimates cover calculations based on quantities and unit rates. Such calculations are done in the form of tabular worksheets. In large projects there may be a number of separate calculations for part projects. Such component costs are then combined to calculate total cost. These are simple worksheet calculations unless conditional processing is required. Such conditional processing is useful if unit prices are to be found for a specific model from a large database.

REVENUE ESTIMATES

Along with costs even revenues are calculated. These calculations are similar to component costs.

FORECASTS OF COSTS

Forecasting requires a technique for projections. Once such technique Time Series Analysis will be covered later in this course. Forecasting techniques vary from case to case. The applicable method should be determined first. Calculation of future forecasts can then be done through worksheets.

FORECASTS OF REVENUES

These will be done similar to the forecast of costs. Here also the method must be determined first. Once the methodology is clear, then the worksheets can be prepared easily.

NET CASH FLOWS

The difference between Revenue and Cost is called the Net Cash flow. This is an important calculation as the entire Project Operation and Performance is based on its cash flows.

BENEFIT COST ANALYSIS

This is the end result of the Project Analysis. The ratio between Present Worth of Benefits and Costs is called the Benefit Cost (BC) ratio. For a project to be viable without profit or loss, the BC Ratio must be 1 or more. Generally a BC Ratio of 1.2 is considered acceptable. For Public projects even lesser BC ratio may be accepted for social reasons.

INTERNAL RATE OF RETURN

Internal Rate of Return or IRR is that Discount Rate at which the Present Worth of Costs is equal to the Present Worth of Benefits. IRR is the most important parameter in Financial and Economic Analysis. There are a number of functions in EXCEL for calculation of IRR.

BREAK-EVEN ANALYSIS

In every project where investment is made it is important to know how long it takes to recover the investment. It is also important to find the breakeven point where the Cash Inflow becomes equal to Cash Outflow. After that point the company has a positive cash flow (i.e. there is surplus cash after meeting expenses).

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 16
- Financial Mathematics
- Introduction to Linear Equations

MARKDOWN

Reduction from original selling Price is called Markdown. <u>Module 4</u>

Module 4 covers the following:

- Financial Mathematics (Lecture 17)
- Applications of Linear Equations
- (Lecture 17-18)
- Break-even Analysis
- (Lectures 19-22)
- Mid-Term Examination

PROJECT FINANCIAL ANALYSIS

Project Financial Analysis covers the following:

- Cost estimates
- Revenue estimates
- Forecasts of costs
- Forecasts of revenues
- Net cash flows
- Benefit cost analysis
- Internal Rate of Return
- Break-Even Analysis

EXCEL FUNCTIONS FINANCIAL ANALYSIS

List of Excel Financial functions is as under. The name and utility of each function is given below:

<u>AMORDEGRC</u> Returns the depreciation for each accounting period by using a depreciation coefficient

AMORLINC

Returns the depreciation for each accounting period. AMORDEGRC **Depreciation Using Depreciation Coefficient** AMORDEGRC(cost,date purchased,first period,salvage,period,rate,basis) Cost cost of the asset. Date purchased date of the purchase of the asset. First period date of the end of the first period. Salvage salvage value at the end of the life of the asset. Period period. Rate rate of depreciation. Basis year basis to be used. AMORLINC **Depreciation Using Prorated Depreciation** AMORLINC(cost,date_purchased,first_period,salvage,period,rate,basis) **Cost** cost of the asset **Date purchased** date of the purchase of the asset. First period date of the end of the first period. Salvage salvage value at the end of the life of the asset. Period period. Rate rate of depreciation. Basis year basis to be used. AMORLINC-EXAMPLE Description Data 2400 Cost 8/19/2008 Date purchased 2401 12/31/2008 End of the first period 2402 2403 300 Salvage value 2404 Period 1 2405 15% Depreciation rate Actual basis (see above) (Result)=AMORLINC(A2,A3,A4,A5,A6,A7,A7)First period depreciation (360) CUMIPMT Returns the cumulative interest paid between two periods CUMPRINC Returns the cumulative principal paid on a loan between two periods DB Returns the depreciation of an asset for a specified period using the fixed-declining balance method DDB Returns the depreciation of an asset for a specified period using the double-declining

balance method or some other method you specify

<u>IRR</u>

Returns the internal rate of return for a series of cash flows

MIRR

Returns the internal rate of return where positive and negative cash flows are financed at different rates

INTERNAL RATE OF RETURN IRR

IRR(values,guess)

LECTURE 18 MATHEMATICS FINANCIAL MATHEMATICS SOLVE TWO LINEAR EQUATIONS WITH TWO UNKNOWNS

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 17
- Solve two linear equations with two unknowns

AMORDEGRC-EXAMPLE

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14	Data	Description				
15	2400	Cost				
16	08-08-19	Date purchased				
17	08-12-31	End of the first period				
18	300	Salvage value				
19	1	Period				
20	0.15					
21	[4	Actual basis (see above)				
	=AMORDEGRC(A15;A16;					
22	A17;A18;A19;A20;A21)					

AMORLINC-EXAMPLE

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15	2400	Cost
16	08-08-19	Date purchased
17	08-12-31	End of the first period
18	300	Salvage value
19	1	Period
20	0.15	
21	4	Actual basis (see above)
	=AMORLINC(A15;A16;	
22	A17;A18;A19;A20;A20)	
23		First period depreciation (360)

DB-EXAMPLE

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25	DB(cost,salvage,life,perio	d,month)
26	Data	Description
27	100000	Initial cost
28	100000	Salvage value
29	6	Lifetime in years
30	=DB(A27;A28;A29;1;7)	Depreciation in first year,
31	DB(cost; salvage ; life; period; [month])	with only 7 months calculated
32		(186,083.33)
33		

ADDITIONAL DB_EXAMPLES

Look at the following examples to see how the DB function can be used in different ways. =DB(A2,A3,A4,1,7) Depreciation in first year, with only 7 months calculated (186,083.33) • =DB(A2,A3,A4,2,7) Depreciation in second year (259,639.42) =DB(A2,A3,A4,3,7) Depreciation in third year (176,814.44)
=DB(A2,A3,A4,4,7) Depreciation in fourth year (120,410.64)
=DB(A2,A3,A4,5,7) Depreciation in fifth year (81,999.64)
=DB(A2,A3,A4,6,7) Depreciation in sixth year (55,841.76)
=DB(A2,A3,A4,7,5) Depreciation in seventh year, with only 5 months calculated (15,845.10)

PV

Returns the present value of an investment

PV(rate,nper,pmt,fv,type)

Rate interest rate per period

Nper total number of payment periods in an annuity

Pmt payment made each period and cannot change over the life of the annuity
Fv future value, or a cash balance you want to attain after the last payment is made
Type number 0 or 1 and indicates when payments are due.

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	SUM ▼ X √ fx =PV	(A48/12; 12*A49;A47; ; 0)				
45	PV(rate, nper,					
46	Data	Description				
	500	Money paid out of an insurance annuity at				
47	500	the end of every month				
48	0.08	Interest rate earned on the money paid out				
49 50	20	Years the money will be paid out				
de S	=PV(A48/12;	Present value of an annuity with the terms				
51 52	12*A49,A47,	above (-59,777.15).				
52 53 54	; 0)					

<u>NPV</u>

Returns the net present value of an investment based on a series of periodic cash flows and a discount rate

NPV(rate,value1,value2, ...)

Rate

rate of discount over the length of one period

Value1, value2, ...

1 to 29 arguments representing the payments and income

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		V(A57;A58;A59;A60;A61)					
	Α	B					
54	NPV(rate, valu	ie1,value2,)					
55	EXAMPLE 1						
56	Data	Description					
57	10%	Annual discount rate					
	-10000	Initial cost of investment one year from					
58		today					
59	3000	Return from first year					
60	4200	Return from second year					
61	6800	Return from third year					
62	=NPV(A57;A5	8;A59;A60;A61)					
63	1188.44						

<u>XNPV</u>

Returns the net present value for a schedule of cash flows that is not necessarily periodic XNPV(rate,values,dates)

Rate

discount rate to apply to the cash flows

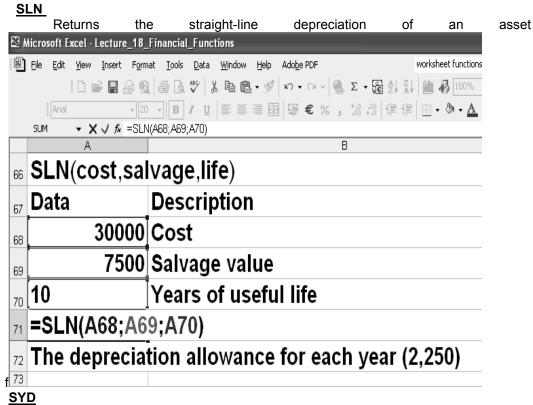
Values

series of cash flows that corresponds to a schedule of payments in dates

Dates

schedule of payment dates that corresponds to the cash flow payments

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54	A B B A A A A A A A A A A A A A A A A A						
55	EXAMPLE 1						
56	Data	Description					
57	10%	Annual discount rate					
	-10000	Initial cost of investment one year from					
58		today					
59	3000	Return from first year					
60	4200	Return from second year					
61	6800	Return from third year					
62	=NPV(A57;A58;A59;A60;A61)						
63	1188.44						



Returns the sum-of-years' digits depreciation of an asset for a specified period

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	А	В					
66	SLN(cost,sa	vage,life)					
67	Data	Description					
68	30000	Cost					
69	7500	Salvage value					
70	10	Years of useful life					
71	71 =SLN(A68;A69;A70)						
72	72 The depreciation allowance for each year (2,250)						
73							

<u>VDB</u>

Returns the depreciation of an asset for a specified or partial period using a declining balance method

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87	factor,no switch)					
88	Data	Description				
89	2400	Initial cost				
90	300	Salvage value				
91	10	Lifetime in years				
92	=VDB(A89;A90;A91*365; A950;1)					
93	First day's depreciation.					
94	Excel automatically assumes that factor is 2 (1.32)					
95						

<u>XIRR</u>

Returns the internal rate of return for a schedule of cash flows that is not necessarily periodic.

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95						
96	Data	Description				
97	-70000	Initial cost of a business				
98	12000 Net income for the first year					
99	15000 Net income for the second year					
100	18000	Net income for the third year				
101	21000	Net income for the fourth year				
102	26000	Net income for the fifth year				
103	=IRR(A97:A101)					
104	IRR after 4 years (-2%)					
105	=IRR(A2:A7)	IRR after 5 years (9%)				
	=IRR(A2:A4,-	IRR after 2 years, include a guess(-44%)				

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109 XIRR(values, da							
· · · · ·	Dates						
110 Values							
111 -10000	2008-01-01						
112 2750	2008-03-01						
113 4250	2008-10-30						
114 3250	2009-02-15						
115 2750	2009-04-01						
116 =XIRR(A111:	XIRR (0.373362535 or 37.34%)						
¹¹⁷ ₁₁₈ A115;B111:							
¹¹⁹ B115;0.1)							
121 122							

LINEAR EQUATIONS

- Solve two linear equations with two variables
- Solve problems that require setting up linear equations with two variables
- Perform linear Cost-Volume-Profit and break-even analysis employing:
- The contribution margin approach
- The algebraic approach of solving the cost and revenue functions

SOLVING LINEAR EQUATIONS-PART 1

Here is an example of solving simultaneous linear equations.

2x - 3y = -6x + y = 2 Solve for y 2x - 3y = -62x + 2y = 4-5y = -10y = 10/5 y = 2

SOLVING LINEAR EQUATIONS - PART 2

Let us look at the same equations again. 2x - 3y = -6 x + y = 2We solved for x. Now let us substitute y by 2 2x - 3(2) = -6 2x - 6 = -6 2x = 0x = 0

LECTURE 19 PERFORM BREAK-EVEN ANALYSIS EXCEL FUNCTIONS FINANCIAL ANALYSIS

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 18
- Perform break-even analysis
- MS EXCEL Financial Functions

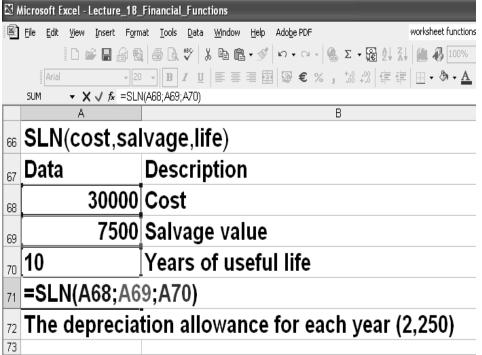
SLN-EXAMPLE

SLN Returns the straight-line depreciation of an asset for one period Syntax: SLN(cost,salvage,life)

Cost is the initial cost of the asset.

Salvage is the value at the end of the depreciation (sometimes called the salvage value of the asset).

Life is the number of periods over which the asset is depreciated (sometimes called the useful life of the asset).



<u>SYD</u>

Returns the sum-of-years' digits depreciation of an asset for a specified period **Syntax**

SYD(cost,salvage,life,per)

Cost is the initial cost of the asset.

Salvage is the value at the end of the depreciation (sometimes called the salvage value of the asset).

Life is the number of periods over which the asset is depreciated (sometimes called the useful life of the asset).

Per is the period and must use the same units as life.

Remark

• SYD is calculated as follows:

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	Α	В				
76	SYD(cost, sal	/age,life,per)				
77	SYD= ((Cost-	Salvage)*(life-per+1)*2)/(life)	*(life+1)			
78						
79	Data	Description				
80	30000	Initial cost				
81	7500	Salvage value				
82	10	Lifespan in years				
83	=SYD(A80;A8	1;A82; 1)				
84	Yeany depre	iation allowance for the firs	t year (4,090.91)			
85						

<u>VDB</u>

Returns the depreciation of an asset for any period you specify, including partial periods, using the double-declining balance method or some other method you specify. VDB stands for variable declining balance.

Syntax

VDB(cost,salvage,life,start_period,end_period,factor,no_switch)

Cost is the initial cost of the asset.

Salvage is the value at the end of the depreciation (sometimes called the salvage value of the asset).

Life is the number of periods over which the asset is depreciated (sometimes called the useful life of the asset).

Start_period is the starting period for which you want to calculate the depreciation. Start_period must use the same units as life.

End_period is the ending period for which you want to calculate the depreciation. End_period must use the same units as life.

Factor is the rate at which the balance declines. If factor is omitted, it is assumed to be 2 (the double-declining balance method). Change factor if you do not want to use the double-declining balance method. For a description of the double-declining balance method, see DDB.

No_switch is a logical value specifying whether to switch to straight-line depreciation when depreciation is greater than the declining balance calculation.

- If **no_switch** is **TRUE**, Microsoft Excel does not switch to straight-line depreciation even when the depreciation is greater than the declining balance calculation.
- If **no_switch** is **FALSE** or omitted, Excel switches to straight-line depreciation when depreciation is greater than the declining balance calculation. All arguments except no_switch must be positive numbers.

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	sum ▼ X √ fx =VD	3(A89;A90;A91*365; A950;1)					
	A	В					
86	VDB(cost, sal	vage,life,start_period,end_period,					
87	factor,no_swite	ch)					
88	Data	Description					
89	2400	Initial cost					
90	300	Salvage value					
91	10	Lifetime in years					
92	=VDB(A89;A90;A91*365; A950;1)						
93	First day's depreciation.						
94	Excel automa	tically assumes that factor is 2 (1.32)					
95							

IRR

Returns the internal rate of return for a series of cash flows represented by the numbers in values. These cash flows do not have to be even, as they would be for an annuity. However, the cash flows must occur at regular intervals, such as monthly or annually. The internal rate of return is the interest rate received for an investment consisting of payments (negative values) and income (positive values) that occur at regular periods. **Syntax**

IRR(values,guess)

Values is an array or a reference to cells that contain numbers for which you want to calculate the internal rate of return.

- **Values** must contain at least one positive value and one negative value to calculate the internal rate of return.
- **IRR** uses the order of values to interpret the order of cash flows. Be sure to enter your payment and income values in the sequence you want.
- If an array or reference argument contains text, logical values, or empty cells, those values are ignored.
 - **Guess** is a number that you guess is close to the result of IRR.
- Microsoft Excel uses an iterative technique for calculating IRR. Starting with guess, IRR cycles through the calculation until the result is accurate within 0.00001 percent. If IRR can't find a result that works after 20 tries, the #NUM! error value is returned.
- In most cases you do not need to provide guess for the IRR calculation. If guess is omitted, it is assumed to be 0.1 (10 percent).
- If IRR gives the #NUM! error value, or if the result is not close to what you expected, try again with a different value for guess.

<u>Remarks</u>

IRR is closely related to **NPV**, the net present value function. The rate of return calculated by IRR is the interest rate corresponding to a 0 (zero) net present value. The following formula demonstrates how NPV and IRR are related:

NPV(IRR(B1:B6),B1:B6) equals 3.60E-08 [Within the accuracy of the IRR calculation, the value 3.60E-08 is effectively 0 (zero).]

IRR-EXAMPLE

In the slide the Excel worksheet is shown.

In cell A97, the investment of 70,000 is entered with minus sign to denote negative cash flow.

In cell A98 to A102, revenue per year (1 to 5) is entered.

In the first formula in cell A103 (=IRR(A97:A101)), only years 1 to 4 were selected for the revenue stream. The IIR is -2% in this case.

In the next formula in cell A105, the entire revenue stream was considered. The IRR improved to 9%.

Next only first 2 years of revenue stream were considered with an initial guess of 10% (not shown in slide). The result was -44%.

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	SUM ▼ X √ fx =IRR(A97:A1	· · · · · · · · · · · · · · · · · · ·	_				
	Α	В	•				
95	IRR(values,guess	5)					
96	Data	Description					
97	-70000	Initial cost of a business					
98	12000	Net income for the first year					
99	15000	Net income for the second year					
100	18000	Net income for the third year					
101	21000	Net income for the fourth year					
102	26000	Net income for the fifth year					
103	=IRR(A97:A101)						
104		IRR after 4 years (-2%)	_				
105	=IRR(A97:A102)	IRR after 5 years (9%)					
	=IRR(A97:A99,-	IRR after 2 years, include a guess(-44%)	•				
4	Sheet1 / Sheet2 / Sheet3 /						
Edit							

<u>XIRR</u>

Returns the internal rate of return for a schedule of cash flows that is not necessarily periodic. To calculate the internal rate of return for a series of periodic cash flows, use the IRR function.

If this function is not available, and returns the #NAME? error, install and load the Analysis ToolPak add-in. To do that:

- 1. On the **Tools** menu, click **Add-Ins**.
- 2. In the Add-Ins available list, select the Analysis ToolPak box, and then click OK.
- 3. If necessary, follow the instructions in the setup program.

Syntax

XIRR(values,dates,guess)

Values is a series of cash flows that corresponds to a schedule of payments in dates. The first payment is optional and corresponds to a cost or payment that occurs at the beginning of the investment. If the first value is a cost or payment, it must be a negative value. All succeeding payments are discounted based on a 365-day year. The series of values must contain at least one positive and one negative value.

Dates is a schedule of payment dates that corresponds to the cash flow payments. The first payment date indicates the beginning of the schedule of payments. All other dates must be later than this date, but they may occur in any order. Dates should be entered by using the DATE function, or as results of other formulas or functions. For example, use DATE(2008,5,23) for the 23rd day of May, 2008. Problems can occur if dates are entered as text.

Guess is a number that you guess is close to the result of XIRR.

Remarks

- Microsoft Excel stores dates as sequential serial numbers so they can be used in calculations. By default, January 1, 1900 is serial number 1, and January 1, 2008 is serial number 39448 because it is 39,448 days after January 1, 1900. Microsoft Excel for the Macintosh uses a different date system as its default.
- Numbers in dates are truncated to integers.
- XIRR expects at least one positive cash flow and one negative cash flow; otherwise, XIRR returns the #NUM! error value.
- If any number in dates is not a valid date, XIRR returns the #VALUE! error value.
- If any number in dates precedes the starting date, XIRR returns the #NUM! error value.
- If values and dates contain a different number of values, XIRR returns the #NUM! error value.
- In most cases you do not need to provide guess for the XIRR calculation. If omitted, guess is assumed to be 0.1 (10 percent).
- XIRR is closely related to XNPV, the net present value function. The rate of return calculated by XIRR is the interest rate corresponding to XNPV = 0.
- Excel uses an iterative technique for calculating XIRR. Using a changing rate (starting with guess), XIRR cycles through the calculation until the result is accurate within 0.000001 percent. If XIRR can't find a result that works after 100 tries, the #NUM! error value is returned. The rate is changed until:

where: $0 = \Sigma$

^{/=1} (1+ rate)^{−365}

- d1 = the 0th payment date.
- Pi = the ith, or last, payment.

di = the ith, or last, payment date.

XIRR EXAMPLE

Here, the investment is in cell A111. The revenue stream is in cells A112 to a115. The dates for each investment or revenue are given in cells B111 to B115. Please note that the dates are in European format year-month-day. On your computer, you may not have this format.

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	`	
110 Valu	es	Dates
111 -1000	00	2008-01-01
112 2750		2008-03-01
113 4250		2008-10-30
114 3250		2009-02-15
115 2750		2009-04-01
116 =XIR	R(A111:	XIRR (0.373362535 or 37.34%)
117 118 A115	;B111:	
119 120 B115	;;0.1)	
121 122		

After entering these days in Excel, you can right click on the cell. You see a short cut menu as shown below.

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114		Insert		
115 2009-04-01		Delete		
116 XIRR (0.37336	14	Clear Contents	7.34%)	
117		Insert Comment		
118	P	Eormat Cells		
119		Pick From List		
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When you will select **Format Cells**, the Format Cells Dialog Box appears as shown below. You can then choose the desired format for the date.

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 items that h 		Swedish and time serial numbers as date values. Except for (*), applied formats do not switch date orders OK Cancel

In cell A116, the formula (XIIR(A111:A115;B111:B115;0.1), the range A111:A115 is the cost and revenue stream. The range B111:B115 is the stream for dates. The third term 0.1 is the initial guess for XIRR.

The answer in fraction or % is given in cell B116(37.34%).

LINEAR EQUATIONS

Linear equations have following applications in Merchandising Mathematics:

- Solve two linear equations with two variables
- Solve problems that require setting up linear equations with two variables
- Perform linear Cost-Volume-Profit and break-even analysis employing:
- The contribution margin approach
- The algebraic approach of solving the cost and revenue functions

SOLVING LINEAR EQUATIONS - AGAIN

Let us look at the example of two linear equations we did in handout 18:

```
2x - 3y = -6 \quad (1)
x + y = 2 \quad (2)
Solve for y

We solved for y.

Result:

y = 2
SOLVING LINEAR EQUATIONS - PART 2

Let us look at the same example again.

<u>Solve for x</u>

We solved for x.

x = 0
```

Check your answer

By substituting the values into <u>each of the equations</u> Equation 1: 2x - 3y = -6 x = 0 y = 2LHS = 2x - 3y = 2(0)-3(2) = -6 = RHSEquation 2: x + y = 2LHS = x + y = 0 + 2 = 2 = RHSThe right side is equal to left hand side. Hence the answer is correct.

LECTURE 20 PERFORM BREAK-EVEN ANALYSIS EXCEL FUNCTIONS FOR FINANCIAL ANALYSIS

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 18
- MS EXCEL Financial Functions
- Perform Break-Even Analysis.

SETTING UP LINEAR EQUATIONS

Zain purchases the same amount of commodity 1 and 2 each week. After price increases from Rs. 1.10 to Rs. 1.15 per item of commodity 1, and from Rs. 0.98 to Rs. 1.14 per item of commodity 2, the weekly bill rose from Rs. 84.40 to Rs. 91.70. How many items of commodity 1 and 2 are purchased each week? Setting up Linear Equations Let x = # of commodity 1 Let y = # of commodity 2 Setting up Linear Equations Equation 1 1.10x + 0.98y = 84.40(1) Eliminate x in (1) by Dividing both sides by 1.10. (1.10x + 0.98y)/1.10 = 84.40/1.10x + 0.8909y = 76.73Equation 2 1.15x+1.14y=91.7 (2) Eliminate x in (2) by Dividing both sides by 1.15 (1.15x + 1.14y)/1.15 = 91.70/1.15x + 0.9913y = 79.74Result 1: x + 0.8909y = 76.73(3) x + 0.9913y = 79.74(4) Next: Subtract (4) from (3): Result 2: 0.1004y = 3.01y = 3.01/0.1004Or y=29.98 (i.e. 30 nos.) 1.10x + 0.98y = 84.40Substitution Substitute value of y in (1). Result: 1.10x + 0.98(29.98) = 84.40Solve: 1.10x + 29.38 = 84.401.10x = 84.40 - 29.38 1.10x = 55.02**Result:** x = 50.02 (i.e. 50 nos.) New weekly cost Commodity 1: 50 x 1.15 = 57.50 Commodity 2:

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132

30 x 1.14 = 34.20 Total cost = 91.70

T<u>ERMINOLOGY</u>

There are either Business Costs or Expenses.

Fixed Costs

Fixed Costs are such costs that do not change if sales increase or decrease e.g. rent, property taxes, some forms of depreciation.

Variable Costs

Variable costs do change in direct proportion to sales volume e.g. material costs and direct labour costs.

Break Even Point

Break Even point we discussed earlier. It is a point at which neither a profit nor loss is made.

Contribution Margin

Contribution Margin is the Rs. amount that is found by deducting **ALL Variable Costs** from **Net Sales** and 'contributes' to meeting **Fixed Costs** and making a '**Net Profit**'

Contribution Rate

Contribution Rate is the Rs. amount expressed as a percent (%) of Net Sales.

A CONTRIBUTION MARGIN STATEMENT

	Rs.	%
Net Sales (Price * # Units Sold)	Х	100
Less: Variable Costs	х	Х
Contribution Margin	х	Х
Less: Fixed Costs	х	Х
Net Income	х	Х

The net sales are calculated by multiplying price per unit with number of units. This figure is treated as 100%. Next, variable costs are specified and deducted from the Net sales to obtain the Contribution Margin. Next, Fixed costs are deducted from the contribution Margin. The result is Net Income. Under the % column, percentage of each item is calculated with respect to the Net Sales.

SCENARIO

Market research for a new product indicates that the product can be sold at Rs. 50 per unit. Cost analysis provides the following information: Fixed Costs (FC) **per period** = Rs. 8640 Variable Costs (VC) = Rs. 30 **per unit.**

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Production Capacity **per period** = 900 units How much does the sale (S) of an additional unit of a firm's product contribute towards increasing its net income?

<u>Formula</u>

Contribution Margin = CM = S - VCContribution Rate = CR = CM/S * 100%*Break Even Point (BEP): ...in Units (x): Rs. x = (FC / CM)* S ...in Sales Rs. : Rs. x = (FC / CM)* S ...in % of Capacity : BEPin Units/PC*100 * At Break Even, Net Profit or Loss = 0 Scenario 1 Summary The new product can be sold at Rs. 50 per unit. Costs are as follows: Fixed Costs are Rs. 8640 for the period. Variable Costs are Rs. 30 per unit Production Capacity is 900 units per period.

LECTURE 21

PERFORM LINEAR COST-VOLUME PROFIT AND BREAK-EVEN ANALYSIS USING THE CONTRIBUTION MARGIN APPROACH

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 18
- Perform Break-Even Analysis
- MS EXCEL Financial Functions
- •

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 20
- Perform linear cost-volume profit and break-even analysis.
- Using the contribution margin approach

SCENARIO 1

CM = S – VC = 50 - 30 = 20 Rs. CR = CM/S * 100% = Rs. 20/50 * 100 =40%

Break Even Point:

Units x = FC / CM = 8640/20 = 432 Units In Rs. x = (FC / CM)* S : (Rs. 8640/Rs.20)* Rs.50 = Rs.21,600 BEPin units/ PC*100 = 432/ 900*100 = 48% of apacity

SCENARIO 2

VU

The Lighting Division of A Lighting Fitting Manufacturer plans to introduce a new street light based on the following accounting information: FC = Rs. 3136 VC = Rs.157 S= Rs.185 Capacity = 320 units Calculate the break even point (BEP) ...in units ...in rupees

...as a percent of capacity

Break Even Point

<u>...in units</u> = FC / CM S – VC = CM

= Rs.185 – 157 = Rs.28 = Rs.3136/28 = 112 Units

Break Even Point

...in Rupees = (FC / CM)* S = (3136/28) * 185 = 20720 Rs.

Break Even Point ...as a percent of capacity

= BEP(in units)/PC*100

= 112/320 * 100

= 35% of Capacity

SCENARIO

FC = Rs.3136 VC = Rs.157 S= Rs.185 Capacity = 320 units Determine the BEP as a % of capacity if FC are reduced to Rs.2688. Formula: = BEP(in units)/PC*100 Step 1... Find CM Step 2... Find BEP in units Step 3... Find % of Capacity Step 1... Find CM S = 185 VC = - 157 CM Rs. 28 Step 2... Find BEP in units = FC/CM = Rs. 2688/ Rs.28 = 96 Units Step 3... Find % of Capacity =BEPin units /PC*100 = 96/320*100 = 30% of Capacity SCENARIO

2-2

2-1

FC = Rs.3136 VC = Rs.157 S = Rs.185 Capacity = 320 units VC = S*80% = Rs.148 Determine the BEP as a % of capacity if FC are increased to Rs.4588, and VC reduced to 80% of S. = BEP(in units)/PC*100 Step 1... Find CM S = 185 VC = -<u>148</u> CM = Rs. 37 Step 2... Find BEP in units = FC/CM = Rs. 4588 / Rs. 37 = 124 Units Step 3... Find % of Capacity =BEPin units /PC*100 = 124/320*100 = 39% of Capacity <u>SCENA</u>RIO 2 -3 FC = Rs. 3136 VC = Rs.157 S= Rs.185 Capacity = 320 units Determine the BEP as a % of capacity if S is reduced to Rs.171. = BEP(in units)/PC*100 Step 1... Find CM S = 171 VC = -157 CM = Rs. 14 Step 2... Find BEP in units = FC/CM = Rs. 3136/ Rs. 14 = 224 Units Step 3... Find % of Capacity =BEPin units /PC*100 = 224/320*100 = 70 % of Capacity

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 21
- Perform Linear Cost-Volume Profit and Break-Even analysis. .
- Using Microsoft Excel

<u>SCENARIO 1</u>

Let us look at different scenarios for calculation of contribution margin and net profit. The explanations are given in the slides.

The Break Even in Rs. Is 21,600. The break Even in units is 48.

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	A10 = BEPin units /PC*100 = %						
	A B C D E	F	G	Н		J	K
	Scenario 1						
2	Scenario i						
	Production Capacity			900			
3	_						
4	Sale = S =			50			
5	Variable Costs = VC =			30			
6	Contribution Margin = C	M = S	S-VC	20	=H4-	H5	
7	Fixed Cost = FC =			8640			
8	Units x = FC / CM =			432	=H7/	Ή6	
9	BEP in Rs. = (FC / CM)*	S		21600	=H8*	* H4	
10	BEP n units /PC*100 = %			48	=H8/	H3*1	00
11							

<u>SCENARIO 2</u> The Break Even in Rs. Is 20,720. The break Even in units is 35.

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	Sconaria 2						
13	Scenario 2						
14	Production Capacity			320			
15	Sale = S =			185			
16	Variable Costs = VC =			157			
17	Contribution Margin = C	M = S	S-VC	28	=H1:	5-H16	
18	Fixed Cost = FC =			3136			
19	Units x = FC / CM =			112	=H18	B/H17	
20	BEP in Rs. = (FC / CM)*	S		20720	=H19	9*H15	
21	BEPin units /PC*100 = %			35	=H19	9/H14	*100
22 23]	

SCENARIO 2-1 The Break Even in Rs. Is 17.760. The break Even in units is 30.

The bleak Even in RS. IS 17.700. The bleak Eve	
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H32 = =H30/H25*100	
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Cooncrie 0.4	
²⁴ Scenario 2-1	
25 Production Capacity	320
26 Sale = S =	185
27 Variable Costs = VC =	157
28 Contribution Margin = CM = S-VC	28 =H26-H27
²⁹ Fixed Cost = FC =	2688
30 Units x = FC / CM =	96 =H29/H28
31 BEP in Rs. = (FC / CM)* S	17760 =H30*H26
32 BEPin units /PC*100 = %	30 =H30/H25*100
33 SCENARIO 2-2	

<u>SCENARIO 2-2</u> The Break Even in Rs. Is 22,940. The break Even in units is 39.

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G41 =			
A B C D E F G	H I J K		
³⁹ Scenario 2-2			
40 Production Capacity	320		
41 Sale = S =	185		
42 Variable Costs = VC = 0.8*S=	148		
43 Contribution Margin = CM = S-VC	37 =H41-H42		
44 Fixed Cost = FC =	4588		
45 Units x = FC / CM =	124 =H44/H43		
46 BEP in Rs. = (FC / CM)* S	22940 =H45*H41		
47 BEPin units /PC*100 = %	39 =H45/H40*100		
48			
SCENARIO 2-3 The Break Even in Rs. Is 38 304. The break Eve	en in units is 70		
The Break Even in Rs. Is 38,304. The break Eve Microsoft Excel - Lecture_22_Scenarios_1_7	en in units is 70.		
The Break Even in Rs. Is 38,304. The break Eve			
The Break Even in Rs. Is 38,304. The break Eve Microsoft Excel - Lecture_22_Scenarios_1_7 Image: State			
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The Break Even in Rs. Is 38,304. The break Eve Microsoft Excel - Lecture_22_Scenarios_1_7 ■ File Edit View Insert Format Iools Data Window Help Adobe PDF □ 2 2 4 D62 = A B C D E F G 51 Scenario 2-3	- 10 • B I U ≡ *.0 ÷.0 & • I		
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The Break Even in Rs. Is 38,304. The break Eve Microsoft Excel - Lecture 22_Scenarios 1_7 Elle Edit View Insert Format Icols Data Window Help Adobe PDF $\square @ I @ I @ I @ I @ I @ I @ I @ I @ I @ $	H I J K 320 171 157		
The Break Even in Rs. Is 38,304. The break Eve Microsoft Excel - Lecture 22 Scenarios 17 Ele Edit View Insert Format Tools Data Window Help Adobe PDF DE2 = A B C D E F G A B C D E F G Scenario 2-3 Production Capacity 3 Sale = S = 5 4 Variable Costs = VC = 5 5 Contribution Margin = CM = S-VC	Image: Horizontal condition Image: Horizontal condition Image: Horizontal condition H I J K 320 J K 171 J K 157 J H 14 =H53-H54 Image: Horizontal condition		
The Break Even in Rs. Is 38,304. The break Eve Microsoft Excel - Lecture_22_Scenarios_1_7 Ele Edt View Insert Format Tools Data Window Help Adobe PDF DE2 = A B C D E F G 51 Scenario 2-3 52 Production Capacity 53 Sale = S = 54 Variable Costs = VC = 55 Contribution Margin = CM = S-VC 56 Fixed Cost = FC =	Image: Horizontal condition Image: Horizontal condititities Image: Horizontal condition		
The Break Even in Rs. Is 38,304. The break Eve Microsoft Excel - Lecture_22_Scenarios_1_7 Ele Edt View Insert Format Tools Data Window Help Adobe PDF DE2 = A B C D E F G 51 Scenario 2-3 52 Production Capacity 53 Sale = S = 54 Variable Costs = VC = 55 Contribution Margin = CM = S-VC 56 Fixed Cost = FC = 57 Units x = FC / CM = 57 Units x = FC / CM = 57 Contribution Scenario 2 = 57 Contribution Scenario 2 = 57 Contribution Scenario 2 = 57 Contribution Margin = CM = S-VC	Image: Image		

SCENARIO 2-4 FC = Rs. 3136 VC = Rs. 157 S= Rs. 185 Capacity = 320units Determine the NI if 134 units are sold! Formula for Net Income NI = #Units above BEP*CM = BEP (in units)/PC*100 Step 1... Find CM S = 185 VC = -<u>157</u> CM = Rs. 28 (CM of Rs.28 per unit) Step 2... Find BEP in units = FC/CM = Rs. 3136/ Rs. 28 = 112 Units Step 3... Find units over BEP Units Sold 134 BEP 112 Over BEP 22 Hence: Company had a NI of 22 * Rs. 28 = Rs. 616 Scenario FC = Rs. 3136 VC = Rs.157 S= Rs.185 Capacity = 320 units What unit sales will generate NI of Rs. 2000? Formula for Net Income #Units above BEP = NI/CM Step 1... Find CM = 185 S VC = -157 CM = Rs. 28 (CM of Rs.28 per unit) Step 2... Find BEP in units = FC/CM = Rs. 3136/ Rs. 28 = 112 Units Step 3... Find units over BEP NI/CM = Rs. 2000/Rs. 28 per Unit = 72 Units above Break Even Hence: 72 Units above BEP + 112 BEP Units

= Total Sales Units = 184

2-5

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83	Variable Costs = VC =			157			
84	Contribution Margin = CM =	S-VC		28	=H82	-H83	
85	Fixed Cost = FC =			3136			
86	Units x = FC / CM =			112	=H85	/H84	
87	BEP in Rs. = (FC / CM)* S			20720	=H86	*H82	
88	BEPin units /PC*100 = %			35	=H86	/H81*1	00
89	Units sold			134			
90	NI =Units over BEP*CM			2000			
91	Units over BEP = NI/CM			71	=H90	H84	
92	Total units = BEP + above	BEP u	nits	183	=H91	+H86	
<u>Scena</u>							1 1
	C = Rs. 3136 /C = Rs.157						
S= Rs.	= Rs.185						
	ty = 320 units ire the unit sales if there is a Net L	oss of	Dc 22	62			
Formu		.055 01	R5.00	0 !			
# Units	below BEP = (NI)/CM						
	Find CM						
-							
CM = F	CM = Rs. 28						
	CM of Rs.28 per unit)						
	Step 2… Find BEP in units FC/CM						
	136/ Rs. 28						
= 112 l							
	Find units below BEP NI/CM 336/Rs. 28 per Unit						
	nits below Break Even						
Hence:							
	12 BEP - 12 Units Below Total Sales Units = 100						
Total							

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Scenario 2-6						
96 Production Capacity			320			
97 Sale = S =			185			
98 Variable Costs = VC =			157			
99 Contribution Margin = CM =	s-vc		28	=H97	-H98	
100 Fixed Cost = FC =			3136			
101 Units $x = FC / CM =$				=H10	0/H99	
102 BEP in Rs. = (FC / CM)* S		_	20720			
102 BEP in RS. – ($1 C 7 C m$) 3					1/H96 [*]	100
				-110	1/130	100
104 Units sold			134			
105 NI =Units over BEP*CM			-336			
106 Units over BEP = NI/CM					5-H99	
107 Total units = BEP + above l FC = Rs. 3136	BEP u	nits [100	=H10	6+H10	1
S= Rs.185 Capacity = 320 units The company operates at 85% capacity Find the Profit or Loss. Formula Funits above BEP *CM = N Step 1 Find CM						
5 = 185 10 = 157						
/C = - <u>157</u> CM = Rs. 28						
CM of Rs.28 per unit)						
tep 2 Find BEP in units						
FC/CM						
[:] Rs. 3136/ Rs. 28 : 112 Units						
20*.85 = 2						
Jnits						
Production 272						
EP 112 Over BEP 160						
lence:						
60 Units * 28 = Profit 4480 Rs.						

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110 Scenario 2-7				
111 Production Capacity= PC =85% Capac	it 272			
112 Sale = S =	185			
113 Variable Costs = VC =	157			
114 Contribution Margin = CM = S-VC	28 =H112-H113			
115 Fixed Cost = FC =	3136			
116 Units x = FC / CM =	112 =H115/H114			
117 BEP in Rs. = (FC / CM)* S	20720 =H116*H112			
118 BEPin units /PC*100 = %	41,176 =H116/H111*100			
119 Units sold	134			
120 Units over BEP = PC-BEP Units	160 =H111-H116			
121 Profit = Units over BEP * CM	4480 =H120*H111			

CASE

Company A's year end operating results were as follows: Total Sales of Rs. 375,000 Operated at 75% of capacity Total Variable Costs were Rs. 150,000 Total Fixed Costs were Rs. 180,000 What was Company A's BEP expressed in rupees of sales?

LECTURE 23 STATISTICAL DATA REPRESENTATION

OBJECTIVES

The objectives of the lecture are to learn about:

- Review Lecture 22
- Statistical Data Representation.

MODULE 5

Statistical data representation (Lecture 23) Measures of central tendency (Lectures 24-25) Measures of dispersion and skewness (Lectures 26-27) **MODULE 6** Correlation (Lecture 28-29) Line Fitting (Lectures 30-31) Time Series and Exponential Smoothing (Lectures 32-33) MODULE 7 Factorials Permutations and Combinations (Lecture 34) Elementary Probability (Lectures 35-36) Chi-Square (Lectures 37) Binomial Distribution (Lectures 38) **MODULE 8** Patterns of probability: Binomial, Poisson and Normal Distributions (Lecture 39-41) Estimating from Samples: Inference (Lectures 42-43)

Hypothesis testing: Chi-Square Distribution

(Lectures 44-45) End-Term Examination

STATISTICAL DATA

Information is collected by government departments, market researchers, opinion pollsters and others. Information then has to be organised and presented in a way that is easy to understand **BASIS FOR CLASSIFICATION** 1. Qualitative: Attributes: sex, religion

- 2. QuantitativeCharacteristics: Heights, weights, incomes etc.
- 3. Geographical: Regions: Provinces, divisions etc.
- 4. Chronological or Temporal
- 5. By time of occurrence: Time series

TYPES OF CLASSIFICATION

There are different types of classifications.

- One-way
- One characteristic: Population
- Two-way
 - Two characteristics at a time
- Three-way Three characteristics at a time

METHODS OF PRESENTATION

Different methods of representation are:

- Text
 - "The majority of population of Punjab is located in rural areas."
- Semitabular
- Data in rows
- Tabular
 - Tables with rows and columns
- Graphic
- Charts and graphs

TYPES OF GRAPHS

- Column Graphs
- Line Graphs
- Circle Graphs (Sector Graphs)
- Conversion Graphs
- Travel Graphs
- Statistical Graphs
- Frequency Tables
- Histograms
- Frequency distributions
- Cumulative Distributions

PICTURE GRAPHS

Picture graphs use the picture as one unit. In the example below, one car represents 10 cars.

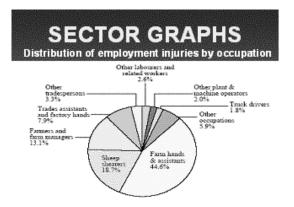
PICTURE GRAPHS

Cars passing school gate during the day

Each represents 10 cars. **A** 4–5 p.m. 2--3 p.m. 12-1 p.m. 10-11 a.m. A A A A 8-9 a.m. 6 6-7 a.m.

SECTOR GRAPHS

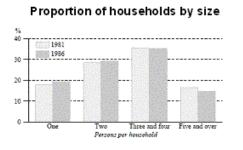
Sector graphs use the division of a circle into different sectors. The full circle is 360 degrees. For each percentage, degees are calculated and sectors plotted.



COLUMN AND BAR GRAPHS

The following slide gives the Proportion of households by size in the form of a Column and Bar graph.

COLUMN AND BAR



LINE GRAPHS

Line graphs are the most commonly used graphs. Here the data of one variable (say Height) is plotted against data of the other variable (say Age).

