
MS EXCEL – AN EFFECTIVE AID IN MIS AND DATA ANALYSIS A CASE STUDY

* Vrushali B. Shah

Abstract:

The article probes into usefulness of Microsoft Excel as an effective aid in MIS and Data Analysis given the fact that various statistical packages are not readily available or may not be useful owing to different requirements. Simple inbuilt functions of MS Excel and its special features have been explained with the help of a Case Study for better understanding. Exhibits have been appended to demonstrate various steps in Data Analysis. Callouts have been inserted into Exhibits for easy understanding.

This article aims at facilitating the micro application of MS Excel in analysis of Ad-hoc Research Projects. It would provide guidelines to officials working in SME Sector and researchers.

Key words: MS Excel, Data Analysis, MIS, Formula, Syntax

Rationale:

This case study has been formulated with the intension or embarking use of MS Excel as a tool for MIS and Data Analysis. Access to various statistical packages is not available to all researchers and in the light of this, the researchers end up with poor data analysis.

MS Excel has got many inbuilt features, which can be conveniently used, for data analysis. Also this package is widely available. In built 'Help' function also enhances use of MS Excel as a tool for data Analysis.

The attempt has been made to demonstrate use of some important functions in MS Excel, which are frequently used for purpose of report generation for MIS and Data Analysis.

Annexures have been appended and special call outs are inserted to facilitate the easy understanding.

If the guidelines in example are meticulously followed, the reader can create own data sheet for analysis with the help of this case study.

* Lecturer, Karmaveer Bhaurao Patil Institute of Management Studies and Research, Satara – 415 001, Maharashtra. E-mail : vrushali.shah@gmail.com

Introduction:

Decision-making is an essence of managing any organization effectively. Correct data is quintessential for effective decisions. Data required in any organization would come mainly from, Secondary Sources, Primary Sources and Management Intelligence System these are basic components of MIS.

A sound MIS would ensure effective and timely decision-making. A good MIS calls for a well-alienated data flow and correct data analysis and this is where MS Excel can help and serve as an effective tool.

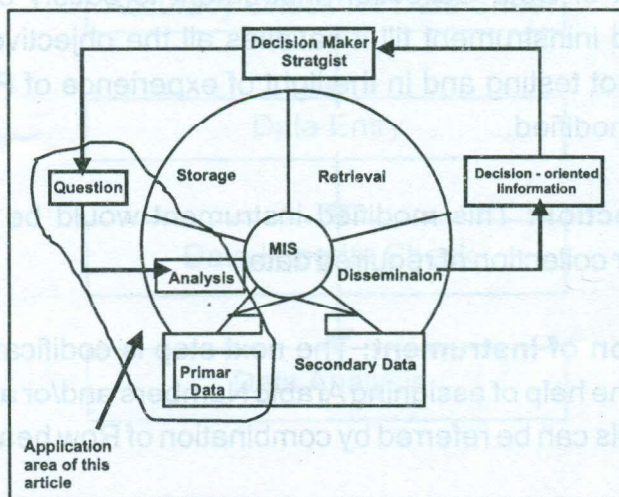
The term MIS refers to formal system of gathering, integrating, comparing, analyzing and dispensing information internal and external to the enterprise in timely , effective and efficient manner.

MS Excel can help in each of these steps and thus can result in increased accuracy and reduced turn around time.

Raw data available either through primary sources or through secondary sources would not serve any purpose because data won't serve as information until they are processed into usable form. Various reports needed, whether internal or external are designed by the organization. Required data is collected first and analysed. For analysis of Secondary Data, organizations generally prefer to develop their own packages as this analysis is routine type and is to be repeated continuously.

MS Excel comes as an aid for analyzing data collected through Ad-hoc Research. Ad-hoc Researches are conducted to satisfy timely needed data which is not available with MIS system and through other data sources. Ad-hoc Research is generally undertaken to bridge the gap between existing information in MIS and information required by decision makers. Following depicted model of MIS encompasses components of MIS and application area of present research article in the same.

Figure No. 01: MIS Model



MS Excel – an electronic spreadsheet can be used effectively for Budget Preparation, Graphical Representation, Financial Analysis, Forecasting and the like with the help of various features explained in the article.

Many times a situation comes where researcher is ready with the data collected but analysis of data owing to its quantum poses a problem. Various statistical tools are available for analysis of data, which require cumbersome calculations.

Readymade softwares are available for data analysis for social sciences viz., SPSS, Sista, and the like but these are not available to all researchers/students owing to high cost. Hence data analysis is done manually by them. This method of manual calculation is vulnerable due to time required and monotony of calculation, which may lead to errors, and arithmetical accuracy in totality cannot be achieved. Microsoft Excel (MS Excel) can be used as an excellent tool for Data Analysis, which would ensure results with arithmetical accuracy in short time span. In addition it would give room for various permutations and combinations of variables for possible interdependability.

This article mainly focuses on use of MS Excel for data analysis. Researchers, executives working in SME sector and beginners are locus of this article.

I Data Analysis – A Concept

Generally collection and analysis of Primary Data follows a pattern, which can be depicted with a flow chart and the same can be done using MS-Excel as follows:

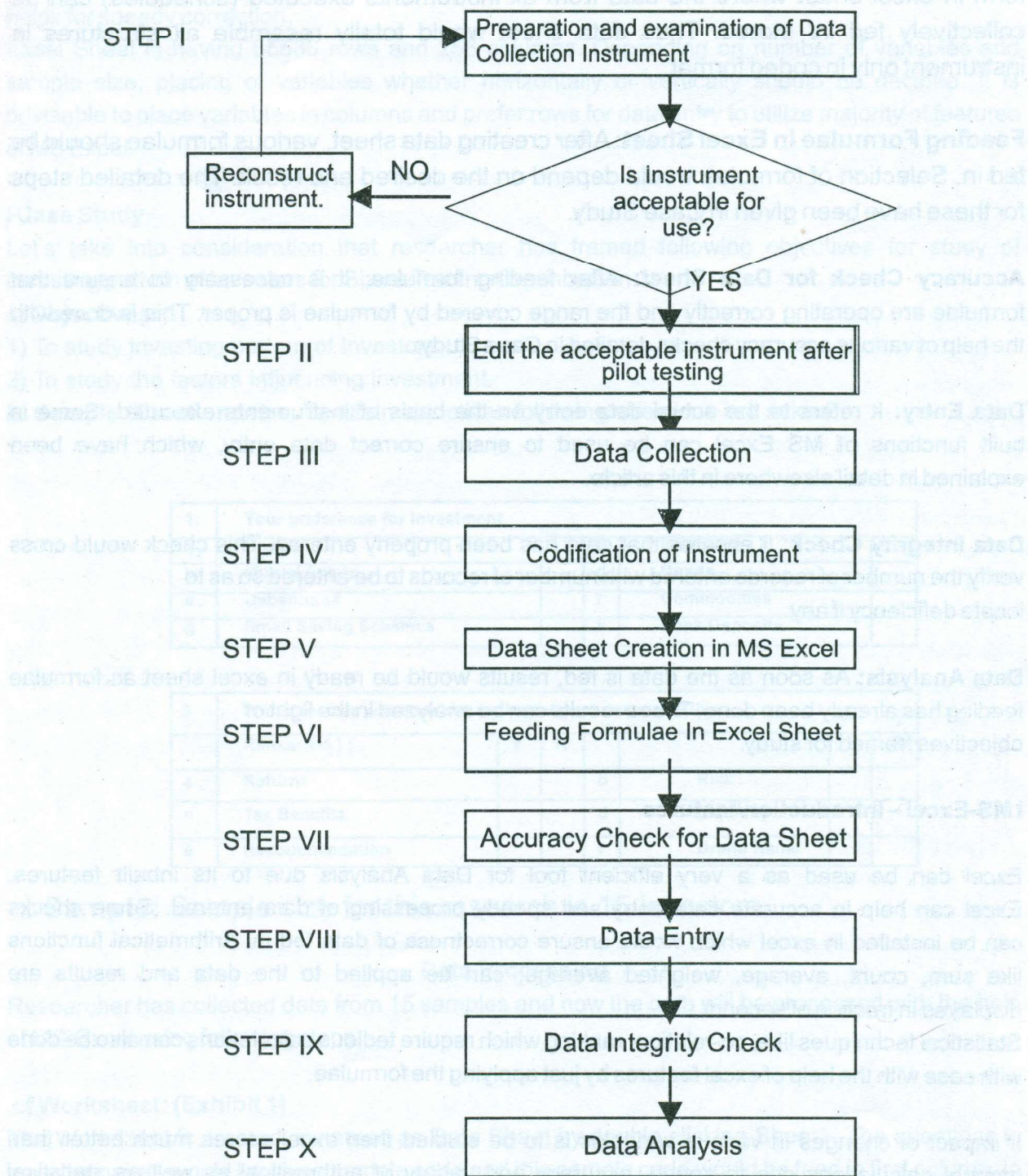
These steps are explained below

Preparation and examination of Data Collection Instrument: The first step is preparation of Data Collection Instrument to satisfy objectives set. Corrections would be required in instrument till it satisfies all the objectives set. This instrument would be used for pilot testing and in the light of experience of Pilot testing; the instrument would be further modified.

Data Collection: This modified instrument would be executed on desired number of samples for collection of required data.

Codification of Instrument: The next step is codification of Instrument. Codification is done with the help of assigning Arabic Numbers and/or alphabets to rows and columns. Desired cells can be referred by combination of Row heading and Column heading.

Figure No. 02: Data Analysis Flow



Data Sheet Creation in MS Excel: Once the instruments are codified, data sheet can be created in MS Excel. Creation of data sheet means creating a copy of instrument in coded form in excel sheet where the data from all instruments executed (schedules) can be collectively fed in/ stored. Thus data sheet would totally resemble all structures in instrument only in coded format.

Feeding Formulae In Excel Sheet: After creating data sheet, various formulae should be fed in. Selection of formulae would depend on the desired end result. The detailed steps for these have been given in Case Study.

Accuracy Check for Data Sheet: After feeding formulae, it is necessary to ensure that formulae are operating correctly and the range covered by formulae is proper. This is done with the help of various accuracy checks detailed in Case Study.

Data Entry: It refers to the actual data entry on the basis of instruments executed. Some in built functions of MS Excel can be used to ensure correct data entry, which have been explained in detail elsewhere in this article.

Data Integrity Check: It ensures that data has been properly entered. This check would cross verify the number of records entered with number of records to be entered so as to locate deficiency if any.

Data Analysis: As soon as the data is fed, results would be ready in excel sheet as formulae feeding has already been done. These results can be analyzed in the light of objectives framed for study.

IMS-Excel – Introduction/features

Excel can be used as a very efficient tool for Data Analysis due to its inbuilt features. Excel can help in accurate data entry and speedy processing of data entered. Some checks can be installed in excel which would ensure correctness of data fed in. Arithmetical functions like sum, count, average, weighted average, can be applied to the data and results are displayed in fraction of second.

Statistical techniques like, co-relation, ranking which require tedious calculations can also be done with ease with the help of excel features by just applying the formulae.

If impact of changes in various variables is to be studied then excel scores much better than manual calculations due to speed, accuracy and variety of arithmetical as well as statistical functions built in.

It is not necessary to remember formulae in MS Excel. Syntax and formulae wizard help in creation of formulae and also in correction of formulae.

As a matter of fact excel can even highlight the cells if the results are not at desirable level which helps for speedy correction.

Excel Sheet is having 65536 rows and 256 columns. Depending on number of variables and sample size, placing of variables whether horizontally or vertically should be decided. It is advisable to place variables in columns and prefer rows for data entry to utilize majority of features of MS Excel.

I Case Study

Let's take into consideration that researcher has framed following objectives for study of Investing pattern of Investors for Share Trading Organization.

a. Objectives:

- 1) To study investing pattern of Investors.
- 2) To study the factors influencing investment.

b. Sample Questionnaire: To attain objectives following questions are asked.

1.	Your preference for investment			
a	Shares		b	Insurance
c	Mutual Funds		d	Bonds
e	Debentures		f	Commodities
g	Small Saving Schemes		h	Bank Deposits

2	Which factors you consider for Investment purpose (Give Ranks: 1-5) :					
		Y	R		Y	R
a	Returns			b	Risk	
c	Tax Benefits			d	Liquidity	
e	Recommendation			f	Brand Name	

c. Sample: Sample size for this research is 15 Investors.

Data Processing

Researcher has collected data from 15 samples and now the data will be processed with the help of MS-Excel using following steps:

of Worksheet: (Exhibit 1)

The Worksheet is created, renamed as Data Sheet by double clicking Sheet1. The questions in questionnaires would be given sample code and this sample code would be feed in first column. In MS Excel column headings are in alphabets and row headings are specified in numbers. A cell on worksheet is referred by writing column name followed by row like A1 or BJ 25.

Next step is coding questionnaire (Exhibit No. 1. Call Out (C.O.) a) and deciding the arrangement of variables and data to be fed in. It is preferable to put variables column wise and data would be fed on rows (Exhibit No. 1. C.O.b & c).

Coding is done i.e. for storing response to first question and alternative 'a' (shares), the column heading would be 1a, for response to alternative 'b', the column heading would be 1b and so on. For Second Question would be 2a, 2b... till all alternatives are covered. For Question 1 only one column having heading 'Y' to store response is required as only preference of investors is asked. But in respect of question 2, response and rank, two alternatives are mentioned. So two columns are required for every alternative. Hence 'Y' column depicts response and 'R' column depicts Ranks assigned if any. (Exhibit No. 1. C.O. f & g).

b. Colour Coding:

Various Structures of the Questionnaire can be separated by using separate colours for easy identification. It would make the excel sheet more user friendly. The different structures of questionnaire are given different colours Like for responses to Qu. 1 grey and light grey colours are used to separate different responses. Same technique has been used for Qu. 2 (Exhibit No. 1. C.O. d). Color-coding can be done by selecting columns and rows and clicking desired background colour on formatting toolbar.

c. Freezing Panes:

While scrolling for data entry, it is desirable that row headings/ column headings keep on appearing. It can be achieved by using Window- Freeze Panes command on desired cell. In the annexed exhibit, this command should be used on cell B6 so that Column headings above it would keep on appearing and row headings i.e. Sample Code would keep on appearing even if scrolling is done. Keyboard shortcut for this is Alt + W, F. But it should be applied after highlighting the first cell of Data Entry. (Exhibit No. 1. C.O. e).

d. Data Validation:

The errors would be minimum if while entering the data itself, some checks are installed which would prevent wrong data entry. Such checks are available in MS Excel in the form of Data Validation. It is done by formatting Cells on work sheet to accept only specific types of Data. Data – Validation- Settings command in MS Excel would allow only specified type of Input in Cell (Numeric, Alphabetic, upper and /or lower limit can also be specified) (Key board Shortcut is Alt + D, L) Input Messages can be given which would be displayed as the cell is highlighted. The Input message are to be tailor made as " Enter 1 for yes, else blank" for Column Y and for column R i.e. column for Ranks, " Enter rank between 1 to 5". This can be achieved by filling relevant details in Input Message in Data Validation. (Exhibit No. 1. C.O. h & i). If any attempt for wrong entry is made, data validation does not permit it. An Error Alert can also be designed by inputting desired message in 'Error Alert' in Data Validation. Thus Data Validation would prevent erroneous data entry.

These all are features of MS Excel supporting correct data entry.

e. Formulae Feeding after Data Validation: (Exhibit No. 2)

As per the requirement for data analysis, formulae should be fed in Data Sheet.

It is easy to feed formula in data sheet in excel. As soon as '=' key on key board is pressed, various formulae with syntax appear in formula bar, of which the required one is chosen. The formula can be filled in with the help of Wizard.

i. Inbuilt Functions:

Depending on results needed different formulae should be fed in data sheet. Following Arithmetic functions are built in excel sheet which can be used for analysis.

Sum: This function returns sum of selected range of cells. Suppose a total of cells from B6 to B20 is needed to know the total number of respondents preferring first option i.e. Shares. Then the cell where total is required (B22), the formula should be written with following syntax. =Sum (B6:B22).

Average: This function calculates the simple average of range selected. The Syntax is =Average(Range) e.g. =Average(B6:B20)

Count: Number of cells filled in a particular range are returned by this function. The syntax is =Count(Range) e.g. =Count(B6:B20) (Exhibit No. 2. C.O. a).

Formula for Sum, Average and Count can be copied by simple copy command Edit- Copy or Ctrl+C and pasting it in adjacent cells where total of preference, average or count for other alternatives is needed. (Exhibit No. 2. C.O. b). Simple copying of formula will change the cell references i.e. if formula from Column A is copied to Column B, automatically the column name would change from A to B. This is called as relative reference. (Exhibit No. 2. N.B. 1)

Countif: Number of cells satisfying a particular criterion (e.g. No. of cells containing Rank 1) are counted by this function. The syntax is =Countif(Range, criteria) eg =Countif(K6:K20, 1) would give the total of number of cells in range containing rank 1. The formula would be =Countif(K6:K20,2) for calculating number of cells in given range containing rank 2. Results of Countif Function can be used for Data Integrity check (Exhibit No. 2. C.O. c)

Rank: This statistical function can rank the values contained in a range of selected cells. The Syntax is =Rank(Reference Cell, Range) e.g. if Ranks of Alternatives in Range K30 to U 30 is to be calculated, then for Rank of value in cell K30, the formula would be =Rank(K30,K30:U30), (Exhibit No. 2. C.O. d)

Countif and Rank functions can also be copied to adjacent cells. In this function, the range given should be constant. So the range is converted into absolute reference, reference of range would not change even if formula is copied.

This can be achieved by simply writing the cells in range by affixing a '\$' sign before them. Like in exhibit, formula for countif function is written as =Countif(\$K\$6:\$K\$26,1). The same formula if copied in the cell below, the cell reference would not change. The formula should be altered by replacing 1 by 2 to calculate number of cells containing Rank 2. The formula would be =Countif(\$K\$6:\$K\$26,2), (Exhibit. No. 2. C.O.c) Formula for Rank would be written as =Rank (K30,\$K\$30:\$U\$30) and copied to adjacent cells. The range would remain same as by assigning \$ sign, it has been converted into absolute reference and reference cell would change so that proper rank can be assigned. ((Exhibit No. 2. C.O. d)

Weighted Average: Using the results of Countif function and simple linking in excel cells, weighted average can be calculated. First weightage to respective ranks to be given is decided. Suppose for Qu. 2, Rank 1 is given weightage of 5, Rank 2 is given weightage 4 and so on. As in the exhibit weighted Average can be calculated by multiplying the number of cells containing rank 1 by weight assigned i.e. 5, (K24 * 5) in exhibit and so on till Rank 5 as only five ranks are taken. The sum total of this would give a weighted average i.e. (K24*5+K25*4+K26*3+K27*2+K28*1), (Exhibit No. 2. C.O. e).

These all are features of MS Excel supporting Data Analysis.

ii. Special Features: (Exhibit 3)

Linking: Data can be stored on various sheets in the same file and it can be linked to get desired results. Linking of cells is also possible between two files. Suppose the data relating to Weighted Average is needed on another sheet 'Exhibit 3' in same file, the cells can be linked by simple method.

1. Go to cell where linking is to be done. (Cell C5 in Exhibit 3)
2. Write address of cell which is to be linked with proper syntax = 'Worksheet Name'! CellAddress (= 'Data Sheet'!K30) and press enter.
3. This can be done with help of key board (Write = in cell where linking is to be done. Use Ctrl + Page Up or Ctrl + Page Down Keys to move through worksheets. Use Arrow keys to arrive on cell to be linked and press enter.

Transpose: The Data stored in rows can be converted in columns and viceversa. Various options are available with transpose function like transferring all contents of cells or transferring selected contents of cells. Suppose the weighted average details are required in columnar form. Then Transpose function can be used to convert data from rows into column and vice versa. Following steps are involved.

- i. Copy the range of cells to be transposed (K30 to U30) on Data Sheet
- ii. Highlight the cell where the data is to be pasted. (C9 in Exhibit 3) Right click the cell, choose Paste Special option.
- iii. In Paste Special function various options are available. Of that choose Values only and Transpose Function and press Ok to get desired result.

Auto Filter: Auto filters can be applied on whole of data sheet and selected cells satisfying the criteria can be displayed. Custom Auto filters can also be prepared.

In Exhibit 3, to apply autofilter following steps are to be followed.

1. Select the row containing headings (A23 to L23 in Exhibit)
2. Choose option Data- Filter- Autofilter.
3. A thick drop down arrow would appear on all row headings. The arrow should be clicked and options should be chosen as per requirement. The options are Top Ten Values, Blanks, Non Blanks or Values in the columns (ranks 1 to 5 in this case study). Custom made auto filters can also be designed as cells containing values more than 1 but less than 4. or any other desired combination.)
4. If 'All' option is chosen all data would be displayed.
5. To cancel Auto Filters same command is to be applied (Data-Filter- Autofilter)
6. The data displayed with the help of Autofilters can be copied elsewhere and used for further calculations.
7. Keyboard shortcut is Alt + D, F, F
8. Autofilters can be applied only if data is contained in form of List.

If Then Function: Results can be calculated depending on satisfaction of given criteria's with the help of arguments in If Then Function.

Correlation: It's a statistical function, which can be used to establish correlation between two series of variables.

Scenarios: It is very often needed as what would be scenario if some variables are changed. In Scenarios, impact of changes in variables can be stored. This function is very useful for the purpose of presentation.

f. Checking:

Checking the accuracy of formulae forms important aspect of correct data analysis.

Checking correctness of formulae can be done in following ways.

Wild Check: If Data is feed anywhere in the sheet or anywhere in the desired area, whether the data is accepted by formulae for calculation; is called as Wild Check. It is to ensure that proper range has been selected in formulae.

Consistency Check: Data with predetermined relationship is entered in Data Sheet and the result of various formulae is verified and tallied with expected result. (e.g. Data of two perfectly correlated series would be entered and result of correlation would be verified.) This check ensures that formulae are yielding proper result.

Extreme Check: Data having predetermined characteristics would be entered and results would be verified. (e.g. Data relating to one sample will be copied in multiple cells and results of formulae would be checked as whether they match the pattern of selected sample)

g. Data Feeding:

After the data sheet is checked for consistency and relevance of formulae, data feeding is done. Data Validation and appropriate freezing of panes would facilitate Data Feeding. The direction of movement of active cell can be changed by using Tools-Options-Edit-Direction (up, down, right, left). Data feeding should be done with utmost care, as results of data analysis would depend on data feeding. (Exhibit No. 2. C.O. f).

h. Data Integrity:

It is essential to check the data integrity i.e. whether the data has been properly entered. Suppose if total 15 records are to be entered then a check should be built in, in such a way that it checks the total of frequency of records entered and compares with total number of records to be entered. Data Integrity checks must be applied to ensure that correct data feeding has been done and no data is missing. If any errors are highlighted by the difference row in data integrity check, it needs to be corrected. Data Integrity can be checked by using Count, Total Frequency and Difference. The Difference would be highlighted with the help of Conditional Formatting. In the Exhibit 4, for Qu. 2 Data Integrity is checked by calculating the total number of samples preferring factor 'a' i.e. returns is counter checked with total frequency of Ranks. Difference is calculated, if it is zero, it is ignored as these figures should tally. If difference is not zero it indicates an error and is highlighted with the help of conditional formatting. (Exhibit No. 4. C.O. a,b,c). Conditional formatting can be done by selecting cells where conditional formats are to be applied and using command Format – Conditional Formatting and specifying the cell value not equal to '0' should be highlighted in Bold and Red colour font by clicking format button. Keyboard shortcut for Conditional Formatting is Alt + O, D.

Auditing: Auditing function can be used to establish the links between precedents or dependents. This function is useful for ensuring accuracy of linkage. Generally this function is used after feeding formulae to check the accuracy of Linkage. As related cells are highlighted in different colours and connected together with arrows, it becomes easier to check the correctness of formulae.

To use auditing function following sequence should be followed:

1. Highlight/select the cell containing formula
2. Use command Tools-Auditing- Trace Precedents, blue arrows would appear to connect the cells using which calculation has been done. Scrolling in worksheet does not disturb the arrows. Similarly Trace Dependents command is used to find cells dependent on selected cell.
3. Auditing can also be used to find errors in formula.
4. All arrows in worksheet can be removed by using Remove Arrows command
5. It is necessary to remove arrows before printing, as arrows would be printed otherwise.
6. Keyboard shortcut for using Auditing function is Alt + T,U

Protection: Worksheets can be protected by passwords. It can be done by command Tools Protection- Protect Sheet/ Protect Workbook. (Alt + T, P) Also facility for tracking changes and highlighting changes is built in which can be used by choosing option Tools-Track changes. (Alt + T, T). If this option is exercised, whatever changes are made in document would be highlighted in different colour (red). The choice of accepting or rejecting these changes is with user. If changes are accepted, the font colour would be changed to Automatic i.e. Black. If changes are rejected original file will be restored.

Hide Function: If two disjoint columns or rows are to be compared with each other, then it can be done without moving the data from those columns/rows. For this hide function is very useful. The columns/ rows in-between can be hidden for time being and can be made to reappear when work is over. Hiding of Columns/rows does not affect data fed in as well as formulae in worksheet. It can be done by highlighting the cell of row/column which is to be hidden using command Format Row- Hide or Format- Column-Hide. (Alt + O, R,H) or (Alt + O,C,H) For Unhiding, adjoining rows/ columns should be selected and Format- Row- Unhide. or Format- Column- Unhide command should be used. (Alt + O, R,U) or (Alt + O,C,U)

i. Getting Results:

As soon as data analysis is complete, results shall be generated as formulae are already fed in and the final worksheet would look like as depicted in Data Sheet as annexed. For Q.1, Count function has been used to check number of persons preferring Investment mode. And ranking has been applied on such count generated. (Refer Exhibit 2) For Q.2, Countif, Weighted Average using Countif and weights assigned, and Ranking using Weighted Average has been used. As soon as the data entry is completed, the result for various functions would be ready. (Refer Exhibit 2)

j. Analysis:

Before analysis, it is necessary to ensure that Data Integrity check has been done and there are no differences. The results are ready and now they can be analyzed. As in the annexed case study, it can be seen that for preference of Investment, majority of respondents have preferred Insurance (count = 12, 80% of respondents, Rank assigned is 1), followed by mutual funds (count = 9, 60% of respondents, Rank 3). Bank Deposits and Small savings (count = 8, 53% of respondents, Rank are preferred thereafter. Less preferred investment Avenues are Shares and Bonds. Ranks have been considered for finding out influential factors for investment. Weighted ranks show that respondents consider Returns (Weighted Score 48, Rank 1) & Risk (Weighted Score 45, Rank 2) as major factor while doing investment. Next matter for investor's concern is Tax Benefit (Weighted Score 32, Rank 3) followed by Brand Name (Weighted Score 23, Rank 4) and recommendation (Weighted Score 22, Rank 5) . Liquidity is not considered as a major factor influencing investment.

VI Conclusion:

Thus MS Excel can be used as an efficient tool for enhancing the quality of Data Analysis and to be useful aid for MIS. Its inbuilt arithmetical and statistical functions would help the quick analysis of data, which is primary demand of MIS. Formulae used by excel for calculation are simple and help in the form of wizards is available. Any error in formula can be troubleshooted with help of excel. Care is to be taken while preparation of Data Sheet, Coding of Instrument and Data Validation. Accuracy of formulae should be test checked before data entry is started. Integrity checks in Data Sheet would ensure proper feeding of data where as data validation would ensure that only correct data is entered. MS Excel is also preferable as it accounts for economy of time with speed and accuracy, its easy availability and user-friendly help feature.

Exhibit No. 01

Exhibit 1		Column Headings in Alphabets												
		1.Your preference for investment					2.Which factors you consider for investment purpose (Give Ranks):							
Sample Code	1a	1b	1c	1d	1e	1f	1g	1h	2a	2b	2c	2d	2e	2f
	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														

a) Coding for alternatives in questionnaire. For Qu. 1, Alternative a, code is 1a

b) Variables are placed in columns

c) Y is for choosing option.

d) Light and dark grey color coding

e) Data Entry would start from this cell B6. So freeze panes command is to be used by highlighting this cell.

f) Y is for giving desired ranks

g) R is for giving desired ranks

h) Enter rank between 1 to 5

i) Enter 1 for 'Yes' else blank

Row headings in numbers

e) Samples are to be fed row

Exhibit 2		Column Headings in Alphabets												
		1.Your preference for investment					2.Which factors you consider for investment purpose (Give Ranks):							
Sample Code	1a	1b	1c	1d	1e	1f	1g	1h	2a	2b	2c	2d	2e	2f
1	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
2	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
3	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
4	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
5	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
6	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
7	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
8	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
9	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
10	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
11	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
12	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
13	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
14	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
15	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
16	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
17	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
18	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
19	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
20	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
21	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
22	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
23	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
24	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
25	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
26	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
27	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
28	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
29	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
30	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
31	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
32	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
33	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R
34	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R

a) =COUNT(S6:S20)

b) Copy of Count

c) =COUNTIF(\$K\$6:\$K\$20,2)

d) =RANK(B22,\$B\$22:\$I\$22)

e) =RANK(K30,\$K\$30:\$U\$30)

f) Data Entry

g) Absolute Reference means referring cell by '\$' sign before column heading and row heading eg. \$B\$6

h) Absolute reference remains same if formula is copied i.e. range of cells referred by absolute reference would be same even if formula is copied.

i) Relative Reference changes to relevant row/column if formula is copied. A combination of relative and absolute reference can be used eg. for Rank the formula is =RANK(B22,\$B\$22:\$I\$22), in which B22 is relative Reference, Whereas range B22 to I 22 is indicated in Absolute reference.

j) Cell Address

k) Weight

l) Copy of (Weighted Average) Formula

m) Copy of

n) =K24*5+K25*4+K26*3+K27*2+K28*1

o) A sheet can be returned by double clicking sheet name of by right click and choosing option rename

Evolutionary Multidisciplinary Optimization in Globalised Services Management

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	
1	DATA SHEET																					
2																						
3	1. Your preference for Investment										2. Which factors you consider for Investment purpose (Give Rank):											
4	Factor	1a	1b	1c	1d	1e	1f	1g	1h	2a	2b	2c	2d	2e	2f							
5		Y	Y	Y	Y	Y	Y	Y	Y	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	
6	1	1	1	1			1	1	1	2	1	1	3	1	5			4				
7	2		1				1	1	1	4	1	1		1	2	1	3					
8	3		1	1			1						1	1					1	2		
9	4	1	1		1	1	1		1	1	1	2		1	3	1	4					
10	5		1	1			1						1	1					1	2		
11	6		1	1	1		1	1	1	3	1	1				1	2					
12	7	1		1	1		1	1	1	1	1	2	1	3	1	4						
13	8		1			1			1	2	1	3					1		1	1		
14	9	1		1				1	1	1	1	2	1	3					1	4		
15	10		1		1	1	1	1	1	2				1	1				1	3		
16	11	1	1	1			1	1	1	2	1	1	1	3			1	4				
17	12	1	1				1	1	1	3				1	2				1	1		
18	13			1	1						1	1	1	2			1	3				
19	14	1	1	1	1		1	1	1	1			1	3			1	2				
20	15		1	1			1	1	1	2	1	1	1	3			1	4				
21																						
22	Count	7	12	9	7	4	5	8	8	12		10		9		6		8		6		
23	Rank	5	1	2	5	8	7	3	3													
24	Rank									4		6		2		1		0		2		
25	Rank									5		3		1		2		2		2		
26	Rank									2		1		6		1		2		1		
27	Rank									1		0		0		1		4		1		
28	Rank									0		0		0		1		0		0		
29																						
30	Weighted Average										49		45		32		19		22		23	
31	Ranking (on the basis of Weighted Average)										1		2		3		6		5		4	
32																						
33	Data Integrity																					
34	Count										12		10		9		6		8		8	
35	Frequency										12		10		9		6		8		6	
36	Difference										0		0		0		0		0		0	
37																						
38																						
39																						
40																						
41																						
42																						

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	Exhibit 4																				
2																					
3	1. Your preference for investment										2. Which factors you consider for investment purpose (Give Ranks):										
4	Sample Code	1a	1b	1c	1d	1e	1f	1g	1h		2a	2b	2c	2d	2e	2f					
5		Y	Y	Y	Y	Y	Y	Y	Y	Y	R	R	R	R	R	R	R	R	R	R	R
6	1	1	1	1	1			1	1	1	2	1	1	1	3	1	5		4		
7	2		1					1	1	1	4	1	1			1	2	1	3		
8	3		1	1				1					1	1						1	2
9	4	1	1							1	1	1	2			1	3	1	4		
10	5		1	1				1						1	1					1	2
11	6		1		1	1			1	1	3	1	1					1	2		
12	7	1		1	1			1	1	1	1	2	1	3	1	4					
13	8		1			1				1	2	1	3					1		1	1
14	9	1		1				1	1	1	1	2	1	3						1	4
15	10		1		1	1	1			1	2				1	1				1	3
16	11	1	1	1						1	2	1	1	1	3			1	4		
17	12	1	1					1	1	1	3				1	2				1	1
18	13			1	1						1	1	1	2			1	3			
19	14	1		1				1	1	1			1	3			1	2			
20	15		1	1						1	2	1	1	3			1	4			
21																					
22	Count	7	12	9	7	4	5	8	8	12		10		9		6		8		6	
23	Ranks	5	1	2	5	8	7	3	3												
24	Rank 1										4	6	2	1	0	2					
25	Rank 2										5	3	1	2	2	2					
26	Rank 3										2	1	6	1	2	1					
27	Rank 4										1	0	0	1	4	1					
28	Rank 5										0	0	0	1	0	0					
29											=Count(I6:I20)										
30	Weighted Average										48	45	32	19	22	23					
31	Ranking (O/b)										1	2	3	6	5	4					
32											a) Count calculates no. of samples exercising option										
33	Data Integrity																				
34	Count										-12	10	9	6	8	6					
35	Frequency										-12	10	9	6	8	6					
36	Difference										0	0	0	0	0	0					
37																					
38																					
39											b) It calculates total of frequency for various ranks										
40																					
41																					
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