



COLLEGE OF DEFENCE MANAGEMENT

JOINING INSTRUCTIONS

MANAGEMENT DEVELOPMENT PROGRAMME (MDP) OPERATIONS RESEARCH (OR) AND SYSTEM ANALYSIS (SA) (02 FEB TO 14 FEB 26)

PART - I: TRAINING

General

1. Management Development Programme - Operations Research and System Analysis (MDP - ORSA) will be conducted at **College of Defence Management** (CDM), Secunderabad from **02 Feb to 14 Feb 26**. The participants of the course are required to report to CDM, Secunderabad by **01 Feb 26 (FN) before 1200hr**.

Aims, Objectives and Eligibility

2. **Aim.** To enable the participants to understand the ORSA techniques as an aid for problem solving and effective decision making.

3. **Objectives.**

3.1 Imbibe adequate knowledge of management concepts and quantitative techniques available for enhancing the effectiveness of decision making.

3.2 Leverage the power of the software application packages in the contextual domain of operational planning and logistics planning.

3.3 Be aware of the approach and methodology of systems analysis for holistic treatment of complex issues.

4. **Qualitative Requirement (QR).** The officers nominated for the Course should be of the rank of **Col/ Lt Col, Capt (IN)/Cdr, Gp Capt/ Wg Cdr** of not less than **12 years' service**. Officers who have already attended HDMC are not eligible to be detailed on the course. The officers must have a working knowledge of MS Excel Software. Officers not meeting these criterion will not be allowed to attend the course.



Course Design

5. **Course Duration.** The duration of the MDP ORSA is **two weeks**. The course is from **02 Feb to 14 Feb 26**.
6. **Working Hours.** Working hours will be from **0830 hr to 1430 hr in the morning session** and **1530 hr to 1700 hr in afternoons (Monday to Saturday)**. There will be four / five sessions conducted each day.
7. **Programme.** The programme begins **on the first day at 0800 hr**. The course programme and material for the duration of the course will be issued to the participants on arrival/ first day.
8. **Training Pedagogy.** The pedagogy of teaching at the College has been designed to be dynamic with focus on participative and interactive learning, for a productive and intellectually stimulating learning experience.
9. **Syllabus & References.** Syllabus for the MDP and suggested reference books is attached as **Appendix A**. MDP primer material for both ORSA and EXCEL have been uploaded on the CDM site (<https://cdm.gov.in>). **All participant officers are advised to go through the primer material of EXCEL and practice the same before arriving for the course. An entrance test will be held on 02 Feb 26 to assess the standard of understanding of the participant officers.**
10. **Study Material.**
 - 10.1 Soft copies of all précis and other study material required by participant officers will be uploaded on the College Wide Network (CWN) on the Virtual Learning Environment (VLE). Participants are also issued with hard copies of a few précis/handouts considered essential.
 - 10.2 CDM has a well-established College Wide Network (CWN) and virtually all aspects of the course curriculum including day to day passage of instructions, class room teaching, submission of solutions, where required, issue of training programme are carried out online. ***It is therefore essential that you are reasonably proficient in your Information Technology related skills.***



11 **Library.** CDM has a vibrant and an exclusive library with a diverse collection of books and research material on various disciplines.

PART II - ADMINISTRATION

Arrival and Departure

11. **Arrival.** All participant officers are requested to **report only on 31 Jan 26 / 01 Feb 2026 (FN) before 1200hr and in any case not before 30 Jan 26 (AN)**. All participant officers are requested to send their **Arrival Information** as per **Appendix B** and **Personal Particulars** as per **Appendix C** to Col Adm by Fax/AWAN. The same may also be shared with the Course **DS, Col Sunil Kuma Udeck (9680136664)** by SMS/What's app on mobile.

12. Officers travelling by air are required to reach CDM under their own arrangements. The officers arriving by train may be provided DD vehicle for move from railway station to the CDM subject to availability and prior arrival intimation.

13. **Reaching CDM from Airport.** Officers may use cab services from the airport to reach CDM and claim the cost of transportation from airport to CDM accordingly. Pre-paid cabs such as Meru Cab and Sky Cab are available at the airport. The distance from airport is approximately 45 km (1½ hr). Cab drivers may be routed towards Secunderabad - Trimulghery route. CDM is located near Amuguda Bus Stop (Yapral). Google Map showing route from Airport to CDM is placed at **Appendix D**.

14. **Departure.** Dispersal from the College on termination of the course may be planned **not before 1500 hr on 14 Feb 26** and not later than **15 Feb 26 (AN)**.

15. **Documents.** All service participants must be in possession of their **Course Nomination Letter, Movement Order** and **Identity Card**.



Administrative Arrangements

16. **Reception.** A reception centre will be established at the **CDM Officers' Mess / Sekhon Block**. All officers arriving at CDM are requested to report to the reception for completion of arrival formalities and for further instructions.

17. **Accommodation.** All participants of the MDP course will be accommodated in the **Sekhon Block / other Guest Rooms** of the College which are located inside the College premises. Required Accommodation is available in CDM. Information regarding accommodation (Mess/ Hotel) will be made available on CDM website by 20 Jan 2026.

18. **Messing.** Officers will be Dining-In at CDM Officers Mess and are requested **not to carry their LRC, as flat rates will be charged** for dining in the CDM Officers Mess.

19. **Dress.** Secunderabad enjoys a moderate climate. **Summer Uniform will be worn on Mondays and on last day (14 Feb 26) for the Valedictory Function.** On all other days **Open Collar** (full sleeve shirts) with name tab (provided by CDM) will be worn.

20. **Medical Support.** The College is dependent on the CDM Medical Inspection Room for medical support. Military Hospital located at a distance of 5 kms and Dental Centre, Bolaram located at approximately 4 kms from the College, are well equipped with all facilities.

21. **Banking Facilities.** ICICI ATM is located within the College campus. SBI branch at No 1 EME Centre is located close to the College. In addition, ATMs of most of the major banks are available in the vicinity.

22. **Leave.** No leave is permitted during the course; however, specific cases may be considered on extreme compassionate grounds with approval of the Commandant.

23. **Sports and Pastime Activities.** Details of sports and pastime activities available at the College are as given below:-

24.1 **Tennis & Squash.** Facilities for tennis and squash are available at CDM.



24.2 **Badminton.** Facilities for badminton are available at RSI.

24.3 **Gym.** A well-equipped gym is available at CDM Officers' Mess.

24.4 **Golf.** There are two 18 hole golf courses, namely the Bison Ecology Park and Training Area (BEPTA) and Eagle Environmental Park and Training Area (EEPTA). Officers can play on payment of green fee.

Contact Details

24. **Training Activities.** Training Branch at CDM will coordinate all the training activities with respect to the MDP. **Basic DS may be contacted for any further clarifications.** The undermentioned officers may be contacted with respect to the training activities of the course: -

24.1	DS Coord	-	6624 (Army) dscoord.ids@gov.in
24.2	Trg Coord	-	6624 (Army) trgcoord.ids@gov.in
24.3	Basic DS	-	9680136664 ds37.ids@gov.in
24.4	Std By DS	-	ds30.ids@gov.in

25. **Administrative Activities.** The undermentioned officers may be contacted with respect to the administrative activities of the course:-

25.1	Col Adm	-	Army- 6615 040-27111731 (Fax) ssoadm.ids@gov.in
25.2	AAQMG	-	Army - 6617
25.3	CDM Duty Clerk	-	040-27111731.



26. **Address.** The postal address of CDM is as follows:-
- | | | | |
|------|--------------|---|--|
| 26.1 | Postal | : | College of Defence Management
Sainikpuri PO
Secunderabad – 500 094 |
| 26.2 | Telegraphic | : | CDM Secunderabad – 500 094 |
| 26.3 | Fax | : | 040-27115741 |
| 26.4 | E-mail | : | dscoord.ids@gov.in
ssoadm.ids@gov.in |
| 26.5 | CDM Web site | : | https://cdm.gov.in |

**Appendix A**

(Refers to Para 9 of Joining Instructions)

**COLLEGE OF DEFENCE MANAGEMENT
FACULTY OF DECISION SCIENCES
MDP ORSA : FEB 2026
SYLLABUS**

1. Syllabus for MDP ORSA is as follows:

<u>S.No</u>	<u>Topic</u>
	Operations Research (OR)
1.1	Introduction to OR
1.2	Linear Programming
1.3	Transportation Model
1.4	Transshipment Model
1.5	Assignment Model
1.6	Travelling Salesman Model
1.7	Networks Models
1.8	Multi Criteria Decision Making
1.9	Decision Theory Models
1.10	Queuing Theory Models
1.11	Simulation Modeling
1.12	Game Theory
	Systems Analysis (SA)
1.13	Introduction to Systems Thinking & System Terminology
1.14	System Definitions and Concepts
1.15	Laws of Systems
1.16	System Dynamics
1.17	System Archetypes
1.18	Leverages
1.19	Stock and Flow Diagram & VENSIM Software
1.20	Soft Systems Methodology

2. **Primer Material.** Primer material on OR/SA and Basic Excel are attached as Annexure 1 & 2 respectively.



3. Reading Material: Operational Research.

3.1 Quantitative Techniques for Decision Making by Anand Sharma, Second Revised Edition, December 2010, Himalaya Publishing House, Delhi, ISBN No 935024-225-7.

3.2 Quantitative Techniques in Management by ND Vohra, published by Tata McGraw Hill Publishing Company Limited, New Delhi, ISBN No 9780070146730.

3.3 Operations Research Principles and Practice, Second Edition by Ravindran Phillips, Solberg, published by John Wiley & Sons (ASIA) Pte Ltd., Singapore ISBN No 9971-51-302-1.

3.4 Operations Research – an introduction, by Hamdy A Taha, Ninth Edition, published by Prentice Hall of India Pvt Limited, New Delhi, ISBN No 81-2032235.

3.5 Operations Research Principles and Practice, by Ravindran Phillips, Solberg, published by John Wiley & Sons (ASIA) Pte Ltd., Singapore, ISBN No 9780471086086.

4. Reading Material: Systems Analysis.

4.1 Fifth Discipline by Peter Senge. Published by RHUK; ISBN 9781905211203.

4.2 Kramer & Jacob de Smit; Systems Thinking: Concepts & Notions. Publisher – Wolters – Noordhoff B.V; ISBN 9020705873.

4.3 Michael C. Jackson; Systems Methodology for Management Sciences. Publisher – Springer – Verlag New York Inc; ISBN 1489926348.

4.4 Michael C. Jackson; Systems Thinking: Creative Holism for Managers. Publisher – John Wiley & Sons; ISBN 0470845228.

4.5 Alan Waring: Practical Systems Thinking. Publisher – Cengage Learning EMEA; ISBN 1861526148.



4.6 Dennis Sherwood: Seeing the Forest for the Trees. Publisher – Nicolas Brealey; ISBN 9781857883114.

College of Defence Management



Appendix B

(Refers to Para 11 of Joining Instructions)

ARRIVAL INFORMATION SLIP: MDP (ORSA)

1. Number, Rank and Name : _____
2. Substantive Rank with Date : _____
3. Acting Rank with Date : _____
4. Mode of Travel : _____
5. Flight / Train Number : _____
6. Date & Time of Arrival : _____
7. Mobile Number : _____
8. E-mail ID : _____
9. Food Habits : Vegetarian/Non-Vegetarian

Dated: _____

(Signature of the Officer)



Appendix C

(Refers to Para 11 of Joining Instructions)

PERSONAL AND SERVICE PARTICULARS: MDP (ORSA)

1. Name (in Block Capitals) :
2. Personal No :
3. Rank.
(a) Substantive with Date : Rank_____ Date_____
(b) Acting with date : Rank_____ Date_____
4. Regiment/Corps/Branch :
5. Decorations :
6. Date of Commission/Seniority :
7. Date of Birth :
8. CDA/ Pay Account No :
9. Bankers & Account No :
10. Identity Card No :
11. Blood Group :
12. NoK and Relationship :
13. E mail ID :
14. Unit and Address :
15. Contact Number :
16. Academic Qualifications :

Place:

Date:

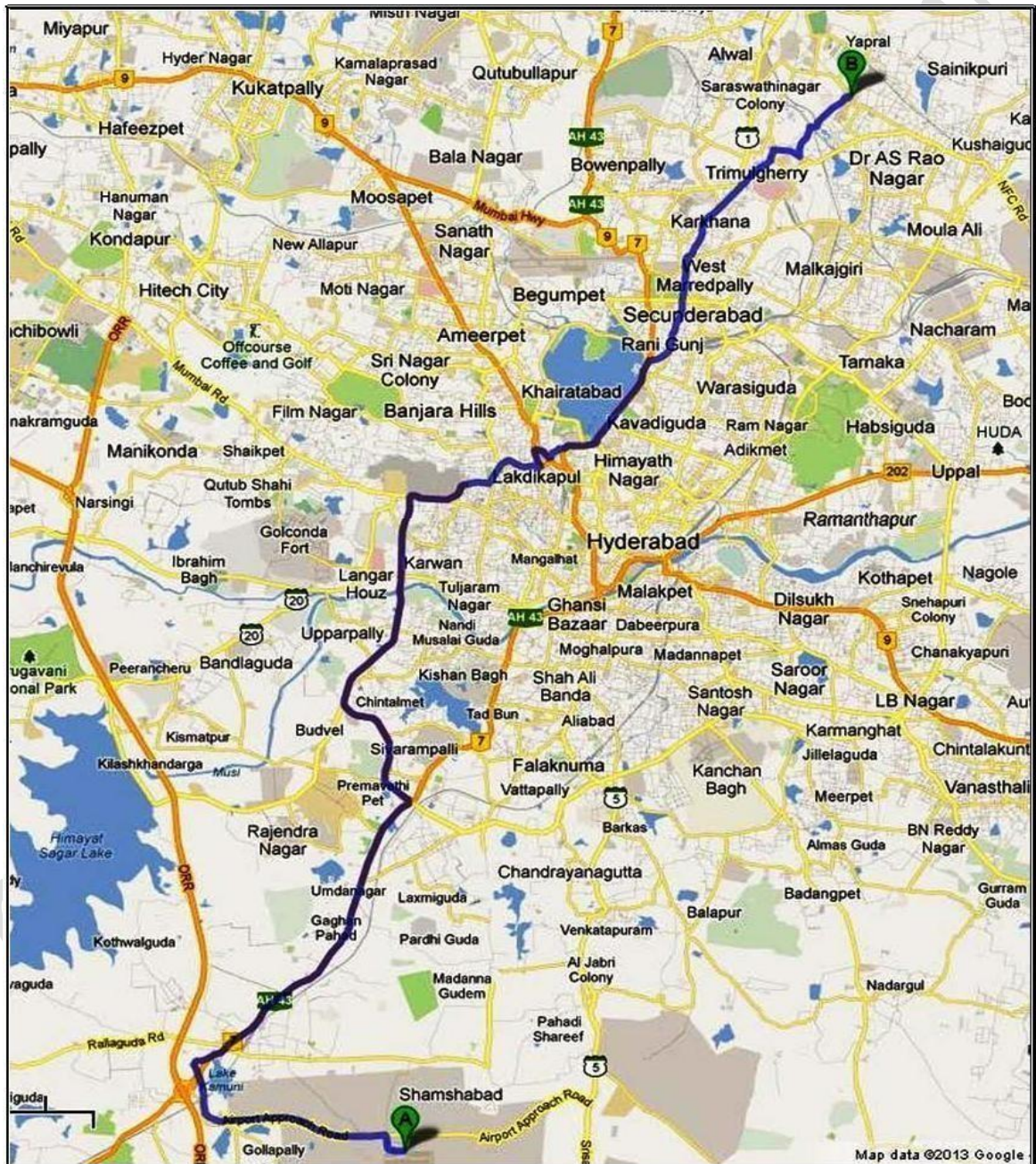
(Signature of Officer)



Appendix D

(Refers to Para 13 of Joining Instructions)

ROUTE MAP RAJIV GANDHI INTERNATIONAL AIRPORT TO CDM





Annexure 1

(Refers to Para 2 of Appendix A)

PRIMER

MDP ORSA : FEB 2026

OPERATIONS RESEARCH (OR)

General

1. OR is the application of modern science on complex problems arising in the direction and management of large systems of men, machines, materials and money in industry, business, government and defense. Its distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as change and risk, with which to predict and compare the outcomes of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically. OR applies scientific methods to improve the effectiveness of operations, decisions and management.

Definition

2. An apt definition of OR in the domain of Armed Forces is:-

“Employment of scientific methods of analysis to provide commanders with quantitative basis for making decisions regarding operations under their control”.

Historical Perspective

3. During the Second World War, the British and American forces realised that military knowledge by itself was not adequate to analyse military systems for finding the best or optimum solutions to their tactical problems. Therefore, the British and then the U.S. military management called upon a large number of scientists to apply a scientific approach to dealing with this and other strategic and tactical problems. In effect, they were asked to do **Research on (Military) Operations**. By developing effective methods of using the new tool of radar, these teams were instrumental in winning the Air Battle of Britain. Through their research on how to better manage



convoy and antisubmarine operations, they also played a major role in winning the Battle of the North Atlantic. Similar efforts assisted the Island Campaign in the Pacific. When the war ended, the success of OR in the war effort spurred interest in applying OR outside the military as well. By the early 1950s, these individuals had introduced the use of OR to a variety of organizations in business, industry, and government. Additional reading material on the history of OR can be accessed at <https://www.informs.org/ORMS-Today/Public-Articles/June-Volume-42-Number-3/History-of-OR-Useful-history-of-operations-research>.

OR Methodology

4. OR methodology consists of seven steps as follows:
 - 4.1 Identification of the Problem / Symptoms by the Commander or the Organisation.
 - 4.2 Formulation of the Problem.
 - 4.3 Data Collection.
 - 4.4 Model Building (Mathematical Model).
 - 4.5 Deriving Solutions from the Model.
 - 4.6 Validation and Implementation.
 - 4.7 Monitoring.

Techniques of OR

5. Some of the more commonly used models and their uses are as follows:
 - 5.1 **Linear Programming (LP).** This is the most commonly used technique and it deals with the allocation of scarce resources in an optimal manner so as to maximise effectiveness or minimise cost e.g. best mix of weapons, units, obstacles etc., to achieve a specified objective. Special models, as variations of LP are: -
 - 5.1.1 **Transportation Model.** Matching of sources of supply to destinations on basis of cost, distance or time. e.g. movement of stores from depots to forward areas.



5.1.2 Assignment Model. To assign a number of 'origins' to the same number of 'destinations' at a minimum total cost e.g. assigning men/machines/units to the same number of jobs/tasks.

6. **Queuing Models.** To determine the amount of servicing facilities to be provided to reduce delays to acceptable levels, considering random pattern of arrivals and servicing time; and optimal utilisation of resources, e.g. number of doctors/beds to be provided in a hospital.

7. **Simulation Models.** Quantifying risk/probability of occurrence of the phenomenon based on probabilistic estimates. Simulation of behaviour pattern of queues, weapons/weapon systems, the outcome of engagements in battle, the breakdown of equipment, repair facilities etc.

8. **Lanchester's Equations.** A mathematical technique for analysing attrition of forces and weapons in battle.

9. **Search Theory.** To evolve a strategy for carrying out the optimal allocation of resources to maximize chances of success in search of a lost object, lost aircraft, submarines/ships, making contact with enemy columns/patrols, etc.

10. **Inventory/Replacement Models.** These deal with analysing material and equipment management problems; when to buy, how much to buy, how much to stock, when to replace equipment and so on.

11. **Decision Matrix (Expected Value Models).** Simultaneously assessment of feasible and alternative courses of action in the face of a number of different environments (states of nature) with assessed probabilities of occurrence e.g. selection of own best course of action from various alternatives considering different courses of action open to the enemy.

12. **Decision Tree.** Basic approach is similar to the decision matrix. Whereas, decision matrix deals with single point decision problems, the decision tree analyses sequential problems e.g. multiphase attack/advance operation.

13. **Analytic Hierarchy Process (AHP).** To carry out a fair and objective selection of personnel or equipment/weapons against laid down criteria / desired attributes even if choices are not closely competing.



14. **Decision Rules.** These deal with the risk-taking profile of a commander, based on which he takes a decision under situations of uncertainty.

15. **Game Theory.** This technique can be used effectively to analyse conflict situations (like war), under conditions of uncertainty.

OR Software

16. Various software are available for solving the problems of OR like MS Excel, POM/QM etc. MS Excel is extensively used at CDM for solving the OR problems. Officers are advised to learn basic functions of MS Excel prior to the commencement of the course. Brief on the basic functionality of Excel required for OR along the important formulas are annexed for reference. Additional material on the usage of MS Excel may be accessed at <https://support.office.com/en-us/article/excel-for-windows-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb>. Basic tutorial on excel may be viewed at <https://www.youtube.com/watch?v=rwbho0CqEAE>.

Web References

<http://www.me.utexas.edu/~jensen/ORMM/>

<http://ifors.org/web/>

<https://www.informs.org/>

<http://www.apors.asia/>

<http://www.orsi.in/>



SYSTEMS ANALYSIS (SA)

Historical Background

17. Right from the evolution stage, human beings have been facing problems arising from operations of systems. At the initial stage, involvement of human beings was limited to their own social systems. With the growth of human civilisation, the types and size of systems has increased and so have the related problems. This brought about the need to systematically scrutinise the systems using scientific tools. Till 1930s there wasn't any known approach to solving complex systemic problems. During World War II some successful systems studies were carried out which had a telling effect on the outcome of war.

18. By mid 1950s, the problems related to very large operating systems were investigated. The systems being complex in nature and scope being quite large, specialists from many disciplines were involved in solving these systemic problems and this problem solving approach was called '**Systems Analysis**'. The name emphasizes the fact that there existed an operating system associated with each problem that was being investigated. The latter half of the last century has seen tremendous growth in both the scope and diversity of 'Systems Analysis' and the growth and scope is getting enlarged in the twenty first century. New tools are being developed by modern systems analysts to address the complex systems problems. Since 1980s the traditional System Analysis is being progressively called '**Systems Thinking**'.

Purpose of Systems Analysis

19. The central purpose of Systems Thinking is to help decision makers to ameliorate the problems and manage the policy issues faced by them. They do it by improving the basis for their judgment by generating information and marshaling evidence bearing on their problems and on possible actions that may be suggested to alleviate the problem. *Thus, a **Systems Approach commonly focuses on a problem arising from interactions among elements in society, enterprises, and the environment; considers various responses to this problem; and supplies evidence about the consequences – good, bad, and indifferent – of these responses.***



Definition

20. There is no standard and universal definition of Systems Analysis. For our purpose, the following definition will meet the objective of studying the discipline:-

A systematic approach for helping a decision maker choose a course of action by investigating his full problem, searching out objectives and alternatives, and comparing them in the light of their consequences, using an appropriate framework or yardstick – in so far as possible analytic – to bring expert judgment and intuition to bear on the problem.

Systems Thinking Methodology

21. Three major methodologies of Systems Thinking **as relevant to Armed Forces** can be broadly classified as:-

21.1 Hard Systems Thinking (HST).

21.2 Systems Dynamics.

21.3 Soft Systems Methodology (SSM).

Hard Systems Thinking (HST)

22. A hard systems approach to problem solving requires the analyst to check that there is a large measurement of agreement among the system owners as to what the perceived problem or opportunity is. There will also have to be a large measure of agreement about the overall goal. Such cases therefore, lend themselves to quantification of various aspects related to the problem.

Systems Dynamics

23. Systems dynamics relates to the problems where the participants are unitary and the complexity of the problem is high. System dynamics thus extends to application of systems thinking to more strategic problems. System dynamics employs the science of feedback, harnessed to the power of the modern digital computer, to unlock the secrets of complex, multiple-loop non-linear systems.

Soft Systems Methodology (SSM)



24. Soft Systems are perceived as those concerned with human activity of some kind. In soft systems a situation is perceived to exhibit crisis, conflict, uncertainty or unease in relationships among the human 'actors'.

Reading Material

Dennis Sherwood: Seeing the forest for the trees.

Peter Senge: The fifth discipline.

Alan Waring: Practical Systems Thinking.

Michael C Jackson: Systems Thinking Creative Holism for Managers.

www.systemsthinking.org

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**Annexure 2**

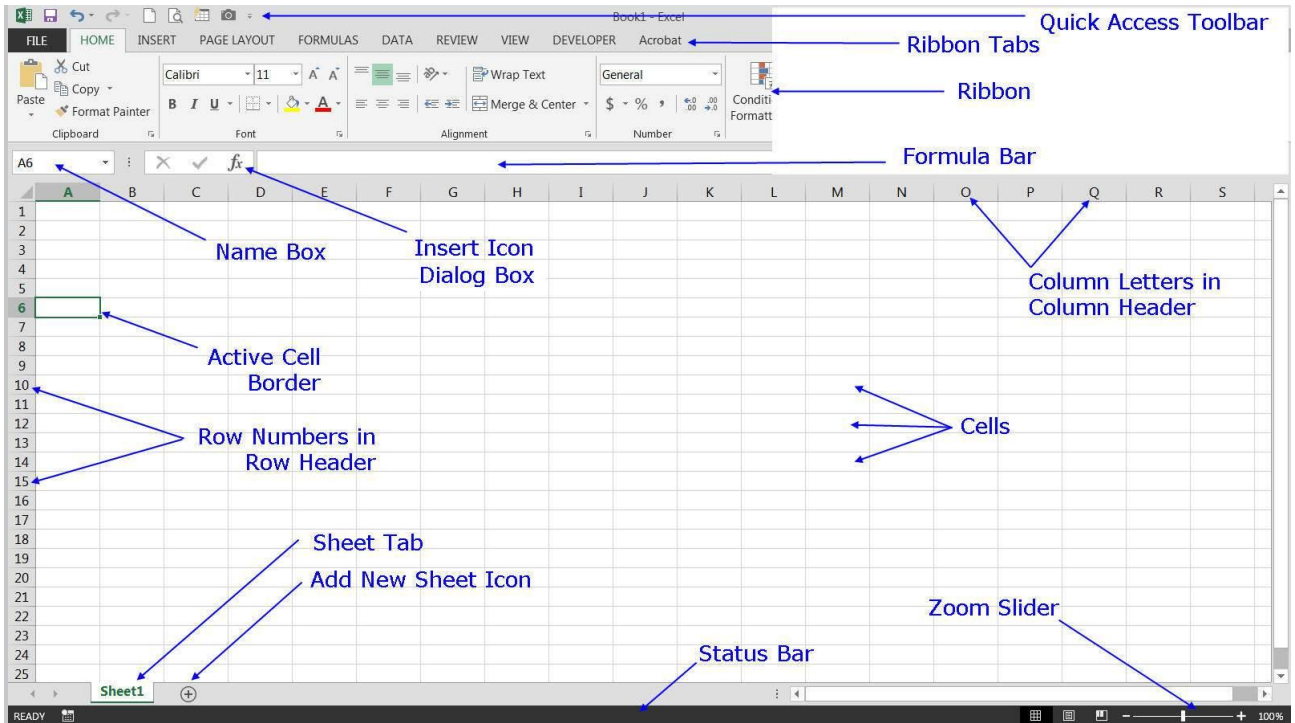
(Refers to Para 2 of Appendix A)

PRIMER**MDP ORSA: FEB 2026****MS EXCEL (BASICS)****General**

1. Excel is an electronic spreadsheet program that is used for storing, organizing and manipulating data. **Data is stored in individual cells** that are usually organized in a **series of columns and rows** in a worksheet; this **collection of columns and rows is referred to as a table**.
2. Spreadsheets programs can also perform calculations on the data using formulas. To help make it easier to find and read the information in a worksheet, Excel has a number of formatting features that can be applied to individual cells, rows, columns, and entire tables of data.
3. Since each worksheet in recent versions of Excel contains billions of cells per worksheet, **each cell has an address known as a cell reference** so that it can be referenced in formulas, charts, and other features of the program.
4. **Active Cell.** The **active cell** is recognized by its green outline. Data is always entered into the active cell. Different cells can be made active by clicking on them with the mouse or by using the arrow keys on the keyboard.
5. **Add Sheet Icon.** Clicking on the **Add sheet icon** next to the Sheet tab at the bottom of the screen adds another worksheet. (You can also use two keyboard shortcuts to add a new worksheet: **Shift+F11** and **Alt+Shift+F1**).



Excel Screen Elements



6. **Column Letters.** Columns run vertically on a worksheet, and each one is identified by a letter in the column header like A, B, Z, AA, AB and so on.
7. **Row Numbers.** Rows run horizontally in a worksheet and are identified by a number starting from 1 in the row header.
8. **Cell.** Cells are the rectangular boxes located in the central area of a worksheet.
 - 8.1 Data entered into a worksheet is stored in a cell. Each cell can hold only one piece of data at a time.
 - 8.2 **A cell is the intersection point of a vertical column and a horizontal row.**
 - 8.3 Each cell in the worksheet can be identified by a **cell reference**, which is a **combination of letters (column reference) and numbers (row reference)** such as A1, F456, or AA34. Here A1 cell refers to Column A and Row 1.



9. **Formula Bar.** Located above the worksheet, this area displays the contents of the active cell. The **formula bar** can also be used for entering or editing data and formulas.
10. **Name Box.** Located next to the formula bar, the **Name Box** displays the cell reference or the **name** of the active cell.
11. **Quick Access Toolbar.** It allows you to add frequently used, commands, click on the down arrow at the end of the toolbar to display available options.
12. **Ribbon.** The **Ribbon** is the strip of buttons and icons located above the worksheet. When clicked on, these buttons and icons activate the various features of the program.
13. **Ribbon Tabs.** They are part of the horizontal ribbon menu that contains links to various features of the program. Each tab – such as **Home**, **Page Layout**, and **Formulas** contains a number of related features and options that are activated by clicking on the appropriate icon.
14. **File Tab.** Clicking on the File tab opens a drop-down menu on the left side of the screen.
 - 14.1 This tab contains items that are mostly related to file and document management, such as opening new or existing worksheet files, saving, and printing.
 - 14.2 The Options item, which is also located on the menu, is used to alter the look of the program as a whole by choosing which screen elements to display, such as scroll bars and gridlines; it also contains options for activating a number of settings including automatic recalculation of worksheet files and choosing which languages to use for spell check and grammar
15. **Sheet Tabs.** By default, there is one worksheet in an Excel 2013 file, but you can add additional sheets. The **Sheet tab** at the bottom of a worksheet tells you the name of the worksheet, such as Sheet1 or Sheet2.
 - 15.1 Renaming a worksheet or changing the tab color can make it easier to keep track of data in large spreadsheet files.



15.1 Switching between worksheets can be done by clicking on the tab of the sheet you want to access. (You can also switch between worksheets with the keyboard shortcut to change between worksheets: **Ctrl+PgUp** and **Ctrl+PgDn**)

16 **Status Bar.** It runs horizontally along the bottom of the screen, can be customized to display a number of options, most of which give the user information about the current worksheet, data the worksheet contains, and the user's keyboard.

16.1 Information includes whether the **Caps Lock**, **Scroll Lock**, and **Num Lock** keys are turned on or off.

16.2 The status bar also contains the **Zoom slider**, which allows users to alter the magnification of a worksheet.

17 **Zoom Slider.** Located in the bottom right corner of the Excel screen, the **Zoom slider** is used to change the magnification of a worksheet when you drag the **slider box** back and forth or click on the **Zoom Out** and **Zoom In** buttons located at either end of the slider.

Entering Data into Your Worksheet



	A	B	C	D	E	F
1		First Name	Surname	Salary		
2		Shyam	Gupta	25000		
3		Rahim	Khan	30000		
4						
5						
6						
7						
8						
9						

18 Entering data into **worksheet** cells is always a three-step process; these steps are as follows:

18.1 Click on the **cell** with mouse or navigate through the keyboard arrow keys where you want the data to go (click on cell B2).

18.2 Type the **data** into the cell (Type Shyam).

18.3 Press the **Enter** key on the keyboard or click on another cell with the mouse.

18.4 To enter multiple data, after typing data in cell B2, use either mouse to go to a particular cell or use navigation arrow keys to move to adjacent cells. For e.g. after typing Shyam in cell B2, use right arrow navigation key to move to cell C2 and type Gupta.

Auto-Completing a Series

	A	B	C	D	E	F	G	H	I	J
1										
2	1									
3	1									
4	1									
5	1									

Copying Data
Type 1 in Cell A2.
Select Cell.
Take mouse pointer to the bottom-right corner on the dot of cell A2.

Filling Series
Type 1 in Cell F2.
Type 2 in Cell F3.
Select both cells.
Take mouse pointer to the bottom-right corner on the dot of cell F3.



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Excel Math Functions

Quickly Sum Columns or Rows of Numbers in Excel

19 The SUM Function Syntax and Arguments.

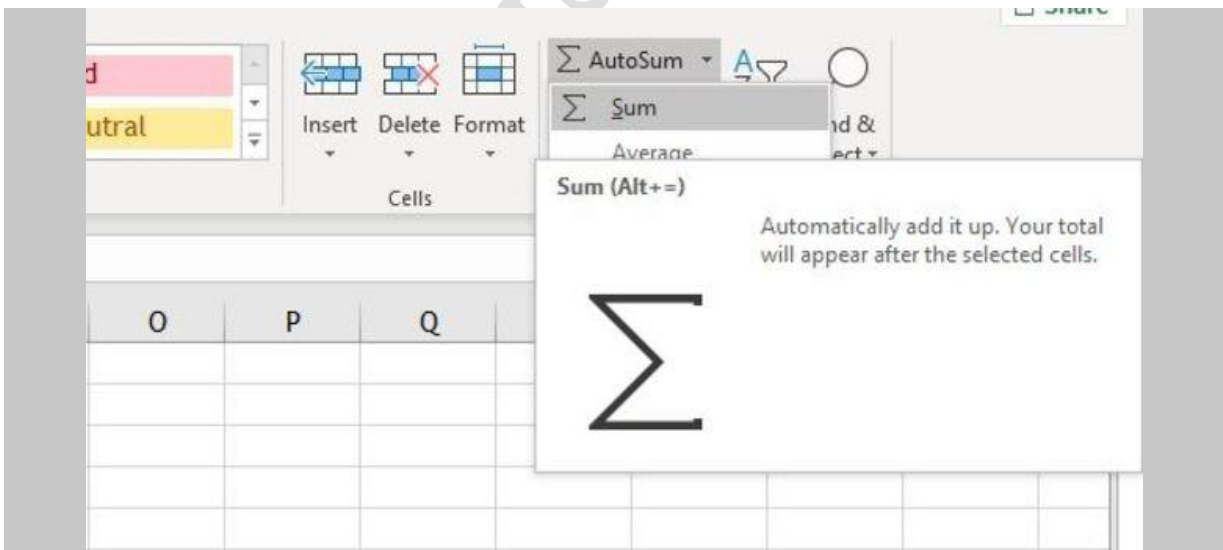
19.1 A function's **syntax** refers to the layout of the function and includes the function's name, brackets, and **arguments**. The syntax for the SUM function is:

19.2 `=SUM(Number1,Number2,...Number255)`

19.3 **Number1** (required) is the first value to be summed. This argument can contain the **data** you want to sum up, or it can be a **cell reference** to the location of the data in the **worksheet**.

19.4 **Number2, Number3, ... Number255** (optional) is the additional values to be summed up to a maximum of 255.

20 Sum Data in Excel Using AutoSUM.



20.1 Use the **AutoSUM** shortcut located on the Home tab of the ribbon to complete the formula without having to type.



20.2 The "Auto" part of the name AutoSUM refers to the method automatically selecting what it believes is the range of cells to be summed by the function. The selected range is shaded and surrounded by an animated border known as marching ants.

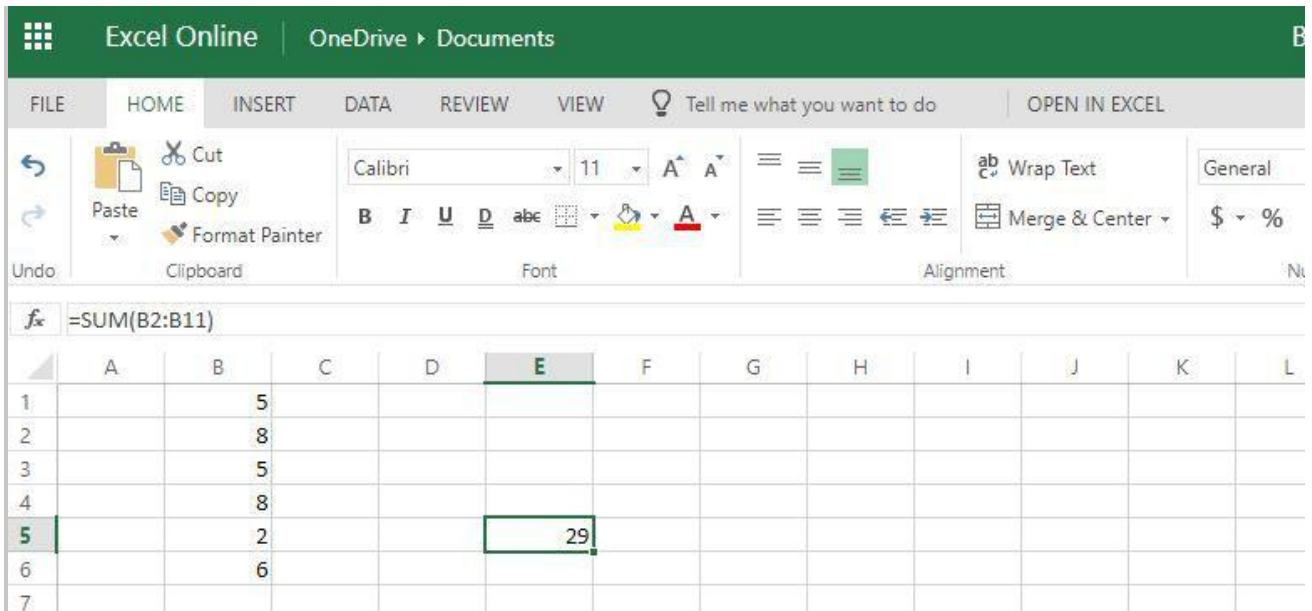
20.3 The AutoSUM function should be input at the bottom of a **column** of data or the right end of a row of data. If you put the AutoSUM function in another spot on the spreadsheet, the range of cells selected as the function's argument may be incorrect. To change the selected range, use the mouse pointer to highlight the correct range before pressing the **Enter** key to complete the function

21 To use AutoSUM

21.1 Click the cell where you want the result to display and click the **AutoSUM** icon on the ribbon.

21.2 Check to see that the selected range, which will form the function's argument, is correct. If it's accurate, press the **Enter** key on the keyboard to complete the function. The answer will display in the cell. When you click on the cell containing the solution, the completed SUM function appears in the formula bar above the worksheet.

22 Using the SUM Function Dialog Box



23 Most functions in Excel can be entered using a **dialog box**, which allows you to input the arguments for the function on separate lines. The dialog box also takes care of the function's syntax, such as the opening and closing parentheses and the commas used to separate individual arguments. Although individual numbers can be entered directly into the dialog box as arguments, it is usually best to enter the data into worksheet cells and enter the cell references as arguments for the function.

24 To enter the SUM function using the dialog box:

- 24.1 Click the cell where the results will be displayed.
- 24.2 Click on the **Formulas** tab of the **ribbon** menu.
- 24.3 Choose **Math & Trig** from the ribbon to open the function drop-down list.
- 24.4 Click **SUM** in the list to bring up the function's dialog box.
- 24.5 Click the **Number1** line in the dialog box.
- 24.6 Highlight at least one cell reference or a range of references.
- 24.7 Click **OK** to complete the function and close the dialog box.

Using Excel's PRODUCT Function



25 Numbers, Arrays, or Ranges of Values. The product is the result of a multiplication operation. The numbers shown in cells A1 to A3 of the example below can be multiplied together using one of two methods

25.1 A formula containing the multiply (*) mathematical operator (see row 5 for an example).

25.2 The PRODUCT function as shown in row 6.

	A	B	C
1	5	2	TRUE
2	10	4	FALSE
3	15	6	
4	Formula	Result	Description
5	=A1*A2*A3	750	Multiplies the numbers in cells A1 through A3 by using a formula
6	=PRODUCT(5,10,15)	750	Multiplies the numbers 5, 10, and 15 together
7	=PRODUCT(A1:A3)	750	Multiplies the numbers in cells A1 through A3
8	=PRODUCT(A1:A3,0.5)	375	Multiplies the numbers in cells A1 through A3, and then multiplies the result by 0.5
9	=PRODUCT(A1:A3,B1:B3)	36000	Multiplies each range A1:A3 and B1:B3 and then multiplies results: (750*48=36,000)
10	=PRODUCT({5,10,15},{2,4,6})	36000	Multiplies the arrays {5,10,15} and {2,4,6} and then multiplies results: (750*48=36,000)
11	=PRODUCT(A1:B1,"text")	#VALUE!	Text data entered into function returns an error value
12	=PRODUCT(A2:B2,FALSE)	0	Boolean value (FALSE) set to 0, therefore, formula is: (10*4*0=0)
13	=PRODUCT(A2:B2,C2)	40	Boolean value (FALSE) in cell C2 is ignored, therefore, formula is (10*4=40)
14			
15			
16			

26 The PRODUCT function comes into play when multiplying the data in many cells. For example, in row 9 in the image, the formula:

=PRODUCT(A1:A3,B1:B3) is equivalent to the formula: **=A1*A2*A3*B1*B2*B3**

27 Syntax and Arguments. The syntax for the PRODUCT function is:

=PRODUCT(Number1,Number2,...,Number255)

27.1 **Number1** (required) is the first number or array that you want to multiply. This argument can be the actual numbers, cell references, or the range of the location of data in the worksheet.

27.2 **Number2, Number3,...,Number255** (optional) are additional numbers, arrays, or ranges up to a maximum of 255 arguments.

28 An Example of the PRODUCT Function. The PRODUCT function is entered into an Excel worksheet by either typing the complete function into the Formula Bar or by using the Function Arguments dialog box. To find the product when multiplying cells



A1, A2, and A3, you could type the formula. Select an empty cell, such as A4, and type the function:

=PRODUCT(A1:A3) ; Press Enter.

29 Although it is possible to enter the complete function manually, it is easier to use the dialog box because it takes care of adding the function's syntax, such as brackets and comma separators between arguments.

30 **To enter the PRODUCT function using the Function Arguments dialog box:**

30.1 Select cell **A4** to make it the active cell.

30.2 On the ribbon, go to **Formulas**.

30.3 Select **Math & Trig**.

30.4 Select **PRODUCT**.

30.5 In the **Function Arguments** dialog box, place the cursor in the **Number1** text box.

31 If the active cell is directly beneath a group of cells, Excel may automatically add the cell references. If you don't want to use these cell references, delete the references.

31.1 On the worksheet, highlight cells **A1** to **A3** to add this range to the dialog box.

31.2 In the **Function Arguments** dialog box, select **OK** to complete the function and to close the dialog box.

31.3 The answer 750 appears in cell A4 because $5 \times 10 \times 15$ equals 750.

31.4 Select cell **A4** to view the complete function in the Formula Bar above the worksheet.



31

The top screenshot shows the Excel interface with the 'Formulas' tab selected. The formula bar displays `=PRODUCT(A1:A3)`. The 'Function Arguments' dialog box is open, showing the 'PRODUCT' function. The 'Number1' argument is set to `A1:A3`, and the 'Number2' argument is empty. The dialog box also shows the formula result as 750.

The bottom screenshot shows the same Excel interface, but the 'Function Arguments' dialog box is closed. The formula bar still displays `=PRODUCT(A1:A3)`, and the result 750 is visible in cell A4.

Video for Multiplication -

<https://www.youtube.com/watch?v=BjvoT2wQ9MA>

Video for excel basic arithmetic operations (add, subtract, multiply and divide)

<https://www.youtube.com/watch?v=1naiWCWfSt4>



Switch between Relative, Absolute, and Mixed References

32 By default, a cell reference is a relative reference, i.e. the reference is relative to the location of the cell. As an example, if you copy the formula **=B4*C4** from cell D4 to D5, the formula in D5 adjusts to the right by one column and becomes **=B5*C5**. To maintain the original cell reference when you copy it, make the cell reference absolute by preceding the columns (B and C) and row (2) with a dollar sign (\$). Then, when you copy the formula **=B\$4*\$C\$4** from D4 to D5, the formula stays exactly the same.

COUNTIF					=B5*C5				
Functions									
	A	B	C	D	E				
1	Product	Quantity	Price	Amount					
2	Bread	2	\$1.50	3					
3	Butter	1	\$1.20	1.2					
4	Cheese	3	\$2.00	6.00					
5	Jam	3	\$1.80	=B5*C5					
6									

33 Absolute and relative cell references can be mixed by preceding either the column or the row value with a dollar sign—which fixes either the column or the row (for example, \$B4 or C\$4).

34 To change the type of cell reference

34.1 Select the cell that contains the formula.

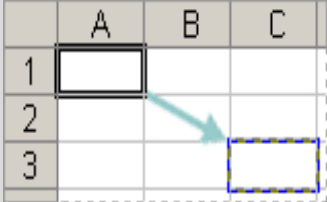
34.2 In the formula bar , select the reference that you want to change.

34.3 Press F4 to switch between the reference types.

35 The table below summarizes how a reference type updates if a formula containing the reference is copied two cells down and two cells to the right.

For a formula being copied:	If the reference is:	It changes to:
	\$A\$1 (absolute column & absolute row)	\$A\$1 (the reference is absolute)
	A\$1 (relative column & absolute row)	C\$1 (the reference is mixed)



For a formula being copied:	If the reference is:	It changes to:
	\$A\$1 (absolute column & absolute row)	\$A\$1 (the reference is absolute)
	\$A1 (absolute column & relative row)	\$A3 (the reference is mixed)
	A1 (relative column & relative row)	C3 (the reference is relative)

SUMPRODUCT Function

36 The **SUMPRODUCT** function returns the sum of the products of corresponding ranges or arrays. The default operation is multiplication, but addition, subtraction, and division are also possible.

37 **Syntax.** To use the default operation (multiplication):

=SUMPRODUCT(array1, [array2], [array3], ...)

38 The SUMPRODUCT function syntax has the following arguments:

Argument	Description
array1 Required	The first array argument whose components you want to multiply and then add.
[array2], [array3], Optional	Array arguments 2 to 255 whose components you want to multiply and then add.

39 **To perform other arithmetic operations.** Use SUMPRODUCT as usual, but replace the commas separating the array arguments with the arithmetic operators you want (*, /, +, -). After all the operations are performed, the results are summed as usual.

40 The array arguments must have the same dimensions. else, SUMPRODUCT returns the #VALUE! error value. For example, =SUMPRODUCT(C2:C10,D2:D5) will return an error as the ranges aren't the same size.

SUMPRODUCT treats non-numeric array entries as if they were zeros.



Tutorial on **SUMPRODUCT** function :

<https://www.youtube.com/watch?v=Lc52EQztcc>

Example

D7				
=SUMPRODUCT(C2:C5,D2:D5)				
	A	B	C	D
1		Item	Cost per Unit	Quantity
2		Green Tea	\$3.25	9
3		Chai	\$2.20	7
4		Mint	\$4.20	3
5		Ginger	\$3.62	6
6				
7			Total Sales	\$78.97
8				

To create the formula using sample list given, **type** in formula bar

=SUMPRODUCT(C2:C5,D2:D5) and press **Enter**. Each cell in column C is multiplied by its corresponding cell in the same row in column D, and the results are added up. The total amount for the groceries is \$78.97.

MMULT function (Matrix Multiplication)

41 The **MMULT** function 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. The formula must be entered as an array formula by first selecting the output range, entering the formula in the top-left-cell of the output range, and then pressing **CTRL+SHIFT+ENTER** to confirm it. Excel inserts curly brackets at the beginning and end of the formula for you.

42 Syntax

MMULT(array1, array2)

Argument - array1, array2 Required (The arrays you want to multiply).

43 Remarks.

43.1 The number of columns in array1 must be the same as the number of rows in array2, and both arrays must contain only numbers.

43.2 Array1 and array2 can be given as cell ranges, array constants, or references.

43.3 **MMULT** returns the #VALUE! error when

43.3.1 Any cells are empty or contain text.



43.3.2 The number of columns in array1 is different from the number of rows in array2.

44 The matrix product array a of two arrays b and c is:

$$44.1 \quad a_{ij} = \sum_{k=1}^n b_{ik} c_{kj}$$

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

Example

	A	B	C
1	Array 1	Array 1	
2	1	3	
3	7	2	
4	Array 2	Array 2	
5	2	0	
6	0	2	
7			
8	Formula	=MMULT(A2:B3,A5:B6)	
9	Result	2	6
10		14	4
11			

Video for MMULT Function

<https://www.youtube.com/watch?v=Vu8ONniwY-A>

Additional material on the usage of MS Excel may be accessed at <https://support.office.com/en-us/article/excel-for-windows-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb>.

Basic tutorial on excel may be viewed at <https://www.youtube.com/watch?v=rwbho0CgEAE>