



MIS775 – Decision Modelling for Business Analytics – Trimester 1 2025

Assessment Task 1 – Investment Portfolio Optimisation – Individual

DUE DATE : Wednesday, 9th April 2025 , by 8:00 pm (Melbourne time)

PERCENTAGE OF FINAL GRADE: 20%

WORD COUNT: 1200 Maximum number of words (excluding tables and diagrams)

Description

Purpose

This assignment task is aligned to the learning outcomes GLO1 & ULO1 and skills GLO4 & ULO3 and GLO5 & ULO2 required to build complex decision models and use advanced quantitative modelling techniques, such as optimisation, to analyse and develop solutions to business problems. By completing this task, you will develop your skills in conceptualising, formulating and representing a business problem as a decision model, developing business decision models using software tools, undertaking sensitivity analysis and evaluating the utility of alternative solutions.

Context/Scenario

This assignment is designed to let you explore and evaluate a number of approaches to investment portfolio optimisation using live real-world data.

In this assignment, you will use investment return data for a period of 4 years to identify the optimum portfolio by applying a range of optimisation methods. In each case, you must determine the percentage (or proportion) of the portfolio to invest in each of 8 investments, such that the percentages are non-negative and sum to 100% (or 1).

Specific Requirements

The assignment has four main sections included in 1 Excel file and 1 PowerPoint file:

Excel File:

- Preliminary Work,
- LP Optimisation Model
- ILP Optimization Model and

Power point File:

Report (PPT file but need to include the relevant Excel worksheet or screenshots)

The requirements of each section are detailed below. The breakdown of marks (total of 100) is given in this document and the Assignment 1 Rubric.

Section 1: Preliminary Work (5 marks)

Choose any four investments listed in the Australian Stock Exchange (ASX), one from each of the sectors given in the following table, to complete a set of 8 investments.

Health Care (S1)	Information Technology (S2)	Communication Services (S3)	Financials (S4)
1. Pro Medicus Limited (ASX:PME)	2. Xero Limited (ASX:XRO)	3. Telstra Group Limited (ASX:TLS)	4. Commonwealth Bank (ASX:CBA)
5. Your choice of investment	6. Your choice of investment	7. Your choice of investment	8. Your choice of investment

To access the stock prices, please refer to **Appendix II** below.

Each stock must have 49 monthly stock prices (January 2021 to January 2025) and compute the monthly rate of return for 48 months or for 4 years. Please refer to **Appendix II** and the provided Assessment 1 Format Excel file.

Stocks should be selected from any 4 different sectors/categories of your choice (let's call them S1, S2, and S3 and S4) with 2 assets in each sector.

The chosen investments must satisfy the following general requirements:

- Each has 48 consecutive months of closing prices, up to and including 1 January 2025.
- “Your choice of investment”- They should be selected from the **four industry sectors (S1 to S4)** listed in the table above. You must choose **only one investment** from each of these four sectors.
- For each of the 8 investments (i.e., the four given investments listed in the table and the rest of the four you chose from those given sectors - “Your choice of investment”), calculate monthly rate of returns, average rate of return and then use their standard deviation to find their risk.
- **The 8 investments should span a reasonable range of volatilities/risk. For this reason, you might try several investments in a sector before settling on a final choice.**
- Classify each of the 8 investments (i.e. the four given investments and the four you chose) into one of three **risk groups R1, R2, and R3**, where $R1 < R2 < R3$. It is up to you to determine the basis for the risk classification, but you must have **at least two investments in each risk group**.
- Define risk categories based on the range. Therefore, R1 should include investment stocks with the lowest risk (lowest standard deviation) and R3 should be in the highest risk .
- Each investment must belong to one of the four industry sectors and one of the three risk categories.

See the below template. Once you have determined what risk group they belong to, you can write the investment/company name in the body of the table below.

	Health Care (S1)		Technology (S2)		Communi. Services (S3)		Financials (S4)		Total
	S11	S12	S21	S22	S31	S32	S41	S42	
R1									at least two investments
R2									at least two investments
R3									at least two investments

For your portfolio optimizations, you should use **modelling data** that you created in the worksheet. The assignment requires you to consider two different approaches to portfolio optimization:

1. Choosing according to investment sector restrictions, and individual investment risk appetite.
2. Choosing according to portfolio size restrictions and risk appetite.

These different approaches allow the exploration of two different optimization techniques: linear programming (LP), and integer linear programming (ILP)

Section 2: LP Optimisation Model (25 Marks)

LP Modelling using appropriate colours for variable cells and objective function cell (green colour), constraint commands cells (blue colour) as you learnt in the class: **Solver set up and results in Excel (refer the given worksheets 2.a and 2.b)**

1. **LP model (Solver set up and results):** In this approach, the aim is to achieve the maximum overall return, subject to the specified requirements regarding the risk mix (percentages in R1 to R3) and sector mix (percentages in S1 to S4).

The following investment requirements and constraints will be applied to the Linear Programming model:

1. Investment in the highest-risk assets shouldn't exceed 15% of the portfolio.
 2. The lowest-risk assets should receive the highest allocation of investments compared to all other risk categories.
 3. To ensure diversification, each sector must have a minimum of 15% invested; apart from one sector that you choose (**your discretion**) to have a minimum of 20% invested.
 4. The minimum investment in each asset should be 5%.
 5. It is up to you to determine **one more restriction** that you wish to impose. This should be "sensible", respecting a sense of diversity in the portfolio, and a defendable risk acceptance approach. The only requirement is that they should respect the learning aims of this assignment and therefore they should not in any way trivialise the problem. There should be realistic range requirements for each of R1 to R3, and S1 to S4. For example, requiring all investments in the portfolio to be in risk sector R1 would trivialise the problem.
2. Solve the problem, and show your optimal result **Sensitivity Analysis (in the worksheet 2.b)**

Section 3: ILP Optimisation Model (20 Marks)

1. **ILP model (Solver set up in worksheet 3.a in excel file. Use appropriate colours for objective function, variables and constraint commands)**

In this approach, the goal is to achieve the maximum expected rate of return, and we assume that the following investment guidelines to be applied:

1. A balanced Portfolio of exactly 5 stocks is to be chosen,
2. The 4 investment sectors must be included.
3. At most 1 of the assets can be in the riskiest group,
4. At least 2 must be in the least risky group.
5. Finally, an asset from R3 can be selected only if at least one asset from R2 is selected.
6. It is up to you to determine **one more restriction** that you wish to impose. This should be "sensible", respecting a sense of diversity in the portfolio, and a defendable risk acceptance approach. The only requirement is that they should respect the learning aims of this assignment and therefore they should not in any way trivialise the problem.

Note that, for each optimisation model under LP and ILP, your spreadsheet should contain an explanation of each optimisation approach taken, the mathematical formulation, and each constraints used. In addition, the Excel Solver dialog box for each optimisation model must be completed in your spreadsheet. You must perform the simplex method to find the optimal solution

Section 4: Report in PPT (50 Marks)

The number of slides should not exceed a maximum of 25. A penalty of -10 marks will be applied if this limit is exceeded.

The PowerPoint document should present all your results comparatively coherently and compellingly. Each model should be accompanied by the following:

3.1 A conceptual diagram of the model (only for the LP model)

3.2 An algebraic formulation of the model (Mathematical modelling)

3.3.1 The optimal solution of LP

- clearly show the Excel sheet of the modelling here, insert a copy
- Include a summary table that includes details of each chosen portfolio, their sector and risk categories, and the basis of choice, with percentages of investments, return and risk for the 4years' of data used to choose the portfolio.

3.3.2 Sensitivity Analysis : Include the sensitivity analysis output sheet in your report and discuss

- Use Excel Solver sensitivity Analysis report to comment on binding constraints, Reduce cost, Shadow price, and the impacts of changes to the risk and sector constraints on the optimum portfolio
- Use the sensitivity analysis report to interpret on how changes to the risk and sector constraints

might affect the optimum portfolio. Interpret on the binding constraints in your portfolio optimization model. Discuss strategies to reduce costs while maintaining an optimal portfolio allocation. Assess the impact of modifying risk and sector constraints on the optimal portfolio composition.

- If any asset is excluded from the optimal solution, determine the required change in its return for it to be selected. Provide a clear explanation of how adjustments in expected returns could lead to the asset's inclusion in the optimal portfolio.

3.4 The optimal solution of ILP

- An algebraic formulation of the model (Mathematical modelling (clearly show the excel sheet of the modelling here, insert a copy))
- Include a summary table that includes details of each chosen portfolio, their sector and risk categories, and the basis of choice, with percentages of investments, return and risk for the 4 years' of data used to choose the portfolio.

Assignments will be marked based on the criteria given in the rubric that follows. Given the range of investments to select from on the Australian stock exchange, it is highly unlikely that you will choose the same portfolio of investments as another student.

The modelling work should be submitted online in the Assignment Folder as a single MS Excel file with the required information in clearly labelled separate worksheets. In addition, you are also required to submit a report - MS PowerPoint file that summarises your models and results. **In summary, two files should be submitted – an Excel spreadsheet and PowerPoint file.**

Learning Outcomes

This task allows you to demonstrate your achievement towards the Unit Learning Outcomes (ULOs) which have been aligned to the [Deakin Graduate Learning Outcomes](#) (GLOs). Deakin GLOs describe the knowledge and capabilities graduates acquire and can demonstrate on completion of their course. This assessment task is an important tool in determining your achievement of the ULOs. If you do not demonstrate achievement of the ULOs you will not be successful in this unit. You are advised to familiarise yourself with these ULOs and GLOs as they will inform you on what you are expected to demonstrate for successful completion of this unit.

The learning outcomes that are aligned with this assessment task are:

Unit Learning Outcomes (ULOs)		Graduate Learning Outcomes (GLOs)
ULO1	Conceptualise, formulate, and represent a business problem as a decision model	GLO1: Discipline-specific knowledge and capabilities: appropriate to the level of study related to a discipline or profession
ULO2	Develop solutions to business problems using advanced decision modelling techniques	GLO5: Problem-solving: creating solutions to authentic (real-world and ill-defined) problems
ULO3	Interpret and analyse the results and evaluate the sensitivity of solutions to the assumptions of the decision models	GLO4: Critical thinking: evaluating information using critical and analytical thinking and judgment

Submission

You must submit your assignment in the Assignment Dropbox on the unit CloudDeakin site on or before the due date. When uploading your assignment, name your document using the following syntax: <your surname_your first name_your Deakin student ID number_[unitcode].pptx. For example, 'Jones_Barry_123456789_ABC123.pptx'. Apply the same naming convention with an xlsx extension when uploading your MS Excel spreadsheet.

When submitting electronically, you must check that you have submitted the work correctly by following the instructions provided in CloudDeakin. Please note that any assignment or part of an assignment submitted after the deadline without an approved extension or via email will NOT be accepted.

Submitting a hard copy of this assignment is not required. You must keep a backup copy of every assignment you submit until the marked assignment has been returned to you. In the unlikely event that one of your assignments is misplaced you will need to submit your backup copy.

Any work you submit may be checked by electronic or other means for the purposes of detecting collusion and/or plagiarism and for authenticating work.

When you submit an assignment through your CloudDeakin unit site, you will receive an email to your Deakin email address confirming that it has been submitted. You should check that you can see your assignment in the Submissions view of the Assignment Dropbox folder after upload and check for, and keep, the email receipt for the submission.

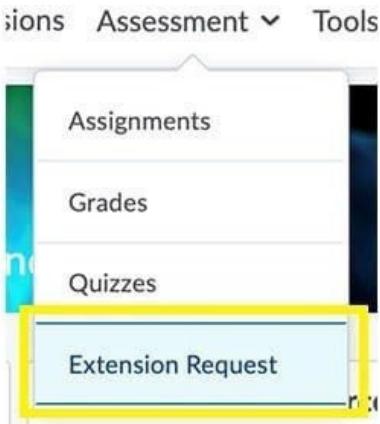
Marking and feedback

The marking rubric indicates the assessment criteria for this task. It is available in the CloudDeakin unit site in the Assessment folder, under Assessment Resources. Criteria act as a boundary around the task and help specify what assessors are looking for in your submission. The criteria are drawn from the ULOs and align with the GLOs. You should familiarise yourself with the assessment criteria before completing and submitting this task.

Students who submit their work by the due date will receive their marks and feedback on CloudDeakin 15 working days after the submission date.

Extensions

If unexpected circumstances beyond your control will prevent you from submitting an assessment by the due date, you should request an assessment extension. Extensions can only be granted for exceptional and/or unavoidable circumstances outside of your control. **Requests for extensions must be made before 12 noon on the submission date** using the online Extension Request form under the Assessment tab on the unit CloudDeakin site. All requests for extensions should be supported by appropriate evidence (e.g., a medical certificate in the case of ill health).



- Requests should be submitted before the assessment is due when you realise you will have difficulty meeting the due date/time. **It is important to note that making a request for an extension does not guarantee that this request will be granted.**

Students requiring a longer extension or who cannot request an extension by the due date should apply for special consideration. **Apply for Special Consideration via StudentConnect within 3 university working days, of the due date, ensuring that you attach relevant documentary evidence.** Extension requests or special considerations must be submitted through the 'Assessment' tab on your unit site as soon as you become aware of any issues meeting the deadline. **Please note that the teaching team is not authorized to grant extensions. Therefore, please do not email the teaching team with extension requests, as they will not be considered.**

- **Special consideration link:** <https://www.deakin.edu.au/students/study-support/assessments-and-examinations/special-consideration>

Late submission penalties

If you submit an assessment task after the due date without an approved extension or special consideration, 5% will be deducted from the available marks for each day after the due date up to seven days*. Work submitted more than seven days after the due date will not be marked and will receive 0% for the task. The Unit Chair may refuse to accept a late submission where it is unreasonable or impracticable to assess the task after the due date. *'Day' means calendar day for electronic submissions and working day for paper submissions.

An example of how the calculation of the late penalty based on an assignment being due on a Thursday at 8:00pm is as follows:

- 1 day late: submitted after Thursday 11:59pm and before Friday 11:59pm – 5% penalty.
- 2 days late: submitted after Friday 11:59pm and before Saturday 11:59pm – 10% penalty.
- 3 days late: submitted after Saturday 11:59pm and before Sunday 11:59pm – 15% penalty.
- 4 days late: submitted after Sunday 11:59pm and before Monday 11:59pm – 20% penalty.
- 5 days late: submitted after Monday 11:59pm and before Tuesday 11:59pm – 25% penalty.
- 6 days late: submitted after Tuesday 11:59pm and before Wednesday 11:59pm – 30% penalty.
- 7 days late: submitted after Wednesday 11:59pm and before Thursday 11:59pm – 35% penalty.

The Dropbox closes the Thursday after 11:59pm AEST/AEDT time.

Since this assignment submission is due on Wednesday, 9th April, the Dropbox open until Wednesday 16th April for late submission. After this, late submissions will no longer be accepted.

Support

The Division of Student Life provides a range of [Study Support](#) resources and services, available throughout the academic year, including **Writing Mentor** and **Maths Mentor** online drop ins and the SmartThinking 24 hour writing feedback service at [this link](#). If you would prefer some more in depth and tailored support, [make an appointment online with a Language and Learning Adviser](#).



The use of genAI as an ASSISTANT

Deakin welcomes the opportunity to engage with emerging technologies in education and seeks to build your capability in the **ethical** and **responsible** use of current and emergent technology. Deakin also upholds a commitment to academic integrity and to ensuring high-quality educational outcomes that prepare you for an AI-driven future.

Using genAI as an assistant is appropriate in this assessment task. To support your learning in this assessment task, **it is recommended that you limit genAI use to assist with specific tasks such as *editing your work to identify grammatical and spelling errors and getting feedback on your work to improve clarity*.** You must modify any AI-generated content you use. **Your final submission should be your own work and show how you have used your own critical thinking skills and what you have learnt in this unit.**

It is important that you take responsibility for your final submission, including:

- **Evaluating the accuracy and quality** of any genAI generated material.
- **Acknowledging how you used genAI** tools in this assessment to ensure you are making informed decisions about your learning, demonstrating learning you have gained in the unit, and acting with integrity.

Please use the **Acknowledgement statements** to guide how you acknowledge the use of genAI in this assessment.

Referencing and Academic Integrity

Deakin takes academic integrity very seriously. It is important that you (and if a group task, your group) complete your own work in every assessment task. Any material used in this assignment that is not your original work must be acknowledged as such and appropriately referenced. You can find information about referencing (and avoiding breaching academic integrity) and other study support resources at the following website: <http://www.deakin.edu.au/students/study-support>

Your rights and responsibilities as a student

As a student you have both rights and responsibilities. Please refer to the document ***Your rights and responsibilities as a student*** in the Unit Guide & Information section in the Content area in the CloudDeakin unit site.

Appendix I

Investment Portfolio Optimisation Report (PowerPoint)

SECTION 1. PRELIMINARY WORK (5 Marks)

- **Introduction**
- **Explain stock (asset) selection**
- **Explain your risk group classifications**

SECTION 2. LP OPTIMISATION MODELS (25 marks)

2. LP model

- **Conceptual diagram**
- **Algebraic formulation**
- **Optimal solution and the relevant worksheet/output sheet of the model**
- **Image of sensitivity report**
- **Interpretation and suggestions**

SECTION 3. ILP OPTIMISATION MODELS (20 Marks)

3 ILP model

- **Algebraic formulation**
- **Optimal solution and the relevant worksheet/output sheet of the model**
- **Interpretation and suggestions**

Section 4 : OPTIMISATION RESULTS AND RECOMMENDED STRATEGY (50 Marks)

- **Summary table of results for all models**
- **Preferred strategy & Rationale**

**** Maximum # of slides are restricted to 25 in the PowerPoint file. If the number exceeds above the limit a penalty will apply**

Appendix II

Overview of Australian Share Market (ASX) : The Australian share market is broken up into 11 Sectors, 24 Industry Groups, 69 Industries and 158 Sub-Industries. Australia's [11 GICS sectors](#) each have a benchmark index that tracks the performance of ASX-listed companies in that sector.

Sector	Industry Group
Energy	Energy
Materials	Materials
Industrials	Capital Goods
	Commercial & Professional Services
	Transportation
Consumer Discretionary	Automobiles & Components
	Consumer Durables & Apparel
	Consumer Services
	Media
	Retailing
Consumer Staples	Food & Staples Retailing
	Food, Beverage & Tobacco
	Household & Personal Products
Healthcare	Health Care Equipment & Services
	Pharmaceuticals, Biotechnology & Life Sciences
Financials	Banks
	Diversified Financials
	Insurance
Information Technology	Software & Services
	Technology Hardware & Equipment
	Semiconductors & Semiconductor Equipment
Telecommunication Services	Telecommunication Services
Utilities	Utilities
Real Estate	Real Estate

How to extract stock prices from the stock markets

Steps to follow:

1. Visit [Australian Stock Exchange \(ASX\) Sectors – Listcorp.](https://www.listcorp.com/asx/sectors/) (<https://www.listcorp.com/asx/sectors/>)
- 2.

ASX Sectors

The Australian Stock Exchange (ASX) uses the Global Industry Classification Standard (GICS) method of categorising companies.

In total the ASX is broken up into 11 Sectors, 25 Industry Groups, 77 Industries and 174 Sub-industries.

 Energy (XEJ) 82.58 +0.255 (+0.31%) 121 companies	 Materials (XMJ) 167.60 -1.505 (-0.89%) 785 companies	 Industrials (XNJ) 79.55 -0.52 (-0.65%) 155 companies
 Consumer Discretionary (XDJ) 40.64 -1.111 (-2.66%) 116 companies	 Consumer Staples (XSJ) 122.45 +0.378 (+0.31%) 64 companies	 Health Care (XHJ) 435.26 +1.259 (+0.29%) 164 companies
 Financials (XFJ) 86.30 -0.538 (-0.62%) 209 companies	 Information Technology (XIJ) 26.17 -0.42 (-1.58%) 144 companies	 Communication Services (XTJ) 16.90 -0.117 (-0.69%) 59 companies
 Utilities (XUJ) 91.08 +1.434 (+1.60%) 21 companies	 Real Estate (XPJ) 17.33 -0.068 (-0.39%) 67 companies	

1. Let us assume that we are looking for “ **health care** ” industry stock performance. Select the Health Care box. . (later change to **Technology, Communication, Finance**)
2. Then you will be directed to the following page.

[ASX](#) > Sectors > Health Care >

ASX Health Care Companies

There are 164 companies in the Health Care sector listed on the [Australian Stock Exchange \(ASX\)](#)

The health care sector is made up of two industry groups:

- Health Care Equipment & Services industry for health care equipment, supplies, providers, services and technology companies.
- Pharmaceuticals, Biotechnology & Life Science industry for companies that produce and supply pharmaceuticals, biotechnology products, and life science services and tools.

Use the filters below to refine the list of companies, or click a company name to see information, share prices, news, dividends and annual reports.

Health Care (164)	Code	Company	Market Cap ↓	Share Price	% Change
Select an industry group					
	1. ASX:CSL	CSL Limited	126.38B	262.47	+0.56%
	2. ASX:SIG	Sigma Healthcare Limited	34.4B	3.00	+0.67%
	3. ASX:PME	Pro Medicus Limited	29.61B	283.51	+0.07%
	4. ASX:RMD	ResMed Inc	21.66B	36.20	-0.28%
	5. ASX:FPH	Fisher & Paykel Healthcare Corporation Limited	18.27B	31.00	-0.55%
	6. ASX:COH	Cochlear Limited	17.6B	267.00	-0.74%
	7. ASX:SHL	Sonic Healthcare Limited	13.5B	28.49	+1.39%
	8. ASX:TLX	Telix Pharmaceuticals Limited	10.22B	31.14	+2.67%
	9. ASX:RHC	Ramsay Health Care Limited	7.9B	34.07	-0.67%

3. Let us assume that we wish to select **Pro Medicus Limited** stock for our portfolio

4. Then note down the code **ASX:PME**

5. Now change that ASX.PME code to **XASX:PME** by adding X to the code as shown here. (**“XASX:PME”**). To use the stockhistory function we need to add the X.

6. Then open the Assignment 1-Format.xlsx Excel file and go to the first worksheet “compute monthly rate of return” and go to B5 cell and write the following excel function. (to facilitate this function you need Microsoft office 365 Excel version, which is available in Deakin Library computers and labs. Also if needed you can download and set up in your laptop)
 $=STOCKHISTORY("XASX.PME","01-01-2021","01-01-2025",2,1,0,1)$

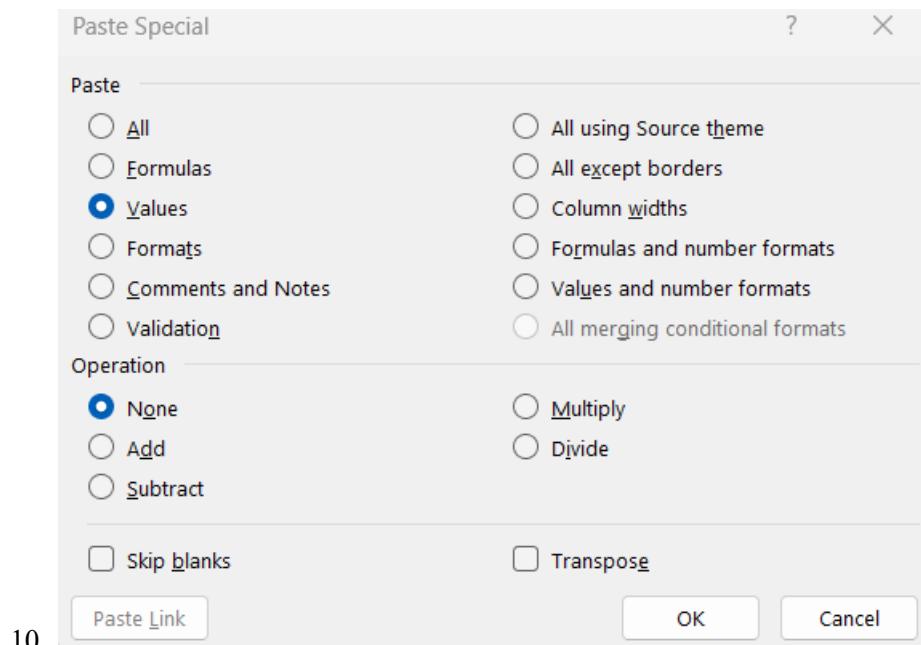
If you wish to find more details about "stockhistory" function, kindly follow the below link

<https://support.microsoft.com/en-au/office/stockhistory-function-1ac8b5b3-5f62-4d94-8ab8-7504ec7239a8>

7. The above function will provide the monthly stock closing prices of “Elevance Health” from January 2021 to January 2025. (you get the date, and closing prices as given in column B and C)
8. Compute the monthly rate of return as shown in D column in % limiting to 2 decimals

$$\text{Monthly Rate of return} = (\text{current closing price} - \text{previous month closing price}) / \text{previous month closing price}$$

9. Now copy those information to the next worksheet “Sample Data (Return and Risk)” using “paste special function” in excel as shown below, choose the copy values and then paste them in the relevant column



10.

Now repeat the process as you complete all other columns to find monthly rate of return for the stock prices of the 8 different stocks following the guidelines of the given specific sectors.

Remark: Disregard any company that has "NA" values in any of the cells under the closing price. Replace it with another company from the same industry.

Ensure that all 48 data points in the Rate of Return column are numerical values in percentages (%) and do not contain "NA".

If you are using any alternative methods to extract stock prices, please ensure that any rows containing dividend information are removed. We are only interested in the listed closing price. Discard all other data, including High, Low, Adjusted Close, and Volume.

Marking Rubric : MIS775 – Decision Modelling for Business Analytics – Trimester 1 2025 Assessment Task 1

Performance Levels Criteria	YET TO ACHIEVE MINIMUM STANDARD		MEETS STANDARD		EXCEEDS STANDARD		Format
	Poor (0-49)		Satisfactory (50-59)	Good (60-69)	Very good (70-79)	Excellent (80-100)	
SECTION 1. PRELIMINARY WORK ULO1/GLO1 Total: 5marks	Downloaded data is not aligned to assignment criteria	Downloaded data has some errors or omissions. Initial processing of data has some errors	Downloaded data has some errors or omissions. Initial processing of data has been correctly performed. Spreadsheet includes some evidence that the data satisfies the assignment criteria	Appropriate data has been downloaded. Initial processing of data has been correctly undertaken. The spreadsheet includes some evidence that the data satisfies the assignment criteria	Appropriate data has been downloaded. Initial processing of data has been correctly undertaken. The spreadsheet clearly demonstrates that the data aligns with assignment criteria	Appropriate data has been downloaded. Initial processing of data has been correctly undertaken. The spreadsheet clearly demonstrates that the data aligns with assignment criteria. Spreadsheet includes a clear and relevant rationale for the choice of risk groups	Excel spreadsheet (1a, 1b) worksheets
SECTION 2. LP OPTIMISATION MODELS Part 1 ULO1,2,3/GLO 1,5 Total: 25 marks	Spreadsheet model/results not included or inappropriate	A vague spreadsheet model is given, analysed and/or contains several modelling errors	An appropriate spreadsheet model is given. There are a few errors and omissions. Solver setup is mostly correct	A clear presentation of the spreadsheet model is given. Solver setup is mostly correct. The sensitivity analysis worksheet included	A clear presentation of the spreadsheet model is given. Solver setup and results are correct. Sensitivity analysis worksheet included	A very clear presentation of the spreadsheet model is given. Solver setup and results are correct. Sensitivity analysis worksheet included.	Excel spreadsheet (2a & 2b) worksheets
SECTION 2. ILP OPTIMISATION MODELS Part 2 ULO1,2,3/GLO1, 5 Total: 20 marks	Spreadsheet model/results not included or inappropriate	A vague spreadsheet model is given, analysed and/or contains several modelling errors	An appropriate spreadsheet model is given. There are a few errors & omissions. Solver setup is mostly correct	A clear spreadsheet model is given. Solver setup and results are mainly correct	A clear spreadsheet model is given. Solver setup and results are correct	A very clear spreadsheet model is given. Solver setup and results are correct	Excel spreadsheet (3a) worksheet
SECTION 3. REPORT ULO3/GLO4 Total: 50marks <ul style="list-style-type: none">• Conceptual diagrams• Algebraic formulations• Optimal solutions• Interpretation of sensitivity analysis• Summary table• Comparison of approaches• Preferred strategy	Report is not included or is inappropriate	Report is not a standalone document. Report displays a general lack of clarity or logic in the interpretation or analysis of results, or there are a few errors or omissions.	Report is largely a standalone document. Some areas of the report display a lack of clarity or logic in the interpretation or analysis of results, or there are a few errors or omissions.	Report is a completely standalone document. Some areas of the report display a lack of depth of understanding.	The report is a completely standalone document. Report comprehensively addresses all areas of modelling. Report displays a depth of understanding across all areas.	Report is a completely standalone document. Include the relevant conceptual model. Include all output sheets relevant to and summary tables. Report comprehensively addresses all areas of modelling. Report displays a depth of understanding across all areas. Report concludes with key insights and valuable suggestions	PowerPoint