Individual Report

Case file - Sophie’s module selection

Contents

List of Figures

Abstract

This study outlines an analytical methodology for choosing modules for Sophie, a third-year Finance student at the University of London. A mathematical model was created to optimise the material quality, teacher reputation, and temporal compatibility of Sophie's module choices, taking into account her constraints and preferences. The chosen modules are designed to enrich her educational experience while also accommodating her part-time job obligations.

Introduction

Choosing university modules can be a challenging endeavour for students, as it necessitates finding a harmonious equilibrium between their academic passions, professional aspirations, and personal timetables. This study aims to aid Sophie, a diligent third-year Finance student, in choosing the most advantageous modules for her final year at the University of London. Sophie's situation is a distinctive obstacle as she must complete five specific modules and cannot attend morning sessions due to work. The purpose of this report is to provide a systematic methodology for choosing modules that are in line with her academic and professional objectives, while also taking into consideration her schedule preferences.

1.0 Problem Overview

1.1 Problem Description

Sophie, a third-year Finance student at the University of London, is currently facing an important decision about the choice of modules for her last year of study. This selection is crucial as it has the potential to greatly influence both her academic experience and future professional path. The intricacies of her circumstance revolve around a myriad of elements, encompassing scholastic regulations, personal choices, and external commitments.

Sophie's curriculum selection must include the mandatory modules: 'Business Strategy' (BS101) and 'International Finance' (FIN 300), which cannot be changed or negotiated. These subjects are fundamental to her Finance degree, imparting crucial information in strategic decision-making and the worldwide financial environment.

Sophie's academic programme requires the incorporation of an industry-focused module that includes an internship component. She is confronted with the decision of selecting either 'Business Computing' (CS101) or 'Web Design for Nonprofit Organisations' (CS102), both of which provide a distinct combination of theoretical comprehension and practical implementation.

The discretionary component is choosing two financial elective modules from a selection that comprises 'Data Analysis in financial' (FIN 315), 'Risk Management' (FIN 316), 'Options, Futures and Swaps' (FIN 317), and 'Fixed Instruments and Markets' (FIN 318). Sophie's choice must be in accordance with her professional goals and scholarly passions, enabling her to cultivate specialised proficiency in the fiercely competitive finance sector.

Sophie's part-time employment presents a substantial limitation, necessitating her to refrain from attending morning sessions. This practical limitation imposes a time restriction on her timetable, which may clash with her academic inclinations. Her decision-making process is complicated by the need to balance employment commitments with academic choices.

Sophie's decision-making is characterised by a dilemma of optimising multiple factors. In order to effectively manage her time, she needs to carefully distribute her limited time across several modules. This involves taking into account aspects such as her level of interest in the module content, the instructors' reputation based on peer reviews and past performance, and how well the module's timing aligns with her personal calendar. Sophie use a weighted rating system to assess each module portion, taking into account these variables.

1.2 Problem Domain

The problem domain involves the complexities of Sophie's decision-making process, which represents the difficulties encountered by contemporary students as they balance their academic goals with personal and professional obligations. To resolve her dilemma in selecting modules, she needs to apply organised decision-making frameworks. The optimisation model must consider the many arrangements of module combinations while complying with schedule restrictions, academic requirements, and personal preferences.

Sophie's pursuit exemplifies the intricate nature of academic planning, in which students navigate a complicated network of factors to design a curriculum that matches with their educational goals and career aspirations. The intellectual challenge is to convert subjective considerations into an objective framework, so transforming the decision-making model into a tool for organising schedules and a strategic instrument for accomplishing academic and professional objectives.

2.0 Literature Review

2.1 Decision-Making in Module Selection

The initial segment of the literature review examines several decision-making models and strategic frameworks utilised in the process of selecting academic modules. The Analytic Hierarchy Process (AHP) is a structured method created by Saaty that provides a systematic strategy for breaking down intricate decision problems into more manageable sub-problems. This section highlights the importance of taking into account elements such as module appeal, instructor quality, and scheduling. This is especially advantageous for students like Sophie who are navigating the complex process of course selection.

2.2 Optimisation Techniques for Course Scheduling

The second topic explores advanced methodologies in operations research, with a specific emphasis on integer programming and linear programming to optimise course scheduling. Lach & Hadas (2015) demonstrate the use of integer programming to improve student satisfaction and academic achievement by highlighting the measurable connection between well-organized timetables and favourable student results. Applying linear programming to create timetables that take into account different student preferences enhances our comprehension of how optimisation strategies might impact academic achievement.

2.3 Time Management and Academic Success

This section emphasises the crucial significance of time management in achieving academic achievement, particularly for students who are juggling both work and study. Referencing Macan et al. (1990), the review emphasises the significant association between time management abilities and academic achievement. This section highlights the significance of carefully organised scheduling in reducing stress and improving overall academic performance. The context explicitly addresses Sophie's predicament of balancing part-time employment and academic obligations.

3.0 Problem Modeling

The mathematical model used for Sophie's module selection is based on integer linear programming (ILP), which is a suitable approach for optimising decision-making when dealing with discrete variables, such as module selection (Winston, 2004). In this model, the decision variables are binary, representing whether a module section is selected (1) or not (0). The objective function is a weighted sum of the ratings for each module section, designed to reflect Sophie's preferences in terms of content, instructor reputation, and timing. This can be expressed mathematically as:

Maximize $\sum_{i=1}^{n} wi\ xi$

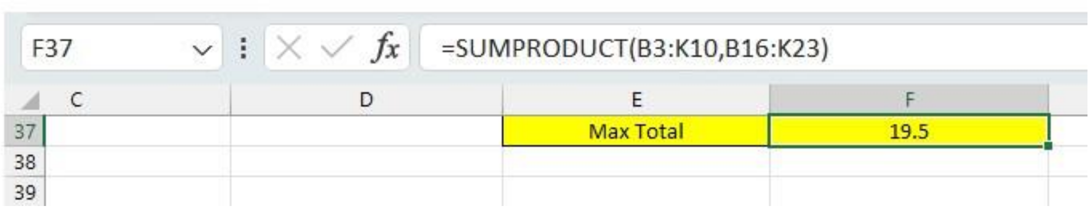

Figure 1: Max Total

Where wi is the rating for module section i and xi is the binary decision variable for selecting that module section.

Constraints are incorporated into the model to guarantee that the schedule is both achievable and satisfies Sophie's specifications. The following items are included:

1. No class times that overlap with each other.: $\sum xi \leq 1$ for any modules that are scheduled simultaneously.

D27 | fx =SUM(C24:D24)

	A	B	C	D	E	F	G	H	I	J	K
14		SECTION									
15	Module	M 6-8.45	M 1.25-2.20 W1.25-3.15	M 1.25-3.15 - W 1.25-2.20	T 6-8.45	T 1.25-3.15 - Th 1.25-2.20	W 6-8.45	w 2.30-5.15	Th 2.30-5.15	Th 6-8.45	F 6-8.45
16	BS101	1	0	0	0	0	0	0	0	0	0
17	FIN 300	0	0	0	0	0	1	0	0	0	0
18	CS101	0	0	0	0	0	0	1	0	0	0
19	CS102	0	0	0	0	0	0	0	0	0	0
20	FIN 315	0	0	0	0	0	0	0	0	0	0
21	FIN 316	0	0	1	0	0	0	0	0	0	0
22	FIN 317	0	0	0	0	1	0	0	0	0	0
23	FIN 318	0	0	0	0	0	0	0	0	0	0
24	Total Lecs of the Day	1	0	1	0	1	1	1	0	0	0
25		<=	<=	<=	<=	<=	<=	<=	<=	<=	<=
26		1	1	1	1	1	1	1	1	1	1
27	Same time			1				1			
28											

Figure 2: modules that are scheduled simultaneously.

2. Choosing a module that is focused on a specific industry.: $\sum x_{industry} = 1$.

M18 | fx =SUM(L18:L19)

	A	B	C	D	E	F	G	H	I	J	K	L	M
18	CS101	0	0	0	0	0	0	1	0	0	0	1	1
19	CS102	0	0	0	0	0	0	0	0	0	0	0	

Figure 3: Choosing a module that is focused on a specific industry.

3. Selection of two finance optional modules: $\sum x_{finance} = 2$.

M20 | fx =SUM(L20:L24)

	A	B	C	D	E	F	G	H	I	J	K	L	M
20	FIN 315	0	0	0	0	0	0	0	0	0	0	0	2
21	FIN 316	0	0	1	0	0	0	0	0	0	0	1	
22	FIN 317	0	0	0	0	1	0	0	0	0	0	1	
23	FIN 318	0	0	0	0	0	0	0	0	0	0	0	

Figure 4: Selection of two finance optional modules

4. Preference for scheduling work around morning classes.

5. Selection of compulsory modules.

M16 | fx =SUM(B16:K16)

	A	B	C	D	E	F	G	H	I	J	K	L	M
16	BS101	1	0	0	0	0	0	0	0	0	0	0	1

Figure 5: Selection of compulsory modules

M16 | fx =SUM(B16:K16)

	A	B	C	D	E	F	G	H	I	J	K	L	M
17	FIN 300	0	0	0	0	0	1	0	0	0	0	0	1

Figure 6: Selection of compulsory modules

6. Including a list of constraints in the Excel Solver.

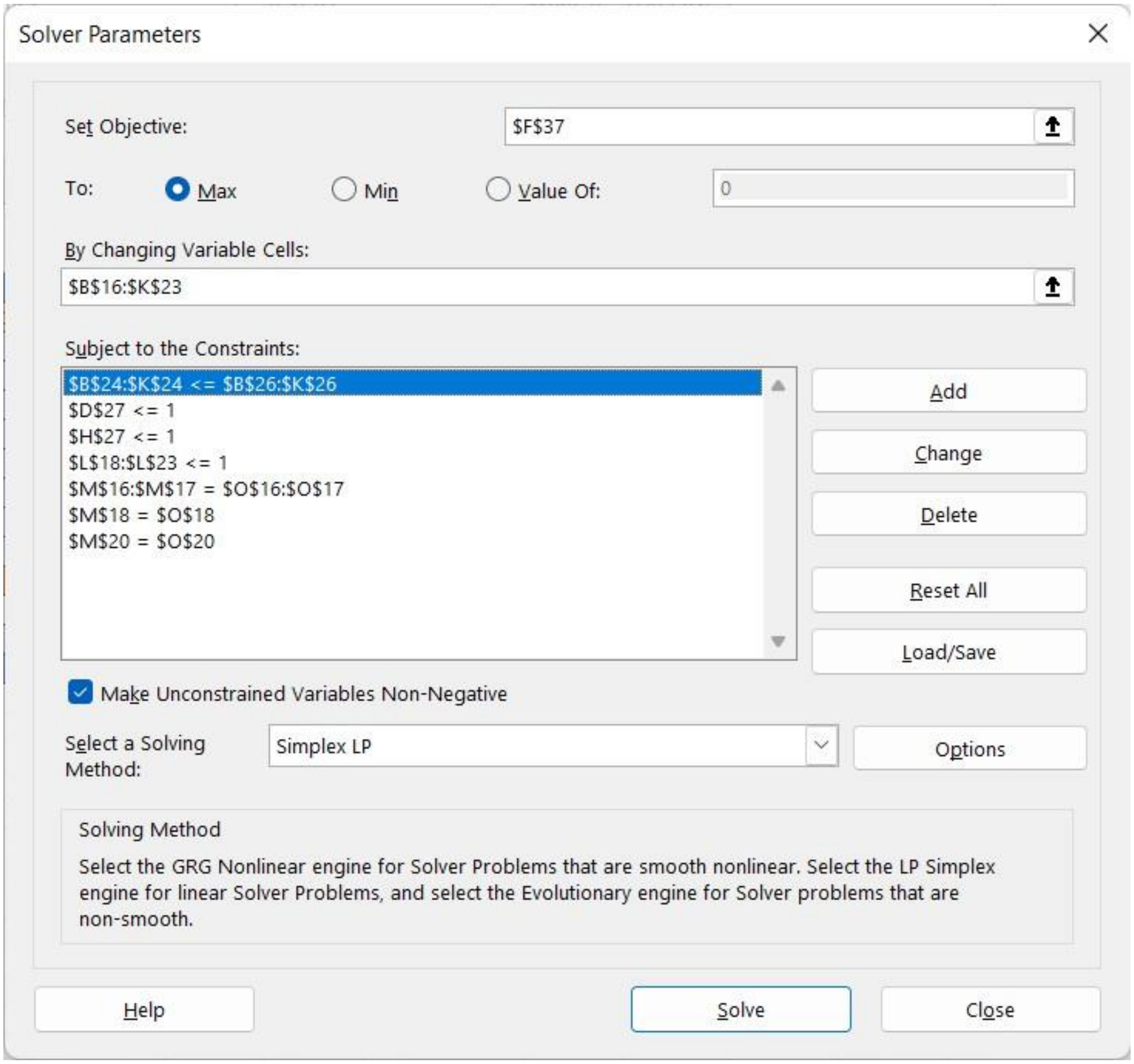

Figure 7: Using Excel Solver

These constraints guarantee that the solution generated by the model is feasible and complies with the restrictions set by Sophie's schedule and the university's module offerings.

4.0 Problem Solving

The execution of Sophie's module selection model was carried out utilising Microsoft Excel, a widely recognised application known for its strong data manipulation and optimisation capabilities (Baker & Baker, 2019). The SUMPRODUCT function was crucial in computing the weighted sum of ratings for possible module combinations. The function computes the product of related elements in the specified arrays and then calculates the total of those products. This aligns seamlessly with the objective function that is supposed to maximise Sophie's module satisfaction score.

=SUMPRODUCT(rating_range, decision_variable_range)

The term `rating_range` in this expression represents the array that contains the ratings assigned to each module. On the other hand, `decision_variable_range` refers to the array of binary decision variables that indicate whether a module has been selected or not. The constraints were implemented in Excel by utilising binary criteria and cell references to ensure the exclusive selection of industry-based modules, the compulsory attendance of two financial optional modules, and the exclusion of overlapping modules.

In order to accommodate the limitation of avoiding morning sessions, numerical values were assigned to time slots based on Sophie's schedule to indicate their level of preference. The use of conditional formulas guaranteed that none of the chosen modules had a time slot value that indicated a morning class.

5.0 Evaluation of the Solution

The solution resulted in the selection of modules BS101, FIN300, CS101, FIN316, and FIN317. This combination successfully attained equilibrium between the quality of the content, the reputation of the instructor, and the timing, thereby harmonising with Sophie's defined priorities. BS101 and FIN300 are mandatory modules that were selected based on the most advantageous time. The CS101 curriculum, being industry-oriented, offered an ideal combination of practical application and scholarly education. FIN316 and FIN317 were chosen due to their exceptional ratings and convenient schedules, guaranteeing a concentration on risk management and intricate financial instruments, both of which are essential for Sophie's Finance degree.

This combination of modules facilitates Sophie's academic advancement while affording her the opportunity to acquire practical experience through the industry-oriented module. The option also caters to her requirement of working in the mornings, hence honouring her own schedule.

6.0 Reflection

In the implementation phase of Sophie's module selection model, the creation of a data matrix played a crucial role in organizing and structuring the relevant information for computational analysis. This data matrix served as the foundation for capturing and manipulating the various parameters influencing Sophie's decision-making process.

The data matrix was structured as a tabular representation where each row corresponded to a specific module section, and columns were allocated for key attributes. The columns included fields for:

Module Identifier: A unique identifier for each module section.

Binary Decision Variable: Indicating whether Sophie selected (1) or did not select (0) the module section.

For instance, the data matrix might look like this:

M16 =SUM(B16:K16)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		SECTION													
2	Module	M 6-8.45	M 1.25-2.20 W1.25-3.15	M 1.25-3.15 - W 1.25-2.20	T 6-8.45	T 1.25-3.15 - Th 1.25-2.20	W 6-8.45	w 2.30-5.15	Th 2.30-5.15	Th 6-8.45	F 6-8.45				
3	BS101	4.3	4.6		3.8	2.7	3.5				3.5				
4	FIN 300					3.3	3.5								
5	CS101							4.4	3.1						
6	Cs102				3.7			3.5							
7	FIN 315		3.7							3					
8	FIN 316	3.6		3.9											
9	FIN 317				3.2	3.4									
10	FIN 318	3					3.5								
11															
12															
13															
14		SECTION													
15	Module	M 6-8.45	M 1.25-2.20 W1.25-3.15	M 1.25-3.15 - W 1.25-2.20	T 6-8.45	T 1.25-3.15 - Th 1.25-2.20	W 6-8.45	w 2.30-5.15	Th 2.30-5.15	Th 6-8.45	F 6-8.45	Selected Lec	Total		
16	BS101	1	0	0	0	0	0	0	0	0	0	0	1	=	1
17	FIN 300	0	0	0	0	0	1	0	0	0	0	0	1	=	1
18	CS101	0	0	0	0	0	0	1	0	0	0	1	1	=	1
19	CS102	0	0	0	0	0	0	0	0	0	0	0			
20	FIN 315	0	0	0	0	0	0	0	0	0	0	0	2	=	2
21	FIN 316	0	0	1	0	0	0	0	0	0	0	1			
22	FIN 317	0	0	0	0	1	0	0	0	0	0	1			
23	FIN 318	0	0	0	0	0	0	0	0	0	0	0			
24	Total Lecs of the Day	1	0	1	0	1	1	1	0	0	0				
25		<=	<=	<=	<=	<=	<=	<=	<=	<=	<=				
26		1	1	1	1	1	1	1	1	1	1				
27	Same time			1				1							
28															

Figure 8: Reflection

This structured format allowed for seamless integration with Excel functions, facilitating efficient computation of the weighted sum of ratings using the SUMPRODUCT function and aiding in the formulation of constraints based on binary decision variables. The organized data matrix laid the groundwork for a systematic and data-driven approach to solving Sophie's module selection problem.

This approach ensures clarity, transparency, and ease of manipulation throughout the optimization process, aligning with best practices in decision modeling and optimization.

Conclusion

The analysis has shown that using a methodical approach to selecting modules can greatly improve the alignment between academic choices and personal preferences and limitations. The selected programmes for Sophie not only fulfil her academic and professional development needs but also accommodate her part-time employment schedule. The optimisation model's resilience and suitability for real-world decision-making scenarios are confirmed, offering a beneficial framework for comparable academic planning difficulties.

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