QBUS2310 - Management Science
Semester 2, 2019
Assignment 2

This is a compulsory individual assignment. It is to be submitted in by 11.59pm on Monday 4 November through Turnitin on the QBUS2310 Canvas site. Instruction for Turnitin submissions are available on Canvas. Your submission will be a multiple submission and should include the assignment (**in PDF format only**) the python code for each question submitted separately. **Note you should also take appropriate screenshots of your python code and excel model and include them in the assignment proper.**

The assignment will count 10 marks towards your final grade but will be marked out of 100. There are 4 questions. Answer all questions. Marks are allocated as follows:

Question 1 (40 marks)

Question 2 (30 marks)

Question 3 (30 marks)

Any breakdown of marks within a question are shown at the question.

Late assignments will be penalised at a rate of 5% per day. Assignment submitted after 5:00pm on Thursday 14 November will receive a zero mark.

Assignment formatting should comply with the Faculty of Business' guidelines and policy (https://business.sydney.edu.au/students/policy).

Hand written assignments are not acceptable. A mark of zero will be awarded for any question or part of question that is hand written, unless explicitly indicated otherwise.

A penalty of 10 marks (i.e. 10% of the total possible score) will apply for inadequate identification of work (missing any of subject code, assessment task, or authorship (SID but not name) on the assignment itself and not just the Turnitin submission.

Mathematical answers must show working. Answers with no working will receive a zero mark.

Written prose must be clear and succinct (bullet points will do) including the proper use of grammar and punctuation. You should use the mathematics to support your written reasoning and arguments.

Good luck.

Question 1 (40 marks)

The Professor you met in the Mid Semester Exam has decided to delay her retirement and now plans to work for up to another 10 years (boy she really must like teaching!), although the exact date of her retirement is somewhat dependent of the success of her investment strategy, which involves investing in a combination of the following five funds.

Investment Fund	% Return (over the period)	Risk Index (points)	Maturity (years)
Capital Guaranteed Fund	6%	7	3
Australian Bonds Fund	7%	4	9
Australian Equities	8%	6	5
Sustainable Growth Fund	9%	5	4
International Equities	11%	9	10

Obviously, she would like to maximise her return while minimising both her level of risk and the time to maturity (maybe she is not as enamoured with her students as we first thought?). Specifically, her objectives are that her overall return must exceed 7.2%, while both the risk level and time to maturity can't exceed 7.5 points and 7.5 years respectively. She has $500,000 in superannuation savings and plans to invest **all** her money.

a) Formulate a MOLP model for the Professor's problem. Determine the best outcome for each of her 3 objectives and set appropriate goals. Marks will be deducted if the mathematical formulation isn't supported with a written explanation. (24 marks, 12 for formulation and 12 for 3 sets of python code)

b) Assuming the Professor wishes to minimise the sum of percentage deviations from all three goals, what is her optimal investment strategy? (6 marks, 3 for formulation and 3 for python code)

c) Use the Minmax function to determine the Professor's optimal investment policy if maximising returns is twice as important as minimising risk and years to maturity. (10 marks, 5 for formulation and 5 for python code)

Question 2 (30 marks)

Sea Swift Shipping operates a weekly cargo run between Darwin and the Tiwi Islands. Sitting on the docks in Darwin are the following consignments from four different customers, who want to transport their cargoes to Melville Island on the next available sailing.

	Consignment Details		
Customer	Tonnage	Volume per ton (m3)	Profit per ton ($)
1. Clearwater Island Lodge	18	4.5	$ 64.00
2. N.T. Land Council	48	4.0	$ 56.00
3. Pluto Mining	15	3.0	$ 48.00
4. Tiwi Timber	30	2.5	$ 40.00

While there are overall tonnage and volume restrictions that must be adhered to, the load master must also ensure that the load is balanced across the vessel's three cargo holds. The weight of cargo in the bow (forward) hold must be within -/+10% of the weight of cargo in the stern (rear) hold. Additionally, the weight of cargo contained in the centre hold must be between 40 – 60% of the total weight of the shipment. While the load master can stow any combination of cargoes, any one hold can only take the cargo from one customer.

	Capacity	
Hold	Tonnage	Volume (m3)
Bow	32	180
Centre	58	210
Stern	40	160

The load master task is to decide on the load combination that will maximise Sea Swift's profits.

a) Formulate an Integer Linear Program model for this problem. Marks will be deducted if the mathematical formulation isn't supported with a written explanation. (20 marks)

b) Create an Excel model to solve the formulation. What is the optimal strategy? Include a screenshot of your Excel model (6 marks, 8 marks for the Excel model, 4 marks for the optimal strategy)

Question 3 (30 marks)

An electrical wholesaler has three distribution centres in Sydney, located in the suburbs of Wetherill Park, Chipping Norton and Casula. They also have three major customers, who have facilities located in Penrith, Bankstown and Northmead.

The following matrix sets out supply and demand volumes (# of pallets of product) as well as the per pallet transportation costs for each distribution centre-customer pair. With respect to supply, each distribution centre carries 50 pallets of safety stock, over and above the amount shown in the matrix which they can use to increase supply if required.

	Distribution Centres			
Customer Facility	1. Wetherill Park	2. Chipping Norton	3. Casula	**Demand**
1. Penrith	32	50	36	200
2. Bankstown	40	40	60	300
3. Northmead	56	70	34	500
Supply	200	300	400	

The wholesaler has the following goals:

As much as possible, it would like to satisfy its customers' demand, while at the same time using as much of its own supply as possible. It also has a goal of keeping delivery costs as near to $58,000 as possible.

a) Formulate a goal programming model for this problem assuming the wholesaler wishes to minimise the sum of percentage deviations from its goals. Marks will be deducted if the mathematical formulation isn't supported with a written explanation. (20 marks).

b) Solve this problem using python and state the solution. A screenshot of the Python code **must** be included in your assignment and the python file should be submitted separately. Please note a minimum of 50% of marks will be deducted where the formulation and the python code are different. (8 marks)

c) How does the solution change if the company wishes to reduce the transportation cost goal by 50%? Comment on your findings. (It is **not** necessary to provide a screenshot of the new python code) (2 marks)

End