VCE General Mathematics Unit 4

Area of Study 2 Networks and decision mathematics sample modelling or problem-solving task: Building and managing a distribution centre warehouse

The modelling or problem-solving task is to be of 2–3 hours’ duration over a period of one week.

Introduction

Large retail groups have distribution centre warehouses built to service several stores in a region. Consider the scenario where a new warehouse is to be built, and then service a network of stores. By using the internet and searching for well-known major retail groups, real data of warehouse locations and store locations can be obtained in relation to a city and its suburbs, for example, Melbourne.

Network construction and aspects of networks for analysis can be chosen according to a common set of specifications, for example the range and number of localities, venues/events to be visited and tasks to be undertaken.

Part 1

Consider a list of activities that will need to be undertaken for a distribution centre warehouse to be built. A [sample list](http://www.cpmtutor.com/c07/exercise5.html) could be used as a guide.

1. Represent the list of activities as a network, and carry out critical path analysis to determine the minimum time for the warehouse to be constructed.
2. Consider a crashing situation where several (for example, three) of the activity completion times are reduced for a cost, and analyse these variations to determine if the previous critical path is changed and/or reduced in time.
3. Due to planning requirements, an additional activity is to be incorporated, such as installing under slab plumbing (for example, 12 days), or installing pre-wiring (for example, 8 days). Analyse the effect of including this activity.

Part 2

A set of stores makes up a distribution network. Include distances to allow calculations to be made. Various travel options will be explored as well as minimum time analysis.

1. Select five to 10 stores positioned at various distances from the distribution centre warehouse, to make up a network and include various routes (with multiple paths between some stores) and travel distances to each store.
2. A particular delivery is needed to ensure all stores receive supplies of a particular product by lunchtime. Map out an efficient delivery run, taking into account the number of trucks used, time, distance and cost. State any assumptions and constraints.
3. A new store is added to the network. Analyse the impact of this on the delivery run developed in b. above.

Part 3

As business expands, more distribution centres are built in outer suburbs of the city. These can be used, along with the original centre, to service all available stores. Trucks from different distribution centres can service various stores, with some of the stores being common to the different distribution centres.

1. Initially, consider, for example, four distribution centres and four stores. Analyse the optimal allocation of services for this scenario.
2. Consider the effect on your analysis in part a. if you add to the initial four stores a small number of additional stores, and then also an additional distribution centre.

Areas of study

The following content from the areas of study is addressed through this task.

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| **Unit 4** | | |
| **Area of study** | **Topics** | **Content dot points** |
| Discrete mathematics | Graphs and networks  Exploring and travelling problems  Trees and minimum connector problems  Shortest path problems  Matching problems  The scheduling problem and critical path analysis | 1, 2  1, 2, 3  1, 2, 3  1, 2  1, 2  1, 3 |

Outcomes

The following outcomes, key knowledge and key skills are addressed through this task.

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| **Unit 4** | | |
| **Outcome** | **Key knowledge dot point** | **Key skills dot point** |
| 1 | 1, 2, 3, 5, 6, 7 | 1, 2, 3, 5, 6, 7 |
| 2 | 1, 2, 3, 4 | 3, 4 |
| 3 | 1, 2, 3, 4, 5, 7 | 1, 3, 4, 5, 9, 10, 11, 12 |