Further Mathematics Unit 4

Matrices module sample modelling or problem-solving task   
– an election campaign

The modelling or problem-solving task is to be of 2 - 3 hours duration over a period of 1 week.

Introduction

An election has been called and several candidates are planning their campaigns for the following weeks until the day of the election. Contextual information and related data for the scenario in each of the parts of the task below can be obtained from various print and/or digital media and web sources such as: <https://www.google.com.au/maps/>; <http://aec.gov.au/> or <http://www.abc.net.au/news/2016-06-08/opinion-polls/7416998>.

Part 1

A candidate proposes to visit several venues/localities in their electorate on a campaign tour. Use a provided adjacency matrix based on map information for a given electorate to construct a diagram of the roads connecting these proposed venues/localities.

a. Find a possible tour so that the candidate can visit each of the given venues/localities.

b. Due to ongoing road works, some diversions are put in place for several roads between venues/localities and others are temporarily made one-way only. Modify the adjacency matrix to incorporate this new information and find a revised tour.

Part 2

There are several candidates for the electorate, and the election campaign may run over a period of one to two months. A survey of voters finds that preferences for the candidates change from week to week leading up to the election according to a given transition diagram. The number of voters enrolled for the electorate is assumed to remain constant until the election is held. An initial state matrix indicates voter preferences for the candidates just prior to the start of the election campaign.

1. Construct the corresponding transition matrix, find the state matrices for the first several weeks of the campaign, and describe the trend in voter preferences over these weeks.
2. The election is held after a specified number of weeks, calculate the number of votes each candidate would be expected to receive on the day of the election. If the campaign turns out to be an extended one, calculate the number of votes each candidate would be expected to receive on the day of the election.
3. From time to time during an election campaign, a particular event may have a significant effect on voter preferences, for example a candidate may withdraw, or be replaced by a different candidate. Assume that an event of this kind occurs during the third week of an extended campaign, and the transition matrix is changed accordingly. Describe the effect of this on the trend in voter preferences and the number of votes the candidates would be expected to receive on the day of the election.

Part 3

The candidates participate in a series of two person debates, where each candidate debates with one of the others. Every candidate debated against all other candidates once and a winner is determined for each debate. The results are recorded and a summary provided at the conclusion of the round of debates.

1. Construct a diagram which represents these results and use one-step and two-step dominance matrices to determine the overall winner of the debates.
2. Given a table of one-step and two-step dominances, determine the outcome the debates.

Areas of study

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

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| --- | --- |
| **Area of study** | **Content dot points** |
| Module – Matrices : *Matrices and their applications*  Module – Matrices : *Transition matrices* | 1, 2, 3, 4, 5  1, 2 |

Outcomes

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

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| **Outcome** | **Key knowledge dot point** | **Key skill dot point** |
| **1** | 1, 2, 3, 5 | 1, 2, 3 |
| **2** | 1, 2, 3, 4 | 1, 2, 3, 4 |
| **3** | 1, 3, 4, 5 | 1, 2, 3, 4, 8, 9, 10, 11 |