General Mathematics Unit 4

‘Matrices’ sample modelling or problem-solving task
– fitness centre

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

Introduction

The local fitness centre is undertaking a review of its equipment, classes and programs. They would like to model the transition of their members in their use of the different fitness offerings and facilities. If the modelling does not show enough use of some of the facilities or equipment, a restructure or redeployment would be proposed.

Part 1

The review firstly examines the movement of members between the gymnasium options of Cardio (*CA*) and Strength (*ST*).

The initial transition matrix detailing the proportion of movements of members is summarised by:



For Part 1, assume there are 180 members who are involved in either the Cardio (*CA*) or Strength (*ST*) options offered in the gymnasium.

a. Initially use the values of *a* = *b* = 0.1. Randomly allocate the 180 members between the two options. Explore how these allocations change over time. Summarise your findings.

b. Choose other values for *a* and *b* that are equal. Again, explore how the allocation of members to the gymnasium options change over time. Are there particular allocations or certain values of *a* and *b* where one of the options is not attended by any of the 180 members? Discuss and justify your findings.

c. Choose different values for *a* and *b* and explore how the allocation of members to the gymnasium change over time. Summarise your findings and justify any conclusions you reach.

Part 2

The fitness centre expands the review to now include another option; Yoga and Pilates (*YP*). Assume the transition matrix is:



For Part 2, assume there are 300 members who are involved in either the Cardio (*CA*), Strength (*ST*) or Yoga and Pilates (*YP*) options offered by the fitness centre.

a. Initially use values of *a* = *b* = *c* = 0.2. Allocate 120 members to the Yoga and Pilates option and randomly split the remainder between the two gymnasium options. Explore how these allocations change over time. Investigate the viability of running all three options under these conditions and summarise your findings.

b. Choose different values for *a*, *b* and *c* and explore how the allocation of members to the three different fitness centre options change over time. Is it viable for the fitness centre to offer all three options? Summarise your findings and justify any conclusions you reach.

Part 3

The fitness centre includes in their review, the idea of increasing member numbers through an advertising campaign. The basis of this is to investigate if a certain number of members will ensure the viability of all the options they offer, regardless of the transitions that occur between each of the respective options.

Initially assume the advertising campaign targets an increase in enrolments of 20. The recurrence relation that helps to describe this is:



where  and 

a. Choose a set of values to represent *a*, *b* and *c*. Investigate the participation of members of the fitness centre in each of the three options over time. Are there transition values that do not make the three options viable? Summarise and justify your findings.

b. Explore other enrolment values different to the original 20. Again, investigate the participation of the members of the fitness centre in each of the three options over time. Discuss the viability of the fitness centre offering the three options and justify any findings.

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** |
| Discrete Mathematics – Matrices:*Transition matrices* | 1, 2, 3, 4 |

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** | 3, 5 | 1, 2, 3 |
| **2** | 1, 2, 3, 4 | 1, 2, 3, 4 |
| **3** | 1, 2, 3, 4, 5, 6, 7 | 1, 2, 3, 5, 7, 8, 9, 10, 11, 12 |