**14 Calculating R0 for non-randomly mixing populations**

**Overview**

In the last practical, we explored the impact of different levels of vaccination coverage in populations with different contact patterns. In both, the age-specific proportion of individuals who were susceptible in the absence of vaccination were identical. However, the vaccine coverage needed to control transmission was different because of the different values of R0 in two choices.

The first part of this practical illustrates how you would calculate the next generation matrix and part II illustrates methods for calculating R0.

**PART I: Calculating the next generation matrix**

Information required to calculate the basic reproduction number are given as below with average duration of infectious period of 11 days:

|  |  |
| --- | --- |
| Age category | Number of Susceptible\* |
| Young | 15000 |
| Middle-aged | 15000 |
| Old | 30000 |



1. How many secondary infectious persons among young individuals will occur as a result of the introduction of

i) 1 infectious young person

ii) 1 infectious middle-aged person and

iii) 1 infectious old person?

1. How many secondary infectious persons does each young, middle-aged and old infectious person generate in a totally susceptible population?

**PART II: Calculating the basic reproduction number**

Introduced one infectious young individual into a totally susceptible population at the start to answer the question 1~4.

1. What proportion of infectious persons in the first generation are young, middle-aged and old as a result of the introduction of one infectious young individual?
2. How many secondary infectious persons resulted directly from the initial infectious person introduced into the population?
3. What happens to the age distribution of the infectious persons in each generation after a few generations have occurred?
4. What is the average number of secondary infectious persons resulting from each infectious person after a few generations have occurred?
5. Change the numbers of infectious persons introduced into the population at the start to take the following values:

i) 20, 50, 30 young, middle-aged and old infectious persons respectively.

ii) 0.5, 0.2 and 0.3 young, middle-aged and old infectious persons respectively.

How does changing the values for the numbers of infectious persons introduced into the population at the start alter your answer to Q3 and Q4?

1. What are the maximum eigenvalue and the corresponding eigenvector of the next generation matrix? How are these related to your answer to the previous questions?
2. Change the value for the proportion of immune to see what happens to the average number of secondary infectious persons resulting from each infectious person after a few

generations have occurred if the following proportions of the population are immune:

i) 25% ii) 50% iii) 72.5% ⅳ) 75%