Institute and Faculty of Actuaries

IFoA ICAT: Scenario Modelling Workstream Introduction to Reproductive Number (R) & Its Calculation

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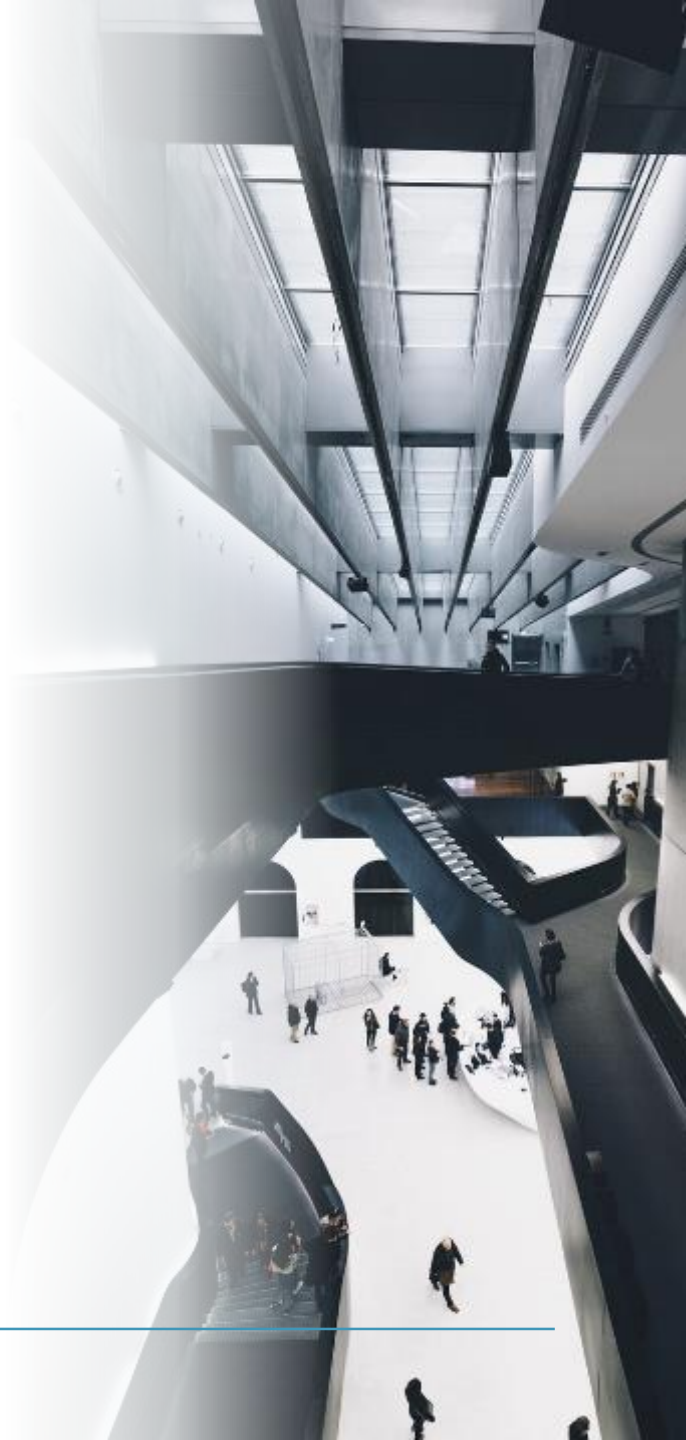
Reproductive Number

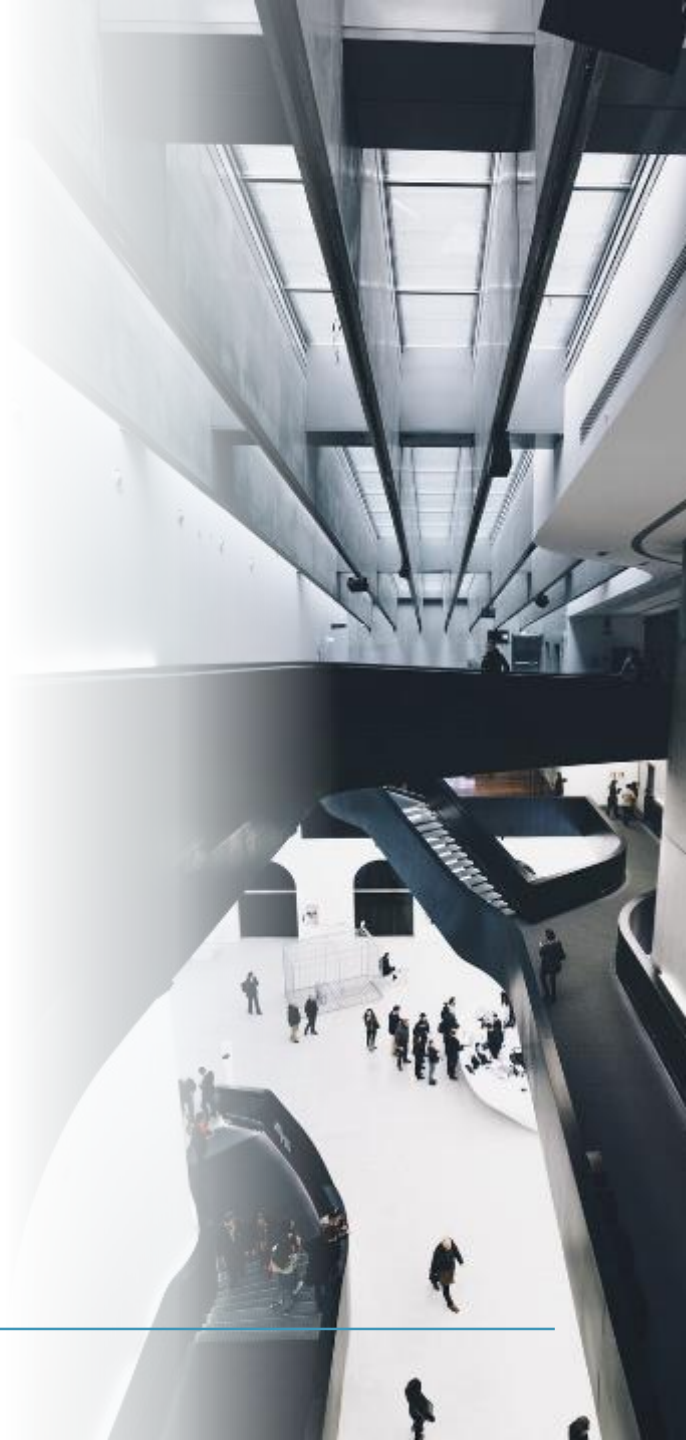
- *Basic Reproductive Number*
  - Average number of secondary cases per primary case in a completely susceptible population
- *Effective Reproductive Number*
  - The expected number of secondary cases per primary case at time t, considering intervention measures in place
- *Instantaneous Reproductive Number*
  - the average number of secondary cases that each infected individual at time t would infect, if the conditions remained as they were at time t



Serial Number

- *Generational Number*
  - The time between primary case exposure and secondary case exposure
- *Serial Number*
  - *The time between onset of symptoms in the primary case and onset of symptoms in secondary case*

Assume β is the infectious contact rate,
γ is the recovery/removal rate,
y_t is the number of cases at time t and
$(g_1, \ldots, g_M)$ is the probability density for serial number, then



Formulas

- *Basic Reproductive Number*

$$R_0 = N\frac{\beta}{\gamma}$$

- *Effective Reproductive Number*

$$y_t = R_e(t-1)g_1 y_{t-1} + \cdots + R_e(t-M)g_M y_{t-M} = \sum_{i=1}^{M} R_e(t-i)g_i y_{t-i}$$

- *Instantaneous Reproductive number*

$$\hat{R}(t) = \frac{y_t}{\sum_{s=1}^{t} g_s \cdot y_{t-s}}$$