Nonlinear Incidence Caused by Phenomenological Heterogeneity in Infectious Disease Dynamics with Random Network Approaches

Author

Abstract

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1 Introduction

Compartmental models, like the susceptible-infectious-recovered (SIR) model discussed by Kermack & McKendrick[1] are commonly used when modeling disease transmission.

1.1 SubSection

Treponema pallidum subspecies pallidum[2, 3].
Itemize

- a
- b
- c
  - (1)
  - (2)

  In practice, diagnoses of early versus late latent stages are determined based on serological testing and clinical input.
- d

2 Data

3 Model Setup

Enumerate

(H1) Assumption

3.1 Subsection

Equation

$$\mathbb{P}(K = k) \propto k^{-\alpha} \tag{1}$$

package `fit_power_law` function from the `igraph` R package
Eqref: (1).

Class Eqns

$$\begin{cases} S(t) & = G_p(\theta(t)) \\ I(t) & = 1 - S(t) - R(t) \\ \dot{R}(t) & = \gamma I(t) \\ \dot{\theta}(t) & = -\beta\theta + \beta\frac{G_p'(\theta)}{G_p'(1)} + \gamma(1-\theta) \end{cases} \tag{2}$$

4 Comparing the network-SIR and MA-SIR models

5 Conclusions

Acknowledgments

We thank XX for his help with the literature review.

Funding Statement

Funding

References

[1] W.O. Kermack and A.G. McKendrick. A contribution to the mathematical theory of epidemics. *Proceedings of the Royal Society A*, 115:700–721, 1927.

[2] Jonathan Dushoff, Joshua B. Plotkin, Simon A. Levin, and David J. D. Earn. Dynamical resonance can account for seasonality of influenza epidemics. *Proceedings of the National Academy of Sciences*, 101(48):16915–16916, 2004.

[3] S. Bansal and L.A. Meyers. The impact of past epidemics on future disease dynamics. *Journal of Theoretical Biology*, 309:176–184, 2012.

Supplementary Information

S1 Section

Table S1: Table Exp

Age Groups			Scaling Parameters	
Age range	Risk Level	Proportion	Symbol	Value
$[18, 20)$	Medium	1.25%	a_1	0.150
$[20, 30)$	High	26.97%	a_2	0.250
$[30, 40)$	Medium	40.66%	a_3	0.150
$[40, 50)$	Low-Medium	21.16%	a_4	0.050
$[50, \infty)$	Low	9.96%	a_5	0.025

S2 Section

S3 Section

S4 Section

Table S2: Complex Table Example

Risk Factor Groups			Scaling Parameters	
Factor Description	Count	Group	Symbol	Value
Anonymous Sex	42	Anonymous Sex	r_1	0.6
Met contact through internet	5			
Bath house	1			
Repeat STI	55	STI	r_2	0.2
Co-Infection with other STI	10			
HIV Status	5			
PrEP for HIV	4			
HIV positive contact	1			
Pregnant	16	Pregnancy Related	r_3	0.0
Tested during first Trimester	4			
Treated $>$ 4 weeks prior to delivery	2			
Received prenatal care	2			
Tested at delivery	1			
Tested at 28-32 Weeks	1			
Tested $>$ 4 weeks prior to delivery	1			
Correctional facility	20	Prison	r_4	0.2
Under-housed/Homeless	28	SES	r_5	0.0
No condom used	55	Sex Behavior	r_6	0.0
More than one sex contacts	22			
Shared sex toys	1			
New sex contact in past 2 months	23			
Sex trade worker	11	Sex Trade	r_7	1.0
Sex with sex trade worker	6			
Sex with same sex	45	Same Sex	r_8	0.6
Injection drug use	38	Substance	r_9	0.3
Inhalation drug use	43			
Judgement impaired by alcohol/drugs	8			
Shared other drug equipment	6			
Sex for drugs/shelter/food	3			
Shared needles	2			
Tattoo and piercing	5	Unknown	r_{10}	0.0
Travel outside province	4			
Other social venue	1			
Unknown	248			
Other	7			