Negative binomial mixture branching process model of transmission: Manuscript outline

Introduction

- Does the mechanistic addition of population structure induce qualitatively different outbreak patterns from a standard negative binomial superspreading model with mean R_0 and dispersion parameter k assuming $R_0 > 1$?
- How does decreasing the level of superspreading by a) changing the population structure e.g., by shifting the contact structure away from opportunistic encounters/aerosol transmission and towards regular contacts/direct contact transmission, and b) decreasing the average number of successful contacts in the superspreading cohort affect heterogeneity in outbreak patterns, and what are the implications for containment?

Model

- Model assumptions and derivation
- probability generating function
- Figure 1: comparison of probability mass functions for standard and mixture models for various values of k
- formulas for mean, variance, CV of number of secondary infections

Probability generating function

- equation for probability of extinction
- meaning of R_0^* when $R_0 > 1$

Chain size distribution

- Derivation
- Figure 2: comparison of chain size distributions for standard and mixture models for various values of k
- mean chain size conditioned on extinction
- variance of chain size conditioned on extinction

Numerical studies (assuming $R_0 > 1$)

- How statistics vary with p, δ and k, keeping R_0 fixed, for the baseline and mixture models (compare the degree of heterogeneity in outbreak patterns)
- Effect of control activities on outbreak patterns: decrease R_0^D, p and δ by factor $1 - c$ and study their effect on variance to mean ratio and probability of extinction (which control activity induces greatest probability of extinction for a given level of control effort below the threshold (assuming the threshold for all activities is the same) and do patterns become more heterogeneous as epidemic control is applied?)

Results

- Figure 3: Coefficient of variation of distribution of secondary infections
- Figure 4: Probability of major outbreak
- Figure 5: Probability of observing a transmission chain of size <= 10
- Figure 6: CV chain size
- Figure 7: Effect of control activities: Control vs. Variance to mean ratio of distribution of secondary infections and control vs. probability of extinction

Discussion