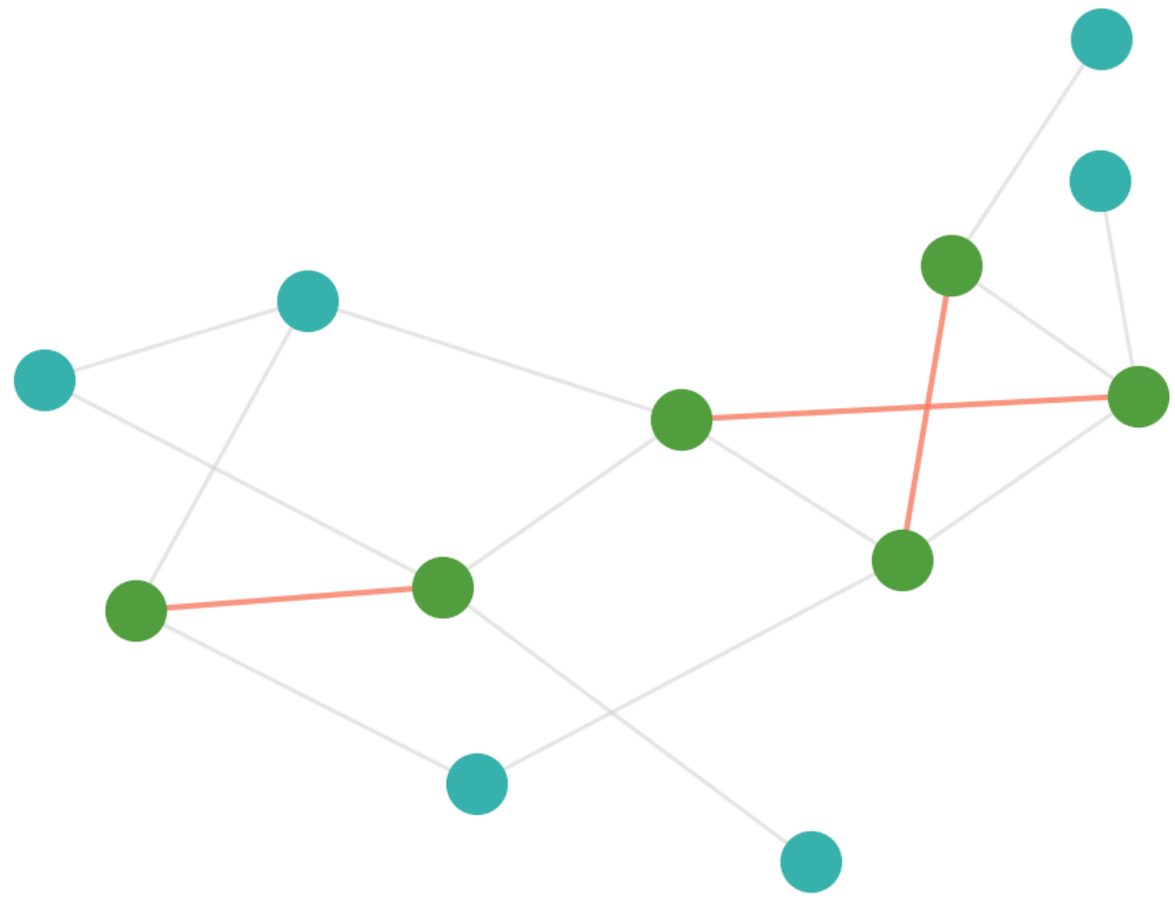

Sensitivity of Epidemic Forecasts with Probability Generating Functions

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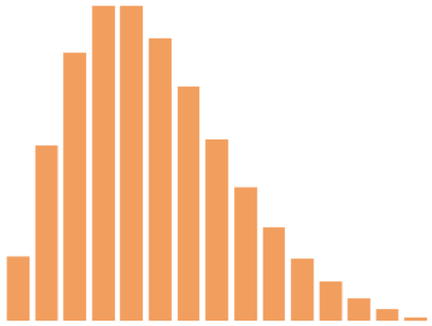
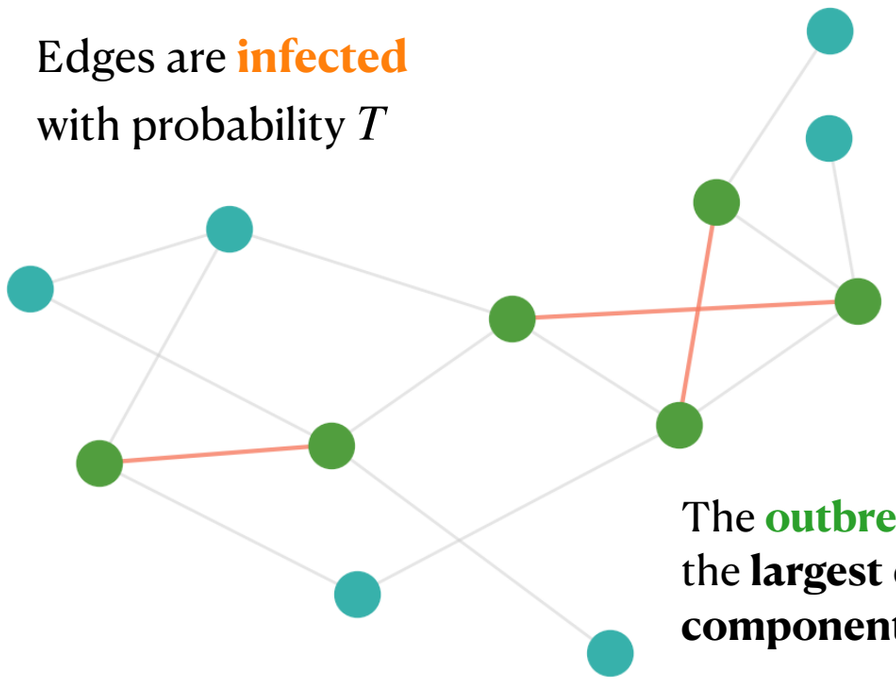
Question:
How sensitive are estimates of contagion **outbreak size** to measurement error?

Contagion as **percolation**



Node degree sampled from a **probability distribution**

Edges are **infected** with probability T



The **outbreak** is the size of the **largest connected component**

We represent the **probability distribution** with a **probability generating function(PGF)**

$$G_0(x) = p_1x^1 + p_2x^2 + p_3x^3 \ldots p_kx^k$$

p_k : probability a randomly chosen node has k neighbors

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$$G_0(x) = p_1 x^1 + p_2 x^2 + p_3 x^3 \ldots p_k x^k$$

Branching Process :

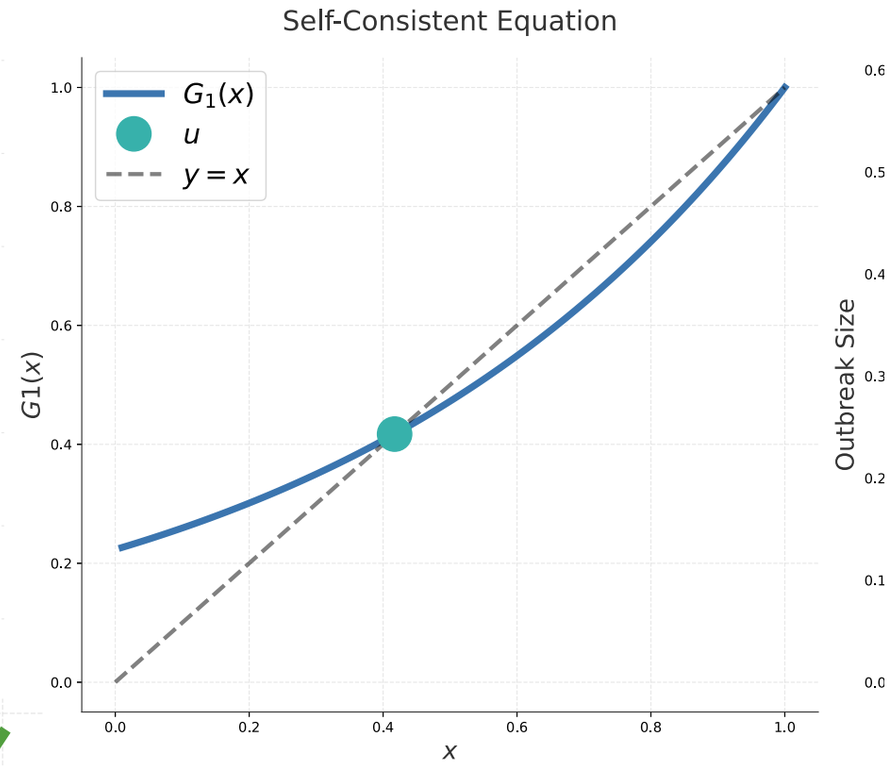
p_k : probability of k infections in next generation

Percolation :

p_k : probability a randomly chosen node has k neighbors

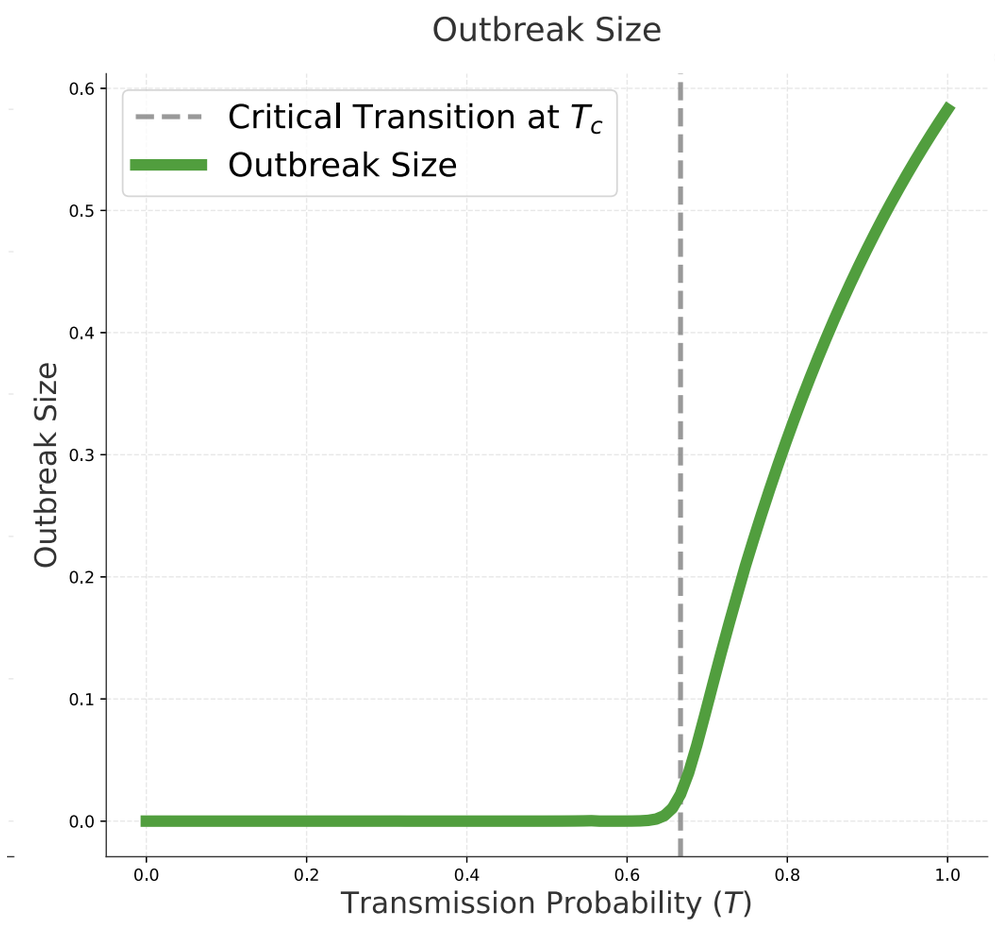
The **average size of an outbreak** is related to the solution to a self consistent equation

$$u = G_1(u)$$



$$\langle s \rangle = 1 - u$$

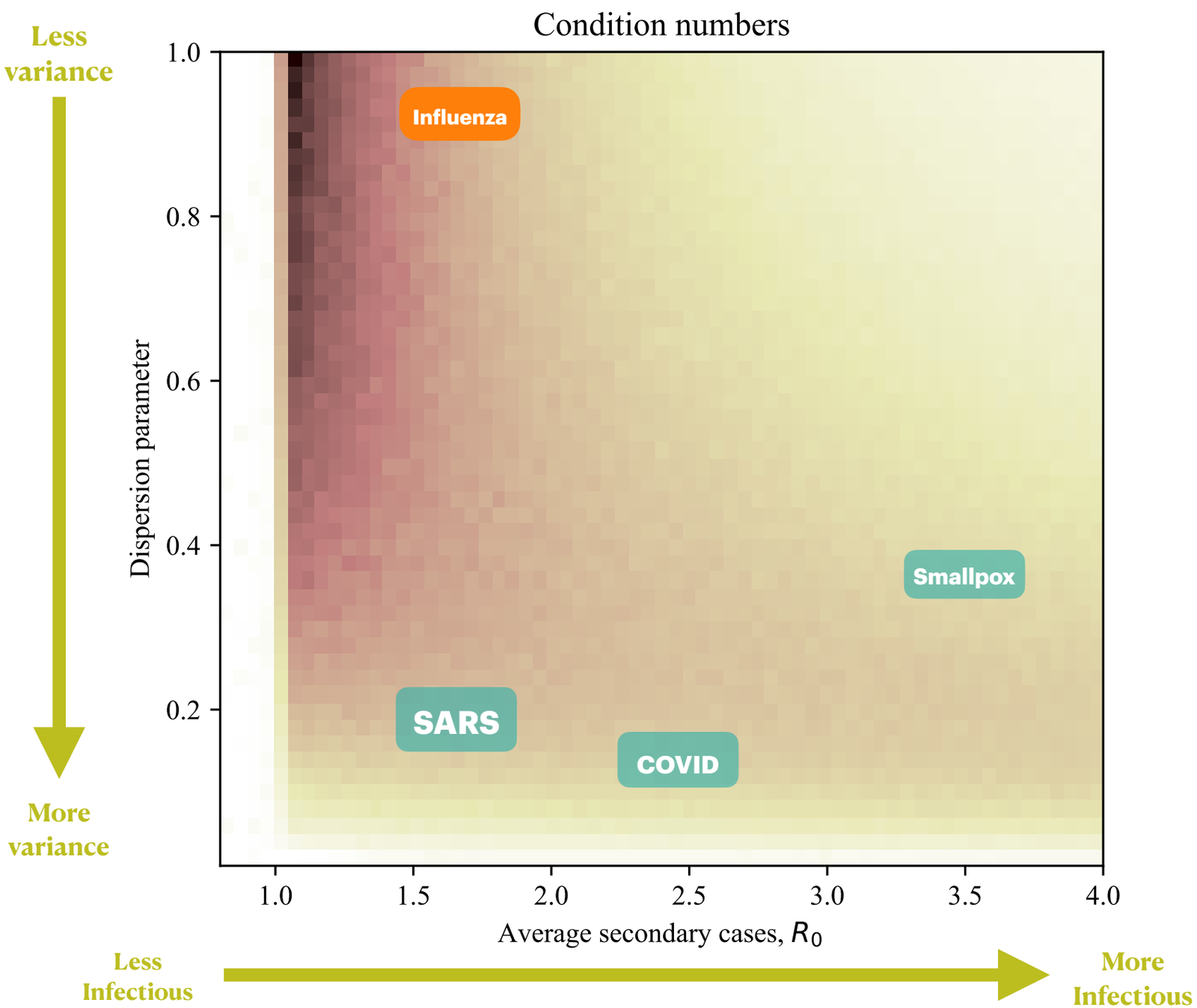
expected outbreak size



Our Method: We calculate the **sensitivity** of the **outbreak size** to **perturbations** in the **degree distribution**

The statistical condition estimate(SCE) is a measures of the sensitivity of the **outbreak size** to **perturbations in distribution**

How do **dynamical parameters** of **real world contagions** effect **sensitivity**

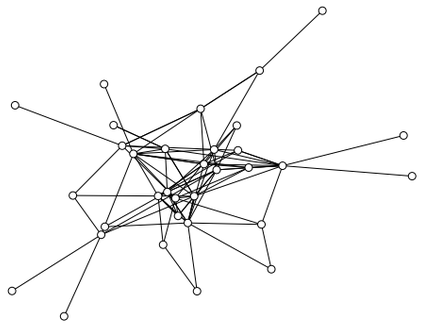


_Contagions with **near critical** R_0 and **high dispersion** like **influenza** are the most sensitive to measurement error

How does **graph structure** effect **sensitivity** ?

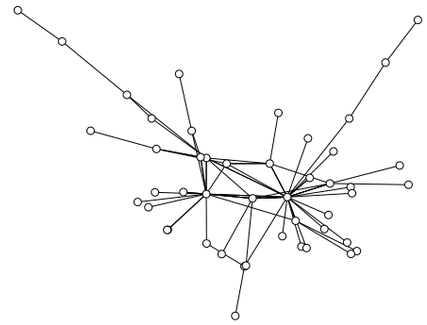
λ: the density of the graph

Erős – Rényi

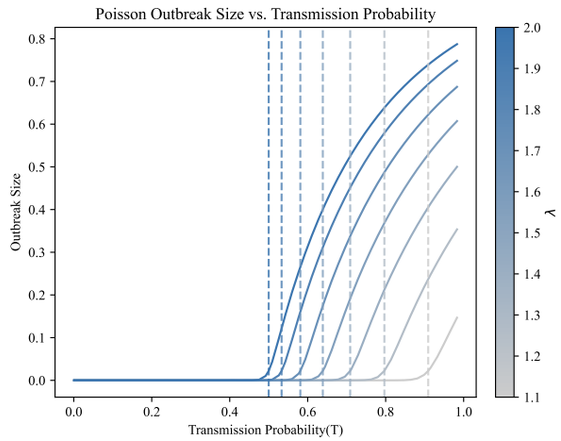


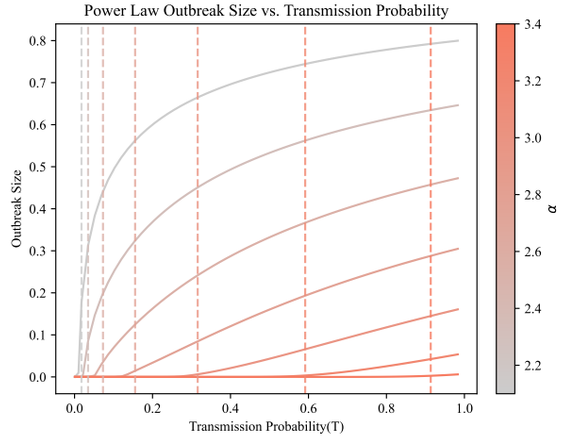
α: the degree heterogeneity of the graph

Power-law CM

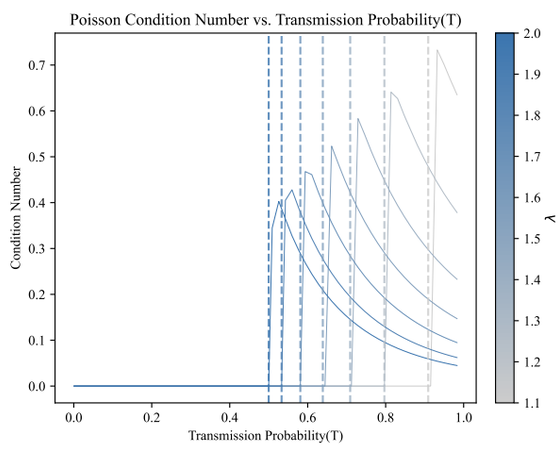


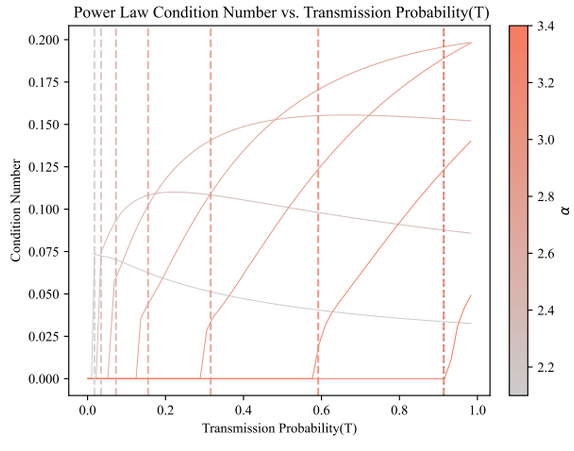
$\langle s \rangle$: Outbreak size





Statistical condition estimate





Sensitivity **jumps at critical transition** regardless of density.

For highly heterogenous graphs sensitivity **increases monotonically** with infection rate.

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