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St Andrews

Learning the Future Spread of an Epidemic

Supervised by Professor Simon Dobson

Simon Buchacher, 25 August 2021

Simulation

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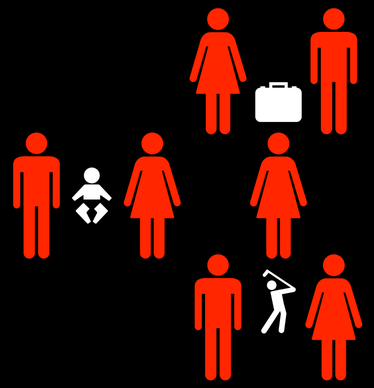
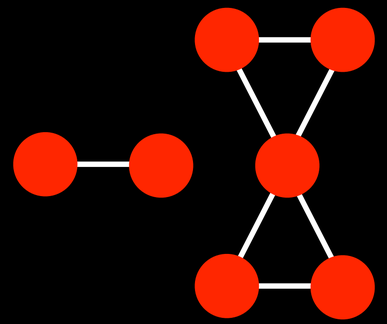
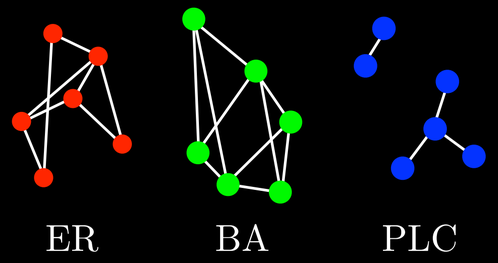


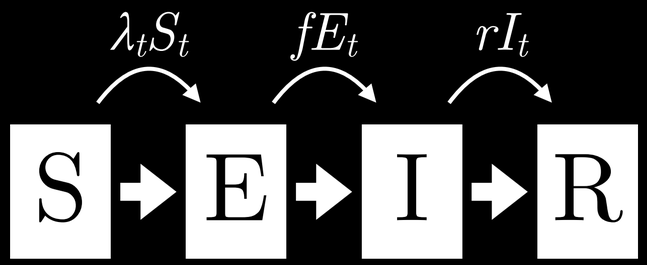
Population



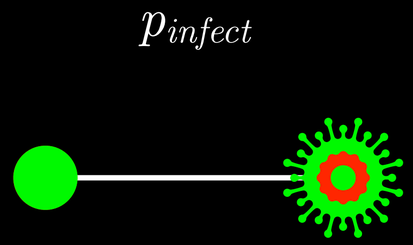
Human Contact Network



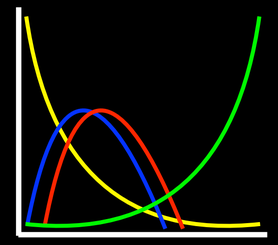
Network Types



Compartmental Model



Network Case



Simulated Epidemic

Dataset

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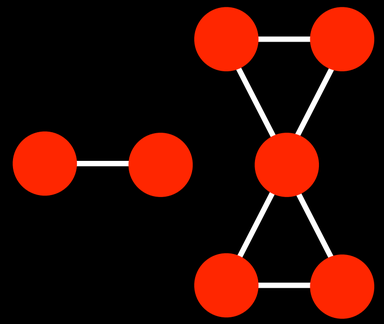
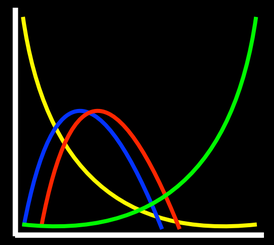


Human Contact Network

Order[1]
Transitivity
Avg. clustering coefficient
Connected components
Connectivity
Assortativity coefficient
Centrality
Density

Network Topological Features



Simulated Epidemic

Peak caseload
Peak caseload time-step

Targets

[1]To be exact, order — or, the number of nodes in the network — is not extracted from the network but is a parameter passed to its generator.

Dataset

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Order	*Transitivity*	*Connected components*	*Avg. clustering coefficient*	*Connectivity*	*Assortativity coefficient*	*Centrality*	*Density*	*Peak caseload*	*Peak caseload time-step*
8802	0.008	1	0.208	TRUE	0.002	9.010	0.008	3444	599
6334	0.011	1	0.491	TRUE	-0.004	1.689	0.011	2839	596
9020	0.003	1	0.393	TRUE	-0.003	2.999	0.003	4333	646
5535	0.015	1	0.394	TRUE	0.003	2.649	0.014	2052	545
...	...	...	...	...	...	...	...	...	...

Machine Learning

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8802	0.008	1	0.208	TRUE	0.002	9.010	0.008	3444	599
6334	0.011	1	0.491	TRUE	-0.004	1.689	0.011	2839	596
9020	0.003	1	0.393	TRUE	-0.003	2.999	0.003	4333	646
5535	0.015	1	0.394	TRUE	0.003	2.649	0.014	2052	545
...	...	...	...	...	...	...	...	...	...

Dataset

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6334	0.011	1	0.491	TRUE	-0.004	1.689	0.011
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...	...	...	...	...	...	...	...

3444	599
2839	596
4333	646
2052	545
...	...

Input and Output

$$Y = f(X, \theta) + \epsilon$$

General Prediction Equation

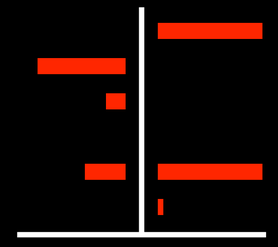
$$\epsilon = Y - f(X, \theta)$$

$$J(\theta) = \frac{1}{2} \sum_{i=1}^{n} (h_\theta(x^{(i)})) - y^{(i)})^2$$

Cost Function Optimisation

Test MSE	R^2
4921.13	-0.04

Model Evaluation



Feature Importance