

Understanding the small world phenomena

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Social Network (Soc 204)
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Princeton University

2/15/17

Logistics:

- ▶ homework
- ▶ go to a precept this week

Questions?

The Quarantine Question: Modern Musings on a Cold Case

Corey Peak, a doctoral student at the Harvard T.H. Chan School of Public Health

Abstract: Quarantine and other movement restrictions are common, and controversial, interventions for controlling emerging infectious disease outbreaks. The West African Ebola epidemic revealed knowledge gaps in the use of quarantine targeted at the scale of both individuals and nations. In this two-part talk, we first use mathematical models to compare the effectiveness of quarantine and symptom monitoring targeted through contact tracing. Second, we use mobile phone data to measure an enormous change in human travel during a national lockdown of Ebola-stricken Sierra Leone. We conclude that modern methods can be used to reassess the value of a bronze-age tool for epidemic control.

Today, 4:30pm in Guyot 100.

Vote:

1. Watts, Chapter 3.
2. Watts, D.J. and Strogatz, S.H. (1998). Collective dynamics of 'small-world' networks. *Nature*.
3. Victor, B. (2011). Scientific Communication As Sequential Art.
4. Watts, D.J. (1999). Networks, dynamics, and the small world phenomenon. *American Journal of Sociology*.

Review:

- ▶ empirical vs modeling approaches

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- ▶ empirical approach runs into difficulties

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Today we will see a different network model

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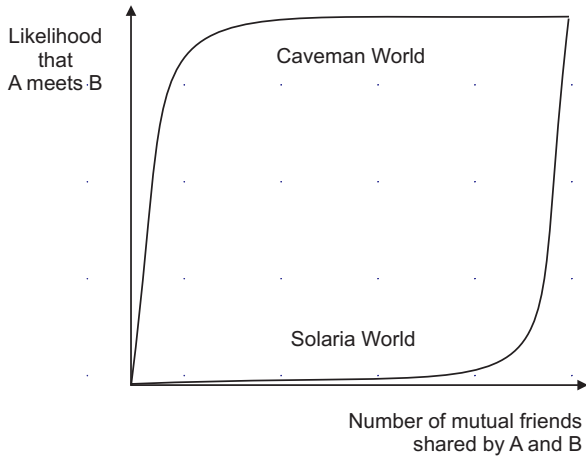
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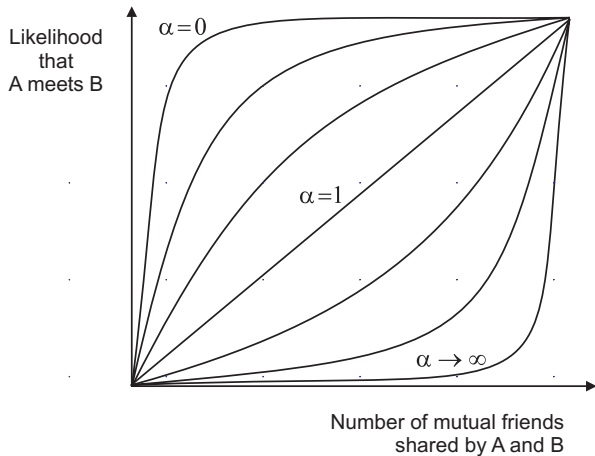
Duncan says that they wanted to capture four main ideas:

- ▶ small overlapping groups that are linked by people who belong to multiple groups
- ▶ social network evolve
- ▶ not all relationships are equally likely
- ▶ occasionally we do things that are not determined by existing network structure

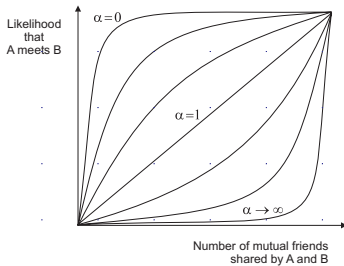
3.1



3.2



3.2



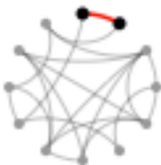
As technology changes do you think we are moving more toward:

1. caveman world ($\alpha = 0$)
2. solaria world ($\alpha \rightarrow \infty$)

First metric:

Characteristic path length L : number of edges in shortest path, averaged over all paths

L is defined as the number of edges in the shortest path between two vertices



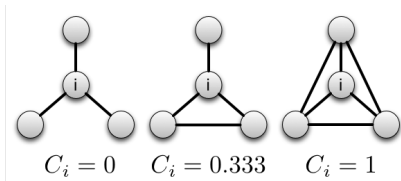
*shortest path
is 1 edge*



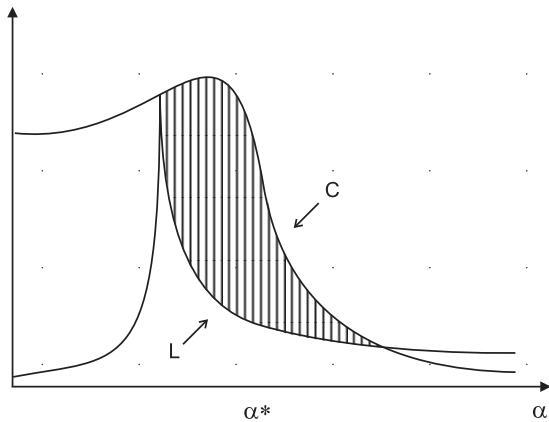
*shortest path
is 3 edges*

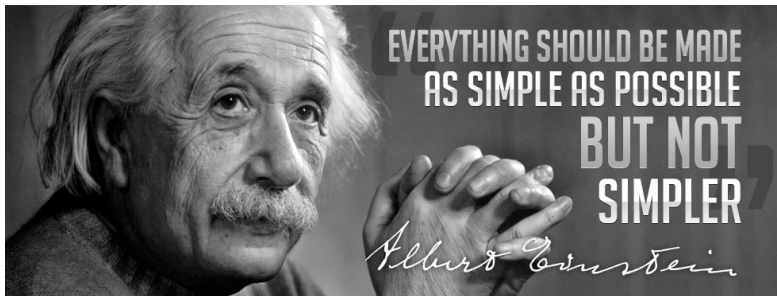
Second metric:

Clustering coefficient C : probability that a two friends of a randomly chosen person are friends



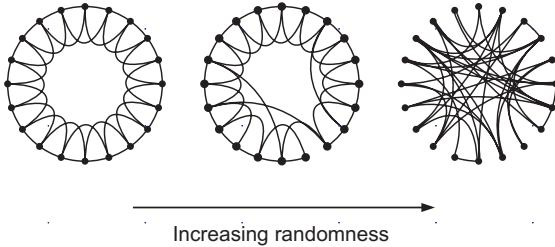
3.4



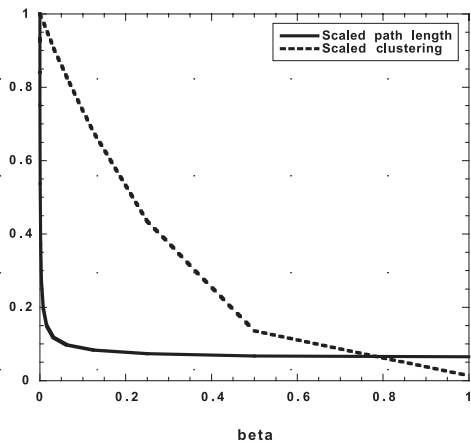


<http://vireomd.net/blog/dhc/einstein-kiss.html>

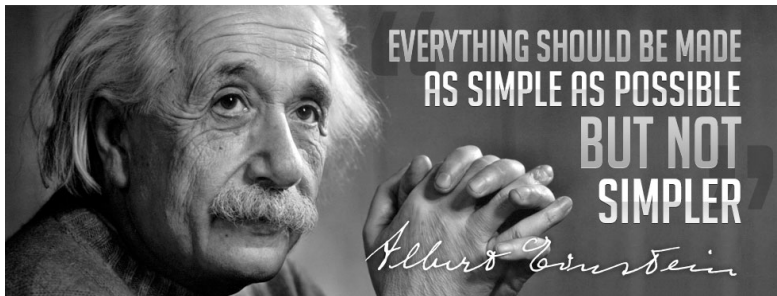
3.6



3.7



http://mathinsight.org/small_world_network



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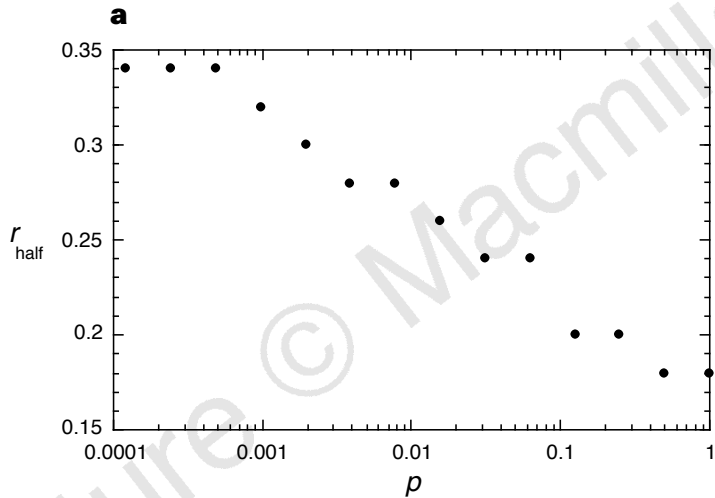
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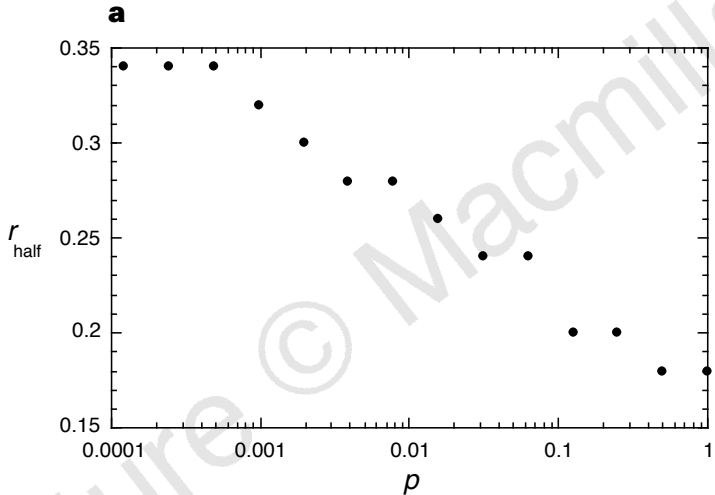
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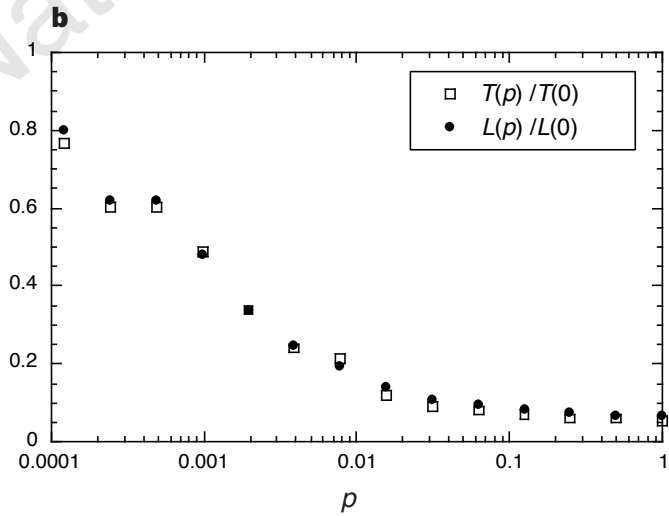
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Movie actors	3.65	2.99	0.79	0.00027
Power Grid	18.7	12.4	0.080	0.005
C. Elegans	2.65	2.25	0.28	0.05

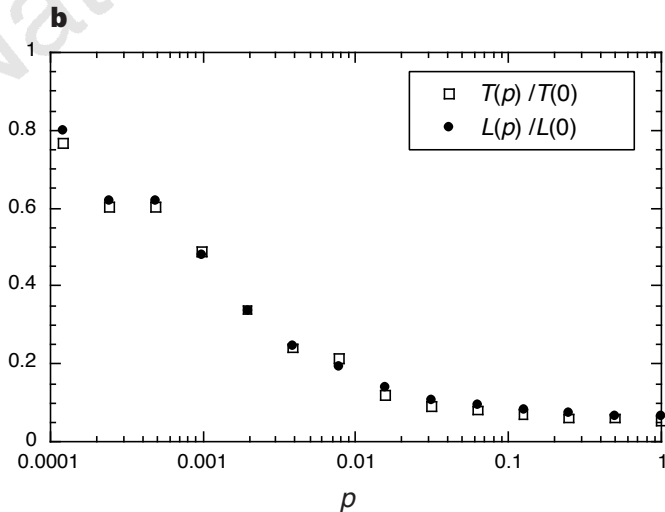
Who cares?





The more shortcuts the less infectious (r) a disease needs to be to spread





The more shortcuts the faster a disease spreads

Making length contractions concrete

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- ▶ small local changes can have global impacts
- ▶ similarity across networks of different types
- ▶ network structure impacts dynamics

Precept this week

Monday:

- ▶ Watts, Chapter 4, 101-114.
- ▶ Barabasi, A.L. and Bonabeau, E. (2003) Scale-free networks. Scientific American, 50-59. (Available from blackboard)
- ▶ Barabasi, A.L. and Albert, R. (1999) The emergence of scaling in random networks. Science, 286:509-512.
- ▶ Barabasi-Albert random graph animation by Eytan Bakshy and Lada Adamic. (optional)
- ▶ Liljeros, F. et al. (2001). The web of human sexual contacts. Nature, 411:907-908 with comment and rejoinder.

<http://bit.ly/socnet204>