Social Media Analytics

Homophily vs. Social Influence

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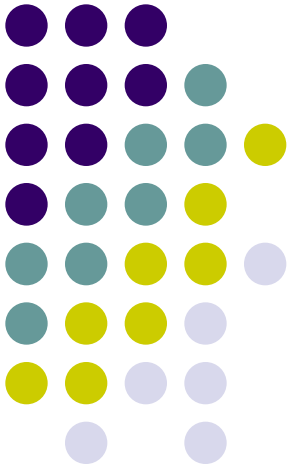
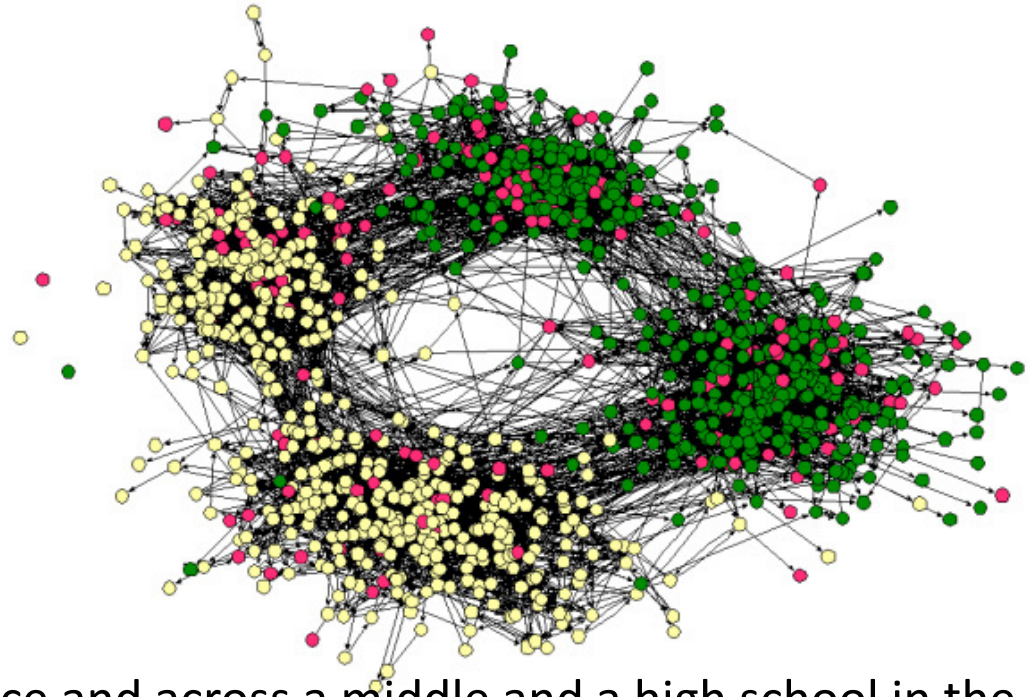


Homophily (Similarity)

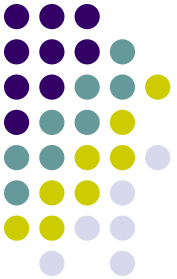
- "Birds of a feather flock together"
  - Your friends/contacts vs. a random sample of people
  - Social networks tend to connect people who are similar to each other



Friendships by race and across a middle and a high school in the same school district

Source: Easley & Kleinberg

Distinguishing Between Social Influence and Homophily

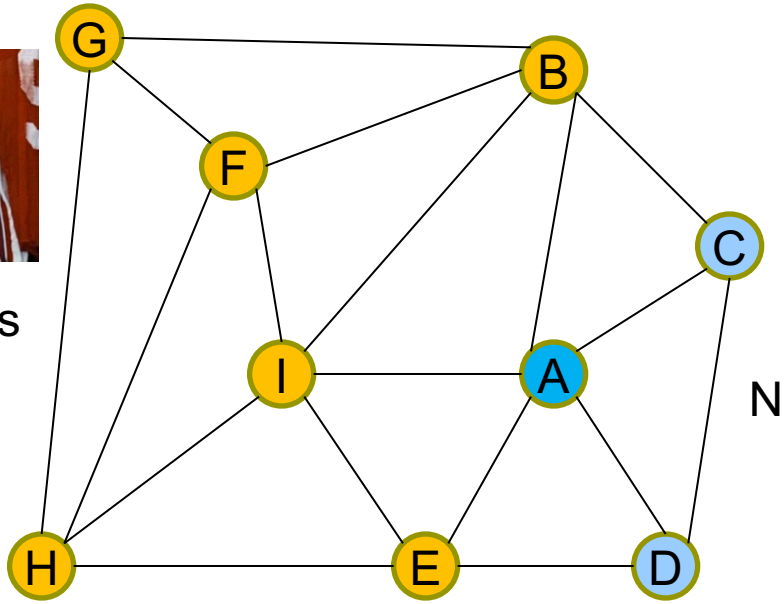


- Can opinions, attitudes & purchases be attributed to social influence?
- Or is it due to homophily?
- E.g., did I buy something because
  - you influenced me?
  - we are just similar?
- What difference would it make to a company's strategy?

Detecting Homophily for Static Attributes

- Have to know what attribute(s) may be relevant
- E.g., gender, interest, educational background, etc.

Jocks



Nerds

- Does this network exhibit homophily?
- What measure can we use?

Source: Easley & Kleinberg

A Little Theoretical Detour

A network with a set of nodes (V) & randomly assigned edges (E^r):

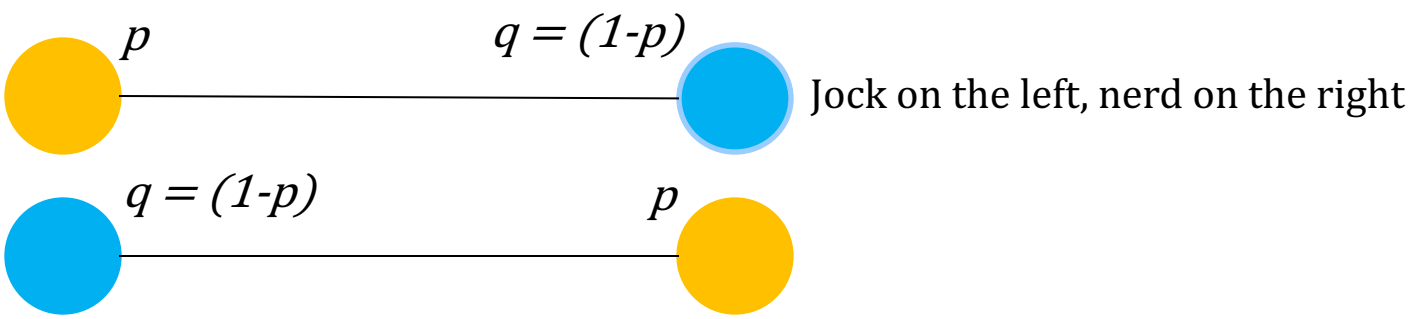
$$R = (V, E^r)$$

Each node is assigned an attribute: say, type = jock with probability p, and type = nerd with probability $q = 1\text{-}p$

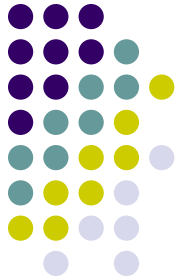
Consider any edge $(i,j) \in E^r$ of this random network R.

Let the random variable $X_{ij} = 1$ if it is a "cross-edge", and $X_{ij} = 0$ otherwise. Then X_{ij} is a Bernoulli random variable such that

$P(X_{ij} = 1) = 2pq$



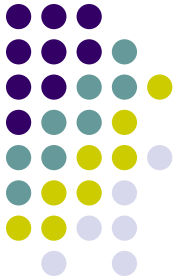
Dynamic Attributes: How Can We Distinguish Between Homophily & Influence?



- Need multiple snapshots in time
- Homophily: Due to **similar** attributes in time *t*, some people may choose to become friends in *t*+1
  - E.g., high achievers in a class may form links
- But some people may become friends in *t*+1 even though their attributes were different in *t*
- Check which effect is stronger

Source: LaFond & Neville

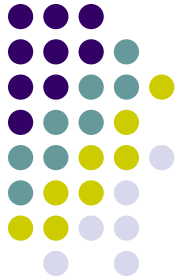
Test for Homophily



- Homophily exists if
- *p*(Becoming friends in *t*+1 where attributes were same in *t*) > *p*(Becoming friends in *t*+1 where attributes were different in *t*)
- *p*(Dissolving friendships in *t*+1 where attributes were same in t) < *p*(Dissolving friendships in *t*+1 where attributes were different in *t*)

Source: LaFond & Neville

Detecting Social Influence



- Some **friends** at *t* with different attributes may become similar in *t*+1 (due to social influence)
  - E.g., some buy a product their friends have
  - Some change their beliefs & attitudes
- But people who are not friends and have different attributes at *t* can also become similar at *t*+1 due to "other" factors
- Which effect is stronger?
  - I.e., is *p*(Attributes becoming same in *t*+1 where the individuals were friends in *t*) > *p*(Attributes becoming same in *t*+1 where the individuals were not friends in *t*)?
  - Is *p*(Attributes becoming different in *t*+1 where the individuals were friends in *t*) < *p*(Attributes becoming different in *t*+1 where the individuals were not friends in *t*)?

Source: LaFond & Neville

Distinguishing Between Homophily & Social Influence: The Case of Dynamic Attributes

Time: *t* *t*+1

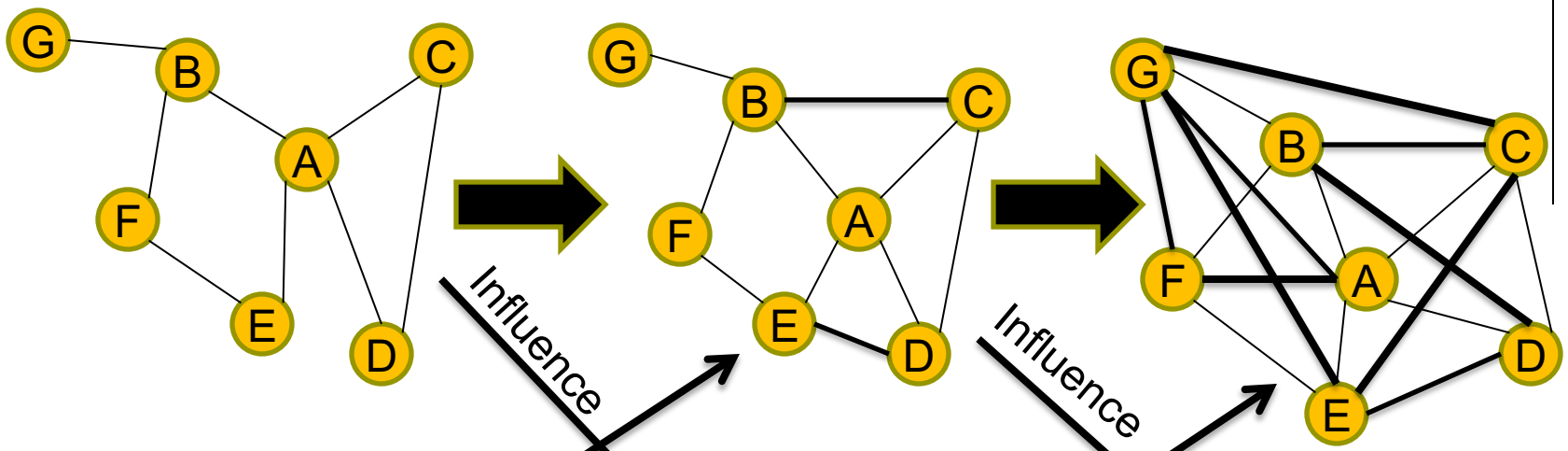
	Subscription
A	Yes
B	No
C	No
D	Yes
E	No
F	Yes
G	Yes

Attribute (e.g., subscription to a music service at time *t*

A	Yes
B	Yes
C	Yes
D	Yes
E	No
F	Yes
G	Yes

Attribute at time t+1

Evidence of Homophily Versus Social Influence



Time: *t*

t+1

t+2

Influence

Homophily

Influence

Homophily

A	Yes
B	No
C	No
D	Yes
E	No
F	Yes
G	Yes

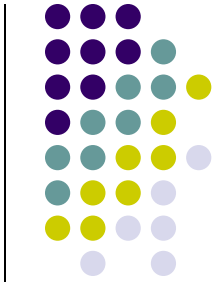
Attribute at time *t*

A	Yes
B	Yes
C	Yes
D	Yes
E	No
F	Yes
G	Yes

Attribute at time *t*+1

Attribute at time *t*+2

Testing Significance Levels



X^i is an atttribute of node v_i

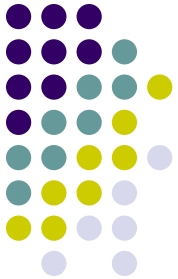
P_R is a set of related nodes (friends) in a network

	$X^i = X^j = x$	$\neg (X^i = X^j = x)$
$(v_i, v_j) \in P_R$	a	b
$(v_i, v_j) \notin P_R$	c	d

$$Relational\ autocorrelation\ C(X,G) = \chi^2 = \frac{N.(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)}$$

Source: LaFond & Neville

Chi-Square (for Contingency Tables)



	Improved Outcome	Didn't improve	Total
Treatment	36	14	50
No Treatment	30	25	55
Total	66	39	105

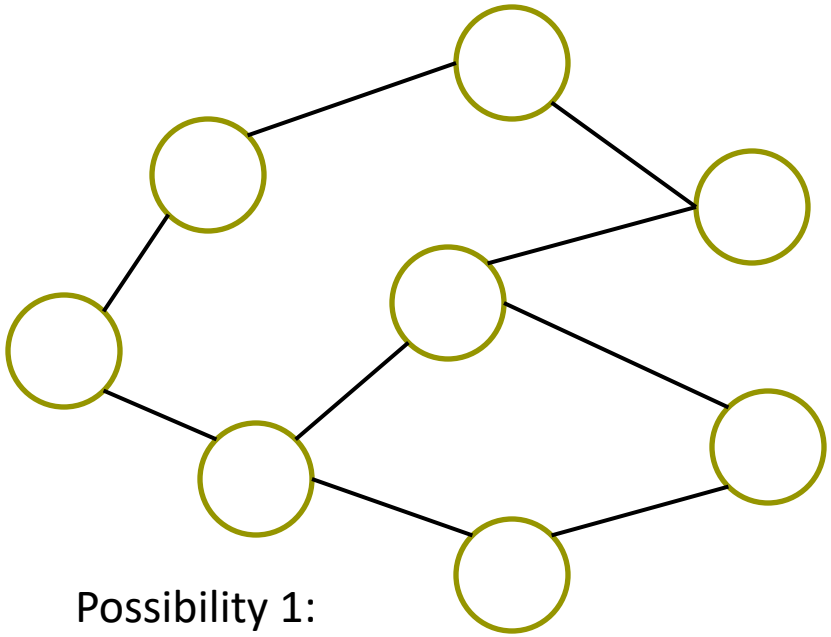
$$\chi^2 = ?$$

$$\chi^2 = \frac{105*(36*25-30*14)^2}{50*55*66*39} = 3.42$$

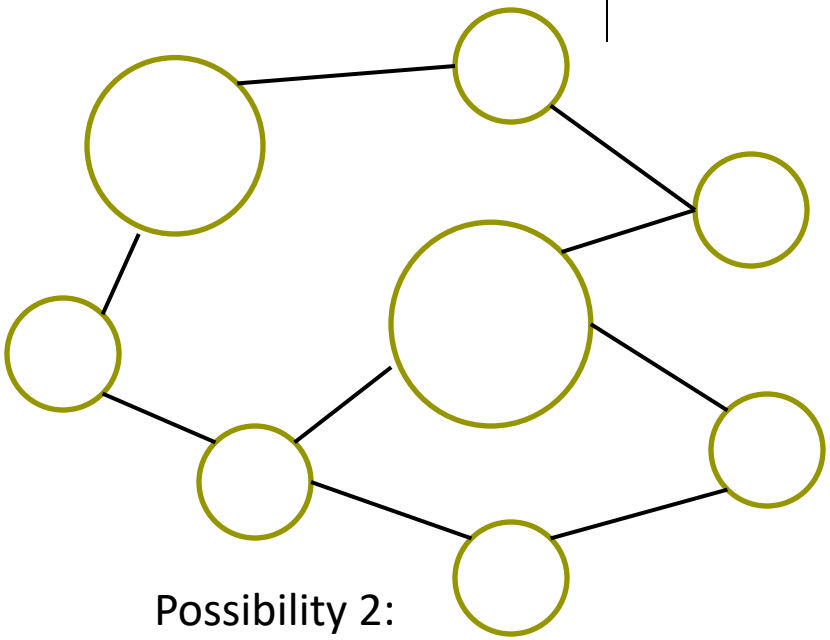
Significance Tests

- Homophily: $C(X_t, G_{t+1}) > C(X_t, G_t)$
- Social influence: $C(X_{t+1}, G_t) > C(X_t, G_t)$

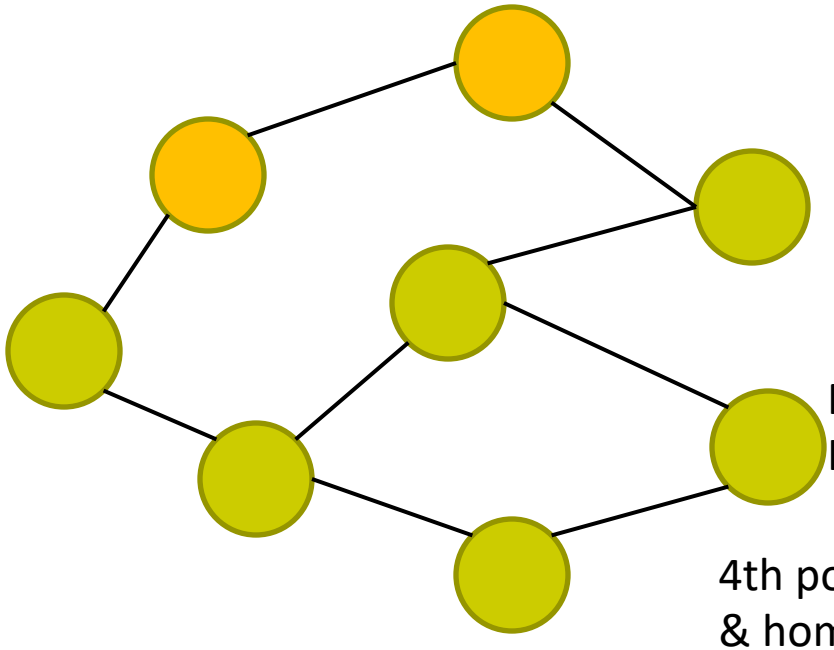
Not all Networks are Created Equal



Possibility 1:
No social influence, no homophily



Possibility 2:
Social influence but no homophily



Possibility 3:
Homophily but no social influence

4th possibility (not shown): Both influence & homophily