Slide 1

Working with Missing Data

Steve Borgatti

LINKS Center Workshop on Social Network Analysis

Slide 2

The problem:

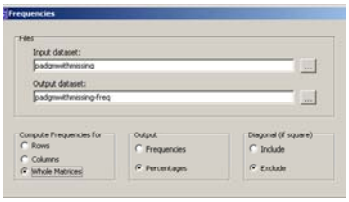
- Some respondents did not participate in the survey, leaving blank rows in the network data matrix
- Important note: if you enter data as edgelist or nodelist using dl file, missing values are automatically converted to zeros.
  - How would you convert them back?

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		A	A	B	B	C	G	G	L	M	P	P	P	R	S	S	T
1	ACCIAIUOL	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2	ALBIZZI	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
3	BARBADORI	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
4	BISCHERI																
5	CASTELLAN	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
6	GINORI	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	GUADAGNI	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1
8	LAMBERTES	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
9	MEDICI	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1
10	PAZZI																
11	PERUZZI	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0
12	PUCCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	RIDOLFI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
14	SALVIATI	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
15	STROZZI	0	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0
16	TORNABUON	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0

Slide 3

Size of the problem

- Counting the number of missing values with Tools | Freq.
  - Select “matrices”



Output: 1

0.000	0.725
1.000	0.150
blank	0.125

		1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
		A A B C G G L M P P R S S T
1	ACCIAIUOL	0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0
2	ALBIZZI	0 0 0 0 0 1 1 0 1 0 0 0 0 0 0 0
3	BARBADORI	0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0
4	BISCHERI	
5	CASTELLAN	0 0 1 0 0 0 0 0 0 0 1 0 0 0 1 0
6	GINORI	0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
7	GUADAGNI	0 1 0 1 0 0 0 1 0 0 0 0 0 0 0 1
8	LAMBERTES	0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0
9	MEDICI	1 1 1 0 0 0 0 0 0 0 0 0 1 1 0 1
10	PAZZI	
11	PERUZZI	0 0 0 1 1 0 0 0 0 0 0 0 0 0 1 0
12	PUCCI	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
13	RIDOLFI	0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 1
14	SALVIATI	0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0
15	STROZZI	0 0 0 1 1 0 0 0 0 0 1 0 1 0 0 0
16	TORNABUON	0 0 0 0 0 0 1 0 1 0 0 0 1 0 0 0

Slide 4

Standard Solutions

- Convert missings to zeros (since you did NOT observe a tie)
  - Re-run having converted missings to ones, to see how different the results could be
- Convert missings to zeros and ones at random, using density of the matrix as guide
- Impute the missing values using other information
  - Symmetricity
  - QAP regression

Slide 5

One solution

- Suppose the data are largely symmetric, and the social relation is logically symmetric
  - Marriage to
  - Saw movie with
- Then we can impute the missing data from the transpose of the matrix
  - i.e., assume that if A says B is a friend, then if B had participated, s/he would have said A was a a friend too
  - So, fill in missing row with the corresponding column

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		A	A	B	B	C	G	G	L	M	P	P	P	R	S	S	T
1	ACCIAIUOL	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2	ALBIZZI	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
3	BARBADORI	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
4	BISCHERI																
5	CASTELLAN	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
6	GINORI	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	GUADAGNI	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1
8	LAMBERTES	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
9	MEDICI	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1
10	PAZZI																
11	PERUZZI	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0
12	PUCCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	RIDOLFI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
14	SALVIATI	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
15	STROZZI	0	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0
16	TORNABUON	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0

Slide 6

Doing it …

- In matrix algebra, you can do it with the REPLACENA command:
  - newdata = replacena(olddata transp(olddata))
- Syntax
  - > <newds> = replacena(<ds1> <ds2>)
  - Where ds1 is the dataset that contains missing values and ds2 is the dataset from which to draw the correct values

Slide 7

What if the relation is not symmetric?

- If the network with missing data is directed (i.e., not necessarily symmetric), we cant do this trick.
  - E.g., you have asked "who do you get advice from"
- Unless …
  - Suppose you have asked both "who do you get advice from" and "who gets advice from you"
  - We can use one to fill in data for the other

Slide 8

Example (without missing data)

Give Info To

	A	B	C	D
A	0	1	0	1
B	1	0	1	0
C	0	1	0	1
D	0	1	0	1

Should be the same

So if a row is missing in GiveInfo, we should be able to fill in from row in transpose of GetInfo

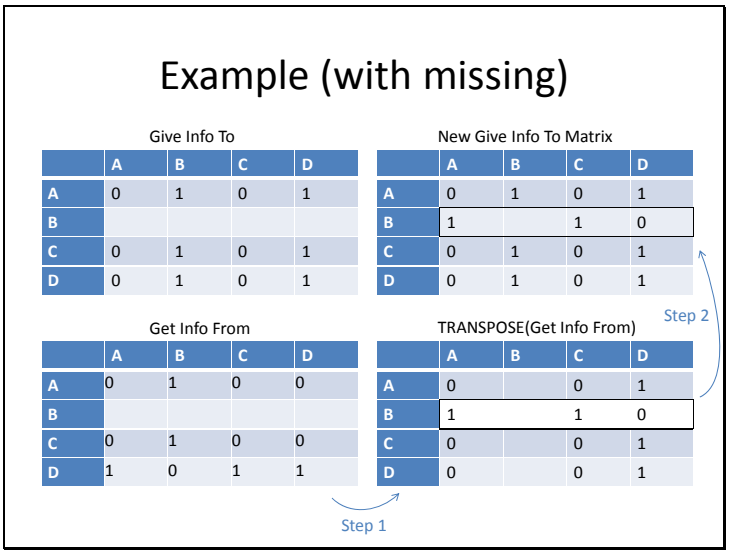
Get Info From

	A	B	C	D
A	0	1	0	0
B	1	0	1	1
C	0	1	0	0
D	1	0	1	1

TRANSPOSE(Get Info From)

	A	B	C	D
A	0	1	0	1
B	1	0	1	0
C	0	1	0	1
D	0	1	0	1

Slide 9



	A	B	C	D
A	0	1	0	1
B				
C	0	1	0	1
D	0	1	0	1

	A	B	C	D
A	0	1	0	1
B	1		1	0
C	0	1	0	1
D	0	1	0	1

	A	B	C	D
A	0	1	0	0
B				
C	0	1	0	0
D	1	0	1	1

	A	B	C	D
A	0		0	1
B	1		1	0
C	0		0	1
D	0		0	1

Slide 10

Do it in UCINET using "REPLACENA"

(in tools|matrix algebra)

- Example
  - > InfoTo = replacena(giveinfo transp(getinfo))
  - > friends = replacena(rawfriends transp(rawfriends))
- Syntax
  - > <newds> = replacena(<ds1> <ds2>)
  - Where ds1 is the dataset that contains missing values and ds2 is the dataset from which to draw the correct values