Network Analysis Using R

A pre-conference workshop for 2016 NAOC Meeting, Washington, D.C.

Date/Time: August 16, 2016, 8am - 4pm

Location: Georgetown West Room, Washington Hilton

Instructors:

- **Daizaburo Shizuka, University of Nebraska-Lincoln (dshizuka2@unl.edu)**
- **Elizabeth A. Hobson, Santa Fe Institute (ehobson@santafe.edu)**

Text: Shizuka, D. *Introduction to Network Analysis in R: A Handbook* (Distributed digitally to participants)

Materials to bring (see directions on next page):

- Laptop computer with:
  - R
  - RStudio (optional)
- Install required packages
- Download sample data ahead of time (in case of internet failure)
- PDF of text (not necessary to print)

Learning Objectives:

- Overview of networks and network theory
- Practice codes for creating networks from data, making measurements
- Address common questions & pitfalls of network analysis
- Use worked examples based on real studies and real data to learn analysis techniques

General Timeline (subject to change):

- 8:00-8:30 Brief intro to networks
- 8:30-10:00 Working with igraph, Discussion on different types of networks
- 10:00-11:00 Measuring networks, Discussion on potential pitfalls
- 11:00-Noon Worked example
- Noon-1:00 Lunch Break (not organized)
- 1:00-1:30 Brief intro to statistical analyses
- 1:30-4:00 Worked examples and discussions

Preparing for the Workshop:

1. Bring a laptop & cords for charging. There should be providing extra power strips, but be prepared in case there aren't enough to go around all the time. We might have to share and take turns charging computers.

2. Have R installed. You can also have RStudio installed, but this is optional. If you are not very familiar with R, it may make it easier to follow along, since we will be doing demos on RStudio. You can download RStudio Desktop here: https://www.rstudio.com/products/rstudio/

3. Install the required packages. We will be using various R packages for worked examples, and it will go more smoothly if everyone has them installed ahead of time. The easiest way is to copy-paste and run this command in R on your computer before the workshop:

```
install.packages(c('igraph', 'bipartite', 'asnipe', 'assortnet', 'popgraph', 'ggplot2',
'ggmap', 'rnetcarto', 'ecodist', 'igraphdata', 'statnet', 'RColorBrewer'))
```

4. Download the sample data. This url will automatically start download of some sample data we will use for demos: **https://dshizuka.github.io/NAOC2016/NAOCworkshop_SampleData.zip**

If you have them downloaded and saved on your computer ahead of time, we will able to use them even if the internet fails at the workshop.

5. Download the Handbook. This handbook will act as our textbook for the workshop. It has sample codes, overview of some methods and worked examples. This handbook supplies much more information than we will be able to cover in the workshop, and we will not be following it along very strictly. The purpose of the handbook is for the participants to have something to take home and work through so that they can retain this information. Download it here:

https://dshizuka.github.io/NAOC2016/NAOC_Network_handbook.pdf

*Note: This handbook has not been peer reviewed or vetted. It may contain some errors.

6. Suggested Readings (optional): We will go through several worked examples based on real studies with real data. These worked examples are in the handbook. You may get more out of these exercises if you have skimmed the papers that the examples are based on. We will not get through all of the worked examples in the handbook. You can download these papers here:

https://dshizuka.github.io/NAOC2016/NetworkWorkshop_pdfs.zip

The list of papers:

- Guimerà, R., Mossa, S., Turtschi, A., & Amaral, L. N. (2005). The worldwide air transportation network: Anomalous centrality, community structure, and cities' global roles. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(22), 7794–7799.
- Burkle, L. A., Marlin, J. C., & Knight, T. M. (2013). Plant-pollinator interactions over 120 years: loss of species, co-occurrence, and function. *Science*.

- Shizuka, D., Chaine, A. S., Anderson, J., Johnson, O., Laursen, I. M., & Lyon, B. E. (2014). Across-year social stability shapes network structure in wintering migrant sparrows. *Ecology Letters*, *17*(8), 998–1007.
- Firth, J. A., & Sheldon, B. C. (2015). Experimental manipulation of avian social structure reveals segregation is carried over across contexts. *Proceedings of the Royal Society B-Biological Sciences*, *282*(1802), 20142350–20142350.
- Franz, M., & Nunn, C. L. (2009). Network-based diffusion analysis: a new method for detecting social learning. *Proc Biol Sci*, *276*(1663), 1829–1836.
- Allen, J., Weinrich, M., Hoppitt, W., & Rendell, L. (2013). Network-based diffusion analysis reveals cultural transmission of lobtail feeding in humpback whales. Multiple Values Selected, 340(6131), 485–488.