

# GESIS Fall Seminar in Computational Social Science 2022

## Syllabus for week 3: “Network Analysis in R”

Lecturers:	Dr. David Schoch	Dr. Termeh Shafie
Affiliation:	Department for Computational Social Science, GESIS Cologne	Department for Computational Social Science, GESIS Cologne
Email:	david.schoch@gesis.org	termeh.shafie@gesis.org

Date: September 19-23, 2022

Time: 09:00-16:00

### About the Lecturers

David Schoch is the team lead for “Transparent Social Analytics” in the Department for Computational Social Science. He holds a PhD in Computer Science and has more than a decade of experience in social network analysis, both in empirical and methodological work. David has (co)-organized several workshops and summer schools on SNA and is very experienced with the R ecosystem. He has (co)-authored 14 packages that cover a large variety of network analytic tasks and have been downloaded more than 1 million times. His main expertise lies in network visualizations and evaluating the importance of actors in networks using measures of centrality.

Termeh Shafie is a Senior Researcher for the team "Digital Society Observatory" in the Department for Computational Social Science at GESIS in Cologne. Termeh has a PhD in Statistics from Stockholm University and her research is mainly focused on method and model development for analyzing social networks. Before joining GESIS, Termeh was a lecturer in Social Statistics at the University of Manchester and affiliated with the "Mitchell Centre for Social Network Analysis". She has also worked as a postdoctoral researcher at the Chair of Social Networks, ETH Zürich, and the Department of Computer and Information Science, University of Konstanz.

### Course Description

The course provides an introduction to social network analysis, covering concepts, methods, and data analysis techniques. The focus lies on practical aspects and how to conduct social network research within the statistical programming language R. Theories are not discussed in great detail, but the material is provided for participants to read up on.

Topics covered in this course include the examination of structural properties of the network (e.g. density, homophily, transitivity), identifying key actors via centrality measures, and detecting communities. Besides the analysis, we will also discuss different visualization techniques for networks that can enhance the interpretability of structural features of the network. More advanced topics include a short introduction to statistical modeling tools such as exponential random graph models.

The course is divided into two 3-hour slots, where the first slot is an interactive lecture that gives some theoretical background and relevant functions and packages from the R ecosystem.

These are exemplified by empirical examples from the social sciences and related fields. The second part will be used to work through a worksheet with room for exploring individual interests and research questions, related to the topic of the day. Participants are thus welcome to bring their own research data and questions which can be explored during the interactive part of the course.

### Keywords

social network analysis; network visualization; R

## Course Prerequisites

- Basic knowledge of R and RStudio. Participants without prior experience in R should consider taking these courses: [R 101](#) (workshop) and [Introduction to CSS with R](#) (week 1).
- Basic knowledge of quantitative research methods

## Target Group

Participants will find the course useful if:

- they wish to use SNA in their research and need an overview of existing methodology
- they have some experience using SNA software (e.g. pajek or visone) but want to transition to R

## Course and Learning Objectives

By the end of the course participants will:

- have acquired a broad skill set to read, analyze and visualize network data in R
- understand the ecosystem of R packages around SNA
- know where to get help and find additional resources for SNA in R

## Organizational Structure of the Course

The course is structured around three hours of classroom introduction and three hours of hands-on lab sessions. During the lab sessions, participants will work through a lab sheet and can explore their own ideas with a range of provided data. Lecturers will also be available for individual consultations on participants' projects and to support work on assignments during the lab session.

## Software and Hardware Requirements

Participants should bring their own laptops and pre-install the following software:

- R and RStudio, including the following packages: igraph, network, sna, graphlayouts, ggraph, backbone, ergm, netrankr.
- Please also download and install one package from GitHub via:  
`devtools::install_github("schochastics/networkdata")`

## Recommended Literature to look at in advance

Borgatti, S.P., Everett, M.G., Johnson, J.C. (2017). *Analyzing Social Networks*. Sage.

Hanneman, R.A., Riddle. M. (2005). *Introduction to Social Network Methods*. Riverside, CA:  
University of California, Riverside

Lusher, D., Koskinen, J., Robins, G. (2013). *Exponential Random Graph Models for Social Networks: Theory, Methods and Applications*. Cambridge University Press.

Robins, G. (2015). *Doing Social Networks Research: Network Research Design for Social Scientists*. Sage.

## Day-to-day Schedule

### Day 1: Introduction

- Introduction to Social Network Analysis and the R ecosystem for Networks

### Day 2: Fundamental Network Concepts and their Application

- Descriptive Statistics
- Centrality
- Cohesive Subgroups

**Day 3: Network Visualizations**

- Introduction to various R packages for plotting networks
- Grammar of Graphics for networks
- Interactive/Dynamic Visualizations

**Day 4: Beyond simple networks**

- Two Mode Networks
- Signed Networks
- Multilevel Networks

**Day 5: Statistical Modelling of Networks**

- Parametric and non-parametric Methods
- Exponential Random Graph Models (ERGMs)
- Stochastic Actor Oriented Models (SAOMs)