

Contents

1	Introducing Network Analysis in R	1
1.1	What Are Networks?	1
1.2	What Is Network Analysis?	3
1.3	Five Good Reasons to Do Network Analysis in R	4
1.3.1	Scope of R	4
1.3.2	Free and Open Nature of R	5
1.3.3	Data and Project Management Capabilities of R	5
1.3.4	Breadth of Network Packages in R	6
1.3.5	Strength of Network Modeling in R	6
1.4	Scope of Book and Resources	6
1.4.1	Scope	6
1.4.2	Book Roadmap	7
1.4.3	Resources	8

Part I Network Analysis Fundamentals

2	The Network Analysis ‘Five-Number Summary’	11
2.1	Network Analysis in R: Where to Start	11
2.2	Preparation	11
2.3	Simple Visualization	12
2.4	Basic Description	12
2.4.1	Size	12
2.4.2	Density	14
2.4.3	Components	15
2.4.4	Diameter	15
2.5	Clustering Coefficient	16
3	Network Data Management in R	17
3.1	Network Data Concepts	17
3.1.1	Network Data Structures	17
3.1.2	Information Stored in Network Objects	20

3.2	Creating and Managing Network Objects in R	21
3.2.1	Creating a Network Object in <code>statnet</code>	21
3.2.2	Managing Node and Tie Attributes	24
3.2.3	Creating a Network Object in <code>igraph</code>	28
3.2.4	Going Back and Forth Between <code>statnet</code> and <code>igraph</code> ...	30
3.3	Importing Network Data	30
3.4	Common Network Data Tasks	32
3.4.1	Filtering Networks Based on Vertex or Edge Attribute Values	32
3.4.2	Transforming a Directed Network to a Non-directed Network	39

Part II Visualization

4	Basic Network Plotting and Layout	45
4.1	The Challenge of Network Visualization	45
4.2	The Aesthetics of Network Layouts	47
4.3	Basic Plotting Algorithms and Methods	49
4.3.1	Finer Control Over Network Layout	50
4.3.2	Network Graph Layouts Using <code>igraph</code>	52
5	Effective Network Graphic Design	55
5.1	Basic Principles	55
5.2	Design Elements	55
5.2.1	Node Color	56
5.2.2	Node Shape	60
5.2.3	Node Size	62
5.2.4	Node Label	66
5.2.5	Edge Width	68
5.2.6	Edge Color	69
5.2.7	Edge Type	70
5.2.8	Legends	71
6	Advanced Network Graphics	73
6.1	Interactive Network Graphics	73
6.1.1	Simple Interactive Networks in <code>igraph</code>	74
6.1.2	Publishing Web-Based Interactive Network Diagrams	74
6.1.3	Statnet Web: Interactive <code>statnet</code> with <code>shiny</code>	77
6.2	Specialized Network Diagrams	77
6.2.1	Arc Diagrams	78
6.2.2	Chord Diagrams	79
6.2.3	Heatmaps for Network Data	82
6.3	Creating Network Diagrams with Other R Packages	84
6.3.1	Network Diagrams with <code>ggplot2</code>	84

Part III Description and Analysis

7	Actor Prominence	91
7.1	Introduction	91
7.2	Centrality: Prominence for Undirected Networks	92
7.2.1	Three Common Measures of Centrality	93
7.2.2	Centrality Measures in R	95
7.2.3	Centralization: Network Level Indices of Centrality	96
7.2.4	Reporting Centrality	97
7.3	Cutpoints and Bridges	101
8	Subgroups	105
8.1	Introduction	105
8.2	Social Cohesion	106
8.2.1	Cliques	107
8.2.2	k-Cores	110
8.3	Community Detection	115
8.3.1	Modularity	115
8.3.2	Community Detection Algorithms	118
9	Affiliation Networks	125
9.1	Defining Affiliation Networks	125
9.1.1	Affiliations as 2-Mode Networks	126
9.1.2	Bipartite Graphs	126
9.2	Affiliation Network Basics	127
9.2.1	Creating Affiliation Networks from Incidence Matrices	127
9.2.2	Creating Affiliation Networks from Edge Lists	129
9.2.3	Plotting Affiliation Networks	130
9.2.4	Projections	131
9.3	Example: Hollywood Actors as an Affiliation Network	133
9.3.1	Analysis of Entire Hollywood Affiliation Network	134
9.3.2	Analysis of the Actor and Movie Projections	139

Part IV Modeling

10	Random Network Models	147
10.1	The Role of Network Models	147
10.2	Models of Network Structure and Formation	148
10.2.1	Erdős-Rényi Random Graph Model	148
10.2.2	Small-World Model	151
10.2.3	Scale-Free Models	154
10.3	Comparing Random Models to Empirical Networks	160

11	Statistical Network Models	163
11.1	Introduction	163
11.2	Building Exponential Random Graph Models	165
11.2.1	Building a Null Model	167
11.2.2	Including Node Attributes	169
11.2.3	Including Dyadic Predictors	171
11.2.4	Including Relational Terms (Network Predictors)	175
11.2.5	Including Local Structural Predictors (Dyad Dependency)	177
11.3	Examining Exponential Random Graph Models	179
11.3.1	Model Interpretation	179
11.3.2	Model Fit	180
11.3.3	Model Diagnostics	183
11.3.4	Simulating Networks Based on Fit Model	183
12	Dynamic Network Models	189
12.1	Introduction	189
12.1.1	Dynamic Networks	189
12.1.2	RSiena	191
12.2	Data Preparation	192
12.3	Model Specification and Estimation	198
12.3.1	Specification of Model Effects	198
12.3.2	Model Estimation	203
12.4	Model Exploration	203
12.4.1	Model Interpretation	203
12.4.2	Goodness-of-Fit	209
12.4.3	Model Simulations	212
13	Simulations	217
13.1	Simulations of Network Dynamics	217
13.1.1	Simulating Social Selection	218
13.1.2	Simulating Social Influence	228
	References	235

<http://www.springer.com/978-3-319-23882-1>

A User's Guide to Network Analysis in R

Luke, D.A.

2015, XII, 238 p. 92 illus., 81 illus. in color., Softcover

ISBN: 978-3-319-23882-1