

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 `statnet` 21
 - 3.2.2 Managing Node and Tie Attributes 24
 - 3.2.3 Creating a Network Object in `igraph` 28
 - 3.2.4 Going Back and Forth Between `statnet` and `igraph` ... 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 `igraph` 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 `igraph` 74
 - 6.1.2 Publishing Web-Based Interactive Network Diagrams 74
 - 6.1.3 Statnet Web: Interactive `statnet` with `shiny` 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 `ggplot2` 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