

# Course Syllabus

SMM638 - Network Analytics | Term I 2025/26

2025-11-20

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## Course Overview

### Module Description

Network Analytics (SMM638) provides a comprehensive introduction to the theory and practice of analyzing networked systems in business and organizational contexts. This module equips students with cutting-edge tools and techniques to understand, visualize, and leverage network structures for strategic decision-making.

## Learning Objectives

By the end of this module, you will be able to:

### Core Competencies

#### 1. Theoretical Foundation

- Master fundamental network concepts, terminology, and mathematical foundations
- Understand different types of networks (social, organizational, technological)
- Apply network theory to real-world business problems

#### 2. Technical Skills

- Collect, clean, and structure network data from multiple sources
- Implement network analysis algorithms in R and Python
- Create compelling visualizations of complex network structures
- Perform statistical analysis on network data

#### 3. Analytical Capabilities

- Calculate and interpret centrality measures to identify key actors
- Detect communities and clusters within networks
- Model network formation and behavior
- Analyze network evolution and dynamics over time

#### 4. Business Applications

- Transform network insights into actionable business strategies
- Apply network analysis to marketing, operations, and organizational design
- Evaluate the impact of network position on performance
- Design network interventions for business outcomes

## Module Relevance

In today's interconnected world, understanding networks is crucial for:

- **Marketing:** Influencer identification, viral marketing, customer segmentation
- **Operations:** Supply chain optimization, knowledge management, innovation diffusion
- **Strategy:** Partnership formation, competitive analysis, ecosystem mapping
- **HR:** Organizational design, team composition, talent management

## Topic 1: Introduction to Network Analytics

### Week 1

#### Learning Outcomes:

- Understand fundamental network concepts and terminology
- Differentiate between network types (one-mode, two-mode, signed, weighted)

- Set up R/Python environment for network analysis
- Perform basic network data management and visualization

#### **Topics Covered:**

- Network elements: nodes, edges, dyads, triads
- Real-world network examples (economic, organizational, social)
- Taxonomy of network measures (node, meso, macro levels)
- Introduction to network analysis software

**Case Study:** RCB: Social network analysis

### **Topic 2: Network Centrality**

**Weeks 2-3**

#### **Learning Outcomes:**

- Calculate and interpret various centrality measures
- Understand when to apply different centrality metrics
- Analyze the relationship between centrality and outcomes
- Implement centrality algorithms in R/Python

#### **Topics Covered:**

- Degree centrality and its variants
- Closeness centrality and information flow
- Betweenness centrality and brokerage
- Eigenvector centrality and influence
- PageRank and its applications
- Local clustering coefficient

**Case Study:** Who is the right influencer? A social network analysis

### **Topic 3: Dyads, Triads, and Network Dynamics**

**Weeks 4-5**

#### **Learning Outcomes:**

- Analyze dyadic patterns and relationships
- Model homophily and its effects
- Understand triadic closure and its implications
- Network evolution patterns
- Test network hypotheses

#### **Topics Covered:**

- Reciprocity and mutuality
- Homophily and selection effects

- Triadic census and transitivity
- Conditional Uniform Graph (CUG) tests

**Case Study:** Feeding SoundCloud’s recommendation system with social network data

#### **Topic 4: Network Cohesion and Communities**

**Weeks 7-8**

##### **Learning Outcomes:**

- Measure network cohesion at multiple levels
- Apply community detection algorithms
- Interpret community structure for business insights
- Implement blockmodeling techniques

##### **Topics Covered:**

- Network density and cohesion metrics
- Core-periphery structures
- Community detection algorithms (Louvain, modularity optimization)
- Blockmodeling

**Case Study:** Profiling beer enthusiasts at BeerAdvocate

#### **Topic 5: Network Position and Performance**

**Weeks 9-10**

##### **Learning Outcomes:**

- Analyze the strategic value of network positions
- Understand closure vs. brokerage trade-offs
- Apply network insights to career development
- Design network interventions

##### **Topics Covered:**

- Structural holes and brokerage opportunities
- Network closure and social capital
- The strength of weak ties
- Network position and innovation
- Career implications of network structure

**Case Study:** Network position and employee performance in Silico’s R&D lab

## Assessment Strategy

### Assessment Components

#### Class Participation (10%)

- Active engagement in discussions
- Quality of questions and insights
- In-class case discussion contribution

*Ongoing throughout term*

#### Mid-Term Project (50%)

- Team-based analysis (3-4 students)
- Real-world dataset
- Technical implementation
- Business recommendations
- 15-minute presentation

*Due: November 10, 2025*

#### Final Project (40%)

- Individual research project
- Business case requesting network analysis
- Executive summary of case discussion (1,000 words)
- 10-minute case discussion, job interview style

*Due: November 28, 2025*

### Assessment Criteria

All assessments will be evaluated on:

#### 1. Technical Proficiency (30%)

- Correct implementation of methods
- Code quality and documentation
- Appropriate use of techniques

#### 2. Analytical Rigor (30%)

- Sound methodology
- Proper interpretation of results
- Statistical validity

#### 3. Business Relevance (30%)

- Clear problem definition
- Actionable insights
- Strategic recommendations

#### 4. Communication (10%)

- Clear presentation
- Effective visualizations
- Professional writing

## Course Resources

### Technical Requirements

#### ! Essential Software Setup

##### Programming Environments:

- **R** (version 4.3+) with RStudio
- **Python** (version 3.9+) with Spyder or Jupyter Lab/Notebooks
- Git for version control

##### Sample R Packages:

```
# Core packages
install.packages(c("igraph", "tidygraph", "ggraph"))

# Statistical modeling
install.packages(c("statnet", "ergm", "btergm"))

# Visualization
install.packages(c("networkD3", "visNetwork", "graphlayouts"))

# Data manipulation
install.packages(c("tidyverse"))
```

##### Sample Python Modules:

```
# Data manipulation and computation
conda install -c conda-forge numpy scipy matplotlib pandas

# Network libraries
conda install -c conda-forge networkx graph-tool

# Interactive visualization
conda install -c conda-forge plotly bokeh pyvis
```

Alternatively, you can create the environment directly using the provided `smm638.yaml` file:

```
conda env create -f smm638.yaml
conda activate smm638
```

## Reading List

### Core Textbooks:

1. **Menczer, F., Fortunato, S., & Davis, C. A. (2020).** *A first course in network science*. Cambridge University Press.
  - Comprehensive yet accessible survey of network science notions and tools
  - Excellent first course in network analysis book
2. **Newman, M. (2018).** *Networks* (2nd ed.). Oxford University Press.
  - Comprehensive mathematical treatment of network problems
  - Excellent for understanding algorithms
  - For the braves...
3. **Easley, D., & Kleinberg, J. (2010).** *Networks, crowds, and markets: Reasoning about a highly connected world*. Cambridge: Cambridge University Press.
  - Focus on economic applications of network concepts and methods
  - Plenty of examples
  - Variety of organizational and market issues, from auctions to social influence in digital platforms
4. **Rawlings, C. M., Smith, J. A., Moody, J., & McFarland, D. A. (2023).** *Network analysis: integrating social network theory, method, and application with R*. Cambridge University Press.
  - Focus on social networks
  - Excellent survey of network notions and methods
  - Online companion with R applications
5. **Carpenter, M. (2009).** *An executive's primer on the strategy of social networks*. Business Expert Press.
  - An executive's perspective on networks
  - A very actionable framework to maximize the value of your network

### Supplementary Readings:

- **Barabási, A. L. (2014).** *Linked: How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life*. Basic Books.
- **Jackson, M. O. (2019).** *The Human Network*. Pantheon Books.
- **Watts, D. J. (2003).** *Six Degrees: The Science of a Connected Age*. Norton.

### Online Resources

**Course Materials:** - GitHub repository: [github.com/simoneSantoni/net-analysis-smm638](https://github.com/simoneSantoni/net-analysis-smm638) - Moodle page with lectures and assignments - Slack workspace for discussions

**External Resources:** - [Awesome Network Analysis](#)

## Course Policies

### Attendance and Participation

- **Attendance:** Mandatory for all sessions
- **Punctuality:** Sessions start promptly; late arrivals disrupt learning
- **Preparation:** Complete readings and exercises before class
- **Engagement:** Active participation expected in all activities

### Collaboration Policy

- **Teamwork:** Encouraged for designated group projects
- **Individual Work:** Must be completed independently
- **Code Sharing:** Allowed for learning, not for assignments
- **Citation:** Always attribute sources and collaborators
- **AI:** Disclose how you use LLMs to get your work done

### Communication

#### Getting Help

1. **Moodle Forum:** First point of contact for content questions
  - Response time: 24-48 hours on weekdays
2. **Office Hours:** Wednesdays 15:00-17:00 (by appointment)
  - Book via: [simone.santoni.1@city.ac.uk](mailto:simone.santoni.1@city.ac.uk)
3. **Email:** For personal/administrative matters only
  - Use clear subject lines: "SMM638 - [Topic]"
4. **Peer Support:** Join study groups on Slack

### Accessibility and Accommodations

Students requiring accommodations should:

1. Contact Student Services for documentation
2. Notify instructor within first two weeks
3. Discuss specific needs and arrangements

All accommodations will be made in accordance with university policies.



## Academic Integrity

- **Plagiarism:** Zero tolerance; all work must be original
- **Collaboration:** Clearly acknowledge all contributions
- **Data Sources:** Properly cite all datasets used
- **Code Attribution:** Credit all borrowed/adapted code (included LLM generated code)

Violations will be reported to the Academic Misconduct Committee.

## Syllabus Modifications

This syllabus may be adjusted to:

- Accommodate class progress
- Incorporate current events/examples
- Respond to student feedback

All changes will be announced via Moodle with one week's notice.

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### Ready to Start?

Network Analytics is a powerful lens for understanding our interconnected world. This module will challenge you to think structurally about business problems and equip you with tools to uncover hidden patterns in complex systems.

**Let's build networks together!**