Course Syllabus

SMM635 - Data Visualization | Term I 2025/26

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Course Overview

Module Description

Data Visualization (SMM635) provides a comprehensive introduction to the principles and practice of creating effective data visualizations for business analytics. This module equips students with

fundamental design principles, practical tools, and hands-on experience to transform complex data into clear, compelling visual narratives that drive decision-making.

Learning Objectives

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

Core Competencies

1. **Design Foundation**
   - Master fundamental principles of effective data visualization design
   - Understand visual perception and cognitive principles
   - Apply design best practices for clarity and impact
2. **Technical Skills**
   - Apply the grammar of graphics to create meaningful visualizations
   - Design appropriate charts for different data types and analytical goals
   - Create interactive visualizations and dashboards using modern tools
   - Leverage Python libraries and Tableau for professional visualizations
3. **Analytical Capabilities**
   - Perform exploratory data analysis through visualization
   - Identify patterns, trends, and anomalies in data
   - Choose optimal visual encodings for different data dimensions
   - Evaluate visualization effectiveness
4. **Business Applications**
   - Apply storytelling techniques to communicate data insights effectively
   - Design dashboards for different audiences and use cases
   - Produce elegant, effective visual solutions to practical business problems
   - Transform data insights into actionable business recommendations

Module Relevance

In today's data-driven world, effective visualization is crucial for:

- **Decision Making**: Transform complex data into actionable insights
- **Communication**: Bridge the gap between analysts and stakeholders
- **Exploration**: Discover patterns and relationships in data
- **Persuasion**: Support arguments with compelling visual evidence

Topic 1: Designing Charts - Processes and Principles

Week 1

Learning Outcomes:

- Understand the data visualization design process
- Master fundamental design principles (clarity, efficiency, aesthetics)
- Apply visual perception theories to chart design
- Critique and improve existing visualizations

Topics Covered:

- The visualization design process
- Pre-attentive attributes and visual hierarchy
- Gestalt principles in data visualization
- Color theory and accessibility
- Common visualization pitfalls and how to avoid them

Topic 2: Design Variables and the Grammar of Graphics

Week 2

Learning Outcomes:

- Understand the grammar of graphics framework
- Map data to visual variables effectively
- Build complex visualizations from simple components
- Implement layered graphics approaches

Topics Covered:

- Introduction to the grammar of graphics
- Visual encoding: position, size, shape, color, orientation
- Scales, coordinates, and transformations
- Faceting and small multiples
- Layering and composition

Topic 3: Exploratory Data Analysis

Week 3

Learning Outcomes:

- Apply visualization techniques for data exploration
- Identify patterns, outliers, and relationships
- Create effective summary visualizations
- Document exploratory findings visually

Topics Covered:

- EDA workflow and visualization
- Distribution visualization techniques
- Correlation and relationship exploration
- Time series exploration
- Missing data visualization

Case Study: Nomis Solutions (A and B) - Customer analytics

Topic 4: Multidimensional Data Visualization

Week 4

Learning Outcomes:

- Handle high-dimensional data effectively
- Apply dimensionality reduction techniques
- Create parallel coordinates and other multidimensional plots
- Design interactive exploration tools

Topics Covered:

- Challenges of high-dimensional data
- Dimensionality reduction visualization
- Parallel coordinates and radar charts
- Heatmaps and matrix visualizations
- Interactive filtering and brushing

Case Study: Saving Lives with Data (A and B) - Healthcare analytics and intervention design

Topic 5: Storytelling with Data

Week 5

Learning Outcomes:

- Structure data stories for maximum impact
- Create narrative flow through visualization
- Balance analysis and narrative
- Present insights persuasively

Topics Covered:

- Narrative structure in data stories
- Annotation and emphasis techniques
- Progressive disclosure of information
- Creating memorable data moments
- Presentation best practices

Case Study: Crop Residue - Agricultural sustainability and environmental impact

Topic 6: Introduction to Tableau

Weeks 7-8

Learning Outcomes:

- Navigate Tableau's interface and features
- Create basic to intermediate visualizations
- Implement calculated fields and parameters
- Design interactive worksheets

Topics Covered:

- Tableau fundamentals and data connections
- Building views with marks and filters
- Calculations and table calculations
- Maps and geographic visualization
- Best practices for Tableau development

Case Study: Accounting and Auditing at Toby Biotech Inc.

Topic 7: Dashboards with Tableau

Weeks 9-10

Learning Outcomes:

- Design effective dashboard layouts
- Implement interactivity and filtering
- Optimize dashboard performance
- Deploy and share dashboards

Topics Covered:

- Dashboard design principles
- Layout and composition strategies
- Actions and interactivity
- Mobile and responsive design
- Publishing and sharing options

Case Study: Market Street Wine - Retail analytics and performance monitoring

Assessment Strategy

Assessment Components

Class Participation (10%)

- Active engagement in discussions
- Quality of visualization critiques
- In-class exercise completion

Ongoing throughout term

Mid-Term Project (50%)

- Team-based analysis (3-4 students)
- Real-world dataset visualization
- Design documentation
- Interactive dashboard
- 15-minute presentation

Due: November 11, 2025

Final Project (40%)

- Individual visualization project
- Business case requiring data visualization
- Complete visual analysis and recommendations
- Professional presentation

Due: December 1, 2025

Assessment Criteria

All assessments will be evaluated on:

1. **Design Quality** (30%)
    - Appropriate chart selection
    - Visual clarity and aesthetics
    - Effective use of color and layout
2. **Technical Execution** (30%)
    - Correct implementation
    - Code quality and documentation
    - Tool proficiency
3. **Analytical Insight** (30%)
    - Data understanding
    - Pattern identification
    - Meaningful conclusions

4. **Communication** (10%)
    - Clear narrative
    - Professional presentation
    - Audience appropriateness

Course Resources

Technical Requirements

Essential Software Setup

Programming Environments:

- **R** (version 4.3+) with RStudio
- **Python** (version 3.9+) with Jupyter Lab
- **Tableau** (student license provided)
- Git for version control

Sample R Packages:

```
# Core visualization
install.packages(c("ggplot2", "plotly", "highcharter"))

# Data manipulation
install.packages(c("tidyverse", "data.table"))

# Specialized visualizations
install.packages(c("treemap", "gganimate", "patchwork"))

# Color and themes
install.packages(c("viridis", "RColorBrewer", "scales"))
```

Sample Python Modules:

```
# Data manipulation
conda install -c conda-forge pandas numpy

# Visualization libraries
conda install -c conda-forge matplotlib seaborn plotly

# Interactive tools
conda install -c conda-forge altair bokeh dash
```

Alternatively, you can create the environment directly using the provided `smm635.yaml` file:

```
conda env create -f smm635.yaml
conda activate smm635
```

Reading List

Core Textbooks:

1. **Tufte, E. R., & Graves-Morris, P. R. (1983).** *The visual display of quantitative information* (Vol. 2, No. 9). Cheshire, CT: Graphics press.
    - The seminal work on data visualization principles
    - Foundation for understanding visual design excellence
2. **Cairo, A. (2012).** *The Functional Art: An introduction to information graphics and visualization.* New Riders.
    - Practical guide to creating effective visualizations
    - Balances theory with hands-on examples
3. **Wilkinson, L. (2011).** *The grammar of graphics.* In Handbook of computational statistics: Concepts and methods (pp. 375-414). Berlin, Heidelberg: Springer Berlin Heidelberg.
    - Theoretical foundation for modern visualization tools
    - Essential for understanding ggplot2 and similar frameworks
4. **Healy, K. (2024).** *Data visualization: a practical introduction.* Princeton University Press.
    - Modern approach to visualization with R
    - Excellent practical examples and code

Online Resources

Course Materials: - GitHub repository: github.com/simoneSantoni/data-viz-smm635 - Moodle page with lectures and assignments - Slack workspace for discussions

External Resources: - Data Visualization Society - Observable - Interactive visualization notebooks - Tableau Public Gallery

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 14:00-16:00 (by appointment)
    - Book via: simone.santoni.1@city.ac.uk
3. **Email**: For personal/administrative matters only
    - Use clear subject lines: "SMM635 - [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 (including 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.

Ready to Start?

Data Visualization is both an art and a science. This module will challenge you to think critically about how we present information and equip you with the tools to create visualizations that inform, engage, and inspire action.
Let's bring data to life together!