

# Course Syllabus

SMM635 - Data Visualization | Term I 2025/26

## Table of contents

Course Overview . . . . .	1
Module Description . . . . .	1
Learning Objectives . . . . .	2
Module Relevance . . . . .	2
Topic 1: Designing Charts - Processes and Principles . . . . .	3
Topic 2: Design Variables and the Grammar of Graphics . . . . .	3
Topic 3: Exploratory Data Analysis . . . . .	3
Topic 4: Multidimensional Data Visualization . . . . .	4
Topic 5: Storytelling with Data . . . . .	4
Topic 6: Introduction to Tableau . . . . .	5
Topic 7: Dashboards with Tableau . . . . .	5
Assessment Strategy . . . . .	6
Assessment Components . . . . .	6
Assessment Criteria . . . . .	6
Course Resources . . . . .	7
Technical Requirements . . . . .	7
Reading List . . . . .	8
Online Resources . . . . .	8
Course Policies . . . . .	9
Attendance and Participation . . . . .	9
Collaboration Policy . . . . .	9
Communication . . . . .	9
Accessibility and Accommodations . . . . .	9
Academic Integrity . . . . .	10
Syllabus Modifications . . . . .	10

## 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 and pricing optimization

## **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 11, 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

### Supplementary Readings:

- **Few, S. (2012).** Show Me the Numbers: Designing Tables and Graphs to Enlighten. Analytics Press.
- **Knaflitz, C. N. (2015).** Storytelling with Data: A Data Visualization Guide for Business Professionals. Wiley.
- **Kirk, A. (2019).** Data Visualisation: A Handbook for Data Driven Design. SAGE.

### Online Resources

**Course Materials:** - GitHub repository: [github.com/simoneSantoni/data-viz-smm635](https://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](mailto: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.

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### 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!**