INDIAN INSTITUTE OF TECHNOLOGY KANPUR

DEPARTMENT OF MANAGEMENT SCIENCES

Proposal for New Course

1. **Course Title:** Data Visualization for Business Analysis and Decisions
2. **Course Number:** DMSXXX
3. **Credits:** 3-0-0-1[10]
4. **Duration of the course**: Full semester
5. **Proposing Instructor:** Suvendu Naskar & Nivedita Bhaktha
6. **Proposing department:** Management Sciences
7. **Pre-requisite Courses:** None. Basics of R/Excel/Computer Programming is helpful.
8. **Other Interested Faculty:**

Course Description

Data visualization, the visual representation of data, is more scientific than artistic in our modern world. This course provides an introduction as well as hands-on experience in data visualization. It introduces students to design principles for creating meaningful displays of quantitative and qualitative data to facilitate managerial decision-making.

The main goal of data visualization is effectively, efficiently, elegantly, accurately as well as meaningfully communicating information which can provide a basic podium for the business decisions. Sophistically designed data visualization systems can greatly assist users with proper reasoning and decision making. It fulfils its objectives only if it encodes the given input in such a manner that our eyes can recognize and our brain can comprehend.

Information visualization lies in that area where design, math, statistics and human visual perception intersect. Ever since human beings need to understand their environment, they have been developing visual tools to gain knowledge of abstract information. Since the early citizens when dealing with field crops to the sailors when conquering new worlds both have been using information visualization to better understand key questions.

This comprehensive semester-long course is designed for students pursuing business analytics, emphasizing exploratory data analysis through advanced data visualization techniques using programming language like R and/or utilities like Excel/Tableau/Power BI programming language. The course combines theoretical foundations, best practices, and hands-on applications to empower students in visually exploring and interpreting complex datasets with objective of business analysis and decisions support. Emphasis is placed on practical applications in the context of business analytics, equipping students with the skills necessary for effective communication and decision-making in data-driven business environments. The course objectives are as follows:

- Develop a deep understanding of the principles of exploratory data analysis.
- Master R/Excel/Tableau for creating intricate and insightful visualizations.
- Learn recommended practices and critical thinking skills for evaluating and improving visualizations.
- Explore a wide range of visualization techniques applicable to diverse data structures.
- Apply EDA techniques to business scenarios.

Course Content

Sl. No.	Broad Title	Topics	No. of Lectures
1.	Introduction	Overview of exploratory data analysis; Principles of effective visual communication	2
2.	Foundations of data visualization	Gestalt principles and their application, Data-ink ratio and minimizing chart-junk, Color theory and its role in visualization	1
3.	Data Cleaning	Basic Charting and data cleaning using excel (before using R) or tableau, foundational calculations using the software for meaningful interpretation	2
4.	Categorical Data	Bar plots, stacked bar plots, and dot plots; Grouped bar plots and dodged bar plots; Mosaic plots and treemaps	3
5.	Continuous Data	Histograms, density plots, and boxplots; Kernel density plots and violin plots; Comparing distributions with multiple continuous variables	3
6.	Multivariate Data	Scatter plots, jitter plots, and rug plots; Lattice plots; Heatmaps for visualizing matrices; Faceting, Grids, Grouping, and Bunching	4
7.	Time Series Data	Line plots; Trend analysis; Event plots	3
8.	Choropleths and Maps	Creating and customizing choropleth maps; Multiple variables on a map	3
9.	Best Practices	Reviewing and critiquing visualizations; Iterative design and refinement; Enhancing data storytelling through visualizations	2
10.	Presentations/Business applications	Case study presentation	3

Remark:

This is an application and Industry oriented course for students who intend to join industry as business analyst, functional analyst, management trainee or similar roles

- Students will read class material, study best and worst practices, compare and contrast real-world examples, engage in problem solving, and participate in discussions related to the course material.
- Students will also practice applying the techniques and best practices discussed to real- world problems with the help of R/Excel/Tableau software.
- Interactive approach of learning through online database platform or artificially generated data meant for this course.
- Learning by doing will be the main teaching methods for this course

We will use one or more of the following tools subject to availability. It is expected for students to have own laptop as most of these tools have stand-alone version which is adequate for learning the core aspects of data visualization.

- R, R Studio (Open source)
- Tableau Desktop Professional (TFT License), Student License or Tableau Public
- Microsoft Excel (Win 2007/Mac 2008 or Win 2010/Mac 2011 or Win 2013)
- Power BI – Optional, subject to availability

Most of the lectures will include visualization demonstration using either of R (and RStudio) and/or GUI tools like Tableau (Student License)/Excel. Depending on the student engagement and domain of interest other visualization tools for business analysis (such as Power BI) will be explored further. This course requires access to laptops and entry level programming knowledge. By and large focus will be given to use visualization principles and artifacts to real world business situation to answer the question "How data visualization can complement management decisions and analysis?".

Textbooks

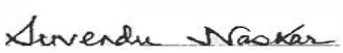
- Healy, Kieran. 2018. *Data Visualization: A Practical Introduction*. Princeton University Press.
- Tufte, Edward R. 2001. *The Visual Display of Quantitative Information*. Vol. 2. Graphics press Cheshire, CT.
- Wickham, Hadley. 2010. *Ggplot2: Elegant Graphics for Data Analysis*. Springer.
- Wilke, C. O. (2019). *Fundamentals of data visualization: A primer on making informative and compelling figures*. O'Reilly Media.
- Wilkinson, Leland. 2013. *The Grammar of Graphics*. Springer Science & Business Media.

- The Big Book Dashboards: Visualizing Your Data Using Real-World Business Scenarios Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, Wiley
- Storytelling with Data: A Data Visualization Guide for Business Professionals by Cole Nussbaumer Knaflic, ISBN-10: 1119002257
- Data Visualization: A Handbook for Data Driven Design by Andy Kirk – 9781473912144 Sage pub.
- Effective Data Visualization: The Right Chart for the Right Data by Stephanie D. H. Evergreen – 9781506303055 Sage pub.
- Data-Driven Security: Analysis, Visualization and Dashboards by Jay Jacobs – Wiley pub. 978-1118793725
- Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics Nathan Yau, Wiley (2011)

Reference Material

- Qin, X., Luo, Y., Tang, N. et al. *Making data visualization more efficient and effective: a survey*. The VLDB Journal 29, 93–117 (2020). https://doi.org/10.1007/s00778-019-00588-3
- Hehman E., Xie S. Y. *Doing Better Data Visualization*. Advances in Methods and Practices in Psychological Science. 2021; 4(4). doi:10.1177/25152459211045334

Signature of Proposer:



Sd/- Suvendu Naskar [Date: 26 August 2024]

Sd/- Nivedita Bhaktha [Date: 26 August 2024]

This course is Approved/ Not Approve

Convener, DoMS

This course is Approved/ Not Approved DPGC

Chairperson SPGC