Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NCEC516	Transportation Statistics and Microsimulation	3	1	0	4

Course Objective

This course aims to equip students with **statistical techniques and microsimulation methods** to analyse and model transportation systems. Students will learn to explore, interpret, and apply **data-driven decision-making approaches** in transportation engineering using **statistical tools, and traffic microsimulation software**.

Learning Outcomes

- **Understand and apply statistical techniques** such as hypothesis testing, regression, and machine learning for analysing transportation data.
- **Develop and evaluate traffic microsimulation models** to study real-world transportation scenarios using tools like SUMO, VISSIM.
- **Interpret statistical outputs and microsimulation results for** effective transportation planning, traffic management, and policy recommendations.

Unit no.	Topics to be covered	Contact Hours	Learning outcome
1	**Exploratory Data Analysis:** Elements of structured data, estimation of location, estimation of variability, exploring data distribution, exploring binary and Categorical data, correlation, exploring two or more variables.	8L+ 3T	Understand and apply exploratory data analysis techniques in transportation studies.
2	**Data and Sampling Distributions:** Random Sampling and Sampling Bias, Sampling Distribution of a Statistic, Confidence Interval, Distributions	7L+ 2T	Learn principles of random sampling and various data-generating distributions
3	**Statistical Experiments and Significance Testing:** Hypothesis Tests, Statistical Significance and p-Values, z-test, t-test, ANOVA, Chi-square test	7L+ 3T	Perform hypothesis testing to derive insights from transportation datasets.
4	**Regression and Prediction:** Simple Linear Regression, Multiple Linear Regression, Prediction Using Regression, Interpreting the Regression Equation, Regression Diagnostics	8L+ 3T	Apply regression models to predict transportation trends and demand.
5	**Machine Learning for Transportation Data:** K-Nearest Neighbors, Tree Models, Bagging and the Random Forest, Boosting, Principal Components Analysis, K-Means Clustering, Hierarchical Clustering	7L+ 2T	Utilize statistical machine learning techniques for transportation data classification and clustering.
6	**Traffic Microsimulation:** Concepts, Applications, Software Tools, Input Data for Microsimulation, Model Calibration and Validation	5L+ 1T	Implement traffic microsimulation models to assess transportation network performance.
	Total Contact Hours	**42L+ 14T**	

Text-books:

1. Washington, S., Karlaftis, M., Mannering, F. and Anastasopoulos, P., 2020. *Statistical and econometric methods for transportation data analysis* (3rd ed.). Chapman and Hall/CRC.
2. Spiegelman, C., Park, E. S., & Rilett, L. R. (2011). *Transportation Statistics and Microsimulation* (1st ed.). Taylor & Francis, Routledge.
3. Möller, D. P. F. (2014). *Introduction to Transportation Analysis, Modeling and Simulation: Computational Foundations and Multimodal Applications* (1st ed.). Springer. https://doi.org/10.1007/978-1-4471-5637-6

Reference Books:

1. Dalpiaz, D. (2019). *Applied Statistics with R.* University of Illinois at Urbana-Champaign. Available at: https://book.stat420.org/.
2. Ayyub, B. M., & McCuen, R. H. (2016). *Probability, Statistics, and Reliability for Engineers and Scientists* (3rd ed.). CRC Press.