

Quantitative Approaches to Decision Making

QIP Short Term Course

IIT Kanpur

Program Schedule

(March 08-13, 2021)

March 8 (Monday)

Time	Speaker	Short Abstract
09:30 – 11:00	J. V. Meenakshi, Delhi School of Economics	Discrete Choice Models The talk will provide an introduction to Discrete Choice Models. Starting with binary choice models, it will then go on to cover the more general case of unordered multinomial choices. It will cover the random utility structure underlying these models, associated assumptions and limitations, estimation and inference. It will then provide examples of applications.
11:30 – 13:00	Nityananda Sarkar, ISI Kolkata	Time Series and Forecasting - I Both the classical and modern approaches of time series analysis would be covered with details.
14:30 – 16:00	Nityananda Sarkar & Samarjit Das, ISI Kolkata	Time Series and Forecasting - II All aspects of the most widely applied time series model, i.e., the Autoregressive Integrated Moving Average (ARIMA) model, including its estimation, identification and model selection procedure would be discussed at length. Special emphasis will be given on forecasting. Illustrations highlighting the empirical issues involved in time series analysis would also be discussed.
16:30 – 18:00	Abhiroop Mukhopadhyay, ISI Delhi	Impact Evaluation In this lecture, we will address the question on how one can estimate causal impacts of policy or interventions that may be implemented in any real-life setting. The lecture will reinterpret some standard econometric tools-for example OLS Regression - as a way to think about causality and introduce the concept of experimental design. We will also introduce some other methods - Instrumental Variable Estimation, Difference estimation and Regression Discontinuity Design methods to address issues of causality.

March 9 (Tuesday)

Time	Speaker	Short Abstract
09:30 – 11:00	Joydeep Dutta, IIT Kanpur	Linear Programming & Simplex Method In this talk we shall discuss an approach due to Manfred Padberg where the simplex method is developed without the tableau and as result of which many combinatorial issues remain hidden. The approach of Padberg is along the same lines. At the end we shall also discuss the revised simplex method.
11:30 – 13:00	Faiz Hamid, IIT Kanpur	Integer Programming & Branch-and-Bound Method Applications of discrete optimization problems are ubiquitous throughout our society. These include capital budgeting, portfolio selection, facility location, production scheduling, scheduling flights and their crews, telecommunication and transportation network design, VLSI circuit design, etc. The lecture aims to model such problems as integer programs (IP). Modelling problems as IP may be tricky sometimes due to presence of “yes-or-no decisions”, “either-or constraints” and “if-then constraints”. The session also includes discussion on the popular branch-and-bound method for solving IP.
14:30 – 16:00	Gajendra K Adil, IIT Bombay	Large Scale Optimization This talk will introduce to the field of Large Scale Optimization with the help of column generation technique. In this context, a commonly referred problem of cutting stock will be solved which is too large to consider all the variables explicitly. However, most of the variables will be non-basic in the optimal solution. This technique leverages this idea to generate only the columns (variables) having the potential to improve the objective function while implicitly considering all possible columns in the LP. Some other examples will also be discussed.
16:30 – 18:00	Amit Upadhyay, IIT Kharagpur	Container Loading Optimization in Indian Railways This session discusses a mathematical model for efficient loading of double-stack container trains. Double-stack container trains reduce the cost of container haulage significantly and improves service quality. For double-stacking of containers, many operational and safety constraints, container service requirements, and intra-terminal handling issues are required to be satisfied. A real-life implementation of this model in Indian Railways, which saved approximately INR 40 crores per year, will be discussed.

March 10 (Wednesday)

Time	Speaker	Short Abstract
09:30 – 11:00	Diptesh Ghosh, IIM Ahmedabad	Network Flow Problem and Applications In this talk, we shall be looking at two common network flow problems, the shortest path problem, and the maximum flow problem. We shall also talk about the associated minimum cut problem. These problems have applications in a wide variety of practical problems, such as route finding in Maps software, and logistics applications. We shall be talking about some basic algorithms used to solve these problems, including the Dijkstra algorithm for the shortest path problem and the Ford Fulkerson algorithm for the maximum flow problem.
11:30 – 13:00	Yogesh K Agarwal, IIM Lucknow	Vehicle Routing Problems This session discusses the vehicle routing problem and its variants. In the vehicle routing problem, the objective is to find the minimum cost routing of vehicles to deliver less-than-truckload shipments from a central depot to a number of customer locations. The well-known traveling salesman problem can be viewed as a special case of this problem when the capacity of the vehicle is more than the total demand of all customers. We discuss a very popular, and simple yet effective, heuristic technique called savings heuristic to solve the problem. Different versions of the problem arising from issues such as backhaul shipments, time-windows, time constraints etc. are also discussed.
14:30 – 16:00	Arshinder Kaur, IIT Madras	Supply Chain Inventory Management with Trade Credit under Uncertain Demand In the business world, both the supplier and the retailer accept the credit to make their business position strong, because the credit not only strengthens their business relationships but also increases the scale of their profits. The long period of credit may increase the demand rate but simultaneously it can also increase the credit default risk. This talk proposes an optimization model to investigate the two-level supply chain trade credit policy under uncertain demand. In this model a supplier offers credit to a single retailer, and the retailer also offers the credit to the end customers. The objective of the model is to determine the distribution-free optimal order quantity of the retailer with an optimal credit period of the supplier, which maximize the profitability of the total supply chain.
16:30 – 18:00	Deep Mukherjee, IIT Kanpur	Stochastic Frontier Analysis Stochastic frontier analysis refers to econometric techniques used to estimate production or cost functions in economics, clearly accounting for the existence of inefficiency on the part of producers. This lecture starts with defining various concepts of efficiencies. Then we will review some of the most important developments in the econometric estimation

		of stochastic frontier models. The lecture will end by demonstrating the use of FRONTIER program to estimate different types of efficiency models.
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March 11 (Thursday)

Time	Speaker	Short Abstract
09:30 – 11:00	Vipin B, IIT Kanpur	<p>Non-linear Optimization and Applications</p> <p>This talk is on the concept of non-linear optimization in an unconstrained environment. The talk will explore the idea of non-linear optimization under stochastic setting. A real-world operations management problem will be used to illustrate the application. The talk will conclude by throwing lights on the emerging research frontiers in the context of non-linear stochastic optimization.</p>
11:30 – 13:00	Surya P Singh, IIT Delhi	<p>Multi-Criteria Decision Making: An Approach to Prioritize Infrastructural Gaps</p> <p>In the present era of rapid economic development, public institutions have always placed priority on 'inclusive economic growth and social justice'. In view of this, the Ministry of Tribal Affairs, Government of India has initiated various programs for the development and welfare of all social groups including scheduled tribes in the country. In this pursuit, several tribal development programmes have been undertaken from time to time in the country. However, quantitative approaches have not been in use for overall planning for tribal development instead traditional approaches have been mostly in practice. The purpose of the talk is to present an application of data and decision science for the overall development planning process.</p>
14:30 – 16:00	Sandeep Juneja, TIFR Mumbai	<p>Monte Carlo Method</p> <p>In this talk we review the Monte Carlo Method. As is well known, Monte Carlo method is used for performance analysis of stochastic models. The advantage is that many complex real-world models that are not amenable to deductive analysis can be easily analysed using Monte Carlo. Further, Monte Carlo method performs well even on high dimension problems. This method requires that the underlying generative distributions be fully specified. This information can be further exploited to speed up statistical algorithms. In this talk we also discuss some applications of the Monte Carlo model including modelling the spread of COVID-epidemic.</p>
16:30 – 18:00	Md. Arshad Rahman, IIT Kanpur	<p>Bayesian Data Analysis</p> <p>In this talk, we review the Bayesian approach to ordinal (mean) regression and ordinal quantile regression, and explain how these models can be estimated using Gibbs sampling in combination with the Metropolis-Hastings algorithm – two well-known Markov chain Monte Carlo methods. We also discuss issues related to model</p>

		identification. Finally, we implement the above-discussed frameworks to study public perception towards federal government's response and Donald Trump's handling of the COVID pandemic in the United States.
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March 12 (Friday)

Time	Speaker	Short Abstract
09:30 – 11:00	Faiz Hamid, IIT Kanpur	<p align="center">Introduction to Machine Learning</p> <p>The session will introduce the concept of machine learning and allied areas such as data mining, big data analysis, etc. Different modeling approaches will be discussed for various real-life problems.</p>
11:30 – 13:00	Nandana Sengupta, IIT Delhi	<p align="center">Machine Learning & Econometrics</p> <p>The talk will start by introducing the fundamental concepts behind Machine Learning, how it differs from traditional econometrics and examples of ML being meaningfully utilized in social science applications. It will then touch upon 3 key techniques which form the foundation of a bulk of ML models: regularization, matrix factorization and classification. Finally, participants will get hands on experience running and analyzing some basic ML applications in either python or R.</p>
14:30 – 16:00	Arnab Bhattacharya, IIT Kanpur	<p align="center">Fog Prediction using Data Science</p> <p>The adverse impacts of fog are well known. Still its estimation and prediction remains a big challenge. While prediction of fog in the long term is important, nowcasting or prediction for very short lead times is extremely critical for many applications and situations. For example, the domestic flight services would dearly like to predict fog events within the next 3 hours since most flights are within that duration. Data science can play a major role in fog prediction. In this talk, we will go over our initial attempts to predict fog up to a lead time of 3 hours and 6 hours in various cities of north India. We train machine learning models using real time data obtained through satellites. Results are publicly disseminated through the website fog.iitk.ac.in.</p>
16:30 – 18:00	B K Mohanty, IIM Lucknow	<p align="center">Product Recommendation in Online Business</p> <p>Product recommendation in the e-market as per the buyers' preferences is a traditional problem in the online business. The preferential rankings of products are based not only on buyers' personalized preferences but also on their popularity. Fuzzy logic has been used to represent the buyers' preferences while the information from various search engines is applied to estimate the product's popularity. Search engines are basically helpful to accumulate web-based information of other customers to appraise the product's popularity. Weighted aggregation of buyers' information and search engines' figures helps us</p>

		obtain the products' preference ranking in the Internet market. The concept of the ordering of fuzzy sets in the unit interval is used for this purpose.
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March 13 (Saturday)

Time	Speaker	Short Abstract
09:30 – 11:00	Sanjib Pohit, NCAER	<p style="text-align: center;">Input Output Models</p> <p>Input-output models, when applied correctly, can be powerful tools for estimating the economy-wide effects of an initial change in economic activity. To effectively use these models, analysts must collect detailed information about the project or program under study. Analysts also need to be aware of the assumptions and limitations of these models. The analysis will help the audience to understand the power of input-model using real life example from India.</p>
11:30 – 13:00	Anand Venkatesh, IRMA	<p style="text-align: center;">Data Envelopment Analysis</p> <p>The session would give an overview of the non-parametric efficiency computing technique known as Data Envelopment Analysis (DEA). From the session, participants would become aware of what DEA is, and how one formulates various DEA model specifications using linear programming. The use of MS Excel in solving DEA models would also be covered.</p>
14:30 – 16:00	Preetam Basu, IIM Calcutta	<p style="text-align: center;">Risk Analysis</p> <p>Risk Analytics is the process by which various risk exposures are identified and measured. Monte Carlo simulation is a technique that allows decision-makers to account for risk in quantitative analysis. It provides the decision-maker with a range of possible outcomes and the probabilities they will occur and the extreme possibilities. The technique is used in various fields such as finance, project management, energy, marketing, manufacturing, engineering, research and development, insurance, oil & gas, and transportation.</p>
16:30 – 18:00	Saudamini Das, IEG Delhi	<p style="text-align: center;">Social Cost Benefit Analysis</p> <p>This lecture will discuss ways of applying social cost benefit analysis (SCBA) for decision making in environmental research. Environmental projects (like afforestation or conservation decisions) have typical features like decision making over a long time horizon, many benefits are public goods nature, invisible, not traded in the market, and similar are opportunity costs of conservation. This lecture will use three examples, mangrove conservation, mangrove regeneration and captive breeding of vultures to explain the derivation of net present value and application of SCBA.</p>