Brij Disa Centre for Data Science and Artificial Intelligence

IIMA

INDIAN INSTITUTE of MANAGEMENT AHMEDABAD

विद्याविनियोगाद्विकास:

ANNUAL REPORT 2025–26

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Brij Disa Centre for Data Science and AI

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FOREWORD

At the Brij Disa Centre for Data Science and Artificial Intelligence (CDSA), Indian Institute of Management Ahmedabad, we remain committed to advancing rigorous and interdisciplinary research in Data Science, Artificial Intelligence, and Analytics. Over the past year, the Centre has continued to strengthen its engagement with academia, industry and policymakers through research collaborations and several knowledge dissemination activities.

One of the key highlights of the year was the successful organization of the **Workshop on Advances in Data-Driven Optimization**, which brought together faculty members, researchers, and doctoral scholars to study emerging developments in distributionally robust optimization and online resource allocation. The workshop was led by Prof. Karthyek Murthy from Singapore University of Technology and Design. It provided participants with deep understanding of decision-making under uncertainty and reinforced CDSA's commitment to building advanced research capabilities in optimization and analytics.

The Centre also played an active role in the **India Management Research Conference (IMRC)** 2025 through a dedicated Data Science and Artificial Intelligence track. The conference facilitated rich academic exchange on topics such as predictive analytics, machine learning, deep learning, generative AI, and prescriptive analytics, while fostering collaboration between researchers and practitioners working at the intersection of technology, business, and policy. Distinguished experts, including Dr. Manas Gaur, Assistant Professor at the University of Maryland, Baltimore County (UMBC) and Prof. Kanti Mardia Mardia OBE, Senior Research Professor at the University of Leeds led the guest speaker sessions. Their contributions significantly enhanced the quality of academic discourse within the track.

Another major milestone this year was the **IIMA/CDSA–ORSI Excellence in Management Science and Analytics Practice Award 2026**, organized in collaboration with the Operational Research Society of India (ORSI), Ahmedabad Chapter. The event featured six outstanding finalists representing prominent Indian organizations, each showcasing innovative applications of analytics with significant economic and societal impact. The finalists included the Department of Food and Public Distribution, Bharat Petroleum Corporation Limited, Container Corporation of India (CONCOR), Thermo Fisher Scientific India, NTPC Limited, and JSW Steel.

The Centre also contributed to the report on **Future of TV in India**, developed in collaboration with Zee Entertainment Enterprises Limited. The study adopted a rigorous, data-driven approach to examine how demographic, economic, and digital factors are reshaping television consumption in India. The report highlighted the continued evolution and expansion of television audiences, particularly in rural and lower-income regions, and demonstrated how analytics can contribute meaningfully to understanding large-scale societal and industry transformations.

Beyond these initiatives, CDSA continued to support several ongoing research projects spanning areas such as stochastic optimization, bilevel optimization, crowd dynamics, AI regulation, geospatial AI, experimental methods and multimodal analytics. These projects embody the Centre's mission of producing research that combines methodological rigor with practical relevance.

The Centre also strengthened its knowledge dissemination efforts through the Communique article series, which explored themes such as explainable AI, algorithmic decision-making, supply chain intelligence, and AI-enabled operational systems. Through these initiatives, CDSA seeks to contribute to informed dialogue on the opportunities and challenges emerging from the rapid advancement of AI and data-driven technologies.

As we move forward, we remain dedicated to fostering meaningful collaborations, nurturing young researchers, and creating research that contributes to business innovation, public policy, and societal progress. We are grateful to our faculty, researchers, collaborators, industry partners, and students for their continued support and contributions to the Centre's growth and success.

ABOUT US

Brij Disa Centre for Data Science and Artificial Intelligence
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The Brij Disa Centre for Data Science and Artificial Intelligence (CDSA) at the Indian Institute of Management Ahmedabad (IIMA) provides a common platform to faculty, scholars, and practitioners for conducting and disseminating cutting-edge research on data analytics and artificial intelligence that offers solutions applicable to business, governance, and policy.

Besides generating action-oriented insights, CDSA is also responsible for dissemination of the knowledge generated for a wider audience both within and outside the realm of the institute. Seminars, workshops, and conferences are regular activities at the Centre, which are conducted to reach out to and engage with multiple stakeholders.

The Centre aims to forge synergistic and collaborative relationships between scholars and practitioners in data-intensive organizations, besides undertaking case-based research to understand the current industry practice and develop case studies for classroom teaching.

Furthermore, through its collaboration with the industry, CDSA takes up challenging consulting projects of considerable practical importance. These projects are targeted at providing an opportunity for students to participate in projects that aim at outcomes that can further benefit the organization and the business, at large.

A key offering from the Centre is the Annual Research Report, which provides a holistic view of the Data Science and Artificial Intelligence industry, identifies challenges and gaps and offers plausible solutions that can be utilised by practitioners and policy makers.

WHAT WE DO

The activities of the centre are four-fold through which the members of the centre engage with businesses, policy makers, students, and other academic institutions.

Industry Connect

Build partnerships to undertake collaborative research and jointly organise workshops.

Consulting Activities

Facilitate businesses by connecting them with researchers to solve challenging business problems.

Data Driven Policy Enablement

Enable policymakers with reports on trends and progression of analytics tools, techniques and other resources.

Knowledge Disssemination

Share knowledge through seminars, fireside chats, workshops, etc. on research and applications of topical interest.

EVENTS

Workshop on Advances in Data-Driven Optimization

The Workshop on Advances in Data-Driven Optimization, held from April 23-25, 2025, focused on Distributionally Robust Optimization (DRO) and Online Resource Allocation (ORA) for decision-making under uncertainty. Designed for faculty members and advanced PhD scholars, the workshop featured 12 lecture-based sessions covering key models, algorithms, and real-world applications.

Led by Prof. Karthyek Murthy from the Singapore University of Technology and Design, the sessions explored data-driven decision-making under uncertainty, including risk models, chance constraints, and variance-based frameworks. Participants were also introduced to optimal transport and Wasserstein distances in robust optimization.

The workshop further covered dynamic and online decision-making topics such as resource allocation, the secretary problem, revenue management, and dynamic pricing strategies. Advanced methods like the Certainty-Equivalent heuristic, fluid approximations, and distributionally robust optimization were also discussed.

Concluding with insights on dual reformulation, stochastic gradient descent, and online allocation problems, the workshop offered a well-rounded blend of theory and practical applications.

Prof. Karthyek Murthy

India Management Research Conference– IMRC 2025

Building on the success of its inaugural edition, the India Management Research Conference (IMRC) returned for its second edition from December 5–7, 2025, bringing together leading academicians, researchers, and practitioners to deliberate on contemporary management challenges and emerging research frontiers. Anchored around the theme "The Future of the Economy: People, Organizations, and Policy," the conference provided a platform for rigorous academic exchange, fostering interdisciplinary dialogue and encouraging collaborative approaches to addressing India-centric management issues.

A major highlight of IMRC 2025 was the Data Science & Artificial Intelligence (CDSA) track, which served as a focal point for discussions at the intersection of data-driven decision-making and business strategy. The track featured a series of high-quality paper presentations and technical sessions, facilitating in-depth knowledge exchange across key domains such as Predictive Analytics, Machine Learning, Deep Learning, optimization techniques for prescriptive analytics, Generative AI, and other emerging AI technologies. The research presented reflected a strong balance between theoretical advancement and practical applicability, demonstrating the growing relevance of data science and AI in solving complex business and policy challenges.

The CDSA sessions also benefited from the participation of distinguished experts, including Dr. Manas Gaur, Assistant Professor at the University of Maryland, Baltimore County (UMBC), and Prof. Kanti Mardia OBE, Senior Research Professor at the University of Leeds. Their insights contributed to enriching the academic discourse, offering global perspectives and advancing the quality of discussions within the track.

Prof. Kanti Mardia

Prof. Saravanan A

Prof. Ankur Sinha

Presenters at IMRC

IIMA/CDSA – ORSI Excellence in Management Science and Analytics Practice Award – 2026

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ORSI Ahmedabad Chapter

The IIMA/CDSA, in collaboration with the Operational Research Society of India (ORSI) Ahmedabad Chapter, had the honour of hosting the CDSA × ORSI Excellence in Management Science and Analytics Practice Award on 11 January 2026 at Indian Institute of Management Ahmedabad.

The event was conducted under the esteemed guidance of Prof. Bharat Bhasker, Director, IIM Ahmedabad, and was supported by the leadership of Prof. Ankur Sinha, Chairperson, Brij Disa Centre for Data Science and Artificial Intelligence and Professor of Operations and Decision Sciences.

The award initiative was conceptualized and spearheaded by Prof. Goutam Dutta, Retired and currently Visiting Professor at IIM Ahmedabad and Editor of Special Issues of OPSEARCH, in collaboration with Dr. Sanjay K Prasad, IBM Distinguished Engineer and Chair of the Award at IBM.

The full-day programme was distinguished by its rigour, relevance, and depth, showcasing not only academic excellence but also real-world, live implementations delivering tangible economic and societal impact. Six exceptional finalists, representing leading national and global institutions, presented their work. These included the Department of Food and Public Distribution, Bharat Petroleum Corporation Limited, Container Corporation of India (CONCOR), Thermo Fisher Scientific India, NTPC Limited, and JSW Steel.

Summary of the Papers

उपभोक्ता मामले विभाग
DEPARTMENT OF
CONSUMER AFFAIRS

Department of Food and Public Distribution, Government of India

The winning paper presents an analytics-driven approach to enhance the efficiency of India's Public Distribution System by optimizing food grain movement, allocation, and storage, reducing wastage while ensuring timely and equitable distribution to beneficiaries across regions.

Bharat Petroleum

BPCL – Bharat Petroleum Corporation Limited

This initiative introduces a predictive analytics-based delivery system to improve LPG accessibility, enabling accurate demand forecasting and optimized distribution, thereby enhancing last-mile efficiency and promoting cleaner fuel adoption.

कॉनकॉर
CONCOR

CONCOR – Container Corporation of India

This project applies prescriptive analytics to optimize container train operations by improving scheduling and asset utilization, reducing transit time and costs while enhancing efficiency across the freight logistics network.

Thermo Fisher Scientific

This project focuses on intelligent cartonization using advanced clustering and optimization techniques to improve packaging efficiency, reduce material usage, and streamline warehouse operations through better space utilization.

NTPC – National Thermal Power Corporation

This initiative leverages large language models to enhance MRO inventory management by improving data standardization and accessibility, leading to more efficient decision-making and improved operational performance.

JSW – Jindal South-West

This project implements analytics-based models to predict hot metal silicon content, enabling real-time monitoring and process optimization, resulting in improved consistency and efficiency in steel manufacturing.

Jury Members

Event Chairs

Prof. Goutam Dutta

Rtd. Professor, Operations and Decision Sciences and Editor, Special Issues of OPSEARCH

Dr. Sanjay K. Prasad

IBM Distinguished Engineer
Chair of the Prize

Launch of Future of TV in India

Is television in India declining, or is it quietly preparing for its next phase of expansion? As explored in Future of TV in India, the country's television landscape is being reshaped by rapid shifts in digital access, economic growth, and demographic change. Rather than viewing television in isolation, this study examines its evolution within a broader ecosystem, where connectivity, income levels, and population dynamics collectively influence how content is consumed.

Conducted in collaboration with Zee Entertainment Enterprises Limited, the research adopts a rigorous, data-driven approach to understand the underlying drivers of TV viewership across India. By analyzing a wide range of socio-economic and digital indicators through regression-based methods, the study identifies the factors that meaningfully shape consumption patterns. Internet penetration, rising income levels, literacy, and demographic structure emerge as key determinants, offering a nuanced perspective on the role of television in an increasingly digital society.

The study was led by the team at Indian Institute of Management Ahmedabad, including Prof. Viswanath Pingali, Prof. Ankur Sinha, and Oindrila Banerjee. Their work brings together academic rigor and industry relevance to provide a grounded understanding of how television continues to adapt and expand within India's evolving media landscape.

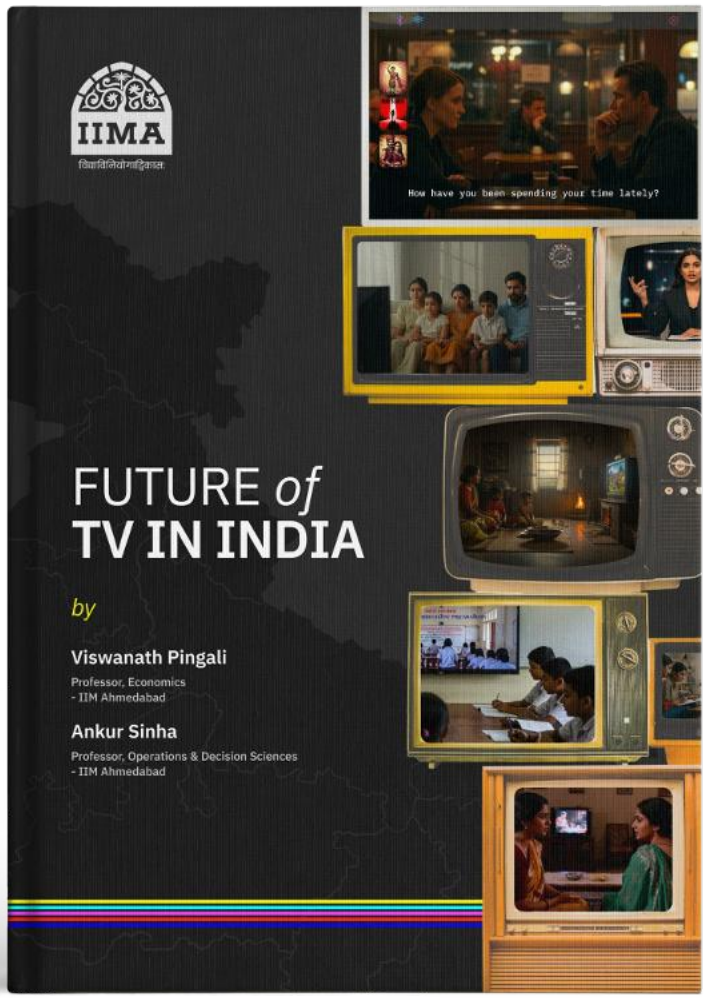
Key Highlights

1 Billion TV audience estimated by 2029

By 2029, lower-income states such as Rajasthan, Odisha, and West Bengal are projected to reach TV penetration levels comparable to current levels in higher-income states like Gujarat and Tamil Nadu.

Internet subscribers are the strongest and most consistent driver of TV audience growth across India—in overall, rural, and low-income regions. A rise in internet penetration is associated with a significant increase in TV viewership.

TV audience will continue growing steadily (≈2–3% annually) across most regions, with the fastest growth expected in rural and low-income states, especially UP/Uttarakhand, Bihar/Jharkhand, and AP/Telangana.



Scan the QR code to explore the full report Future of TV in India

ONGOING RESEARCH PROJECTS

Big Data modeling and prediction for problems in management *

Abstract

Crime prediction is a critical component of modern urban safety planning, aiming to forecast when and where crimes are likely to occur so that law enforcement can respond proactively. Traditional methods often struggle with the complex, non-linear dynamics of crime, which are shaped by a web of spatial, temporal, and social factors. To address these challenges, our research adopts a Bayesian modeling framework for the Spatio-Temporal Model of Crime Prediction, tailored to urban street crime data, which offers a principled approach to incorporating prior knowledge and quantifying uncertainty in predictions. The central challenge lies in accurately modeling the spatial and temporal patterns of crime incidents, which tend to be highly irregular and influenced by latent environmental and social factors. To address this, we employ a kernel-based likelihood structure combined with latent variables representing the spatial and temporal components of each crime event. The novelty of the model lies in implementation of adaptive bandwidths and weights, which enable it to capture subtle shifts in crime patterns across neighbourhoods and time periods. This leads to reliable forecasts, providing decision-makers with a clearer view of likely crime hotspots and the uncertainty surrounding predictions. The model is applied to real-world crime data from an Indian city and the resulting predictions can assist law enforcement in resource allocation, hotspot identification, and proactive policing.

Centre Researcher

Dr. Parth Mehta

Post-doctoral Researcher

A Prediction-Prescription Framework for Procurement Planning under Supply Uncertainty *

Abstract

In this work, we study the problem of next-day mine supply prediction for a major thermal-based power generation company in India. The objective is to predict which mines are likely to supply material, namely coal, on the following day under supply uncertainty. We evaluate several machine learning models and a Log-Gaussian Cox Process approach to capture mine-supply patterns. Motivated by the discrete spatial locations of mines, irregular supply behavior, and varying historical supply frequencies, we propose a context-driven statistical approach, namely a Kernel Density Estimation (KDE) model with adaptive bandwidths and supply-based weights. The proposed KDE model shows better performance than the other applied approaches in terms of F1-score and balanced accuracy. The predicted mine-supply probabilities are subsequently incorporated into a two-stage stochastic optimization model to support material procurement and inventory decisions. The proposed prediction-prescription framework provides a data-driven approach for improving operational planning under uncertain mine supply.

Centre Researchers

Dr. Kundan Singh

Post-doctoral Researcher

Dr. Chhavi Sharma

Post-doctoral Researcher

*** Projects led by**

Prof. Karthik Sriram

Associate Professor of Operations and Decision Sciences

Prof. Ankur Sinha

Professor of Operations and Decision Sciences

Supporting Parents to Impact Foundational Literacy and Numeracy (FLN) of Children

Abstract

India has made rapid strides when it comes to access to primary schooling and enrolment. Data from a variety of sources suggests that the percentage of children in the age-group of 6 to 10 years enrolled in school is near universal, and the drop-out rates low. But at the same time, concerns about learning outcomes persist. It is well accepted that a large fraction of enrolled children are below the level expected at the grade in which they are enrolled and lack Foundational Literacy and Numeracy (FLN) skills. Saajha, an NGO based in Delhi, is attempting to tackle this challenge by focusing on the parents of children attending government primary schools, an approach which is receiving increased attention recently. Saajha onboards parents on their WhatsApp platform, conducts the assessment of their children over telephone and based on their learning level shares appropriate learning content with parents through their WhatsApp chatbot. We are collaborating with Saajha to design and implement multiple experiments to improve their operational efficiency and reduce their cost of engaging with parents.

Project led by

Prof. Ambrish Dongre

Associate Professor of Ravi J. Matthai Centre For Educational Innovation

Centre Researchers

Dr. Neaketa Chawla

Post-doctoral Researcher

Rhythm Bhatia

Pre-doctoral Researcher

Building a Trademarks dataset for empirical and data driven legal research

Abstract

Publicly accessible bulk datasets of trademark application and registration information are crucial for enabling comprehensive and data-driven research on the administration of trademark law. Such datasets allow researchers to systematically examine trends, predictability, and potential biases in how trademark provisions are applied in India. Given the lack of comparable large-scale datasets, empirical scholarship relating to trademarks in India remains very scarce. This position is most critically visible in legal scholarship, empirically studying the functioning and efficacy of trademark systems in India. To alleviate this lacuna and contribute to the empirical literature examining trademark systems, this project aims to create a novel dataset by downloading and collecting examination reports from the online portal of the Indian Trade Marks Registry.

Project led by

Prof. M P Ram Mohan

Professor of Strategy

Centre Researcher

Prerna Seerwani

Pre-doctoral Researcher

Price shock and supply chain reorganisation

Abstract

The Russia-Ukraine war has underscored the vulnerability of global supply chains, particularly in critical sectors like energy and commodities. These disruptions have had far-reaching effects, including in India, where price volatility—especially in coal—has posed significant challenges for firms. This project analyzes Goods and Services Tax (GST) data from an Indian state, offering a unique opportunity to examine large-scale economic networks through detailed business-to-business transaction records. Using network-theoretic approaches, we explore patterns such as community structures while focusing on how production networks absorb and respond to external shocks. A key objective is to understand how firms adjust their pricing strategies in response to coal supply disruptions triggered by global events.

Project led by

Prof. Anindya Chakrabarti

Associate Professor of Economics

Centre Researcher

Vijay V Venkitesh

Pre-doctoral Researcher

Dynamic Market Microstructure Modelling via Machine Learning

Abstract

Modern electronic markets are driven by high-frequency trading and the interactions of a vast number of heterogeneous traders, giving rise to complex dynamics that traditional models often fail to capture. These dynamics can lead to emergent behaviors, systemic vulnerabilities, and endogenous market fragility in fast-paced, data-driven environments. This project develops a mathematical modelling framework to examine how collective trading behaviors influence price formation, liquidity, and overall market stability, while capturing interactions among numerous participants. A key objective is to derive an indicator to quantitatively assess market fragility and stability, identify trader states contributing most to systemic risk, and explore potential regulatory interventions. Using high-frequency market data, the project provides actionable insights for understanding, predicting, and managing risks in modern electronic markets, offering a robust foundation for research and policy design.

Project led by

Prof. Tanmoy Majilla

Assistant Professor Centre for Management in Agriculture

Centre Researcher

Aswathi Ajith

Pre-doctoral Researcher

Decoding Corporate Communication through Multimodal Analytics

Abstract

Corporate social media communication has emerged as a critical driver of brand visibility, stakeholder engagement, and firm value. Increasingly, companies are using media-rich content, beyond text, such as images, videos, etc., for their social media communications. While existing literature has extensively examined the role of textual and technical visual features in shaping user engagement with firm-generated content, research on understanding the content within images is largely unexplored. This study addresses that gap by investigating whether the demographic visual cues, such as gender, age and race of the human subjects depicted in corporate imagery, along with work-setting contexts and image aesthetics, impact on the engagement. Drawing on a large-scale dataset of image-based posts by S&P 100 firms on X (formerly Twitter), we employ an Abductive ML methodology. In this approach, we use Machine Learning for algorithm-supported induction to identify the robust patterns in the data, Explainable AI to interpret the most salient features driving those patterns, Abductive Reasoning to develop theoretical explanations, and finally Regression to test the resulting hypotheses. The study contributes to the growing literature on firm-generated content and explainable AI. It further highlights the persistent gender and age stereotypes in corporate visual communication, with broader implications for diversity and inclusion in corporate communications.

Project led by

Prof. Adrija Majumdar

Assistant Professor of Information Systems

Centre Researcher

Vaishnavi Sharma

Pre-doctoral Researcher

Agentic AI as a Socio-Technical Paradigm: Exploring Challenges, Opportunities, and Mitigation Strategies for Consumer Engagement

Abstract

Agentic Artificial Intelligence (AI), characterized by autonomy, adaptability, and goal-directed behavior, marks a significant shift from reactive systems to self-directed agents, yet its implications for marketing and consumer engagement remain under-theorized. This study conceptualizes agentic AI as a socio-technical paradigm that reshapes human–machine interactions and redistributes agency across organizational processes. It investigates how marketing practitioners interpret and operationalize agentic AI in consumer-facing contexts, while examining emerging tensions between autonomy and control. The research also explores challenges related to trust, accountability, and unintended outcomes associated with autonomous systems. Using a multi-stage grounded theory approach, the study draws on qualitative data from marketing executives experienced in AI-enabled engagement systems. Data collection includes a screening phase followed by structured essays and iterative theoretical sampling. The analysis aims to develop a process-oriented and empirically grounded framework. The study contributes to theory building in consumer research and offers actionable insights for managing agentic AI in practice.

Project led by

Prof. Rajat Sharma

Associate Professor of Marketing

Centre Researcher

Dr. Shivinder Nijjer

Post-doctoral Researcher

Strategic and Operational Planning for Electric Bus Systems: A Unified, Degradation-Aware Optimization Architecture

Abstract

The global transition to sustainable public transit relies heavily on the efficient planning and operation of electric bus fleets. However, designing these systems presents significant computational challenges, as discrete routing decisions are tightly coupled with the continuous and non-linear physics of battery degradation. Moreover, optimizing daily operations in isolation often fails to account for long-term infrastructure investments and battery health costs. To address these challenges, this research proposes a unified, degradation-aware planning and scheduling framework for electric bus systems that explicitly integrates fleet sizing, infrastructure planning, and daily operations. Given the scale and complexity of this coupled problem—which often causes traditional commercial solvers to stall due to fractional degeneracy—the project explores a state-of-the-art optimization engine based on a graph-theoretic branch-and-cut methodology. By incorporating dynamic Pareto-optimal cuts and advanced combinatorial strengthening techniques, the approach aims to overcome conventional linear programming limitations and efficiently prune degenerate search spaces. By embedding battery health dynamics within a highly scalable optimization framework, the proposed solution enables transit agencies to make cost-effective, service-preserving electrification decisions that support both immediate operational efficiency and the long-term sustainability of electric bus fleets.

Project led by

Prof. Sachin Jayaswal

Professor of Operations and Decision Sciences

Centre Researcher

Dr. Pranav Gairola

Post-doctoral Researcher

Legal Framework for AI Regulation and Governance: A Comparative Study

Abstract

Artificial Intelligence (AI) has rapidly become a transformative yet contested technology, offering benefits such as enhanced decision-making, medical advancements, and efficiency across sectors, while simultaneously raising concerns around bias, surveillance, privacy, and accountability. As AI systems evolve, existing legal frameworks have proven inadequate to address emerging regulatory challenges. This has led to a global race to regulate AI, with jurisdictions such as the EU, US, UK, and India adopting divergent approaches ranging from rules-based to principles-based frameworks. Recent developments, including major policy initiatives and international summits, highlight both the urgency and complexity of establishing effective AI governance. However, current regulations largely focus on immediate risks, often overlooking long-term threats and the misuse of AI by human actors. Additionally, geopolitical competition and economic interests are reshaping regulatory priorities, potentially weakening safeguards. This study conducts a comparative analysis of AI governance across key jurisdictions, examining the political economy shaping regulatory approaches. It also explores the roles of governments, big tech firms, and other stakeholders in influencing policy outcomes. Using a mixed-method approach, including legal analysis and stakeholder insights, the research evaluates the effectiveness of existing frameworks. The study ultimately aims to propose pathways toward a coherent and globally relevant AI governance framework.

Project led by

Prof. Saravanan A

Assistant Professor
Professor of Strategy

Centre Researcher

Adithya Kiliveedu

Pre-doctoral Researcher

Data-driven Decision Rules for Stochastic Optimization

Abstract

A decision rule is a policy that prescribes the decision of an optimization model. It is an alternative to solving an optimization model from scratch. The decision rule provides quick decisions; thus, it is useful for decision-making in giant models that often arise in supply chain networks. In this work, we are designing data-driven decision rules for stochastic optimization problems that arise in operations management. These decision rules are grounded in the principled rigor of operations research and data science techniques, and they aim to provide high-quality solutions to optimization problems that are frequently solved in real time. It also paves the way for carrying out sensitivity and stability analyses of the solutions to optimization problems.

Project led by

Prof. Navneeth Vidyarthi

Concordia University, Montreal

Prof. Ankur Sinha

Professor of Operations and Decision Sciences

Centre Researcher

Dr. Chhavi Sharma

Post-doctoral Researcher

Spatial Dynamics of Land Use and its Transformation †

Abstract

As regions experience rapid urbanization and environmental shifts, tracking land-use transformation requires moving beyond static, lagged surveys to continuous, real-time monitoring. This research project aims to decode these complex spatial dynamics by harnessing the current paradigm shift in Geospatial Artificial Intelligence (GeoAI). This study focuses on building more adaptable, localized solutions. The research aims to develop heterogeneity-aware GeoAI architectures for the Indian landscape. By ingesting multimodal data—fusing different-resolution multispectral imagery, with non-spatial attributes (such as residential demographics, commercial data, or specific infrastructure details) tagged directly to geographic anchors—the system can natively encode shifting spatial relationships alongside vital socioeconomic realities. This comprehensive approach enables high-fidelity anomaly detection and precise land-use classification. The core objective is to translate these complex, multidimensional representations into actionable public policy. By serving as a critical translation layer between advanced industry technology and government priorities, the project will output bespoke, query-based decision-support dashboards. These tools will empower policymakers to shape a data-driven approach to land management and policy decisions.

Centre Researcher

Tarun Tiwari

Pre-doctoral Researcher

Exact Methods to solve General Bilevel Optimisation Problems †

Abstract

Combinatorial Bilevel Optimisation Problem involves hierarchical decision problem structure, but has limited development on the scalable exact methods for general setting. Existing approaches rely on reformulations with strong assumptions on the structure of lower level problem, and approximations of the lower level's decision space. Currently this work involves developing an exact solution framework for binary bilevel optimisation problem, which further can be extended for integer or continuous decision variables under appropriate structural assumptions. The focus is on reformulation and identifying constraints that can be integrated into a branch-and-cut framework, a state-of-the-art integer programming technique, with guarantees on optimality and problem tractability. The main goal of this work is to contribute to advancement on exact methods for a wider class of bilevel problem.

Centre Researcher

Jepan Taji

Pre-doctoral Researcher

Momentum - Controlled Accelerated Optimization for Data-Driven Machine learning problems †

Abstract

Many large-scale data-driven applications in machine learning rely on fast optimization algorithms, yet their performance is often limited by instability and oscillatory behavior. We focus on the design and analysis of a momentum-based accelerated optimization algorithm that improves stability while retaining fast convergence. By carefully controlling the momentum dynamics, the proposed method achieves reduced oscillations and smoother iterative behavior. A Lyapunov-based theoretical analysis establishes global convergence guarantees and accelerated convergence rates, with numerical results demonstrating smooth, stable behavior, particularly for ill-conditioned problems.

Centre Researcher

Dr. Nantu Kumar Bisui

Post-doctoral Researcher

Bilevel Optimization based Decomposition Approach for Optimization †

Abstract

Mathematical programming-based optimization methods—such as linear programming, mixed-integer programming, and dynamic programming—guarantee optimality but often require substantial computational time and resources, especially when applied to complex, real-world problems. In contrast, approximation-based techniques, including heuristics and metaheuristics (genetic algorithms, simulated annealing, tabu search, ant colony optimization, etc.), offer faster solutions but do not ensure optimality and may struggle with scalability. Our team is developing a bilevel optimization-based decomposition approach to address these limitations and leverage the strengths of both exact and approximation methods. This method can simultaneously apply the classical optimization method and heuristic methods to efficiently solve large-scale, real-world problems across domains such as business, science, and engineering. The BOBD framework is designed to produce high-quality solutions within practical timeframes, making it well-suited for complex optimization tasks.

Centre Researchers

Dr. Dhaval Pujara

Post-doctoral Researcher

Shobhit Arora

Pre-doctoral Researcher

Pedestrian Group Dynamics: An Experimental and Simulation-Based Study †

Abstract

Pedestrians in religious gatherings commonly move in social groups rather than as solo travelers. This highlights the need for a deeper understanding of how groups of different sizes move in dense crowds and how group dynamics influence crowd movement. The present study addresses this gap by analyzing pedestrian groups using the social force model. The group behavior study in the Indian crowd is motivated by the observations from the world's largest religious gathering, the Maha Kumbh Mela 2025, held in Prayagraj, Uttar Pradesh, India. In Indian religious gatherings, group participation is observed significantly more than individual participation. This is especially evident during religious events, where it is more common to attend with friends, family, and social groups rather than alone. Crowd dynamics, such as lane forming, grouping, overtaking, avoidance of obstacles and panic behavior are modeled to ensure crowd control and safety.

Centre Researcher

Dr. Akash Verma

Post-doctoral Researcher

† **Projects led by Prof. Ankur Sinha**

PUBLICATIONS BY CENTRE MEMBERS IN 2025-26

Prof. Ankur Sinha

Professor of Operations and Decision Sciences

A. Sinha, S. Arora, and D. Pujara. "AutoOpt: A Dataset and a Unified Framework for Automating Optimization Problem Solving." Advances in Neural Information Processing Systems (NeurIPS), 2025.

A. Sinha and S. Gunwal. "A linear programming-based hyper local search for tuning hyperparameters." Operations Research Letters 61:107287, 2025.

A. Sinha, C. Agarwal, and P. Malo. "FinBloom: Knowledge-Grounding Large Language Model with Real-Time Financial Data." Knowledge-Based Systems, 2026.

Prof. Karthik Sriram

Associate Professor of Operations and Decision Sciences

K. Sriram, A. Sinha, and S. Choudhary. "Predictive Hotspot Mapping for Data-driven Crime Prediction." Production and Operations Management, 2026.

Prof. M P Ram Mohan

Professor of Strategy

M. P., Rammohan, Aditya Gupta, and Vijay V. Venkitesh. "An Empirical Analysis of'Scandalous' and'Obscene'Trade Marks in India." NYU J. Intell. Prop. & Ent., 2025.

M. P., Rammohan. "Artificial Intelligence, Developers, and Copyright Infringement: The Liability Dilemma." Indian J. Intell. Prop. L. 15 2025.

COMPLETED RESEARCH PROJECTS

Organizational, economic, public policy, and human resource dynamics of large congregations

Abstract

Effective management of large-scale public gatherings, such as the Kumbh Mela, is vital to safeguard public safety. It plays a crucial role in optimizing operational resources and enhancing the overall visitor experience. To demonstrate effective event management, we use a queueing model to develop a simulation. The simulation study is performed using Arena simulation software. The study focuses on key performance measures such as average queue length and waiting time of a visitor for the 'snan'. The objective is to evaluate optimal waiting space, improve operational efficiency, identify critical bottlenecks and derive actionable insights for optimizing large-scale event planning. By analyzing crowd dynamics and resource utilization, the study aims to enhance safety protocols and improve the overall experience for visitors.

Research Project ***Completed***

An iterative gradient-based bilevel approach for hyperparameter tuning in machine learning

Abstract

Hyperparameter tuning in the area of machine learning is often achieved using naive techniques, such as random search and grid search that only lead to an approximate set of hyperparameters. Although techniques such as Bayesian optimization perform an intelligent search on the domain of hyperparameters, it does not guarantee an optimal solution. A major drawback of most of these approaches is that as the number of hyperparameters increases, the search domain increases exponentially, thereby increasing the computational cost and making the approaches slow. The hyperparameter optimization problem is inherently a bilevel optimization task, and there exist studies that have attempted bilevel solution methodologies for solving this problem. These techniques often assume a unique set of weights that minimizes the loss on the training set. Such an assumption is violated by deep learning architectures. Our study is on gradient-based bilevel optimization method for solving the hyperparameter optimization problem. The method is general and can be easily applied to any class of machine learning algorithms that involve continuous hyperparameters.

Research Project ***Published*** Link to the paper

Mathematical Expression Recognition for Optimization Problems

Abstract

Mathematical expression recognition is an essential task in scientific document understanding, facilitating the automatic extraction and interpretation of complex notational structures. Despite recent progress, existing systems often fall short when handling the intricate spatial arrangements and semantic hierarchies inherent in mathematical notation. To address these limitations, our research introduces a novel deep learning-based model specifically designed for robust recognition of handwritten and printed mathematical expressions. The model leverages a hybrid encoder-decoder architecture, integrating convolutional neural networks (CNNs) for visual feature extraction with a transformer-based decoder to accurately capture structural dependencies in two-dimensional math layouts.

Research Project ***Published*** Link to the paper

Projects by Prof. Ankur Sinha

Financial networks from big data: A multivariate time series based approach

Abstract

Financial markets exhibit non-trivial comovement and dependency structure. The standard approach in the finance literature is to consider the market in its aggregate form. A more recent 'data'-oriented approach emphasizes a more granular decomposition of the market so that the aggregate dynamics can be broken down into contributions arising from individual assets. This leads to two analytical problems. First, one has to necessarily deal with a large amount of data such that the process scales with the volume of data (large N and large T where T>>N). Two, analyzing such a large volume of data requires toolkits which are at the intersection of econometrics and machine learning. In this project, the goal is to construct large scale financial networks based on multivariate time series data to capture the dynamics of the system. The main idea is to provide an algorithmic approach to convert time series into networks such that the properties of time series are also inherited by the resulting network. The spectral structure of the comovement network is known to capture, at least partially, the booms and busts in the markets. Here, we take up two specific problems.One, how reliably does the spectral structure reflect the system for the case where T~N. Two, a large chunk of the literature on networks construction depends on bivariate modelling which is subject to failure due to multiple hypothesis testing. Therefore, an imminent question is how to construct a network with a direct multivariate model.

Project by

Prof. Anindya Chakrabarti

Associate Professor of
Economics

Research Project ***Completed***

Hiring for the Future – A People Analytics Approach

Abstract

The future of work is a critical aspect for many organizations. A 2020 report by the World Economic Forum suggests that among the various challenges faced by organization one of the most critical areas is skill gaps. They argue that skill gaps continue to remain high as in-demand skills across jobs change in the short term. The top skills and skill groups which employers see as rising in prominence in the lead up to 2025 include groups such as critical thinking and analysis as well as problem-solving, and skills in self-management such as active learning, resilience, stress tolerance and flexibility. On average, companies estimate that around 40% of workers will require reskilling of six months or less and 94% of business leaders report that they expect employees to pick up new skills on the job, a sharp uptake from 65% in 2018. The changing nature of work and the exponential technology development imply that employees need to constantly re-skill and up-skill. In the current environment, while knowledge can be accessed via multiple sources the behaviours to develop oneself become more important. What behaviours will organizations require for ensuring they have a workforce that can reskill and upskill exponentially? This will be the primary area of research for this study. Using a data-driven approach, this study uses surveys and NLP to understand which behavioural traits enable re-skilling at pace. We will employ text-mining methods and techniques to identify behavioural traits that help in re-skilling. The insights from this will be further validated and tested using a survey instrument administered to a large sample of individuals

Project by

Prof. Aditya Christopher Moses

Assistant Professor of
Human Resources Management

Research Project ***Completed***

Effects of Dynamic Rewards on Solver Efforts in Creative Crowdsourcing

Abstract

The study is on the nuanced impact of dynamic rewards in creative crowdsourcing. It shall include randomized trials during contests with dynamically adjusted rewards. It shall also combine dynamic rewards with feedback. This multifaceted approach aims to understand how variations in rewards, feedback, and their combination influence designer behavior, submission diversity, and solution quality. The study will also explore the implications of dynamic rewards and the increasing role of AI-based tools in evaluating creative submissions, contributing to discussions on optimizing creative crowdsourcing platforms.

Project by

Prof. Swanand Deodhar

Associate Professor of
Information Systems

Prof. Samrat Gupta

Associate Professor of
Information Systems

*Research Project **Completed***

Data-driven auction design: A computational approach

Abstract

Auctions are often used to sell property rights for liquor licenses, spectrum licenses, land and mineral rights, and construction projects etc. This project investigates potential improvements in these auctions using a computational data-driven approach. The first part of this project will be to collect primary data of the participants and their choices in auctions. Subsequently, using the game-theoretic properties of the chosen auction design, we will computationally estimate the true (unobservable) value distribution across players of the object(s) being auctioned (e.g., liquor licenses). The estimation method used will be non-parametric “distance minimization” between the observed out-of-sample distribution of bids, and the predicted out-of-sample distribution of bids using optimally calibrated parameter values. E.g., Athey, Levin, and Seira (QJE 2011) use their estimated model to make comparative static predictions and test that for fit against data from timber auctions. Finally, to analyse which auction design would have best met the various aims of the auction designer, we will use the calibrated model, parameters, and the estimated valuations of the bidders. In particular, using these we will simulate the revenue, efficiency, and other metrics of importance for different auction designs. In addition to the use of simulation described above, to analyse alternate auction designs, we will use simulations of variations of the estimated model, parameters (like risk aversion, budgets etc.), and value distributions to analyse the different rates with which different auction designs can meet the various possible aims of the auction designer.

Project by

Prof. Jeevant Rampal

Associate Professor of
Economics

*Research Project **Completed***

Causes, Symptoms and Consequences of Sociocultural polarization

Abstract

The Information and Communication Technology (ICT) provides users unparalleled access to information from around the globe. In spite of demographic differences, people can communicate, express and evolve their opinions on topics ranging from politics to culture. The wide-ranging information exchange on digital media can lead to two scenarios viz. formation of public sphere or formation of echo chambers. While the public sphere, which promotes greater diversity, is a well-researched domain, substantially less research has been conducted on echo chambers in relation to socio-cultural events. Despite the huge affirmative impact of socio-cultural events on society, the proliferation of controversies around them and reinforcement through echo chambers is collectively having malefic effects on societies. Recent controversies around socio-cultural products such as movies, painting, books, cartoons, etc. resulted in serious outcomes. For example, Indian movie Padmavat brought polarization of public perception which further reinforced through echo chambers and escalated into widespread agitations. It led to mass destruction of property and human suffering during agitation. We believe this represents a mounting problem for society, one that is likely to intensify in the era of social media. Thus, understanding the causes, symptoms and consequences of socio-cultural polarization is critical and would be valuable for developing interventions to reduce unhealthy societal and organizational polarisations.

Project by

Prof. Samrat Gupta

Associate Professor of Information Systems

Research Project ***Published***

Link to the paper

Multi-period Facility Interdiction Problem

Abstract

We propose to study a multiperiod interdiction problem, in which the leader (attacker) with a limited interdiction budget decides the sequence of facilities to interdict (destroy) over time so as to inflict the maximum cumulative damage to the follower. The follower's objective is to serve a given set of demand points from the surviving subset of facilities the minimum cumulative cost across all periods. for this, his decisions include the assignments of demand nodes to the surviving facilities and the allocation of his limited budget to the revival of interdicted facilities and the protection of the surviving facilities against their interdiction in the future periods. The multi-period version of the problem, which is the focus of the proposed study, presents additional complexity due to the leader's interdiction decisions constrained by the follower's protection decisions. The objective of the proposed study is to design efficient exact solution methods for this challenging bilevel integer program.

Project by

Prof. Sachin Jayaswal

Professor of Operations and Decision Sciences

Research Project ***Completed***

Models of implied volatility and information content of option prices

Abstract

The proposed research project on modeling implied volatility (IV) and understanding the information content of option prices is part of our larger research agenda on studying ways to quantify uncertainty in financial markets, focusing on India. Traders in options markets do not usually quote option prices, but the volatility implied by them. IV is that volatility input to the famous Black-Scholes option pricing formula such that the Black-Scholes prices match the market price of the options. It has been observed that IV is not a constant but varies systematically with strike/delta and expiration date. The shape of the observed relationship between implied volatility and strike is called volatility smile or skew. In this project, we plan to explore various ways of modeling the dynamics of volatility smile using variants of state-space models and the Kalman Filter.The proposed research project on modeling implied volatility (IV) and understanding the information content of option prices is part of our larger research agenda on studying ways to quantify uncertainty in financial markets, focusing on India. Traders in options markets do not usually quote option prices, but the volatility implied by them. IV is that volatility input to the famous Black-Scholes option pricing formula such that the Black-Scholes prices match the market price of the options. It has been observed that IV is not a constant but varies systematically with strike/delta and expiration date. The shape of the observed relationship between implied volatility and strike is called volatility smile or skew. In this project, we plan to explore various ways of modeling the dynamics of volatility smile using variants of state-space models and the Kalman Filter.

Project by

Prof. Sobhesh kumar Agarwalla

Professor of Finance and Accounting

Prof. Vineet Virmani

Associate Professor of Finance and Accounting

Research Project ***Completed***

Artificial Intelligence, Contracts, and Indian Legal Systems

Abstract

This project aims to explore the impact of Artificial Intelligence in the Indian legal systems. Specifically, the study explores Artificial Intelligence in contract management, courts and management of cases, impact of AI in corporate law and governance, etc.

Project by

Prof. M P Ram Mohan

Professor of Strategy

Research Project ***Completed***

Optimal Merkle Trees for Blockchain Transactions

Abstract

Today blockchain technologies have wide applications because it is not possible to alter information in the particular block without altering the subsequent blocks. Blockchain technologies are used where decentralized structure, security and privacy are required. Blockchain technology relies heavily on the efficiency of Merkle trees for managing and updating transaction data. In this research, we are trying to take advantage of typical transaction characteristics to better construct the Merkle tree to improve the performance of the blockchain network. It consists of identifying a tree structure with the minimum number of hash transfers over a network required to validate the account data associated with each transaction based on the distribution of all transactions. Using the typical characteristics of transaction distributions, we propose a novel approach to minimize the number of hash transfers over a network required to validate transactions. Our optimization models are formulated as a binary quadratic program (BQP), which we linearize using various linearization techniques. In addition to this we also have our own set of symmetry breaking constraints. To solve this model efficiently, we use the cplex internal benders Benders that utilizes the inherent network flow structure in the separation sub-problems. We use the divide and conquer method to construct a Merkle Tree of large no accounts which significantly improve transaction processing efficiency.

Project led by

Prof. Sachin Jayaswal

Professor of Operations and Decision Sciences

*Research Project **Completed***

High-frequency trading: Measuring latency from big data

Abstract

Over the last decade, the Indian market has seen significant growth in algorithmic trading and more specifically, high-frequency trading (HFT) activity. During this period, we have witnessed a significant change in the trading landscape as presently close to half of the trading volume in the stock exchanges is contributed by algorithms. This rise has not always been smooth as there have been calls for regulations to restrict algorithmic trading activity due to the fear of probable market manipulation. Latency is considered one of the most important market parameters for HFTs. Using a large novel dataset of order and trade level data from the NSE, we would like to inspect how the latency in the Indian market has changed and if that has caused any shift in the way HFTs operate. We would also like to observe how the different market quality parameters have evolved over this time.

Project by

Prof. Anirban Banerjee

Assistant Professor of Finance and Accounting

*Research Project **Published***

Link to the paper

Can an AI Coach Help You Lose More Weight Than a Human Coach: Empirical Evidence From a Mobile Fitness Tracking App

Abstract

Artificial intelligence(AI) assisted tools are increasingly being used in health care contexts to provide advice and motivation. But whether AI can be a good or even better substitute for human involvement in these contexts is an open question. We provide empirical evidence to answer this question specifically in the context of fitness tracking mobile applications (apps). In addition to facilitating the tracking of activity and food intake, such apps provide advice and motivation in the form of targeted messages to their consumers, and this can be done through human coaches or an AI coach. An AI coach allows these apps to scale their offerings to a larger number of consumers, available on demand to consumers, and potentially more finely targeted by leveraging vast amounts of data. On the other hand, human coaches might be better placed to show empathy, and consumers might also feel more accountable to humans. We compare human and AI coaches on their effectiveness in helping consumers achieve their weight-loss goals. Our empirical analysis is in the context of a large-scale mobile app that offers consumers different levels of subscription plans with human and AI coaches respectively, and specifically compares adopters of the two kinds of plans on their weight loss and goal achievement. We address the potential self-selection in plans by employing a matching-based approach. We find, for our sample of almost 65000 consumers that human-based plans do better than those in AI-based plans in helping them achieve their goals, but that this differs by consumer characteristics including age, gender and body mass index (BMI).

Project by

Prof. Anuj Kapoor

Past Centre Member

Research Project ***Completed***

Sentimental Analysis on Amazon Book Reviews in India (vs US)

Abstract

Major empirical methods: web scrapping, data pre-processing, sentimental and emotions analysis. This research will compare the emotional and sentimental analysis of book reviews that were posted on Amazon.in (India) and Amazon.com (US) by taking into consideration of other characteristics such as book ratings, book cost, discounts available on the book, etc. This study will focus mostly on the sentiments and emotions expressed in Amazon USA and India book reviews. I explored various algorithms like VADER (Valence Aware Dictionary and Sentiment Reasoner), Textblob, SentiBERT etc. to detect the sentiments present in the product reviews also explored emotions like happy, fear, disgust, anticipation, joy, sadness, surprise, and trust.

Project by

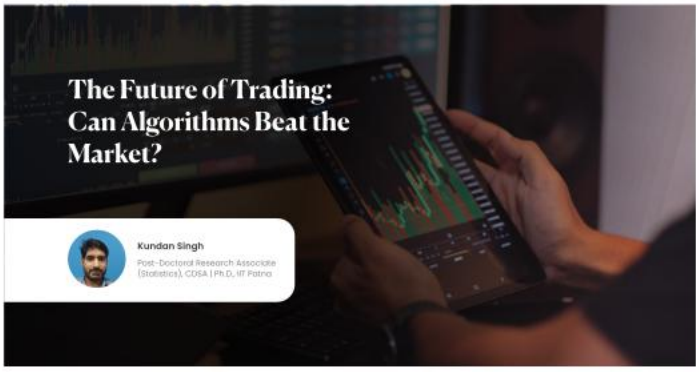
Prof. Hyokjin Kwak

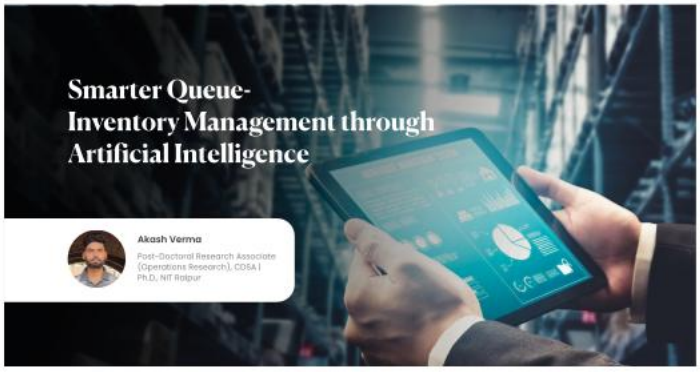
Past Centre Member

Research Project ***Completed***

COMMUNIQUE ARTICLES

November 2025 article series explored the growing influence of artificial intelligence and data-driven decision-making across industries. The pieces examined how AI systems can sometimes prioritise measurable outcomes over holistic impact, while also highlighting the importance of Explainable AI (XAI) in building transparency and trust. The series further delved into the role of algorithms in financial markets, questioning their ability to consistently outperform human judgment. In the operations domain, it showcased how AI is transforming inventory management and improving efficiency. Finally, the collection underscored the strategic value of supply chain network data in driving economic performance within an increasingly interconnected global landscape.





SEMINARS 2025-26

The Brij Disa Centre for Data Science and Artificial Intelligence at IIMA, in collaboration with the Misra Centre for Financial Markets and Economy (MCFME) and Equipoise – The Economics Club at IIMA, organized a policy talk on "Sovereign AI: A Pathway to Viksit Bharat" on January 31, 2026, at the IIMA New Campus.

The session featured Sujeet Kumar, a second-term Member of Parliament (Rajya Sabha), as the keynote speaker, and was moderated by Prof. Sobhesh K. Agarwalla. The talk explored the strategic importance of Sovereign AI in shaping India's technological and economic future, aligning with the vision of Viksit Bharat.

Shri Sujeet Kumar brought a multidisciplinary perspective, drawing from his experience as a parliamentarian, legal expert, and global policy professional. His insights spanned technology governance, regulatory frameworks, and the role of artificial intelligence in national development.

The session witnessed active participation from students, faculty, and researchers, fostering meaningful dialogue on the intersection of public policy, data science, and emerging technologies. The event underscored the Centre's continued commitment to facilitating discussions on critical and contemporary issues at the nexus of technology and society.

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