Indian Institute of Technology, Kanpur

Proposal for a New Course

1. **Course No:** ECO 7XX

2. **Course Title:** Spatial data analysis: Methods and Applications

3. **Per Week Lectures:** _2_(L), Tutorial: _0_(T), Laboratory: 0_(P), Additional Hours[0-2]: 0

    _____(A), Credits (3*L+2*T+P+A): 9_

4. **Duration of Course:** Full Semester

5. **Proposing Department:** Economic Sciences

    Other Departments/IDPs which may be interested in the proposed

    course: Other faculty members interested in teaching the proposed

    course

6. **Proposing Instructor(s):** Malabika Koley

7. **Course Description:**

A) **Objectives:**

This is an advanced level course in spatial econometrics. Spatial data is becoming increasingly popular in a variety of fields such as economics of crime, regional science and urban economics, agricultural economics, health economics, developmental economics, trade and finance, just to name a few. Therefore, the aim of this course is to introduce students to the various tools and techniques of spatial econometric modeling and data analysis.

B) **Contents** (*preferably in the form of 5 to 10 broad titles)*:

S. No	Broad Title	Topics	No. of Lectures
1.	Introduction	Introduction to spatial data with examples using real data, spatial dependence and clustering, why spatial modeling matters?	2
2.	Exploratory spatial data analysis (ESDA)	Choropleth maps, Global Moran's I, Moran's scatterplot, Local Moran's I, Geary's C, Tests for spatial dependence	2
3.	Spatial Neighborhood Structure	Modeling neighborhood structure using weight matrices, exogenous and endogenous weight matrices, time varying weight matrices, selection of weight matrix; the three kinds of spatial spillover effects	4
4.	Spatial Econometric Models	For Conditional Mean: Spatial autoregressive model (SAR), conditional autoregressive model (CAR), spatial error model (SEM), Combination of SAR and SEM (SAC), spatial lag model (SLX), spatial Durbin model (SDM), spatial Durbin error model (SDEM), general nesting spatial model (GNS), matrix exponential spatial specification (MESS); interpretation using impact effects, multiplier effect.	4

		For conditional higher order moments: Spatial autoregressive conditional heteroskedasticity model (S-ARCH), generalized spatial autoregressive conditional heteroskedasticity (S-GARCH) model	
5.	Inference of spatial econometric models	Estimation: Maximum likelihood estimation (MLE), quasi-MLE (QMLE), Instrumental variable (IV)/ two-stage least squares (2SLS), generalized method of moments (GMM) Testing: Trinity of tests: likelihood ratio (LR), Wald (W), Rao's score test (RS), conditional Rao's score test (CRS), robust Rao's score test (RS*), Non-nested tests.	4
6.	Spatial panel data models (SPD)	Fixed and random effects models, static and dynamic panel data models, estimation and testing of SPD.	2
7.	Spatial quantile regression models	Quantile regression in spatial modeling, applications	2
8.	Challenges and Critiques of spatial econometric modeling	Modifiable Areal Unit problem (MAUP), sparse weight matrix	2
9.	Applications of spatial econometric modeling	Applications in economics of crime, housing prices, regional science and urban economics, gravity trade model. Spatial volatility of housing prices, clustering of health services, among others.	4

C) **Pre-requisites:** Knowledge of econometrics (Instructor's consent)

D) **Short summary for including in the Courses of Study Booklet:**

Spatial dependence and spatial clustering are prevalent not only in the different areas of economics, but also in many other fields such as regional science, engineering, biological sciences, health sciences, among others. The primary aim of this course is to provide students with an in-depth understanding of the distinctive characteristics of spatial data and how to analyze such data with the help of spatial econometric modeling. By the end of the course, students should be able to identify and formally test the possible presence of spatial dependence in their dataset, and model such dependence using the different kinds of specifications learnt in class. Spatial econometrics is a rapidly growing area, and thus, there is much scope for research, both theoretical and empirical. Although the focus of the course will be on the many applications of spatial modeling in economics, it may be of interest to anyone who is seeking to learn the different tools and techniques of spatial analysis. Knowledge of econometrics and/or statistics will be required for the course.

8. **Recommended books:**

1. Anselin, Luc. *Spatial econometrics: methods and models*. Vol. 4. Springer Science & Business Media.
2. LeSage, James, and Robert Kelley Pace. *Introduction to spatial econometrics*. Chapman and Hall/CRC, 2009.

3. Elhorst, J. Paul. *Spatial econometrics: from cross-sectional data to spatial panels*. Vol. 479. Heidelberg: Springer, 2014.
4. McMillen, Daniel P. *Quantile regression for spatial data*. Springer Science & Business Media, 2012.
5. Cressie, Noel. *Statistics for spatial data*. John Wiley & Sons, 2015.

10.   **Recommended Readings:**

1. Anselin, Luc, Anil K. Bera, Raymond Florax, and Mann J. Yoon. "Simple diagnostic tests for spatial dependence." *Regional Science and Urban Economics* 26, no. 1 (1996): 77-104.
2. Anselin, Luc, and A. K. Bera. "Spatial dependence in linear regression models with an introduction to spatial econometrics, A. Ullah and DEA Giles (eds.), Handbook of Applied Economics Statistics." *New York: Marcel Dekker* 237 (1998): 289.
3. Anselin, Luc. "Spatial externalities, spatial multipliers, and spatial econometrics." *International regional science review* 26, no. 2 (2003): 153-166.
4. Anselin, Luc. "Thirty years of spatial econometrics." *Papers in regional science* 89, no. 1 (2010): 3-26.
5. Elhorst, J. Paul. "Applied spatial econometrics: raising the bar." *Spatial Economic Analysis* 5, no. 1 (2010): 9-28.
6. Elhorst, J. Paul, and J. Paul Elhorst. "Spatial Panel Data Models." Spatial econometrics: From cross-sectional data to spatial panels (2014): 37-93.
7. Anselin, Luc. "Spatial econometrics." *Handbook of spatial analysis in the social sciences* (2022): 101-122.

** The above list is not final. There may be some exclusions and additions to the list. Empirical papers will be discussed.

Dated: Nov. 26, 2024   Proposer: Malabika Koley_____

Dated:_____DUGC/DPGC Convener:_____

The course is approved / not approved

Chairman, SUGC/SPGC

Dated:_____