Indian Institute of Technology Kanpur
Proposal for a New Course

1. Course No: ECO251

2. Course Title: Econometrics I

3. Per Week Lectures: 3 (L), Tutorial: 1 (T), Laboratory: 0 (P), Additional Hours: 0

Credits: (3*L+T +P+A): 11 credits

Duration of Course: Full Semester Course

4. Proposing Department: Economic Sciences

Other Departments which may be interested: None

5. Proposing instructor: Faculty members of the Department of Economic Sciences

Level of the course: UG

6. Course Description:

A) Objectives: The overall objective of the course is to introduce the students to common econometric models, how to estimate these models and when to employ them for making proper inferences. Ultimately, the material learned during the course should enable the students to make a more informed choice of the econometric models and to better understand, test, and interpret estimation results within the context of a specific problem.

Note that this is a re-design of the current course 'ECO341A: Econometrics I'.

B) Contents

S. No.	Broad title	Topics	No. of Lectures*
1.	Common families of distributions	Discrete distributions: Bernoulli, Binomial, Hypergeometric, Poisson, Negative Binomial; Continuous distributions: Uniform, Normal, Gamma, inverse-Gamma, Beta, Cauchy, lognormal, Student-t, F distribution, Exponential family of distributions	2

2.	Multiple Random Variables	Joint and marginal distributions, conditional distributions and independence, bivariate transformations, hierarchical models and mixture distributions, covariance and correlation, multivariate distributions.	3
3.	Properties of Random Sample	Random samples, sums of random samples, sampling from a normal distribution, convergence in probability, convergence in distribution, almost sure convergence, Delta method.	3
4.	Estimation and Hypothesis Testing	Methods for finding point estimators: method of moments, maximum likelihood estimation (calculus and numerical techniques) and least squares method. Small samples properties of point estimators (single parameters and multi-parameter): bias, precision, efficiency. Large sample properties of estimators: consistency, convergence in distribution and asymptotic efficiency. Interval estimation, hypothesis testing: elements of a statistical test, power of a test, likelihood ratio tests. Asymptotic tests: LR, LM and Wald tests. The relationship between confidence intervals and hypothesis tests.	6
5.	Linear Regression Model	Assumptions of linear regression model, estimation via least squares, sampling properties of least squares rule, sampling performance – Gauss Markov Theorem. Prediction and degree of explanation.	6
6.	Normal Linear Regression Model	Maximum likelihood estimation of β and σ^2, independence of the MLE for β and σ^2, sufficiency and sampling performance, Cramer-Rao lower bound of the estimators. Model selection criterions: R-square, AIC, BIC. Monte Carlo simulations and real-world applications.	6

7.	Restricted Maximum Likelihood Estimators	Mean and covariance of RMLE, consequence of incorrect restrictions, examples. Interval estimation: single and multiple linear combination of the β vector. Example of joint confidence intervals. Interval estimation of σ^2, prediction interval estimator. Hypothesis testing with RMLE.	5
8.	General Linear Regression Model	Linear Regression Model with unknown covariance matrix. GLS and FGLS estimators. Heteroscedasticity. Tests for multiplicative heteroscedasticity, Goldfeld-Quandt test, Breusch-Pagan test. Examples and real life applications. Autocorrelation, GLS and FGLS estimators. Tests for first order autoregressive errors, an asymptotic test, Durbin-Watson test. Examples and real-world applications.	5
9.	Miscellaneous/Additional Topics.	Probit and Logit. Seemingly Unrelated Regression. Examples and real-world applications.	4

*50-minute lecture each, total of 40 lectures.

C) Prerequisites: MSO201A (Probability and Statistics) / HSO201A (Applied Probability and Statistics) / MSO205A (Introduction to Probability) and MTH2xx (Theory of Statistics).

D) Short summary for including in the Courses of Study Booklet: This is the first level course in econometrics that discusses the estimation of some common econometric models, the theoretical properties of the estimators, how to make inference and finally apply the models on real-world econometric problems. The estimation methods that will be under focus are Least Squares (LS) and Maximum Likelihood (ML) techniques.

The lectures will introduce the theoretical aspects of the econometric models, their estimation and inference. We will complement the lectures by a variety of real-world applications on actual data sets through homework assignments and lab classes. Students are expected to implement the knowledge gained from the class to real-world applications for a complete understanding of the econometric problem. The course will include use of R, MATLAB or other similar software.

7) Recommended textbooks:

Statistical Inference, by George Casella and Roger L. Berger. Duxbury Advanced Series, Second Edition. 2002.

Introductory Econometrics: A Modern Approach, by Jeffrey M. Wooldridge. South-Western College Publishing, 6th Edition. 2015.

Econometric Analysis, by William Green. Pearson, 8th Edition. 2018.

Introduction to the Theory and Practice of Econometrics, by George G. Judge, R. Carter Hill, William E. Griffiths, Helmut Lutkepohl and Tsoung-Chao Lee. Wiley Publication, Second Edition. 1988.

DUGC Approval Date Signature of DUGC Convener

The course is approved/not approved.

Chairperson, SUGC