

BOSTON COLLEGE
Department of Economics

econ3370: Topics in Applied Econometrics (Fall 2022)
Stokes 111S: Weds (3:00 – 5:30ish)

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TA: Vaibhav Ojha
Office Hours: TBD

Course Description:¹ This is an advanced econometrics/data-analytics course and a follow-on to econ2228. Selected topics include linear and non-linear least squares estimation as well as maximum likelihood estimation, including logit/probit, ordered logit/probit and poisson/negative binomial count regression models. A term-long research project is an important part of the course. The analytics in the course will be Stata- and Excel-based, but students, in doing their own work, should feel free to work in R, SAS, Python, Matlab or whatever their statistical language of choice might be.

Illustrative examples and datasets are drawn largely, but not exclusively, from the sports world. We could easily work with other data, but there's so much publicly available sports-related data available... Why not? ... and besides, it's fun! Non-sports-related topics that I'm considering include: propagation in pandemics (e.g. covid), gun control, traffic fatalities, real estate valuation and S&P sovereign debt ratings.

Prerequisites: Intermediate Microeconomics (econ2201 or econ2203) and Introductory Econometrics (econ2228). Students are expected to have excelled in econ2228 (I hope you received a B+ or better, and preferably an A or A-), and to know how to run basic econometric models using Stata ... and to be comfortable interpreting regression results.

Texts/Canvas: There are no required texts for this course. I will post materials to Canvas as necessary.

Accommodations: If you are a student with a documented disability seeking reasonable accommodations in this course, please contact Kathy Duggan (x2-8093; dugganka@bc.edu) at the Connors Family Learning Center regarding learning disabilities and ADHD, or staff in the Disability Services Office regarding all other types of disabilities, including temporary disabilities. Advance notice and appropriate documentation are required for accommodations.

Academic Integrity: You will be held to Boston College's standards of academic integrity. If you have any questions as to what that means, see BC's academic integrity policies webpage.²

Pass/Fail: It is perfectly fine, of course, to take the course Pass/Fail... but it is definitely not OK to do so and shirk on group projects/exercises. That is not fair to your teammates... and they will come to hate you! Accordingly: If you are taking the course Pass/Fail, please let me know at the start of the semester, and I will monitor goings-on and make adjustments if necessary.

¹ This course is modeled to some extent after Professor Ray Fair's Economics 438 course @ Yale: <https://economics.yale.edu/undergraduate/courses/438/202103>

² https://www.bc.edu/content/bc-web/academics/sites/university-catalog/policies-procedures.html#academic_integrity_policies

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Class Structure: This course has a somewhat unusual class structure. We will meet once a week for about 2.5 hours. The first half or so of class time (Half #1) will be devoted to standard pedagogy. The second half (Half #2) will be devoted to in-class applied/empirical exercises and focused on the material discussed in Half #1. In-class Exercise work will typically not be completed in Half #2, but can be finished over the course of the following week and turned in by/at the start of the next class. Our course TA, Vaibhav Ojha, and I will be assisting students in-class during Half #2.

I will be posting class/exercise material in advance, and will assume that you've had a chance to review that material prior to class. That way we can hit the ground running!

Hardware (for in-class work): Given the unusual structure of the course, students should bring their laptops with them to class. If you are not able to do this, let me know in advance and I'll arrange for a laptop for you. Note that loaner laptops are available through O'Neill Library.

Course Structure: There are five graded elements in the course; they are (%'s of course grade are in parentheses):

1. One mid-term exam (30%)

There will be one online 90 minute exam (a Canvas Quiz) covering the empirical methods and applications developed in this course. The exam will be open book, open notes, open universe... with one exception there will be no restrictions on the materials that you can use while taking the exam. That exception is that you are not allowed to collaborate with classmates or other individuals whilst taking the exam. The exact exam date is yet to be determined, but you'll see that I'm proposing Thursday 12/1 in the next to last week of classes. Exam grades are curved.

2. Weekly exercises (30%)

As discussed above there will be weekly exercises/assignments/problem-sets devoted to the topic of the week. I will distribute these prior to class, so that you are well prepared (there will be some pre-class work). Each exercise will have you working with data and applying the econometrics methods featured in the course. You will be completing Answer Sheets for each exercise, which will be graded on a 10 point scale. Exercises are graded as team assignments (I will not give separate grades for team members, irrespective of how much each teammate might have contributed to the assignment). I will drop your lowest exercise score when computing course grades. My hope and expectation is that teams will generally do quite well on these exercises.

As mentioned above, you'll have the rest of the week to complete any exercise work not finished in-class during Half #2. (My expectation is that you will need that time to complete the Exercise.) At the latest, exercise Answer Sheets should be submitted by the start of the next class, when I will also quickly review the answers to the exercise.

These will typically be team assignments (usually with two students per team). I will assign the teams, which will change from exercise to exercise.

3. Empirical research project and presentations (27.5%)

This will be a team assignment, which will kick-off with team assignments by Mon Sep 26th, after the first four classes. I will assign teams, each of which will have two randomly selected

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students. Students who would like to work together should let me know their preference by Friday Sep 23rd. I will do my best to honor those requests, but I cannot make any teammate guarantees. More details about the actual assignment below.

4. NCAA Football Week 11 Forecast Challenge (7.5%)

One of the great things about forecasting models is that you get to see how well your model performs. With the *NCAAF11 Challenge* you'll be predicting the outcomes of about 50 NCAA FBS-FBS games in week 11 of the upcoming NCAAF season, beginning with the Friday Nov 4th game featuring your BC Eagles @ home against Duke. This will be a team assignment with two students per team (as usual, I will assign teams... by Weds Oct 12th). I will also participate on this Challenge. Your grade will depend on how well you do relative to the other forecasts (including my forecasts). Stay tuned for more details.

Warning: A general rule with forecasting models is that *less is more...* or put differently, *parsimony is preferred* (overfitting the data can lead to very bad forecasts). And so knowledge of NCAA football may in fact be more of a hindrance than a help.

5. Review Quiz (5%)

There will be an online Quiz covering the review material in the first two classes. This is designed to ensure that everyone is up to speed with their 2228 metrics material, and well prepared to tackle the more challenging topics in this course. The Quiz date is yet to be determined, but you'll see below that I am proposing Mon Sep 19th. As with the Mid Term exam, this Quiz will be open book, open notes, open universe... but closed colleagues.

Software: This course will make extensive use of both Excel and Stata:

You should have worked with Stata in your Econometrics course. At the start of the semester, we will review how to access and run Stata through BC's apps server. To avoid traffic jams on the apps server, you may want to purchase a six-month Stata/BE license for \$48. For details, go to <https://www.stata.com/order/new/edu/profplus/student-pricing/>.

This course also makes extensive use of Excel, particularly its Solver functionality. You should not take this course if you do not have strong Excel skills. To brush up on your Excel skills, you could take a look at any one of about a gazillion websites. Here's one that students have in the past found useful: <https://www.excel-easy.com/>

Important: Unfortunately, the features offered by Excel differ somewhat across platforms and over time. For this course, you will need to have access to Excel's *Analysis ToolPak* and *SolverAdd-in*. If your version of Excel is anything other than Excel 2011 for the Mac, you should be in great shape, though you may have to install the Tool-Pak and Solver functionality (that should be straightforward). If you have Excel 2011 for the Mac, then you have at least two options: 1) run Excel on BC's apps server, which has these capabilities and is faster than you might imagine, or 2) go to <https://www.bc.edu/content/bc-web/offices/its/support/software-hardware/software-downloads.html> and download and install a more recent version of Excel. There are other options as well, if you don't like these two:). Let me know and I'll be happy to help.

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The Applied/Empirical Research Project

The empirical research project will kick off with team assignments at the end of September (you'll see that I'm proposing Mon Sep 26th). As mentioned above, there will be two teammates per team. I will randomly assign teams, although... Let me know if you would like to be teamed with a specific teammate, and I will do my best to honor your request... but I cannot make any teammate guarantees. As I said above: *Students who would like to work together should let me know their preference by Friday Sep 23rd.*

There are no restrictions on topics, but your analysis should employ techniques/methods that have been developed/considered in this course. I'm happy to help with topic selection, and more generally over the course of the project.

As you'll see in the Calendar, I plan on setting aside two classes for one-on-one meetings in which each team will review with me their progress to date, and I'll provide helpful (I hope!) feedback. This should help to keep projects on schedule, and assure a successful outcome.

There are two end-of-semester deliverables: A hardcopy Presentation (PowerPoint or Word or whatever... I just have to be able to print it out) as well as an in-class presentation @ the last class. Your deliverable/presentation should include a detailed discussion of your data, analysis, results and conclusions. As part of that presentation you should discuss what's *new and different* about your work. (You should not fret for one moment over *new and different*... my experience is that once you are working with data, *new and different* appears everywhere you look.)

I'll say more about the project specifics when we kick things off.

At the end of the semester teammates will assess their own and each other's performance using the posted Peer Evaluation form (see posting to Canvas). Students' grades will reflect both their individual performance as well as the quality of the final team submission.

To review the important research project dates:

- Fri Sep 23rd: Deadline for letting me know if you have a preferred teammate
- Mon Sep 26th: Project teams assigned
- Weds Oct 10th: One-on-one meetings to discuss your topic
- Weds Nov 30th: One-on-one research project update meeting
- Weds Dec 7th: Research project due; In-class presentation

Empirical work is slow going... and always slower than expected, even for veterans. Be sure to leave yourself enough time to complete the assignment to your satisfaction.

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Course Topics: While the list may change, at the moment I anticipate that we'll be focusing on the following topics over the course of the semester, working with both Stata and Excel:

1) Gathering data and building datasets

2) Least Squares Estimation

- a) Review of Ordinary Least Squares (OLS) estimation and inference, working with Simple and Multiple Linear Regression (SLR and MLR) models (estimation, endogeneity, partial correlations, inference, multicollinearity, heteroskedasticity, dummies, F tests, etc.)
- b) Binary dependent variables I: Linear Probability Models (LPMs)
- c) Functional forms: fixed effects, percentile dummies, polynomials, and splines (linear and cubic)
- d) Non-linear least squares, estimation and inference
- e) Differences-in-Differences (Diff-n-Diff) and Regression Discontinuity Design (RDD) analysis

3) Maximum Likelihood Estimation

- a) Binary dependent variables II: Logit and probit models
- b) More about limited dependent variables: Working with ordered/ordinal data; Ordered logit and probit, and perhaps multinomial logit/probit
- c) Count models (non-negative integer dependent variables): Poisson and negative binomial models

4) Choosing covariates

- a) Machine learning and variable selection algorithms

Topics that we will definitely not, consider in this course: time series; sophisticated panel data techniques; simultaneous equations; Instrumental Variables (IVs); Generalized Method of Moments (GMM) estimation.

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Proposed Schedule of Topics: The schedule and topics will likely evolve as we work through the semester, but here's a sense of what I have in mind at the moment:

- 1) Weds 8/31: Review #1 - OLS/SLR models (estimation, GOF and inference)
- 2) Weds 9/7: Review #2 - ... and MLR models (estimation, GOF and inference)
- 3) Weds 9/14: Binary dependent variables I and functional forms: Linear Probability Models

Mon 9/19: Quiz on Reviews #1 and #2

- 4) Weds 9/21: Non-linear least squares

Mon 9/26: Research project teams assigned

- 5) Weds 9/28: Generalized Least Squares (GLS) and Variable Selection Algos
- 6) Weds 10/5: MLE I - Introduction to Maximum Likelihood Estimation (Logit and Probit)

Fall Break

- 7) Weds 10/12: One-on-one research project meetings; *NCAAF11 Challenge* teams assigned
- 8) Weds 10/19: MLE II - Maximum Likelihood Estimation, continued
- 9) Weds 10/26: OLS v. MLE - Retrodictive and Predictive Ratings Models
- 10) Weds 11/2: MLE III - Ordered Logit/Probit & Multinomial Logit

Fri 11/4: *NCAAF11 Challenge* forecasts due by 6 PM

- 11) Weds 11/9: MLE IV - Count Regression Models: Poisson and Negative Binomial
- 12) Weds 11/16: Diff-n-Diff and Regression Discontinuity Design (RDD) models

Thanksgiving Break

- 13) Weds 11/30: One-on-one research project update meetings

Thurs 12/1: Mid-Term exam

- 14) Weds 12/7: Research projects due; In-class presentations