USC Marshall
School of Business

PRELIMINARY SYLLABUS SUBJECT TO CHANGE

FBE-551: QUANTITATIVE INVESTING
Fall 2022
3.0 units

MW 11:00 a.m. - 12:20 p.m.
or
M 6:30 p.m. - 9:30 p.m.

Instructor: Christopher S. Jones

Office hours (Zoom): Tuesdays 10:30a.m.-11:30a.m.
Thursdays 6:00p.m.-7:00 p.m.

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COURSE DESCRIPTION

Modern investment management is increasingly quantitative in nature, and investment strategies are more and more determined by the output of data-driven models rather than the subjective views of analysts and portfolio managers. In this course, we will learn how to build, test, and implement the types of models in use today by quantitative asset managers.

Perhaps the best way to define this course and understand its objectives is to describe how it differs from other courses.

In a traditional investments course (e.g., FBE 555), students are focused mainly on the instruments used in portfolio management, various theories about the pricing of those instruments, and methods for forming investment portfolios that maximize some risk-adjusted return. In industry jargon, this type of course focuses on skills used mostly on the "buy side" (mutual funds, hedge funds, etc.). While some discussion of data is included, students in a typical investments course are usually digesting summaries of that data rather than doing any deep data analysis themselves, as these courses typically lack the programming component required to do this analysis.

In a typical quantitative finance course, such as those offered in the Viterbi School or in the USC Mathematics Department, stochastic calculus and derivatives pricing are often the focus. These courses often do often contain a substantial programming component, but it is usually geared towards implementing models of derivatives pricing via Monte Carlo simulation or solving a set of differential equations. A more technical way to describe these courses is that they often

focus on methods to understand the risk-neutral distribution of security prices. In industry jargon, these courses tend to focus on skills more useful on the "sell side" (investment banks, brokerage firms, etc.).

Like an investments course, this course focuses on the real-world (as opposed to risk-neutral) distribution of prices, with the goal of constructing profitable investment strategies. Differently from that type of course, it relies less on theory and much more on original data analysis. We will discuss what is already known about financial markets, but our focus will be on learning how to create knowledge rather than acquire it second-hand. In addition, this course is less about the construction of optimal portfolios than it is about finding specific investment strategies, with attractive risk/return properties, that are useful as components of a larger, more diversified portfolio. Put differently, in a typical investments course we are learning the skills to be a portfolio manager. In this course, we are learning the skills to be a buy side quantitative researcher.

The course will have a substantial programming component, which will be carried out in Python. That said, learning to code is not the main goal. The course will not provide students with a general knowledge of Python, but rather only the components of Python necessary to do the buy-side quant research that will be our focus. These components are very different from those that a derivatives-focused course would use, and they are much more limited than those that a general programming course would cover.

In short, the course is intended to be highly complementary to those that already exist at USC and many other universities.

COURSE OBECTIVES

Upon successful completion of this course, students will be able to:

1. Describe the most common strategies used in quantitative investing.

2. Propose, test, and implement novel quantitative investing strategies.

3. Perform the statistical analysis and computer programming necessary for estimating models of security prices.

4. Present their investment ideas and results in a way that is understandable to the layperson and to the finance professional.

5. Articulate the research analyst role at quantitative buy-side firms.

PREREQUISITES

Note: The USC course registration system may allow students to enroll in 551 even if you do not meet the course's prerequisites. After you enroll in the course, I will ask you to submit a questionnaire on whether you meet the criteria below. Students failing to meet the criteria may be dropped from the course.

For MBA and MSF students, the sole prerequisite is FBE 555: Investment Analysis and Portfolio Management. For non-MBAs, additional prerequisites are GSBA 548: Corporate Finance and some graduate-level course in statistics.

I expect all students taking this course to understand the basic math of investing. This includes but is not limited to (1) calculating rates of rate of return from stock prices and dividends, (2) computing portfolio returns as weighted averages of individual asset returns, (3) the dividend discount model, and (4) the mathematics of short selling and leverage.

In terms of statistics, I expect that all students will have a high level of comfort with (1) basic statistics like mean, variance, covariance, etc., (2) the implementation of and assumptions behind OLS regression, and (3) statistical hypothesis testing.

I encourage all students contemplating the course to make an appointment with me if they are unsure about whether they meet these requirements.

Finally, for students with substantial programming experience, I will consider allowing FBE 555 to be taken concurrently with this class. Please schedule an appointment with me if you would like to explore this option.

COURSE FORMAT

The course will meet twice per week, following the schedule typical for a 3-unit elective. In addition, a moderate amount of material will be pre-recorded, to be viewed online prior to class. Much but not all of this is related to Python coding. If you have not coded in Python before or are missing a prerequisite, then expect to watch 45 minutes of videos per week outside of class. In some cases, a list of discussion questions will be distributed prior to the week in which the videos are to be watched. Be prepared to answer these questions in class.

Assigned readings will also need to be completed prior to class. Class time will mainly be spent discussing the videos, readings, and homework.

Flipping the class will allow students to absorb lecture material at their own pace. Students will have a variety of different backgrounds and prior coursework, which will determine in part how difficult these lectures will be to understand, and students with limited finance backgrounds should expect to augment these videos with additional readings.

COURSE MATERIALS

There is no required textbook for the course. The videos that I am creating, to be watched outside of class, are a partial substitute. More significantly, there will be numerous required readings, listed below, as well as course notes that will be available on the course web site at least one week prior to the class in which they are scheduled to be discussed.

Readings are a mix of industry white papers, articles from practitioner-oriented journals such as the *Journal of Portfolio Management*, and some articles from academic-oriented journals like

the *Journal of Finance*. White papers and articles from practitioner journals are usually written by practitioners for use by other practitioners. Articles from the premier finance journals are usually written by academics, but they are widely read by sophisticated industry people as well. These will be more challenging, but I will do my best to walk you through them.

There are many books that are potentially useful as references. A standard investments text such as the following will be useful for general background:

> *Investments*, 12th edition, by Zvi Bodie, Alex Kane, and Alan Marcus, McGraw Hill

A Python reference will also be useful. The one I recommend to all students is

> *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython*, 2nd edition, by Wes McKinney, O'Reilly

Another that is free and relatively up-to date is

> *Introduction to Python for Econometrics, Statistics and Data Analysis*, 4rd edition, by Kevin Sheppard, available at https://www.kevinsheppard.com/Python_for_Econometrics

Finally, each student will need to be able to bring a laptop to class. The laptop should be running Python 3.4 or higher and have the ability to run the Jupyter notebook. I strongly recommend the use of the Anaconda distribution and Anaconda Navigator.

GRADING

The course will include a midterm, a final exam, approximately 6 problem sets, and a final project.

The first three problem sets are to be done individually. Subsequent problems sets and the final project are to be done in groups of 2-4 students. The same group should work together for all assignments and the final project. At the beginning of the semester, I will ask students to propose their own teams, though I reserve the right to modify the membership of teams that are too unbalanced in terms of prior knowledge and experience.

The overall course grade is determined by the following percentages:

Midterm exam	15%
Final exam	20%
Homework assignments	25%
Final project	30%
Class participation	10%

The midterm and final will focus on the financial concepts covered but will also include basic programming concepts. The midterm will be held during class on 10/X/2022. The final will be on 12/X/2022 from 11:00am to 1:00pm.

Homework assignments will generally require the submission of a Jupyter notebook file. These homeworks will be graded with some allowance for errors. Grades will be determined by three factors. One is the completeness of the assignment. A problem set that is finished with good effort will not be penalized if it contains a reasonable number of mistakes. The second factor is performance in answering questions in class related to the homework. Your assignments will allow you to be creative, and the class will benefit from a coherent explanation of how you approached the assignment and what your results were. Note that these questions will be posed to individuals, not to teams, so each team member must be prepared to discuss. The final factor in your problem set grade is a peer evaluation. This is described in more detail in Appendix II below.

The final project consists of the design, research, testing, and implementation of an original quantitative investment strategy. Aim for a report of 15-20 pages in addition to the submission of all Python code used in the report. As with homework, your project grade will be determined by several factors. This includes the quality of your report in terms of both the concept and the execution. (The final project should be correct!) It also includes a final presentation, in which each member of the team should expect to be asked a number of questions about the project. Finally, it includes a peer evaluation.

The class participation score will be determined based on the ability to participate in class discussions of videos and readings.

STATEMENT ON ACADEMIC CONDUCT AND SUPPORT SYSTEMS

Academic Conduct:
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Students with Disabilities:
USC is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. If you have a disability that may impact your performance, attendance, or grades in this course and require accommodations, you must first register with the Office of Disability Services and Programs (www.usc.edu/disability). DSP provides certification for students with disabilities and helps arrange the relevant accommodations. Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to your TA) as early in the semester as possible. DSP is located in GFS (Grace Ford Salvatori Hall) 120 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776. Email: ability@usc.edu.

Support Systems:
Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship & Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

Student Support & Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC – https://diversity.usc.edu/
Tabs for Events, Programs and Training, Task Force (including representatives for each school), Chronology, Participate, Resources for Students

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.
Provides overall safety to USC community. dps.usc.edu

TENTATIVE COURSE OUTLINE AND ASSIGNMENTS

Lecture	Lecture topics	Readings	Videos
1-2	Introduction to the course and to quantitative investing		Jupyter Notebooks, Introduction to Dataframes
3	Python basics		Extracting Columns from Dataframes, Introduction to Indexes, Extracting Rows from Dataframes
4	Trading and market structure		Trading, Working with Indexes
5	Portfolio performance evaluation	teaching note on performance evaluation	Common Dataframe Methods
6-8	Time series return predictability	Faber, "A quantitative approach to tactical asset allocation," Journal of Wealth Management, 2007 Hull and Qiao, "A practitioner's defense of return predictability," Journal of Portfolio Management, 2017	OLS regression, The Rolling Method, For Loops and Vectorization, Asset Allocation Parts 1 and 2
9	Volatility prediction	Li, Zhang, and Zhang, "The information content of Chinese volatility index for volatility forecasting," Applied Economics Letters, 2020	Asset Allocation Parts 3 and 4
10	Asset allocation	Dreyer and Hubrich, "Tail-risk mitigation with managed volatility strategies," Journal of Investment Strategies, 2020	If Statements
11-12	Return reversal	de Groot, Huij, and Zhou, "Another look at trading costs and short-term reversal profits," Journal of Banking and Finance, 2012	Multi-Indexes, The Groupby Method
13	Midterm		
14-15	Pairs trading/statistical arbitrage	Engelberg, Gao, and Jagannathan, "An anatomy of pairs trading," working paper, 2008. Gatev, Goetzmann, and Rouwenhorst, "Pairs trading: Performance of a relative-value arbitrage rule," Review of Financial Studies, 2006	The Apply Method, Writing Functions
16	Fama-Macbeth regression	teaching note on Fama-Macbeth	
17	Value investing	Gray, "The Quantitative value investing philosophy," alphaarchitect.com, 2014	

18	CRSP and Compustat		
19	Implementation details	Asness and Liew, "Smart beta – Not new, not beta, still awesome," AQR white paper, 2014	
20-21	Momentum	Asness, Frazzini, Israel, and Moskowitz, "Fact, Fiction, and Momentum Investing," Journal of Portfolio Management, 2014	
22-23	Volatility and beta anomalies	van Vliet and Blitz, "The conservative formula: Quantitative investing made easy," working paper, 2018 "How AQR places bets against beta," investopedia.com, 2018	

Appendix I. MARSHALL GRADUATE PROGRAMS LEARNING GOALS
How FBE 551 Contributes to Marshall Graduate Program Learning Goals

Marshall Graduate Program Learning Goals	FBE 551 Objectives that support this goal (see below)	Assessment Method*
Learning Goal #1: Develop Personal Strengths. **Our graduates will develop a global and entrepreneurial mindset, lead with integrity, purpose and ethical perspective, and draw value from diversity and inclusion.**		
1.1 Possess personal integrity and a commitment to an organization's purpose and core values.		
1.2 Expand awareness with a global and entrepreneurial mindset, drawing value from diversity and inclusion.		
1.3 Exhibit awareness of ethical dimensions and professional standards in decision making.	2, 4	presentations, peer evaluation
Learning Goal #2: Gain Knowledge and Skills. **Our graduates will develop a deep understanding of the key functions of business enterprises and will be able to identify and take advantage of opportunities in a complex, uncertain and dynamic business environment using critical and analytical thinking skills.**		
2.1 Gain knowledge of the key functions of business enterprises.	1, 3, 5	exams, homework, discussion
2.2 Acquire advanced skills to understand and analyze significant business opportunities, which can be complex, uncertain and dynamic.	1, 2	exams, homework, discussion, final project
2.3 Use critical and analytical thinking to identify viable options that can create short-term and long-term value for organizations and their stakeholders.	2, 3	homework, final project
Learning Goal #3: Motivate and Build High Performing Teams. **Our graduates will achieve results by fostering collaboration, communication and adaptability on individual, team, and organization levels.**		
3.1 Motivate and work with colleagues, partners, and other stakeholders to achieve organizational purposes.	2, 3	homework, final project, discussions, peer evaluation
3.2 Help build and sustain high-performing teams by infusing teams with a variety of perspectives, talents, and skills and aligning individual success with team success and with overall organizational success.	2	homework, final project, peer evaluation
3.3 Foster collaboration, communication and adaptability in helping organizations excel in a changing business landscape.	4	presentation of final project, discussions

Objectives (repeated from page 2):
1. Describe the most common strategies used in quantitative investing.
2. Propose, test, and implement novel quantitative investing strategies.

3. Perform the statistical analysis and computer programming necessary for estimating models of security prices.
4. Present their investment ideas and results in a way that is understandable to the layperson and to the finance professional.
5. Articulate the research analyst role at quantitative buy-side firms.

Appendix II

SAMPLE PEER EVALUATION FORM

Please identify your team and team members for the ____ Project(s) that you worked on. Then rate all your team members, *including yourself,* based on the **contributions** of each team member for the selected assignment according to the criteria listed below. On a scale of 0 to 2, with 0 indicating does not meet expectations, 1 meets expectations and 2 exceeds expectations, rate each person on each of the five criteria. Lastly, add up the points for each person with the maximum number of points for each person being 10. In the box below, describe the exact contributions of each team member, including yourself.

Team Members/ Assessment Criteria of Team Contributions	Team Member 1	Team Member 2	Team Member 3	Yourself
1. Conceptualization of the project (coming up with the idea, the scope, and/or the application)				
2. Managing the assignment (making a work plan, keeping the group on track)				
3. Execution (locating and cleaning data, coding)				
4. Written exposition (writing, preparing figures)				
5. Presentation prep (creating presentation slides, prepping group members for questions)				
Total				

Contribution details: