

FIN4124/4719 FINTECH AND FINANCIAL DATA ANALYTICS

AY2020/21 Semester 2

Class Meetings: BIZ1 #02-02; Tuesdays 1200-1500

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MODULE DESCRIPTION

This course covers analytical tools and innovations in finance that solve practical problems. The objective is to connect theory with practice by building models, testing them with data, and using them for financial decision making. The topics include (1) efficient market hypothesis, (2) behavioral finance, (3) event studies, (4) Monte Carlo simulation, (5) artificial intelligence, (6) blockchain, (7) fintech, and (8) real option. The course adopts a cookbook approach to model, code, and solve problems in finance.

This course aims to nurture a **product mindset** in developing data analytical solutions in finance. Students are expected to be comfortable with statistics, the fundamental concepts in finance, the stock market, and programming (i.e., Python).

To convey the materials, the course employs classroom lectures and discussions, coding bootcamps and problem sets, and mini product development projects. Some work will be done individually and some in groups. **Each student is expected to contribute regularly to classroom discussion synchronously and asynchronously.** This is particularly true when we discuss assignments, but also during lectures and general discussions.

The material for this course needs to be absorbed consistently. As the course progresses, students should work on the coding bootcamps and problem sets to prepare for projects and quizzes. All these problems are essential for a full understanding of the material covered in the course. Students should find it helpful to read the assigned readings before we cover the material in class. Supplementary materials on coding are available through DataCamp for Classroom.

LEARNING OUTCOMES

1. Apply theories and concepts to study problems in finance.
2. Develop useful models to analyze and solve problems in finance.
3. Implement, assess, troubleshoot, and evaluate solutions.
4. Understand the key fintech concepts and their impact on the financial services sector.
5. Understand and develop strategies to unleash the potential of fintech in the financial services sector.

PREREQUISITE

You should be comfortable with tools for the analysis of data; familiarity with programming languages, like Python or R, will be needed. You should have taken one module in investment analysis (FIN3102 or FIN3702 or QF3101) and one module in data analytics (DAO2702 or DSC2008 or CS1010 or CS1101) or the equivalent.

COURSE MATERIALS

1. Textbook (Optional)

- a. Yves Hilpisch. *“Python for Finance,”* 2nd edition, O’Reilly (2019). ISBN 9781492024330.
- b. Antony Lewis. *“The Basics of Bitcoins and Blockchains,”* Mango Publishing (2018). ISBN 9781633538009.

2. **Class presentation slides and relevant resources** will be posted on LumiNUS. Please note that the materials do not comprise self-contained lectures. Rather, the intent is to reduce the amount of rote copying so that more time can be devoted class discussion.
3. **Selected articles** from academic finance journals and periodicals (WSJ, Economist, etc.) will be shared directly in **Microsoft Teams**.
4. **Project assignments** (see below).
5. **Team homework problems** (including those that are not part of the graded assignments) are important as they prepare you for projects and quizzes.

TECHNICAL ON-BOARDING

Platform/Tool	Purpose
LumiNUS	LumiNUS is the platform for formal communications , distribution of course materials , and submission of project assignments and homework problems.
Microsoft Teams	Microsoft Teams is the platform for informal communications, sharing, and discussions for this course. Your activities here (e.g., sharing class notes, supporting a point of view with facts, challenging a point of view, synthesizing new ideas or arguments, troubleshooting your peers' technical problem, encouraging class discussion with thought-provoking insights/articles) count towards class participation .
Zoom	Zoom is a class delivery tool for live classes for on- and off-site students . Recordings are available on LumiNUS for review after-class. Your activities here (e.g., Q&As) count towards class participation . I recommend you turn the video on during classes.
Poll Everywhere	Poll Everywhere is a tool for our live classes . Please register an account with your NUS credential . Your activities (e.g., Q&As, polls) here count towards class participation and class attendance .
Kaggle (cloud)/ Anaconda (local)	Jupyter notebook (i.e., .ipynb file) integrates Python code and its output in a single document that also combines rich text and graphics. You can run the notebook in the cloud through Kaggle or locally through Jupyter Notebook, which is part of Anaconda data science toolkit, or other IDEs. Please submit both notebook and dataset for coding related group homework.

Platform/Tool	Purpose									
DataCamp for the Classroom	<p>This is a supplementary platform for self-paced learning. If you complete the recommended DataCamp Skill Tracks, you will receive statements of accomplishment from DataCamp. You will receive an invitation to join DataCamp before the course starts.</p> <table border="1"> <thead> <tr> <th>DataCamp Skill Track</th> <th>Related Bootcamps</th> <th>Duration</th> </tr> </thead> <tbody> <tr> <td>Finance Fundamentals</td> <td>Bootcamp #1 to #6</td> <td>25 H</td> </tr> <tr> <td>Applied Finance</td> <td>Bootcamp #4 to #6</td> <td>16 H</td> </tr> </tbody> </table> <ol style="list-style-type: none"> You can tailor your learning journey according to your needs. These Skill Tracks prepare you for the Bootcamps and tests. Also, the rewards for your effort are statements of accomplishment from DataCamp. This class is supported by DataCamp, the most intuitive learning platform for data science. Learn R, Python, and SQL the way you learn best through a combination of short expert videos and hands-on-the-keyboard exercises. Take over 100+ courses by expert instructors on topics such as importing data, data visualization, or machine learning and learn faster through immediate and personalized feedback on every exercise. Spread the word about DataCamp's initiative to spread data science education around the world by sharing your DataCamp for the Classroom use and activities on social media (LinkedIn, Twitter, etc.). 	DataCamp Skill Track	Related Bootcamps	Duration	Finance Fundamentals	Bootcamp #1 to #6	25 H	Applied Finance	Bootcamp #4 to #6	16 H
DataCamp Skill Track	Related Bootcamps	Duration								
Finance Fundamentals	Bootcamp #1 to #6	25 H								
Applied Finance	Bootcamp #4 to #6	16 H								

ASSESSMENTS

Component	Weight
Team Homework	10%
Project 1: TBA (due and presented on Week 7)	10%
Project 2: TBA (due and presented on Week 13)	20%
Quiz 1: TBA (Week 6)	20%
Quiz 2: TBA (Week 12)	30%
Class Participation and Citizenship	10%
Total	100%

Letter grades will be assigned based on the class distribution of the course's total scores. The grade cutoff points will be adjusted based on the class's overall performance.

Projects

Each project report may be prepared by **teams of 3-4 participants**; individual submissions are **not** accepted. The objective is to answer the questions provided in each project assignment. The project reports should not exceed five double-spaced pages of **text**. The intent of this page limitation is to enforce careful and concise writing.

The five-page limitation does not include **figures and exhibits**; please include those as you deem necessary to convince (but not confuse) the reader. Your response should be consistent with and supported by your main analysis. Project reports (and supporting documents) should be submitted to the instructor **by 10 am on the due date** via LumiNUS.

While each group will submit only one report for the group, **all students must come fully prepared to present their solutions to the rest of the class.** Each group should bring a short presentation slide deck (PowerPoint or otherwise) in a USB thumb drive and share the short presentation file with the instructor on Microsoft Teams (i.e., private chatroom for the group) before the class session. **I will randomly select some groups to present their work during the class discussion.** The whole group will be penalized if the presentation is longer than **10 minutes**, is unclear, or does not match the group's project report. I may interrupt the presentation to clarify certain issues or correct contents in the interest of the class. As I may **randomly select a group member** to present the group's slide deck, I highly recommend each group member to practice the presentation to improve clarity and ensure that they meet the time constraint.

Grading of the group projects will be based on the accuracy of the analytical analysis (60%) and on exposition and presentation of findings (40%; this includes the classroom presentation component above). I will conduct a **group evaluation survey** after project reports are submitted. Please keep track of how your teammates contribute to the report and how your team functions as a whole.

Team Homework

Students will be asked to do and submit a series of team homework assignments. At two points in the term (weeks 7 and 13), I will grade one randomly selected homework assignment. Failure to turn in a homework assignment (even one which is not eventually graded) by its deadline will result in a zero grade.

Quizzes

There will be two **in-class** quizzes in Week 6 and Week 12. The quiz format will likely be a combination of multiple-choice and true-false questions, fill-in-the-blank questions, extensive numerical problems, and essay-type questions. These questions will be designed to test your knowledge of conceptual and qualitative material, as well as your analytical and problem-solving skills. The **second quiz** will be **cumulative** but will emphasize topics covered after the first quiz.

If you are unable to take the first quiz on the scheduled date for a valid and documented reason, the weighting of the first quiz's grade will be transferred to the second quiz (pending approval from the Head of the Finance Department). Students must take the second quiz to receive a passing grade for this module.

Class Participation and Citizenship

I will observe student participation in the course (e.g., classroom, Microsoft Teams, Zoom, Poll Everywhere) and reward students who make a substantial effort. Simply attending classes is a necessary condition, but **not sufficient** to receive a favorable class participation grade. In evaluating class participation, I will look for comments that are thoughtful and lead the class discussion forward. My evaluation will be based on how well you have participated in class, looking at the quality, not the quantity, of your participation. You can improve your participation grade considerably by coming to class prepared. Participation points are awarded **at my discretion** and are based solely on **my opinion** of your efforts and your contribution to class discussions. These points are not automatically given, but must be earned. They are not **subject to negotiation**.

CONTACTS

To ensure that I am available for consultation, I recommend that you direct message me through Microsoft Teams to arrange an appointment.

CLASS POLICIES

Attendance

Our class discussions will go beyond the scope of the textbook for most topics. Therefore, it is important for you to attend class. You are responsible for all announcements made in class. If you are unable to attend a particular class, please notify the professor of your absence *prior* to that class. Failure to notify the professor of absence, or missing more than **two sessions** during the course, might result in a failing grade. For an excused absence, the make-up for missed work will be determined by the professor in consultation with the student.

Tablets, PDAs, Phones

Please be respectful of others in your usage of electronic devices and wireless communication. By taking this class, you agree to be bound by the following policies:

- **Mobile phones** need to be shut off or set to silent mode during class session. No telephone calls, SMS/MMS messages, e-mails and/or chats during class. Upon violation of this policy, you will be asked to put your mobile device on the table in off mode and FACE DOWN. You may also be asked to deposit your devices in a designated area in the classroom.
- **Laptops and tablets** are restricted to note-taking, Poll Everywhere, and Zoom use only. The use of these devices for chat sessions, checking/answering e-mails, and web surfing is prohibited. I will announce exceptions to the policy for class sessions with course-related content on the web.
- Violation of the policies can lower the class citizenship component of course grade above.

ACADEMIC HONESTY & PLAGIARISM

Academic integrity and honesty is essential for the pursuit and acquisition of knowledge. The University and School expect every student to uphold academic integrity & honesty at all times. Academic dishonesty is any misrepresentation with the intent to deceive, or failure to acknowledge the source, or falsification of information, or inaccuracy of statements, or cheating at examinations/tests, or inappropriate use of resources.

Plagiarism is 'the practice of taking someone else's work or ideas and passing them off as one's own' (The New Oxford Dictionary of English). The University and School will not condone plagiarism. Students should adopt this rule - You have the obligation to make clear to the assessor which is your own work, and which is the work of others. Otherwise, your assessor is entitled to assume that everything being presented for assessment is being presented as entirely your own work. This is a minimum standard. **In case of any doubts, you should consult your instructor.**

- Additional guidance is available [HERE](#).
- Online Module on Plagiarism [HERE](#).

TENTATIVE COURSE SCHEDULE [Subject to Change]

This is an approximate schedule of topics that will be covered. The assigned readings will provide the framework for classroom discussions. All readings are required; please read them prior to the corresponding lecture. Recommended reading will be assigned throughout the course. Adjustments might be made during the course if the pace is faster/slower than expected. (* in front of the week number denotes team homework is due at the beginning of that class meeting; # denotes pre-recorded bootcamp session)

Session	Week	Date	Topic	Reading
Course Overview & Efficient Market Hypothesis	1	12 Jan	1. Describe random walk 2. # Test random walk hypothesis	1. Michael T. Maloney, and J. Harold Mulherin. "The complexity of price discovery in an efficient market: the stock market reaction to the Challenger crash," Journal of Corporate Finance, 9 (2003): 453-479. 2. Andrew W. Lo, A. Craig MacKinlay. "Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test," The Review of Financial Studies, 1 (1988): 41-66.
Behavioral Finance	*2	19 Jan	1. Review behavioral finance basics 2. # Test overreaction hypothesis	1. Robert J. Shiller, "Stock Prices and Social Dynamics," Brookings Papers on Economic Activity, 2 (1984): 457-498. 2. Werner F. M. De Bondt, and Richard Thaler. "Does the Stock Market Overreact?" The Journal of Finance 40, 3 (1985): 793-805.
Event Studies	*3	26 Jan	1. Conduct event studies 2. # Test underreaction hypothesis	1. Ball, Ray, and Philip Brown. "An Empirical Evaluation of Accounting Income Numbers." Journal of Accounting Research, 6 (1968): 159-178. 2. Louis Ederington, Jeremy Goh, Yen Teik Lee, Lisa (Zongfei) Yang. "Are Bond Ratings Informative? Evidence from Regulatory Regime Changes," The Journal of Fixed Income, 29 (2019): 6-19. 3. Quoc-Anh Do, Yen Teik Lee, Bang D. Nguyen, and Kieu-Trang Nguyen. "Power, Scrutiny, and Congressmen's Favoritism for Friends' Firms," Working Paper (2020).
Monte Carlo Simulation	*4	2 Feb	1. Calculate option prices 2. # Simulate optimal portfolio weights	1. Black, Fischer, and Myron Scholes. "The Pricing of Options and Corporate Liabilities." Journal of Political Economy, 81 (1973): 637-654.
AI in Finance	*5	9 Feb	1. Review machine learning basics 2. Discuss machine learning in factor models 3. #Predict default	1. Alex Chincó, Adam D. Clark-Joseph, and Mao Ye. "Sparse Signals in the Cross-Section of Returns," The Journal of Finance, 74 (2019): 449-492. 2. Machine learning for finance in Python.
Quiz 1, Brainstorm	*6	16 Feb	1. Quiz 1 2. Class Brainstorm	
RECESS WEEK				

Session	Week	Date	Topic	Reading
Project 1 Presentation, External Speaker (TBA)	7	2 Mar	1. Project 1 Presentation 2. <i>External speaker</i> : AI use cases in financial services (tentative)	
Algorithmic Trading, Digital Payments	8	9 Mar	1. Describe algorithmic trading 2. Explain digital payments	1. Antony Lewis (Money, Digital Money) 2. Committee on Payments and Market Infrastructures. "Payment aspects of financial inclusion in the fintech era," Work Bank Group (2020).
Blockchain in Finance	9	16 Mar	1. Explain cryptography 2. Discuss blockchain mechanics and cryptocurrency	1. Antony Lewis (Cryptography, Cryptocurrencies, Blockchain Technology) 2. Xin Deng, Yen Teik Lee, and Zhengting Zhong. "Decrypting Coin Winners: Disclosure Quality, Governance Mechanism and Team Networks," Working Paper (2018).
Fintech	10	23 Mar	1. Explain disruption theory 2. Review fintech drivers and digital transformation	1. Clayton M. Christensen, Michael E. Raynor, and Rory McDonald. "What is disruptive innovation?" Harvard Business Review (2015) 2. Jim McKelvey. "Good entrepreneurs don't set out to disrupt," Harvard Business Review (2020). 3. Ant Financial (A) HBS Case 9-617-060
Fintech, External Speaker (TBA)	*11	30 Mar	1. Discuss strategic responses and real option framework 2. <i>External speaker</i> : Discuss blockchain in financial services (tentative)	
Quiz 2 , Brainstorm	12	6 Apr	1. Quiz 2 2. Class Brainstorm	
Project 2 Presentation	13	13 Apr	1. Project 2 Presentation	

Note: The default delivery plan is face-to-face instruction for all students with live Zoom streaming (for those are symptomatic or living in extraordinary circumstances). With the ongoing COVID-19 pandemic, there are contingency plans for face-to-face and virtual instruction alternatives if policies and guidelines change during the semester. Stay tuned to LumiNUS and Microsoft Teams announcements.

ACKNOWLEDGMENTS

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1. Ideas and inspirations

Johan Sulaeman (<https://bizfaculty.nus.edu.sg/faculty-details/?profid=372>)

Adrien Verdahan (web.mit.edu/adrienv/www)

Jiang Wang (web.mit.edu/wangj/www/)

S.P. Kothari (mitsloan.mit.edu/faculty/directory/s-p-kothari)

Jonathan Lewellen (faculty.tuck.dartmouth.edu/jonathan-lewellen/)

Antony Lewis (iss.nus.edu.sg/about-us/staff/detail/15aaf18b-7c0e-44f7-9c89-177a0b67f651/Antony%20LEWIS)

2. Learning and platforms

DataCamp (datacamp.com) for the access to Datacamp for Classrooms