

Quantitative Finance
Course Number: 22:839:641
Course Title: Blockchain and Cryptocurrency

COURSE DESCRIPTION

This course is aimed for an audience with a quantitative background, who is interested in learning how blockchain technology is implemented in the financial industry and how it is about to change the future of financial services (including payments) and the global economy, as a whole.

Many financial institutions such as Fidelity, E-Trade, JP Morgan, Bank of America, to name a few, have blockchain and cryptocurrency divisions and labs (and not to mention the many crypto funds and startups). Some have crypto market trading desks and are increasingly seeking for crypto market – traders, analysts and researchers. They are constantly trying to better understand crypto market data and blockchain data as it relates to the digital assets which trades on the crypto exchanges. Some are building solutions, using blockchain technology to facilitate financial transactions, such as cross-border payments, over the counter transactions or bonds issuing. Some are looking into tokenization (e.g., Goldman Sachs). As a side bar – Spencer Dinwiddie of the Brooklyn Nets is looking into tokenizing his \$34 million contract 😊

The course will examine all the issues that are of interest to these financial institutions and beyond.

Big tech is also taking a stab at the space of cryptocurrencies. The most talked about is – Libra of Facebook. It has received lots of regulatory scrutiny both in the US and globally. The course will examine the complex issues with the structure of this cryptocurrency – if it's even a cryptocurrency – and why the criticism from policy makers and legislators.

The course will cover all data related to blockchain and cryptocurrency ecosystem – market data (from crypto exchanges), network (blockchain data) and any other data related to the development and understanding of blockchain projects.

COURSE MATERIALS

Blockchain and Cryptocurrency is an evolving and ever-changing space. Therefore, there are no specific textbooks for this course.

Readings for the course will be based on articles (some are written by the course professor), U.S. and international regulatory and legislators documents (including proposals, guidelines, letter of position,

etc.), white papers (including of blockchain projects), and any other material that is deemed relevant to understanding the subject.

Readings will be posted on Canvas at least a week before due.

LEARNING GOALS AND OBJECTIVES

1. **Knowledge.** This course is designed to help students develop skills and knowledge in the area of blockchain and cryptocurrency, in general, and in particular, as it applies to finance and the financial industry. The course is aimed to build a solid foundation in the understanding of the capabilities and challenges that blockchain technology is facing and how it is projected to evolve: what it can and cannot do, what the benefits are and what the challenges are.

Students will learn how to work with and analyze data related to the blockchain and cryptocurrency space. This is a data intensive space, where data is fragmented. A careful dive into the data is paramount to the understanding of this field.

2. **Critical Thinking and Innovation.** Blockchain is an emerging new technology that is bound to impact any business and industry as we know it. The course aims to encourage critical thinking and innovation: students will evaluate business problems that could be solved with blockchain technology and the impact that it might bring economically and socially.

Students are the generation that will take us to the next technological leap, and they are encouraged to take active part of it.

3. **Global perspective.** Although the course is not an international business course, blockchain is, by its essence, a technology that has emerged to connect us globally – starting with its first use case, Bitcoin. Therefore, the course takes a global approach both in the applications and the regulations affecting the space. Emphasis will be on understanding how blockchain can assist in diminishing both geographical and cultural boundaries and connecting people and businesses cross-borders.

4. **Effective Communication.** Students will demonstrate the ability to construct and deliver clear, concise, and convincing written and oral business communications by preparing executive summaries, written case evaluations, and by presenting their cases in a classroom setting.

PREREQUISITES

Knowledge of Python programming language.

ACADEMIC INTEGRITY

I do NOT tolerate cheating. Students are responsible for understanding the RU Academic Integrity Policy (<http://academicintegrity.rutgers.edu/>)

I will strongly enforce this Policy and pursue *all* violations. On all examinations and assignments, students must sign the RU Honor Pledge, which states, “On my honor, I have neither received nor given any unauthorized assistance on this examination or assignment.” I will screen all written assignments

through *SafeAssign* or *Turnitin*, plagiarism detection services that compare the work against a large database of past work. Don't let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

ATTENDANCE AND PREPARATION POLICY

- Expect me to attend all class sessions. I expect the same of my students. If I am to be absent, my department chair or I will send you notice via email and Canvas as far in advance as possible. If a student is to be absent, report the absence in advance at <https://sims.rutgers.edu/ssra/>. If the absence is due to religious observance, a Rutgers-approved activity, illness, or family emergency/death and the student seeks makeup work, the student should also send me an email with full details and supporting documentation [within three days of your first absence].

If a student misses a class, it's the student responsibility to make-up for any missing material.

- For weather emergencies, consult the campus home page. If the campus is open, class will be held, unless there is an emergency on my end, in which case I will notify everyone by email at least three hours prior to the start of class.

- Expect me to arrive on time for each class session. I expect the same of my students. If a student is going to be tardy, then they should quietly enter the room and make their way to the back of the classroom so as not to disturb the other students.

- Expect me to remain for the entirety of each class session. I expect the same of my students. If a student is going to leave early, then they should please let me know at the beginning of class, so that I can seat them near an exit and minimize any class disruptions.

- Expect me to prepare properly for each class session. I expect the same of my students. Students should complete all background reading and assignments. The minimum expectation is that for each three-hour class session, a student should have prepared by studying for at least twice as many hours.

- Expect me to participate fully in each class session. I expect the same of my students. Stay focused and involved. You cannot learn if you are not paying attention.

STUDENTS EXPECTATIONS

- In this course you will be expected to complete a number of tasks including: downloading and uploading documents to the LMS
 - accessing documents online
 - viewing online videos
 - participating in online discussion groups
 - participating in synchronous online discussions
 - submit and present group assignment
 - critique and give feedback to other groups' assignments
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CLASSROOM CONDUCT

I expect students to conduct themselves professionally at all times in my class. Students must be respectful of others and of sometimes extremely differing points of view, that may sometimes even seem offensive. That doesn't mean that students have to agree with each other, but they do have to give each other the opportunity to present their views in a safe, professional, and unthreatening venue. Disrespectful students will be asked to leave my classroom.

Drinking non-alcoholic beverages is permitted in classroom, provided that the classroom rules at RBS allow such things, and that the drink isn't so aromatic, or you are so noisome as to be distracting to your classmates. A simple gage is that if your neighbor can smell it, then it doesn't belong in my classroom. Food of any sort is prohibited in classrooms. Your classmates probably don't want to smell your food or watch you eat, and neither do I. Please eat either before or after class.

Laptops, tablets, smart phone or any other electronic device are only allowed for notes taking, not texting or surfing the web.

We will be using the internet, occasionally, for in-class assignments. Internet should be used only for this purpose, not for surfing the web.

HARDWARE AND SOFTWARE REQUIREMENTS

Below is the minimum hardware recommended by OTIS. These specs should allow student systems to capably support a full Windows10 Professional environment with Office365, RBS course-specific applications and virtual computing environments).

- I5 Processor
- Windows 10 Professional
- 8gb of RAM
- 256gb hard drive
- 720p webcam
- Internal mic

RBS Newark Students in need of financial assistance may submit their request via a form:
<https://myrun.newark.rutgers.edu/care-team>

Students can also benefit from reviewing:
<https://myrbs.business.rutgers.edu/students/learning-remotely>

If students have any technology issues, they should reach out to OTIS help desk [at helpdesk@business.rutgers.edu](mailto:helpdesk@business.rutgers.edu)

GRADING POLICY

The grading structure will be as follows:

Participation and in-class assignments	15%
Assignments (group of 4 students)	60%
Final project (group of 4 students)	25%

Grade distribution

Your final grade will be a weighted average of the grading scheme delineated in the grading policy section. Your final grade will be based on the following grid. I will rigidly adhere to the grading scheme, so please don't ask me to "bump" you up to an "A" if you are at 89.9: that is a B+. **Note, that the Business School has a target grade point average of 3.0 for all Master graduate courses, where an A=4, B+=3.5, B=3, C+=2.5, C=2, D+=1.5, D=1, and F=0.**

Range	Grade
90-100	A
$90 > x \geq 87$	B+
$87 > x \geq 80$	B
$80 > x \geq 77$	C+
$77 > x \geq 70$	C
$70 > x \geq 67$	D+
$67 > x \geq 60$	D
$60 > x$	F

Participation and in-class assignments:

"Participation" does not mean "attendance".

Students are required to participate in class discussions and in the in-class assignments. Class assignments are set in teams of 3-4 students. However, each member of the team is required to participate in the assignment – "one voice" approach (i.e., one student doing all the work) is not acceptable. I may decide, arbitrarily, who represents the team in the discussion.

Assignments:

Students will work in groups to solve assignments and will submit – as a group – **a typed, double-spaced** assignment write-up for each of the assigned assignments.

Most assignments are analytical and should include: the code, summary of results, explanation and any stats or graphics, when necessary.

Final Project – Due last day of class ():

- The final project is a group assignment to be handed in on the last day of classes.
- Should include – the code, summary of results, explanation and any stats or graphics, when necessary.

Students will be assigned individual grades based upon the group's overall performance and these grades will be adjusted up or down depending up the student's individual contribution to that performance. Every group will have five points per group member to distribute in evaluating their team members' contributions to the project. For example, if you have a group of four people, there will be 20 points for your team to distribute. How you distribute the points among the group members must reflect the importance of each individual's contribution. If one group member did no work at all, then they would receive a 0, and there would be 20 points left over to allocate among the remaining three group members. If on the other hand, everyone did the same amount of work, then all four people would get an allocation of 5 points. Note, that the average student that does their fair share of the work should receive an evaluation of 5 from their group mates, irrespective of the size of the group. These evaluations will be

used by me to adjust each individual student's score up or down depending on the average evaluation.

Presentations and Peer Review

1. Each assignment and the Final project will be presented in class on their due dates.
2. After the presentation, each of the other teams will be given a few minutes to critique and give feedback to the presenting team.
3. **15% of your grade for each assignment** will be based on your critique/feedback you gave to the other teams
4. **30% of your grade for the final project** will be based on your critique/feedback you gave to the other teams:
 - a. Each team will review the other team's final project and submit a short review with their feedback and critique within 24 hours after our last session.
 - b. The report should be no more than 2 pages
 - c. Critique and feedback must be well founded and reasoned.

COURSE SCHEDULE

Tentative schedule and topics to be covered. I will announce the assignments a week before they are due.

A. Introductory to blockchain technology

Week 1 to week 4

Assuming the students have no prior knowledge in the blockchain and cryptocurrency space, it is important to introduce basic concepts and an overview of the blockchain landscape. This section will include basic understanding on blockchain and Distributed Ledger Technology (DLT) in general – the benefits as well as the challenges it is facing. A review of different types of blockchains and protocols to illustrate that not all blockchains are made equal – comparison is challenging and use cases and fit need to consider the different attributes of each type of blockchain.

We will cover in this section, the following, but not limited to:

- What is blockchain?
- Distributed Ledger Technology (DLT)
 - Relationship to blockchain
 - Did you know that Github is a DLT?
- Types of protocols
 - Proof of Work, Proof of Stake, Delegated Proof of Stake (and the list is keep evolving)
 - What is mining? Who are producers? Who are creators? Who are....?
- Challenges: Scalability, Security, Privacy
- Private versus Public blockchains
- Types of private blockchains
 - Corda, Hyperledger, Quorum
- What are smart contracts?
 - Hype versus the risks
- Use cases:
 - Healthcare
 - Supply chain

- Art and luxury goods
- Payments

B. Analyzing Blockchain Data and Crypto Market Data

Week 4 to week 14

There is an increase demand for blockchain data scientists and cryptocurrencies (quantitative) analysts. Many financial institutions such as Fidelity, E-Trade, JP Morgan, Bank of America, to name a few, have blockchain and cryptocurrency divisions and labs (and not to mention the many crypto funds and startups). Furthermore, it seems that Facebook is also forming its own blockchain lab and cryptocurrency initiatives with job postings for blockchain data scientists to join their organization. As of May 2019, blockchain jobs are not only most in demand but also have the highest entry salary.

With so much demand, it is imperative to appropriately prepare students to the job market of tomorrow.

We will thoroughly explain blockchain and crypto market microstructure concepts and then we will introduce students to different data sources of both blockchain data and crypto market data. As a blockchain data scientist or a cryptocurrency analyst you would need to analyze data and understand the present and future value and risk of the blockchain project and/or the cryptocurrency, similar to analyzing any company or financial instrument. Not only that the data is fragmented on different platforms and data sources, but it is also not easy to interpret as it does not resemble any attributes of traditional financial instruments. It is, therefore, important to spend time and understand the full cycle of transactions (and related attributes) as they pertain to blockchain and cryptocurrency and have some hands-on experience in analyzing this data.

NOTE:

(1) All data analysis will be done with Python

(2) Data:

- a. The instructor will provide proprietary data from crypto exchanges and from blockchains**
- b. Students will learn how to tap into API's to collect data. (this is how it is done at financial institutions on the job.)**

B1. Analyzing blockchain data

Week 4 to week 7

We will cover in this section, the following, but not limited to:

- What are tokens?
- Types of tokens:
 - Security
 - Payments
 - Protocols
 - Service (i.e., application)
- What are stablecoins?
 - Mechanism
 - Examples of usage

- Understanding blockchain data
 - Experimenting with different blockchain explorers
- Analyzing blockchain data
 - Blockchain explorers
 - API's
 - Use cases
- Analyzing developers' data

B2. Decentralized Finance (DeFi) and Central Bank Digital Currency (CBDC)

Week 8 to week 9

Decentralized Finance (DeFi)

- What it means
- How it will impact all financial and economic activities (including gaming)
- Examples of different types of DeFi protocols
- How to use DeFi product
- How to create a DeFi product
- How a DeFi product or service could be implemented in your business or profession
- Interoperability
 - Why does it matter?
 - Wrapped tokens
 - Blockchain bridges
 - ICON blockchain
 - Polkadot – multichain alternative
 - Other technologies

Central Bank Digital Currency (CBDC)

- Pilots underway
- How would it affect businesses?
- China's CBDC to launch in Winter Olympic 2022
- Digital Dollar Project

B3. Non-Fungible Token (NFT)

Week 10

B4. Analyzing crypto market data

Week 11 to week 12

We will cover in this section, the following, but not limited to:

- Centralized versus Decentralized Exchanges
- Regulated versus non-regulated exchanges
- Crypto market microstructure
 - Fragmentation and manipulation
- Why hacks?

- Crypto as an asset class
 - Crypto financial instruments
 - Futures – one day settlement to perpetual futures, Investment Trust, ETP
 - Crypto custody
- Understanding market data
 - Exchanges API's
 - Exchange data and relationship to blockchain data
- Analyzing market data

B5. Connecting the dots – blockchain data and crypto market data

Week 13 to week 14

We will cover in this section, the following, but not limited to:

- Inspecting different blockchains and their respective cryptocurrency or token. We will examine the relationship between blockchain data and crypto market data to identify:
 - Signals for trading/investing
 - Market manipulations
 - Valuation and risk of cryptocurrencies
 - Including other data from different sources to get a better understanding on future value and risk

Guest Speakers:

During the semester will have a few guest speakers working in the crypto and blockchain space and in particular in the Decentralized Finance (DeFi) space.

Speakers will be confirmed during the semester.

Tentative Assignments Due:

- Assignment 1 – Propose a blockchain use case, preferably in finance or economic applications
- Assignment 2 – Analyzing bitcoin (and forks bitcoin) blockchain data
- Assignment 3 – Analyzing miners' data
- Assignment 4 – Propose a solution for CBDC
- Assignment 5 – Creating an NFT – propose a business use case for NFT and create an
- Assignment 6 – Analyzing developers' data
- Assignment 7 – Analyzing crypto market data for a particular pair
- Assignment 8 – Analyzing crypto market data for several pairs (interactions and comparison)

Final Project – due last day of class – ():

Students will develop a crypto trading algorithm using all the knowledge about blockchain and cryptocurrency they have learned and experienced during this course.

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey,

provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. More information can be found at ods.rutgers.edu.

[Rutgers University-New Brunswick ODS phone (848)445-6800 or email dsoffice@echo.rutgers.edu]

[Rutgers University-Newark ODS phone (973)353-5375 or email ods@newark.rutgers.edu]

If you are ***pregnant***, the Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy.

[Rutgers University-New Brunswick Title IX Coordinator phone (848)932-8200 or email jackie.moran@rutgers.edu]

[Rutgers University-Newark Office of Title IX and ADA Compliance phone (973)353-1906 or email TitleIX@newark.rutgers.edu]

If you seek ***religious accommodations***, the Office of the Dean of Students is available to verify absences for religious observance, as needed.

[Rutgers University-New Brunswick Dean of Students phone (848)932-2300 or email deanofstudents@echo.rutgers.edu]

[Rutgers University-Newark Dean of Students phone (973)353-5063 or email DeanofStudents@newark.rutgers.edu]

If you have experienced any form of ***gender or sex-based discrimination or harassment***, including sexual assault, sexual harassment, relationship violence, or stalking, the Office for Violence Prevention and Victim Assistance provides help and support. More information can be found at <http://vpva.rutgers.edu/>.

[Rutgers University-New Brunswick incident report link: <http://studentconduct.rutgers.edu/concern/>. You may contact the Office for Violence Prevention and Victim Assistance at (848)932-1181]

[Rutgers University-Newark incident report link: https://cm.maxient.com/reportingform.php?RutgersUniv&layout_id=7 . You may also contact the Office of Title IX and ADA Compliance at (973)353-1906 or email at TitleIX@newark.rutgers.edu. If you wish to speak with a staff member who is confidential and does **not** have a reporting responsibility, you may contact the Office for Violence Prevention and Victim Assistance at (973)353-1918 or email run.vpva@rutgers.edu]

If students who have experienced a temporary condition or injury that is adversely affecting their ability to fully participate, you should submit a request via <https://temporaryconditions.rutgers.edu> .

If you are a military *veteran* or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. <http://veterans.rutgers.edu/>

If you are in need of *mental health* services, please use our readily available services.

[Rutgers University-Newark Counseling Center: <http://counseling.newark.rutgers.edu/>]

[Rutgers Counseling and Psychological Services–New Brunswick: <http://rhscaps.rutgers.edu/>]

If you are in need of *physical health* services, please use our readily available services.

[Rutgers Health Services – Newark: <http://health.newark.rutgers.edu/>]

[Rutgers Health Services – New Brunswick: <http://health.rutgers.edu/>]

If you are in need of *legal* services, please use our readily available services: <http://rusls.rutgers.edu/>

Students experiencing difficulty in courses due to *English as a second language (ESL)* should contact the Program in American Language Studies for supports.

[Rutgers–Newark: PALS@newark.rutgers.edu]

[Rutgers–New Brunswick: eslpals@english.rutgers.edu]

If you are in need of additional *academic assistance*, please use our readily available services.

[Rutgers University-Newark Learning Center: <http://www.ncas.rutgers.edu/rlc>

[Rutgers University-Newark Writing Center: <http://www.ncas.rutgers.edu/writingcenter>]

[Rutgers University-New Brunswick Learning Center: <https://rlc.rutgers.edu/>]

[Optional items that many faculty include:

- Students must sign, date, and return a statement declaring that they understand the RU Academic Integrity Policy.

- Students must sign, date, and return a statement declaring that they understand this syllabus.]

The following must be signed by the student and returned to the professor.