

2. Syllabus Overview

- Class website and full syllabus: http://www.math.cmu.edu/~gautam/sj/teaching/2020-21/370-dtime-finance
- TA's: Jonghwa Park < jonghwap@andrew.cmu.edu>, Karl Xiao < kzx@andrew.cmu.edu>, Hongyi Zhou < hongyizh@andrew.cmu.edu>
- Homework Due: Every Wednesday, before class (on Gradescope)
- Midterms: Wed Sep 29, 5th week, and Wed Nov 3rd, 10th week (self proctored, can be taken any time)
- Zoom lectures:
 - \triangleright Please enable video. (It helps me pace lectures).
 - ▷ Mute your mic when you're not speaking. Use headphones if possible. Consent to be recorded.
 - ▷ If I get disconnected, check your email for instructions.
- Homework:
 - ▷ Good quality scans please! Use a scanning app, and not simply take photos. (I use Adobe Scan.)
 - ightarrow 20% penalty if turned in within an hour of the deadline. 100% penalty after that.
 - ▷ Two homework assignments can be turned in 24h late without penalty.
 - ▷ Bottom 2 homework scores are dropped from your grade (personal emergencies, other deadlines, etc.).
 - ▷ Collaboration is encouraged. Homework is not a test ensure you learn from doing the homework.
 - ▷ You must write solutions independently, and can only turn in solutions you fully understand.
- Exams:
 - \triangleright Can be taken at any time on the exam day. Open book. Use of internet allowed.
 - Collaboration is forbidden. You may not seek or receive assistance from other people. (Can search forums; but may not post.)
 - ▷ Self proctored: Zoom call. Record yourself, and your screen to the cloud.
 - ▷ Share the recording link; also download a copy and upload it to the designated location immediately after turning in your exam.

- Academic Integrity
 - \triangleright' Zero tolerance for violations (automatic **R**).
 - ▷ Violations include:
 - Not writing up solutions independently and/or plagiarizing solutions
 - Turning in solutions you do not understand.
 - Seeking, receiving or providing assistance during an exam.
 - Discussing the exam on the exam day (24h). Even if you have finished the exam, others may be taking it.
 - ▷ All violations will be reported to the university, and they may impose additional penalties.
- Grading: 30% homework, 20% each midterm, 30% final.

- 3. Replication, and Arbitrage Free Pricing
- Start with a *financial market* consisting of traded assets (stocks, bonds, money market, options, etc.)
- We model the price of these assets through random variables (stochastic processes).
- No Arbitrage Assumption:
 - ▷ In order to make money, you have to take risk. (Can't make something out of nothing.)
 - \triangleright There doesn't exist a trading strategy with $X_0 = 0, X_n \ge 0$ and $P(X_n > 0) > 0$.
- Now consider a non-traded asset Y (e.g. an option). How do you price it?
- Arbitrage free price: V_0 is the arbitrage free price of Y, if given the opportunity to trade Y at price V_0 , the market remains arbitrage free.



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At time
$$N \rightarrow wealth = \begin{cases} X_N & From the diry strat \\ -Y_N & Churry NTA \\ (V_0 - X_0)(1 + r^N) & Bank \end{cases}$$

 $N = Y_N$
 $N = V_N$
 $N =$

Theorem 3.2. The arbitrage free price is unique if and only if there is a replicating strategy! In this case, the arbitrage free price is exactly the initial capital of the replicating strategy.

Proof. We already proved that if a replicating strategy exists then the arbitrage free price is unique. The other direction is harder, and will be done later. \Box

More on this lata.

Question 3.3. If a replicating strategy exists, must it be unique?

NO! But, the initial wealth of the reflicating Stateory Are to be unique (it is the AFPD)