NATIONAL TAIWAN UNIVERSITY
Department of International Business

Financial Computation (金融計算)

Location: Room 305, Building 2, College of Management
Class Time: Tuesday 14:20-17:20, Spring 2025

Syllabus

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COURSE DESCRIPTION

The discipline of **Financial Computation (金融計算)** or **Financial Engineering (財務工程)** combines four fields: **Finance**, **Computer Science**, **Mathematics**, and **Statistics**.

The major goal of this course is to teach how to solve **pricing problems** for various **derivative contracts**, such as **Asian options (亞洲式選擇權)**, **lookback options (回顧選擇權)**, **rainbow options (彩虹選擇權)**, **barrier options (障礙選擇權)**, **convertible bonds (可轉換公司債)**, etc. Students will learn four major pricing methods, including the derivation of **analytic formulae (解析解)**, **Monte Carlo simulation (蒙地卡羅模擬)**, **tree model**, and **finite difference method (有限差分法)**. Students are required to implement the above methods to price several representative option contracts.

To ensure the fluency of my lecture, I assume that students are equipped with the basic knowledge in Finance, especially that associated with derivatives. Thus, it requires that students have learned the course of **"Futures and Options"** or other similar courses. Extended from the knowledge learned in **"Futures and Options"**, several topics will be comprehensively studied in this course, such as **stochastic processes (隨機過程)**, option pricing methods, various numerical techniques, hedging strategies for derivatives, etc.

Basic ability of computer programming is necessary for students to complete their assignment. However, the time constraint does not allow me to teach computer programming in detail, so students need to learn it while implementing option pricing methods. **VBA is a highly recommended computer language for beginners due to its simplicity and wide availability.**[1] My website provides several PowerPoint, PDF,

[1] For students who want to develop programs with Python, I suggest using Anaconda Spyder (designed specifically for working with Python) or Python in Visual Studio Code (an integrated development

EXCEL sample files to briefly introduce VBA. **Do not worry about lacking computer programming skills.** According to my experience of teaching this course for more than 20 years, less than 4% of students failed this course, and none of them are due to zero programming experience.

It is my hope that students in this class can be equipped with advanced financial theories, good programming practices, and adequate mathematics ability and most importantly, understand the true meaning of financial engineering.

LECTURE NOTES AND REFERENCES

Lecture Notes: **http://homepage.ntu.edu.tw/~jryanwang/** → Course Information → Financial Computation or Financial Engineering (graduate level).
(**Do not** access NTU COOL for the syllabus and lecture notes.)

Lecture Video: The each-week lecture video will be posted on NTU COOL within 24 hours after the class is dismissed. If not, please remind me by sending me an email. The lecture videos are provided only for the students officially enrolled in this course to review the lecture but not available for audit students.

References:

1. Options, Futures, and Other Derivatives, by John C. Hull, 11th ed., 2022.
2. Financial Engineering and Computation: Principles, Mathematics, Algorithms, by Yuh-Dauh Lyuu, 2002.
3. Derivatives: The Theory and Practice of Financial Engineering, by Paul Wilmott, 1998.
4. Monte Carlo Methods in Financial Engineering (Stochastic Modelling and Applied Probability), by Paul Glasserman, 2003.
5. Introduction to Stochastic Calculus with Applications, 3rd ed., by Fima C. Klebaner, 2012.
6. Financial Calculus: An Introduction to Derivative Pricing, by Martin Baxter and Andrew Rennie, 1996.
7. Numerical Recipes: The Art of Scientific Computing, 3rd ed., by William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery, 2007.
8. The Complete Guide to Option Pricing Formulas, by Espen G. Haug, 2nd ed., 2007.
9. 金融工程學：金融商品創新與選擇權理論，第三版，陳松男, 2008.

environment (IDE) supporting many programming languages including Python). Although JupyterLab and Jupyter Notebook are widely used, it is not recommended since they are not user-friendly for debugging (setting breakpoints, executing scripts line by line, and watching changes of variable values).

ASSIGNMENTS AND GRADING

Five computer-program assignments (each represents 20% of the final score) 92%

Extra bonuses (2-3 computer programs) 10-15%

※ For each assignment, the basic requirement is worth 80 points, and there are at most two bonuses worth additional 10-15 points. For assignments 1 to 5, the maximum points that one can earn are 90, 90, 95, 95, and 90, respectively.

※ For each of the five computer-program assignments, there are two weeks available for students to accomplish it.

※ On the due date of each assignment, the demonstration of your program will take place in the third hour of the lecture.

※ If you cannot attend the lecture on a demonstration day due to some **emergent reasons**, you need to **notify me in advance** and **show me some proofs**, e.g., a medical diagnosis. Any late notification is not acceptable.

※ Every one-week delay of demonstrating your program assignment will result in a deduction of 5 points (maximum cumulative deduction of 20 points) from the score you earn.

※ In addition to these 5 assignments, there are 2 or 3 extra bonuses, each of which is worth 5 additional points to your final grade in this course.

※ For extra bonuses, they will be demonstrated on the final demonstration day in the semester.

※ It is highly encouraged to discuss the assignment with classmates, but **do not copy programs** from others. Copying behavior (according to the judgement of the teaching assistant or me) will result in a 50% deduction from both your score and the score of the classmate who allows you to copy his/her programs.

※ To maintain fairness in the class, there is no alternative for the five computer-program assignments and extra bonuses. Any email to ask for possibility of making up your grades will be ignored.

※ For your information, there were 64 students enrolled in this course last year, 90.6% of students obtained grade A- or above, and 4.7% of students failed the course.

※ If you had learned this course and received a grade of A- or above at past, taking it again is a waste of your time. Therefore, these students are not allowed to take this course, but I can grant these students access to watch lecture videos on NTU COOL.

RULES IN CLASS

※ **Do not** distract other students from listening to my lecture, e.g., do not chat with other students while I am talking.

※ If you have any questions during my lecture, feel free to interrupt me.

COURSE SCHEDULE

Week	Date	Topic	Reading
1	Feb. 18	Course overview VBA introduction Overview of Options	Syllabus Ch 3
2	Feb. 25	Overview of Options Stochastic Process	Ch 3 Ch 1
3	Mar. 4	Stochastic Process	Ch 1
4	Mar. 11	Stochastic Process	Ch 1
5	Mar. 18	Stochastic Process	Ch 1
6	Mar. 25	Black-Scholes Model	Ch 2
7	Apr. 1	Black-Scholes Model*	Ch 2
8	Apr. 8	Binomial Tree Model*	Ch 4
9	Apr. 15	Binomial Tree Model†	Ch 4
10	Apr. 22	Monte-Carlo Simulation* and Finite Difference Method	Ch 5
11	Apr. 29	Monte-Carlo Simulation and Finite Difference Method†	Ch 5
12	May 6	Lookback Option*	Ch 9
13	May 13	Lookback Option	Ch 9
14	May 20	Asian Option*	Ch 10
15	May 27	Asian Option	Ch 10
16	June 3	Monte Carlo Simulation for American Options†	Ch 11
17	June 10 (discussible)	Final demonstration day	

* Homework assignment supposed

† Extra bonus assignment supposed

★ Rows in gray indicating the demonstration days

※ Note that the above schedule is an estimated version, I will dynamically adjust the speed of my lecture according to the feedback of students.

※ You are welcome to ask me questions about the content in other untaught chapters.

OFFICE HOURS

Monday 15:10-16:30

Room 712, Building 2, College of Management

※ It is not suggested to ask academic or programming questions in emails. First, it is almost impossible to discuss academic issues or programming details in emails. Second, I believe that face-to-face communication is the best way to make me understand your questions and give you the most accurate instructions to solve your

problems.

※ To maintain fairness in the class, the teaching assistant and I cannot help any student to debug his/her programs before the due date. Instead, the teaching assistant and I can explain the "suggested algorithm" taught in class or try to understand "your algorithm" and discuss it with you.

※ Try to fully utilize the office hours before making an individual appointment.

COURSE OBJECTIVES

After completing this course with a grade of A- or above, students should be able to

※ Apply the martingale pricing method, (least squares) Monte Carlo simulation, tree model, and finite difference method to price various kinds of derivative assets.

※ Derive the mean, variance, or even the distribution of a stochastic process at a future time point.

※ Know clearly the features of contracts of plain vanilla options, rainbow options, lookback options, and Asian options and the difficulties for pricing them.

※ Being equipped with the programming ability to conduct researches in the field of financial engineering.

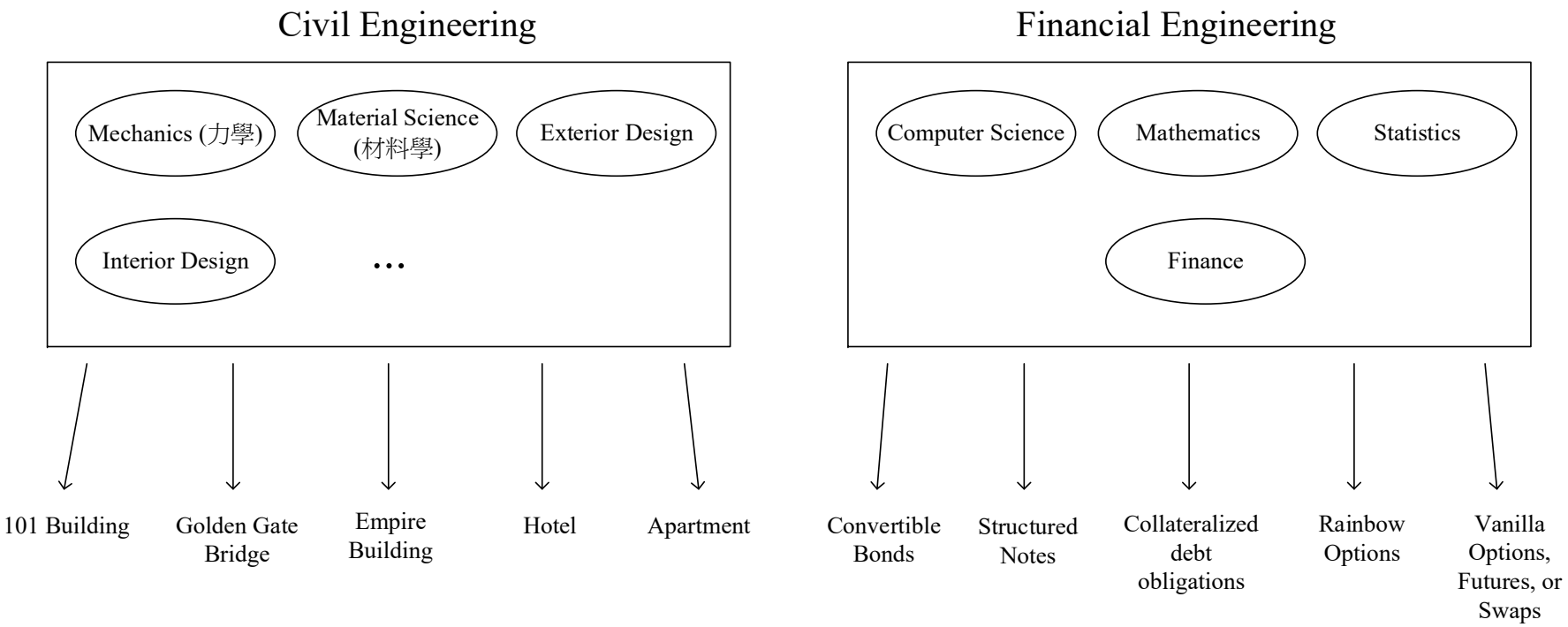
※ Read academic papers in the field of financial engineering.

SPECIAL NOTES

※ For **graduate students in Department of International Business or Department of Finance** who would like to ask me to be the advisor of their master or PhD theses, they need to pass this course with a grade of A- or above first. In addition, I would like to limit myself to supervising a maximum of four master-degree students in one year.

※ I need two volunteers to help me to turn on the PC and projector, download the lecture notes, and **borrow the portable wireless microphone (from Receiving Room on the first floor in Building 2, College of Management)** before each-week lecture. Students in Department of International Business have higher priority to apply for the job. The final scores of each volunteer will be awarded an additional three points.

Reason for the term of “Financial Engineering”



※ Common business model: Design and produce products at the least costs, and sell them at the highest prices