NATIONAL TAIWAN UNIVERSITY
Department of International Business

Financial Computation (金融計算)

Professor Jr-Yan Wang (王之彥) **Spring 2024**
Room 301, Building 2, College of Management **Tuesday 9:10-12:10**
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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 learn how to solve **pricing problems** for various derivative contracts by developing **analytic formulae (解析解)** and/or **computer programs (電腦程式)**. Specifically, various pricing approaches for some important exotic options will be introduced in this course, such as **Asian options (亞洲式選擇權)**, **barrier options (障礙選擇權)**, **lookback options (回顧選擇權)**, **convertible bonds (可轉換公司債)**, and **rainbow options (彩虹選擇權)**.

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 courses 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 models, various numerical techniques, hedging strategies for options/futures, etc.

Basic ability of computer programming is necessary for students to implement their assignment. However, the time constraint does not allow me to teach computer programming in detail, so students need to learn it while completing their assignments. **VBA is a highly recommended computer language for beginners.**[1] My website provides several PowerPoint, PDF, 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 can learn many financial theories, good programming practices, advanced mathematics, and most importantly, the true meaning of the financial engineering in this course.

[1] For students who want to develop programs with Python, I suggest to use Visual Studio Code, a universal integrated development environment (IDE) for many programming languages. Although Jupyter is widely used, it is not user-friendly for debugging and thus not recommended.

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 dismissed. If not, please remind me via sending me an email. The videos on NTU COOL are only available for the enrolled students to review the lecture but not accessible 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.

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.

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

※ 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 or Covid-19 rapid test result. Any late notification is not acceptable.

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

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

※ For your information, 91% of students obtain grade A- or above, and 4% of students fail the course last year.

※ It is highly encouraged to discuss the assignment with classmates, but **do not copy programs** from others. The copying behavior (according to the judgement of the teaching assistant or me) will result in a 50% deduction from 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.

RULES IN CLASS

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

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

COURSE SCHEDULE

Week	Date	Topic	Reading
1	Feb. 20	Course overview VBA introduction Overview of Options	Syllabus Ch 3
2	Feb. 27	Overview of Options Stochastic Process	Ch 3 Ch 1
3	Mar. 5	Stochastic Process	Ch 1
4	Mar. 12	Stochastic Process	Ch 1

5	Mar. 19	Stochastic Process	Ch 1
6	Mar. 26	Black-Scholes Model	Ch 2
7	Apr. 2	Black-Scholes Model*	Ch 2
8	Apr. 9	Binomial Tree Model*	Ch 4
9	Apr. 16	Binomial Tree Model†	Ch 4
10	Apr. 23	Monte-Carlo Simulation* and Finite Difference Method	Ch 5
11	Apr. 30	Monte-Carlo Simulation and Finite Difference Method†	Ch 5
12	May 7	Lookback Option*	Ch 9
13	May 14	Lookback Option	Ch 9
14	May 21	Asian Option*	Ch 10
15	May 28	Asian Option	Ch 10
16	June 4	Monte Carlo Simulation for American Options†	Ch 11
17	TBD	Final demonstration day	

* Homework assignment supposed † Extra bonus assignment supposed

※ 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

Tuesday 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 the face-to-face communication is the best way to make me understand your questions and give you the most accurate instruction 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" or try to understand "your algorithm" and discuss it with you.

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

SEMESTER-END LEARNING GOALS

※ Students can apply the martingale pricing method, (least squares) Monte Carlo simulation, binomial tree model, and finite difference method to price various kinds

of derivative assets.

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

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

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

※ Students are able to 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 study and pass this course first. In addition, I would like to limit myself to supervise 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 the Custodian Office (Management 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 the job. The final scores of the two volunteers will be awarded additional three points.

TEACHING ASSISTANT

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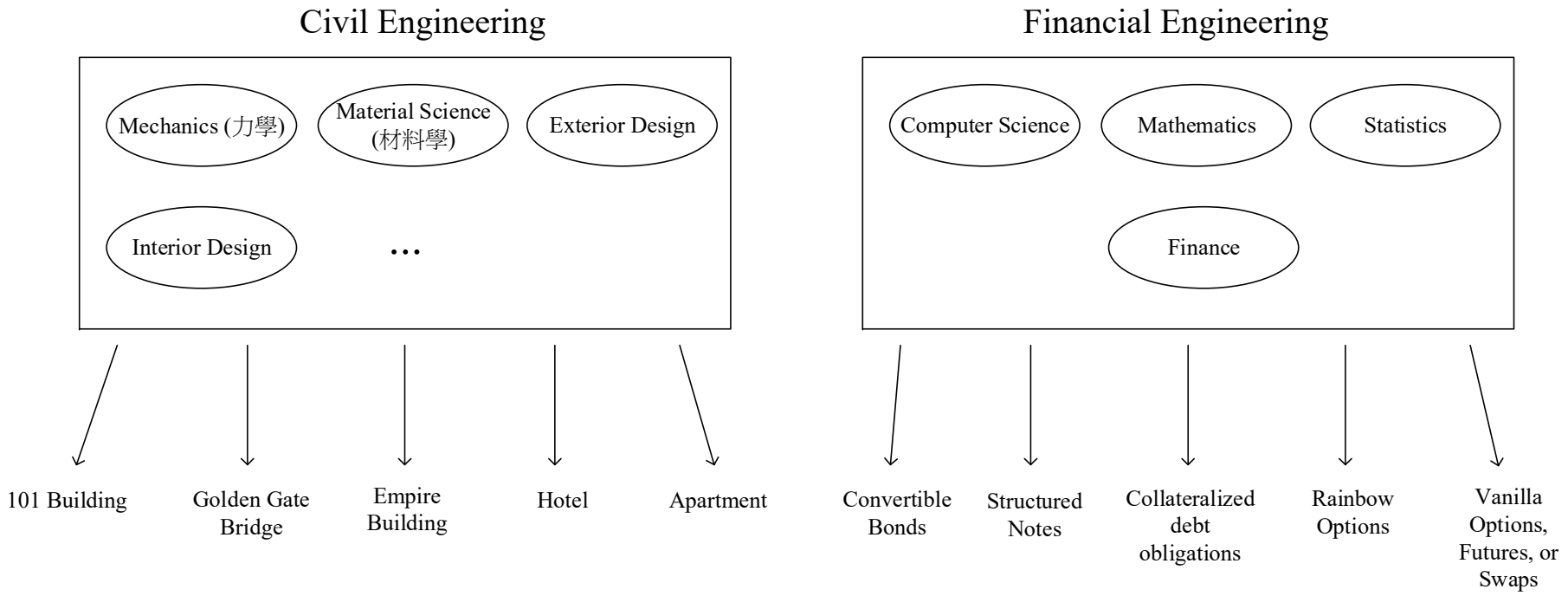
The reason for the term of “Financial Engineering”



※ Common business model: Produce or create products at the least costs, and sell them at the highest prices