

**NATIONAL TAIWAN UNIVERSITY**  
**Department of International Business**  
**Financial Computation (金融計算)**

**Professor Jr-Yan Wang (王之彥)**  
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**Spring 2023**  
**Thursday 9:10-12:10**  
**02-33664987**

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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 (財務)**, **Computer Science (電腦)**, **Mathematics (數學)**, and **Statistics (統計)**. 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, the pricing methods and their mathematical fundamentals for many 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 about derivatives. It would be better that students already learned the courses of “**Futures and Options**” or other similar courses before. Extended from the knowledge learned in “**Futures and Options**”, several topics will be sufficiently studied in this course, such as stochastic processes (隨機過程), option pricing models, various numerical techniques, hedging strategies for options/futures, etc.

The basic ability of computer programming is required for students to implement their assignment. However, the time constraint does not allow me to teach computer programming in details, so students need to learn it simultaneously when implementing homework. VBA is a highly recommended computer language for beginners.<sup>1</sup> My website provides several PowerPoint, PDF, EXCEL sample files to briefly introduce VBA. **Do not worry about the lack of the computer programming skill.** According to my experience to teach this course for more than 20 years, a high percentage of students in this course never wrote a computer program before, but less than 1% of students failed this course.

It is my hope that students can learn many financial theories, good programming practices, advanced mathematics, and most importantly, the true meaning of the

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<sup>1</sup> 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 recommended.

financial engineering in this course.

## **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, 10<sup>th</sup> ed., 2018.
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, 3<sup>rd</sup> 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, 3<sup>rd</sup> 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, 2<sup>nd</sup> 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 can be earned 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 assignment, 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 events, 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.
- ※ 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. 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.
- ※ Due to the pandemic of COVID-19, please **wear a facial mask** in the classroom, especially when approaching to the lectern to ask me questions. Moreover, eating and drinking (except water) are not allowed in the classroom.

### **COURSE SCHEDULE**

Week	Date	Topic	Reading
1	Feb. 23	Course overview VBA introduction Overview of Options	Syllabus Ch 3
2	Mar. 2	Overview of Options Stochastic Process	Ch 3 Ch 1

3	Mar. 9	Stochastic Process	Ch 1
4	Mar. 16	Stochastic Process	Ch 1
5	Mar. 23	Stochastic Process	Ch 1
6	Mar. 30	Black-Scholes Model	Ch 2
7	Apr. 6	Black-Scholes Model*	Ch 2
8	Apr. 13	Binomial Tree Model*	Ch 4
9	Apr. 20	Binomial Tree Model <sup>†</sup>	Ch 4
10	Apr. 27	Monte-Carlo Simulation* and Finite Difference Method	Ch 5
11	May 4	Monte-Carlo Simulation and Finite Difference Method <sup>†</sup>	Ch 5
12	May 11	Lookback Option*	Ch 9
13	May 18	Lookback Option	Ch 9
14	May 28	Asian Option*	Ch 10
15	June 1	Asian Option	Ch 10
16	June 8	Monte Carlo Simulation for American Options <sup>†</sup>	Ch 11
17	June 15	Final demonstration day	

\* Homework assignment supposed      <sup>†</sup> 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**

Monday 15:10-16:30 and Thursday 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.

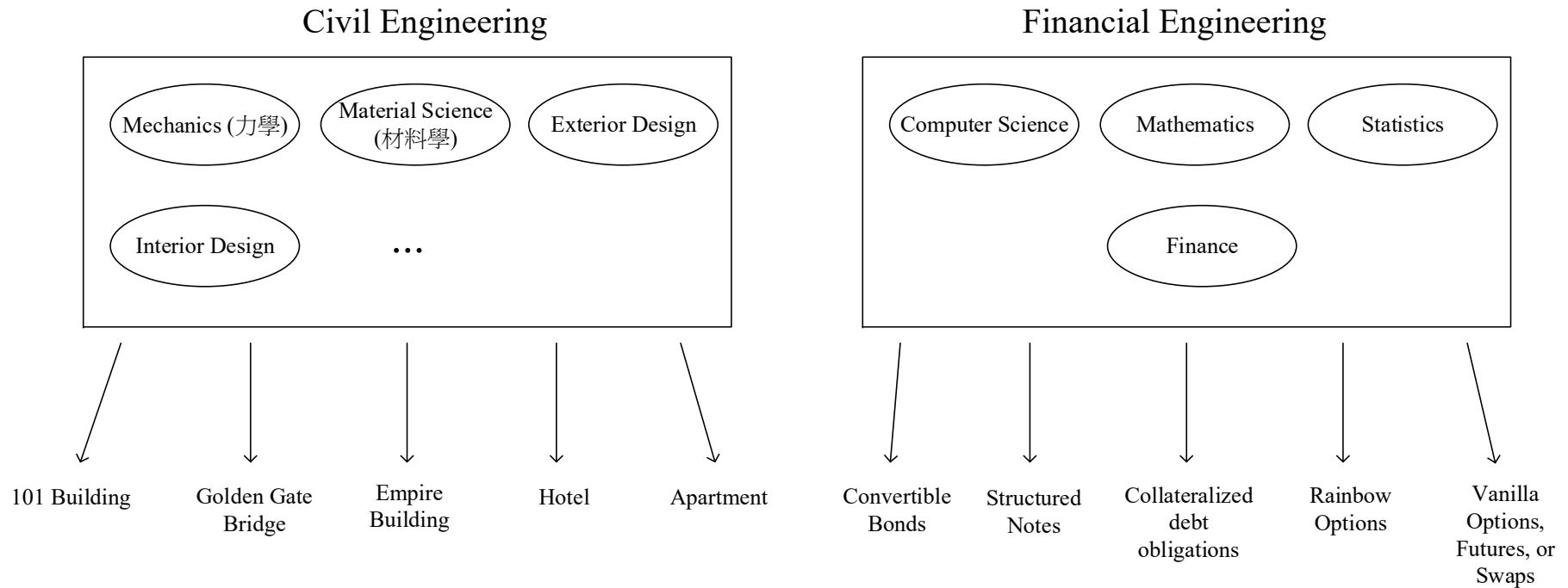
### **SPECIAL NOTE**

- ※ For students in **Graduate Institutes of International Business and Finance** in College of Management who would like to ask me to be the advisor of their master or Ph.D. theses, they need to study and pass this course first. In addition, I would like 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 reception office in Building 2, College of Management) before each-week lecture. The final scores of the two volunteers will be awarded additional three points.

### **TEACHING ASSISTANT**

盧與明          d08922008@ntu.edu.tw

# 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