**King Fahd University of Petroleum and Minerals**
**Department of Mathematics**
**MATH-562: Fundamentals of Option Pricing**
**Term 212**

**Instructor**: Dr. Brahim Mezerdi
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**Office Hours:** 2:00 pm – 3:00 pm UT
**Class**: 5:20 pm – 6:35 pm U.T
**Location:** Blg # 59 - 1009

**Course Objectives:**
Introduce discrete and continuous time finance and the theory and practice of derivative pricing and hedging. Provide students with the mathematical skills needed for the valuation of derivatives. Focus will be on the application of results rather than their mathematical derivation. Be able to apply of stochastic methods to analyse and solve the famous Black-Scholes formula, to price options.

**Course Description:**
**MATH562: Fundamentals of Option Pricing** **(3-0-3)**
Basic principles of option pricing, binomial model, the Black-Scholes model, arbitrage, complete and incomplete markets, trading strategies, European options, American options. Topics include Risk-neutral Valuation, options on stock Indices, currencies, futures, the Greek letters, Interest Rate Derivatives, Black-Scholes PDE and formula.

**Pre-requisite:** MATH 564

**Textbook: Hugo D. Junghenn,** An Introduction to Financial Mathematics, Option Valuation. Chapman and Hall/CRC, Second Edition 2019.

**Reference**: **Robert L. McDonald** (2009), Derivative Markets. Pearson, Third Edition, **2013**.

**Assessment***

| Activity | Weight |
|---|---|
| Class Evaluation (quizzes) | 10% |
| Homework | 20% |
| Midterm Exam | 30% |
| Final Exam (Comprehensive) | 40% |

**Grade Assignment**
Relative Grading based on overall performance of the students registered in this course.

**Academic Integrity**
All KFUPM policies regarding **ethics** and **academic honesty** apply to this course.

**General Notes**
Students are encouraged to regularly check the blackboard announcements.

**Syllabus (Tentative)**

| Week | Sections | Topics |
|---|---|---|
| **1** | 1.1 – 1.5 | **Basic finance**<br>• Interest rate, Inflation, Annuities<br>• Bonds , Internal rate of return |
| **2** | 2.1 - 2.2 | **Probability Spaces**<br>• Sample spaces and events<br>• Discrete probability spaces |
| **3** | 2.4 - 2.5 | **Probability Spaces**<br>• Conditional probability<br>• independence |
| **4** | 3.3 – 3.4 | **Random Variables**<br>• Discrete random variables<br>• Continuous random variables |
| **5** | 3.6- 3.8 | **Random Variables**<br>• Independent random variables<br>• Identically random variables<br>• Sums independent random variables |
| **6** | 4.1 – 4.3 | **Options and arbitrage**<br>• The price of an asset<br>• Arbitrage<br>• Classification of derivatives |
| **7** | 4.4 – 4.9 | **Options and arbitrage**<br>• Forwards and currency forwards<br>• Futurs<br>• Call and Put Options<br>• Properties of options |
| 8 | 5.1 – 5.2 | **Discrete time portfolio processes**<br>• Discrete time stochastic processes<br>• Portfolios processes and the value process |
| **9** | 5.3 – 5.5 | **Discrete time portfolio processes**<br>• Self financing trading strategies<br>• Equivalent characterizations of self financing<br>• Option valuation by portfolios |
| **10** | 6.6 - 6.7 | **Expectation and variance**<br>• The strong law of large numbers<br>• The central limit theorem |
| **11** | 7.1 – 7.2 | **The Binomial Model**<br>• Construction of the binomial model<br>• Completeness and arbitrage in the binomial model |
| **12** | 11.1 – 11.2 | **Stochastic calculus**<br>• Continuous time stochastic processes<br>• Brownian motion and geometric Brownain motion |
| **13** | 11.3 – 11.5 | **Stochastic calculus**<br>• Stochastic integrals<br>• Ito formula<br>• Stochastic differential equations |
| **14** | 12.1 – 12.3 | **Black Scholes Merton Model**<br>• The stock price SDE<br>• Continuous time portfolios<br>• The Black Scholes formula |
| **Eid Al-Fitr Holidays April 24-May 7** | | |
| **15** | 12.4 | **Black Scholes Merton Model**<br>• Properties of the Black Scholes call function |
| **16** | | **Review and catch up** |