# KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
## DEPARTMENT OF MATHEMATICS

# STAT 516: Stochastic Processes in Finance


## Instructor: Dr. Brahim Mezerdi

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Office Hours: UT 10:30 AM – 12:00 AM or by appointment

Time: UT, 17:20 – 18:35
Place: Building 24 – Room 244

**Textbook**

- **T. Mikosch.** Elementary Stochastic Calculus with Finance in View. World Scientific Publishing Co. Pte. Ltd. 1998.

**Additional References:**

- **Sheldon M. Ross** , Introduction to Probability Models, 11-th edition (2014)
- **Bernt Øksendal** Stochastic Differential Equations: An Introduction with Applications. 6th Edition. Springer 2010.

**Course Description:**

**1. Catalog Course Description** (*General description in the form used in Bulletin)*
Axioms of Probability, Random variables. Stochastic processes, Brownian motion, Stochastic integral, A simple version of the Itô lemma. Introduction of Stochastic differential equations (SDEs). Applications of Stochastic calculus in Finance: Black-Scholes equation and Black-Scholes Option Pricing formula.

**Prerequisites (if any)**

Graduate Standing

**Course Objectives**

1. Equip students with the necessary skills to solve linear stochastic differential equations arising in finance.
2. Familiarize students with the application of stochastic calculus in financial modeling.
3. Cultivate the students abilities to utilize the Black-Scholes formula for pricing financial derivatives.

**Assessment** for this course is based on class activities (Quizzes), a midterm exam and a comprehensive final exam, as described in the following table.

**Grading Policy:**

| | Date | Time | Place | Materials | Percentage |
|---|---|---|---|---|---|
| **Midterm Exam** | TBA | TBA | TBA | TBA | 30 % |
| **Final Exam** | TBA | TBA | TBA | Comprehensive | 40 % |
| **Project** | | | | | 15 % |
| **Class Work** | It is based on quizzes, class tests or other class activities determined by the instructor. | | | | 15 % |

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

Important Attendance Notes:

- In accordance with University rules, **20 % , 6 unexcused absences** or 33.3 %, **10 excused-unexcused absences** will automatically result in a grade of **DN**.
- Attendance on time is very important. Mostly, attendance will be checked within the first five minutes of the class. Entering the class after that, is considered as one late, and every two times late equals to one absence. The student has to be available until the end of the class.

**Suggested Problems:**

- ✓ Suggested problems will be posted on the BLACKBOARD towards the end of each chapter.

**Cheating in Exams:**

Cheating or any attempt of cheating by use of illegal activities, techniques and forms of fraud will result in a grade of **DN** in the course along with reporting the incident to the higher university administration. Cheating in exams includes (but is not limited to)

- Looking at the papers of other students
- Talking to other students
- Using mobiles or any other electronic devices **including Smart Watch**

**Missing an Exam:** In case a student misses an exam (Exam I, Exam II, or the Final Exam) for a legitimate reason (such as medical emergencies), she/he must bring an official excuse from Students Affairs. Otherwise, she/he will get zero in the missed exam.

**The Usage of Mobiles in Class:** Students are not allowed to use mobiles for any purpose during class time. Students who want to use electronic devices to take notes must take permission from their instructor. Violations of these rules will result in a penalty decided by the instructor.

## Syllabus – A rough weekly guideline

| Week # | Date | Section | Material | Notes |
|---|---|---|---|---|
| 1 | Aug25 – Aug29 | | Axioms of Probability | |
| **2** | Sep 01 – Sep 05 | | Conditional Probabilities<br>Independent events | |
| 2 | Sep 08 – Sep 12 | | Random variables<br>Discrete random variables – Examples | |
| 3 | Sep 15 – Sep 19 | | Continuous random variables<br>Density, Expectation and variance of random variables | |

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|---|---|---|---|---|
| 4 | Sep 22 – Sep 26 | | Gaussian and Lognormal distribution | |
| | **Sep 23** | **Monday, National Day Holiday** | | |
| 5 | Sep 29 – Oct03 | | Stochastic processes | |
| 6 | Oct 06 – Oct 10 | | **B**rownian Motion | |
| 7 | Oct 13 – Oct 17 | | Itô stochastic integral | |
| 8 | Oct 20 – Oct 24 | | Simple version of Itô formula | |
| 9 | Oct 27 – Oct 31 | | Introduction to Stochastic differential equations | . |
| 10 | Nov 03 – Nov 07 | | Geometric Brownian motion<br>Linear Stochastic Differential Equations | |
| 11 | Nov 10 – Nov 14 | | MIDTERM BREAK | |
| 11 | Nov 17 – Nov 21 | | Binomial Model | |
| 12 | Nov 24 – Nov 28 | | The Option Pricing Problem. | |
| 13 | Dec 01 – Dec 05 | | The Black-Scholes equation | |
| 14 | Dec 08 – Dec 12 | | The Black-Scholes formula | |
| 15 | Dec 15 – Dec 16 | | Examples | |
| 16 | Dec 16 | | Catch-Up and Review | **Last Day of Class** |
| | Final Exam (Comprehensive): As posted on the Registrar Website | | | |

**Communication:**

- For regular announcements, students are advised to check Blackboard regularly.