

## Term Information

Effective Term Autumn 2021

## General Information

Course Bulletin Listing/Subject Area Mathematics  
Fiscal Unit/Academic Org Mathematics - D0671  
College/Academic Group Arts and Sciences  
Level/Career Graduate, Undergraduate  
Course Number/Catalog 5635  
Course Title Stochastic Calculus for Finance I  
Transcript Abbreviation Stochastic Calc 1  
Course Description Mathematics used in financial asset pricing, based on Wiener (Brownian motion) processes, with applications. Overview of needed real analysis, stochastic processes, Ito Calculus, Risk-neutral measure, connections with PDEs.  
Semester Credit Hours/Units Fixed: 3

## Offering Information

Length Of Course 14 Week, 12 Week, 8 Week, 7 Week, 6 Week  
Flexibly Scheduled Course Never  
Does any section of this course have a distance education component? No  
Grading Basis Letter Grade  
Repeatable No  
Course Components Lecture  
Grade Roster Component Lecture  
Credit Available by Exam No  
Admission Condition Course No  
Off Campus Never  
Campus of Offering Columbus

## Prerequisites and Exclusions

Prerequisites/Corequisites A grade of C- or better in 3589 or 3345; and a grade of C- or better in 4530, 5530H or Stat 4201; and enrollment in Math major or Actuarial Science major, or Grad standing; or permission of department.  
Exclusions  
Electronically Enforced Yes

## Cross-Listings

Cross-Listings

## Subject/CIP Code

Subject/CIP Code 27.0101  
Subsidy Level Doctoral Course  
Intended Rank Junior, Senior, Masters, Doctoral

## Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

## Course Details

### Course goals or learning objectives/outcomes

- Understand mathematics of financial asset pricing.
- Understand the Ito Calculus.
- Understand mathematics of risk-neutral measure.

### Content Topic List

- Distributions and  $\sigma$ -algebras
- Convergence and computation of expectation values
- Change of measure, convexity, filtration
- Conditional expectation
- Scaled random walk and Brownian motion
- Quadratic variation, Markov property
- Ito integral, Ito-Doebelin formula
- BSM equation, multivariable stochastic calculus
- Risk-neutral measure, martingale representation
- Applications: cash flow, dividend-paying stocks, futures
- SDEs, PDEs, Feynman-Kac theorem

### Sought Concurrence

No

## Attachments

- Mathematics 5635.pdf: Syllabus  
*(Syllabus. Owner: Husen, William J)*
- Mathematics 5635\_update.pdf: Syllabus - updated  
*(Syllabus. Owner: Husen, William J)*
- Curriculum\_map\_actsci\_03102021.docx: Curriculum map - Act Sci  
*(Other Supporting Documentation. Owner: Husen, William J)*
- Curriculum\_map\_math\_03102021.docx: Curriculum map - Math  
*(Other Supporting Documentation. Owner: Husen, William J)*

## Comments

- Revised according to comments (additional syllabus details and curriculum maps) *(by Husen, William J on 03/30/2021 02:56 PM)*
- See NMS panel feedback sent on 2-26-20. *(by Vankeerbergen, Bernadette Chantal on 02/26/2020 11:52 AM)*

**COURSE REQUEST**  
5635 - Status: PENDING

Last Updated: Vankeerbergen, Bernadette  
Chantal  
04/06/2021

**Workflow Information**

Status	User(s)	Date/Time	Step
Submitted	Husen, William J	02/11/2020 12:15 PM	Submitted for Approval
Approved	Husen, William J	02/11/2020 12:25 PM	Unit Approval
Approved	Haddad, Deborah Moore	02/11/2020 02:00 PM	College Approval
Revision Requested	Vankeerbergen, Bernadette Chantal	02/26/2020 11:52 AM	ASCCAO Approval
Submitted	Husen, William J	03/30/2021 02:53 PM	Submitted for Approval
Approved	Husen, William J	03/30/2021 02:56 PM	Unit Approval
Approved	Vankeerbergen, Bernadette Chantal	04/06/2021 01:48 PM	College Approval
Pending Approval	Jenkins, Mary Ellen Bigler Hanlin, Deborah Kay Oldroyd, Shelby Quinn Hilty, Michael Vankeerbergen, Bernadette Chantal	04/06/2021 01:48 PM	ASCCAO Approval

# Mathematics 5635

## Stochastic Calculus for Finance I

**Format:** Lecture

**Credit Hours:** 3 (3 contact hours per week)

**Prerequisites:** A grade of C- or better in 3589 or 3345; and a grade of C- or better in 4530, 5530H or Stat; and enrollment in Math major or Actuarial Science major, or Grad standing; or permission of department.

**Description:** Mathematics used in financial asset pricing, based on Wiener (Brownian motion) processes, with applications. Overview of needed real analysis, stochastic processes, Ito Calculus, Risk-neutral measure, connections with PDEs.

**Required Text:** *Stochastic Calculus for Finance II: Continuous-Time Models*, by Steven E. Shreve, published by Springer, ISBN: 0387401016

**Homework:** Weekly homework will be assigned and collected. This homework will consist of textbook problems along with additional assigned applied problems. Homework, along with class preparation, should take approximately 6 hours per week.

**Exams:** There will be one midterm and one final exam in this course. Both exams will be similar to homework questions but also contain problems that are designed to assess student understanding. The midterm will be a 55 minute exam and the final exam will be 1 hour and 45 minutes.

**Course Grade:** Grades for this course will be based on student performance according to the following weighting of assessment:

Homework and participation	25%
Midterm exam (up to Ito integral)	25%
Final exam (comprehensive)	50%

### Weekly Course Outline:

Week	Topics	Assignment
1	Distributions and $\sigma$ -algebras	HW 1
2	Convergence and computation of expectation values	HW 2
3	Change of measure, convexity, filtration	HW3
4	Change of measure, convexity, filtration; Conditional expectation	HW 4
5	Scaled random walk and Brownian motion; Quadratic variation, Markov property	HW 5
6	Ito integral, Ito-Doeblin formula	HW 6
7	Ito integral, Ito-Doeblin formula; Review	Midterm Exam
8	BSM equation, multivariable stochastic calculus	HW 7
9	Risk-neutral measure, martingale representation	HW 8
10	Risk-neutral measure, martingale representation	HW 9
11	Applications: cash flow, dividend-paying stocks, futures;	HW 10
12	Applications: cash flow, dividend-paying stocks, futures	HW 11
13	DEs, PDEs, Feynman-Kac theorem	HW 12
14	SDEs, PDEs, Feynman-Kac theorem; Review	

**Disability Statement:** The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; 098 Baker Hall, 113 W. 12th Avenue.

**Academic Misconduct Statement:** It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

Actuarial Science BS/BA Curriculum Map					
<b>Goal 1</b>	<b>To supply a strong general background in mathematics, statistics, and relevant concepts from the insurance industry</b>				
<b>Goal 2</b>	<b>To prepare students to take some of the national actuarial examinations administered by the Society of Actuaries and the Casualty Actuarial Society</b>				
<b>Course</b>	<b>Goal 1</b>	<b>Goal 2</b>			
Math 1151	Beginning	Beginning			
Math 1152	Beginning	Beginning			
ACCTMIS 2000	Beginning				
Econ 2001.01	Beginning				
Econ 2002.01	Beginning				
CSE 1222	Beginning	Intermediate			
CSE 1223	Beginning	Intermediate			
CSE 2111	Beginning	Intermediate			
Comm 2110	Beginning				
Comm 2131	Beginning				
Comm 2367	Beginning				
BusFin 3120	Intermediate	Beginning			
English 3304	Beginning				
Math 2153	Intermediate	Beginning			
Math 2568	Intermediate	Beginning			
Math 3588	Intermediate	Advanced			
Math 3618	Intermediate	Advanced			
Math 4530	Advanced	Advanced			
Stat 4201	Advanced	Advanced			
Math 5632	Advanced	Advanced			
Stat 4202	Advanced	Advanced			
Math 5630	Advanced	Advanced			
Math 5631	Advanced	Advanced			
Math 5633	Advanced	Advanced			
Math 5634	Advanced	Advanced			
<b>Math 5635</b>	<b>Advanced</b>	<b>Advanced</b>			
<b>Math 5636</b>	<b>Advanced</b>	<b>Advanced</b>			

Math - BS/BA Curriculum Map					
<b>Goal 1</b>	<b>Learn conceptual frameworks needed to study higher mathematics, including an introduction to mathematical reasoning and an understanding of how to read and write proofs.</b>				
<b>Goal 2</b>	<b>Aquire basic mastery of core areas of mathematics including calculus, analysis and algebra.</b>				
<b>Goal 3</b>	<b>Develop powerful mathematical problem solving skills.</b>				
<b>Goal 4</b>	<b>Learn to communicate mathematical understanding effectively.</b>				
<b>Goal 5</b>	<b>Become proficient in chosen tracks within the major.</b>				
<b>Course</b>	<b>Goal 1</b>	<b>Goal 2</b>	<b>Goal 3</b>	<b>Goal 4</b>	<b>Goal 5</b>
AcctMIS 2000			Beginning		Intermediate
Biochem 4511					Advanced
Biology 1113			Beginning		Intermediate
Biology 1114			Beginning		Intermediate
Biology 3401					Intermediate
BusFin 3120			Intermediate	Intermediate	Advanced
BusFin 3220			Intermediate	Intermediate	Advanced
Chem 1210			Beginning		Intermediate
Chem 1220			Beginning		Intermediate
Chem 2210					Advanced
Chem 2510					Advanced
Chem 4300					Advanced
Chem 4310					Advanced
CSE 1222			Beginning		Intermediate
CSE 1223			Beginning		Intermediate
CSE 2221			Beginning	Beginning	
CSE 2111			Beginning		Intermediate
Econ 2001.01			Beginning		Intermediate
Econ 2002.01			Beginning		Intermediate
EEOB 3310					Advanced
EEOB 3420					Advanced
EEOB 4520					Advanced
Math 1151	Beginning	Beginning	Beginning		
Math 1152	Beginning	Beginning	Beginning		
Math 1181H	Intermediate	Intermediate	Beginning		
Math 1295				Intermediate	Beginning
Math 2153	Intermediate	Intermediate	Beginning		
Math 2182H	Intermediate	Intermediate	Beginning		
Math 2255	Beginning	Intermediate	Intermediate	Beginning	

Math 2568	Beginning	Beginning	Beginning		Beginning
Math 2568H	Intermediate	Beginning	Intermediate	Beginning	Beginning
Math 3345	Advanced	Advanced	Intermediate	Intermediate	Intermediate
Math 3345H	Advanced	Advanced	Intermediate	Intermediate	Intermediate
Math 3350				Intermediate	Beginning
Math 3589			Intermediate	Intermediate	Advanced
Math 3607			Intermediate	Intermediate	Advanced
Math 3618			Intermediate	Advanced	Advanced
Math 4181H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 4182H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 4350			Intermediate	Advanced	Advanced
Math 4504	Advanced	Intermediate	Intermediate	Advanced	Advanced
Math 4507	Advanced	Intermediate	Intermediate	Advanced	Advanced
Math 4512	Intermediate		Intermediate	Intermediate	Intermediate
Math 4530	Intermediate	Beginning	Intermediate	Intermediate	Intermediate
Math 4547	Advanced	Advanced	Intermediate	Advanced	Beginning
Math 4548	Advanced	Advanced	Intermediate	Advanced	Beginning
Math 4551	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Math 4552	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Math 4556			Intermediate	Advanced	Advanced
Math 4557	Intermediate		Intermediate	Intermediate	Intermediate
Math 4570	Intermediate	Intermediate	Advanced	Intermediate	Intermediate
Math 4573	Advanced	Intermediate	Intermediate	Intermediate	Intermediate
Math 4575	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Math 4578	Intermediate	Intermediate	Intermediate	Intermediate	Advanced
Math 4580	Advanced	Advanced	Intermediate	Advanced	Beginning
Math 4581	Advanced	Advanced	Intermediate	Advanced	Beginning
Math 5101	Beginning	Advanced	Intermediate		Intermediate
Math 5102	Beginning	Advanced	Intermediate		Intermediate
Math 5421	Beginning	Beginning	Intermediate	Beginning	Advanced
Math 5451	Beginning	Beginning	Intermediate	Beginning	Advanced
Math 5520H	Advanced	Advanced	Advanced	Advanced	Intermediate
Math 5522H	Advanced	Advanced	Advanced	Advanced	Intermediate
Math 5529H	Advanced	Advanced	Advanced	Advanced	Intermediate
Math 5530H	Advanced	Advanced	Advanced	Advanced	Intermediate
Math 5540H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 5540H	Advanced	Advanced	Advanced	Intermediate	Beginning
Math 5576H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 5590H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 5591H	Advanced	Advanced	Advanced	Advanced	Advanced
Math 5632			Intermediate	Advanced	Advanced

<b>Math 5635</b>			<b>Intermediate</b>	<b>Advanced</b>	<b>Advanced</b>
<b>Math 5636</b>			<b>Intermediate</b>	<b>Advanced</b>	<b>Advanced</b>
Math 5660					Intermediate
Math 5756			Beginning	Intermediate	Intermediate
Math 5757			Beginning	Intermediate	Intermediate
MolGen 4500					Advanced
MolGen 5601					Advanced
Physics 1250			Beginning		Intermediate
Physics 1251			Beginning		Intermediate
Physics 2300					Advanced
Physics 2301					Advanced
Stat 4201	Intermediate	Beginning	Intermediate	Intermediate	Intermediate
Stat 4202	Intermediate		Intermediate		Intermediate