Stochastic Processes 1 - opis przedmiotu

Informacje ogólne

Nazwa przedmiotu	Stochastic Processes 1
Kod przedmiotu	11.1-WK-MATD-SP1-S22
Wydział	Wydział Matematyki, Informatyki i Ekonometrii
Kierunek	WMIiE - oferta ERASMUS
Profil	-
Rodzaj studiów	Program Erasmus
Semestr rozpoczęcia	semestr zimowy 2022/2023

Informacje o przedmiocie

Semestr	2
Liczba punktów ECTS do zdobycia	7
Typ przedmiotu	obieralny
Język nauczania	angielski
Sylabus opracował	• dr hab. Anna Karczewska, prof. UZ

Formy zajęć

Forma zajęć	Liczba godzin w semestrze (stacjonarne)	Liczba godzin w tygodniu (stacjonarne)	Liczba godzin w semestrze (niestacjonarne)	Liczba godzin w tygodniu (niestacjonarne)	Forma zaliczenia
Wykład	30	2	-	-	Egzamin
Ćwiczenia	30	2	-	-	Zaliczenie na ocenę

Cel przedmiotu

The aim of this course is to give a general understanding of the basic principles of stochastic processes.

These probability concepts will be illustrated with examples from biology and finance.

Wymagania wstępne

Mathematical analysis 1 and 2 courses, a Linear algebra course and a Probability course.

Zakres tematyczny

Lecture

1. Brief review of probability theory: probability and events, definition of random variables and distributions, moments, convergence of random sequences.
2. Introduction to stochastic processes: definition of a stochastic process, trajectories of a process, several definitions of regularity for a process, an introductory example - a simple birth process.
3. Discrete time Markov chains: definitions and notation, classification of states, first passage time, basic theorems for Markov chains, Markovian property and transition probabilities, stationary probability distribution.
4. Biological applications of discrete time Markov chains: gambler's ruin problem, general birth and death process, SIS epidemic model.
5. Poisson process: definition and basic properties of a Poisson process, construction of a Poisson process.
6. Continuous time Markov chains: definition and basic properties, continuous time birth and death chains.
7. General properties of stochastic processes: the existence of a process with given distributions, stochastic equivalence and separability of stochastic processes.
8. Wiener process: normal distribution, an idea of construction of a Wiener process, the Markov property, a "universal" filtration, properties of sample paths.
9. Finance applications: option pricing and arbitrage theorem.

Class

1. Brief review of probability theory: examples of random variables and distributions, calculating of moments, examples of convergent random sequences.
2. Introduction to stochastic processes: examples of stochastic processes, trajectories of a process, several definitions of regularity for a process, an introductory example - a simple birth process.
3. Discrete time Markov chains: discussion of first passage time, illustration of basic theorems for Markov chains, Markovian property and transition probabilities, stationary probability distribution.
4. Biological applications of discrete time Markov chains: general birth and death process, SIS epidemic model for some diseases.
5. Poisson process: basic properties of a Poisson process.
6. Continuous time Markov chains: basic properties, discussion of continuous time birth and death chains.
7. General properties of stochastic processes: the existence of processes with given distributions, stochastic equivalence and separability of stochastic processes.
8. Wiener process: normal distribution, the Markov property, properties of sample paths.
9. Finance applications: discussion of examples.

Metody kształcenia

Traditional lecture - the teacher conducts a lecture.

Class - students solve exercises and discuss problems.

Efekty uczenia się i metody weryfikacji osiągania efektów uczenia się

Opis efektu	Symbole efektów	Metody weryfikacji	Forma zajęć
Student understands the definitions of stochastic processes and their applications.		• dyskusja • test • test końcowy	• Wykład • Ćwiczenia
Student knows basic theorems on stochastic processes.		• dyskusja • test • test końcowy	• Wykład • Ćwiczenia
Student knows the construction of Wiener process.		• dyskusja • test • test końcowy	• Wykład • Ćwiczenia
Student knows and understands basic properties of Wiener process.		• dyskusja • test • test końcowy	• Wykład • Ćwiczenia
Student knows and understands basic theorems on Markov chains and some their applications.		• dyskusja • test • test końcowy	• Wykład • Ćwiczenia
Student is able to construct some models basing on stochastic processes.		• dyskusja • projekt • test końcowy	• Wykład • Ćwiczenia
Student is able to find proper literature on stochastic processes and their applications.		• dyskusja • przygotowanie projektu	• Ćwiczenia

Warunki zaliczenia

Class

The final grade for the class is issued on the basis of the points obtained by student from two written tests and for active participation in classes.

Lecture

The condition for taking the exam is a positive grade from the class. The exam verifies the learning outcomes in terms of knowledge and skills. The exam will be conducted in written form.

The condition for passing the course is a positive exam grade.

Literatura podstawowa

W. Feller, An Introduction to Probability Theory and Its Applications, Volumes I and II, J. Wiley & Sons, New York, 1971.

I. Karatzas and S. E. Shreve, Brownian Motion and Stochastic Calculus, Springer, New York, 1991.

Literatura uzupełniająca

S. E. Shreve, Stochastic Calculus for Finance I and II, Springer, New York, 2004.

Uwagi

Zmodyfikowane przez dr hab. Anna Karczewska, prof. UZ (ostatnia modyfikacja: 19-04-2022 15:00)