

STOCHASTIC ANALYSIS OF TIME SERIES

1. GENERAL

| | | | |
|---|---|--------------------------------|--------------------------|
| SCHOOL | SCHOOL OF ENGINEERING | | |
| DEPARTMENT | CIVIL ENGINEERING/ MSc APPLIED MATHEMATICS | | |
| LEVEL OF STUDIES | MSc - LEVEL 7 | | |
| COURSE CODE | | SEMESTER | 2 nd SEMESTER |
| COURSE TITLE | STOCHASTIC ANALYSIS OF TIME SERIES | | |
| TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i> | | TEACHING HOURS PER WEEK | ECTS CREDITS |
| | | 3 | 7,5 |
| <i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i> | | | |
| COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i> | Scientific area | | |
| PREREQUISITES: | NO | | |
| TEACHING & EXAMINATION LANGUAGE: | Greek | | |
| COURSE OFFERED TO ERASMUS STUDENTS: | NO | | |
| COURSE URL: | https://eclass.duth.gr/courses/1021375 | | |

2. LEARNING OUTCOMES

Learning Outcomes

Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

After completing the course, postgraduate students will be able to:

- Use stochastic time series models and the method of least squares.
- Estimate Parameters with different methods.
- Determining the appropriate model.
- Calculate of residuals and estimation of their autocorrelation coefficient.
- Calculate of the likelihood function of correlated observations.
- To use Iterative Kalman filter and prediction equations and their applications Applications.
- Kalman filter smoothing equations. Predictions and applications.
- Non-Gaussian and nonlinear state-space models. Bayesian models and their applications.
- The Monte Carlo Markov Chain method.

General Skills

Name the desirable general skills upon successful completion of the module

| | |
|--|--|
| <i>Search, analysis and synthesis of data and information,</i> | <i>Project design and management</i> |
| <i>ICT Use</i> | <i>Equity and Inclusion</i> |
| <i>Adaptation to new situations</i> | <i>Respect for the natural environment</i> |
| <i>Decision making</i> | <i>Sustainability</i> |
| <i>Autonomous work</i> | <i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i> |
| <i>Teamwork</i> | <i>Critical thinking</i> |
| <i>Working in an international environment</i> | <i>Promoting free, creative and inductive reasoning</i> |
| <i>Working in an interdisciplinary environment</i> | |
| <i>Production of new research ideas</i> | |

| |
|---|
| <ul style="list-style-type: none"> – Search, analysis and synthesis of data and information, using the necessary technologies. – Autonomous work. – Production of free, creative and inductive thinking. – Decision making. |
|---|

3. COURSE CONTENT

Stochastic time series models. Parameter estimation using the method of least squares. Parameter estimation by maximizing the likelihood function. Short term forecasts. Examples. Determining the appropriate model. Health check. Calculation of residuals and estimation of their autocorrelation coefficient. The general state-space model. Stochastic time series models that are special cases of the general state-space model. Calculation of the likelihood function of correlated observations. Kalman filter. Iterative Kalman filter equations. Kalman filter prediction equations. Renewal equations of the Kalman filter. Applications. Steady state of state-space models. Selection of initial values. Kalman filter smoothing equations. Predictions and applications in noisy random walk and non-local linear stress models. Non-Gaussian and nonlinear state-space models. Bayesian models and their applications. The Monte Carlo Markov Chain method.

4. LEARNING & TEACHING METHODS - EVALUATION

| | | |
|---|---|--------------------------|
| TEACHING METHOD <i>Face to face, Distance learning, etc.</i> | Distance learning | |
| USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i> | Use of ICT technologies in Teaching and Communication with students | |
| TEACHING ORGANIZATION <i>The ways and methods of teaching are described in detail.</i> <i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i> <i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i> | Activity | Workload/semester |
| | Lectures | 39 |
| | Research & Analysis | 0 |
| | Review studies | 108 |
| | Examinations | 3 |
| | Total | 150 |
| STUDENT EVALUATION | | |

| | |
|---|---------------------|
| <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p> | <p>Examinations</p> |
|---|---------------------|

5. SUGGESTED BIBLIOGRAPHY

1. G. Kitagawa "Introduction to Time Series Modeling", Chapman&Hall/CRC, London, 2010.
2. G. Janacek, "Practical Time Series", Arnold, London, 2001.
3. J. Durbin and S.J. Koopans, "Time Series Analysis by State Space Models", 2nd Edition, Oxford University Press, Oxford, 2012.
4. A.C Harvey, S.J. Koopman and N. Shephard (Eds), "State Space and Unobserved Component Models: Theory and Applications", Cambridge, Cambridge University Press, 2004.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

| | |
|---|--|
| Teacher (full name): | Alexandros Rigas |
| Contact details: | rigas@ee.duth.gr |
| Supervisors: (1) | NO |
| Evaluation methods: (2) | Written examination by distance learning methods |
| Implementation Instructions: (3) | <ul style="list-style-type: none"> • Failure to enter or entry at an unscheduled time will result in the student being disqualified from the exam. • Throughout the exam, examinees are connected to MS Teams and should have an open microphone so that there is uninterrupted audio contact between the examinee and the examiner. At the same time, they should immediately activate their microphone and camera in case they are asked for identification. • Required technological equipment: Ability to connect to the internet, use a camera, speakers, microphone, ability to scan/photograph the manuscript and create a pdf or compressed file in case of more than one page of response to a topic. • For the written exam, the examinees: (1) they will read the topics that will be posted in the eclass in the “Tasks” of the course one by one, (2) they will write their answer in Ms-Word (3) they will create a pdf or compressed zip/rar file and (4) they will upload it to eClass – Assignments - Submit Assignment, in a predetermined time (for each topic will be given a time proportional to its difficulty and extent) CAUTION! The file must be readable, otherwise they cannot be corrected and will be rejected. • Within the framework of actions for the protection of personal data, it is prohibited to record the examination process in any way, as well as to record or publish or post on websites or share with third parties or transmit or distribute in any way all or part of the distance examination. Also, it is the students' responsibility to protect their personal data by showing only what is required on camera. • Non-compliance of examinees with the rules of the examination and a finding of fraud on their part will result in the application of the plagiarism provisions. In the case of inability to participate in a remote assessment, the decision of the Rector's Council of the IFT will be made. |

(16) Please write YES or NO

(17) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(18) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.