UAB
Universitat Autònoma de Barcelona

Time Series

Code: 104863
Credits: 6

2026/2027

Degree programme	Type	Course
Applied Statistics	OB	3

Contact lecturer

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Group languages

You can consult this information at the end of the document.

Prerequisites

It is advisable to have knowledge on probability, statistical inference.

Objectives

This course aims to introduce students to time series models and their applications. A time series is a set of observations of a random phenomenon evolving over time (or any other ordered magnitude). Time series appear in many fields of application. Therefore, their analysis and the modelling of the underlying random phenomena are of crucial theoretical and applied importance. The ultimate goal is the modelling of the mechanism that generates the data, performing model diagnostics, and predicting future values.

Learning outcomes

- CM09 (Assess the suitability of the models with the correct use and interpretation of indicators and graphs.) Assess the suitability of the models with the correct use and interpretation of indicators and graphs.
- CM10 (Modify the existing software if required by the statistic model, or create new software, if necessary.) Modify the existing software if required by the statistic model, or create new software, if necessary.
- KM14 (Identify models to make inferences in processes dependent of time or other ordered variables.) Identify models to make inferences in processes dependent of time or other ordered variables.
- SM11 (Analyse the residuals of a statistical model.) Analyse the residuals of a statistical model.
- SM12 (Interpret the results obtained to formulate conclusions about the experimental hypotheses.) Interpret the results obtained to formulate conclusions about the experimental hypotheses.
- SM14 (Use graphs to visualise the fit and suitability of the model.) Use graphs to visualise the fit and suitability of the model.

Contents

1. Introduction. Classical analysis of time series models.
2. Stationary Processes. On the concept of stationarity, examples. Simulation.
3. Linear models. MA(q) and AR(p). Correlograms. Yule-Walker equations. The difference operator. Relationship between MA snd AR models. The autocorrelation and partial autocorrelation functions.
4. ARIMA Models. The ARMA(p,q) model. Parameter estimation: method of moments, MLE, unconditional and conditional least squares. Kalman Filter. The ARIMA(p,d,q) and SARIMA models. The Box-Jenkins

method. Segmentation.
5. Diagnostic checking and Forecasting. AIC and BIC criteria. Analysis of residuals. Confidence intervals for predictions.
6. Models for non-stationary series: ARCH/GARCH, ARMA with covariates
7. Count Time Series: The INAR models.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Theoretical sessions	26	1.04	
Practical sessions	26	1.04	
Real data analysis	25	1	
Personal work	60	2.4	

During the two weekly theoretical hours, the fundamental theoretical results will be presented, and computer-based exercises and problems will be solved. During the two weekly hours of computer-based practical sessions, R will be used to apply the models studied in the theoretical classes.

The gender perspective in teaching goes beyond the content of the courses, as it also involves reviewing teaching methodologies and interactions between students and teaching staff, both inside and outside the classroom. In this regard, participatory teaching methodologies, which foster an egalitarian and less hierarchical classroom environment, avoid gender-stereotyped examples and sexist language, and aim to develop critical thinking and respect for the diversity and plurality of ideas, people and situations, are generally more favourable to the integration and full participation of female students in the classroom. For this reason, their effective implementation will be sought in this course.

In this course, the use of Artificial Intelligence (AI) technologies is permitted as an integral part of the development of coursework, provided that the final result reflects a significant contribution by the student in terms of analysis and personal reflection. Students must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these tools have influenced the process and the final outcome of the activity. Failure to be transparent about the use of AI will be considered a breach of academic integrity and may result in a penalty in the mark for the activity, or more serious sanctions in severe cases.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes

Mid-term exam	0,3	2	0.08	CM09, KM14, SM11, SM12, SM14
Homework (exercises and computer activities)	0,3	8	0.32	CM09, CM10, KM14, SM11, SM12, SM14
Final Exam	0,4	3	0.12	CM09, KM14, SM11, SM12, SM14

In the continuous assessment modality, the course will be assessed through coursework submissions (submission of exercises, problem-solving tests and/or practical assignments) and two exams. In order to obtain the weighted continuous assessment mark, students must achieve a minimum score of 3/10 in each of the components.

Students who have opted for the single assessment modality must complete an assessment consisting of a theory exam, a problem-solving test, and the submission of the reports corresponding to the first and last practical sessions of the course. The assessment of these submissions may require an evaluation interview with the lecturer. The student's final mark will be the weighted average of the three activities mentioned above, with the exam accounting for 45% of the mark, the test for 45%, and the submissions for 10%.

If the final mark does not reach 5, the student will have another opportunity to pass the course through the resit exam, which will take place on the date set by the degree coordination. In this exam, students may recover 70% of the mark corresponding to theory and problem-solving. The practical assignment submission component is not recoverable.

Any irregularity committed during an assessment activity - academic fraud, plagiarism, or misuse of AI, unless such use is expressly authorised in the course guide - that may lead to a significant variation in the mark will result in that assessment activity being graded with a 0. If the course guide establishes that, in order to pass the course, it is an essential requirement to have obtained a minimum mark in that assessment activity, or if several irregularities occur in assessment activities for the same course, the final mark for the course will be 0. In addition, disciplinary proceedings may be initiated against any student who commits any of these irregularities.

Bibliography

1. Bisegard, S. (2011). *Time Series Analysis and Forecasting By Example. John Wiley & Sons, Inc., Hoboken, New Jersey.* https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010344849906709
2. Brockwell, P.J. and Davis, R.A. (2002). Introduction to Time Series and Forecasting. 2nd edit. Springer. https://bibcercador.uab.cat/permalink/34CSUC_UAB/cugbhl/alma991002663039706709
3. Cryer, J.D. and Chan, K.S. (2008). Time Series Analysis with Applications to R. 2nd. edit. Springer. https://bibcercador.uab.cat/permalink/34CSUC_UAB/1gfv7p7/alma991008499229706709
4. Peña, R.D. *A course in time series analysis*. https://onlinelibrary-wiley-com.are.uab.cat/doi/book/10.1002/9781118032978
5. Peña, D., Tiao, G.C., and Tsay, R.S. (2001). *A Course in Time Series Analysis. John Wiley & Sons, Inc.* https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010577691606709
6. Shumway, R.H. and Stoffer, D.S. (2011). Time Series Analysis and its Applications. 3rd. edit. Springer. https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjcib/alma991011050079506709
7. Tsay., R.S. (2010). Analysis of Financial Time Series, 3rd Edition, Wiley. https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjcib/alma991011050079506709

Software

R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

We shall use several R libraries, including forecast, TSA, TSeries, quantmod, fgarch, tscount.

Students can also use Python if they wish.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	1	Catalan	first semester	afternoon
(PLAB) Practical laboratories	1	Catalan	first semester	afternoon
(PLAB) Practical laboratories	2	Catalan	first semester	afternoon