



# UNIVERSITÀ DEGLI STUDI DI PALERMO

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| <b>DEPARTMENT</b>                   | Scienze Economiche, Aziendali e Statistiche                                                                  |             |                  |
| <b>ACADEMIC YEAR</b>                | 2018/2019                                                                                                    |             |                  |
| <b>BACHELOR'S DEGREE (BSC)</b>      | STATISTICS FOR DATA ANALYSIS                                                                                 |             |                  |
| <b>SUBJECT</b>                      | ANALYSIS OF SPACE AND TIME SERIES                                                                            |             |                  |
| <b>TYPE OF EDUCATIONAL ACTIVITY</b> | B                                                                                                            |             |                  |
| <b>AMBIT</b>                        | 50250-Statistico, statistico applicato, demografico                                                          |             |                  |
| <b>CODE</b>                         | 15451                                                                                                        |             |                  |
| <b>SCIENTIFIC SECTOR(S)</b>         | SECS-S/01                                                                                                    |             |                  |
| <b>HEAD PROFESSOR(S)</b>            | DI SALVO FRANCESCA                                                                                           | Ricercatore | Univ. di PALERMO |
| <b>OTHER PROFESSOR(S)</b>           |                                                                                                              |             |                  |
| <b>CREDITS</b>                      | 6                                                                                                            |             |                  |
| <b>INDIVIDUAL STUDY (Hrs)</b>       | 98                                                                                                           |             |                  |
| <b>COURSE ACTIVITY (Hrs)</b>        | 52                                                                                                           |             |                  |
| <b>PROPAEDEUTICAL SUBJECTS</b>      | 19596 - STATISTICAL INFERENCE                                                                                |             |                  |
| <b>MUTUALIZATION</b>                |                                                                                                              |             |                  |
| <b>YEAR</b>                         | 3                                                                                                            |             |                  |
| <b>TERM (SEMESTER)</b>              | 1° semester                                                                                                  |             |                  |
| <b>ATTENDANCE</b>                   | Not mandatory                                                                                                |             |                  |
| <b>EVALUATION</b>                   | Out of 30                                                                                                    |             |                  |
| <b>TEACHER OFFICE HOURS</b>         | <b>DI SALVO FRANCESCA</b><br>Wednesday 12:00 - 14:00 dipartimento seas. Si richiede una mail di prenotazione |             |                  |

**DOCENTE:** Prof.ssa FRANCESCA DI SALVO

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| <b>PREREQUISITES</b>          | Prerequisites are Inferential Statistics, knowledge of statistical package R.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>LEARNING OUTCOMES</b>      | Skills for learning.<br>Skills for integrating his own knowledge.<br>Skills for starting specialized courses and seminars about methodologies in spatio-temporal statistical analysis.<br>Skills for working in multidisciplinary groups, in which Statistics should be integrated with the other knowledge<br>Skills for solving technical problems, for developing a statistical analysis of data, as well as for presenting final results.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>ASSESSMENT METHODS</b>     | <p>The students will attend a practical exam that consists of two problems, each of them with 4 - 6 questions, that are to be solved using R Statistical Computing Environment software .</p> <p>In order to pass the exam, the candidate have to :</p> <p>A) demonstrate his own knowledge<br/>B) demonstrate proper technical language<br/>C) handle with data referred to time or space, in describing the concept of dependence and quantifying it with different kind of data<br/>D) conduct routine temporal and/or spatial statistical analysis using R.</p> <p>The exam consists also in two questions in English : the first one will be a traslanton and the second one a question. The exam will be passed if the candidate shows a fair knowledge of spoken English with a proper use of technical terms.</p> <p>Some rules:<br/>A candidate is permitted to bring the following items to an exam: pen, pencil, drafting instruments. All equipment brought to the examination must be placed on the candidate's desk and kept in view during the examination.<br/>Unauthorized materials include books, class notes aid sheets and unauthorized electronic devices .</p> <p>Ten and five minutes before the end of the examination, the presiding examiner will announce the number of minutes remaining.</p> <p>The candidate has to complete his writing in no more than two hours.</p> <p>Some rules:<br/>A candidate is permitted to bring the following items to an exam: pen, pencil, drafting instruments. All equipment brought to the examination must be placed on the candidate's desk and kept in view during the examination.<br/>Unauthorized materials include books, class notes aid sheets and unauthorized electronic devices .</p> <p>At ten and five minutes before the end of the examination the presiding examiner will announce the number of minutes remaining.</p> <p>In order to pass the exame, the candidate has to complete his writing in no more than two hours and he must solve both the problems .</p> |
| <b>EDUCATIONAL OBJECTIVES</b> | Upon successfully completing this course, students will be able to describe and recognize the main characteristics of spatial and temporal series, the trend, cycle and seasonality components and apply techniques to model their evolution; concerning with georeferenced observations, students will be able to distinguish between continous and discrete process, to identify the proper scale of observation and the proper geographical scale for representing spatial data; students will be able to conduct statistical analysis using R Statistical Computing Environment software and libraries for temporal and spatial analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>TEACHING METHODS</b>       | The course is taught using a combination of lectures and practical sessions in computer lab                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>SUGGESTED BIBLIOGRAPHY</b> | <p>E. Bee Dagum (2002), Analisi delle serie storiche. Springer<br/>R. S. Bivand, E. J. Pebesma, and V. Gomez-Rubio (2008), Applied Spatial Data in R Springer: New York, NY.</p> <p>A Little Book of R For Time Series, Release 0.2, 2016<br/>By Avril Coghlan, Parasite Genomics Group, Wellcome Trust Sanger Institute, Cambridge,<br/>available at <a href="https://media.readthedocs.org/pdf/a-little-book-of-r-for-timeseries/latest/a-little-book-of-r-for-time-series.pdf">https://media.readthedocs.org/pdf/a-little-book-of-r-for-timeseries/latest/a-little-book-of-r-for-time-series.pdf</a>.</p> <p>The gstat package - E. Pebesma<br/>URL <a href="http://cran.r-project.org/web/packages/gstat">http://cran.r-project.org/web/packages/gstat</a><br/><a href="http://www.gstat.org/gstat.pdf">www.gstat.org/gstat.pdf</a></p> <p>The geoR package - Paulo J. Ribeiro Jr and Peter J. Diggle<br/>URL <a href="http://cran.r-project.org/web/packages/geoR/">http://cran.r-project.org/web/packages/geoR/</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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|  | <p>The spatstat package - A. Baddeley R. Turner.<br/>URL <a href="http://www.maths.uwa.edu.au/adrian/spatstat.html">http://www.maths.uwa.edu.au/adrian/spatstat.html</a></p> <p>The spdep package - R. Bivand et al.<br/>URL <a href="http://cran.r-project.org/web/packages/">http://cran.r-project.org/web/packages/</a></p> <p>The maptools package - R. Bivand et al.<br/>URL <a href="http://cran.r-project.org/web/packages/maptools">http://cran.r-project.org/web/packages/maptools</a></p> <p>Software, manuali e dispense open content indicate dal docente e disponibili sul sito <a href="http://dssm.unipa.it/CRAN">http://dssm.unipa.it/CRAN</a></p> |
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## SYLLABUS

| Hrs | Frontal teaching                                                                                                                                                                                                                                                        |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Course Description, Course Purpose and exams information and rules                                                                                                                                                                                                      |
| 4   | Introduction to time and spatial series. Introduction to Stochastic Processes. Stationary stochastic processes. The autocorrelation function of a Stationary stochastic process: properties, representation and meaning. Estimation of the autocorrelation function.    |
| 5   | Time series decomposition and estimation of its components. Parametric and non parametric models for estimation of trend and seasonality.                                                                                                                               |
| 6   | The wold theorem and ARMA/ARIMA models. Moving Average Models . Invertibility of MA(q). Autoregressive models. Partial Autocorrelation function. Identification of the order of the Process. Seasonality and ARIMA models: Parameter estimation and Residuals analysis. |
| 4   | Introduction to analysis of spatially dependent data. spatial dependence and different types of georeferenced data                                                                                                                                                      |
| 4   | Geostatistical data: stationarity. Covariance and Variogram; variogram analysis and kriging                                                                                                                                                                             |
| 4   | point process analysis. first and second order properties.                                                                                                                                                                                                              |
| 4   | Statistical models for areal data. regular and irregular grids. Contiguity matrices                                                                                                                                                                                     |
| Hrs | Practice                                                                                                                                                                                                                                                                |
| 2   | Using R facilities for plotting and decomposing time series. Using timeseries, KernSmooth libraries                                                                                                                                                                     |
| 2   | Examples of time series analysis with R                                                                                                                                                                                                                                 |
| 4   | Selecting a Candidate ARIMA Model; estimation of parameters; predictions and representations.                                                                                                                                                                           |
| 8   | Spatial data analysis in R with the use of the libraries geoR, akima, spatstat, sp, spdep, maptools, gstat.                                                                                                                                                             |
| 4   | Areal data representations; spatial correlation indices; contiguity matrices.                                                                                                                                                                                           |