DEGREE IN RADIOLOGY, DIAGNOSTIC IMAGING AND RADIOTHERAPY TECHNIQUES

Integrated Teaching: INFORMATION TECHNOLOGY, STATISTICS AND PHYSICS APPLIED TO RADIOLOGICAL SCIENCE
SSD: MED/01, INF/01, ING-INF/05, FIS/07
Credits: 8
Responsible Professor: Luca Del Greco
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Module: Statistica medica applicata alle scienze radiologiche
SSD: MED/01
Number of credits: 1
Professor: Monica Sane Schepisi
E-mail: monica.saneschepisi@unicamillus.org

Module: Informatica applicata alle scienze radiologiche
SSD: INF/01
Number of credits: 2
Professor: Luca Del Greco
E-mail: luca.delgreco@unicamillus.org

Module: Elaborazione dati e archiviazione
SSD: ING-INF/05
Number of credits:2
Professor: Luca Del Greco
E-mail: luca.delgreco@unicamillus.org

Module: Fisica di base e fisica delle radiazioni
SSD: FIS/07
Number of credits: 3
Professor: Andrea Bellome
E-mail: andrea.bellome@unicamillus.org

PRE-REQUISITES

Although there are no prerequisites, minimum basic knowledge of mathematics, physics and basic statistics are required.

LEARNING OBJECTIVES

It is an essential objective of the **Medical Statistics Applied to Radiological Sciences** module to learn the knowledge of the essential elements of medical statistics which include: parameters for

descriptive analysis (average, median, fashion and frequency measurement of the distribution of categorical variables), parameters for the analysis of variability (variance , standard deviation and confidence intervals) and elements of inferential statistics (use and interpretation of the most common statistical tests), introduction to regression techniques.
The module of Information **Technology applied to Radiological Sciences** aims to provide the student with the skills necessary to understand the key role that Information Technology (IT) plays for today's society and, in particular, in the technical-health professions.
The module of **Data processing and storage** intends to provide students with the basic knowledge to understand the role of Information Systems and their lifecycle, specifically focusing on database management systems.
The aim of the **Basic Physics and Radiation Physics** module within the integrated course of Computer Science, Statistics and Physics applied to Radiological Sciences is to provide students with the knowledge on the foundations of applied physics necessary for the performance of their future activity. In particular, the understanding of the physical principles underlying medical physics and the functioning of medical instrumentation will be addressed. At the end of the module, students will know the fundamental concepts of application of the scientific method to the study of biomedical phenomena (choice and measurement of parameters, evaluation of errors), they will be able to describe the physical phenomena of complex systems using appropriate mathematical tools, they will know the scientific bases of medical procedures and the operating principles of equipment commonly used for diagnostics and therapy.

LEARNING OUTCOMES

Knowledge and Understanding

At the end of the module the student will learn:

- Classify the variables according to their form; understand and calculate the extent of the distribution of different variables; understand and calculate the measure of sample variability; design and analyze clinical studies using binary variables; make a comparison between continuous variables; address the concept of model in inferential statistics; use simple linear regression models; use multiple linear regression models for the analysis of confounders; use nonlinear models (logistic regression).
- Know the basic characteristics of modern IT systems, an understanding of the main applications of IT systems, the elements that contribute to defining the architecture of an IT system in terms of the relative hardware and software components that compose them, the difference between base and application software, the use of software to specify the actions that a computer must perform, the social impact of computers and IT technologies. what computer systems are and why they are needed. The different types of IT systems commonly adopted in companies and their purposes, the development cycle (life cycle) of an IT system, a basic knowledge of programming languages and coding, the different approaches to software development (oriented objects, structured, etc.), what are databases and database management systems.
- Having understood the experimental method and having acquired the rigor in the use and transformations of the units of measurement. Know and correctly understand the terminology of physics. Know the fundamental principles and laws of physics concerning kinematics, dynamics, electricity and magnetism, vibrations and waves, radiation and nuclear physics. Apply these concepts to biological and physiological phenomena in living

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organisms. Identify and recognize the physical principles that regulate the function of specific human organs.

Applying Knowledge and Understanding
At the end of the module, the student will be able to:

- Use the knowledge acquired for the deepening of elementary aspects relating to the use of statistics in the radiological field and to relate knowledge of causes with other professionals in the health sector;
- Apply the IT knowledge explained in the module and the tools used to real cases of application in the health sector;
- Apply knowledge of database structures and data management to real-world healthcare application cases;
- Apply the principles of physics to selected problems and to a variable range of situations. Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.

Communication Skills
At the end of the module, the student must know:
express yourself using specific scientific terminology. Use the appropriate scientific and technical terminology also in relation to the different radiological techniques. How to properly use the terminology commonly adopted in the IT world.

Making Judgements
At the end of the module, the student will have to

- Know how to carry out general assessments of the potential of medical statistics in both care and clinical research.
- Have an adequate knowledge and skills to be familiar with IT systems and their components;
- Have an adequate knowledge and skills to be familiar with IT systems, database management systems and their life cycles.
- Identify the fundamental role of correct theoretical knowledge of the subject in clinical practice.

Learning skills
The student will have acquired learning skills and methods suitable for deepening and improving his or her skills in the fields of statistics, computer science and physics, also by consulting scientific literature.

COURSE SYLLABUS

Medical Statistics Applied to radiological sciences

- Types of data, evaluation, and presentation of data: central tendency measures, measures of variability
- Probability: assessment and role of probability
- The Normal distribution, Sampling techniques
- Principles of statistical inference
- Inference from a sample mean, Comparison of two averages; Inference from a sample proportion, Comparison between two proportions

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- The Hypothesis testing system, Chi square test
- Linear regression
- The evaluation of diagnostic tests, Measurements reproducibility
- Introduction to multivariate regression, Multiple linear regression

Information Technology applied to Radiological Sciences

- Introduction to IT systems
- IT system hardware (CPU, memory, Input / Output)
- IT systems software: system software (operating system and utilities), application software (word processing, spreadsheets, databases, etc.)

Data Processing and storage

- Introduction to information systems
- Types of information systems
- The life cycle of information systems
- Database and Database Management System (DBMS)

Basics of Physics and Physics of radiations

- Introduction, measurement, estimating
- Describing motion: kinematics in one dimension
- Two-dimensional kinematics; Vectors
- Dynamics: Newton's laws of motion
- Circular motion; Gravitation
- Work and Energy
- Oscillations and waves
- Electric charge and electric field
- Electric potential
- Electric currents
- DC circuits
- Magnetism
- Electromagnetic induction and Faraday's law
- Electromagnetic waves
- The wave nature of light
- Optical instruments
- Early quantum theory and models of the atom
- Nuclear physics and radioactivity
- Nuclear energy; Effects and uses of radiation

COURSE STRUCTURE

The integrated course of **Information Technology, Statistics and Physics Applied to Radiological Science** is organized in lectures for a total of 80 hours and theoretical-practical exercises. The teachers use Power Point presentations to deal with the teaching topics.

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COURSE GRADE DETERMINATION

The exam is unique for the entire integrated course Information Technology, Statistics and Physics Applied to Radiological Science, it is not possible to take exam tests for the individual modules. The acquisition of the expected learning outcomes will be assessed through a written multiple choice test (30 questions in 45 minutes). Each correct answer has a value of "1", while each wrong or omitted answer has a value of "0".
Those who have achieved a minimum score of 18/30 can access the oral exam to improve their marks. The oral test is optional and consists of a maximum of three questions which may lead to an increase or decrease in the grade of the written test. You can be rejected in the oral exam.
The final exam grade will be calculated according to the following criteria:

Not suitable	Significant deficiencies and/or inaccuracies in knowledge and understanding of the topics; limited ability to analyse and summarise, frequent generalisations.
18-20	Barely sufficient knowledge and understanding of the topics with possible imperfections; sufficient capacity for analysis, synthesis and autonomy of judgement.
21-23	Routine knowledge and understanding of topics; correct analysis and synthesis skills with coherent logical argumentation.
24-26	Fair knowledge and understanding of the topics; good analytical and synthetic skills with rigorously expressed arguments.
27-29	Comprehensive knowledge and understanding of the topics; considerable ability to analyse, synthesise. Good autonomy of judgement.
30-30L	Very good knowledge and understanding of topics. Remarkable ability to analyse and synthesise and independent judgement. Arguments expressed in an original manner.

READING MATERIALS

MEDICAL STATISTICS APPLIED TO RADIOLOGICAL SCIENCES:

Essential Medical Statistics, 2nd Edition by Betty R. Kirkwood, Jonathan A. C. Sterne

INFORMATION TECHNOLOGY APPLIED TO RADIOLOGICAL SCIENCES:

Deborah Morley and Charles S. Parker, *Understanding Computers: Today and Tomorrow (16th edition)* - Cengage Learning

DATA PROCESSING AND STORAGE:

Deborah Morley and Charles S. Parker, *Understanding Computers: Today and Tomorrow (16th edition)* - Cengage Learning

BASICS OF PHYSICS AND PHYSICS OF RADIATIONS:

Douglas C. Giancoli “PHYSICS: Principles with Applications” Seventh edition or subsequent, Pearson Education. Inc