SUBJECT GUIDE Academic year 2013-2014

Biometrics

MODULE	CONTENT	YEAR	TERM	CREDITS	TYPE
Physics & Mathematics	Biometrics	1st	1st	6	Obligatory

LECTURER(S)	Postal address, telephone nº, e-mail address
Dra. Ana Mª Aguilera del Pino, Catedrática de Universidad E-mail: aaguiler@ugr.es Dr. Antonio Arcos Cebrián, Profesor Titular de Universidad. E-mail: arcos@ugr.es Dr. Manuel Escabias Machuca, Profesor Titular de Universidad. E-mail: escabias@ugr.es Dr. Francisco Jiménez Gómez, Catedrático de Escuela Universitaria. E-mail: fjmnez@ugr.es Dr. Francisco A. Ocaña Lara, Profesor Titular de Universidad. E-mail: focana@ugr.es Dra. Eva Ramos Ábalos, Profesora Contratada Doctora. E-mail: ramosa@ugr.es Dr. Mariano J. Valderrama Bonnet, Catedrático de Universidad E-mail: valderra@ugr.es	Dpto. Estadística e Investigación Operativa, Floor 1, Faculty of Pharmacy Campus de Cartuja, s.n. URL: http://www.ugr.es/~udocente/
DEGREE WITHIN WHICH THE SUBJECT IS TAUGHT	
Grade in Pharmacy	

PREREQUISITES and/or RECOMMENDATIONS (if necessary)

The following mathematical concepts are considered as basic:

- Logarithms and their properties
- Trigonometric functions
- Determinants of 2x2 and 3x3 matrices
- Solving of linear equation systems
- Line equations: alternative formulations
- Differentiation
- Integration (immediate ones, by change of variables, by parts)

BRIEF ACCOUNT OF THE SUBJECT PROGRAMME

Basic principles of Mathematics, Biometrics and Statistics applied in Pharmaceutical Sciences.

GENERAL AND PARTICULAR ABILITIES

Learn to apply the scientific method and acquire skills in handling legislation, sources of information, literature, development of protocols and other aspects that are considered necessary for the design and critical assessment of preclinical and clinical trials.
Specific abilities:
1. Apply mathematical knowledge to the pharmaceutical sciences.
2. Apply computational techniques and data processing to the information from physical, chemical or biological problems.
3. Design experiments guided by statistical criteria.
4. Evaluate scientific results obtained from drug and health products.
5. Apply statistical analysis skills to the pharmaceutical sciences.

OBJECTIVES (EXPRESSED IN TERMS OF EXPECTED RESULTS OF THE TEACHING PROGRAMME)

1. Know the mathematical approach to the causal relationship underlying a natural phenomenon or an experiment and describe the rate of change of a variable in terms of other dependent variables by means of differential calculus, applying such mathematical concepts to the evaluation of errors.
2. Set up and solve a differential equation governing a phenomenon in Pharmaceutical Sciences, and interpret the derived results.
3. Know the methods of univariate and bivariate descriptive statistics, including the regression techniques.
4. Interpret the concepts and main theoretic results of probability mainly addressed to applications (Bayes theorem, clinical diagnosis measures, ROC curve, etc.).
5. Understand statistical inference method and its associated basic notions

DETAILED SUBJECT SYLLABUS

1. Models for dependency among variables
1.1. The mathematical model
1.2. Instantaneous variation rate
    1.2.1. Differentiability in the case of an independent variable
    1.2.2. Differentiability in the case of several independent variables
1.3. Homogeneous functions
1.4. Maximum and minimum
    1.4.1. Case of an independent variable
    1.4.2. Case of several independent variables
Exercises and applications

2. Correlation and Regression
2.1. Least-squares fitting
2.2. Covariance and linear correlation coefficient
2.3. Regression by means of the least-squares method
2.4. Linear regression by means of the least-squares method
    2.4.1. Theoretical setting and regression equations
    2.4.2. Residual variance and determination coefficient
    2.4.3. Regression through the origin
2.5. Parabolic regression
2.6. Non-polynomial regression
Exercises and applications

3. Applications of the Differential
3.1. Differential of a function
    3.1.1. Differential in the case of an independent variable
    3.1.2. Differential in the case of several independent variables

3.2. Analysis of measuring errors
3.3. Derivative of a composite function
    3.3.1. Case of an independent variable
    3.3.2 Case of several independent variables
3.4. Derivative of an implicit function
    3.4.1. Case of an independent variable
    3.4.2. Case of several independent variables
3.5. Thermodynamic models
3.6. Systems of implicit functions
    3.6.1. Case of an independent variable
    3.6.2. Case of several independent variables
3.7. Polynomial approximation of a function
    3.7.1. Case of an independent variable
    3.7.2. Case of several independent variables
3.8. Directional derivatives and gradient
3.9. Plane tangent to a surface
3.10. Divergence and rotational of a vector field
Exercises and applications

4. Modelling with Differential Equations
4.1. Basic concepts
4.2. Separable variables equation
4.3. Homogeneous equation
4.4. Exact equation
4.5. Linear equation
4.6. Formulation of biometrics models
    4.6.1. Population growth models
    4.6.2. Loss of element activity
    4.6.3. Cooling of a element
    4.6.4. Transformation of a substance
Exercises and applications

5. Probability of Random Events
5.1. Algebra of events
5.2. Probability of a random event. Conditioning
5.3. Noteworthy probability theorems
5.4. Application to the clinical diagnostic
Exercises and applications

6. Random variables and Probability Distributions
6.1. Distribution function
6.2. Discrete and continuous random variables
    6.2.1. Discrete variables
    6.2.2. Continuous variables
6.3. Expectation and variance
    6.3.1. Expectation of a random variable
    6.3.2. Variance of a random variable
6.4. Study of some discrete random models
    6.4.1. Binomial model
    6.4.2. Poisson model
    6.4.3. Hypergeometric model
    6.4.4. Geometric or Pascal model
    6.4.5. Negative binomial model
6.5. Study of some continuous random models
    6.5.1. Normal or Gauss model
    6.5.2. Exponential model
    6.5.3. Lognormal model

6.5.4. Pareto model
Exercises and applications

7. Introduction to Statistical Inference
7.1. Estimation and hypothesis testing
7.2. Point estimation and confidence intervals
7.3. Estimation of the normal model
7.4. Sample size calculation
Exercises and applications

PRACTICES

Practice 1. Descriptive data analysis I: Tables and graphic displays
Practice 2. Descriptive data analysis II: Summary statistics
Practice 3. Bidimensional variables: Covariance and linear correlation coefficient
Practice 4. Regression: Fitting data to a linear model. Parabolic regression. Fitting non-polynomial models
Practice 5. Point estimation and confidence intervals

READING

E. Cobo, P. Muñoz and J.A. González: Bioestadística para no Estadísticos. Elsevier, Barcelona (2007).
E. Guervós, M.B. G.-Nicolás and A. G.-Rosales: Introducción al Cálculo. García-Maroto Eds., Madrid (2008).
K.P. Hadeler: Matemáticas para Biólogos. Reverté, Barcelona (1982).
A. Martín-Andrés and J.D. Luna del Castillo: Bioestadística para Ciencias de la Salud. Norma, Madrid (2005)
F. Rius and F.J. Barón: Bioestadística. Thomson-Paraninfo, Madrid (2008).
S.M. Ross: Introducción a la Estadística. Reverté, Barcelona (2007).
M. Sánchez, G. Frutos and P.L. Cuesta: Estadística y Matemáticas Aplicadas. Síntesis, Madrid (1996).
M.J. Valderrama: Biometría. La Madraza, Granada (2011).
S. Warner and S.R. Costenoble: Cálculo Aplicado. Thompson, Madrid (2002).

RECOMMENDED INTERNET LINKS

Webpage of the Department of Statistics and Operations Research at *Campus de Cartuja*: http://www.ugr.es/~udocente
Web-based learning platform SWAD: http://swad.ugr.es
Information on professors: http://www.ugr.es/~udocente/miembros.htm