

## MODULE DESCRIPTOR

<b>MODULE TITLE</b>	THEORY OF PROBABILITY AND STATISTICS		
<b>MODULE CODE</b>	MA1871 (L4)	<b>CREDIT VALUE</b>	20 CREDITS (10 ECTS)
<b>CAMPUS</b>	UCLAN CYPRUS		
<b>SCHOOL</b>	SCHOOL OF SCIENCE		

### MODULE AIMS

The first part of the module is devoted to probability theory and it aims to introduce students to important concepts related to probabilities through the theoretic foundations of probability theory. The second part of the module is an introduction to statistical analysis and its main objective is to teach students how to infer useful information about a population by using estimation methods, confidence intervals and testing of hypotheses.

### MODULE CONTENT

#### Probability Theory

**Probability:** Classical definition, events, samples spaces, axiomatic definition.

**Conditional Probability:** Independence, conditional probability, law of total probability, Bayes's rule.

**Random Variables:** Probability density function, cumulative distribution function, expected value, variance, moment generating function, distribution of functions of random variables.

**Discrete Distributions:** Bernoulli, binomial, Poisson, geometric, negative binomial distributions.

**Continuous Distributions:** Uniform, exponential, normal, Student's, Chi-square, F distributions and their relationships.

**Joint Distributions:** Independence, covariance, sums of independent random variables, marginal distributions, conditional distributions, conditional expectation, multivariate normal distribution.

**Approximations to Distributions:** Chebyshev's inequality, weak law of large numbers, strong law of large numbers, Poisson approximation, central limit theorem.

#### Statistical Analysis

**Estimation:** Efficient and Sufficient Statistics, Unbiased Estimators, Exponential Families of Distributions, Minimum Variance Unbiased Estimators, Cramer-Rao lower bound.

**Methods of Estimation:** Method of Moments, Method of Maximum Likelihood, Bayes Estimation.

**Confidence Intervals:** Confidence interval for the mean of a normal distribution, Confidence interval for the difference of means of two normal distributions, Confidence interval for the variance of a normal distribution, Confidence interval for the ratio of variances of two normal distributions.

**Testing of Hypothesis:** Tests for the mean and the variance of a normal distribution, Tests for proportions, Neyman-Pearson Lemma, Likelihood ratio tests, Link between confidence interval and hypothesis testing.

## INTENDED LEARNING OUTCOMES

On successful completion of this module a student will be able to:	
1.	Apply basic probability concepts and rules for discrete and continuous random variables
2.	Apply known results related to probability theory in order to comprehend basic concepts of statistical inference.
3.	Select and apply various statistical methods to real-life problems

## TEACHING METHODS

The class contact will consist of teaching classes together with workshops. Teaching classes will introduce new material and provide examples. Tutorials have no new material introduced. Students will attempt problems during the tutorials. Key elements of the learning strategy are regular sessions during which problems are attempted. Throughout the week students will be given a list of problems to attempt.

The module will be assessed principally by examination. However, to facilitate and monitor the formative learning process selected set exercises will be submitted for assessment. These will present regular opportunities for feedback and feedforward. At the end of the module, students will be expected to include a reflective component in this portfolio of work. This will make up the coursework component of the module.

## ASSESSMENT METHODS

The module is assessed through a Portfolio of set exercises and a Written exam.