The Hong Kong Polytechnic University

Subject Description Form

Subject Code	AMA1616
Subject Title	Quantitative Skills and Experimental Design for Scientists
Credit Value	3
Level	1
Pre-requisite/ Co-requisite/ Exclusion	N/A
Objectives	This subject aims to introduce and equip students with knowledge on basic scientific experiment design and quantitative skills to interpret results.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand the nature and need of use of quantitative skills in scientific study b) describe data using appropriate terminologies and figures c) apply appropriate statistical inferences for interpretation of data d) design experiments with proper controls and reference groups e) demonstrate the abilities of logical and analytical thinking
Subject Synopsis/ Indicative Syllabus	1. Common data types Introduction to random variables such as uniform, binomial, Poisson, Gaussian, etc. and their probability distributions. 2. Probability and estimates Basic probability rules; conditional probability. 3. Population and sampling Understanding of sampling theory; use of appropriate summary statistics and distributions to describe data including mean, median, mode, variance, standard deviation, standard error, confidence interval, interquartile ranges etc; data independence, optimal sample size estimation; use of appropriate figures. 4. Statistical inferences: parametric and non-parametric tests Understanding of assumptions and the use of common parametric and non-parametric tests (e.g. t-tests, ANOVA, correlations, regressions) for making statistical inferences. Type I /Type II error. Calculation of minimum sample size, statistical power, and effect size. 5. Design of experiment Common designs of experiment (e.g. Latin square, complete randomized), design of appropriate control and reference, and the

	application of statistical tests for data interpretation in chemistry, physics and biology research.
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the general statistics concepts of the topics in the syllabus through examples of scientific work are then reinforced by learning activities involving exercises and group project. Students will also practice using software such as Excel and SPSS for data input, sorting, screening, statistical tests and figure plotting. Other open-source software such as G Power/R will also be introduced.

Assessment Methods in Alignment with Intended Learning Outcomes	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
			a	b	c	d	e
	1. Mid-term Quiz	20%	✓	✓	✓	✓	✓
	2. Assignment	15%	✓	✓	✓	✓	✓
	3. Group project	25%	✓	✓	✓	✓	✓
	4. Examination	40%	✓	✓	✓	✓	✓
	Total	100%					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The subject focuses on knowledge and understanding of quantitative skills and experimental design for scientists, thus, exam-based assessment is the most appropriate assessment method. A 40% worth of written examination is held at the end of the semester.

Moreover, 20% worth of mid-term quiz, 15% worth of assignment and 25% worth of group project are included as components of continuous assessment to keep the students in progress.

Student Study Effort Expected	Class contact:	
	▪ Lecture	26Hrs.
	▪ Tutorial and computer demonstration	13Hrs.
	Other student study effort:	
	▪ Self-study	60Hrs.

	▪ Assignment	10Hrs.
	▪ Group Project	10Hrs.
	Total student study effort	119 Hrs.
Reading List and References	Text book: Statistics. Donnelly RA Jr and Abdel-Raouf F. 2016. Alpha, Indianapolis, Indiana. ISBN : 9781465454096 Recommended reading: The lady tasting tea : how statistics revolutionized science in the twentieth century. Salsburg D. 2001. Freeman, New York, New York. ISBN : 0716741067 Library location: Q175.S2345 2001 Hands-on exploratory data analysis with R: Become an expert in exploratory data analysis using R packages. Datar R, Garg H. 2019. Packt Publishing, Birmingham, UK. ISBN: 178980437X Library online access	