Subject Description Form

Subject Code	BME5155
Subject Title	Research Methods and Biostatistics
Credit Value	3
Level	5
Responsible staff & Department/School	Dr Chunyi WEN (BME)
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	The objective of this subject is to prepare the students to be able to plan a piece of meaningful, independent research, using appropriate design and methods, incorporating ethically acceptable behaviour and adhering to accepted ethical principles, and using appropriate statistical analysis and methods of presentation of findings for the type and amount of data, the purpose of the research and the targeted audience or vehicle for communication of findings.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Demonstrate understanding of the importance of planning and information gathering in research and demonstrate good planning and information gathering skills b. Use a range of information gathering approaches appropriately c. Demonstrate the ability to critically and comprehensively review the scientific literature on a given topic d. Develop different type of research approaches that are used in health sciences e. Perform power calculations and demonstrate understanding of type I and type II errors and the meaning of one-tail and two-tail p values in planning, performing and evaluating statistical analyses of research data f. Select and use the appropriate statistical tool(s) and presentation method(s) for a given set of research data and purpose g. Demonstrate understanding of the key elements of a research proposal h. Evaluate and summarize given research data/findings i. Demonstrate knowledge, understanding and application of accepted ethical principles in research involving human subjects or animals j. Prepare a detailed research proposal incorporating background, literature review, aims, methods, data analysis and importance of a research project of a selected topic in health science & technology.
Contribution to Programme Outcomes (Refer to Part I Section 2)	Programme Learning Outcome (a): Acquire and apply advanced levels of knowledge and skills in BME professions. (Teach, Practice, and Measure) Programme Learning Outcome (d): Develop analytical and research skills that will help them incorporate evidence-based practice in the delivery of healthcare services and industry. (Teach, Practice, and Measure) Programme Learning Outcome (e) demonstrate their abilities to continuously develop themselves in their professional practice. (Teach and Practice)

Subject Synopsis/ Indicative Syllabus

APPROACHES & DESIGN. Different types of research & research data; different approaches to research in health sciences; qualitative and quantitative research; observational, cross-sectional, case-control, nested case control, prospective, intervention studies – which is right for you? Issues of blinding, power, purpose and outcome.

ETHICAL ISSUES. Ethical principles and approval procedures: what are you doing, why and to whom or what? risk/benefit analysis.

VALIDITY, FEASIBILITY AND VALUE. Could and should it be done? How should it be done? Issues & case studies in healthcare and health sciences research ethics.

KEY TERMS AND CONCEPTS for planning for data collection & analysis – types of data; power, significance and error; sample size.

FOCUSING ON THE PROBLEM. Formulating hypotheses, identifying the problem and asking questions; non-hypothesis driven research; importance of literature searching and critical analysis of published literature; sources of information; avoiding plagiarism; more on power and error and sample size. Main elements of a research proposal; reviewing the literature; outcomes and significance of findings.

PLANNING AND PERFORMING STATISTICAL ANALYSIS; fitting the data, the question and the analysis together; interpreting P values – what they mean and what they do not mean; one sided or two sided P? sample size calculations; summary statistics. Which tests and why? Type I and Type II errors; identifying and handling skewed data; parametric and non-parametric tests; correlations and differences ; one-sided and two sided analysis; odds ratios; relative risk; comparing groups and methods; Analysis of sample datasets/demo of statistical analysis software.

GETTING THE MESSAGE ACROSS: tables and figures; line graphs, scatter plots, box charts, pie charts and columns; error bars. Are the data valid? What do they mean? Reaching the appropriate conclusion; How and when to report data? Monitoring progress; Preparing for write up and presenting research findings.

ABSTRACTS, POSTERS & PAPERS. Identifying and presenting an overview of the work and the key findings; elements of a scientific paper, choosing a journal; styles, ranking, impact factor; formatting, referencing and acknowledgements; clarity and focus; separating speculation, opinion and fact.

CRITICAL ANALYSIS. Reviewing and critiquing data, proposals and papers.

Teaching/Learning Methodology

Lecture, group discussion, guided reading, case studies

Teaching/learning methodology	Intended subject learning outcomes									
	a	b	c	d	e	f	g	h	i	j
1. Lectures	√	√	√	√	√	√	√	√	√	√
2. Tutorials	√	√	√	√	√	√	√	√		
3. Guided reading	√		√	√	√	√	√		√	
4. Case studies	√			√		√		√	√	

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed									
		a	b	c	d	e	f	g	h	i	j
writing assignment (literature review - information search/critique)	35%	√	√	√	√		√	√	√	√	√
Group presentation (Identifying research gap and formulating hypothesis)	35%	√	√	√		√		√	√	√	
Lab reports on data analytics	30%					√	√		√		
Total	100 %										

Students are required to integrate the knowledge acquired in the classes in their proposal writing assignment. The information gathering/critique assignment is used to assess whether students are able to conduct independent literature search and paper critique. A data analysis test is used to assess students' knowledge in biostatistics.

Student Study Effort Expected

Class Contact:	
▪ In class (lecture/ group discussion / workshop / case studies)	39 Hrs.
Other student study effort:	
▪ Self-study, guided reading, preparing assignments	78 Hrs.
Total student study effort	117 Hrs.

Reading List and References

Articles (Compulsory)

- Kocher MS, Zurakowski D. Clinical epidemiology and biostatistics: a primer for orthopaedic surgeons. J Bone Joint Surg Am. 2004 Mar;86(3):607-20.
- Petrie A. Statistics in orthopaedic papers. J Bone Joint Surg Br. 2006 Sep;88(9):1121-36.

Online resources (Optional)

- Biostatistics Tutorial Full course for Beginners to Experts (6:35:31)

(https://www.youtube.com/watch?v=1Q6_LRZwZrc)

0:00 Module 1 - Introduction to Statistics
29:13 Module 2 - Describing Data: Shape
45:44 Module 3 - Describing Data: Central Tendency
1:03:34 Module 4 - Describing Data: Variability
1:34:51 Module 5 - Describing Data: Z-scores
1:43:25 Module 6 - Probability (part I)
2:09:21 Module 6 - Probability (part II)
2:26:22 Module 7 - Distribution of Sample Means
2:41:24 Module 9 - Estimation & Confidence Intervals & Effect Size
2:56:59 Module 10 - Misleading with Statistics
3:17:43 Module 11 - Biostatistics in Medical Decision-making
4:13:36 Module 11b - Biostatistics in Medical Decision-Making: Clinical Application
4:56:51 Module 12 - Biostatistics in Epidemiology
5:05:16 Module 13 - Asking Questions: Research Study Design

	5:10:15 Module 14 - Bias & Confounders 5:39:20 Module 16 - Correlation & Regression 6:06:19 Module 17 - Non-parametric Tests ▪ Research by design: How to Use SPSS for Beginners https://www.youtube.com/c/ResearchByDesign
Date of Last Major Revision	6 May 2021
Date of Last Minor Revision	19 Aug 2022