

**Course Title:** Statistical data analysis and research methods  
**Course Subject Code:** BMI      **Course Number:** 504  
**Type of Instruction:** SEM      **Class Number:** 16249  
**Semester:** Spring 2025

Version January 09, 2025

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## 1 Course Information

- Date(s)/Time(s): Thursdays Jan 23 – May 1 (Final Exam May 8), 10AM – 12.30/1PM
- Location: Classes: remote (online real-time), Final exam: in person.
- Delivery Mode: Online synchronous (with availability of class-recordings afterwards)
- Number of Credits: 3
- Instructors
  - Course director: Werner Ceusters, MD (contact: 77 Goodell street, 5<sup>th</sup> floor, on appointment: [wceusters@gmail.com](mailto:wceusters@gmail.com))
  - Lecturers:
    - Statistics: Zackary Falls, PhD (contact: 77 Goodell street, 5<sup>th</sup> floor, on appointment: [zmfalls@buffalo.edu](mailto:zmfalls@buffalo.edu))
    - All other topics: Werner Ceusters, MD (contact: 77 Goodell street, 5<sup>th</sup> floor, on appointment only through [wceusters@gmail.com](mailto:wceusters@gmail.com))

## 2 Course Description

- This course provides a thorough introduction to research design and methods used in biomedical sciences in general and biomedical informatics in particular. Its main aim is to enhance the students' quantitative and qualitative research skills. Five themes will be covered: (1) the fundamentals of scientific research; (2) elements of philosophy of science, (3) quantitative research methods including statistics; clinical epidemiology, population studies and big data; (4) theoretically informed qualitative research; and (5) integration of research methods in biomedical sciences, including biomedical informatics.
- Most classes in the course consists of a theoretical and practical part, either in-class, or in the form of assignments and tests. The theoretical parts are in the form of interactive lectures surveying the formulation of research questions, the development of testable hypotheses, the selection and application of appropriate research designs and methods, data collection and analysis methods. These skills are then applied in the practical parts most of which are components for a skeleton of a research proposal which students will develop for a topic in their interest, but satisfying the principles outlined below.
- At the end of the course, students should be able to apply the methods taught in subsequent courses and research projects and use them for the evaluation and production of research proposals and papers.
- Course prerequisites: none.

## 3 Student Learning Outcomes (SLO)

### 3.1 *Mapping of course learning outcomes to program and institutional outcomes and competencies.*

Course Learning Outcomes; students will be able to:	BMI Graduate Program Outcomes / Competencies	Instructional methods	Assessment
1. Explain the fundamentals of scientific inquiry	O1: The most widely used clinical and informatics research methods	Lectures: C1, C2, C3, C5, C6, C7	Assignments: A2, A3 Final exam
2. Articulate research questions	O2: The generation, acquisition, modeling, representation, and management of evidence-based knowledge sources for decision support O3: The characteristics of public health data as distinguished from clinical healthcare data	Lectures: C1, C2, C3, C9 Discussion: C4	Assignments: A1 Final exam
3. Assess the quality of quantitative and qualitative studies	O1: The most widely used clinical and informatics research methods O4: Methods of data representation, manipulation, storage, analysis and mining in healthcare and biomedical research databases	Lectures: C3, C9, C8, C7 Discussion: C4	Assignments: A6
4. Understand and apply the concept of hypothesis in quantitative studies	O1: The most widely used clinical and informatics research methods. O5: Technical approaches to acquiring, modeling, representing and managing healthcare and biomedical research knowledge	Lectures: C2, C5, C6, C7 Discussion: C4	Assignments: A2, A3, A6 Final exam
5. Explain the role of causal theories in the design and interpretation of quantitative studies	O6: Research & data management methods with large clinical populations, including clinical trials O7: The essential components of clinical and biomedical data statistical analysis	Lectures: C2, C9, C5, C6, C7 Discussion: C4 Guided exercise: C9	Assignments: A2, A3, A6 Final exam

6. Understand and use statistical methods for calculating summary estimates, measures of variability and confidence intervals	O7: The essential components of clinical and biomedical data statistical analysis	Lectures: <b>C9</b> , C11, C7	Assignment: A5 Final exam
7. Understand probabilities and discrete and continuous distributions	O7: The essential components of clinical and biomedical data statistical analysis	Lectures: C3, <b>C10</b> , C11, C12	Assignment: A5 Final exam
8. Carry out and interpret a variety of tests of significance	O7: The essential components of clinical and biomedical data statistical analysis	Lectures: C3, C10, <b>C12</b>	Assignment: A5 Final exam
9. Understand and use power and sample size calculations	O7: The essential components of clinical and biomedical data statistical analysis	Lectures: <b>C3</b> , C12	Assignment: A5 Final exam
10. Use theory in qualitative research	O1: The most widely used clinical and informatics research methods	Lectures: C2, C8, <b>C5</b> , <b>C6</b>	Assignments: A2, A3, A6
11. Explain different forms of qualitative inquiry, including interviews, focus groups and observations and understand their benefits and limitations	O8: Information retrieval and critical analysis skills	Lectures: <b>C8</b> , C5	Assignments: A2, A6 Final exam
12. Explain and use different tools for qualitative data analysis	O7: The essential components of clinical and biomedical data statistical analysis	Lectures: <b>C8</b> , C5	Assignment: A6
13. Judge the suitability of different statistical methods to describe research findings	O7: The essential components of clinical and biomedical data statistical analysis	Lectures: C10, C11, <b>C12</b>	Assignment: A5 Final exam
14. Construct a coherent research proposal that includes an abstract, introductions, literature review, research questions, ethical considerations, and methodology	O9: Ethical theories and challenges in Biomedical Informatics	Lectures: C1, C2, C3, C9, C8, C5, C7 Discussion: C4	Assignment: A6
15. Present and defend a research proposal in public	O7: The essential components of clinical and biomedical data statistical analysis	Lectures: C1, C2, C9, C8, C6, C11, C12, C17 Discussion: C4	Assignments: A7, A8
16. Reflect critically on the extent to which this course contributed to an increase in the skills and competencies you deem important for your future career	O8: Information retrieval and critical analysis skills		Final exam

### 3.2 Mapping of course learning outcomes to institutional outcomes and competencies.

Applicable institutional outcomes	Instructional methods	Assessment
UB1. Demonstrate domain expertise, including critical reasoning and analysis.	Lectures: C1, C2, C3, C5, C6, C7, C8, C9, C10, C11, C12 Readings: R1-R10	Assignments: A1-A8 Final exam
UB2. Apply effective communication, information, and digital literacy skills.		Assignments: A6, A7 Final Exam
UB3. Demonstrate ethical and professional responsibility and act according to the norms of the chosen discipline.	Discussions: C4 Guided exercises: C9	Assignment: A8
UB5. Collaborate positively with others to achieve a common purpose.	Discussions: C4 Guided exercises: C9	
UB6. Assess, articulate, and acknowledge personal skills, abilities and growth areas.		Final exam

## 4 COURSE REQUIREMENTS

### 4.1 Course materials

This course requires the following papers and electronic publications, all of which are available publicly or through the UB Libraries: (links to the papers are provided in the detailed class descriptions starting page 8):

- R1. Shortliffe, E.H., *The organization and content of informatics doctoral dissertations*. J Am Med Inform Assoc, 2016. **23**(4): p. 840-3.
- R2. Wagensberg, J., *On the Existence and Uniqueness of the Scientific Method*. Biol Theory, 2014. **9**(3): p. 331-346.
- R3. Ioannidis, J.P., *Why most published research findings are false*. PLoS Med, 2005. **2**(8): p. e124.
- R4. Ioannidis, J.P., *Why Most Clinical Research Is Not Useful*. PLoS Med, 2016. **13**(6): p. e1002049.
- R5. Ozonoff, D.M. and P. Grandjean, *What is useful research? The good, the bad, and the stable*. Environ Health, 2020. **19**(1): p. 2.
- R6. Almozino, G., et al., *The Dental, Oral, Medical Epidemiological (DOME) Study: Protocol and Study Methods*. Methods Inf Med, 2020. **59**(4-05): p. 119-130.
- R7. Delgado-Rodriguez, M. and J. Llorca, *Bias*. J Epidemiol Community Health, 2004. **58**(8): p. 635-41.
- R8. McCluskey, A. and A.G. Lalkhen, *Statistics II: Central tendency and spread of data*. Continuing Education in Anaesthesia Critical Care & Pain, 2007. **7**(4): p. 127-130.
- R9. Cohen, H.W., *P values: use and misuse in medical literature*. Am J Hypertens, 2011. **24**(1): p. 18-23.
- R10. Norman, G. and D. Streiner, *Biostatistics : The Bare Essentials*. 2014, Shelton, UNITED STATES: People's Medical Publishing House.

### 4.2 Assignments and tests

- This course has no scheduled tests. Instructors may however decide during the course to create tests for which students can obtain extra credit counting towards the final grade.
- All assignments except A8 need to be completed and uploaded to the **UB Box** folder **BMI504-2025-upload-assignments**, to which students will be invited as 'uploader'. All assignments except A7 and A8 must be submitted as Microsoft Word document prior to the deadlines specified in the course schedule. **Google doc links or any other link to a cloud server are not allowed.** The filename should be formatted as this: BMI504-[assignment-index(or indices, see further)]-[your UBIT name]. For example, if the course director were a student: "BMI504-A1-ceusters.docx" (no square brackets!) would be the filename for the first assignment. Note that your UBIT name is usually not just your last name. A7 must be uploaded as PowerPoint file following a similar naming convention.
- The main assignment is A6, a fully worked out proposal skeleton for a scientific research project to be built according to precise specifications given during the course and summarized in the document **ProposalSkeleton2025.pdf**. It must be uploaded as 'BMI504-A6-[your UBIT name].docx'. The layout and formatting of **ProposalTemplate2025.docx** must be strictly followed.
- Parts of this research proposal are the subject of separate **voluntary** assignments A1, A2, A3 and A4. These assignments may be submitted not earlier than after class C4 and not later than April 6. They may be submitted in any order, though A1 ... A4 is the most coherent one. They may be submitted separate or in combination.
- The assignments will be commented upon and graded by the instructor and then, in the spirit of team science, sent to **all and only students that submitted the corresponding assignment(s) by that time**. By doing so, all students participating in the voluntary assignments can benefit from the comments. Grades received for these assignments **do not count towards the final grade**, but are to be seen as an indication of how that part of the proposal would be assessed were it included as such in the final proposal. This approach gives the students the opportunity to receive feedback on these components so that they can be improved for inclusion in the final version. There is thus no requirement to do assignments A1, A2, A3, and A4, but when they are not done within the specified timeline, no intermediate feedback on the respective parts will be provided. Not receiving feedback may of course have a negative effect on the overall score of A6.
- That an assignment is intended to be Ax or two assignments Ax and Ay combined, must be reflected in the filename, e.g. 'BMI504-A2-[your UBIT name].docx' or 'BMI504-A2A4-[your UBIT name].docx' when the student wants to have A2 and A4 commented upon. Since each section Ax will be commented upon only once, it is advised to complete all sections corresponding to a given assignment. Otherwise, sections of Ax that were left blank despite 'Ax' appearing in the filename, will never be commented upon. Students may however also fill out sections they do not want to have checked at that time, but that might be useful for the instructor to better understand what the student is aiming for in sections to be commented upon.
- Assignments A1...A4 and A6 must be completed **on the very same document**, with **track changes on** all the time and no content or comments 'hard' deleted. This means that with each submission after the first one, the filename needs to be changed so as to reflect the sections the student wants to receive comments on. Failure to follow any of these instructions will result in the instructor not reviewing the work.
- Assignments A1...A4 that are submitted at least 3 days before a class Cn, can be discussed during Cn.
- A5 is an **obligatory** assignment. When assignment A5 is not delivered in time, a penalty of 1% of the positive final score will be applied for every 24 hours of delay. When this assignment is not delivered at all, the penalty will be equal to the % for which the assignment counts towards the final grade.
- Assessment criteria for assignments will be covered in detail in the course slides and discussed in the relevant classes.

5

- All classes will be on-line in real-time using Zoom. Attendance for each class is restricted to students logging into Zoom using their UB Zoom-account and official UBIDname. Students must register once in advance for all meetings using the link: [https://buffalo.zoom.us/meeting/register/\\_QgRnQLUS46I\\_zCAVqJsbw](https://buffalo.zoom.us/meeting/register/_QgRnQLUS46I_zCAVqJsbw). After registering, students will receive a confirmation email containing information about how to join the meetings.
- Students are prohibited from sharing the registration link and subsequent meeting link, and doing so could lead to academic misconduct charges.
- Students must logon in time. Cameras must be on, and clearly show faces. Adjust lighting conditions of the room when needed. Microphones must be muted at login time. When the instructor asks a question, students wishing – or asked – to respond must unmute, and mute once ordered to do so or after finished speaking.
- If for whatever reason during the course the link will not work, or an ongoing class is interrupted either because of a failure on the side of Zoom or of the infrastructure of the instructor (interruption of power, internet access, ...), students need to stay on-line and wait for instructions over email while the instructor works out an alternative (Skype, Google chat, ...).
- Recordings of the classes will be made available together with class slides and any other useful information in the UB Box folder **BMI504-2025-Class-materials**.
- Students must attend all classes and must participate in class discussions. See attendance policy regulations on page 6 for exceptions.
- Students are required to participate in the course evaluation process organized by the Graduate School or the BMI department.

## 6

- Grading follows standard graduate policies (<https://www.buffalo.edu/grad/succeed/current-students/policy-library.html?q=grading> )
- Learning assessments will be graded based on rubric criteria and weighted according to the following detailed break-down. If the final results for all students are outside the expected range, curve grading might be used at the discretion of the course director in consensus with all instructors. Curving will never lead to lower grades compared to not curving.

<b>Class</b>	<b>Date</b>	<b>Instructor</b>	<b>Pre-class required readings</b>	<b>Assessments</b>	<b>Due dates</b>	<b>Final Score weight</b>
C1	23-Jan	Ceusters (1)	R1	Post-class assignment A0		
C2	30-Jan	Ceusters (2)	R2			
C3	06-Feb	Ceusters (3)	R3			
C4	13-Feb	Ceusters (4)	R4, R5, R6	Post-class assignment <b>A1</b>	Feb 17 – Apr 6	(2.5% towards A6)
C5	20-Feb	Ceusters (5)	R7			
C6	27-Feb	Ceusters (6)	R8	Post-class assignment <b>A2</b>	Feb 17 – Apr 6	(6.5% towards A6)
C7	06-Mar	Ceusters (7)	R9			
C8	13-Mar	Ceusters (8)	R10	Post-class assignment <b>A3</b>	Feb 17 – Apr 6	(23% towards A6)
Spring break						
C9	27-Mar	Ceusters (9)		Post-class assignment <b>A4</b>	April 6 – noon !	(18% towards A6)
C10	03-Apr	Ceusters (10)	R11, R12			
C11	10-Apr	Falls (1)	R13	Post-class assignment <b>A5</b>	April 25 – noon	5%
C12	17-Apr	Ceusters (11)				
C13	24-Apr	Ceusters (12)	R14	Post-class assignments <b>A6,</b> <b>A7</b>	May 1 – 9am April 28 – noon	50% 5%
C14	01-May	Ceusters (13)		In-class presentation <b>A8</b>		10%
EXAM	08-May	Ceusters (14)		In-class open-book exam		30%
<b>TOTAL</b>						<b>100%</b>

Detailed requirements and how points will be earned on A6 are provided in document ProposalSkeleton2025.pdf

Final Grades:

Grade	Quality Points	Percentage
A	4.0	93.0% -100.00%
A-	3.67	90.0% - 92.9%
B+	3.33	87.0% - 89.9%
B	3.00	83.0% - 86.9%

B-	2.67	80.0% - 82.9%
C+	2.33	77.0% - 79.9%
C	2.00	73.0% - 76.9%
C-	1.67	70.0% - 72.9%
D+	1.33	67.0% - 69.9%
D	1.00	60.0% - 66.9%

F1	0	for a student who participated beyond the 60% point of the class
F2	0	for a student who started participating, but stopped prior to the 60% point of the class
F3	0	for a student who did not participate in the class

Incomplete grades cannot be earned.

## **7 COURSE FEES**

Standard UB tuition and fees. No extra costs.

## **8 ATTENDANCE POLICY**

Students are expected to attend *all* classes. For religious observances, university sanctioned events, athletic commitments and family/work obligations/emergencies, absences may be granted upon request and subsequent approval by the course director *prior* to the absence. Requests are to be sent by email. Medical absence must be accompanied by a doctor's note. Even if absence is granted, it can have an effect on the finally obtained grade (see grading policy) unless additional coursework in replacement for missed graded activities is performed.

For course cancellation/emergency planning, see the university website for cancellations/delays due to weather or other unforeseen events (<http://www.buffalo.edu/administrative-services/emergency-management/emergency-procedures.html> )

## **9 ACADEMIC INTEGRITY**

- Academic integrity is a fundamental university value. Through the honest completion of academic work, students sustain the integrity of the university while facilitating the university's imperative for the transmission of knowledge and culture based upon the generation of new and innovative ideas. See <http://grad.buffalo.edu/Academics/Policies-Procedures/Academic-Integrity.html>.
- Students must design an original research study. It is allowed to be inspired by what can be found in the literature, but the proposed study must be sufficiently distinct from what it is inspired by.
- Students may collaborate for certain unscheduled assignments or tests in which case the submitted materials should be clearly labeled as such, with the names of all collaborating students. In case students who collaborate cannot come to a consensus for certain parts of the work, alternate solutions proposed by individual students should be clearly marked as such. Grading of individual students will take into account such alternatives.
- The use of generative AI is allowed, but not advised. There are still too many issues with this technology brought about by the combination of unrelated sources with incoherent prose as consequence. Individual statements may be correct, but incoherent in context.

## **10 ACCESSIBILITY RESOURCES**

If you have any disability which requires reasonable accommodations to enable you to participate in this course, please contact the Office of Accessibility Resources, 25 Capen Hall, 645-2608, and also the course director of this course. The office will provide you with information and review appropriate arrangements for reasonable accommodations. <https://www.buffalo.edu/studentlife/who-we-are/departments/accessibility.html>.

## **11 UNIVERSITY SUPPORT SERVICES**

Students are often unaware of university support services. For example, the Center for Excellence in Writing provides support for written work, and several tutoring centers on campus provide academic success support and resources.

## **12 AVAILABLE RESOURCES ON SEXUAL ASSAULT**

UB is committed to providing an environment free of all forms of discrimination and sexual harassment, including sexual assault, domestic and dating violence and stalking. You may call [UB's Office of Equity, Diversity and Inclusion](https://www.buffalo.edu/equity.html) at (716) 645-2266 for more information. <https://www.buffalo.edu/equity.html>

## **13 COUNSELING SERVICES:**

As a student you may experience a range of issues that can cause barriers to learning or reduce your ability to participate in daily activities. These might include strained relationships, anxiety, high levels of stress, alcohol/drug problems, feeling down, health concerns, or unwanted sexual experiences. Counseling, Health Services, and Health Promotion are here to help with these or other concerns. You learn can more about these programs and services by contacting:

Counseling Services

120 Richmond Quad (North Campus), 716-645-2720

202 Michael Hall (South Campus), 716-829-5800

Health Services  
4350 Maple Rd, Amherst, NY 14226, 716-829-3316

Office of Health Promotion  
114 Student Union (North Campus), 716-645-2837

#### ***14 PROTECTING COURSE MATERIALS DISCLAIMER***

The Graduate School's Improper Distribution of Course Materials policy is in place to protect course materials.

All materials prepared and/or assigned by the instructors for this course are for the students' educational benefit. Other than for permitted collaborative work, students may not photograph, record, reproduce, transmit, distribute, upload, sell or exchange course materials, without my prior written permission. "Course materials" include, but are not limited to, all instructor-prepared and assigned materials, such as lectures; lecture notes; discussion prompts; study aids; tests and assignments; and presentation materials such as PowerPoint slides, or transparencies; and course packets or handouts. Public distribution of such materials may also constitute copyright infringement in violation of federal or state law. Students who violate this policy will be required to complete an educational sanction about the value of intellectual property. More serious and/or repeat violations of this policy may be treated as acts of "academic dishonesty" and/or subject a student to disciplinary charges under the Student Code of Conduct.

**C1. Jan 23 / Ceusters / Course introduction – Introduction to research and research proposals**

**Required reading pre-class for BMI PhD students (suggested for others):**

- R1** Shortliffe, E.H., *The organization and content of informatics doctoral dissertations*. J Am Med Inform Assoc, 2016. 23(4): p. 840-3.  
<https://academic.oup.com/jamia/article/23/4/840/2201488> [1]

**Class structure:**

- Participant and instructor introduction
- Course introduction, housekeeping rules, expectations, course project work

**Post-class assignments:**

- Required reading  
**R2** Wagensberg, J., *On the Existence and Uniqueness of the Scientific Method*. Biol Theory, 2014. 9(3): p. 331-346.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4131153/pdf/13752\\_2014\\_Article\\_166.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4131153/pdf/13752_2014_Article_166.pdf) [2]
- A0:** Reflect about your research interests concerning your future MSc or PhD thesis and formulate a number of research topics. These topics should for BMI students fit at least one of the detailed learning objectives for biomedical informaticists described in the document '*BMI504-Spring2025-topic-requirements.pdf*'. For students outside the BMI department, any topic will do. Be prepared to present and discuss this informally in class C2. No prior submission needed.

**C2. Jan 30 / Ceusters / Fundamentals of science and research**

**Required reading pre-class:**

- R2** Wagensberg, J., *On the Existence and Uniqueness of the Scientific Method*. Biol Theory, 2014. 9(3): p. 331-346.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4131153/pdf/13752\\_2014\\_Article\\_166.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4131153/pdf/13752_2014_Article_166.pdf) [2]

**Class structure:**

- Traditional lecture on (1) philosophy of science and research and (2) the scientific method
- Students will report on pre-class assignment (b) and explain their ideas, each presentation followed by discussion.

**Post-class assignment:**

Required reading:

- R3** Ioannidis, J.P., *Why most published research findings are false*. PLoS Med, 2005. 2(8): p. e124.  
<https://www.ncbi.nlm.nih.gov/pubmed/16060722> [3]

**C3. Feb 6 / Ceusters / Parameters for research designs**

**Pre-class reading:**

- R3** Ioannidis, J.P., *Why most published research findings are false*. PLoS Med, 2005. 2(8): p. e124.  
<https://www.ncbi.nlm.nih.gov/pubmed/16060722> [3]

**Class structure:**

Lecture introducing various research designs

**Post-class assignment:**

- Required readings:  
**R4** Ioannidis, J.P., *Why Most Clinical Research Is Not Useful*. PLoS Med, 2016. 13(6): p. e1002049.  
<http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002049> [4]  
**R5** Ozonoff, D.M. and P. Grandjean, *What is useful research? The good, the bad, and the stable*. Environ Health, 2020. 19(1): p. 2.[5]  
<https://ehjournal.biomedcentral.com/articles/10.1186/s12940-019-0556-5>
- On the basis of the lecture and papers **R4** and **R5**, reflect further on concrete topics for your research proposal, and pick one for presentation during C4.

**C4. Feb 13 / Ceusters / Planning of research projects**

**Pre-class readings:**

- R4** Ioannidis, J.P., *Why Most Clinical Research Is Not Useful*. PLoS Med, 2016. 13(6): p. e1002049.  
<http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002049> [4]  
**R5** Ozonoff, D.M. and P. Grandjean, *What is useful research? The good, the bad, and the stable*. Environ Health, 2020. 19(1): p. 2.[5]  
<https://ehjournal.biomedcentral.com/articles/10.1186/s12940-019-0556-5>

**Class structure:**

Discussion of individual proposals. At the end of the class, the scope and goals of the projects should be clear.

**Post-class assignment:**

**SUGGESTED: A1:** Complete the sections marked 'A1' in the **ProposalSkeleton2025** document.  
**Preferred submission date: February 17 – noon.**

### **C5. Feb 20 / Ceusters / Mixed methods: Integration of quantitative and qualitative methods**

#### **Class structure:**

- The first part will be an interactive lecture covering the topic.
- Discussion on key points observed in submitted A1-assignments (if any)
- The third part, time permitting, will consist of a guided discussion aimed at determining the best research design to (dis)confirm hypotheses proposed for the individual research projects and to include an experimental design requiring a mixed design if not yet present in the original research proposal.

#### **Post-class assignment:**

SUGGESTED reading:

- R6** Almozino, G., et al., *The Dental, Oral, Medical Epidemiological (DOME) Study: Protocol and Study Methods*. *Methods Inf Med*, 2020. **59**(4-05): p. 119-130. [6]  
<https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0040-1718582>

### **C6. Feb 27/ Ceusters / Introduction to data analysis of quantitative and qualitative variables**

#### **Pre-class reading:**

- R6** Almozino, G., et al., *The Dental, Oral, Medical Epidemiological (DOME) Study: Protocol and Study Methods*. *Methods Inf Med*, 2020. **59**(4-05): p. 119-130. [6]  
<https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0040-1718582>

**Class structure:** interactive lecture

#### **Post-class assignment:**

**SUGGESTED: A2:** Complete the sections marked 'A2' in the **ProposalSkeleton2025** document.  
**Preferred submission date:** March 2 – noon.

### **C7. Mar 6 / Ceusters / Clinical trial designs**

#### **Class structure:**

- Lecture on cohort study design, clinical study design, analysis of clinical trials, randomized controlled clinical trials, 2x2 factorial designs, cross over designs.
- Discussion on key points observed in submitted assignments (if any)

### **C8. Mar 13 / Ceusters / Qualitative research methods: theory and data collection methods**

#### **Class structure:**

Lecture on common qualitative data collection methods (Document Review, Observation, Interview (face-to-face), Focus Group Discussion, Ethnography, ...)

#### **Post-class assignment:**

Required reading:

- R7** Delgado-Rodriguez, M. and J. Llorca, *Bias*. *J Epidemiol Community Health*, 2004. **58**(8): p. 635-41.  
<https://jech.bmj.com/content/58/8/635> [7]

Assignment:

**SUGGESTED: A3:** Complete the sections marked 'A3' in the **ProposalSkeleton2025** document.  
**Preferred submission date:** March 24 – noon.

### **C9. Mar 27 / Ceusters / Types of Bias**

#### **Pre-class reading:**

- R7** Delgado-Rodriguez, M. and J. Llorca, *Bias*. *J Epidemiol Community Health*, 2004. **58**(8): p. 635-41.  
<https://jech.bmj.com/content/58/8/635> [7]

#### **Class structure:**

- Question answering re required reading
- Interactive lecture on various types of bias, followed by guided exercise.
- Discussion on key points observed in submitted assignments (if any)

### **C10. Apr 3 / Ceusters / Elements of epidemiology**

#### **Class structure:**

Lecture covering essential notions in population studies such as incidence, prevalence, mortality ratios, validity, reliability, sensitivity, and specificity, etc...

#### **Post-class assignment:**

**A4:** Complete ALL sections in your proposal.  
**Hard due date:** April 6 – noon.

**Required reading:**

- R8** McCluskey, A. and A.G. Lalkhen, *Statistics II: Central tendency and spread of data*. Continuing Education in Anaesthesia Critical Care & Pain, 2007. 7(4): p. 127-130.  
<https://academic.oup.com/bjaed/article/7/4/127/466523> [8]
- R9** Cohen, H.W., *P values: use and misuse in medical literature*. Am J Hypertens, 2011. 24(1): p. 18-23.. [9]  
<https://academic.oup.com/ajh/article/24/1/18/165807>

**C11. Apr 10 / Ceusters / Descriptive and elementary statistics****Pre-class reading:**

- R8** McCluskey, A. and A.G. Lalkhen, *Statistics II: Central tendency and spread of data*. Continuing Education in Anaesthesia Critical Care & Pain, 2007. 7(4): p. 127-130.  
<https://academic.oup.com/bjaed/article/7/4/127/466523> [8]
- R9** Cohen, H.W., *P values: use and misuse in medical literature*. Am J Hypertens, 2011. 24(1): p. 18-23.. [9]  
<https://academic.oup.com/ajh/article/24/1/18/165807>

**Class structure:**

- Lecture covering the theories and applications of average value, median, mode, variance, standard deviation, inter-quartile range, skewness, kurtosis, histogram, box and whisker plot.
- Discussion on key points observed in submitted assignments (if any)

**Post-class assignments:**

Suggested reference book:

- R10** Norman, G. and D. Streiner, *Biostatistics : The Bare Essentials*. 2014, Shelton, UNITED STATES: People's Medical Publishing House. [10]  
 Accessible through UB Libraries login: <http://ebookcentral.proquest.com/lib/buffalo/detail.action?docID=3386956>

**C12. Apr 17/ Falls / Statistical analysis****Class structure:**

Lecture plus guided group work on statistics relevant to the students' research proposals. Completed assignments A4 will be used to determine the relevant content of the class. Possibilities are: Discrete and Continuous Distributions, the Normal Distribution, the Central Limit Theorem, Population vs Sample, Hypothesis Testing and Confidence Intervals (Z-test, t-test, Chi-Square Test, Fisher Exact, non-parametric), Power and Sample Size Calculations for One and Two-Sample Hypothesis tests.

**Post-lecture assignment:**

- A5: Part 1:** For each student, questions will be designed addressing statistical problems relevant to the student's individual research project. Students will be expected to formally answer these questions with full, detailed explanations.
- Part 2:** Students will be given a mockup biomedical dataset and a set of questions related to the dataset. They must use the statistical skills and tests they were taught in the lecture to assess the characteristics of the dataset and select and carry out the appropriate statistical tests to answer the questions posed.

**Due date: April 25 – noon**

**C13. Apr 24 / Ceusters / Final wrap-up of research proposals****Class structure:**

- Discussion of required presentation format (slides-A7 and oral presentation – A8).
- Final outstanding questions related to final proposal A6.

**Post-lecture assignment:**

Students will complete their final research proposal (A6) and prepare a Powerpoint presentation (A7) of this proposal for formal presentation (A8) during C14.

**Due date for A6: May 1 – 9am**

**Due date for A7: April 28 – noon**

**C14. May 1/ Ceusters / Presentation of final research proposals**

**Class structure:** presentation of research proposals. Each student has 150 minutes divided by number of students participating, 75% of time for presentation, 25% for questions. Grading will be based on the clarity of the presentation and the student's ability to respond to targeted questions.

**C15. FINAL EXAM: May 8 / 10AM**

The final exam (open book) will be held **IN PERSON, Dept of BMI, 77 Goodell St, Buffalo, NY 14203, 5<sup>th</sup> floor, room 506**. It will be composed of questions and exercises covering the complete content of the course, i.e. all slides and all papers (including 'suggested' ones, except **R10**), as well as any additional information that might have been given orally during the lectures. Students may use any documentation they consider useful to consult during the exam, whether or not used during the course. They must do the exam however alone!