

Course Title: Statistical data analysis and research methods (version Feb 7, 2017)

Course Subject Code: BMI

Course Number: 504

Type of Instruction: LEC

Class Number: 22903

Semester: Spring 2017

1. Course Information

- Date(s)/Time(s): Wednesdays 1-4 PM
- Delivery Mode: Traditional
- Number of Credits: 3
- Instructors
 - Course director: Werner Ceusters, MD (contact: 77 Goodell street, 5th floor, on appointment: wceusters@gmail.com)
 - Lecturers:
 - Clinical Trials: Peter Elkin, MD (contact: 77 Goodell street, 5th floor, on appointment: elkinp@buffalo.edu)
 - Statistics: Sarah Mullin, MSc (contact: 77 Goodell street, 5th floor, on appointment: sarahmul@buffalo.edu)
 - Epidemiology: Shyamashree Sinha, MD (contact: 77 Goodell street, 5th floor, on appointment: shyamash@buffalo.edu)
 - All other topics: Werner Ceusters, MD (contact: 77 Goodell street, 5th floor, on appointment only through wceusters@gmail.com)

2. Course Description

- This course provides an introduction to research design and methods in biomedical informatics and aims to enhance the students' quantitative and qualitative research skills. The course will be 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 can be applied in subsequent courses and research projects as well as in the evaluation and production of research papers. The course consists of six themes: (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; (5) integration of research methods in biomedical informatics; and (6) research ethics, including informed consent, and role of IRBs. The course will encompass lectures and practicums.
- Course prerequisites: none.

3. Student Learning Outcomes (SLO)

Course Learning Outcomes; students will be able to:	BMI Graduate Program Outcomes / Competencies	Instructional Method(s)	Assessment Method(s)
1. Explain the fundamentals of scientific inquiry	O1: The most widely used clinical and informatics research methods	lecture	In-class test Essay assignment
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	Lecture Hands-on training	Post-lecture quiz
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	Lecture Hands-on session	In-class test Case studies

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	Lecture with case studies Hands-on session	Post-lecture quiz
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	Interactive lecture Analysis of case studies Hands-on session	Participation in discussion Post-lecture quiz Inferential statistics exercise (homework)
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	Lecture Hands-on session	In-class test Case studies
7. Understand probabilities and discrete and continuous distributions	O7:The essential components of clinical and biomedical data statistical analysis	Lecture Hands-on session	Statistical exercise (homework)
8. Carry out and interpret a variety of tests of significance	O7:The essential components of clinical and biomedical data statistical analysis	Lecture Hands-on session	Statistical exercise (homework)
9. Understand and use power and sample size calculations	O7:The essential components of clinical and biomedical data statistical analysis	Lecture Hands-on session	Statistical exercise (homework)
10. Use theory in qualitative research	O1:The most widely used clinical and informatics research methods	Lecture Discussion of paper	Open-book test Participation in discussion
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	Interactive lecture	Participation in discussion
12. Explain and use different tools for qualitative data analysis	O7:The essential components of clinical and biomedical data statistical analysis	Lecture Hands-on session	In-class test Case study (homework)
13. Judge the suitability of different statistical methods to describe research findings	O7:The essential components of clinical and biomedical data statistical analysis	Analysis of case studies	Post-lecture quiz
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	Lecture Hands-on session Analysis of case studies	In-class test Case study (homework) Post-lecture quiz Role play in editorial committee

4. COURSE REQUIREMENTS

- Students are required to read 22 papers and electronic publications as listed in the course materials below and several chapters out of 1 book.
- Some lectures will start with a pre-test to assess the student's preparedness for the class, and a post-test to assess his attention to the lecture.
- For several lectures, availability of laptop (hands-on, open-book tests) is required.
- All assignments need to be completed prior to the deadline specified in the course schedule.

5. GRADING POLICY

- Grading follows standard graduate policies (<http://grad.buffalo.edu/Academics/Policies-Procedures/Grading-Procedures.html>)
- Learning assessments will be graded based on rubric criteria and weighted according to the following detailed break-down.

Class	Date	Instructor	Assessment	Due date	Score weight
C1	1-Feb	Ceusters	in-class test on reading	1-Feb	4%
C2	8-Feb	Ceusters	end-of-class test	8-Feb	3%
			assignment in time	2/15/17 12:00 PM	2%
			assignment result	2/15/17 12:00 PM	4%
C3	15-Feb	Ceusters	participation in discussion	15-Feb	3%
			assignment in time	2/22/17 12:00 PM	1%
			assignment result	2/22/17 12:00 PM	3%
C4	22-Feb	Ceusters	participation in discussion	22-Feb	3%
			test on pre-class readings	22-Feb	3%
C5	1-Mar	Sinha	test on pre-class readings	1-Mar	2%
			assignment in time	3/8/17 12:00 PM	1%
			assignment result	3/8/17 12:00 PM	4%
C6	8-Mar	Ceusters	assignment in time	3/15/17 12:00 PM	1%
			assignment result	3/15/17 12:00 PM	4%
C7	15-Mar	Elkin	assignment result		8%
C8	29-Mar	Sinha	test on pre-class readings	29-Mar	3%
			post-class test	29-Mar	5%
C9	5-Apr	Mullin	assignment in time	4/12/17 12:00 PM	1%
			assignment result	4/12/17 12:00 PM	7%
C10	12-Apr	Mullin	assignment in time	4/19/17 12:00 PM	1%
			assignment result	4/19/17 12:00 PM	7%
C11	19-Apr	Mullin	assignment in time	4/26/17 12:00 PM	1%
			assignment result	4/26/17 12:00 PM	7%
C12	26-Apr	Ceusters	participation in discussion	26-Apr	5%
C13	3-May	Ceusters	role identification	3-May	3%
			reviewers comments	3-May	3%
			response to reviewers	3-May	4%
C14	10-May	Ceusters	open-book test	10-May	7%
Total					100%
Delivery on time					8%
Pre-readings					12%
In-class participation					36%
Assignments					44%

Bonus score: final score = class scores + max 30% of (100% - class scores)

- Each student who wishes to participate (consent through email) receives for each class taught by Ceusters prior to May:
 - The detailed results of his score for that class,
 - The total results of each participating student for that class, all students (including self) being represented by unique identifiers,
 - The result of a function applied to (1) its own total score for that class and (2) the total scores of the other participating students for that class.
- To obtain a bonus score, participating students must prior to May 7 send to me their assessment of which pseudonym was assigned to which student.
- Scoring:
 - +10% for correct assessment of your own pseudonym;
 - +10% for finding the function,
 - +10%/(part. stud.) for each other student you assess correctly;
 - 20%/(part. stud.) for each student that assesses your pseudonym correctly.

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%
F	0	59.9 or below

An interim grade of Incomplete (I) may be assigned if the student has not completed all requirements for the course. An interim grade of 'I' shall not be assigned to a student who did not attend the course. The default grade accompanying an interim grade of 'I' shall be 'U' and will be displayed on the UB record as 'IU.' The default Unsatisfactory (U) grade shall become the permanent course grade of record if the 'IU' is not changed through formal notice by the instructor upon the student's completion of the course.

Assignment of an interim 'IU' is at the discretion of the instructor. A grade of 'IU' can be assigned only if successful completion of unfulfilled course requirements can result in a final grade better than the default 'U' grade. The student should have a passing average in the requirements already completed. The instructor shall provide the student specification, in writing, of the requirements to be fulfilled.

6. 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 may collaborate for the assignments 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.

7. 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 instructor of this course .. The office will provide you with information and review appropriate arrangements for reasonable accommodations. <http://www.student-affairs.buffalo.edu/ods/>

8. COURSE FEES

Standard UB tuition and fees. No extra costs, except for students wishing to purchase the statistics handbook.

9. Course Organization / Schedule

Reference: <http://registrar.buffalo.edu/calendars/academic/>

1) Feb 1 / Ceusters / Fundamentals of research: introduction / SLO 1

Pre class reading:

John P. A. Ioannidis

Why Most Clinical Research Is Not Useful

PLoS Med 13(6): e1002049

<http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002049>

Class structure:

- a) Overview of the course with
 - a. assessment of student expectations,
 - b. preferences in examples to be addressed within the context of resp. classes
- b) In-class test on pre-class reading
- c) Discussion of the pre-reading based on
 - a. answers from (b)
 - b. worldviews relevant to research, research versus engineering, types of research

Post-class assignment: none

Assessment: in-class test on pre-class reading

2) Feb 8 / Ceusters / Philosophy of science and ontology / SLO 1

Pre class reading: none

Class structure:

- a) traditional interactive lecture covering an introduction to the philosophical basis of research with a special focus on Ontological Realism
- b) application of the previous through a guided discussion on what counts as ‘mental disease’
- c) in-class application test

Post-class assignment:

Read the following paper:

Kirsti Malterud

Theory and interpretation in qualitative studies from general practice: Why and how?

Scandinavian Journal of Public Health, 2016; 44: 120–129

<http://journals.sagepub.com/doi/pdf/10.1177/1403494815621181>

Write a 2-page essay on this paper (Letter size, margins 1 inch, Arial 11p, single line spacing, justified, MS Word format or RTF) discussing the contents in light of what you learned in classes 1 and 2.

Deadline: Wednesday March 1, noon.

Assessment:

- 1) in-class application test: students will be presented with three evolving scenarios about behaviors in some populations. Each scenario will add some more observations about the populations. Students will be asked to suggest for each scenario hypotheses about the observed behaviors and specify a research method and analysis procedure for each hypothesis. For the 2nd and 3rd scenario, they will also need to indicate which hypotheses from the previous scenario(s), if any at all, can be ruled out on the basis of the new observations.
- 2) Evaluation of post-class assignment:
 - a) Delivered in time
 - b) content

3) Feb 15 / Ceusters / Qualitative research methods: theory and data collection methods / SLO 10**Pre-class reading:**

Kirsti Malterud

Theory and interpretation in qualitative studies from general practice: Why and how?

Scandinavian Journal of Public Health, 2016; 44: 120–129

<http://journals.sagepub.com/doi/pdf/10.1177/1403494815621181>

Class structure:

- a) lecture on common qualitative data collection methods (Document Review, Observation, Interview (face-to-face), Focus Group Discussion, Ethnography,...)
- b) discussion of the C2-application test in light of a)
- c) discussion of the pre-reading paper on the basis of what was taught in the lecture

Post-class assignment: open book test with multiple choice questions and open-ended motivation based on literature. Deadline: Feb 22, noon.

Assessment:

- 1) Participation in discussion
- 2) Evaluation of post-class assessment:
 - a) Delivered in time
 - b) content

4) Feb 22 / Ceusters / Introduction to data analysis of quantitative and qualitative variables / SLO 5, 11**Pre-class reading:**

1. Savitri Abeyasekera
Quantitative analysis approaches to qualitative data: why, when and how?
<https://www.reading.ac.uk/ssc/resources/QantatitativeAnalysisApproachesToQualitativeDataWhyWhenAndHow.pdf>
2. John P. A. Ioannidis
Why Most Published Research Findings Are False
PLOS Medicine 2005;2(8):e124
<http://robotics.cs.tamu.edu/RSS2015NegativeResults/pmed.0020124.pdf>

Class structure: interactive lecture

Post-class assignment: none

Assessment:

- 1) pre-lecture test on readings
- 2) participation in interactive lecture

5) Mar 1 / Sinha / Surveys and questionnaire construction for qualitative and quantitative research / SLO 3, 12, 14**Pre class reading:**

The students can read any one (or two) of the following three papers and there will be a set of five multiple choice questions and one free text question for each paper. Bonus point may be awarded to the person that reads more. (points 10+5 for each additional paper)

1. Brian Castellani and John Castellani.
Data Mining: Qualitative Analysis with Health Informatics Data.
Qualitative Health Research 2003;13(7): 1005-1018.
DOI: <https://doi.org/10.1177/1049732303253523>
2. Gude WT, van der Veer SN, de Keizer NF, Coiera E, Peek N.
Optimizing Digital Health Informatics Interventions Through Unobtrusive Quantitative Process Evaluations.
Stud Health Technol Inform. 2016;228:594-8.
<http://ebooks.iospress.nl/publication/44682>
3. Ashish K. Jha, E. John Orav, Jie Zheng, and Arnold M. Epstein.
Patients' Perception of Hospital Care in the United States
N Engl J Med 2008; 359:1921-1931.
<http://www.nejm.org/doi/pdf/10.1056/NEJMs0804116>

Class structure: the 150-minute class will be divided into two sections. The first half will be a lecture with pptx presentation. The second half will be a hands on questionnaire writing session with the help of Epi Info an open source software from CDC that can be downloaded from <https://www.cdc.gov/epiinfo/index.html>

Post class assignment: take home case study. Due date: March 8, noon

Assessment:

- 1) Quiz on pre-class readings
- 2) Evaluation of post-class assignment:
 - a) Delivered in time
 - b) content

6) Mar 8 / Ceusters / Descriptive and elementary statistics / SLO 3, 6

Pre-class reading:

Anthony McCluskey and Abdul Ghaaliq Lalkhen
Statistics II: Central tendency and spread of data
Continuing Education in Anaesthesia, Critical Care & Pain 2007;7(4):127-130.
<http://ceaccp.oxfordjournals.org/content/7/4/127.full.pdf+html>

Class structure:

- a) the 1st half will be a lecture covering the theories and applications of average value, median, mode, variance, standard deviation, inter-quartile range, skewness, kurtosis, histogram, box and whisker plot.
- b) The 2nd half will be a guided application of the use of MS Excel for elementary and descriptive statistics

Post class assignment: what hypotheses about the evolution of reportable communicable diseases in Erie county can you derive from the data available at <http://www2.erie.gov/health/sites/www2.erie.gov.health/files/uploads/pdfs/reportablediseases.pdf>? Provide arguments using methods and techniques discussed in this class and demonstrate using MS Excel. Due date: March 15, noon.

Assessment:

Evaluation of post-class assignment:

- a) Delivered in time
- b) content

7) Mar 15 / Elkin / Clinical epidemiology (I) / SLO 4, 5, 13, 14

Pre-class readings:

1. Stuart J. Pocock, Tim C. Clayton, Gregg W. Stone,
Making Sense of Statistics in Clinical Trial Reports
Journal Of The American College Of Cardiology 2015;66(22): 2536–2549
<http://www.sciencedirect.com/science/article/pii/S0735109715068941>
2. Stuart J. Pocock, Tim C. Clayton, Gregg W. Stone,
Statistical Controversies in Reporting of Clinical Trials
Journal Of The American College Of Cardiology 2015;66(23): 2648 – 2662
<http://www.sciencedirect.com/science/article/pii/S0735109715069624>
3. Stuart J. Pocock, Tim C. Clayton, Gregg W. Stone,
Design of Major Randomized Trials
Journal Of The American College Of Cardiology 2015;66(24): 2757–2766
<http://www.sciencedirect.com/science/article/pii/S0735109715071016>
4. Challenging Issues in Clinical Trial Design,
Journal Of The American College Of Cardiology 2015;66(25): 2886 – 2898
<http://www.sciencedirect.com/science/article/pii/S0735109715071995>

Class structure: lecture on cohort study design, clinical study design, analysis of clinical trials, randomized controlled clinical trials, sample size and power, survival analysis, missing data, Cox proportional hazard model, hazard ratio, kaplan meier, 2x2 factorial designs, cross over designs.

Post-lecture assignment: there will be a post-lecture quiz.

Assessment: results of post-lecture quiz

Mar 22: NO CLASS: SPRING RECESS

8) Mar 29 / Sinha / Clinical epidemiology (II) / SLO 2, 6

Pre Class Readings:

The students can read any one (or two) of the following three papers and there will be a set of five multiple choice questions and one free text question for each paper. Bonus point may be awarded to the person that reads more. (points 10+5 for each additional paper)

1. M Delgado-Rodríguez and J Llorca.
Bias.
J Epidemiol Community Health 2004;58:635-641
<http://jech.bmj.com/content/58/8/635.full.pdf+html>
2. Stephen J Mooney, Daniel J Westreich, and Abdulrahman M El-Sayed.
Epidemiology in the era of Big Data
Epidemiology. 2015 May; 26(3): 390–394.
<http://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC4385465&blobtype=pdf>
3. Griffin M. Weber, Kenneth D. Mandl, Isaac S. Kohane.
Finding the Missing Link for Big Biomedical Data
JAMA. 2014;311(24):2479-2480
<http://jamanetwork.com/journals/jama/fullarticle/1883026>

Class structure: a lecture covering the topics population studies and big data, incidence, prevalence, mortality ratios, validity, reliability, sensitivity, and specificity will be followed by discussion, more Epi Info exploration (see class 5) and Applied Epidemiology MCQ quiz.

Post-class assignment: none

Assessment: results of pre-class reading tests and end-of-class MCQ

9) Apr 5 / Mullin / Statistical analysis (I) / SLO 6, 7, 8, 9

Pre-class readings:

Streiner, David and Norman, Geoffrey
Biostatistics: Bare Essentials
People's Medical Publishing House
Chapters 4, 5, 6, 7 and 10
Accessible through UB Libraries login: <http://ebookcentral.proquest.com/lib/buffalo/detail.action?docID=3386956>

Class structure: Lecture plus guided group work on Principles of Probability, 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: will address statistical problems using R and biological data and reflect what was taught in class and the reading. A rubric will be provided for each set of problems outlining what needs to be included in order to receive full credit. Due date: Apr 12, noon.

Assessment:

Evaluation of post-class assignment:

- a) Delivered in time
- b) content

10) Apr 12 / Mullin / Statistical analysis (II) / SLO 4, 5

Pre-class readings:

Streiner, David and Norman, Geoffrey
Biostatistics: Bare Essentials
People's Medical Publishing House
Chapters 8, 9, 13, 14
Accessible through UB Libraries login: <http://ebookcentral.proquest.com/lib/buffalo/detail.action?docID=3386956>

Class-structure: Lecture plus guided group work on types of studies, randomization, correlation, linear regression, ANOVA, random vs. fixed effects, multiple comparison

Post-lecture assignment: will address statistical problems using R and biological data and reflect what was taught in class and the reading. A rubric will be provided for each set of problems outlining what needs to be included in order to receive full credit. . Due date: Apr 19, noon.

Assessment:

Evaluation of post-class assignment:

- a) Delivered in time
- b) content

11) Apr 19 / Mullin /Statistical analysis (III) / SLO 5

Pre-class readings:

1. Stefany Coxé , Stephen G. West & Leona S. Aiken
The Analysis of Count Data: A Gentle Introduction to Poisson Regression and Its Alternatives
Journal of Personality Assessment
Through UB Libraries: <http://www.tandfonline.com/doi/abs/10.1080/00223890802634175>
2. Kristin L. Sainani
Statistically Speaking: Logistic Regression
PM&R 2014;6(12):1157–1162
Through UB Libraries: <http://www.sciencedirect.com/science/article/pii/S1934148214014439>

Class structure: Lecture plus guided group work on Logistic Regression, Poisson and Negative Binomial Regression, Generalized Linear Models

Post-lecture assignment: will address statistical problems using R and biological data and reflect what was taught in class and the reading. A rubric will be provided for each set of problems outlining what needs to be included in order to receive full credit. Due date: Apr 26, noon.

Assessment:

Evaluation of post-class assignment:

- a) Delivered in time
- b) content

12) Apr 26 / Ceusters /Mixed methods: Integration of quantitative and qualitative methods / SLO 11, 12, 13

Pre-class reading:

Lawrence A. Palinkas, Gregory A. Aarons, Sarah Horwitz, Patricia Chamberlain, Michael Hurlburt, John Landsverk
Mixed Method Designs in Implementation Research
Adm Policy Ment Health (2011) 38:44–53
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3025112/pdf/10488_2010_Article_314.pdf

Class structure: interactive lecture

Post-class assignment: none

Assessment: students will be asked questions (and responses recorded), partially based on the pre-class reading, partially on previous parts of the lecture, relevant to next topic to be introduced.

13) May 3 / Ceusters /Fundamentals of research: format and content of research papers and reports / SLO14

Pre-class readings:

- 1) <https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously>
- 2) <https://www.elsevier.com/connect/8-reasons-i-rejected-your-article>

- 3) <https://www.elsevier.com/connect/8-reasons-i-accepted-your-article>
- 4) A recently published article, suitable for a Journal Club in biomedical informatics, TBD

Class structure: during the first half, the class will simulate a meeting of an editorial committee which will discuss the merits of the paper and write review comments with the possibility to indicate whether or not they individually agree with the individual comments. Different roles will be assigned to the students: neutral reviewers, biased reviewers in favor of the publication, biased against the publication. The second half will consist of all students writing together the ‘response to reviewers’, with the possibility to indicate whether or not they individually agree with the way the ‘group as author’ would accept or deny each of the individual requests for modifications.

Assessment: students will be scored by the instructor on the following elements:

- a) 30%: They need to identify which students were assigned what kind of reviewer role. For each correct identification they make, they will be given two points. They will lose a point for each student by whom they are correctly identified as playing the role assigned to them. They will lose 20% of the points when recognized by no one, this to ensure they play the role right.
- b) 30%: the degree to which their reviewers’ comments correspond with those of the instructor, with extra points for comments not made by the instructor, but assessed as adequate.
- c) 40%: the degree to which their agreement to modifications made correspond with how the instructor would respond.

14) May 10 / Ceusters / Research ethics; plagiarism; informed consent; IRB / SLO 14

Pre-class reading: none

Class structure: interactive lecture followed by in-class open book test on the topics covered in the lecture.

Post-class assignment: none

Assessment: scores on in-class open-book test.

10. COURSE MATERIALS

- This course requires the following papers and electronic publications, all of which are available publicly or through the UB Libraries:
 - 1) John P. A. Ioannidis. Why Most Clinical Research Is Not Useful. PLoS Med 13(6): e1002049, <http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002049>
 - 2) Kirsti Malterud. Theory and interpretation in qualitative studies from general practice: Why and how? Scandinavian Journal of Public Health, 2016; 44: 120–129. <http://journals.sagepub.com/doi/pdf/10.1177/1403494815621181>.
 - 3) Savitri Abeyasekera. Quantitative analysis approaches to qualitative data: why, when and how? <https://www.reading.ac.uk/ssc/resources/QantatitativeAnalysisApproachesToQualitativeDataWhyWhenAndHow.pdf>
 - 4) John P. A. Ioannidis. Why Most Published Research Findings Are False. PLOS Medicine 2005;2(8):e124. <http://robotics.cs.tamu.edu/RSS2015NegativeResults/pmed.0020124.pdf>
 - 5) Brian Castellani and John Castellani. Data Mining: Qualitative Analysis with Health Informatics Data. Qualitative Health Research 2003;13(7): 1005-1018. <https://doi.org/10.1177/1049732303253523>
 - 6) Gude WT, van der Veer SN, de Keizer NF, Coiera E, Peek N. Optimizing Digital Health Informatics Interventions Through Unobtrusive Quantitative Process Evaluations. Stud Health Technol Inform. 2016;228:594-8. <http://ebooks.iospress.nl/publication/44682>
 - 7) Ashish K. Jha, E. John Orav, Jie Zheng, and Arnold M. Epstein. Patients' Perception of Hospital Care in the United States. N Engl J Med 2008; 359:1921-1931. <http://www.nejm.org/doi/pdf/10.1056/NEJMsa0804116>
 - 8) Anthony McCluskey and Abdul Ghaaliq Lalkhen. Statistics II: Central tendency and spread of data. Continuing Education in Anaesthesia, Critical Care & Pain 2007;7(4):127-130. <http://ceaccp.oxfordjournals.org/content/7/4/127.full.pdf+html>
 - 9) Stuart J. Pocock, Tim C. Clayton, Gregg W. Stone. Making Sense of Statistics in Clinical Trial Reports. Journal Of The American College Of Cardiology 2015;66(22): 2536–2549. <http://www.sciencedirect.com/science/article/pii/S0735109715068941>
 - 10) Stuart J. Pocock, Tim C. Clayton, Gregg W. Stone. Statistical Controversies in Reporting of Clinical Trials. Journal Of The American College Of Cardiology 2015;66(23): 2648 – 2662. <http://www.sciencedirect.com/science/article/pii/S0735109715069624>
 - 11) Stuart J. Pocock, Tim C. Clayton, Gregg W. Stone. Design of Major Randomized Trials. Journal Of The American College Of Cardiology 2015;66(24): 2757–2766. <http://www.sciencedirect.com/science/article/pii/S0735109715071016>
 - 12) Challenging Issues in Clinical Trial Design. Journal Of The American College Of Cardiology 2015;66(25): 2886 – 2898. <http://www.sciencedirect.com/science/article/pii/S0735109715071995>

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- 19) <https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously>
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- 21) <https://www.elsevier.com/connect/8-reasons-i-accepted-your-article>

- This course requires in addition the following book: Streiner, David and Norman, Geoffrey. *Biostatistics: Bare Essentials*. People's Medical Publishing House. Limited copies are available in the UB Library. Older versions might be found electronically on the web. We recommend purchasing.
- One more electronic article (TBD) will be used. We will make sure it is publicly accessible.

11. ATTENDANCE POLICY

Students are expected to attend *all* lectures and lab exercises. For religious observances, university sanctioned events, athletic commitments and family/work obligations/emergencies, absences may be granted upon request but 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://emergency.buffalo.edu/campus-weather-alerts.html>)

12. CLASSROOM DECORUM

Students are expected to arrive in due time for each class. Most lectures will start with a pre-lecture test to assess the student's level of preparation for the class. This test contributes to the final grading. Use of cell phones and laptops is allowed for the purposes of the class, but not for private reasons. Additional rules of conduct, when applicable, will be explained by the instructors prior to the class.

13. 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.