Campus:
2400 Bridgeway Boulevard, Suite 290
Sausalito, California 94965 USA

Postal Mailing Address:
PO Box 564
Mill Valley, California 94942 USA
Website: www.EnergyMedicineUniversity.org
Phone: 415-331-1011
Fax: 415-331-9293

Instructor Contact Information

York Dobyns, PhD
Location: Lexington, Kentucky, USA
Email: york@energymedicineuniversity.org
Phone: 609-516-8409

EMP 874: Survey of Statistical Methods and Reasoning

COURSE OVERVIEW:
This course is intended to give the student a basic grounding in both the theory and practice of a wide variety of statistical methods. Introductory material will be available for students who have had no experience at all with probability and statistics, but the course as a whole will proceed from the assumption that students are familiar with at least some basic concepts of the field. The students are expected to gain at least basic familiarity with a wide toolkit of standard statistical tests and the types of data for which they are appropriate. In addition to basic analysis tools students will be introduced to the topics of Bayesian statistical inference, meta-analysis, statistical power analysis, and basic concepts of experimental design.

Students will be expected to install the R software package for statistical analysis and graphics.

NEED STATEMENT:
Energy medicine is a controversial and incompletely understood topic, and is therefore a subject of considerable ongoing research. Someone who wishes to participate in research on energy medicine must understand statistics well enough to distinguish between good and bad studies, understand what statistical reports of various kinds mean, and perform their own basic analyses.

LEARNING OBJECTIVES:
Students successfully completing this course will know and understand:
•The meaning of standard statistical terminology such as Z and T statistics, chi-squared values, F statistics, mean, median, effect size, confidence intervals.
•How to construct an appropriate statistical test given a particular hypothesis to be examined and a type of data collected for it.
•The distinction between a p-value and a Bayesian odds ratio or posterior probability, and what each of them implies.
•How to compute statistical power and estimate whether an experiment is adequate to test a particular hypothesis.
•How to make statistical inferences across multiple experiments
•How to use standard, widely available general-purpose statistical analysis software (e.g. Excel statistics built-in functions). Students will be expected to install the R software package for statistical analysis and graphics.

FACULTY-STUDENT COMMUNICATION

The primary means of communication with students will be via e-mail; phone conversations should be scheduled in advance via e-mail. Students are encouraged, but not required, to obtain Skype accounts for audio conferencing and/or real-time text chats. Students are expected to take responsibility for maintaining contact with the instructor and to make contact on at least a weekly basis.

The instructor will distribute supplementary reading materials for specific topics as Rich Text Format (.RTF) files, and may provide URLs for useful online resources in e-mails. Students will be required to submit assignments as RTF files (these can be prepared by a number of word processing programs including MSWORD).

COURSE DELIVERY STYLE

Distance Education - Coursework is completed at a location determined by the student utilizing a computer that has the ability to play audio and video clips, with Microsoft Office Word, Excel, PowerPoint, Adobe Reader, along with a current web browser, internet connection and email address. Contact and communication with distance students is typically conducted by telephone, Internet, Skype, text chat, and email. Students are also encouraged to contact the University by facsimiles, and postal mail, and by personal visit to the University.

All lessons, coursework and papers must be copied to lessons@energymedineuniversity.org from both the student and professor.

Students read texts (including textbooks, supplemental readings, and external online resources) and perform exercises as assigned by the instructor, returning reports and assignment results as RTF documents attached to e-mail. Group discussions and Q&A will be handled in text through EMU's interactive forums. If some discussion topic appears to require faster turnaround time a realtime audio conference will be scheduled, using either Skype or a conference calling service if there are students without Skype access. Individual discussions will be scheduled as needed.

After completing any assigned reading, but before attempting exercises or problem/paper assignments, students should contact the instructor by e-mail if they have any questions about the assigned reading material, or if there is anything in the assigned reading material that they do not feel they understood.

COURSE ASSIGNMENTS

Note: Specific assignments of individual exercises from the textbook are not listed in the syllabus. To save space in the assignment descriptions, please note the following:

- **Every assignment that involves readings from a primary textbook will also include supplemental material provided by the instructor (text documents, URLS to useful websites, etc.).**
- **Every reading assignment from a primary textbook will include exercises assigned by the instructor from that assignment's chapters, which the student will complete and report by e-mail.**
- **Assignments do not require you to read all of either textbook, but you may find it useful to do so anyway as an aid to fuller understanding.**

Some assignments will require a certain amount of mathematical calculation. Commonly available spreadsheet software should be adequate for completing these assignments.

For brevity, the two texts will be referred to as "DeVore" and "Rosenthal".

Assignment 1: Introductory Summary
Write and submit a short essay summarizing your current knowledge of probability and statistics. This will **not** be graded but will be used to estimate whether you are ready to proceed with the course material as discussed below or need some additional introductory material. If you are assigned additional introductory material it will be your responsibility to study it before proceeding to the regular course readings. This essay should be prepared immediately upon the start of the course.

Assignment 2: Topic Summary
Read the "Statistical Methods Toolkit" document provided by the instructor. This will provide a very abbreviated summary of all the methods and topics discussed in the course. The remainder of the course will give more details on how, when, and why to use the various techniques, and practice in working with them. After reading "Statistical Methods Toolkit" you will write a short paper (not more than 3 pages) in which you will identify those particular topics in which you feel the greatest need for more clarification.

Assignment 3: Introductory Background
Read Chapters 1-4 of DeVore.
This assignment is intended to establish a quick grounding in the basic underlying theory of probability and statistics, so exercises will be minimal but students are encouraged to ask any questions if anything is unclear.

Assignment 4: Estimating a Value
Read Chapters 6-7 of DeVore (chapter 5 will be returned to later).
In addition to the textbook exercises you will be requested to compute confidence

intervals for sample datasets provided by the instructor.

Assignment 5: Hypothesis Testing
Read Chapter 8 of DeVore.
The supplemental material in this assignment will address Bayesian hypothesis testing, which is not covered in either textbook. After reading the supplemental material you will analyze a sample dataset provided by the instructor, using both frequentist statistics (the p-value based approach taught by the textbook) and Bayesian probability updating. You will write a 5-10 page paper about your analysis in which, after presenting your analysis results, you discuss the distinction between a P-value and a Bayesian posterior odds adjustment, and suggest appropriate ways of describing each one to a layperson unfamiliar with statistics.

Assignment 6: Multiple variables
Read Chapter 5 of DeVore. Supplemental material will address additional applications of covariance and correlation measures, and additional exercises covering the supplemental material will be assigned.

Assignment 7: Multiple Populations
Read Chapters 9-11 of DeVore. Chapters 10 and 11, on ANOVA, will be dealt with only lightly; a basic familiarity with ANOVA concepts is helpful for understanding certain types of analyses, but in general multivariate regression is a more useful and flexible technique.

Assignment 8: Regression Methods
Read Chapters 12-13 of DeVore. You will be presented with outputs from five different multiple regression analyses. For each of these sets of results you will write a 1-2 page report describing the conclusions that can be drawn from the analysis and interpreting their meaning.

Assignment 9: Meta-Analysis
Read in Rosenthal: Chapters 1, 2, 4, and 5. Supplemental material will extend Rosenthal's discussion of the file drawer problem in meta-analysis. Do not attempt the assigned exercises until after you have had a Q&A session about meta-analysis. You will write two papers. In one, you will compute file-drawer values for an actual published meta-analysis (provided by the instructor) both by Rosenthal's criterion and by more recent, more conservative file-drawer estimates, and discuss the differences between the two, the validity of the assumptions on which they are based, and the plausibility that either computed filedrawer actually exists. In the second paper you will be presented with paradigms for several different areas of research and will discuss appropriate meta-analytic tools for each one.

Assignment 10: Final Review
You will return to Assignment 2 and review the "Statistical Toolkit" introduction;

after doing so you will ask the instructor for clarification of any topic addressed there that you still don't think you understand adequately. After Q&A you will take a final exam designed to test your ability to recognize the statistical methods appropriate to any particular problem and use them correctly.

ASSIGNMENT TIMING AND GRADING
Assignment 1 is to be completed immediately (or as soon as possible) upon the start of the course. The remaining assignments are to be completed at two-week intervals for an 18-week total duration. Contributions to overall grade are as follows:

Assignment	% of grade
1	0 (not graded)
2	0 (not graded)
3	10%
4	10%
5	15%
6	10%
7	10%
8	10%
9	15%
10	20%

REQUIRED TEXTS
Probability and Statistics for Engineering and the Sciences, Enhanced Review Edition, by Jay L. DeVore, Brooks/Cole, Belmont, CA. (This 2009 version of the Seventh Edition is available through Amazon.com; a large number of used copies are available at low cost. Students should **not** get the Eighth Edition from 2012; aside from the much greater expense, this is not the edition that the instructor will be using to make assignments!)

Meta-Analytic Procedures for Social Research (Applied Social Research Methods), by Robert Rosenthal, 1991, SAGE Publications Inc. (This is also available in reasonable-quality used copies through Amazon resellers, and can be ordered new from SAGE at somewhat greater cost.)