University of Michigan, School of Nursing (UMSN)

UMSN Scientific Methods for Health Sciences Training

Doctorate-Program Course-Series proposal to redesign the Analytical Methods Core

November 2013

Executive Summary

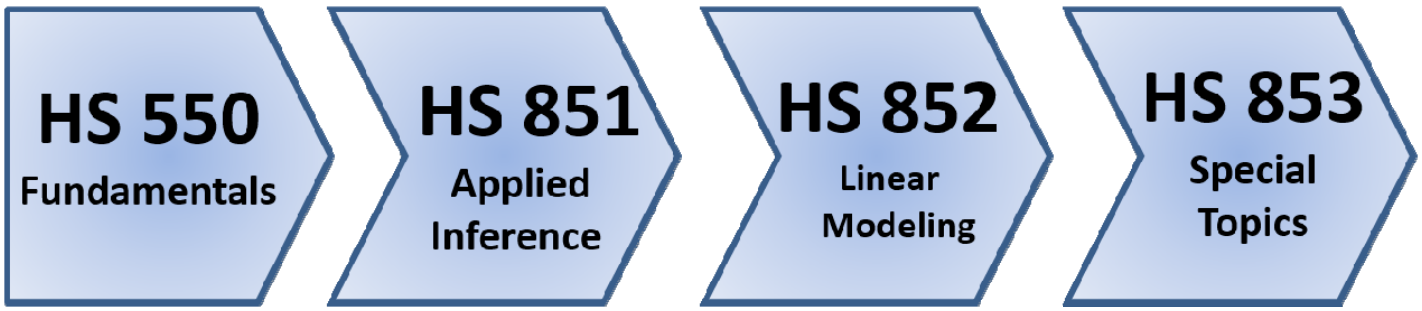
The 2010 report of the American Association of Colleges of Nursing (AACN), entitled "The Research-Focused Doctoral Program in Nursing: Pathways to Excellence" [1], outlined the need to advance nursing science training and emphasize the knowledge of basic and applied sciences in doctorate training in nursing and healthcare research. The Association of Schools of Public Health (ASPH) Education Committee [2,3] also promotes the increase of analytical methods competencies for doctoral students across the health sciences. The European Association of Schools of Public Health committee on Doctoral Programs recommends [4] that graduate students in health sciences are trained and capable to design, implement and interpret critical analytical approaches, with an interdisciplinary understanding of sources of error and differences of opinion.

This recommendation was largely driven by the clear observation that multidisciplinary knowledge and significant technical skills would be necessary to tackle healthcare challenges related to new and reemerging infectious diseases, growth of racial and ethnic populations, demands of chronic illness care, changes in healthcare delivery, and increasing globalization. Nursing doctorate students need rigorous training in scientific and analytical methods, study designs, data collection techniques, and application of research findings in practice, to address and investigate complex healthcare issues.

Since 2006, the UMSN has been on the National forefront of nursing research, practice and education, as well as implementing modern information technology, pedagogical and clinical advances. In June, 2012, a small group of faculty appointed by Dean Potempa and representative of all divisions, discussed and proposed a draft sequence (e.g. level 1, 2, 3) of methodological concepts and associated statistical procedures required of doctoral students. This information was forwarded to the Analytic Methods Core for their consideration. In Fall 2013, the Dean of the UMSN, Dean Potempa, formed the Analytics Core (AC), composed of Ivo Dinov, Jason Mitchell, Colwick Wilson, and Marita Titler, with many other UMSN faculty contributing to this redesign of the doctoral analytical methods curriculum.

Dean Potempa's charge for the AC is to redesign the UMSN doctoral analytical methods curriculum to address the following two goals: (1) Reduce the wide variation of students' analytic skills, scientific knowledge and quantitative abilities of the UMSN graduate students; and (2) Prepare exclusive cadres of scientists in nursing and healthcare capable of leading scientific teams in the conception of research proposals with strong methodological designs and analytic approaches to address innovative study aims. In response to this specific charge, the AC designed an **integrated series of Scientific Methods for Health Sciences courses**: HS 550 (Fundamentals), as a prerequisite to the following courses, HS 851 (Applied Inference), HS 852 (Linear Modeling) and HS 853 (Special Topics).

[1] http://www.aacn.nche.edu/education-resources/phdposition.pdf
[2] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3056048/
[3] http://www.asph.org/userfiles/DrPHVersion1.3.pdf
[4] http://aspher.org/mod/file/download.php?file_guid=317383



Curriculum Committee Criteria

Following the review elements outlined in the Curriculum Committee Procedures (November 2012), the sections below address the required Curriculum Committee review criteria for a new or revised UMSN curriculum program, like the doctoral analytical methods curriculum.

1. **Describe why the revised program is needed.**

There are both extrinsic and intrinsic reasons for the proposed redesign of the doctoral analytical methods curriculum at the UMSN. In the past decade, there has been a significant grass-roots effort to improve the analytical aspect of nursing education, establish nursing doctoral students as leaders and in health research and clinical practice, and broaden the methodological competencies across institutions, graduate nursing degrees and transformative nursing research projects. In addition, within the UMSN, there is a focused movement to attenuate the wide variability of analytic skills, and quantitative abilities of graduate nursing students and train doctorate nursing students as leaders of scientific teams with significant methodological design and analytic abilities.

2. **Describe how the proposal has been reviewed with pertinent faculty**

The proposal for redesigning the Analytical Methods Curriculum has been developed in close collaboration of faculty in all 3 UMSN divisions (D1: Acute, Critical, and Long-term Care, D2: Health Promotion and Risk Reduction, and D3: Nursing Business & Health Systems). The Analytics Core (AC) Committee, I. Dinov, I. Titler, C. Wilson, J. Mitchell, met with various constituents, solicited feedback from individual faculty and presented at several UMSN committees. Specifically, AC presented the analytical methods courses to each of the 3 UMSN divisions (during their monthly events (October 2013), the Curriculum Committee (November 2013), PhD Curriculum Committee (October 2013), BSN-to-DNP Committee (October 2013) and DNP Committee (October 2013). At these events, the overall objectives and major concepts were presented and faculty feedback was solicited and incorporated in the evolving plan. These AC presentations were focused on the following goals:

- Present the new Analytical Methods Course Series proposal to faculty
- Discuss the doctoral students' research needs, the implementation challenges, and impact of the proposed redesign
- Synergies with ongoing UMSN curricular redesign efforts (e.g., MS core, BSN-to-DNP, current DNP program, PhD revisions committee)
- Solicit constructive feedback, and critiques, from all UMSN faculty

Monthly reports were made at each of the division meetings by the respective faculty members on the AC. We attempted to engage all UMSN faculty at our open weekly AC meetings (Wednesdays 9 AM 4190), during the redesign presentations and in individual discussions to obtain broad, critical and

constructive recommendations to ensure the future approval of the proposed curriculum by the entire UMSN faculty body.

3. **Describe how the objectives of the revised program are congruent with professional standards and the nursing education, in general**

With guidance from Dean Potempa, and the UMSN Executive Committee (EC), the following 2 overarching analytical methods curriculum redesign goals emerged:

1) Reduce the wide variation of students' analytic skills, scientific knowledge and quantitative abilities of the UMSN graduate students; and

2) Prepare exclusive cadres of scientists in nursing and healthcare capable of leading scientific teams in the conception of research proposals with strong methodological designs and analytic approaches to address innovative study aims.

Although, there are no AACN doctorate (PhD) standards and essentials, the AC reviewed the AACN recommendations and standards for other nursing training programs (e.g., DNP, MS, BSN), the current scientific literature for the needs of newly minted Nursing PhDs, and the Health Sciences doctoral methods training recommendations of national and international organizations. Following internal discussions of the research demands, translational research-driven nursing-practice, current scope of doctorate students' analytical training, and the modern needs of healthcare researchers, the AC came up with a set of specific aims to meet the overarching goals, see **Table** below.

Analytical Methods Course Redesign Aims
1. Introduce emergent Health Science research methods in UMSN doctoral curriculum
2. Establish innovative University of Michigan *Difference* in Nursing Education
3. Enrich doctoral student training experiences
4. Train clinically-oriented research-capable healthcare providers
5. Increase student motivation to engage in state-of-the-art analytics methods
6. Strengthen the scientific and analytics training of the nursing doctorate students

Redesign Objectives:

We expect that nursing doctoral students that successfully complete the new Health Sciences course-series will be able to:

1. Demonstrate knowledge and skills to actively participate, significantly contribute to, and provide authoritative leadership in interdisciplinary teams and diverse research studies.

2. Avoid common mistakes and misconceptions in using probability, statistics and analytics methods due to violations of assumption or lack of theoretical foundation.

3. Demonstrate skills to review work of others (published studies and grant proposals), assess the impact of observed healthcare procedures, analyze data, synthesize summative information, and effectively communicate study designs, scientific methods, and technological protocols for advanced healthcare investigations.

A variety of resources were used by the faculty in preparation for this curriculum redesign plan including:

- AACN Research-Focused Doctoral Program in Nursing: Pathways to Excellence (2010)
- GoogleScholar® Doctorate Nursing Education Publications (2010+)
- Current Nursing Reviews (www.currentnursing.com/reviews)
- UMichigan Resources (ISR, CLRT, SPH, MedSch, CSCAR, ICPSR, SOCR, etc.)
- UMSN materials (DNP, PhD, BSN-to-PhD redesigns, etc.)
- Association of Schools of Public Health (ASPH) Education Committee recommendations
- European Association of Schools of Public Health Committee on Doctoral Programmes

4. **Briefly describe how the structure and content of the revised program permits achievement of its objectives, including:**

   a. **General description of the Program**

The designed doctorate analytical methods curriculum includes a total of 3 core courses (851, 852, 853), each of 4 credits (12 credits total) plus a 4 credit Foundations course (HS550) as a pre-requisite to the doctoral level courses. This pre-requisite may be achieved by taking the HS550 course or a comparable course elsewhere. The **Table** below illustrates the course-series as it relates to the current doctoral programs

UMSN Scientific Methods for Health Sciences Course Series				
HS 550 Fundamentals	***HS 851 Applied Inference***	***HS 852 Linear Modeling***	***HS 853 Special Topics***	**Track**
Required	Recommended	Optional	Optional	**MS**
Prerequisite/Required	Required	Required	Recommended	**DNP**
Prerequisite/Required	Required	Required	Required	**PhD**

   b. **Credit allotment**

All proposed didactic courses will follow the Rackham and School of Nursing credit allocation guidelines with 1 contact hour per credit for lecture or laboratory work. Each of these courses includes 3 credits (instructor/lecture) + 1 credit (computer laboratory) + 0 credit (discussion/journal club).

   c. **Prerequisites**

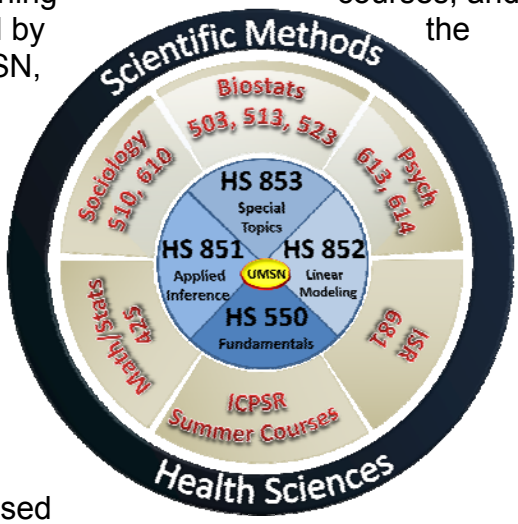
The first course in the HS 550 series serves as a core prerequisite for the HS 851, 852 and 853 courses. Itself, HS 550 requires basic quantitative requirements, like college algebra, calculus, undergraduate statistics or other upper-division quantitative General Elective (GE) course. Doctoral students can complement this required series of 3 analytic courses with other courses on campus.

   d. **Syllabi for courses**

Syllabi for all courses in this program have been prepared by content experts according to Curriculum Committee guidelines. They are included in the **Appendix**, along with one example of a self-contained learning module demonstrating how we plan to organize the instructional materials for the topics listed within the scope of each course in the HS 851-853 series.

5. **Briefly describe how the revised program fits with and affects related curricula**

In the process of redesigning the analytical methods doctoral training courses, and in addition to synergizing between the course-revisions proposed by the broader PhD Redesign Committee, we reviewed the current UMSN, SPH, ISR and other UMichigan departments and institutes, see **Figure**. We recommend that the current DNP curriculum offer HS851 and HS852 in lieu of N802 (Epidemiology) and N800 (Statistics). This recommendation is based upon the expertise of Drs. Mitchell and Wilson who currently teach N802 and N800 respectively. In addition, we have met once with the newly formulated BSN to DNP taskforce. Currently we are working with the PhD revisions committee to integrate these courses into the PhD curriculum.



6. **Describe the plan and timeline for implementation**

The **Table** below illustrates the HS 550-853 series and the proposed teaching assignments. The UMSN Analytics Core faculty will work together on the implementation and delivery of the entire course series, guest lecturers will be invited to present specific applications and conceptual demonstrations in line with the syllabi and topics discussed in each course.

Course Number	Fall 2014	Winter 2015	Fall 2015	Winter 2016
HS 550	Ivo **Dinov**		TBD	
HS 851	Ivo **Dinov**		TBD	
HS 852		James **Yang**		TBD/Dinov
HS 853			Ivo **Dinov**	

7. **Describe potential barriers, if any**

We do not anticipate significant barriers. We recognize this is a major shift in doctoral-level quantitative training at the UMSN for current graduate students as well as for prospective applicants. As the analytic series matures (e.g., in 2-3 years), we expect that graduate nursing program candidates' quantitative skills will significantly improve and we will observe a gradual increase in analytics methods training in the pool of UMSN doctoral applicants. To assess the improvement in doctoral students' analytical skills, and to determine whether a reduction in the variability of these skills amongst the graduate student body was achieved, we propose to implement regular program reviews and assessments of the proposed analytic methods series. Redesign and reorganization of the courses will occur as necessary. An important component to this evaluation and assessment will require communication and integration with curriculum revisions in the PhD and DNP programs, and communication of progress and challenges with the UMSN faculty.

The Scientific Methods for Health Sciences courses will require access to a modern computer laboratory 2-5 hours a week for instructor or/and TA supervised training and student self-learning and assignment completion. This lab needs to be equipped with modern laptops with high-speed internet connections, a suite of appropriate (TBD) software tools, storage capabilities and account management (by UMSN IT). For courses over 20 students, a 25% research assistant will be required for each section of 20 students (one class can have 1 or more sections, which take lectures together, but split for laboratory and discussion sessions). This may be especially important for the HS 550 and HS 851 courses, which we expect to be highly impacted (oversubscribed). The AC is still discussing the software needs and will provide a recommendation on licensing and costs associated with software in 2014.

8. **Describe the plan for evaluation**

We plan to conduct formative and summative evaluation activities for the HS 550-series. We will engage with ISR/CLRT for mid-term informal, anonymous and independent review of the course and instructor. Utilize standard end-of-course evaluation mechanism and solicit recommendations from the School of Nursing Evaluation Committee. These are per-course (small-program, small-P) evaluation metrics). In addition, we will conduct holistic HS 550-course-series evaluations (large-Program, large-P) assessment of the analytical methods course-series redesign. The **Table** below shows the large-P qualitative and quantitative evaluation metrics.

Expected Outcomes (Measuring Success)
Qualitative metrics • **Successful core UMSN analytical methods course sequence** • **Use of novel HS techniques in doctorate dissertations** • **Student, mentor, stakeholder satisfaction** • **Student-researcher confidence** • **CLRT-driven evaluations in HS 550-series courses**
Quantitative metrics • **Jobs and position ranks of UMSN graduates** • **Quality, volume and background-diversity of UMSN applicants** • **Attrition of graduate students** • **Grad-student led pubs, fellowship/grant applications**

Notes:

- Computer lab will require hardwired laptops with (optional) access of personal laptops. Discuss with Kinnothan Nelson, UMSN IT, the logistics for that (before and after the new UMSN building is available).
- Discuss with Susan Pressler the needs for classroom/lab support. Example, define the level from GSI, grader or instructional aide. Initially, until we get a group of graduate students skilled in statistics/methods, we are going to have to hire from other grad programs in the university so we will have to advertise, interview and choose GSI's in Spring/Summer 2014.
- Regarding the addition of new faculty (TBD) to the AC (expected Summer/Fall 2014), we need a contingency plan.

Essential Resources

Personnel and Technological Needs for rolling out the HS 550-course series in Fall 2014

Resource Type	Essential Needs	Rationale
Infrastructure	• Lab **Space**: 25-30 seat laboratory with individual laptops, LAW and WiFi connections for lab computers and personal mobile devices • **Computers**: Internet connected (LAN), locked to desks. Modern processors (2.5GHz+), with sufficient memory (4GB+ RAM, 500GB+ HD), PCs? Presenter's machines need to be top of the line (Haswell chipset) • Phase Implementation: o Phase I: using currently available resources (UMSN). May require special computer room for 2014-2015, school year, as current lab has only a dozen seats. o Phase II: using the space in new UMSN building. Work with IT to spec a lab room with 30-40 seats. • **Software**: SSH, Office 2010+, Adobe CS4+, Java, Java3D, Pipeline Client (http://goo.gl/LlJ6ey), Screensharing or webmeeting software for instructor's machines (2), Chrome, Firefox, SHIVA (http://goo.gl/EHBTTy), BrainSuite (http://goo.gl/OkxEpi), Stata, R (R-project.org), SPSS, SAS, other (TBD) • **Network**: 1GB Network connection • **Webmeeting**: Ability to stream instruction sessions live (audio, instructor/podium video, and instructor screen), record, archive and webcast asynchronously (on demand) previous sessions • **Lecture classrooms**: seating up to 50 students (note that HS 550 may eventually grow over 100, but probably not until 2015/2016). Need to have all software, functionality and capability • **Displays**: 2 large digital displays, if possible. If not, overhead projector + drop-down screen. Instructor can present podium screen or any attendee screen	• **Hands-on training** is a critical component of the HS550 analytical methods training, and requires a modern computer laboratory with uniform access to infrastructure resources • AC will attempt to bring direct **research atmosphere** in the classroom • A **blended** instructional approach will be utilized – (a)synchronous student, assistant, instructor communications, screensharing, webcasting, podcasting • **Modern** infrastructure and software will be necessary to demonstrate data management, processing, visualization and interpretation (in *real-time*) • AC will attempt to demonstrate diverse array of software tools to **maximize the exposure** of the nursing graduate students

Personnel	• Four UMSN Analytics Core **Faculty** (Dinov and TBD) will each teach one four-credit course for the first 2 years. In the unlikely event that new Faculty are not recruited in Summer 2014, as expected, adjunct/temp SPH instructors will cover teaching courses. • **IT** Support: o IT will help with configuring lap infrastructure in Summer 2014 o One IT person will be available during lab/discussion sessions for the first 4 weeks of each semester o IT person will be available on standby during lab/discussion periods • Format: Will try a mix of standard of blended teaching format. All lectures will be streamed live and archived. Students will be split into discussion/lab sections of 30 or less, if the total number of enrolled students exceeds 30 (dues to room capacity and to preserve interactive discussion learning experiences). • **Graduate** Student Assistants: For each section of 30, or less, students enrolled in each of the 4 HS courses, one GSI (25%) is requested to assist with laboratory training, discussions, grading, assistance with asynchronous student communications (e.g., CTools course-specific forums). Initially, experienced and knowledgeable GSIs may be selected from other schools, until sufficient cadre of UMSN graduates are trained in analytical HS methods. As we will be teaching 2 courses each semester (Fall/Winter), this would translate into 1 GSI hire (50%), HS853 may not require a GSI.	• All four AC faculty members have complementary expertise and **significant collective experience** to cover the material in the HS 851-853 course-series, see the teaching schedule in the Exec Summary • As with all high-tech endeavors, the implementation of the HS550-series will require significant IT support to ensure smooth operation and **emersion of students** into the new curriculum, both during formal instruction and self-learning • Most advanced scientific methods courses rely on dichotomous instructional model (lecture + discussion/lab), conducted by faculty and fellow graduate students, respectively. This model amalgamates the **mentor-based** and **peer-based** training. GSA's are critical learning partners and provide invaluable assistance with course management (e.g., grading)

Appendix A: HS 550, 851, 852, 853 Course Series Organization, Objectives, and Coverage

University of Michigan School of Nursing
HS 550 Scientific Methods for Health Sciences: Fundamentals

Credit hours: 4 (3 lecture) + 1 (lab)

Prerequisites: Quantitative General Elective course in past 4 years (examples include, but are not limited to mathematics, statistics, quantitative methods classes).

Class Schedule: TBD

Location: TBD

Instructor: Faculty of record: TBD annually (Ivo D **Dinov**)

Course Description: This course provides students with an introduction to probability reasoning and statistical inference. Students will learn theoretical concepts and apply analytic skills for collecting, managing, modeling, processing, interpreting and visualizing (mostly univariate) data. Students will learn the basic probability modeling and statistical analysis methods and acquire knowledge to read recently published health research publications.

Objectives: Students will:

1. Apply data management strategies to sample data files
2. Carry out statistical tests to answer common healthcare research questions using appropriate methods and software tools
3. Understand the core analytical data modeling techniques and their appropriate use

Examples of Topics Covered:

- EDA/Charts
- Ubiquitous variation
- Parametric inference
- Probability Theory
- Odds Ratio/Relative Risk
- Distributions
- Exploratory data analysis
- Resampling/Simulation
- Design of Experiments
- Intro to Epidemiology
- Estimation
- Hypothesis testing
- Experiments vs. Observational studies
- Data management (tables, streams, cloud, warehouses, DBs, arrays, binary, ASCII, handling, mechanics)
- Power, sample-size, effect-size, sensitivity, specificity
- Bias/Precision
- Association vs. Causality
- Rate-of-change
- Clinical vs. Stat significance
- Statistical Independence Bayesian Rule

Teaching and Learning Methods: This course meets four times on campus however, as necessary, blended instructional techniques will be employed to accommodate student and program constrains. Synchronous web-streaming of lectures/labs and asynchronous virtual office hour forums will be supported. Assignments will be announced on the web and will be electronically collected, graded and recorded. A variety of teaching methods will be used including lecture, Journal Club, discussion, small group work, and guest presentation.

Required Texts: TBD
Additional resources will be made available through the c-tools site and may include chapters, websites for review, references, reports posted online, ebooks and learning modules.

Assignments and Evaluation Methods

- 15% Laboratory Assignments
- 30% Homework Projects
- 20% Midterm 1 Exam
- 20% Midterm 2 Exam
- 15% Final Paper

University of Michigan School of Nursing
HS 851 Scientific Methods for Health Sciences: Applied Inferences

Credit hours: 4 (3 lecture) + 1 (lab)

Prerequisites: HS 550, or equivalent, instructor may review syllabi of previously taken courses (past 5 years) and/or require a test to assess the equivalence of the student background, as necessary.

Class Schedule: TBD

Location: TBD

Instructor: Faculty of record: TBD annually (Ivo D **Dinov**)

Course Description: HS 851 introduces students to applied inference methods in studies involving multiple variables. Specific methods that will be discussed include linear regression, analysis of variance, and different regression models. This course will emphasize the scientific formulation, analytical modeling, computational tools and applied statistical inference in diverse health-sciences problems. Data interrogation, modeling approaches, rigorous interpretation and inference will be emphasized throughout.

Objectives: Students will:

1. Understand the commonly used statistical methods of published scientific papers
2. Conduct statistical calculations/analyses on available data
3. Use software tools to analyze specific case-studies data
4. Communicate advanced statistical concepts/techniques
5. Determine, explain and interpret assumptions and limitations

Examples of Topics Covered:

- Epidemiology
- Correlation/SLR
- (ρ and slope inference, 1-2 samples)
- ROC Curve
- ANOVA
- Non-parametric inference
- Cronbach's α
- Measurement Reliability/Validity
- Survival Analysis
- Decision theory
- CLT/LLNs – limiting results and misconceptions
- Association Tests
- Bayesian Inference
- PCA/ICA/Factor Analysis
- Point/Interval Estimation (CI) – MoM, MLE
- Instrument performance Evaluation
- Study/Research Critiques
- Common mistakes and misconceptions in using probability and statistics, identifying potential assumption violations, and avoiding them

Teaching and Learning Methods: This course meets four times on campus however, as necessary, blended instructional techniques will be employed to accommodate student and program constrains. Synchronous web-streaming of lectures/labs and asynchronous virtual office hour forums will be supported. Assignments will be announced on the web and will be electronically collected, graded and recorded. A variety of teaching methods will be used including lecture, Journal Club, discussion, small group work, and guest presentation.

Required Texts: TBD
Additional resources will be made available through the c-tools site and may include chapters, websites for review, references, reports posted online, ebooks and learning modules.

Assignments and Evaluation Methods

- 15% Laboratory Assignments
- 30% Homework Projects
- 20% Midterm 1 Exam
- 20% Midterm 2 Exam
- 15% Final Paper

University of Michigan School of Nursing

HS 852 Scientific Methods for Health Sciences: Linear Modeling

Credit hours: 4 (3 lecture) + 1 (lab)

Prerequisites: HS 851, or equivalent

Class Schedule: TBD

Location: TBD

Instructor: Faculty of record: TBD annually (Ivo D **Dinov**)

Course Description:
This is a general linear modeling course, building on HS 851, focusing on commonly employed scientific computing techniques used in health sciences. The primary aim of the course is to provide students with the necessary skills to determine appropriate use, carry out, and interpret general linear modeling. Statistical software will be used to manipulate data, fit models and perform model diagnostics.

Objectives: Students will:

1 Compare and contrast advanced statistical concepts, grasp model assumptions/limitations and apply them for quantitative analyses in healthcare research
2. Apply multivariate statistical modeling enabling consistency between research questions and selected advanced statistical analyses
3. Critique and select appropriate advanced statistical linear models for defined healthcare issues
4. Conduct multivariate statistical analyses, such as multidimensional chi squares, logistic regression, principal components analysis, survival analysis, repeated measures ANOVA, MANOVA, MANCOVA, linear mixed models, hierarchical linear models.

Examples of Topics Covered:

- MLR Regression
- GLM
- ANOVA
- ANCOVA
- MANOVA
- MANCOVA
- Repeated measures ANOVA
- (partial) correlation
- Time series analysis
- Fixed, randomized and mixed models
- Hierarchical Linear Models
- Mixture modeling
- Surveys
- Longitudinal data
- Generalized Estimating Equations (GEE) models
- Model Fitting and Model Quality (KS-test)
- Common mistakes and misconceptions in using probability and statistics, identifying potential assumption violations, and avoiding them.

Teaching and Learning Methods: This course meets four times on campus however, as necessary, blended instructional techniques will be employed to accommodate student and program constrains. Synchronous web-streaming of lectures/labs and asynchronous virtual office hour forums will be supported. Assignments will be announced on the web and will be electronically collected, graded and recorded. A variety of teaching methods will be used including lecture, Journal Club, discussion, small group work, and guest presentation.

Required Texts: TBD
Additional resources will be made available through the c-tools site and may include chapters, websites for review, references, reports posted online, ebooks and learning modules.

Assignments and Evaluation Methods

- 15% Laboratory Assignments
- 30% Homework Projects
- 20% Midterm 1 Exam
- 20% Midterm 2 Exam
- 15% Final Paper

University of Michigan School of Nursing
HS 853 Scientific Methods for Health Sciences: Special Topics

Credit hours: 4 (2 lectures) + (2 discussion/journal club)

Prerequisites: HS 852, or equivalent

Class Schedule: TBD

Location: TBD

Instructor: Faculty of record: TBD annually (Ivo D **Dinov**)

Course Description: This course will cover a number of modern analytical methods for advanced healthcare research. Specific focus will be on reviewing and using innovative modeling, computational, analytic and visualization techniques to address specific driving biomedical and healthcare applications. The course will cover the 5 dimensions of Big-Data (volume, complexity, time/scale, source and management)

Objectives: Students will:

1. Research, employ and report on recent advanced health sciences analytical methods
2. Read, comprehend and present recent reports of innovative scientific methods applicable to a broad range of health problems
3. Experiment with real Big-Data

Examples of Topics Covered:

- Scientific Visualization
- PCOR/CER methods Heterogeneity of Treatment Effects
- Big-Data / Big-Science
- Missing data
- Genotype-Environment-Phenotype associations
- Medical imaging
- Data Networks
- Adaptive Clinical Trials
- Databases/registries
- Meta-analyses
- Causality/Causal Inference, SEM
- Classification methods
- Time-series analysis
- Scientific Validation
- Geographic Information Systems (GIS)
- Rasch measurement model/analysis
- MCMC sampling for Bayesian inference
- Network Analysis

Teaching and Learning Methods: This course meets four times on campus however, as necessary, blended instructional techniques will be employed to accommodate student and program constrains. Synchronous web-streaming of lectures/labs and asynchronous virtual office hour forums will be supported. Assignments will be

announced on the web and will be electronically collected, graded and recorded. A variety of teaching methods will be used including lecture, Journal Club, discussion, small group work, and guest presentation.

Required Texts: TBD
Additional resources will be made available through the c-tools site and may include chapters, websites for review, references, reports posted online, ebooks and learning modules.

Assignments and Evaluation Methods

- 25% Laboratory Assignments
- 30% Homework Projects
- 45% Final Paper