Nikou, Roshan

From: Graduate.Council.Web.Site@www.uky.edu
Sent: Tuesday, December 02, 2008 9:57 PM
To: Nikou, Roshan
Cc: Price, Cleo
Subject: Investigator Report

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College/Department/Unit: = MS in Statistics
Category:_ = Change
Date_for_Council_Review: = 12/4/08
Recommendation_is:_ = Approve
Investigator: = Bill Smith
E-mail_Address = bsmith@engr.uky.edu
1__Modifications: = None
2__Considerations: = N/A
3__Contacts: = Kurt Viele, Statistics.
4__Additional_Information: = The change was made to create a theoretical sequence and an applied sequence within the Statistics department. Several course changes and a few new course applications have also been submitted.

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UNIVERSITY OF KENTUCKY
REQUEST FOR CHANGE IN MASTERS DEGREE PROGRAM

Program: Master of Science in Statistics

Department/Division: Statistics

College: Arts and Sciences Bulletin pp 2008 Bulletin 359-364

Degree Title (Old): _____ Major (New): _____

CIP Code: _____ HEGIS Code: _____

Accrediting Agency (if applicable): none

I. CHANGE(S) IN PROGRAM REQUIREMENTS

		Current	Proposed
1.	Number of transfer credits allowed (Graduate School limit: 9 hours or 25% of coursework)		no changes
2.	Residence requirement (if applicable)		no changes
3.	Language(s) and/or skill(s) required		no changes
4.	Termination criteria		no changes
5.	Plan A requirements*	STA503, 531, 532, 601, 603, 624 9 additional hours and thesis. 6 of the 9 must be from STA 612, 616, 621, 643, 644, 661, 665	STA 602, 623, 606, 603, 605, 632 one of (STA 607, 624, 643, thesis) or (STA 635, CPH664, STA665, thesis)
6.	Plan B requirements*	same as A, but 15 additional hours.	thesis replaced by 9 hours of electives in track 1 thesis replaced by 3 hours of STA693, 3 hours of elective in track 2 electives chosen from list attached.
7.	Distribution of course levels required (At least one half must be at 600+ level & two thirds must be in organized courses)		course renumberings make all courses 600 level or above.
8.	Required courses (if applicable)		see attached and above
9.	Required distribution of courses within program (if applicable)		no changes
10.	Final examination requirements		no changes

* If there is only one plan for the degree, plans involving a thesis (or the equivalent in studio work, etc.) should be discussed under Plan A and those not involving a thesis should be discussed under Plan B.

NOTE: To the extent that proposed changes in 5, 6 or 8 above involve the addition of courses in other programs, please submit correspondence from the other program(s) pertaining to the availability of such courses to your students.

11. Any other requirements not covered above
none

II. RATIONALE FOR CHANGE(S)
If the rationale involves accreditation requirements, please include specific references to those requirements.
The Department of Statistics is proposing to revise the M.S. in Statistics to provide a better balance between the preexisting theoretical components of the program and applied material necessary to work as a practicing statistician. The primary changes are
1) revision of the "theory" sequence STA531, STA532, STA601, including renumbering 531 to 623, 532 to 606, and 601 to 607
2) revision of the "applied" sequence STA503, STA603, STA643, including renumbering 503 to 602.
3) Inclusion of a biostatistics track to formalize a set of courses students often take currently
4) Add courses in computational methods and longitudinal methods
5) Several prerequisite changes, most to accommodate the revision of the theory sequence STA531, STA532, STA601
see attached for more details

Signatures of Approval:

2/6/2008
Date of Approval by Department Faculty

Arnold Stromberg
Reported by Department Chair

11/7/08 Leonidas G. Bachas
Date of Approval by College Faculty

Reported by College Dean
Leonidas Bachas

*Date of Approval by Undergraduate Council

Reported by Undergraduate Council Chair

12/8/08
*Date of Approval by Graduate Council

Reported by Graduate Council Chair

*Date of Approval by Health Care Colleges Council (HCCC)

Reported by HCCC Chair

*Date of Approval by Senate Council

Reported by Senate Council Office

*Date of Approval by University Senate

Reported by Senate Council Office

*If applicable, as provided by the Rules of the University Senate

ACTION OTHER THAN APPROVAL

Rev 07/06

Proposed Revision of the M.S. in Statistics

Executive Summary and List of materials submitted

Briefly, we are proposing to change our master's program by creating two tracks, one an applied biostatistical track and another a more theoretical track. As part of this revision, we are reworking our applied methods sequence STA503/603/643 and our theoretical sequence STA531/532/601. We are also introducing three new courses (computational inference, longitudinal data analysis, and a biostatistical practicum). The extended rationale discusses the details. These changes require no additional resources to implement and allow timely entry to and completion of the Ph.D. program in Statistics.

This revision provides an opportune time to renumber the 500 level courses 503/531/532, which are currently intended only for graduate students, to the 600 level as 602/623/606. The remainder of the course changes are minor changes simply involving changing prerequisites based on course restructurings and/or renumberings.

Materials included

Explanation of rationale (10 Pages, includes curricula for new courses)

Masters program change form

Ph.D. program change form - only involves the addition of electives caused by the restructuring of the M.S. program.

Forms creating new courses – STA605 (Computational Inference), STA632 (Longitudinal Data Analysis), and STA693 (Biostatistics Practicum).

Forms for Major Revisions of Theory (531/532/601) and Methods (503/603/643) sequences – includes renumberings of 503 to 602, 531 to 623, 532 to 606, and 601 to 607.

Forms for Minor changes (all prerequisites, primarily due to rearrangement/renumbering of STA532 and STA601) - STA612, STA616, STA621, STA624, STA630, STA635, STA662, STA665, STA701, STA705

Proposed Revision of the M.S. in Statistics

The Department of Statistics is proposing to revise its current M.S. in Statistics. The proposed changes are motivated by recent developments both in the field of Statistics and local to the University of Kentucky.

The field of statistics in general has become heavily interdisciplinary in recent years. Many of our recent graduates work in multidisciplinary teams in university medical centers, pharmaceutical companies, government agencies, and other public and private enterprises.

At UK, the Department of Statistics is one of the largest collaborative grant units on campus, with collaborations in Agriculture, Arts and Sciences, Dentistry, Education, Medicine, Nursing, Pharmacy, and Public Health. Many of our current graduate students work as RAs in these areas. In recent years we have also experienced a large influx of students from these areas obtaining degrees in Statistics (for example, Biology graduate students acquiring Ph.Ds in both Biology and Statistics). This recent emphasis on applied, collaborative work is in contrast to a more mathematical background common historically.

While statistical methods have the root in mathematical theory, and some mathematical theory is certainly required for proper understanding of those methods, the changes enumerated below are intended to strike a balance between the heavy mathematical theory currently required by the program and the applied work currently valued in the statistics field and across the campus at UK. In addition, we have attempted to spread out the required mathematical theory so that students whose primary training is not mathematical are not immediately overwhelmed during the first year of study. We are also introducing courses in modern topics such as computational inference methods.

These changes also complete an agreement entered into upon the creation of the College of Public Health, whereby the Department of Statistics agreed to implement Biostatistics tracks into both its M.S. and Ph.D. program. The Biostatistics track in the Ph.D. program was implemented a few years ago. The proposed biostatistics track formalizes a set of course options that student largely have available to them now, but having a track will make the emphasis clear to employers. Many recent graduates have biostatistics careers in such places as the Duke Medical Center, the Duke VA Hospital, Emory University, the FDA, Eli Lilly, and other primarily biostatistical employers.

These changes were unanimously approved by the Statistics graduate faculty at a meeting on February 6, 2008.

Changes to Curriculum

The current curriculum requires

STA503 (Introduction to Statistical Methods),
STA531 (Theory of Probability)
STA532 (Theory of Statistical Inference I),
STA601 (Theory of Statistical Inference II)
STA603 (Introduction to Linear Models and Experimental Design)
STA624 (Applied Stochastic Processes).

These courses total 20 hours and are typically all taken in the first year.

Under Plan A, students then take an additional 9 hours and complete a thesis, while under Plan B students take an additional 15 hours. In either plan A or plan B, at least six (6) hours of the coursework must be from the list (all courses below 3 hours each)

STA612 (Sequential Analysis)
STA616 (Design and Analysis of Sample Surveys)
STA621 (Nonparametric Inference)
STA643 (Advanced Experimental Design)
STA644 (Advanced Linear and Nonlinear Models)
STA661 (Multivariate Analysis I)
STA665 (Categorical Data Analysis)

The proposed curriculum is

Core courses (20 hours)

STA602 Introduction to Statistical Methods (renumbered STA503)
STA623 Theory of Probability (renumbered STA531)
STA606 Theory of Statistical Inference I (renumbered STA532)
STA603 Introduction to Linear Models and Experimental Design
STA605 Computational Inference (new course)
STA632 Longitudinal Data Analysis (new course)

Track requirements (15 hours)
Students must take one of the following two sets of courses

Mathematical Statistics Track	Biostatistics Track
STA607 Theory of Statistical Inference II (renumbered STA601)	STA635 Survivability and Life Testing

STA624 Applied Stochastic Processes
STA643 Advanced Experimental Design
6 hours of electives

CPH664 Clinical Trials
STA665 Categorical Data Analysis
3 hours of STA693 (Biostatistics Practicum)
3 hours of electives

Student also have a thesis option as before – Under Plan A (with thesis), the 2 electives in the statistics track may be replaced with a master's thesis, OR the biostatistics practicum and one elective may be replaced with a thesis in the biostatistics track. In either case, 6 hours are replaced by the master's thesis.

Electives – Must be selected from the list MA471G (Real Analysis), STA601 (Inference II), STA612 (Sequential), STA616 (Sampling), STA621 (Nonparametrics), STA624 (Stochastic Processes), STA626 (Time Series), STA630 (Bayesian), STA635 (Survival), STA643 (Exp. Design), STA644 (Nonlinear), STA653 (Clinical Trials), STA661 (Multivariate), STA662 (Resampling), STA665 (Categorical), CPH664 (Clinical Trials), CPH636 (Data Mining), and CPH631 (Survey Sampling). Any course on this list NOT required for the students track may be used as an elective. Thus, for example, STA665 would count as an elective for the statistics track, but it is a track requirement for the biostatistics track. Similarly, STA624 would be an elective for the biostatistics track but is a track requirement for the statistics track.

Motivation – To incorporate more modern computational methods into the curriculum via STA605, and to emphasize course offerings commonly taken by students (e.g. STA635 and STA665) as a "biostatistics track" for recruitment and job placement purposes. Note students could theoretically complete both tracks if they chose, and both tracks allow for timely entry into the statistics Ph.D. program. In fact, we would anticipate it likely that students continuing for a Ph.D. will complete most, if not all, of both M.S. tracks in the course of the Ph.D. curriculum in addition to their Ph.D. courseload.

Teaching Resources

The Department of Statistics does not envision any additional resources being required for this revision. While the creation of two tracks does in theory require 3-4 extra courses to be offered, these will be handled by a combination of 1) The College of Public Health currently offers CPH664 (Clinical Trials) and CPH632 (Longitudinal Data Analysis, which we intend to crosslist with STA632 upon completion of CPH's revision of CPH632) and will continue to do this (see attached letter from Dr. Richard Kryscio, Chair of the Department of Biostatistics in Public Health), 2) Several recent hires in the Department of Statistics are coming off their initial period of course releases, which should provide at least one extra course per year, and 3) Targeting the graduate elective offerings of the department as necessary so a sufficient number of courses are offered.

Changes to the "Theory" and "Applied" sequences

As a whole, the "theory" sequence STA531 (Theory of Probability), STA532 (Theory of Statistical Inference I) and STA601 (Theory of Statistical Inference II) are largely unchanged. However, we have moved material around to allow all the basic theoretical material required for the core master's courses to be included in STA531/532 while saving more advanced topics for the STA601 course required only for the mathematical statistics track. Similarly, while the "appled" sequence 503/603/643 has also been revamped with some addition of recently developed methodology, the core change is a rearrangement of the topic order to place more theoretical topics in STA643, with STA503/603 heavily emphasizing methodology and data analysis methods.

The department is also using this opportunity to renumber STA503/531/532 to the 600 level as 602/623/606, as these courses are intended to be exclusively for graduate students (we cannot recall an undergraduate student ever being in these courses, as the department has non-degree courses STA570/524/525 which are more appropriate). We are also renumbering STA601 as STA607 to keep the correct sequence in the inference courses. The choice of number reflects grouping numbers based on subject, with probability courses 623/624, inference courses 605/606/607, and applied methods courses 602/603.

Revised STA531/532/601 Renumbered STA623/606/607	Topics and Learning Objectives
623 (was STA531) (3 credits, emphasis on Probability. Course is offered in standard lecture format. Standard text is Casella and Berger, Statistical Inference, 2nd edition)	• Set Theory, Probability Theory, Conditional Probability and Independence, Random Variables, Distribution Functions, Density and Mass Functions (3 weeks) • Distribution of Functions of a Random Variable, Expected Values, Moments and Moment Generating Functions, Differentiating Under an Integral Sign (3 weeks) • Discrete Distributions, Continuous Distributions, Exponential Families, Location and Scale Families, Inequalities and Identities (3 weeks) • Joint and Marginal Distributions, Conditional Distributions and Independence, Bivariate Transformations, Covariance and Correlation, Multivariate Distributions, Inequalities (4 weeks) • Basic Concepts of Random Samples, Sums of Random Variables from a Random Sample (emphasize properties of expectations, variances, covariances, and moment generating functions) (2 weeks)

606 (was STA532) (3 credits, emphasis on Statistical Inference of point estimation, interval estimation, and hypothesis testing. Course is offered in standard lecture format. Standard text is Casella and Berger, Statistical Inference, 2nd edition)	• Sampling for the Normal Distribution, Order Statistics, Convergence Concepts (emphasize Central Limit Theorem) (3.5 weeks) • Methods of Finding Point Estimators (2 weeks) • Methods of Finding Tests (2 weeks) • Methods of Finding Interval Estimators (1.5 weeks) • Partial Coverage of sufficiency principle (1.5 weeks) • Partial Coverage of evaluating point estimators (1.5 weeks) – mean square error, unbiasedness, Cramer-Rao lower bound. • Asymptotics (3 weeks) – efficiency and consistency of point estimators, hypothesis testing, interval estimators
607 (was STA601) (3 credit; Emphasis on more advanced topics in inference. Course is offered in standard lecture format. Standard text is Casella and Berger, Statistical Inference, 2nd edition)	• More discussion of the sufficiency principle (1 week) – completeness and its relation to minimal sufficiency. • Methods of Evaluating Point Estimators (1.5 weeks) – Lehmann-Scheffe theorem, decision theory • Methods for evaluating tests (2 weeks) • Methods for evaluating interval estimators (1.5 weeks) • Robustness and M-Estimation (2 weeks) • Sequential Analysis (2 weeks) • Censored Data (2 weeks) • Model Selection (3 weeks) – AIC, BIC, Cross Validation, GCV.

Revised STA503/603/643 STA503 to be renumbered STA602	Topics and Learning Objectives
602 (was STA503) (4 credit; Stats/Biostats Core, Semester 1) Focus: (i) Basic Data Analysis Skills and (ii) Introduction to experimental design and ANOVA.	Sampling distributions, formal statistical models, significance testing and point and interval estimation, and basics of sampling; Experimental design: Completely randomized, randomized blocks, nested/hierarchical, Latin squares; Analysis of variance: One-, two-, and multi-way factorials, fixed and random effects models, ANOVA tables, multiple comparison procedures, model selection and diagnostics; Rank-based analysis; Simple linear regression:

Computer Work Integral Part of the Course. 3 hours lecture, 2 hours lab.	Modes of parametric inference, diagnostics and corrective procedures, applied nonparametric regression; • Capability to analyze real data using appropriate basic parametric and nonparametric statistical methods for means, variances, proportions, rates, and survival; • Understanding issues of power and sample size; • Ability to report and present the results in a professional manner; • Ability to use the software packages R and SAS, for appropriate data analysis, and Latex and Powerpoint for presentation (software training is not part of this course, students learn the basics in the "elementary statistical computing" class).
603 (4 credit; Stats/Biostats Core, Semester 2) Focus: Data Analysis Using Linear and Generalized Linear Regression Models, Computer Work Integral Part of the Course. 3 hours lecture, 2 hours lab.	Multivariate normal distribution, linear models in matrix notation; Multiple linear regression: Design matrices and matrix formulation, modes of parametric inference, distributional results, tools for model building and selection, categorical predictors, interaction, connection to ANOVA, types of sums of squares, polynomial regression, diagnostics and flexible alternatives such as weighted least squares, and robust, ridge and nonparametric regression; Generalized linear models, binomial regression, Poisson regression, Gamma regression, overdispersed GLMs, quasi-likelihood, estimating equations, iterated reweighted least squares, introduction to random and mixed effects models, case-control studies, applications; • Familiarity with possibilities and limitations of linear and generalized linear models; • Correct identification of fixed and random effects, mixed models; • Ability to use linear and generalized linear models in data analysis, along with contrasts and multiple comparisons, under consideration of power and sample size issues; • Ability to employ model building and diagnostics tools and corrective procedures, and methods to deal with practical problems such as unbalanced data, missing values, co-linearity, correlated data, non-normal data; • Capability of appropriate real data analysis using R and SAS including as well as clear and concise presentation of results. Note: STA 603 will require STA 532 as a co-requisite and the instructors of 532 and 603 will need to coordinate to ensure that the last part of GLMs can be taught using asymptotic MLE theory.
643 (3 credit; Stats Core/Biostats Elective, Semester 3) Focus: Theory of Linear Models and Experimental Design, Based on Matrix Algebra	• Understanding of linear model interpretation in vector spaces and projections, and the use of generalized inverses; • Understanding identifiability and estimability of contrasts; • Familiarity with main theoretical results regarding normal equations, Gauss-Markov, MVUE, MLE, distribution theory; • Ability to independently derive distributional results for new situations; • Familiarity with complex designs such as crossover, split-plot, and repeated measures; • Asymptotics for general linear models; • Familiarity with nonlinear regression models.

New courses

Three new courses are proposed, STA605 in Computational Inference, STA632 in Longitudinal Data Analysis, and STA693 (Biostatistics Practicum).

STA605

Content

1) Introduction to statistics packages (3 weeks),
2) Newton-Raphson maximization and Numerical Integration (1 week) – emphasis includes implementation issues such as choice of starting values (including boundaries in an unbounded integration problem) and convergence to local minima/maxima)
3) Integration via sampling techniques (1 week) – rejection and importance sampling
4) Bootstrapping (3 weeks)
5) Simulations (3 weeks) – Illustration of sampling distributions, including those for point estimators, interval estimators (e.g. coverage), hypothesis testing (e.g. sizes and power), and p-values. Should include their use with nonparametric techniques such as rank tests.
6) Multivariate Normal Density and MLEs (4 weeks) – Introduction to the multivariate normal density with exploratory methods (e.g. graphs of contours, etc.), definition of MLEs, sampling distribution of MLEs for simple single parameter distributions, bivariate sampling distribution of joint MLEs for normal mean and variance and simple linear regression estimates. Use of Newton-Raphson to compute MLEs for iid Beta and Gamma distributions and their resulting bivariate sampling distributions. Introduction to asymptotic normal sampling distribution of MLEs, and the illustration that the approximation works well in the previous examples (ties in with simulations studies, for example showing 95% confidence ellipsoids work). Also show examples of problems with using asymptotic results in small data sets.

Grading – grading will be based on a combination of exams and small computing projects.

STA632

Course Description: This course presents statistical techniques for analyzing longitudinal studies and repeated measures experiments that occur frequently in public health, clinical trials, and outcomes research. This course will cover linear mixed models, generalized linear mixed models and an introduction to nonlinear models as they apply to the analysis of correlated data. (Prereq STA532 and STA603)

Objectives: A student in this course will be introduced to appropriate statistical methods used in the analysis of longitudinal data and the analysis of repeated measures experiments for both interval level and categorical measurements. Specifically, the objectives of the course are as follows:

- Learn how to analyze designed experiments with repeated measures from three points of view: analysis of variance, multivariate analysis, and linear mixed models
- Learn how to analyze and design observational longitudinal studies with linear trends
- Learn how to analyze models with random coefficients and to model covariance structures
- Become familiar with theory underpinning the software used to fit mixed models to data in the Gaussian outcomes case
- Utilize statistical methodologies for longitudinal and repeated measures data including restricted maximum likelihood, generalized estimating equations, and weighted least squares
- Learn how to analyze mixed models with non-Gaussian outcomes: binary, ordinal, and. Poisson response with random effects.
- Provide students with an introduction to nonlinear models as applicable to growth curve data, Zero-inflated Poisson models, and pharmacokinetic models.

References:

1. Davis (2002) *Statistical Methods for the Analysis of Repeated Measurements*. Springer.
2. Diggle, Liang, Zeger, and Heagerty (2002) *Analysis of Longitudinal Data*. Oxford.
3. Little, Milliken, Stroup, Wolfinger, and Schabenberger (2006) *SAS for Mixed Models*, SAS Institute.
4. Brown and Prescott (2006) *Applied Mixed Models in Medicine*. Wiley.
5. Hedeker and Gibbons (2006) *Longitudinal Data Analysis* Wiley.
6. Fitzmaurice, Laird, and Ware (2004) *Applied Longitudinal Analysis*. Wiley

Detailed Outline:

1. Repeated Measures Introduction
    a. Univariate Methods
    b. Multivariate Approaches
    c. Repeated Measures ANOVA: single group case
    d. Repeated Measures ANOVA: multiple groups case
2. Linear Mixed Models: Gaussian Data
    a. Simple linear regression with random intercept
    b. Compound symmetry and intraclass correlation
    c. Simple linear regression with random slope and intercept
    d. Specification of the Linear Mixed Model for the linear regression cases
    e. Design of longitudinal Studies: sample size and power
3. Linear Mixed Models (LMM): General theory
    a. Matrix formulation
    b. Estimation in the LMM
    c. Two stage and weighted least squares
    d. Maximum Likelihood
    e. Restricted maximum likelihood
    f. Inference for fixed effects: Wald tests
    g. Inference for Variance components

4. Linear Mixed Models in Practice
    a. Robust estimation of errors in parameter estimates of fixed effects
    b. Approximate t statistics
    c. Covariance pattern models:
       (i) structured versus unstructured patterns

       (ii) autocorrelated errors

    d. Residual analysis / transformed residuals
    e. Prediction and shrinkage
    f. Software: Proc Mixed in SAS
5. Generalized linear models
    a. Exponential family
    b. Marginal models
    c. Generalized estimating Equations
    d. Weighted least squares
6. Linear Mixed Model: non Gaussian Case
    a. Binary outcomes
    b. Ordinal Outcomes
    c. Nominal Outcomes
    d. Count responses
    e. Software: Proc Glimmix in SAS
7. Cluster Randomized and Multi-center Trials

8. NonlinearMixed Models

    f. Specification of the Model
    g. Application: Growth Curves
    h. Application: Zero-Inflated and Hurdle Models
    i. Application: Pharmacokinetics
    j. Software; Proc Nlmixed in SAS

Grading will be based on exams and homework.

STA693

This course is the most flexible as a practicum course. Students will conduct small consulting projects under the guidance of a faculty member. These projects will vary depending on the semester and what is available, although certainly historically there is no shortage of such problems (the SSTARS center on campus alone generates a sufficient number of small suitable projects). Grades will be based on the resulting data analysis projects, and based on both quality of analysis as well as quality of presentation.

Prerequisite changes

The revision to the theory sequence STA531/532/601 and subsequent renumbering to STA623/606/607 creates a situation where several courses which previously had a prerequisite of STA601 now are satisfied with a prerequisite of STA606 (in particular, hypothesis testing now appears in STA606). The following courses all have minor prerequisite changes – STA612, STA616, STA621, STA624, STA630, STA635, STA662, STA665, and STA705. In a couple of these instances we noticed prerequisites that should have been changed long ago, which have also been completed here. There are no substantive changes in these courses.

Sample Curricula

Below are possible sequences of courses which would allow timely graduation from either the M.S. or Ph.D programs in statistics under the new requirements.

M.S. only (where two courses are listed, the first refers to students in the mathematical statistics track while the second refers to students in the biostatistics track).

Fall Year 1	Spring Year 1	Fall Year 2	Spring Year 2
602	603	607 or Elec/693	632
623	606	643 or Elec	Elec or 665
605	624 or CPH664	Elec or 635	Elec or 693

Ph.D. (This actually shows the completion of both tracks of the M.S. during the course of the Ph.D. curriculum, students obviously could substitute some electives, the intent here is to show both tracks can result in a timely doctorate).

Fall 1	Spring 1	Fall 2	Spring 2	Fall 3	Spring 3	Fall 4	Spring 4
602	603	607	632	701	705	702/709	
623	606	643	665	703	707		
605	CPH664	635	700	Elec	Elec		

Reading course/s STA715 could be placed in the 3rd year electives, in which case students would have to take electives from the Ph.D. elective list in year 4, as they do now. In addition, students in the biostatistics track will need to complete 3 hours of STA693, which could be done in a number of different ways (1 unit in three terms, including summer, or by delaying a Ph.D. elective into the fourth year, etc., or simply omitting one of the "Mathematical Statistics Track" courses). We of course envision students making these minor adjustments based on their personal circumstances and interests.