New Course Request **Indiana University** Indianapolis Campus

Check Appropriate Boxes: Undergraduate credit ☐ Graduate credit ☒ Professional credit ☐

1. School/Division Science 2. Academic Subject Code STAT
3. Course Number 62800 (must be cleared with University Enrollment Services) 4. Instructor TBA
5. Course Title Advanced Statistical Inference

   Recommended Abbreviation (Optional) _____
   (Limited to 32 Characters including spaces)
6. First time this course is to be offered (Semester/Year): Fall 2010
7. Credit Hours: Fixed at 3 or Variable from _____ to _____
8. Is this course to be graded S-F (only)? Yes ____ No X
9. Is variable title approval being requested? Yes ____ No X
10. Course description (not to exceed 50 words) for Bulletin publication: P: STAT 51900 and STAT 52800 C: STAT 61900; This course will cover basic measure theory and probability statistics and subfields, conditional expectations and probability distributions, asymptotic theory of estimation and likelihood based inference, optimal statistical tests, confidence sets and U-statistics. Other topics that might be covered include invariance, Edgeworth expansions, and saddle point method.
11. Lecture Contact Hours: Fixed at 3 or Variable from _____ to _____
12. Non-Lecture Contact Hours: Fixed at N/A or Variable from _____ to _____
13. Estimated enrollment: 15 of which 100 percent are expected to be graduate students.
14. Frequency of scheduling: annually Will this course be required for majors? yes- as option
15. Justification for new course: New course for Ph.D. Biostatistics program
16. Are the necessary reading materials currently available in the appropriate library? yes
17. Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.
18. If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant.
19. A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by:

_____ Date 10-9-2009
Department Chairman/Division Director

_____ Date _____
Dean of Graduate School (when required)

Approved by:

_____ Date 10/30/2009
Dean

_____ Date _____
Chancellor/Vice-President

_____ Date _____
University Enrollment Services

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.

UPS 724

University Enrollment Services Final—White; Chancellor/Vice-President—Blue; School/Division—Yellow; Department/Division—Pink; University Enrollment Services Advance—White

Office of the Registrar
FORM 40G REV. 9/06

PURDUE UNIVERSITY

REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF A GRADUATE COURSE
(500-600 LEVEL)

Print Form

DEPARTMENT Mathematical Sciences EFFECTIVE SESSION Fall 2010

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- [X] 1. New course with supporting documents (complete proposal form)
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered
- [ ] 12. Transfer from one department to another

PROPOSED:		EXISTING:	
Subject Abbreviation	STAT	Subject Abbreviation	
Course Number	62800	Course Number	
Long Title	Advanced Statistical Inference		
Short Title			

Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

TERMS OFFERED
Check All That Apply:
[ ] Summer [X] Fall [ ] Spring

CAMPUS(ES) INVOLVED
[ ] Calumet [ ] N. Central
[ ] Cont Ed [ ] Tech Statewide
[ ] Ft. Wayne [ ] W. Lafayette
[X] Indianapolis

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range: Minimum Cr. Hrs
(Check One) To [ ] Or [ ]
Maximum Cr. Hrs.
3. Equivalent Credit: Yes [ ] No [ ]
4. Thesis Credit: Yes [ ] No [ ]

COURSE ATTRIBUTES: Check All That Apply

1. Pass/Not Pass Only		7. Registration Approval Type	
2. Satisfactory/Unsatisfactory Only		Department	
3. Repeatable		Instructor	
Maximum Repeatable Credit:		8. Variable Title	
4. Credit by Examination		9. Remedial	
5. Designator Required		10. Honors	
6. Special Fees		11. Full Time Privilege	
		12. Off Campus Experience	

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated	Delivery Method (Asyn. Or Syn.)	Delivery Medium (Audio, Internet, Live, Text-Based, Video)
Lecture			16			Live
Recitation						
Presentation						
Laboratory						
Lab Prep						
Studio						
Distance						
Clinic						
Experiential						
Research						
Ind. Study						
Pract/Observ						

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):

P: STAT 51900 and STAT 52800, C: STAT 61900
This course will cover basic measure theory and probability, statistics and subfields, conditional expectations and probability distributions, asymptotic theory of estimation and likelihood based inference, optimal statistical tests, confidence sets and U-statistics. Other topics that might be covered include invariance, Edgeworth expansions, and saddle point method.

Calumet Department Head	Date	Calumet School Dean	Date	Calumet Undergrad Curriculum Committee	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date	Fort Wayne Chancellor	Date
Indianapolis Department Head	10-8-2009 Date	Indianapolis School Dean James M. Murphy	10/20/2009 Date	Undergrad Curriculum Committee	Date
North Central Department Head	Date	North Central Chancellor	Date	Date Approved by Graduate Council	
West Lafayette Department Head	Date	West Lafayette College/School Dean	Date	Graduate Council Secretary	Date
Graduate Area Committee Convener	Date	Graduate Dean	Date	West Lafayette Registrar	Date

OFFICE OF THE REGISTRAR

To: Purdue University Graduate Council

From: Faculty Member: Ben Boukai

Department: Mathematical Sciences

Campus: Indianapolis

Date: 10-7-09

For Reviewer's comments only
Select One
Reviewer:
Comments:

Subject: Proposal for New Graduate Course-Documents Supporting Registrar's Form 40

Contact information if questions arise

Name: Ben Boukai

Phone Number : 317-274-6926

E-mail: bboukai@math.iupui.edu

Campus Address: 402 N. Blackford St., LD 270

Course Number: STAT 62800

Course Title: Advanced Statistical Inference

A. Justification for the Course

☒ Explain how this course relates to other courses offered in the department or other departments and how this course fulfills a recognized need.

☒ This course is intended primarily for students Choose one: from within this department

B. Level of the course:

☒ Justify request for graduate course level by indicating anticipated enrollments of undergraduate and graduate students.

Anticipated Undergraduate Student Enrollment:

Anticipated Graduate Student Enrollment: 100%

C. **Prerequisites:** (If none, please explain reasons for absence)

☒ STAT 51900, STAT 52800, C: STAT 61900

D. **Course Instructor:**

☐ Instructor's Name TBA

E1. **Course Outline:**

☒ (An outline of topics to be covered and an indication of the relative emphasis or time devoted to each topic is necessary. If laboratory or field experience is involved, the nature of this component should be explained as well).

E2. ☒ Method of Evaluation or Assessment:

F. **Reading List:**

☒ A reading list or bibliography should be limited to material the students will be required to read in order to successfully complete the course. It should not be a compilation of general reference material.

A. Justification for the course:

This is an advanced statistics course for the biostatistics PhD program. The purpose of the course is to help graduate students build solid background in theory and methods of statistical inference. It is fundamentally important for students to study other advanced statistical courses and to carry out methodological research in the field of Biostatistics. This course will cover basic large sample theorems including laws of large numbers and central limit theorems, M-estimates in particular maximum likelihood estimates and the consistency and asymptotic normality, optimal hypothesis testing, density estimates, edgeworth expansion and saddle point expansion, high dimensional inference and false discovery rate, U-statistics and the asymptotic distributions, robust statistics including breakdown point and influence function. Other topics that might be covered include re-sampling theory and semiparametric efficiency.

B. Learning Outcomes and Method of Evaluation or Assessment:

As a result of having completed the proposed course, the students are expected to be familiar with commonly used distributions, understand and be able to apply the asymptotic theorems to study the asymptotic properties of estimators, be able to compute MLE's in numerical methods, understand the concept of efficient estimators and be able to construct efficient estimates, know how to estimate densities, understand and be able to apply optimal tests, understand the concept of robust statistics, understand U-statistics and able apply them to derive asymptotic distributions of U-statistics.

Evaluation is based on one mid-term examination (40 points), a comprehensive final examination (80 points) and 12 Homework assignments (120 points total). Some of the homework assignments might require programming in SAS, S-plus/R. Grades will be assigned using an absolute scale based on attained percentage score: A+=[95, 100], A=[90, 94], A-=[85, 89], B+=[80, 84], etc.

C. Prerequisites:

Pre-requisites : STAT 519 or STAT 51900, and STAT 528 or STAT 52800
Co-requisite: STAT 61900

D. Course Instructor(s):

TBA

E. Course Outline

Convergence Modes and Limit Theorems: Important modes of convergence including almost sure convergence, convergence in probability, convergence in moments, and convergence in distribution, laws of large numbers, Slutsky's theorem, the delta method.
Estimation: M- and Z-estimators and Maximum likelihood estimators, and the consistency and asymptotic normality, the Cramer–Rao lower bound, efficiency of MLE's, one-step estimators and the method of scoring, EM algorism, invariance principle, and semiparametric efficiency.
Hypotheses Testing: Sufficiency and completeness, uniformly most powerful tests and uniformly most powerful unbiased tests. Commonly used tests including likelihood ratio test, score test and Wald tests, and Wilks' theorem,

Density estimation and Approximation: Histogram density estimates, kernel density estimates and the asymptotic behaviors, Edgeworth expansion, and saddle-point expansion.
High-Dimensional Inference and False Discovery: Chisquare tests with many cells and sparse multinomials, regression models with many parameters, multiple testing and false discovery.
U-statistics: U-statistics and their applications, Hoeffding's decomposition, asymptotic Distribution, and moments.
Roust statistics: breakdown point, influence function, Huber estimator, L-And R-estimator, Theil-Sen estimator.

F. Reading List

Jun Shao (2003), *Mathematical statistics*, Springer.
Ferguson, T. S. (1996), *A course in large sample theory*, Chapman & Hall/CRC, first edition.
A.W. van der Vaart (2000), *Asymptotic Statistics*, Cambridge University Press, first edition.
Lehmann, E. L. (1997), *Testing statistical hypotheses*, Springer, second edition.
Jureckova, J. and Picek, J. (2006). *Robust Statistical Methods with R*, Chapman & Hall/CRC, first edition.
Hogg, V.H., McKean, J.W. and Craig, A. T. (2005). *Introduction to Mathematical Statistics*, Pearson Prentice Education, Inc.
DasGupta, A. (2008). *Asymptotic Theory of Statistics and Probability*, Springer Science+Business Media, LLC.
Wasserman, L. (2004). *All of Statistics*: *A Concise Course in Statistical Inference*, Springer, first edition.

G. Library Resources:

Jun Shao (2003), *Mathematical statistics*, Springer.
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H. Example of Course Syllabus: See Attached

STAT 62800 Advanced Statistical Inference

Instructor: TBA
Pre-requisites : STAT 519 or STAT 51900, and STAT 528 or STAT 52800
Co-requisite: STAT 61900

COURSE DESCRIPTION AND RATIONALE: This is an advanced statistics course for the biostatistics PhD program. The purpose of the course is to help graduate students build solid background in theory and methods of statistical inference. It is fundamentally important for students to study other advanced statistical courses and to carry out methodological research in the field of Biostatistics. This course will cover basic large sample theorems including laws of large numbers and central limit theorems, M-estimates in particular maximum likelihood estimates and the consistency and asymptotic normality, optimal hypothesis testing, density estimates, edgeworth expansion and saddle point expansion, high dimensional inference and false discovery rate, U-statistics and the asymptotic distributions, robust statistics including breakdown point and influence function. Other topics that might be covered include re-sampling theory and semiparametric efficiency.

EDUCATIONAL OBJECTIVES: As a result of having completed the proposed course, the students are expected to be familiar with commonly used distributions, understand and be able to apply the asymptotic theorems to study the asymptotic properties of estimators, be able to compute MLE's in numerical methods, understand the concept of efficient estimators and be able to construct efficient estimates, know how to estimate densities, understand and be able to apply optimal tests, understand the concept of robust statistics, understand U-statistics and able apply them to derive asymptotic distributions of U-statistics.

COURSE CONTENTS:

A. **Convergence Modes and Limit Theorems**: Important modes of convergence including almost sure convergence, convergence in probability, convergence in moments, and convergence in distribution, laws of large numbers, Slutsky's theorem, the delta method.
B. **Estimation**: M- and Z-estimators and Maximum likelihood estimators, and the consistency and asymptotic normality, the Cramer–Rao lower bound, efficiency of MLE's, one-step estimators and the method of scoring, EM algorism, invariance principle, and semiparametric efficiency.
C. **Hypotheses Testing**: Sufficiency and completeness, uniformly most powerful tests and uniformly most powerful unbiased tests. Commonly used tests including likelihood ratio test, score test and Wald tests, and Wilks' theorem,
D. **Density estimation and Approximation:** Histogram density estimates, kernel density estimates and the asymptotic behaviors, Edgeworth expansion, and saddle-point expansion.
E. **High-Dimensional Inference and False Discovery:** Chisquare tests with many cells and sparse multinomials, regression models with many parameters, multiple testing and false discovery.

F. **U-statistics**: U-statistics and their applications, Hoeffding's decomposition, asymptotic Distribution, and moments.
G. **Roust statistics:** breakdown point, influence function, Huber estimator, L-And R-estimator, Theil-Sen estimator.

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CHEATING AND PLAGIARISM:

Academic misconduct will *not* be tolerated and all cases will be reported. Examine the IU Code of Student Rights, Responsibilities, and Conduct at http://life.iupui.edu/help/code.asp and in particular examine the rules regarding academic misconduct at http://life.iupui.edu/help/docs/Part_3all.html. Violations of these rules will result in a grade of "F" (or 0%) for the assignment in question, and may result in an "F" for the course or even expulsion from the university (see http://life.iupui.edu/help/docs/Part_4all.html#sanction).

Americans with Disabilities Act:
If you need any special accommodations due to a disability, please contact Adaptive Educational Services at (317)-274-3241. The office is located in CA 001E.