In Workflow

1. 17ST GR Director of Curriculum (demarti4@ncsu.edu; bondell@stat.ncsu.edu)
2. 17ST UG Director of Curriculum (muse@stat.ncsu.edu)
3. 17ST Grad Head (stefansk@ncsu.edu)
4. 17ST UnderGrad Head (stefansk@ncsu.edu)
5. COS CC Coordinator UG (COS CC Coordinator UG@ncsu.edu)
6. COS CC Meeting UG (Greg_Neyhart@ncsu.edu; cibowma2@ncsu.edu)
7. COS CC Chair UG (gneyhart@ncsu.edu)
8. COS Final Review UG (cibowma2@ncsu.edu)
9. COS Dean UG (david_bristol@ncsu.edu)
10. COS CC Coordinator GR (alun_lloyd@ncsu.edu; cibowma2@ncsu.edu)
11. COS CC Meeting GR (alun_lloyd@ncsu.edu; cibowma2@ncsu.edu)
12. COS CC Chair GR ()
13. COS Final Review GR (cibowma2@ncsu.edu; alun_lloyd@ncsu.edu)
14. COS Dean GR (david_bristol@ncsu.edu; wditto@ncsu.edu; cibowma2@ncsu.edu)
15. alloyd (alun_lloyd@ncsu.edu)
16. OUCC Review (courses-curricula@ncsu.edu, aeherget@ncsu.edu, lamarcus@ncsu.edu)
17. UCCC Coordinator (courses-curricula@ncsu.edu, aeherget@ncsu.edu, lamarcus@ncsu.edu)
18. UCCC Meeting (courses-curricula@ncsu.edu, aeherget@ncsu.edu, lamarcus@ncsu.edu)
19. UCCC Chair (andy_nowel@ncsu.edu)
20. OUCC Final Signature (barbara_kirby@ncsu.edu)
21. OUCC Final Review (lamarcus@ncsu.edu)
22. ABGS Coordinator (mlnosbis@ncsu.edu)
23. ABGS Meeting (mlnosbis@ncsu.edu)
24. ABGS Chair (mlnosbis@ncsu.edu)
25. Grad Final Review (mlnosbis@ncsu.edu)
26. PeopleSoft (none)

Approval Path

   Donald Martin (demarti4): Approved for 17ST GR Director of Curriculum
2. Tue, 01 Mar 2016 23:55:57 GMT
   Spencer Muse (muse): Approved for 17ST UG Director of Curriculum
   Donald Martin (demarti4): Approved for 17ST Grad Head
4. Wed, 02 Mar 2016 02:33:59 GMT
   Montserrat Fuentes (fuentes): Approved for 17ST UnderGrad Head
5. Wed, 02 Mar 2016 14:38:26 GMT
   Cheryll Bowman-Medhin (cibowma2): Approved for COS CC Coordinator UG
6. Thu, 03 Mar 2016 13:44:01 GMT
   Cheryll Bowman-Medhin (cibowma2): Approved for COS CC Meeting UG
   Gregory Neyhart (Greg_Neyhart): Approved for COS CC Chair UG
8. Wed, 07 Sep 2016 16:19:11 GMT
   Cheryll Bowman-Medhin (cibowma2): Approved for COS Final Review UG
9. Wed, 07 Sep 2016 16:59:34 GMT
   Jo-Ann Cohen (cohen): Approved for COS Dean UG
10. Wed, 07 Sep 2016 17:12:09 GMT
    Cheryll Bowman-Medhin (cibowma2): Approved for COS CC Coordinator GR
11. Tue, 13 Sep 2016 14:42:29 GMT
Date Submitted: Wed, 17 Feb 2016 18:12:33 GMT

**Viewing: ST 405/ST 505 : Applied Nonparametric Statistics**

Changes proposed by: boos

**Change Type**

Major

**Course Prefix**

ST (Statistics)

**Course Number**

405

**Course ID**

020247

**Dual-Level Course**

Yes

**Dual-Level Course Number:**

505

**Cross-listed Course**

No

**Title**

Applied Nonparametric Statistics
Abbreviated Title
Applied Nonpar. Statistics

College
College of Sciences

Academic Org Code
Statistics (17ST)

CIP Discipline Specialty Number
27.0501

CIP Discipline Specialty Title
Statistics, General.

Term Offering
Fall Only

Year Offering
Offered Every Year

Effective Date
Spring 2016

Previously taught as Special Topics?
No

Course Delivery
Face-to-Face (On Campus)
Distance Education (DELTA)
Online (Internet)

Grading Method
Graded with S/U option

Credit Hours
3

Course Length
16

weeks

Contact Hours
(Per Week)

Component Type           Contact Hours
Lecture                  3.0

Course Attribute(s)
Course Is Repeatable for Credit
No

Instructor Name
Wenbin Lu

Instructor Title
Professor

Grad Faculty Status
Full

Anticipated On-Campus Enrollment
Open when course_delivery = campus OR course_delivery = blended OR course_delivery = flip

<table>
<thead>
<tr>
<th>Enrollment Component</th>
<th>Per Semester</th>
<th>Per Section</th>
<th>Multiple Sections?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>25</td>
<td>25</td>
<td>No</td>
<td>We expect up to 10 undergraduates in the piggyback ST 405, with a total of 25 in the combined courses (405 + 505).</td>
</tr>
</tbody>
</table>

DELTA/Online Enrollment:
Open when course_delivery = distance OR course_delivery = online OR course_delivery = remote

<table>
<thead>
<tr>
<th>Delivery Format</th>
<th>Per Semester</th>
<th>Per Section</th>
<th>Multiple Sections?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEC</td>
<td>10</td>
<td>10</td>
<td>No</td>
<td>graduate version online</td>
</tr>
</tbody>
</table>

Course Prerequisites, Corequisites, and Restrictive Statement
Prerequisite: (ST 422 and ST 430) or ST 511 (Basic Statistical Inference and Experimentation) or equivalent.

Is the course required or an elective for a Curriculum?
No

Catalog Description
Statistical methods requiring relatively mild assumptions about the form of the population distribution. Classical nonparametric hypothesis testing methods, Spearman and Kendall correlation coefficients, permutation tests, bootstrap methods, and nonparametric regressions will be covered.

Justification for each revision:
ST 505 has been taught for many years and almost always has advanced undergraduates in the course. As we are significantly expanding the number of dual level courses in the department, we are creating a dual-level version of this course. In addition to the students it has always attracted, by having a course that better accommodates our undergraduates we will be able to attract and service a larger number of our undergraduate majors.

Does this course have a fee?
No

Is this a GEP Course?
No

Consultation

Instructional Resources Statement
No new resources will be required because this course has been regularly taught every year for many years.

Course Objectives/Goals
Students will gain a competency in the basic theory and methods of rank and permutation statistics. They will learn when to use these distribution-free methods instead of methods associated with normal distributions. Students will be able to use SAS or R to carry out the analyses.
Student Learning Outcomes

**Upon completion of this course students will be able to:**

1. Decide when to use rank and permutation methods in place of standard t-tests and ANOVA.

2. For each of the following procedures, evaluate them for suitability, implement them with computer software, and interpret results.

   i) Binomial test
   ii) Wilcoxon signed rank test
   iii) Two-sample permutation test
   iv) Wilcoxon rank-sum test
   v) Confidence Interval and Hodges-Lehmann Estimate
   vi) Tests for Equality of Scales
   vii) Permutation F-test and Kruskal-Wallis test
   viii) Multiple comparisons
   ix) Tests for ordered alternatives
   x) Paired comparisons
   xi) Permutation test for RCB design
   xii) Friedman test, Cochran's Q test, Kendall test and Page test
   xiii) Spearman rank correlation and Kendall's tau
   xiv) Chi-square test for association and Fisher's exam test
   xv) Bootstrap methods: confidence interval and hypothesis testing
   xvi) Nonparametric density estimation and regression: smoothing and kernel methods

**ST 505 Only**: Demonstrate the ability to work with more theoretical aspects of selected topics via derivations, proofs, or other more advanced statistical techniques

Student Evaluation Methods

<table>
<thead>
<tr>
<th>Evaluation Method</th>
<th>Weighting/Points for Each</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>30%</td>
<td>ST 505 will have additional questions.</td>
</tr>
<tr>
<td>Midterm</td>
<td>20%</td>
<td>ST 505 will have additional questions.</td>
</tr>
<tr>
<td>Midterm</td>
<td>20%</td>
<td>ST 505 will have additional questions.</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
<td>ST 505 will have additional questions.</td>
</tr>
</tbody>
</table>

Topical Outline/Course Schedule

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time Devoted to Each Topic</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-sample Z-test and t-test Central limit theorem and large sample Z-test</td>
<td>1 week</td>
<td></td>
</tr>
<tr>
<td>Introduction to R, Binomial test, Wilcoxon signed rank test</td>
<td>1 week</td>
<td></td>
</tr>
<tr>
<td>Two-sample permutation test, Wilcoxon rank-sum test, Confidence Interval and Hodges-Lehmann Estimate, Tests for Equality of Scales</td>
<td>3 weeks</td>
<td></td>
</tr>
<tr>
<td>Permutation F-test Kruskal-Wallis test Multiple comparisons Tests for ordered alternatives</td>
<td>3 weeks</td>
<td></td>
</tr>
<tr>
<td>Paired comparisons Permutation test for RCB design Friedman test, Cochran's Q test, Kendall test and Page test</td>
<td>2 weeks</td>
<td></td>
</tr>
</tbody>
</table>
Spearman rank correlation and Kendall's tau Chi-square test for association and Fisher's exam test 1 week
Bootstrap methods: confidence interval and hypothesis testing 2 weeks
Nonparametric density estimation and regression: smoothing and kernel methods 2 weeks
Final exam 1 week

Syllabus

ST_405_505_dec5_2016.pdf

Additional Documentation

Additional Comments

405 and 505 will differ in the following way. 505 will have an additional learning outcome: Demonstrate the ability to work with more theoretical aspects of selected topics via derivations, proofs, or other more advanced statistical techniques. 505 students will have additional HW and Exam questions to evaluate this learning outcome.

minosbis 1/5/2017: Note that the grading basis in CIM says Graded with S/U option. Since this is a dual-level course, that is the correct grading method in CIM. Undergraduates have to be able to take as S/U, but graduate students will not be able to take this for S/U and it will be available for graduate student audit.

ABGS Reviewer Comments:
-No comments/concerns.

Course Reviewer Comments

minosbis (Fri, 05 Feb 2016 21:16:01 GMT): Rollback: Taken out of the workflow upon request by Dennis Boos.
alilloyd (Mon, 21 Nov 2016 15:34:37 GMT): Passed college committee: 11/11/16

Key: 5096