Ogden College of Science and Engineering
Western Kentucky University
Office of the Dean
745-6371

REPORT TO THE GRADUATE COUNCIL COMMITTEE

DATE: November 22, 2013

FROM: Ogden College of Science and Engineering

The Ogden College of Science and Engineering submits the following items for consideration at the November meeting:

Consent	**Delete a Course** Math 432G, Intermediate Analysis II Contact: Ferhan Atici, ferhan.atici@wku.edu, 56229
Action	**Proposal to Create a New Course** STAT 550, Statistical Methods II Contact: Ngoc Nguyen, ngoc.nguyen@wku.edu, 56221
Action	**Proposal to Revise Graduate Program** Reference number 085, Master of Science in Mathematics Contact: Ferhan Atici, ferhan.atici@wku.edu, 56229

MINUTES – OCSE Graduate Curriculum Committee **October 25, 2013**

Members Present: Dr. Michael Smith, Dr. David Keeling, Dr. Martin Stone, Dr. Ivan Novikov, Dr. Zhonghang Xia, Dr. Ferhan Atici, Dr. Raja Dakshinamurthy, Dr. Daniel Jackson, Dr. Shane Palmquist

Cathleen Webb, Chair

This meeting was held via email.

OLD BUSINESS

Keeling/Smith moved approval of the minutes from the April 27, 2013 and September 27, 2013 meetings. Motion approved.

NEW BUSINESS

Consent Agenda

Keeling/Smith moved approval of the Consent Agenda. Motion approved.

October 20/2013

Ogden College of Science and Engineering
Department of Mathematics
Proposal to Delete a Course
(Consent Item)

Contact Person: Ferhan Atici, ferhan.atici@wku.edu, 56229

1. **Identification of course:**
   - 1.1 Current course prefix (subject area) and number: MATH 432G
   - 1.2 Course title: Intermediate Analysis II
   - 1.3 Credit hours: 3

2. **Rationale for the course deletion:** This course has not been offered in more than 5 years, and there are no plans to offer the course in the future.

3. **Effect of course deletion on programs or other departments, if known:** This course is not required in the mathematics master program and so its deletion will have no effect on program completion.

4. **Proposed term for implementation:** Spring, 2014

5. **Dates of prior committee approvals:**

   Department of Mathematics: 11/15/2013

   OCSE Graduate Committee _____

   Graduate Council _____

   University Senate _____

Attachment: Course Inventory Form

Proposal Date: October 17, 2013

Ogden College of Science and Engineering
Department of Mathematics
Proposal to Create a New Course
(Action Item)

Contact Person: Ngoc Nguyen, ngoc.nguyen@wku.edu, 745-6221

1. Identification of proposed course:

1.1 Course prefix (subject area) and number: STAT 550
1.2 Course title: Statistical Methods II
1.3 Abbreviated course title: Statistical Methods II
1.4 Credit hours and contact hours: 3
1.5 Grade Type: standard letter grade
1.6 Prerequisites:
STAT 549 with a grade of C or better; or permission of instructor.
1.7 Course catalog listing:
Continuation of STAT 549. Topics include multiple linear regression, generalized linear models, two-way ANOVA and more general factorial design, block and nested designs, mixed and random effects models, analysis of covariance. Emphasis on analyzing real data using statistical software packages, such as SAS, SPSS, or R.

2. Rationale:

2.1 Reason for developing the proposed course:
Statistical methods for data analysis are widely used in many fields including (but not limited to) biology, business, economics, engineering, education, medicine, sociology, physics, and psychology. In our ever-increasing global society, making informed decisions is greatly enhanced by a strong understanding of how to analyze data. Additionally, with the vast amounts of data that are now collected and produced on a daily basis, the demand for employees skilled in data analysis is rising. This course will expose students to many important statistical methods and techniques and provide them with useful, marketable skills for a variety of career paths. This course is intended as a continuation of STAT 549 Statistical Methods I; it will expand students' abilities in statistical methodology beyond what is usually learned in a basic course.

This course will be an elective course for graduate students enrolled in the MS program in the Department of Mathematics. This course is also open to students in other departments who are interested in statistical methods.

2.2 Projected enrollment in the proposed course:
Initially, it is expected that mainly mathematics graduate students will have interest in this course. Considering only the number of graduate mathematics majors, STAT 550 is projected to initially enroll approximately 8 students per

offering. However, it is expected that this number will increase as graduate students from other departments are informed about the course.

2.3 Relationship of the proposed course to courses now offered by the department: STAT 550 is a continuation of STAT 549 and extends upon the topics currently covered in STAT 549. This course will provide students with more complete and extensive knowledge of various statistical methods.

2.4 Relationship of the proposed course to courses offered in other departments: At the undergraduate level, some of these topics are taught in courses offered by the Departments of Economics, Biology, and Geography. At the graduate level, some of these topics are taught in discipline-focused courses offered by the Departments of Agriculture, Economics, Sociology, Public Heath, Psychology, and Educational Leadership program (AGRI 491G, AGRI 590, ECON 465G, ECON 506, SOCL 408G, SOCL 510, SOCL 513, SOCL 514, SOCL 515, PH 501, PH 520, HCA 520, PSY512, PSY 513, EDFN 501, EDFN 601, EDFN 603, EDLD 712, EDLD722). Some of these courses also require one or more prerequisites in the same discipline. STAT 550 will cover statistical methods which can be used in a broad range of applications across many disciplines.

2.5 Relationship of the proposed course to courses offered in other institutions: Many mathematics and/or statistics departments offer graduate level courses in statistical methods.

Benchmark institutions with graduate courses that cover similar topics:

- Eastern Michigan University: MATH 573 Statistical Data Analysis
- Middle Tennessee State University: STAT 5130 Applied Statistics
- Missouri State University: MTH 645 Applied Statistics
- Northern Arizona University: STA 570/571 Statistical Methods I/II
- Oakland University: STA 502/503 Applied Linear Models I/II
- Stephen F. Austin State University: STA 520/521 Statistical Analysis I/II
- University of Northern Iowa: STAT 3771/5771 Applied Statistical Methods for Research
- Western Illinois University: STAT 553 Applied Statistical Methods
- Wichita State University: STAT 764 Analysis of Variance
- Youngstown State University: STAT 6949 Design and Analysis of Experiments
- University of Kentucky: STA 679 Design and Analysis of Experiments II

3. Discussion of proposed course:

3.1 Schedule type: L

3.2 Learning Outcomes:

A student who has successfully completed this course will be able to:

- Use multiple linear regression techniques to analyze data.
- Identify and implement various designs of experiments.

- Perform correct analysis of experimental or observational data using statistical software packages.
- Assess model fit and validity of assumptions.
- Suggest remedial measures or alternative analyses when assumptions are not met.
- Analyze real data sets using various statistical methods.
- Use statistical software package(s) to aid in performing the above tasks.

3.3 Content outline:

- Multiple linear regression
  - least squares estimation
  - inferences for multiple regression
  - F-test
  - residual diagnostics
  - transformations
- Model selection
  - multicollinearity
  - stepwise regression methods
  - variable selection methods
  - model assessment
- Factorial design
  - fixed models
  - mixed and random models
- Block and nested design
- Analysis of covariance
- Generalized linear models
  - binomial data
  - Poisson data
- Additional topics chosen by instructor (time permitting)

3.4 Student expectations and requirements:
Regular attendance is required. The student's grade in the course will be determined by performance on homework assignments, tests, projects, and/or a comprehensive final examination.

3.5 Tentative texts and course materials:

Cody, R. P. and Smith, J. K. 2005. *Applied Statistics and the SAS Programming Language* (5th Edition). New Jersey: Prentice Hall

Creswell, J. W. 2013. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (4rd Edition). London: Sage Publications.

Devore, J. L. 2011. *Probability and Statistics for Engineering and the Sciences* (8th Edition). Boston: Duxbury Press.

Freund, R. J., Mohr, D., and Wilson, W. J. 2010. *Statistical Methods* (3rd Edition). Academic Press.

Kutner, M., Nachtsheim, C., Neter, J., and Li, W. 2004. *Applied Linear Statistical Models* (5th Edition). Chicago: McGraw-Hill/Irwin.

Lawson, J. 2010. *Design and Analysis of Experiments with SAS* (1st Edition). New York: Chapman & Hall

Montgomery, D. C. 2012. *Design and Analysis of Experiments* (8th Edition). New York: Wiley.

Rao, P. V. 1997. *Statistical Research Methods in Life Sciences* (1st Edition). Boston: Duxbury Press

SAS Institute, Inc. 2012. *Getting Started with SAS Enterprise Miner 12.1*. Cary, NC: SAS Institute, Inc.

4. Resources:

4.1 Library resources:
See attached bibliography and Library Resources Form.

4.2 Computer resources:
Computers with installation of SPSS, SAS and R computing software.

5. Budget implications:

5.1 Proposed method of staffing:
This course will initially be offered on a very limited basis due to the limited number of statisticians in the Department of Mathematics. When more statistics faculty members are hired, the frequency of offering can be increased.

5.2 Special equipment needed:
A classroom equipped with an instructor desktop computer hooked to an LCD projector is sufficient; the department has access to several such classrooms.

5.3 Expendable materials needed: None

5.4 Laboratory materials needed: None

6. Proposed term for implementation: Fall 2014

7. Dates of prior committee approvals:

Department of Mathematics November 15, 2013

OCSE Graduate Curriculum Committee _____

Graduate Council _____

University Senate _____

Attachment: Bibliography, Library Resources Form, Course Inventory Form

Ogden College of Science and Engineering
Department of Mathematics
Proposal to Revise Graduate Program
(Action Item)

Contact Person: Ferhan Atici, ferhan.atici@wku.edu, 5-6229

1. **Identification of program:**
   - 1.1 Current program reference number: 085
   - 1.2 Current program title: Master of Science: in Mathematics
   - 1.3 Credit hours:3

2. **Identification of the proposed program changes:**
   Adding a course to the graduate program in Mathematics

3. **Detailed program description:**

Current Program	Proposed Program
The M.S. has two options available. The M.S. (general option) provides knowledge in such traditional areas as analysis, algebra, topology, and applied mathematics, and is recommended for students who wish to obtain a Ph. D. degree, to teach in a community college, or to seek employment in industry with an emphasis on conceptual foundations. The M.S. (computational option) is designed for students seeking employment in industry with an emphasis on computational mathematics and/or computer science in addition to knowledge in traditional areas.	The M.S. has two options available. The M.S. (general option) provides knowledge in such traditional areas as analysis, algebra, topology, and applied mathematics, and is recommended for students who wish to obtain a Ph. D. degree, to teach in a community college, or to seek employment in industry with an emphasis on conceptual foundations. The M.S. (computational option) is designed for students seeking employment in industry with an emphasis on computational mathematics and/or computer science in addition to knowledge in traditional areas.
General Option: Admission Requirements Admission requirements for the M.S. in Mathematics General Option include: 1.One of the following: (a) A minimum GAP score of 600 [GAP = (GRE-V + GRE-Q) + (Undergraduate GPA x 100)] or a minimum GAP score of 3000 for students who took the GRE prior to August 2011 [GAP = (GRE-V + GRE-Q) x Undergraduate GPA] *Students who took the GRE prior to 2002 should contact the graduate advisor of the program; (b) A GRE score of at least 300. For options (a) or (b) WKU requires a minimum score of 139 on both the verbal and quantitative parts of the GRE; (c) For students that graduate from WKU with a mathematics major, a GPA of at least 3.3 in their	General Option: Admission Requirements Admission requirements for the M.S. in Mathematics General Option include: 1.One of the following: (a) A minimum GAP score of 600 [GAP = (GRE-V + GRE-Q) + (Undergraduate GPA x 100)] or a minimum GAP score of 3000 for students who took the GRE prior to August 2011 [GAP = (GRE-V + GRE-Q) x Undergraduate GPA] *Students who took the GRE prior to 2002 should contact the graduate advisor of the program; (b) A GRE score of at least 300. For options (a) or (b) WKU requires a minimum score of 139 on both the verbal and quantitative parts of the GRE; (c) For students that graduate from WKU with a mathematics major, a GPA of at least 3.3 in their

mathematics major. 2. Successful completion of the following undergraduate courses: (a) a one year calculus sequence; (b) linear algebra; (c) discrete mathematics; (d) a one year sequence of programming courses; (e) A.B.A. degree with a major in either Computer Science, Engineering, Mathematics, or Physics. 3. A cumulative grade point average of 3.0 (on a 4.0 scale) is required in at least one of the following: (a) all mathematics courses that are listed in (a) through (d) of Item 2 above; (b) all courses in the major listed in (e) of Item 2 above. Admission may be granted to a student having at most one deficiency in the undergraduate courses listed in Item 2 above. Degree Requirements minimum of 30 hours The Master of Science in Mathematics (General Option) requires a minimum of 30 hours of graduate-level mathematics courses. A maximum of 12 hours at the 400G level may be included in the entire program. A research tool is required and may entail coursework beyond the 30 hours of mathematics. The research tool must be completed during the first 15 hours of coursework and may be fulfilled by a mathematics reading course, a computer science course, a foreign language examination, or another option approved by a Mathematics Department graduate advisor. In addition, all students in the M.S. program (general option) must have a working knowledge of a high-level programming language or computer algebra system. A student may, upon prior approval of the Mathematics Department Graduate Committee, include in his/her program a maximum of 6 hours of coursework from a related field. Comprehensive exams are required. Required Core 1. The following courses must be completed: MATH 417G Algebraic Systems* MATH 431G Intermediate Analysis I* MATH 439G Topology I* 2. One of the following applied mathematics courses: MATH 529 Applied Probability MATH 531 Advanced Differential Equations MATH 535 Advanced Applied Mathematics I MATH 536 Advanced Applied Mathematics II MATH 540 Stochastic Processes	mathematics major. 2. Successful completion of the following undergraduate courses: (a) a one year calculus sequence; (b) linear algebra; (c) discrete mathematics; (d) a one year sequence of programming courses; (e) A.B.A. degree with a major in either Computer Science, Engineering, Mathematics, or Physics. 3. A cumulative grade point average of 3.0 (on a 4.0 scale) is required in at least one of the following: (a) all mathematics courses that are listed in (a) through (d) of Item 2 above; (b) all courses in the major listed in (e) of Item 2 above. Admission may be granted to a student having at most one deficiency in the undergraduate courses listed in Item 2 above. Degree Requirements minimum of 30 hours The Master of Science in Mathematics (General Option) requires a minimum of 30 hours of graduate-level mathematics courses. A maximum of 12 hours at the 400G level may be included in the entire program. A research tool is required and may entail coursework beyond the 30 hours of mathematics. The research tool must be completed during the first 15 hours of coursework and may be fulfilled by a mathematics reading course, a computer science course, a foreign language examination, or another option approved by a Mathematics Department graduate advisor. In addition, all students in the M.S. program (general option) must have a working knowledge of a high-level programming language or computer algebra system. A student may, upon prior approval of the Mathematics Department Graduate Committee, include in his/her program a maximum of 6 hours of coursework from a related field. Comprehensive exams are required. Required Core 1. The following courses must be completed: MATH 417G Algebraic Systems* MATH 431G Intermediate Analysis I* MATH 439G Topology I* 2. One of the following applied mathematics courses: MATH 529 Applied Probability MATH 531 Advanced Differential Equations MATH 535 Advanced Applied Mathematics I MATH 536 Advanced Applied Mathematics II MATH 540 Stochastic Processes

MATH 541 Graph Theory *MATH 542 Advanced Topics in Discrete Mathematics* *MATH 550 Complex Analysis* *MATH 570 Topics in Operations Research* *STAT 549 Statistical Methods I* *Another course as approved by the Mathematics Department Graduate Committee.*	MATH 541 Graph Theory MATH 542 Advanced Topics in Discrete Mathematics MATH 550 Complex Analysis MATH 570 Topics in Operations Research STAT 549 Statistical Methods I **STAT 550 Statistical Methods II** Another course as approved by the Mathematics Department Graduate Committee.
3. The following course is required: *MATH 532 Real Analysis*	3. The following course is required: MATH 532 Real Analysis
4. One of the following two-course sequences: *MATH 417G Algebraic Systems AND* *MATH 517 Topics from Algebra* *MATH 439G Topology I AND MATH 539 Topology II* *MATH 450G Complex Variables AND MATH 550 Complex Analysis* *MATH 435G Partial Differential Equations AND MATH 535 Advanced Applied Mathematics I* *MATH 470G Introduction to Operations Research AND MATH 570 Topics in Operations Research* *MATH 529 Applied Probability AND MATH 540 Stochastic Processes* *MATH 435G Partial Differential Equations AND MATH 531 Advanced Differential Equations* *MATH 535 Advanced Applied Mathematics I AND MATH 536 Advanced Applied Mathematics II* *MATH 405G Numerical Analysis I AND MATH 406G^ Numerical Analysis II* **If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department* *graduate advisor.* *^Sequence can be taken by students who have substituted a 500-level course for at least one of the three courses listed in (1).*	4. One of the following two-course sequences: MATH 417G Algebraic Systems AND MATH 517 Topics from Algebra MATH 439G Topology I AND MATH 539 Topology II MATH 450G Complex Variables AND MATH 550 Complex Analysis MATH 435G Partial Differential Equations AND MATH 535 Advanced Applied Mathematics I MATH 470G Introduction to Operations Research AND MATH 570 Topics in Operations Research MATH 529 Applied Probability AND MATH 540 Stochastic Processes MATH 435G Partial Differential Equations AND MATH 531 Advanced Differential Equations MATH 535 Advanced Applied Mathematics I AND MATH 536 Advanced Applied Mathematics II MATH 405G Numerical Analysis I AND MATH 406G^ Numerical Analysis II **STAT 549 Statistical Methods I AND STAT 550 Statistical Methods II** *If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department graduate advisor. ^Sequence can be taken by students who have substituted a 500-level course for at least one of the three courses listed in (1).
Electives *The remaining mathematics courses in the student program must be chosen from:* *MATH 405G Numerical Analysis I* *MATH 406G Numerical Analysis II* *MATH 415G Algebra and Number Theory* *MATH 423G Geometry II* *MATH 435G Partial Differential Equations* *MATH 450G Complex Variables*	Electives The remaining mathematics courses in the student program must be chosen from: MATH 405G Numerical Analysis I MATH 406G Numerical Analysis II MATH 415G Algebra and Number Theory MATH 423G Geometry II MATH 435G Partial Differential Equations MATH 450G Complex Variables

MATH 470G Introduction to Operations Research *MATH 504 Application of Technology to Problems in Mathematics* *MATH 517 Topics from Algebra* *MATH 529 Applied Probability* *MATH 531 Advanced Differential Equations* *MATH 535 Advanced Applied Mathematics I* *MATH 536 Advanced. Applied Mathematics II* *MATH 539 Topology II* *MATH 540 Stochastic Processes* *MATH 541 Graph Theory* *MATH 542 Advanced Topics in Discrete Mathematics* *MATH 550 Complex Analysis* *MATH 560 Functional Analysis* *MATH 570 Topics in Operations Research* *MATH 590 Special Topics in Mathematics* *STAT 549 Statistical Methods I*	MATH 470G Introduction to Operations Research MATH 504 Application of Technology to Problems in Mathematics MATH 517 Topics from Algebra MATH 529 Applied Probability MATH 531 Advanced Differential Equations MATH 535 Advanced Applied Mathematics I MATH 536 Advanced. Applied Mathematics II MATH 539 Topology II MATH 540 Stochastic Processes MATH 541 Graph Theory MATH 542 Advanced Topics in Discrete Mathematics MATH 550 Complex Analysis MATH 560 Functional Analysis MATH 570 Topics in Operations Research MATH 590 Special Topics in Mathematics STAT 549 Statistical Methods I **STAT 550 Statistical Methods II**
Research Tool *A research tool is required and may entail coursework beyond the 30 hours of mathematics. The research tool can be fulfilled in a variety of ways, some of which are listed below:* *Taking the MATH 598 Graduate Seminar (1.5 credit hours each) for two semesters Courses in other disciplines. The research tool course should be in disciplines that have a strong relation to mathematics. For example, any graduate or 400 level computer science course pre-approved by the student's graduate advisor will be accepted. However, a student with no prior programming experience cannot take such a course and instead could choose a first year undergraduate programming course. Learning how to use a standard statistical or mathematical package (such as SAS, SPSS, R or Mathematica by taking a course. The research tool cannot be taken during the last semester.*	Research Tool A research tool is required and may entail coursework beyond the 30 hours of mathematics. The research tool can be fulfilled in a variety of ways, some of which are listed below: Taking the MATH 598 Graduate Seminar (1.5 credit hours each) for two semesters Courses in other disciplines. The research tool course should be in disciplines that have a strong relation to mathematics. For example, any graduate or 400 level computer science course pre-approved by the student's graduate advisor will be accepted. However, a student with no prior programming experience cannot take such a course and instead could choose a first year undergraduate programming course. Learning how to use a standard statistical or mathematical package (such as SAS, SPSS, R or Mathematica by taking a course. The research tool cannot be taken during the last semester.
Optional Thesis 6 hours *Students who choose to write a thesis are required to complete 6 hours of MATH 599 Thesis Research and Writing and to give an oral defense of the thesis.*	Optional Thesis 6 hours Students who choose to write a thesis are required to complete 6 hours of MATH 599 Thesis Research and Writing and to give an oral defense of the thesis.
Computational Mathematics Option	Computational Mathematics Option
Admission Requirements *1. One of the following:* *(a) A minimum GAP score of 600 [GAP = (GRE-V + GRE-Q) + (Undergraduate GPA x 100)] or a minimum GAP score of 3000 for students who took the GRE prior to August 2011 [GAP = (GRE-V + GRE-Q) x Undergraduate GPA] *Students who took the GRE prior to 2002 should contact the graduate advisor of the program;*	Admission Requirements 1. One of the following: (a) A minimum GAP score of 600 [GAP = (GRE-V + GRE-Q) + (Undergraduate GPA x 100)] or a minimum GAP score of 3000 for students who took the GRE prior to August 2011 [GAP = (GRE-V + GRE-Q) x Undergraduate GPA] *Students who took the GRE prior to 2002 should contact the graduate advisor of the program;

(b) A GRE score of at least 300. For options (a) or (b) WKU requires a minimum score of 139 on both the verbal and quantitative parts of the GRE; (c) For students that graduate from WKU with a mathematics major, a GPA of at least 3.3 in their mathematics major.	(b) A GRE score of at least 300. For options (a) or (b) WKU requires a minimum score of 139 on both the verbal and quantitative parts of the GRE; (c) For students that graduate from WKU with a mathematics major, a GPA of at least 3.3 in their mathematics major.
2. Completion of the following undergraduate courses: *(a) a one year calculus sequence;* *(b) linear algebra;* *(c) discrete mathematics;* *(d) a one year sequence of programming courses;* *(e) a B.A. degree with a major in either Computer Science, Engineering, Mathematics or Physics.* *3. A cumulative grade point average of at least 3.0 (on a 4.0 scale) in at least one of the following:* *(a) all mathematics and computer science courses that are listed in (a) through (d) of Item 2 above;* *or* *(b) all courses in the major listed in (e) of Item 2 above. Students cannot enter the program if they have a deficiency in the courses listed in Item 2 above*	2. Completion of the following undergraduate courses: (a) a one year calculus sequence; (b) linear algebra; (c) discrete mathematics; (d) a one year sequence of programming courses; (e) a B.A. degree with a major in either Computer Science, Engineering, Mathematics or Physics. 3. A cumulative grade point average of at least 3.0 (on a 4.0 scale) in at least one of the following: (a) all mathematics and computer science courses that are listed in (a) through (d) of Item 2 above; or (b) all courses in the major listed in (e) of Item 2 above. Students cannot enter the program if they have a deficiency in the courses listed in Item 2 above
Degree Requirements minimum of 30 hours *The Master of Science in Mathematics (Computational Mathematics Option) requires a minimum of 30 hours of graduate-level mathematics and computer science courses. A maximum of 12 hours at the 400G level may be included in the entire program. All students in the M.S. program (computational mathematics option) must have a working knowledge of a high-level programming language. The CS classes required in this option do not allow for additional courses in a related field.*	Degree Requirements minimum of 30 hours The Master of Science in Mathematics (Computational Mathematics Option) requires a minimum of 30 hours of graduate-level mathematics and computer science courses. A maximum of 12 hours at the 400G level may be included in the entire program. All students in the M.S. program (computational mathematics option) must have a working knowledge of a high-level programming language. The CS classes required in this option do not allow for additional courses in a related field.
Comprehensive exams are required.	Comprehensive exams are required.
Required Core *MATH/CS 405G Numerical Analysis I** *MATH 470G Introduction to Operations Research** *CS 549 Algorithms Analysis** *STAT 549 Statistical Methods I* *MATH 406G Numerical Analysis II* *At least two courses from the list below:* *CS 562 Parallel and Distributed Computing* *CS 565 Data Mining Techniques and Tools* *CS 595 Advanced Topics in Computer Science (with advisor approval)* **If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department graduate advisor.*	Required Core MATH/CS 405G Numerical Analysis I* MATH 470G Introduction to Operations Research* CS 549 Algorithms Analysis* STAT 549 Statistical Methods I MATH 406G Numerical Analysis II At least two courses from the list below: CS 562 Parallel and Distributed Computing CS 565 Data Mining Techniques and Tools CS 595 Advanced Topics in Computer Science (with advisor approval) *If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department graduate advisor.

Electives *MATH 431G Intermediate Analysis I* *MATH 541 Graph Theory* *MATH 570 Topics in Operations Research* *MATH 504 Application of Technology to Problems in Mathematics* *MATH 540 Stochastic Processes* *MATH 542 Advanced Topics in Discrete Mathematics* *MATH 590 Special Topics in Mathematics (with advisor approval)*	Electives MATH 431G Intermediate Analysis I MATH 541 Graph Theory MATH 570 Topics in Operations Research MATH 504 Application of Technology to Problems in Mathematics MATH 540 Stochastic Processes MATH 542 Advanced Topics in Discrete Mathematics MATH 590 Special Topics in Mathematics (with advisor approval) **STAT 550 Statistical Methods II**
Research Tool *This requirement is satisfied by the computer science classes.* *Optional Thesis 6 hours* *Students who choose to write a thesis are required to complete 6 hours of MATH 599 Thesis Research and Writing and to give an oral defense of the thesis.*	Research Tool This requirement is satisfied by the computer science classes. Optional Thesis 6 hours Students who choose to write a thesis are required to complete 6 hours of MATH 599 Thesis Research and Writing and to give an oral defense of the thesis.

4. Rationale for the proposed program change:

We added a new course STAT 550 as an elective course to the program so that our students can take this class as part of their program

5. Proposed term for implementation and special provisions (if applicable):

6. Dates of prior committee approvals:

_____Department/Division: _11/15/2013_____

_____Curriculum Committee _____

Professional Education Council (if applicable) _____

~~General Education Committee (if applicable)~~ _____

Undergraduate Curriculum Committee _____

University Senate _____