

# **Departmental Assessment for Middle States: Department of Mathematics and Computer Science - Spring 2015**

## **Learning outcome goals for department of Mathematics and Computer Science:**

The graduate will...

1. demonstrate algorithmic problem solving skills and techniques appropriate to the given major within the department.
2. take practical “real world” problems and translate problems into abstractions that can be solved through the skills and techniques of the major.
3. apply the problem solving skills to the abstract model of “real world” problems to generate meaningful solutions and analyses of the problems.

## **Brief Review of Assessment Procedures for 2013-2014:**

Actuarial Studies – the external assessment provided by the Society of Actuaries (SOA Exam P) is used to determine mastery of our graduate outcomes. The Society of Actuaries provides a scoring that mimics our rubric.

Computer Science – a substantive analysis and treatment from a Junior/Senior level course will be assessed against the rubric.

E-commerce - a substantive analysis and treatment from a Junior/Senior level course will be assessed against the rubric.

Mathematics – a substantive analysis and treatment from a Junior/Senior level course will be assessed against the rubric.

Management Information Systems - a substantive analysis and treatment from a Junior/Senior level course will be assessed against the rubric.

Web Development – the product(s) of CSci 431 Web Portfolio will be assessed against the rubric.

## **Review of 2013-2014 Recommendations and Assessment Procedures for the 2014-2015 Assessment:**

Recommendations from the 2013-2014 report:

- 1) We recommend that students complete all 100-level requirements by the end of their Sophomore year. Since Actuarial Studies is an interdisciplinary major there are numerous 100-level courses that form the foundation for understanding and solving actuarial problems. All of these skills should be developed prior to taking substantial numbers of upper level courses.
- 2) Offering a “once every two year” Actuarial Exam Preparation course does not make sense. We recommend abandoning the listed course and replacing it with targeted directed/independent study classes with the Actuarial Studies professor.

- 3) Determine a “non-SOA” mechanism to assess the effectiveness of our FM (Financial Mathematics) component of our Actuarial Studies program.

#### Action Plan from the 2013-2014 report:

- 1) With the new college-wide integrative requirement there is room for additional major classes in the Freshman year schedule. It is now possible to advise students so that they can take care of most of their 100 level courses within the first year and a half. We are actively advising entering Actuarial Studies students to add more major courses to their Freshman year.
- 2) We are not scheduling the Actuarial Exam Preparation course and Dr. Wu is engaged in modifying the curriculum to address this change. He will be handling test preparation with students through individualized instruction.

The department continues to follow through on its 2014 recommendations and action plan:

Action #1 is currently being implemented. We will need to assess its success in 2016 when we should have the ability to determine if 2014 entering Freshmen in Actuarial Studies have completed their 100 level requirements by the end of Fall 2015. This action will carry over to 2015-2016.

Action #2 has been implemented. The Actuarial Exam Preparation course is no longer offered. Student preparation for actuarial exams is now provided through individualized instruction and faculty led independent study.

Recommendations #1 and 2 are carried out by the Action #1 and #2.

Recommendation #3 carries over. We did not take any action on creating a mechanism to assess the effectiveness of the Financial Mathematics component of our Actuarial Studies program. While we will continue to consider this problem, addressing the problem in a meaningful way may have to wait until we have hired a tenure-track faculty member for the Actuarial Studies position.

### **Modifications of 2013-2014 Assessment Procedures for the 2014-2015 Assessment:**

#### **General improvements to our assessment procedures:**

Based on conversations with assessment consultants and with administration at the college we are adopting the approach that each student piece subject to our assessment procedures will be evaluated against our rubric by two tenure-track faculty within the department. We have adopted that approach for the 2014-2015 assessment.

The department understands the necessity of assessing all of its major programs, but did not gather sufficient samples to assess all of its programs for 2013-2014. Only one of the department’s six majors, Actuarial Studies, was assessed over the 2013-2014. The department has rectified this deficiency for the 2014-2015 assessment.

#### **Changes to our assessment procedures specific to major programs:**

In addition to obtaining adequate samples for the 2014-2015 assessment review the department is making changes to its assessment approach for two of the majors within the department: Actuarial Studies and Web Development.

**Rationale for changing assessment approach for Actuarial Studies:**

Upon consultation with assessment consultants it became clear that the 2013-2014 assessment approach for our Actuarial Studies program does not provide adequate detail to allow us to produce focused recommendations and a meaningful action plan. To provide sufficient detail regarding the efficacy of the program we are adding to our review “a substantive analysis and treatment from a Junior/Senior level course which will be assessed against our rubric.” As a gross measure of students successfully meeting outcomes we will continue to report on our students’ results on the SOA Exam P examination administered by the Society of Actuaries.

**Rationale for changing assessment approach for Web Development:**

The 2013-2014 description of our assessment approach indicated we would be sampling student work from the CSci 431 Web Portfolio class. We did obtain the required samples (3 sampled out of an N=3), but presently have a staffing situation where the department has no tenure-track faculty member for the Web Development major program. Rather than proceed under these circumstances we are changing the assessment review approach for the Web Development major to “when feasible, product(s) of CSci 431 Web Portfolio will be assessed against the rubric. Otherwise, a substantive analysis and treatment from a Junior/Senior level course for the major which will be assessed against our rubric.”

**Specific sampling and assessment of 2014-2015 major programs of the Department of Mathematics and Computer Science:**

Samples will be evaluated using a 0 to 9 scale where 6 indicates adequate mastery of the subject material for a graduate of that major.

**Rubric:**

The sample will be evaluated using a 0 to 9 scale where 6 indicates adequate mastery of the subject material for a graduate of that major.

Each learning outcome should be rated on a 0 to 3 point scale as follows:

- 0: no evidence of competence
- 1: partial competence – some portions of the outcome are met but others are not met
- 2: competence – all aspects of the outcome are met
- 3: exemplary – all aspects of the outcome are met, and exceptionally high quality is noted. In order to evaluate as “exemplary” the sample must minimally demonstrate competence for all three learning outcomes.

**Applying the Rubric:**

In 2014-2015 the department of Mathematics and Computer Science will assess students from each major based on the following approach:

**Actuarial Studies** – Gross external assessments provided by the Society of Actuaries, SOA Exam P and SOA Exam FM, will be used to determine general mastery of our graduate outcomes. We will not apply the departmental rubric to these results. Rather, we will report them to indicate students’ overall mastery of the program’s learning outcomes.

In addition four student samples from Math 461 Statistics (N=7) will be assessed against the rubric. Unlike the SOA exam results, we expect that the Math 461 assessment will allow us to make meaningful recommendations for the program.

**Computer Science, E-Commerce, Management Information Systems, and Web Development majors** – four student samples from CSci 427 Operating Systems (N=11) will be assessed against the rubric.

**Mathematics** – four student samples from Math 461 Statistics (N=7) will be assessed against the rubric.

## **Results and Discussion for Actuarial Studies SOA Exams P and FM:**

The department recognizes that the SOA Exams P and FM provide gross measures of student competence in the Actuarial studies major. As a professional organization, the assessment by the SOA is well respected and we concur with the society's summative assessment of these graduates capabilities. However, the department acknowledges that it is challenging to develop meaningful recommendations and action plans based on the SOA Examinations since they do not provide any breakdown with respect to mastery of specific outcomes. We intend to continue to report student outcomes on these tests as a general barometer of the health and efficacy of the program, but we intend to supplement this gross assessment mechanism with assessments of upper level courses that contribute to the Actuarial Studies major. The assessment of Math 461 Statistics below represents our effort to examine components and make recommendations for improving our Actuarial Studies and Mathematics programs.

During the 2013-2014 academic year there were 3 Actuarial Studies students taking Actuarial exams. Each of these students took the Society of Actuaries Exam P (Probability). The passing score for SOA exams is a 6. The following results were reported by SOA.

Student A (2013) scored a 6

Student B (2013) scored a 6

Student C (2014) scored a 3

During the 2014-2015 academic year there we have had 5 Actuarial Studies students who have taken or will be taking Actuarial exams. Four of the students took/or will be taking Exam P (Probability) and one took Exam FM (Financial Mathematics). The following results were reported by SOA.

Exam P:

Student A (2014) failed – but did not share the failing score with Dr. Wu

Student B (2015) scored a 6

Student C (2015) is scheduled to take the later this month

Student D (2015) is scheduled to take the exam later this month

Exam FM:

Student E (2014) scored a 7

### **Discussion:**

Dr. Jie Wu and Prof. Grover discussed the results of the individual student's performance on the SOA exams. Based on the information we have so far, the pass rate of 2 out of 3 (or 67%) on completed exams in 2014-2015 is identical to the results of 2013-2014. While we are pleased with the slight rise in scores

there is little evidence that changes to the Actuarial Studies program instituted last year have produced any significant results to our pass rate.

At this time, the department has no further recommendations and action plan with respect to this component of the Actuarial Studies assessment except to continue to monitor and report on student success on SOA.

**Proposed action item:**

Continue to monitor and report on student performance on SOA examinations. We will make an attempt to obtain exact scores from each student who takes the exam in 2015-2016. A possible solution is to require that students not only take one SOA examination as a major requirement, but they must also provide a report of the results of the SOA examination to the department chair in order to be certified for graduation.

**Results and Discussion for Math 461 Statistics:**

Four samples were selected out of a class of 11. The assessment constructed by Dr. Richins and Dr. Wu follows:

	Outcome #1 algorithmic skills	Outcome #2 describe real-world problems as abstractions	Outcome #3 generate solutions and analyses
<b>Sample A</b>			
rationale	2-The analysis seems complete, but there are some calculation mistakes that detract from the conclusion of the project.	3-The student was able to use data to generate a linear regression model to predict percentages of M&M candy colors and compare those percentages to the ones published on M&M website	2-The conclusion really relies on only part of the analysis done in the project. Student does point out potential biases.
<b>Sample B</b>			
rationale	2- The problem was solved completely and the parameters of the assignment were completely met.	3-The model generated gave the student insight into how field position in baseball affects the OPS of the player.	3-Student did an excellent job of explaining how the results made sense in terms of characteristics of position players.
<b>Sample C</b>			
rationale	2-The appropriate tests were completed, but results were not interpreted correctly in all cases.	2-An appropriate model is created, but again the analysis falls short.	1-Analyses are incomplete, level of significances changes without mention, and no explanation of results is given.
<b>Sample D</b>			
rationale	1-Results of important tests were ignored completely.	2-The model appears be useful overall.	1-Analysis is very incomplete. Some results can be better explained just using the Minitab printout. Poor overall performance in this area.

**Discussion:**

*Algorithmic Skills:* Students did well overall in this category. This is probably somewhat due to the fact that they used Minitab to complete most of the calculations necessary to solve the problems at hand. Students did generally understand the need to perform a statistical test to validate their models.

*Describe real-world problems as abstractions:* Students were all able to generate a model and at least partially explain the predictions that could be made with that model.

*Generate Solutions and Analyses:* Some students had great difficulty in correctly interpreting the results that they obtained from Minitab. There was some fundamental misunderstanding of what statistical tests were telling them. On the other hand, the first two samples that were scored did very well in this category.

**Proposed action items specific to this course and the programs it serves:**

1. Give students more seminar sessions in class to discuss the results of their projects, the idea being that the preparation of some students will “rub off” on those that are lacking when correct results and interpretations are presented.
2. Encourage students to put more effort into data gathering. The samples used should be larger, and data should be randomly chosen. In most cases, the data was gathered from a convenient sample.
3. The theory in our Statistics course is sometimes lacking because of time constraints imposed by the need to adequately cover material that is needed by the Actuarial Studies majors in the course. We need to develop a mechanism to help alleviate this problem.

**Proposed action items specific to the assessment process for these majors:**

4. As a department, we may consider using a different class for our assessment. For example, Differential Equations (even though it is not a senior-level course) contains material that would fit the rubric used quite well.
5. Assessment may be improved if the work assessed came from an exam rather than from a project. It is difficult to tell whether the work produced is the student’s own or whether it was produced in collaboration with other students or with help from the professor.

## Results and Discussion for CSci 427 Operating Systems:

Four samples were selected out of a class of 7. The assessment constructed by Prof. Anderson and Prof. Grover follows:

	Outcome #1 algorithmic skills	Outcome #2 describe real-world problems as abstractions	Outcome #3 generate solutions and analyses
<b>Sample A CS427_03 RSA Encryption</b>	#3 - Exemplary	#3 - Exemplary	Not Applicable
rationale	Lemmas and theorems relevant to RSA encryption are discussed. Mathematical representation is represented clearly. Student applies encryption/decryption techniques competently.	Student makes clear reference to uses for encryption. Student demonstrates how real-world problems can be translated into an abstract model of the problem.	The format of this project - a research paper does not lend itself well to assessing this outcome
<b>Sample B CS427_04 Secondary Storage</b>	#0 - No evidence of competence	#0 - No evidence of competence	Not Applicable
rationale	Student is largely reporting facts without demonstrating a serious attempt to introduce appropriate relevant algorithms except at the most superficial level. No evidence of competence.	Attempts are made to introduce real-world applications but detail is missing or stated unclearly.	The format of this project - a research paper does not lend itself well to assessing this outcome
<b>Sample C CS427_07 Virtualization and Security Threats</b>	#0 - No evidence of competence	#2 - Competent	Not Applicable
rationale	Student is largely reporting facts without demonstrating a serious attempt to introduce appropriate relevant algorithms except at the most superficial level. No evidence of competence.	The value and representation of virtual machines is covered well. The abstract models are not very detailed but are largely clear and accurate.	The format of this project - a research paper does not lend itself well to assessing this outcome
<b>Sample D CS427_09 Encryption</b>	#1 – Partial competence	#1 - Partial competence	Not Applicable
rationale	Many of the technical aspects of encryption are not addressed. The "why" is clear, but the "how" has not been examined.	Some attention is paid to developing an abstract model from a real-world problem, but the translation from one to another was incomplete and not handled well.	The format of this project - a research paper does not lend itself well to assessing this outcome

## **Discussion:**

The quality of English writing in the four chosen samples is quite high. This was not the case for the entire class, however. The major concern most students had with presentation was a lack of graphical description for complex concepts (e.g. RAID disk structure, public key-based encryption).

If our primary departmental learning outcomes are to be assessed appropriately, it may be appropriate to consider drawing samples from a different source. While the Operating Systems course can be effectively assessed against departmental outcomes, writing-intensive course assignments are not well suited to assessing outcome #3, Generate Solutions and Analyses. However, students who choose to do a project (those elusive creatures) would likely submit final products which could be used to assess all of the departmental outcomes. Instituting a requirement for two smaller WIC tasks, one a research paper and the other a project with a corresponding written component, could provide sufficient material to assess.

*Algorithmic Skills:* Most topics in computer science satisfy this outcome. For the four samples we have from CSCI 427 this term, only the students who conducted a study of encryption methods focused in any meaningful way on algorithms. The others avoided the technicalities to such an extent that they were assessed as “No evidence of competence.” For the students who addressed this outcome, they generally did well. This outcome is best assessed with a project instead of a writing assignment, unless that assignment is appropriately technical and the student is forced to explain algorithmic processes.

*Describe real-world problems as abstractions:* While the clarity of writing in some of the sample pieces leaves something to be desired, overall the samples demonstrated sound command of this outcome. The WIC prompt seems able to provide samples appropriate for evaluating this aspect of our curriculum.

*Generate Solutions and Analyses:* With the exception of the first sample, there really is no reasonable way to assess this outcome with the WIC research paper samples received. Students were provided an option to write a project with an accompanying, somewhat shorter, paper for the class or to write a research paper. With only one student producing a project, it is not surprising that it was not selected for assessment. We suggest that a project-based approach to assessing this outcome, or a well-structured examination question may allow for a more complete assessment of student outcomes.

## **Proposed action items specific to this course and the programs it serves:**

1. Despite a call for an inclusion of algorithmic concepts in the writing prompt, the samples showed that students either did not completely understand the expectation or were unable to demonstrate any in-depth, formal, understanding of the algorithms relevant to their research paper. We recommend that this class address this concern by requiring students to submit a preliminary draft of their paper well before the final due date with any algorithm(s) required by the research to be clearly articulated within the draft. This would have the added benefit of introducing a desirable plan, write, revise process appropriate to a WIC exercise.

2. Similarly, while making connections between real-world problems was handled better by students the connection was not necessarily made consistently. In order to address this it may be appropriate to



require students to provide a proposal that not only outlines the topic, but describes real-world problems that the topic being researched is intended to solve.

### **Proposed action items specific to the assessment process for these majors:**

3. We recommend that for the purpose of assessment it is much more practical to construct a final exam with appropriate questions that, while appropriate for the course, are specifically designed to be used for assessment purposes as well. Using specifically constructed examination questions to address the given departmental outcomes may be a much efficient and precise method for completing the assessment task.

## **Discussion for 2014-2015 Math and Computer Science Departmental Assessment Unrelated to Specific Course Assessments:**

### **General Departmental Learning Outcome Issues:**

Assessing a department that houses six major programs presents a considerable challenge. It is worthwhile noting that despite the varied major programs there are courses which may be shared in common by two or more major programs. This was the case in this year's departmental assessment. In an effort to streamline assessment of departmental major programs we chose to assess courses that would allow us to have meet our departmental assessment needs without having to sample a rather large number of classes.

We have established three, somewhat general, departmental learning outcomes that we believe effectively capture the outcomes of each of the major programs. This allows us to assess all of the major programs while only sampling a few classes – in this year's assessment only two classes. We hope to be able to continue to use courses which are integral to more than one major program in order to avoid making the assessment process excessively burdensome to the department.

One of the concerns we have about using these fairly general learning outcomes is that it is likely that there are certain very specific outcomes which we should be considering for each major program that are hard to "break out" and address based on the results of the general departmental learning outcomes assessment. We expect to revisit this issue in future assessment cycles.

### **Staffing Issues:**

In addition to the learning outcome concerns referenced above, there is an ongoing concern regarding continuity in staffing our programs with highly qualified faculty who can deliver our programs effectively. As of this writing, the Department of Mathematics and Computer Science is composed of six full-time faculty. In addition, there is a vacant position that we need to fill which has direct responsibility for our Web Development, E-Commerce, and Management Information Systems major program. In the 2014-2015 academic year that position was filled by a Visiting Professor. It appears that, if we are successful in our present search, that this will be the case for 2015-2016. Of the six presently filled positions, one faculty member will be leaving the department at the end of this summer. That faculty member presently directs our Actuarial Studies program. Of the department's five continuing full-time we are aware that a non-tenure track faculty member will be retiring at the end of the 2015-2016 academic year.

With the present volatility in departmental staffing, we are skeptical of making significant progress on our action plans for 2015-2016. We recognize there are efforts that we need to take in order to improve

our programs. At present, we do not have adequate staffing to competently address all of these concerns in a meaningful way.

**Proposed General Action Items Unrelated to Specific Course Assessments:**

- 1) The department will review our learning outcomes in 2015-2016 and affirm or modify these learning outcomes in an effort to make sure that we are capturing the appropriate results that that enable us to make recommendations for significant improvements to our programs.
- 2) The department, in conjunction with administration, will recruit and hire qualified tenure-track faculty specific to the Actuarial Studies, e-Commerce, Management Information Systems, and Web Development majors.
- 3) The department, in conjunction with administration, will look for practical solutions to minimize faculty turnover for the department.

**Summary:**

The department reviewed its six major programs and the assessment process for these programs by individually assessing

- 1) Student results from Society of Actuaries examinations
- 2) Student projects from Math 461 Statistics, and
- 3) Student research papers from CSci 427 Operating Systems

In addition, the department examined and provided action items relating to

- 1) Departmental learning outcome goals
- 2) Staffing issues relevant to the delivery of our major programs

Recommended actions for the 2015-2016 academic year follow in the table below:

Item assessed	Corresponding action items derived from assessment	Departmental learning outcome addressed or if the action corresponds primarily to assessment
2013-2014 Assessment Report	1. Assess to what degree students are completing Actuarial Studies 100-level requirements by the end of their third semester.	#1

	2. Develop a meaningful approach to assess student learning outcomes for the Financial Mathematics component of the Actuarial Studies program	Assessment
SOA examination results	1. Continue to monitor and report on student performance on SOA examinations.	#1, 2, 3 - but only in an overarching general fashion
	2. Obtain better compliance from students in reporting SOA exam scores to the department	Assessment
Item assessed	Corresponding action items derived from assessment	Departmental learning outcome addressed or if the action corresponds primarily to assessment
Project from Math 461 Statistics	1. Use class discussion and peer-review of project results to model appropriate skill development, modeling and analysis	#1, 2, 3
	2. Provide additional guidance, instruction, and encouragement to students in creating an appropriate data set	#1
	3. Review course content to examine how best to address theory behind statistics more effectively	#1 - from the perspective that theoretical understanding facilitates the ability to use the tool effectively
	4. Review courses within the major and recommend a listing of courses that are best suited for assessing departmental outcomes.	Assessment
	5. Develop and apply a more effective approach to selecting appropriate student submissions (e.g. exercises, examinations, papers) for assessing departmental objectives.	Assessment
Paper from CSci 427 Operating Systems	1. In classes with a major paper/project require an early draft to insure students are considering algorithmic concerns appropriately.	#1

	2. In classes with a major paper/project require a proposal that demonstrates the student can articulate the relationship between a real world problem and an abstraction that is solvable through application of an appropriate algorithm.	#2
	3. Identical to action item #5 for Math 461	Assessment

Item assessed	Corresponding action items derived from assessment	Departmental learning outcome addressed or if the action corresponds primarily to assessment
General departmental observations relevant to delivery of curriculum	1. Review and revise, if necessary, departmental learning outcomes.	Assessment
	2. Recruit and retain necessary staffing.	Necessary to meet all departmental learning outcomes.
	3. Develop and implement appropriate faculty retention strategies.	Necessary to meet all departmental learning outcomes.