Please enter the appropriate information concerning your student learning assessment activities for this year.

**Academic Year of Report:** 2013/2014  **College:** COTS
**Department:** Mathematics  **Program:** BS, Mathematics

1. What student learning outcomes were assessed this year, and why?
   In answering this question, please identify the specific student learning outcomes you assessed this year, reasons for assessing these outcomes, with the outcomes written in clear, measurable terms, and note how the outcomes are linked to department, college and university mission and goals.

   Outcomes 4 and 7 of the Student Learning Outcomes (attached) were assessed. We chose these because proof writing is an essential aspect of mathematics and this has been a problem for us in the past (see the 2008 report) and has not been assessed in isolation for the past few years (which have focused on reading and writing).

2. How were they assessed?
   In answering these questions, please concisely describe the specific methods used in assessing student learning. Please also specify the population assessed, when the assessment took place, and the standard of mastery (criterion) against which you will compare your assessment results. If appropriate, please list survey or questionnaire response rate from total population.

   **A) What methods were used?**

   We decided to target the “Senior Sequences” (MATH 451–453, MATH 461–463, and MATH 471–473) rather than looking at student curated portfolios to better understand student ability at the start and conclusion of the student’s final year. The data consisted of informal student discussions about the difficulties of proof writing and informal interviews with the instructors of these courses about student abilities.

   **B) Who was assessed?**

   Students in the two Senior Sequences offered in 2013–2014 were assessed. This group of students consisted primarily of students who were completing their major requirements, although a few of these students were taking these courses as juniors and anticipated another year of mathematics.

   **C) When was it assessed?**


3. What was learned?
In answering this question, please report results in specific qualitative or quantitative terms, with the results linked to the outcomes you assessed, and compared to the standard of mastery (criterion) you noted above. Please also include a concise interpretation or analysis of the results.

While students can produce isolated proofs in order to fulfill the requirements of MATH 499S (see 2013–2014 report), proof writing remains problematic.

According to the instructors, many students in the first quarter of a Senior Sequence are incapable of independently producing a proof. This leads to a great deal of time and effort in these courses being devoted to the mechanics of proof writing. This is unfortunate because the Senior Sequences are intended to focus on content rather than mechanics.

According to the students, the formal requirements for the Senior Sequences (MATH 260) fails to adequately prepare them for the expectations in these courses.

4. What will the department or program do as a result of that information?
In answering this question, please note specific changes to your program as they affect student learning, and as they are related to results from the assessment process. If no changes are planned, please describe why no changes are needed. In addition, how will the department report the results and changes to internal and external constituents (e.g., advisory groups, newsletters, forums, etc.).

After similar results in the 2008 Student Outcome Assessment Report, new 300-level elective courses were added to the curriculum in order to better bridge the gap. We believe these courses did not succeed because of their elective nature. Proof writing is difficult and many students opted to not take these elective courses because non-proof oriented electives were available and generally regarded as easier. In order to solve this issue, the Mathematics BS degree is being adjusted to require these 300-level proof-oriented courses as pre-requisites for the Senior Sequences.

5. What did the department or program do in response to last year’s assessment information?
In answering this question, please describe any changes that have been made to improve student learning based on previous assessment results. Please also discuss any changes you have made to your assessment plan or assessment methods.

Because the Assessment Information indicated that 8/9 seniors were capable of writing proofs while instructors teaching the Senior Sequences were experiencing great difficulty with student proof-writing, the decision was made to consider qualitative data from the Senior Sequences in this year’s assessment.

6. Questions or suggestions concerning Assessment of Student Learning at Central Washington University:
Many Student Learning Outcomes for this program are assessed through Course Grades and Portfolios.

For Course Grade based assessment, the Criterion of Achievement is “80% of students pass course with a B or better on 1st or 2nd attempt” referred to as “Grade Criterion” in the table below.

For all Portfolio based assessment, the Criterion of Achievement is “75% of applicable Portfolio artifacts achieve a rating of Exemplary or Proficient” referred to as “Portfolio Criterion” in the table below.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Method(s) of Assessment</th>
<th>Who Assessed</th>
<th>When Assessed</th>
<th>Criterion of Achievement</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Graduates will be able to use differential and integral calculus as well as sequences and series to solve problems.</td>
<td>Course Grades</td>
<td>Students in MATH 172, 173, 272, 273</td>
<td>Quarterly</td>
<td>Grade Criterion</td>
<td>100% of the students assessed met this criterion.</td>
</tr>
<tr>
<td>2. Graduates will be able to use concepts of vector subspaces of $\mathbb{R}^n$ and $\mathbb{R}^{m\times n}$ to solve problems.</td>
<td>Course Grades</td>
<td>Students in MATH 265</td>
<td>Quarterly</td>
<td>Grade Criterion</td>
<td>100% of the students assessed met this criterion.</td>
</tr>
<tr>
<td>3. Graduates will be to write proofs using contrapositive, contradiction, cases, and mathematical induction.</td>
<td>499S Portfolio</td>
<td>Students in MATH 499S</td>
<td>Winter</td>
<td>Portfolio Criterion</td>
<td>8 of 9 students met this criterion</td>
</tr>
<tr>
<td>4. Graduates will know standard applications of calculus, linear algebra, and statistics.</td>
<td>499S Portfolio</td>
<td>Students in MATH 499S</td>
<td>Winter</td>
<td>Portfolio Criterion</td>
<td>8 of 9 students met this criterion</td>
</tr>
<tr>
<td>5. Graduates will be able to apply their understanding of mathematics to fields outside of mathematics.</td>
<td>499S Portfolio</td>
<td>Students in MATH 499S</td>
<td>Winter</td>
<td>Portfolio Criterion</td>
<td>8 of 9 students met this criterion</td>
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<td>6. Graduates will be able to describe the differences between the following types of mathematics: discrete/continuous, algebraic/geometric, pure/applied, deterministic/stochastic.</td>
<td>499S Portfolio</td>
<td>Students in MATH 499S</td>
<td>Winter</td>
<td>Portfolio Criterion</td>
<td>This criterion was not assessed.</td>
</tr>
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<td>7. Graduates will be able to communicate mathematical ideas through writing.</td>
<td>499S Portfolio</td>
<td>Students in MATH 499S</td>
<td>Winter</td>
<td>Portfolio Criterion</td>
<td>7 of 9 students met this criterion</td>
</tr>
<tr>
<td>8. Graduates will be able to communicate mathematical ideas orally.</td>
<td>499S Portfolio</td>
<td>Students in MATH 499S</td>
<td>Winter</td>
<td>Portfolio Criterion</td>
<td>8 of 9 students met this criterion</td>
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