LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): ____BS____
(BA, BS, BFA, MA, MS, LACC, etc.)

Course # / Title: ____Mth 253 – Sequences and Series_____________________

Faculty name: ______Scott Beaver___________________________________

Date: ______6/15/10_________________

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

B) Check the embedded assessment tool(s) used :
- ☐ Exam question

Western Oregon University
Embedded Assessment Log Report

Exam 1

Math 253 - Calculus III - Spring Term 2010
April 21, 2010
Instructor: S. Beaver

1. (15 points) Consider the sequence (a_n) where $a_n = \dfrac{5n}{7n-1}$. For $\epsilon = .0005$, guess the limit ℓ (you need not show any work in finding ℓ) and find an $j \in \mathbb{N}$ such that for all $n > j$, we have $|a_n - \ell| < \epsilon$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

2. (12 points) Does the sequence whose n^{th} term is given by the formula below converge? If so, find the limit. If not, explain why.

$$a_n = (-1)^{n+3}(n^3 + 2).$$

   Mathematical Knowledge - mastery of a body of mathematics.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

3. (14 points) Show that the sequence whose n^{th} term is given by the formula below converges, and in doing so find the limit ℓ.

$$a_n = \frac{n^2 - 3n^{\frac{1}{2}}}{6n^2 - 1}$$

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

4. (15 points) Does the sequence whose n^{th} term is given by the formula below converge? If so, find the limit. If not, explain why. *Hint: A French mathematician with an apostrophe in his name...*

$$a_n = n^2 \sin\left(\frac{3}{n^2}\right).$$

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

5. (15 points) Does the sequence whose n^{th} term is given by the formula below converge? If so, find the limit. If not, explain why.

$$a_n = (-1)^n \frac{2n}{n+3}.$$

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

6. (15 points) Does the sequence whose n^{th} term is given by the formula below converge? If so, find the limit. If not, explain why.

$$a_n = \frac{4\cos^5(n^4) + 2\sin^2(\sqrt{n})}{n^2+3}$$

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

7. (14 points) Does the sequence whose n^{th} term is given by the formula below converge? If so, find the limit. If not, explain why. *Hint: There will be two theorems involved here...*

$$a_n = \cos\left(\arctan(n)\right).$$

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

8. Extra Credit (10 points, 2 each) True or False: Give a counterexample in the case of a false statement, or a short explanation in the case of a true statement:

a). If $\lim(a_n) = \ell$, and $f(x)$ is a function with $a_n = f(n)$ for every n, then $\lim_{x \to \infty} f(x) = \ell$.

b). If $(b_n) \to \ell$ and $(c_n) \to \ell$ and both (b_n) and (c_n) are subsequences of (a_n), then $(a_n) \to \ell$.

c). Any geometric sequence with $|r|$ sufficiently small converges.

d). If $(a_n) \to \ell$, then $\left(\frac{1}{a_n}\right) \to \frac{1}{\ell}$.

e). If $(a_n) \to \ell$, then $\left(a_n^2\right) \to \ell^2$.

Mathematical Knowledge - mastery of a body of mathematics.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

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Exam 2

Math 253 - Calculus III - Spring Term 2010
May 19, 2010
Instructor: S. Beaver

1. (15 points) Determine the sum of $\sum \frac{(-1)^{n-1}}{(n!)\,3^n}$ to within three decimal places.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

2. (15 points) Determine whether $\sum \frac{1}{n^2+n+1}$ converges.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

3. (15 points) Determine whether $\sum \frac{(-1)^{n-2}\ln n}{n}$ converges.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

4. (15 points) Determine whether $\sum \frac{\cos(n)\sin(n)}{n^2}$ converges absolutely.

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

5. (12 points) Determine whether $\sum \frac{100^n}{n!}$ converges.

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

6. (14 points) Determine whether $\sum \frac{(-1)^n n}{\ln n}$ converges.

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

7. (14 points) Determine whether $\sum \tan \frac{1}{n}$ converges.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

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Final Exam

Math 253 - Calculus III - Spring Term 2010
June 9, 2010
Instructor: S. Beaver

1. (15 points) Find a PSR for $f(x) = x^4 \ln(1 + 3x^6)$ and give the IOC.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

2. (15 points) Determine $\int_0^{0.3} \frac{\ln(1+x) - x}{x^2}\, dx$ to within four decimal places.

   Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

3. (15 points) Find a PSR for $\int x^{-3}\sin(2\pi x^3)$ and give the IOC.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

4. (15 points) Find a PSR for $\dfrac{x^3}{(1+2x)^3}$ and give the IOC.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

5. (15 points) Using the definition of Maclaurin Series, find the PSR for $f(x)\frac{1}{\sqrt{x+2}}$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

6. (15 points) Determine whether $\sum \frac{(-1)^n \ln n}{n}$ converges.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

7. (15 points) Determine whether $\left((2n)^{\frac{1}{3n}}\right)$ converges.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

8. (15 points) Find the sum of the series $\displaystyle\sum_{n=2}^{\infty} \frac{2}{n^2 - n}$.

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For

Program Review

Degree Program(s): ____BS____

(BA, BS, BFA, MA, MS, LACC, etc.)

Course # / Title: ____Mth 403 – Senior Projects_____________________

Faculty name: ______Scott Beaver___________________________________

Date: _______6/15/10__________________

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

Modeling Skills - the ability to translate various real-world scenarios into mathematical models.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

B) Check the embedded assessment tool(s) used:

☐ Capstone paper / project

Each of the graduating senior mathematics majors completed a pair of 50-minute public presentations, a presentation at the Academic Excellence Showcase, and a separate presentation at either the Northwest Undergraduate Mathematics Symposium at Oregon State University or at the Pacific Northwest MAA Meeting at Seattle University this spring, and an original, though typically but not necessarily expository paper on an advanced mathematical topic of their choosing. The topics were chosen from one or more advanced national mathematics journals such as the American Mathematical Monthly, College Mathematics, or the Pi Mu Epsilon Journal among others.

The goal in all cases was to gain a deep understanding of an advanced mathematical topic, possibly of graduate level and ensure that the proofs in each article, typically left to the reader (assumed to possess a strong undergraduate or graduate mathematical background) were fully explained and completed without gaps in understanding or presentation. Further exploratory activity was expected and a critical part of this capstone undergraduate research project.

Copies of the videos of recorded talks are available on the UCS M Drive and a bound copy of all of the capstone papers will be available in the Mathematics Department Office by the end of August 2010.

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For

Program Review

Degree Program(s): ____BS____
(BA, BS, BFA, MA, MS, LACC, etc.)

Course # / Title: ____Mth 416 – Complex Analysis____________________

Faculty name: ______Scott Beaver___________________________________

Date: ______6/15/10_________________

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Technological Skills - the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

B) Check the embedded assessment tool(s) used :
- ☐ Exam question

Exam 1

Math 416 - Complex Analysis
Instructor: S. Beaver
April 21, 2010

1. (30 points, 10 each) Sketch carefully the locus of points $z \in \mathbb{C}$ with

   (a) $|z - (3 + 3i)| = 5$

   (b) $|z + 3i| = |z - 3i|$

   (c) $|z^2 - 4z - 3| = 0$

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

2. (10 points) Find two real trigonometric identities from (DeMoivre's Theorem) $e^{in\theta} = \cos n\theta + i \sin n\theta$ for $n = 3$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

3. (20 points; 10 each) Find all solutions of:

   (a) $e^z = 1 + \sqrt{3}i$

   (b) $z^{2-2i} = -3 + \sqrt{3}i$

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

4. (10 points) Find and graph all of the primitive 8^{th} roots of $z = -2 + 2i$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

5. (15 points) Let S_1 be the circle $\{\, z \in \mathbb{C} \mid |z - i| = 1 \,\}$ and f be the mapping $z \mapsto \dfrac{1}{z}$. Find an equation of the image of $S_1 \cap \operatorname{dom} f$ under the mapping f, and sketch both S_1 and $f(S_1 \cap \operatorname{dom} f)$ on the same plane.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

6. (10 points) Define $\sin z := \dfrac{e^{iz} - e^{-iz}}{2i}$, $\cos z := \dfrac{e^{iz} + e^{-iz}}{2}$. Show that $\forall\ z \in \mathbb{C}$,

$$\sin^2 z + \cos^2 z = 1.$$

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

7. (10 points) Show that $f(z) = \bar{z}$ is not differentiable at any point.

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

Exam 2

Math 416 - Complex Analysis
Instructor: S. Beaver
May 19, 2010

1. (25 points) Evaluate $\int_0^{2\pi} \frac{d\,\theta}{1 - 2a\cos\theta + a^2}$, $0 < a < 1$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

2. (15 points) Evaluate $\int_\gamma \frac{z^2}{4 - z^2}\,dz$ where γ is the square whose boundary is $-1 \leq \text{Re } z \leq 1,\ -1 \leq \text{Im } z \leq 1$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

3. (20 points) Derive the polar form of the Cauchy-Riemann equations.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

4. (20 points) Compute $\int_\gamma \frac{dz}{z}$ where γ is the left-hand half of the circle $\{z \mid |z| = 2\}$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

5. (20 points) Suppose that $f(z) = u(x,y) + iv(x,y)$, $z_0 = x_0 + iy_0$, $w_0 = u_0 + iv_0$. Prove that if $(z_n) \to z_0$,

$$\lim_{n\to\infty} (f(z_n)) = w_0 \Rightarrow \lim_{(x_n,y_n) \to (x_0,y_0)} u(x_n, y_n) = u_0.$$

   The proof for v is similar and you need not demonstrate it.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures.

Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

Final Exam

Math 416 - Complex Analysis
Instructor: S. Beaver
June 7, 2010

1. (20 points) Use the Residue Theorem to compute $\int_0^{2\pi} \frac{d\theta}{2+\cos^2\theta}$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

2. (20 points) Evaluate $\int_\gamma \frac{e^z}{z-\pi i}\,dz$ where γ is the circle $\{z \in \mathbb{C} \mid |z| = 4\}$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

3. (20 points) Evaluate $\int_\gamma \frac{e^{z^2}}{(z-i)^3}\,dz$ where γ is the circle $\{z \in \mathbb{C} \mid |z-i| = 1\}$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

4. (20 points) Evaluate $\int_\gamma e^{\frac{5}{z}}\,dz$ where γ is the circle $\{z \in \mathbb{C} \mid |z| = 1\}$.

   Mathematical Knowledge - mastery of a body of mathematics.

   Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

   Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

   Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

5. (20 points) Evaluate $\int_\gamma \frac{1}{z \sin z}\, dz$ where γ is the circle $\{z \in \mathbb{C} \mid |z| = 1\}$.

Mathematical Knowledge - mastery of a body of mathematics.

Problem Solving Skills - the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.

Skilled use of Methods of Proof - the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems - the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

Communication Skills - the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): BS Mathematics

(BA, BS, BFA, MA, MS, LACC, etc.)

Course # / Title: MTH 254/Multivariate Calculus

Faculty name: Hamid Behmard

Date: 6/6/2010

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

Mathematical Knowledge
Problem Solving Skills

B) Check the embedded assessment tool(s) used :

X Exam question
☐ Essay
☐ Oral presentation
☐ Thesis
☐ Portfolios
☐ Practicum / Service Learning
☐ Capstone paper / project
☐ Other ____

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

Please submit a copy of this action report to the LAS dean's office by end of spring term. (Note: It is understood that analysis of the results of the embedded process may not be reviewed until fall term.)

MTH254 **Final** **June 7, 2010**

Print your name: **Behmard**

Show your work for each problem in order to receive credit. Allocate your time wisely.

(10 pts.) 1. (a) Find the parametric equations for the line of intersection of the planes $3x + 2y - z = 7,\ x - 4y + 2z = 0$

(5 pts.) (b) Find the angle between the planes.

(5 pts.) (c) At what point (x_0, y_0, z_0) does this line intersect with the xy-plane?

(10 pts.) 2. Find the position vector of a particle that has the given acceleration and the specified initial velocity and position.

$$\mathbf{a}(t) = t^2\mathbf{i} + e^t\mathbf{j} + \sin(t)\mathbf{k}, \quad \mathbf{v}(0) = \mathbf{j}, \quad \mathbf{r}(0) = \mathbf{i} - \mathbf{k}$$

LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): BS Mathematics

(BA, BS, BFA, MA, MS, LACC, etc.)

Course # / Title: MTH 280/Intro to Proof

Faculty name: Hamid Behmard

Date: 6/7/2010

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

Mathematical Knowledge
Problem Solving Skills
Skilled use of Methods of Proof
Communication Skills

B) Check the embedded assessment tool(s) used :

X Exam question
☐ Essay
☐ Oral presentation
☐ Thesis
☐ Portfolios
☐ Practicum / Service Learning
☐ Capstone paper / project
☐ Other ____

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

Please submit a copy of this action report to the LAS dean's office by end of spring term. (Note: It is understood that analysis of the results of the embedded process may not be reviewed until fall term.)

Name:

MTH280 **Final** **Spring 2010**

- **Write your name before you start the test.**
- The grading will be strict, so be formal, thorough and careful.
- The style of your presentation is a major factor in grading. That means poor solutions will lose points.

Definition 1 *A function f from a set A to a set B is* **one-to-one** *or* **injective** *provided for any a_1 and a_2 in A, if $f(a_1) = f(a_2)$, then $a_1 = a_2$.*

Definition 2 *A function f from a set A to a set B is* **onto** *or* **surjective** *provided for every element b in the set B, there is an element a in the set A such that $f(a) = b$.*

Definition 3 *For any $x, y \in \mathbb{Z}$, $x|y$ provided there exists $k \in \mathbb{Z}$ such that $y = kx$.*

(20 pts.) 1. Prove: Suppose $a, b, c \in \mathbb{Z}$. If $a|b$ and $a|c$, then $a|(2b + 80c)$.

(20 pts.) 2. Define $p : \mathbb{R} \to \mathbb{R}$ by $p(t) = t - 1.5$. Prove p is bijective.

(20 pts.) 3. Let $C = \{m \in \mathbb{R} : m = w^2 + 1 \text{ for some } w \in \mathbb{R}\}$ and $G = \{k \in \mathbb{R} : k \geq 2\}$. Prove $G \subseteq C$.

(20 pts.) 4. Prove that for all $n \in \mathbb{Z}^+, 1 + 2 + 3 + \cdots + n = n(n + 1)/2$.

(6 pts.) 5. (a) Use negation of the definition to complete the following. $f : A \to B$ is *not* injective means . . .

(6 pts.) (b) Use negation of the definition to complete the following. $f : A \to B$ is *not* surjective means . . .

(2 pts. each) 6. Circle TRUE or FALSE. Be very careful.

(a) For every $x \in \mathbb{R}$, if $x^2 \geq x$, then $x \geq 1$.	TRUE	FALSE
(b) For every $t \in \mathbb{Z}$, there exists a $u \in \mathbb{Z}$ such that $t = u^3 + 1$.	TRUE	FALSE
(c) Suppose n is a positive integer. $3^n - 1$ is not prime.	TRUE	FALSE
(d) If $a, b \in \mathbb{R}$, then $a/b \in \mathbb{R}$.	TRUE	FALSE

LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): BS Mathematics

(BA, BS, BFA, MA, MS, LACC, etc.)

Course # / Title: MTH 351/Introductory Numerical Analysis

Faculty name: Hamid Behmard

Date: 6/7/2010

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

Mathematical Knowledge
Problem Solving Skills
Modeling Skills
Technological Skills
Subject Awareness

B) Check the embedded assessment tool(s) used :

X Exam question
☐ Essay
☐ Oral presentation
☐ Thesis
☐ Portfolios
☐ Practicum / Service Learning
☐ Capstone paper / project
☐ Other ____

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

Please submit a copy of this action report to the LAS dean's office by end of spring term. (Note: It is understood that analysis of the results of the embedded process may not be reviewed until fall term.)

Introduction to Numerical Analysis (MTH 351)
Midterm II due 24 hours from the time of its reception

This is a take home exam consisting of five problems each worth 20 points. You may only consult your textbook or your notes. Please **do not** consult with each other, other resources, or any of the faculties of WOU or any other university. Violation of this request will be considered academic dishonesty.

1. What is the order of convergence of the iteration

$$x_{n+1} = \frac{x_n(x_n^2 + 3a)}{3x_n^2 + a}$$

   as it converges to the fixed point $\alpha = \sqrt{a}$.

2. Solve problems 15 on page 134, 7 on page 201, 13 on page 217, and 16 on page 218 from our textbook.

MATHEMATICS 495-595 / COURSE PURPOSE

This course is designed for students planning to be middle school teachers and for in-service K-8 teachers seeking a mathematics endorsement. The course's learning objectives are:

- Build upon and expand understanding of algebra and how its ideas can be expanded and developed into higher mathematical analysis (calculus)
- Explore the foundational calculus concepts of differentiation and integration, examples of their applications and the relationship between these two processes
- Apply visual and hands-on methods, integrated with the use of a graphing calculator
- Develop teaching and learning insights through weekly assignments and explorations

By the end of Mathematics 495/595, students should be proficient in each of the following TSPC (Teacher's Standards and Practices Commission) competencies recommended for elementary and middle school teachers.

Algebra and Functions

- Candidates explore and analyze patterns and functions, and describe, extend, create, and make generalizations about geometric and numeric patterns.
- Candidates employ concepts of equality and relational thinking to solve problems, and utilize algebraic notation to represent calculation.
- Candidates use verbal, pictorial, tabular, symbolic, and graphic representations to emphasize relationships among quantities.

Geometry

- Candidates understand length, area, and volume: see rectangles as arrays of squares, rectangular solids as arrays of cubes; recognize the behavior of measure (length, area, and volume) under uniform dilations; devise area formulas for basic shapes; understand the independence of perimeter and area, of surface area and volume.

Problem Solving

- Candidates engage in mathematical inquiry through understanding a problem, exploring, conjecturing, experimenting, and justifying.
- Candidates develop and evaluate mathematical arguments (i.e., informal proofs), and the foundations on which arguments are built.

Communication

- Candidates organize and consolidate their mathematical thinking through communication.
- Candidates communicate coherently and use the language of mathematics (symbols and terminology) to express ideas precisely.
- Candidates analyze the mathematical thinking of others.

Connections

- Candidates understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- Candidates recognize and apply mathematics in contexts outside of mathematics.

LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): BA/BS Education

Course # / Title: MTH 495 Calculus for Middle School Teachers

Faculty name: Klay Kruczek

Date: 17 June 2010

A) State the program **(extended) learning outcome** or **general education goal** this assessment is linked to:

1. Problem Solving - the ability to understand complicated situations, which are applications of K-8 mathematical topics and to apply learned skills and techniques to resolve them.
2. Ability to Model Problems - the ability to translate various real-world scenarios into mathematical models that can be explored by hands-on models, paper-and-pencil methods and technological applications where appropriate.
3. Communication Skills - Ability to precisely articulate (both in writing and orally) K - 8 mathematical topics in a way that is clear and understandable to elementary and middle school students.

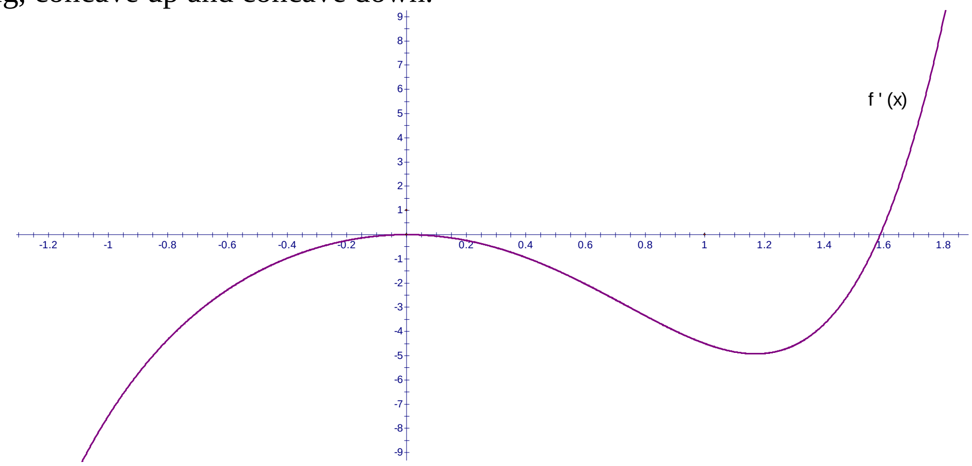
B) Check the embedded assessment tool(s) used :

X Exam question
☐ Essay
☐ Oral presentation
☐ Thesis
☐ Portfolios
☐ Practicum / Service Learning
☐ Capstone paper / project
☐ Other

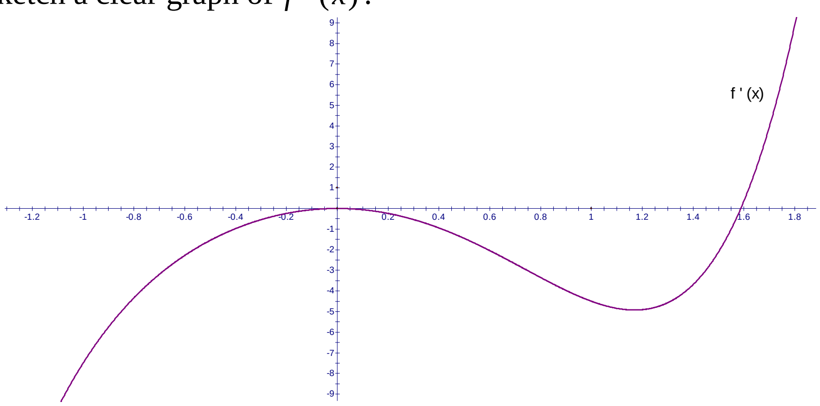
Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

Selected questions from the final exam for MTH 495.

1. Graphing (5 points each)
   a. This is $f'(x)$, given that $f(0)=2$, sketch a clear graph of $f(x)$. Mark where $f(x)$ is increasing, decreasing, concave up and concave down.



   b. This is $f'(x)$, sketch a clear graph of $f''(x)$.



RESULTS: 7/10 fully met outcomes by scoring at least 80%; 1/10 partially met the outcomes by scoring 70-79%

2. Suppose you wish to construct a rectangular box made of metal. The base is square, there is no top, and the volume of the container must be 72 cubic meters. Suppose the material for the sides costs $3 per square meter, and the material for base costs $2 per square meter. Let x be the length of a side of the square base (in meters).
   a. What is the domain and range of the cost function?
   b. Use calculus to find the least cost container, show your work for setting up your function, check your cost is the least cost using the second derivative (explain) and give a sketch with labeled dimensions and cost of the least cost box.

RESULTS: 5/10 fully met outcomes by scoring at least 80%; 1/10 partially met the outcomes by scoring 70-79%

(5 points each) A bug, located at (0, 1) starts scurrying away from the origin of a large set of axes painted on a patio. The function $v(t) = t^3 + 3t + 5$ inches/minute, describes the velocity of a bug at t minutes. Include units throughout your answers.

a. Find the distance from the origin the bug traveled from $t = 2$ to $t = 6$ minutes.
b. What is the acceleration of the bug at $t = 2$ minutes?
c. What is the distance traveled function (from the origin) for the bug?
d. Describe the bug’s behavior; is the bug walking back and forth or always moving away from the origin? Is the bug speeding up, slowing down or …?

RESULTS: 8/10 fully met outcomes by scoring at least 80%

LAS Embedded Assessment Action Report For *Program Review*

Degree Program(s): Mathematics Support for EC/ELEM, ELEM/MS Education majors

(**BA, BS,** BFA, MA, MS, LACC, etc.)

Course # / Title: Math 212 / Mathematics for Elementary Teachers II

Faculty name: Mathematics: C. Beaver; Burton

Date: Spring Term 2010

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

Students will demonstrate:
Problem Solving and Problem Writing Skills - the ability to create and understand complicated situations, which are applications of K-8 mathematical topics and to apply learned skills and techniques to resolve them.

Ability to Model Problems – the ability to translate various real–world scenarios into mathematical models that can be explored by hands-on models, paper-and-pencil methods and technological applications where appropriate.

Communication Skills - Ability to precisely articulate (both in writing and orally) K – 8 mathematical topics in a way that is clear and understandable to elementary and middle school students.

B) Check the embedded assessment tool(s) used :

- ☐ Exam question
- ☐ Essay
- ☐ Oral presentation
- ☐ Thesis
- ☐ Portfolios
- ☐ Practicum / Service Learning
- ☐ Capstone paper / project
- x☐ Other _Problem of the Week____

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

Please submit a copy of this action report to the LAS dean's office.

Name: ______________________

Math 212 POW One

FORMAT

- Write neatly and clearly on white paper (lined or unlined)
- Attach a POW cover sheet to the front of your work for turn in

Before starting your problem solving process:

✓ Refer to your POW directions (linked to your Math 212 home page)

✓ Read **all** of the directions given here

1. Use Polya's four-step problem solving process throughout. Clearly mark each of the four steps. You may combine the following into one problem. You do not have to distinguish the parts a – e.

   a. **Bennett, Burton and Nelson: Puzzler §5.2**
   After a cake has been cut into three equal pieces, as shown here, a hostess discovers that four people each want an equal share of the cake. How can she make <u>one more straight cut</u> so that each of the FOUR people gets the same amount of cake? Note: The WHOLE cake needs to be eaten.

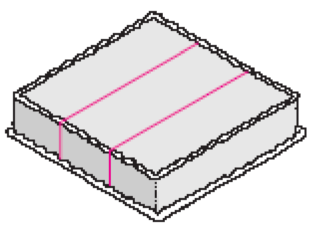


Figure 1

   Using the same problem setup (cake initially cut as in Figure 1) for parts b – e:

   b. Suppose now that FIVE people want to equally share the cake. Can the hostess still make 1 straight cut? If not what is the least amount of cuts that she needs to make? Hint: four cuts are too many!

   c. Suppose now that SIX people want to equally share the cake. Can the hostess still make 1 straight cut? If not what is the least amount of cuts that she needs to make? Hint: five cuts are too many!

   d. Suppose now that *n* people want to equally share the cake where n is a multiple of 3, i.e. n = 3, 6, 9, 12, … Can the hostess still make 1 straight cut? If not what is the least amount of cuts that she needs to make?

   e. Suppose now that *n* people want to equally share the cake where n is **not** a multiple of 3; i.e., n = 7, 8, 10, 11, … Can the hostess still make 1 straight cut? If not what is the least amount of cuts that she needs to make?

LAS Embedded Assessment Action Report For *Program Review*

Degree Program(s): Mathematics Support for EC/ELEM, ELEM/MS Education majors

(**BA, BS,** BFA, MA, MS, LACC, etc.)

Course # / Title: Math 213 / Mathematics for Elementary Teachers III

Faculty name: Mathematics: Burton

Date: Spring Term 2010

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

Students will demonstrate:
Problem Solving and Problem Writing Skills - the ability to create and understand complicated situations, which are applications of K-8 mathematical topics and to apply learned skills and techniques to resolve them.

Ability to Model Problems – the ability to translate various real–world scenarios into mathematical models that can be explored by hands-on models, paper-and-pencil methods and technological applications where appropriate.

Communication Skills - Ability to precisely articulate (both in writing and orally) K – 8 mathematical topics in a way that is clear and understandable to elementary and middle school students.

Effective Classroom Management - Appreciation of a variety of pedagogical approaches and knowledge of an assortment of presentation and classroom working environments to effectively support the learning of mathematics for students with diverse learning styles.

B) Check the embedded assessment tool(s) used :

- X☐ Exam question
- X☐ Essay /IN TERMS OF PROBLEM AND LESSON WRITING
- X☐ Oral presentation/ IN TERMS OF SHARING WORK IN FRONT OF CLASS AND LESSON PLAN PRESENTATIONS
- ☐ Thesis
- ☐ Portfolios
- ☐ Practicum / Service Learning
- ☐ Capstone paper / project
- ☐ Other ____

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

Please submit a copy of this action report to the LAS dean's office.

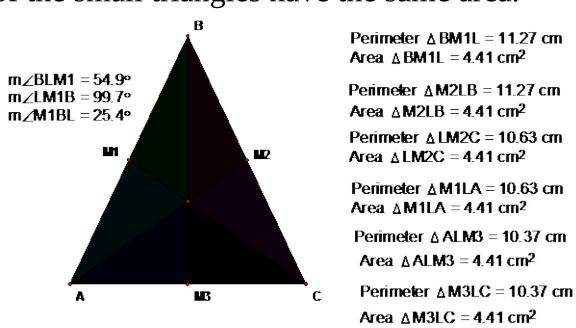
Math 213; class presentation assessment task
Scavenger Hunt
You will draw a topic the first week of class; your task is to find two references to this topic in two different mathematics textbooks for children. Bring copies class to share. Towards the beginning of class you will be asked to share what you have found with the class—you will be asked to project up the pages and briefly discuss how they relate to the topic and to our class

Math 213; problem solving assessment task, integrating technology

Geometer's Sketchpad Question
1a. A kite is a quadrilateral with two non overlapping pairs of adjacent sides that are congruent. There is an interesting relationship between the AREA of a kite and the PRODUCT of the lengths of its two DIAGONALS.

QUESTION & DIRECTIONS
For isosceles triangle ABC
i. Will any of the six small triangles be congruent regardless of how triangle ABC is moved and transformed?
ii. Will any of the perimeters of the six small triangles be equal regardless of how triangle ABC is moved and transformed?
iii. Will any of the areas of the six small triangles be equal regardless of how triangle ABC is moved and transformed?
Support your solution using at least TWO different ISOSCELES triangle / measurement sets. Copy triangle ABC to create a second set.

Sample Student Response (image and measurements cut and pasted from student gsp file)
i. Triangle BM1L and Triangle M2LB are congruent. Triangle LM2C and Triangle M1LA are congruent. Triangle ALM3 and Triangle M3LC are congruent.
ii.Triangle BM1L and Triangle M2LB have the same perimeter. Triangle LM2C and Triangle M1LA also. Triangle ALM3 and Triangle M3LC aswell.
iii. All of the small triangles have the same area.



LAS
Embedded Assessment Action Report Explanation
Michael Ward, Mathematics

Internally, the Mathematics Department uses a set of eight Extended Learning Outcomes instead of the edited set of three outcomes created for consistency in the Catalog. Our embedded assessment references our Extended Outcomes.

LEARNING OUTCOMES

1. Develop problem solving, modeling and technological skills.
2. Demonstrate ability to make rigorous mathematical arguments, work with axiomatic systems, and precisely articulate (both in writing and orally) complicated and technical arguments
(both mathematical and logical).
3. Understand the distinction between applied and theoretical mathematics, the connection between the two fields, and the breadth of each field.

EXTENDED LEARNING OUTCOMES FOR MAJORS AND MINORS

Students will demonstrate:

1. Mathematical Knowledge—demonstrate mastery of a body of mathematics
2. Problem Solving Skills – the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.
3. Modeling Skills – the ability to translate various real-world scenarios into mathematical models.
4. Technological Skills – the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.
5. Skilled use of Methods of Proof – the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems – the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.
6. Communication Skills – the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.
7. Subject Awareness – an awareness of the distinction between applied and theoretical mathematics, an appreciation of the connection between the two fields, and a reasonable perception of the breadth of each field.
8. Career Awareness – an awareness of the career and educational opportunities for mathematics majors; this many include internship and undergraduate research experiences.

LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): BA/BS Mathematics

Course # / Title: MTH 251 Calculus I

Faculty name: Michael Ward

Date: 16 June 2010

A) State the program **(extended) learning outcome** or **general education goal** this assessment is linked to:

(MK) Mathematical Knowledge – demonstrate mastery of a body of mathematics

(TS) Technological Skills – the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.

(CS) Communication Skills – the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

B) Check the embedded assessment tool(s) used :

- X Exam questions MK, TS
- X Essay MK, CS
- ☐ Oral presentation
- ☐ Thesis
- ☐ Portfolios
- ☐ Practicum / Service Learning
- ☐ Capstone paper / project
- ☐ Other ____

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

MTH 251 Maple Final Exam Problems Spring 2010

When the rest of the exam is written, the point values here may need to be scaled so that this portion of the exam is not disproportionately high.

1. (6 pts) Find the derivatives of the following functions using Differentiation Tutor to apply one rule at a time. Record a list of each rule as you use it in the order that you used it on . Submit the list. (I wonder if there is a way to have Maple keep track of the list. Extra Credit for finding a way.)

1a. $\frac{e^x}{1+x}$ Derivative (EXACTLY as produced by Maple) ______________________________

Rules used, in order:

1b. $2x\sqrt{x^2+1}$ Derivative (EXACTLY as produced by Maple) ________________________

Rules used, in order:

2. (6 pts. (This problem is adapted from a worksheet by Klay Kruczek.)

2a. Find the first, second, third, fourth, fifth and sixth derivatives of f(x)=cos x (by hand or with Maple).

2b. You should notice a pattern.

Using the pattern explain how to quickly predict the nth derivative of f(x) = cos x.

According to your explanation, the 103rd derivative is ____________________

According to Maple, the 103rd derivative is

2c. Suppose g(x)=x sin x (using Maple). Use Maple to calculate the following. Write the answer in the blanks.
The fourth derivative of g. ____________________________________
The eighth derivative of g. ____________________________________
The twelfth derivative of g. ____________________________________
The sixteenth derivative of g. ____________________________________
The twentieth derivative of g. ____________________________________
The twenty fourth derivative of g. ____________________________________

2d. Based on the above examples, conjecture a general formula for the 4k[th] derivative of g (where k is any positive integer):

____

4. (2 pts.) Enter the following (without making *any* changes) and explain the output.

$diff(t^3 + 3t + 1, x)$

Output ____

Explanation:

5. (6 pts.) According to the book, the frequency f of a vibrating violin string is given by $f = \frac{1}{2L}\sqrt{\frac{T}{\rho}}$ where L is the length of the string, T is its tension, and ρ is its linear density. Use Maple to find the rate of change of frequency with respect to

a. the length L (when T and ρ are constant)
b. the linear density ρ (when L and T are constant)

Simplify the answers with Maple. Write the initial unsimplified answer exaclty as produced by Maple and then the simplified answer below.

5a. Unsimplified: Simplified:

5b. Unsimplified: Simplified:

c. According to 5a, the frequency (circle the correct answer) INCREASES DECREASES as the length increases. WHY?

RESULTS: 14/27 fully met outcomes MK, TS by scoring at least 80%; 4/27 partially met the outcomes by scoring 70-79%; 2/27 did not take this portion of the final exam.

ADDITIONAL RESULTS: Every problem (with the exception of a couple of small bonus problems) on the final exam measured outcome MK. 7/28 fully met outcome MK by scoring at lest 80%; 9/27 partially met the outcome by scoring at least 68%.

MTH 251 **Test 2: Essay** **Spring 2010**

Essay Due: Thursday, 20 May 2010, 2PM (earlier submissions are welcomed)

1. One of the following topics will be assigned to you at random. Each addresses a foundational idea in MTH 251.

   - Explain, from a graphical point of view, why the slope of the tangent line to the graph of a function g at the point corresponding to input a is $\lim_{h \to 0} \frac{g(a+h) - g(a)}{h}$, assuming the graph has a tangent line at input a. Audience: A student who knows about limits, but knows nothing more about calculus.
   - Explain, from a graphical point of view, why the slope of the tangent line to the graph of a function g at the point corresponding to input a is $\lim_{x \to a} \frac{g(x) - g(a)}{x - a}$, assuming the graph has a tangent line at input a. Audience: A student who knows about limits, but knows nothing more about calculus.
   - Explain, from a physical point of view, why the instantaneous rate of change of a function g at input a is $\lim_{h \to 0} \frac{g(a+h) - g(a)}{h}$ and why the units are (units of output)/(unit of input).
   - Explain, from a physical point of view, why the instantaneous rate of change of a function g at input a is $\lim_{x \to a} \frac{g(x) - g(a)}{x - a}$ and why the units are (units of output)/(unit of input).

2. Write an essay on your topic.

   Essay checklist

   - ☐ Essay is directed at the specified audience.
   - ☐ The writing is low-context. That means it is not directed to someone, like the professor, who already knows the material and wants you to write a few lines to indicate you know approximately what is going on. Imagine you are writing a textbook.
   - ☐ The emphasis should be on *why* things are as they are and not just *what* they are or what to do.
   - ☐ The essay includes informative graphs.
   - ☐ Essay includes an example or sample problem along with a general discussion.
   - ☐ Proper grammar, spelling, sentence structure, paragraphing are used.
   - ☐ Essay is in your own words and style, not those from the text or from lecture or from the web.
   - ☐ Attach this sheet to your essay.

3. You are encouraged to bring a draft of your essay to office hours for feedback. Experience shows that a complete essay is unlikely without consultation.

4. I hesitate to say anything about length, but 1 - 2 pages should be enough.

5. The essay may be typed, handwritten (very legibly!), or a combination of the two.

OVER ↪

6. Collaboration: None allowed. You may use your text and your notes, but no other source of any kind, including the Web. You may not have any person help you except the instructor (or a consultant at the writing center). Violation of these rules is academic dishonesty and makes one subject to the applicable procedures and penalties.

7. The score will be based on the following guide. Ten points are possible on this essay. Pay close attention to the descriptors e.g. a "partially complete" essay earns 6/10 points.

12	enhanced and correct (2 bonus "quality points")
10	thoroughly developed and correct
8	complete and correct (with perhaps a very small error)
6	partially complete or partially effective or partially right
4	underdeveloped, sketchy or wrong
2	ineffective, minimal or wrong
0	missing

RESULTS: 10/29 fully met outcomes MK, CS by scoring 8 or 10; 5/29 partially met the outcomes by scoring 6; 9/29 did not meet the outcomes; 5/29 did not write the essay.

LAS
Embedded Assessment Action Report Explanation
Michael Ward, Mathematics

Internally, the Mathematics Department uses a set of eight Extended Learning Outcomes instead of the edited set of three outcomes created for consistency in the Catalog. Our embedded assessment references our Extended Outcomes.

LEARNING OUTCOMES

1. Develop problem solving, modeling and technological skills.
2. Demonstrate ability to make rigorous mathematical arguments, work with axiomatic systems, and precisely articulate (both in writing and orally) complicated and technical arguments (both mathematical and logical).
3. Understand the distinction between applied and theoretical mathematics, the connection between the two fields, and the breadth of each field.

EXTENDED LEARNING OUTCOMES FOR MAJORS AND MINORS

Students will demonstrate:

1. Mathematical Knowledge—demonstrate mastery of a body of mathematics
2. Problem Solving Skills – the ability to analyze complicated problems in a variety of subject areas, and to synthesize solutions to such problems.
3. Modeling Skills – the ability to translate various real-world scenarios into mathematical models.
4. Technological Skills – the ability to properly determine and effectively use computing tools and other technologies to solve problems and support conjectures.
5. Skilled use of Methods of Proof – the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems – the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.
6. Communication Skills – the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.
7. Subject Awareness – an awareness of the distinction between applied and theoretical mathematics, an appreciation of the connection between the two fields, and a reasonable perception of the breadth of each field.
8. Career Awareness – an awareness of the career and educational opportunities for mathematics majors; this many include internship and undergraduate research experiences.

LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): BA/BS Mathematics (& some sciences)

Course # / Title: MTH 345 Ring Theory

Faculty name: Michael Ward

Date: 16 June 2010

A) State the program **(extended) learning outcome** or **general education goal** this assessment is linked to:

(MK) Mathematical Knowledge – demonstrate mastery of a body of mathematics

(MP) Skilled use of Methods of Proof – the ability to make rigorous mathematical arguments including how to both prove and disprove conjectures. Including working with axiomatic systems – the ability to determine if given examples satisfy the given axioms and the ability to demonstrate logical consequences of those axioms.

(CS) Communication Skills – the ability to precisely articulate (both in writing and orally) complicated and technical arguments. These can be both mathematical and logical.

B) Check the embedded assessment tool(s) used :

- ☐ Exam question
- ☐ Essay
- X Oral presentation MP, CS
- ☐ Thesis
- ☐ Portfolios
- ☐ Practicum / Service Learning
- ☐ Capstone paper / project
- X Other “Capstone” homework exercise MK, MP, CS

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

These Mini-projects are to be presented in class. A rubric for assessment, compliments of S. Beaver, is on the back.

Schedule a meeting with Mike no later than three calendar days before your presentation to show what you plan to do. Through a dress-rehearsal, check the timing of your presentation before the meeting.

At the final exam, each person will draw one of these theorems, other than one s/he presented, to prove.

Topic	Team	Date
Thm. 15.3 First Isomorphism Thm	David, Aaron	May 13
2nd and 3rd Isomorphism Thms. = problems 3,4 6e p. 339, 7e p. 341	Nick, Jesse	May 14
Thms. 14.3 and 14.4	Richard, Chris	May 20
Thm. 17.5, Corollaries 1 & 2, Example 10 (& 11 if time) 6e pp. 309 - 312, 7e pp. 311-313	Kady, Rosemary	May 28
Geometric Constructions (see M. Ward soon for details)	Tim, David	June 2

Presentation Scoring Guide and Rubric

Evaluation Criteria / Score	4	3	2	1	0	Weight	Possible points
Introduction - Effectiveness of your brief initial discussion of the content, scope, and flow of your presentation	Your introduction makes perfectly clear the salient points and scope of your talk	A bit too brief or missing an important item	Contains some relevant information but not nearly enough	Poorly worded or confusing introduction	No introduction	2	8
Logical Clarity - Your effectiveness in presenting your ideas without (uncorrected) logical flaws	No logical errors	One or two logical errors	Three logical errors	Four logical errors	Five or more logical errors	3	12
Subject Knowledge - Your ability to handle questions	You answer 90% or more of the questions fully and with appropriate elaboration	Your answer to 70%-90% of the questions was sufficient	Your answer to 40%-69% of the questions was sufficient	Your answer to 10%-39% of the questions was sufficient	Your answer to less than 10% of the questions was sufficient	4	16
Temporal Organization - To what degree your talk proceeded without jumping around between ideas, or filling in a detail which should have been provided earlier	All ideas presented in a logical, clear sequence	One unanticipated jump between ideas or filled-in missing detail	Two or three unanticipated jumps between ideas or filled-in missing details	Four or five unanticipated jumps between ideas or filled-in missing details	Six or more unanticipated jumps between ideas or filled-in missing details	3	12
Spatial Organization - Your blackboard technique and neatness; note that slides minimize your chances of scoring poorly here	Excellent use of space, obvious boundaries between ideas, clear and legible handwriting	One or two instances of cramming, poor handwriting, or unclear boundaries	Three or four instances of cramming, poor handwriting, or unclear boundaries	Five instances of cramming, poor handwriting, or unclear boundaries	More than five instances of cramming, poor handwriting, or unclear boundaries	3	12
Relative Pace - The appropriateness of the pace of your talk for yor audience	Ideal pace for the class, you pause when appropriate	Infrequent inappropriate pace, but you still check your audience frequently for apparent grasp	Several instances of inappropriate pace, but you still check your audience several times	Only a few instances of appropriate pace	Consistently too fast or too slow	2	8
Delivery / Eye Contact - How well you interacted with your audience	You speak to the audience, you almost never check your notes, and you spoke clearly	Good eye contact, but you return to your notes occasionally, or occasionally speak too quietly	Fair eye contact with your audience, but frequently return to your notes or speak too quietly	You are usually reading from your notes or speaking too quietly	No eye contact to speak of, or you're presentation was very difficult to hear	3	12
Mechanics - Spelling, grammar, punctuation, etc.	No errors	One or two errors	Three or four errors	Four or five errors	More than five errors	1	4
Creativity / Paraphrasing - The degree to which your talk was presented in your own style	Obviously you owned the presentation	Well-paraphrased with a few unnecessary exceptions	Some creativity, but you seem quite bound to the source material	Little creativity or paraphrasing	Presentation recited from the source material	2	8
Graphics - The relevance and clarity of your graphics (if you used, or should have used, any)	Graphics are clear, presented at appropriate times, and each reinforces or explains an idea in your talk	Good graphics, but some room for improvement in clarity, neatness, or relevance	Significant room for improvement	Poorly presented or some missing graphics	Confusing graphics, or no graphics when there should have been	2	8
						25	100

RESULTS: 8/8 students fully met the outcome MP, CS by scoring 87% or higher.

Collaboration Ban in effect for items 3 and 5. Collaboration allowed on the other items.

1. Study the theorems in this chapter.
2. Computations: 6e problems 2, 11, 30; 7e problems 2, 11, 32

   Problem 2 may be rephrased as "In $\mathbb{Z}_3[x]$, show $\widehat{x^4+x} = \widehat{x^2+x}$."
3. Theory:
   (a) 6e problems 7, 17, 19, 20; 7e problems 7, 17, 20, 21
   (b) Give a counterexample to the Degree Rule when the hypothesis that D is an integral domain is dropped.
4. (a) Assume K is a field and F is a subfield of K. Further assume that σ is an automorphism of K with the property that $\sigma(r) = r$ for every $r \in F$. Prove for every $f(x) \in F[x](\subseteq K[x])$, if $z \in K$ is a zero/root of $f(x)$, then $\sigma(z)$ is also a zero/root of $f(x)$.
   (b) Using Chapter 6, 6e problem 23, 7e problem 25 (proved last term), prove the "well-known" theorem that for every $g(x) \in \mathbb{R}[x]$, if $a + bi$ with $a, b \in \mathbb{R}$ is a zero/root of $g(x)$, then $a - bi$ is also a zero/root of $g(x)$.
5. Use the First Isomorphism Theorem to prove
   - $\mathbb{R}[x]/\langle x^2+1\rangle$ is isomorphic to $\mathbb{C}$, if the last digit of your V-number is even.
   - $\mathbb{Q}[x]/\langle x^2-2\rangle$ is isomorphic to $\mathbb{Q}[\sqrt{2}]$ (i.e. 6e problem 40; 7e problem 42), if the last digit of your V-number is odd.

Assessment notes: Problems 3 and 5 quite thoroughly address (extended) learning outcome MK, MP, CS.

Scoring Guide

6	enhanced and correct
5	thoroughly developed and correct
4	complete and correct (with perhaps a very small error)
3	partially complete or partially effective or partially right
2	underdeveloped, sketchy or wrong
1	ineffective, minimal or wrong
0	missing

Resist the temptation to translate those numbers into grades! 3 does not mean C. It means what it says, nothing more nor less.

RESULTS: Problem 5 2/8 fully met outcomes MK, MP, CS by scoring 4 or 5; 2/8 partially met the outcomes by scoring 3; 1/8 did not meet the outcomes; 3/8 did not complete the assignment (two were overwhelmed by their senior projects).

Problem 3 #7 6/8 fully met outcomes MK, MP, CS by scoring 4 or 5; 1/8 did not meet the outcomes; 1/8 did not do the assignment. #17 4/8 fully met the outcomes; 3/8 did not; 1/8 did not do the assignment. #19 & 21 (or 20 & 21). 5/8 fully met; 2/8 not met; 1/8 did not do the assignment.

LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): ______BS/BA (Mathematics Major/Minor Course)______________

(BA, BS, BFA, MA, MS, LACC, etc.)

Course # / Title: ______Mathematical Statistics ________________________________

Faculty name: _____Cheryl Beaver____

Date: ______June 10, 2010________________________

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

- ♦ Mathematical Knowledge – mastery of a body of mathematics.
- ♦ Develop problem solving, modeling and technological skills.
- ♦ Understand the distinction between applied and theoretical mathematics, the connection between the two fields, and the breadth of each field.
- ♦ Modeling Skills – the ability to translate various real-world scenarios into mathematical models.

B) Check the embedded assessment tool(s) used :

X Exam question
☐ Essay
☐ Oral presentation
☐ Thesis
☐ Portfolios
☐ Practicum / Service Learning
☐ Capstone paper / project
X Other Project (non-capstone)______________________________________

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.
Please submit a copy of this action report to the LAS dean's office.

Exam Questions

1. A sociologist interviews families where the husband and wife, early in their marriage, decide to keep having children until they had their first girl (then stop). (All 100 couples did eventually have a girl.) Assume the probability that any given child is a girl is 0.5. The results were as follows: 55 families had 1 child; 34 families had 2; 5 families had 3; 2 families had 4; 4 families had 4 and 3 families had 6 or more. Do a Chi-Square goodness of fit test to see whether the distribution can be adequately described by a geometric p.m.f. Use $\alpha = 0.05$ and group the families with 5 or more children.

2. Assume that the number of doughnuts eaten by students during a statistics class has a normal distribution with $\mu = 1.5$ and $\sigma^2 = 1.25$. How many doughnuts should the teacher bring so that the probability of running out of doughnuts is less than 10% in a class of 18 students.

3. A study analyzing gas prices in urban versus rural locations of Western Oregon was performed. Let X denote the price of a gallon of regular gas at an urban gas station in Western Oregon and let Y denote the price of a gallon of regular gas at a rural gas station in Western Oregon. Assume that

   X is $N(\mu_X, 0.0225)$ and Y is $N(\mu_Y, 0.0441)$. The researchers wished to test the null hypothesis:

   $H0 : \mu_X = \mu_Y$

   against the alternative hypothesis

   $H1 : \mu_X > \mu_Y$

   using a confidence level of _ = 0.05.

   (a) In a random sample of $n = 30$ urban gas stations, they found $x = 3.01$, and in a random sample
   of $m = 42$ rural gas stations, $y = 2.89$ What is the conclusion of the test?

   (b) What is the p-value of the test? Does this support the answer you found in (a)? Explain.

   (c) Find a one-sided 95% confidence interval giving a lower bound for $\mu X - \mu Y$. Does the confidence interval support the conclusion of the hypothesis test in (a)? Explain.

4. It has been said that a majority of people living in Roswell, New Mexico, believe that we have been visited by extraterrestrial life. In a random sample of $n = 120$ residents of Roswell, a confidence interval for p, the true proportion of people in Roswell, NM that believe we have been visited by extraterrestrial life, was given to be (0.526, 0.674).

   (a) What is the level of confidence in this interval?

   (b) How many of the 120 residents of Roswell that were asked answered that they did believe we have been visited by extraterrestrial life?

   (c) If the researchers wish to do another survey to confirm these results, how many people should they include in their sample to get a 98% confidence interval with error of no more than $\varepsilon = \pm 0.05$.?

Statistics Project

Math 366 Project
Spring 2010

You may work by yourself or with a partner.

Project Part 1:

1. Choose a question you'd like answered or a hypothesis you want tested. Make it relevant to you. Try to guess the distribution and identify the parameters you are looking for.
2. Determine your target population
3. Determine your method for gathering samples (you will need at least 25 samples)
   - ♦ Try to identify any bias or confounding variables (if applicable) in your study and indicate how you will address these
   - ♦ Will your sample accurately represent your target population? If not, either modify your sampling method or better identify your population.

(Informal) Presentation 1:

Wednesday May 5: Present your proposed question to the class. Type or neatly write answers to the following (you will turn it in). This will be a short (few minutes each) informal verbal presentation introducing your topic. You can just project your answers on the document camera.

Question:

Expected distribution:

Parameters to estimate:

Targeted Population:

Method for gathering data:

Possible Biases or Confounding variables and ways you will address them:

Project Part 2:

4. Gather your data (at least 25 data points).
5. Display your data in a graph that best illustrates your results.
6. Estimate your answer/parameters giving a confidence interval for your results or the outcome of a hypothesis test (you'll know how to do this by then).
7. Interpret your results as fully as possible.
8. Propose ways your study could have been improved.
9. Neatly write or type up these results and turn in on the day of your presentation.

Presentation 2:

Wed/Fri May 26/28: Present your results to the class. Presentation will be about 5 minutes. Use document camera to show graphs and other results.

LAS Embedded Assessment Action Report For *Program Review*

Degree Program(s): Mathematics Support for EC/ELEM, ELEM/MS Education majors

(**BA, BS,** BFA, MA, MS, LACC, etc.)

Course # / Title: Math 39 / Integrated Methods

Faculty name: Mathematics: Burton

Date: Spring Term 2010

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

- Improve mathematics content knowledge and problem solving skills by building upon and extending knowledge acquired in other mathematics education classes
- Acquire and expand ideas of approaching most of the strands of the K-8 mathematics curriculum
- Gain experience in creating and modifying lesson plans and longer units
- Reflect on effective methods for the elementary and middle school classroom

B) Check the embedded assessment tool(s) used :

☐ Exam question
☐ Essay
X ☐ Oral presentation/Throughout the term students designed, planned and presented lessons to the other students in the class.
☐ Thesis
☐ Portfolios
☐ Practicum / Service Learning
X☐ Capstone paper / project
Presentations at AES 2010

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.

Please submit a copy of this action report to the LAS dean's office.

Students in this class presented seven different projects in AES 2010. The following are their titles, abstracts and some photos. The students did an outstanding job. They were practiced, prepared and frankly smooth speakers. Their sessions were well attended and the audiences were happy to participate in the lessons and presentations. The session was an absolute success and a credit to these hard working students.

Pizzeria Proportions
Students will discover that one hundred percent doesn't necessary require one hundred parts to make a whole. By choosing their favorite pizza toppings students will begin their journey on this fun and delicious introduction to percentages. Through numerous pizza related activities students explore the relationships between fractions, decimals, and percents.

Penguins and Proportions
Animal ecologists have traveled across Antarctica tagging various penguins in order to determine the population of penguins across the continent. We are going to inform fourth graders of this method and teach them a technique in order to determine how many of the penguins were marked in order to collect this data. Using a cup of marked and unmarked beans, students will determine the population of marked penguins on an imaginary continent. The students will do this by taking various samples of differing amounts of beans and creating ratios to solve this perplexing problem.

Mathematics at the Mall
A new skill of converting proportions into percentages will be learned through an activity called "Mathematics at the Mall". Students will create their own store on grid paper, complete with percents of the store going to different sections of merchandise. The stores will be compiled into the "Mall of Mathematics". While engaging in this exciting activity, students will explore the concepts of where they see and use percents and proportions in their everyday lives.

You Are What You Eat
The objective of this lesson is to open student's eyes to the contents of their diet. Students will explore different food labels to better understand calories, while discovering the connection between mathematics and health. We'll be focusing on the calories from fat, carbohydrates, and protein. Each student will get the opportunity to explore two popular food items and calculate their caloric intake. To gage student's comprehension, at the end of the lesson, students will compare products and determine the healthiest product choices.

Constructing Percent Dolls
This lesson provides an opportunity for students to create a scale doll version of themselves. They will measure different body parts and calculate the percentage of that body part compared to their total height. Using proportions, students will then determine a scale to build their dolls, which will be made out of pipe cleaners!

Creating Consciousness Using Math
The objective of this lesson is to help students understand and become aware of how to interpret statistical information that is relevant to issues in our country and around the world. Students will look at state populations and how they are affected by social issues such as poverty,

unemployment, and healthcare. We will compare these results between the different states' data. Our overall goal is for students to be able to tangibly understand proportions.

Understanding Mathematics Through Art

The lesson to be presented aims to help students understand equivalency between fractions, decimals, and percents by using art to develop conversion skills. Students will use visual models to deepen their understanding of rational numbers. They will learn to understand how subjects as diverse as mathematics and art can be interrelated. Students will be engaged by using different colored squares to create abstract art that illustrates portions of wholes. In addition, students will calculate the fractions, decimals, and percents for each of the colors in their creations. Students will ultimately learn how to understand mathematics through the lens of an artist.

LAS
Embedded Assessment Action Report

For

Program Review

Degree Program(s): __BS/BA Education

(BA, BS, BFA, MA, MS, LACC, etc.)

Course # / Title: _MTH 396 Elementary Problem Solving___________

Faculty name: __Cheryl Beaver_____________

Date: ______June 11, 2010__________

A) State the program **learning outcome** or **general education goal** this assessment is linked to:

- Problem Solving and Problem Writing Skills - the ability to create and understand complicated situations, which are applications of K-8 mathematical topics and to apply learned skills and techniques to resolve them.

- Ability to Model Problems - the ability to translate various real-world scenarios into mathematical models that can be explored by hands-on models, paper-and-pencil methods and technological applications where appropriate.

- Communication Skills - Ability to precisely articulate (both in writing and orally) K - 8 mathematical topics in a way that is clear and understandable to elementary and middle school students.

B) Check the embedded assessment tool(s) used :

☒ Exam question
☐ Essay
☐ Oral presentation
☐ Thesis
☒ Portfolios
☐ Practicum / Service Learning
☐ Capstone paper / project
x Other __Mentoring Project____

Attach a copy of the actual question / assignment as it is presented to the student or a description of the embedded process.
Please submit a copy of this action report to the LAS dean's office.

Learning Outcome: Problem Writing and communication:

Portfolio Assignments for Mathematics 396

You will have **three** portfolio assignments. There are two parts to each assignment.

PART A:
Write a word problem to illustrate a given prescribed problem solving strategy. The problem should require at least three mathematical steps to solve!

- The problem should be appropriate for grades levels 4 – 7.
- Include with each problem a rubric created specifically for the problem.
- Include a solution that would receive a perfect score according to your rubric.
- Include a section giving comments for teachers.
- Try to make the problems interesting and relevant to children's lives, and thus useful for you upon entry into the teaching profession.
- Try to write each problem ON YOUR OWN, without borrowing from other resources. Cite your reference if applicable.
- Have fun and use your imagination.

Please organize your writing in the following format:

- **Problem**
- **Prescribed Strategy**
- **Rubric**
- **Solution**
- **Comments for Teachers.** The Comments for Teachers section can include ideas for (a) extending or generalizing the problem, or (b) reflective comments about which topics this problem illustrates within the elementary or middle school mathematics curriculum. *You must use a different rubric for each portfolio problem.*

DUE DATES:

- **Portfolio 1 Part A** due on 4/14: draw a diagram, use a picture, or eliminate possibilities (**a table is NOT a picture/diagram**) (choose one of these strategies)
- **Portfolio 2 Part A** due on 4/26: use sub-problems or patterns or counting techniques (choose one)
- **Portfolio 3 Part A** due on 5/26: use Venn diagrams, working backwards or algebra (choose one)

PART B: For Part B you will be looking at Portfolio PART A written by a classmate.

1. Read their problem and solution. Score their problem according to the rubric they submitted.
2. Also score their work according to the following rubric. Support your scores with comments.

Problem: Ten (10) points are given for this section of the assignment which contains the wording of the actual problem:

- Two (2) points are given for prescribing a strategy which is appropriate and efficient.

- Two (2) points are given for writing a problem that illustrates an important mathematical idea.
- Two (2) points are given for writing a multi-step problem that uses at least 3 steps.
- Two (2) points are given for an interesting story.
- Two (2) points are given for clarity and good use of language.

Prescribed Strategy: Two (2) points are given for specifying which problem-solving strategy your problem is illustrating

Rubric: Six (6) points are given for the rubric assigned as follows:

- Three (3) points for a rubric clearly stating the expectations.
- Three (3) points for a rubric which appropriately assesses the problem.

The remaining six (6) points are assigned as follows:

- Four (4) points for a complete and correct **solution** that would receive full credit according to your rubric.
- Two (2) points for the **Comments for Teachers** section.

Scoring breakdown

Strategy	0	1	2
Problem Strategy			
Idea	0	1	2
Multi-step	0	1	2
Story	0	1	2
Language	0	1	2
	0	1	2
Rubric			
Clear expectations	0	1 2	3
Appropriate	0	1 2	3
Solution	0	1 2	3 4
Comments	0	1	2

Comments:

3. After scoring their problem you will answer the following questions:
   a. What could be added to the problem to make it clearer or what information is unnecessary for the problem and does not add value?
   b. Give a specific, thoughtful suggestion on how to modify the problem to make it more difficult for an advanced learner.
   c. Give a specific, thoughtful suggestion on how to modify the problem to make it easier for a struggling learner.
   d. Comment on the rubric. Was it appropriate? Were there categories missing? List at least one change you would make to improve the rubric. Justify your change.

Learning Outcomes: Problem Solving & Ability to Model Problems

Mathematics 396 Final Exam Spring 2010

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In your groups of 3-4 please solve five out of the following six problems. Each group member is responsible for writing up at least one solution. Your answer will be graded on interpretation, strategy, accuracy, completeness and clarity so be sure to explain yourself well. You will not be graded on reflection, but it is always a good idea to check your work. After you write up a solution it is a good idea to have the other group members proofread it. Each problem is worth 20 points.

Problem 1: Maile was driving through the Midwest recently and happened to tune in to a country music station. After having listed to the station for an hour, Maile had heard 25 songs. All but 1 were about either truck drivers, being in love, hound dog owners, or some combination of the three. She noted the following information:

a. All of the truck drivers were in love.
b. Three-fourths of the truck drivers were not hound dog owners.
c. There were six hound dog owners who were in love.
d. Of the hound dog owners who were not truck drivers, half of them were in love.
e. Eighty percent of all the songs concerned people in love.

How many songs concerned people who were in love but were not truck drivers or not hound dog owners?

Problem 2: Kate had three African snails named Sluggo, Pokey, and Lag. Each of the snails loves to eat lettuce. One day, Kate gave each snail the same number of heads of lettuce. The snails started munching away. Each snail ate at a constant rate of speed. When Sluggo finished all of his heads of lettuce, Pokey had 17 heads left and Lag had 26 heads left. When Pokey finished all of his lettuce, Lag had 12 heads left. How many heads of lettuce did each snail start with? (Assume each snail started with fewer than 100 heads of lettuce.)

Problem 3: Both contestants on the game show *Math Masters* were excellent mathematicians. The host gave each of them a positive whole number and told them that the product of their numbers was 15, 20, 24, or 28. The first contest to determine the other’s number would be the winner. It was not possible for either contestant to determine the other’s number immediately. Both contestants thought about it and made some notes. Finally, one contestant determined the other contestant’s number. What was the **loser’s** number?

Problem 4: I walk 6 feet/second, and I run three times as fast. Last night I was walking across a four-lane street. Halfway across the street, I noticed a car to my right that was just passing a fire hydrant. I started running, because the car was driving too fast for my sense of safety. It took 8 seconds for me to cross the street. One second after I reached the curb, the car sped by me. I then turned right and started walking again. I walked a distance that was three times the distance across the street until I reached the fire hydrant. How fast was the car moving in miles per hour (recall there are 5280 feet in a mile).

Problem 5: A group of 34 adults and 27 children comes to a river they wish to cross. They find a small boat that will hold 1 adult or 2 children. Everyone is able to row the boat. **a)** Show that everyone can get across the lake in 187 trips. (Count trips as one-way.) **b)** Find a formula for the smallest number of trips it will take for any group of adults and children to cross. Find the formula in terms of variables A=number of adults and C=number of children.

Problem 6: For Mandy's graduation, her family went out to dinner at a Mexican restaurant. The restaurant served a bowl of chips for every three people, a bowl of salsa for every two people, and a bowl of guacamole for every four people. There were seven more bowls than people. How many bowls of each type of food were there?

Learning Outcome: Communication Skills

Drexel Online Mentoring Assignment: The students participate in the Drexel on-line Math Forum mentoring program. Middle and high school students from around the country submit solutions to the Math Forum's "Problem of the Week". Our WOU students mentor these students by grading their responses via a scoring rubric, then writing a mentoring reply to give the students advice on how to improve their solution. The students who receive the reply have the opportunity to submit a revision and get re-graded by their WOU mentor.