Please submit your report to your department chair or program coordinator, the Associate Dean and Dean of your College, and to james.solomon@csun.edu, Director of the Office of Academic Assessment and Program Review, by September 30, 2020. You may, but are not required to, submit a separate report for each program, including graduate degree programs, which conducted assessment activities, or you may combine programs in a single report. Please include this form with your report in the same file and identify your department/program in the file name. Please do not change the date on the form, and be sure to check that your report is ADA accessible.

College: Science and Mathematics  
Department: Mathematics  
Program: B.A., B.S., and M.S.  
Assessment liaison: Daniel Katz

1. Please check off whichever is applicable:
   A. ____ X ____ Measured student work within program major/options.  
   B. ____ X ____ Analyzed results of measurement within program major/options.  
   C. _______ Applied results of analysis to program review/curriculum/review/revision major/options.  
   D. _______ Participated in the 2019-20 assessment of General Education Section D: Social Sciences and U.S. History and Government student learning outcomes

2. Overview of Annual Assessment Project(s). On a separate sheet, provide a brief overview of this year’s assessment activities, including:
   - an explanation for why your department chose the assessment activities (measurement, analysis, application, or GE assessment) that it enacted  
   - if your department implemented assessment option A, identify which program SLOs were assessed (please identify the SLOs in full), in which classes and/or contexts, what assessment instruments were used and the methodology employed, the resulting scores, and the relation between this year’s measure of student work and that of past years: (include as an appendix any and all relevant materials that you wish to include)  
   - if your department implemented assessment option B, identify what conclusions were drawn from the analysis of measured results, what changes to the program were planned in response, and the relation between this year’s analyses and past and future assessment activities  
   - if your department implemented option C, identify the program modifications that were adopted, and the relation between program modifications and past and future assessment activities  
   - if your program implemented option D, exclusively or simultaneously with options A, B, and/or C, identify the GE learning outcomes assessed, the assessment instruments and methodology employed, and the resulting scores  
   - in what way(s) your assessment activities may reflect the university’s commitment to diversity in all its dimensions but especially with respect to underrepresented groups  
   - any other assessment-related information you wish to include: e.g. SLO revision (especially to ensure continuing alignment between program course offerings and both program and university student learning outcomes) and the creation or modification of new assessment instruments

Overview of Assessment Projects
2019–2020 Academic Year
Report to the Office of Academic Assessment

Prepared by the Assessment Committee
(Alberto Candel, Daniel Katz, and Jason Lo)
in Collaboration with the Graduate Committee
Department of Mathematics
California State University, Northridge

16 September 2020
Contents

1 Introduction 3
   1.1 Synopsis of Activities Done for Academic Year 2019–2020 3
   1.2 Preview of Planned Assessment Activities for Academic Year 2020–2021 4
   1.3 Corrigendum to the 2018–2019 Report 5

2 Spring 2020: Measurement and Analysis of Math 450A Class 6
   2.1 SLO Assessed 6
   2.2 Role in the Program 6
   2.3 Sections 6
   2.4 Signature Assignment 7
   2.5 Results, Analysis, and Recommendations 7

3 Spring 2020: Measurement and Analysis of Math 462 Class 10
   3.1 SLO Assessed 10
   3.2 Role in the Program 10
   3.3 Section 11
   3.4 Signature Assignment 11
   3.5 Results, Analysis, and Recommendations 11

4 New Program SLOs for the Master’s Degree Program in Mathematics 13

5 Spring 2020: Measurement and Analysis of Math 655 Class 15
   5.1 SLO Assessed 15
   5.2 Role in the Program 15
   5.3 Section 15
   5.4 Signature Assignment 15
   5.5 Results, Analysis, and Recommendations 16

A Rubrics 18
A.1 Assessment Rubric for Math 450A (Fall 2019) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 18
A.2 Assessment Rubric for Math 462 (Spring 2020) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 19
A.3 Assessment Rubric for Math 655 (Spring 2020) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 19
Chapter 1

Introduction

1.1 Synopsis of Activities Done for Academic Year 2019–2020

This report describes all the assessment activities performed by the Department of Mathematics at California State University, Northridge for the 2019–2020 academic year:

- We assessed SLO 2 of the undergraduate program (Rigorously establish fundamental analytic properties and results, such as limits, continuity, differentiability and integrability) in the Math 450A class (Advanced Calculus I) in Fall 2019. Our measurement indicates that students are not understanding what it is they need to prove, and therefore relatively few have success in proving it. The signature assignment asked students to supply definitions of concepts followed by particular examples where they are asked to apply those definitions. We propose that in the future, instructors should ask students to state explicitly what one needs to prove after they supply a definition but before they write a proof.

- We assessed SLO 3 of the undergraduate program (Demonstrate facility with the objects, terminology and concepts of linear algebra) in the Math 462 class (Advanced Linear Algebra) in Spring 2020, using a signature assignment that occurred after the shift to online learning. Our measurement indicates that the student learning outcome was being achieved at a satisfactory level.

- A revision of the Master’s Program in Mathematics was approved by the Chancellor’s Office in Fall 2019. Along with this revision, the Mathematics Depart-
1.2 Preview of Planned Assessment Activities for Academic Year 2020–2021

First we consider the Bachelor’s Program in Mathematics. In the 2015–2016 academic year, the Department of Mathematics revised the undergraduate program SLOs. For the past few years, we have been assessing these new undergraduate SLOs to obtain a first measure of our program so as to build a baseline for future assessment and a reference point to assist in curriculum development. So far we have assessed all five of the undergraduate program SLOs. Although our original plan had been to complete measurements and analysis of all SLOs and then shift emphasis from measurement and analysis to application, the sudden shift to online synchronous teaching has forced us back to measurement and analysis because what we are doing and what we are able to do has changed, and we need to understand how well we are managing this new situation. In view of the results of our recent measurement of SLO 2 in the Math 450A class, we consider it a priority to work with the future instructors of this class to help students to achieve the learning outcome.

Now we consider the Master’s Program in Mathematics. In Spring 2016, the department created SLOs for the Master’s Program in Mathematics, and we assessed SLOs for this program in 2016–17, 2017–18, and 2018–19. In Fall of 2019, a revision to this program was approved by the Chancellor’s Office, and this revision slightly modified the Program SLOs for the master’s degree. We present these new SLOs in Chapter 4. Because there is a great deal of overlap between the new and old SLOs, all assessments done in 2016–19 involved SLOs that are identical to ones on the new list. Once the program revision was approved, we began assessing SLOs on the new list, as these SLOs are not only applicable to the revised program but also perfectly applicable for the work of students who are still operating within the parameters of the program as it was prior to the revision. The past assessments of 2016–17, 2017–18, and 2018–19 respectively concern what we now call SLOs 5, 1, and 2, and
the assessment for 2019–20 that we present in this report concerns the current SLO 4. Therefore we have already assessed four out of the five total current SLOs for the master’s program.

1.3 Corrigendum to the 2018–2019 Report

In Section 2.1 of the report for 2018–2019, it was stated that we had in the past (Fall 2015) assessed bachelor’s program SLO 1 (Devise proofs of basic results concerning sets and number systems). In fact, an earlier set of SLOs was in force at the time of the 2015 assessment, and it was actually SLO 3 of this older set (Present clear and rigorous proofs) that was assessed during the Fall 2015 assessment. Nonetheless, the present SLO 1 is the natural successor to that earlier SLO, and the signature assignments under discussion that were used in all the measurements of either of these SLOs would work equally well for both SLOs. Therefore the motivations for and outcomes of the interventions and measurements of the 2018–2019 report do not change in any way.
Chapter 2

Spring 2020: Measurement and Analysis of Math 450A Class

2.1 SLO Assessed

The following SLO for the Mathematics Bachelor’s Program was assessed:

SLO 2: Rigorously establish fundamental analytic properties and results, such as limits, continuity, differentiability and integrability.

2.2 Role in the Program

Math 450A is required for mathematics majors in all options of the bachelor’s program. Math 450A teaches the theoretical foundations of calculus.

2.3 Sections

Two sections of this course were offered in Fall 2019: Section 1 (30 students) and Section 3 (19 students). The textbook for Section 1 was Understanding Analysis, second edition by Stephen Abbott, and the textbook for Section 3 was A First Course in Real Analysis, second edition by Murray H. Protter, Charles B. Morrey. For the purposes of this report, the sections were randomly assigned labels of Section A and Section B.
2.4 Signature Assignment

The signature assignment consisted of two parts of a problem on the in-class final exam. For Problem 1, students are asked (for Problem 1) to state the supremum of a given subset of the set of real numbers and prove that their claim is correct. For Problem 2, students are asked to state the infimum of a given subset of the set of real numbers and prove that their claim is correct.

2.5 Results, Analysis, and Recommendations

Of the 49 students enrolled in the class, 44 took the final exam. Two full time faculty of the Mathematics Department scored the signature assignment according to the rubric included in Appendix A.1. Table 2.1 shows the mean and median scores for the individual Sections and for the entire class. There does not appear to be any marked difference between the sections. Figures 2.1 and 2.2 show the distribution of scores for the entire class.

It would appear that the fundamental problem with student responses to both Problem 1 and Problem 2 is that many students lack a basic understanding of what they need to do to establish that a certain number is the supremum or infimum of a set. That is, if one wants to prove that \( v \) is the supremum of a set \( S \), then one must prove (i) that \( v \) is an upper bound of \( S \) and (ii) that no number less than \( v \) is an upper bound of \( S \). And if one wants to prove that \( w \) is the infimum of \( S \), then one must prove (i) that \( w \) is a lower bound of \( S \) and (ii) that no number greater than \( w \) is a lower bound of \( S \).

To try to diagnose what is going wrong, one of the scorers did an additional appraisal of both Problems, breaking down the progression of thoughts one would follow in a typical successful approach to the problem. Here we report the percentages of students who were successful in following each step. First of all, one should state

<table>
<thead>
<tr>
<th>Section</th>
<th>Problem 1 Median</th>
<th>Problem 1 Mean</th>
<th>Problem 2 Median</th>
<th>Problem 2 Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1.1</td>
<td>0</td>
<td>0.7</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1.1</td>
<td>0</td>
<td>0.8</td>
</tr>
<tr>
<td>entire class</td>
<td>1</td>
<td>1.1</td>
<td>0</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Figure 2.1: Score distribution for Math 450A final Problem 1

Figure 2.2: Score distribution for Math 450A final Problem 2

the correct value of the supremum (students had a 95% success rate with this) or infimum (82% success rate).

Many students state explicitly that the supremum is the least upper bound and that the infimum is the greatest lower bound, and a few who do not nevertheless construct their proofs in a way that implicitly makes it clear that they are aware that the supremum (resp., infimum) is the least upper (resp., greatest lower) bound. Overall one could say that about 77% of students manifest at least a memory of the formulation of “least upper bound” and 82% for “greatest lower bound.”

The real difficulty seems to begin with students comprehending what demands
such formulations make on them in order for them to prove that something is the
“least upper bound” or “greatest lower bound.” About 41% of the students showed
clear awareness that proving that a value \( v \) is the “least upper bound” of a set \( S \)
Involves two tasks: (i) proving that \( v \) is an upper bound of \( S \) and (ii) proving that
no number less than \( v \) is an upper bound of \( S \). Similarly, only about 36% of students
showed clear awareness that proving that a value \( w \) is the “greatest lower bound” of
a set \( S \) involves two tasks: (i) proving that \( w \) is a lower bound of \( S \) and (ii) proving
that no number greater than \( w \) is a lower bound of \( S \).

Furthermore, many of the students do not supply clear arguments for the two
parts, (i) and (ii), of each proof discussed in the previous paragraph. For the part
we have labeled (i), only about 47% give some evidence that they understand what
it really means for a number \( v \) to be an upper bound of a set \( S \), and only 27% give
some evidence that they understand what it really means for \( w \) to be a lower bound
of a set \( S \). For the part we have labeled (ii), only 16% prove that no value less than
their value \( v \) is an upper bound of \( S \), and only 14% prove that no value greater than
their value \( w \) is a lower bound of \( S \).

We should add that in Problem 1, some students could avoid using the logic just
outlined by stating that the set has a maximum element, stating the value \( v \) of that
maximum element, and then employing the theorem that if \( v \) is a maximum element
of a set \( S \) then \( v \) is the supremum of \( S \). Some students take this approach, but often
without explanation of why their stated value is a maximum element, and some also
mix this correct approach with false statements so that their account is not entirely
satisfactory.

In many cases, students deploy the typical technical machinery of analysis (use
of small quantities named epsilon) without any real understanding of how this ma-
chinery can be used to prove the two things that need to be proved for each of the
problems. It is as if they recall having seen these tools used in a proof of a similar
claim, and they want produce a similar proof, but have not really stopped to ask
themselves what exactly they need to prove for this problem.

We suggest that in the future, more emphasis should be laid on making the
students explicitly state what they need to prove after they make their definition.
Then they can be asked to try to carry out their stated program of proof. This
should help students to achieve a greater understanding of what they need to do
and it should also help instructors to pinpoint students’ difficulties. Also, on the
practical side, for proofs involving small quantities ("epsilons"), students should be
trained in the technical aspects of such arguments so that what they write actually
demonstrates what needs to be shown.
Chapter 3

Spring 2020: Measurement and Analysis of Math 462 Class

3.1 SLO Assessed

The following SLO for the Mathematics Bachelor’s Program was assessed:

SLO 3: Demonstrate facility with the objects, terminology and concepts of linear algebra.

3.2 Role in the Program

Math 462 is required for mathematics majors in the B.A. general option, the B.S. in mathematics option, and the B.S. statistics option. It can be used to fulfill the upper division math elective requirements for the other bachelor’s program options (B.A. four-year integrated mathematics subject matter program for the single subject credential, B.A. junior-year integrated mathematics subject matter program for the single subject credential, and B.S. applied mathematics option). Math 462 serves as a student’s second exposure to linear algebra. It focuses on the abstract theory of vector spaces and linear transformations, and builds up to the theory of canonical forms for linear operators, including operators on inner product spaces.
3.3 Section

One section of this course was offered in Spring 2020: it had 22 students. The textbook was *Linear Algebra for the Young Mathematician* by Steven H. Weintraub.

3.4 Signature Assignment

The signature assignment was a problem on a take-home midterm given during the term after instruction had been shifted to an online format. Students were given 24 hours to complete the exam with the use of books and notes, but without collaborating with other persons. The signature assignment explores the theory of forming a matrix representation of a linear transformation and then working out a concrete example. As such, it resembles the signature assignment that was used the last time SLO 3 was assessed in the Math 462 class (and in its prerequisite, Math 262) in the 2016–2017 academic year.

3.5 Results, Analysis, and Recommendations

Of the 22 students enrolled in the class, 18 turned in the midterm. Two full time faculty of the Mathematics Department scored the signature assignment according to the rubric included in Appendix A.2. The mean score was 2.47 and the median score was 3. Figure 3.1 shows the distribution of scores.

![Figure 3.1: Score distribution for Math 462 midterm](image)
CHAPTER 3. MEASUREMENT AND ANALYSIS OF MATH 462

More than half of the students were able to give a perfect or near-perfect answer, and most of the rest made significant progress on the problem. This is a satisfactory outcome.

We can attempt to compare this to a previous measurement of the same SLO in the same course (Math 462) in the Spring of 2017, and we specifically compare to Problem 2 within that previous assessment, as that problem concerns the same topic as this year’s assessment: matrix representation of a linear transformation. The scores for that previous measurement had a mean of 1.97 and a median of 2 (as compared to 2.47 and 3, respectively, this year). It would appear at first sight that there is a superior achievement of the SLO this year, but we must consider matters carefully before coming to that conclusion.

The theoretical underpinnings of both problems are the same, but there are some important differences in what the students were asked to do. The problem from the 2017 assessment had two parts: part (a), in which the students were asked to state in theoretical terms the formula for the matrix representation of a linear transformation with respect to specified bases, and part (b), which was a practical calculation that asked the students to apply this formula to a specific instance. The problem from the 2020 assessment only asked for the practical calculation, but the details of this calculation were more challenging than those of the 2017 problem. One should not jump to the conclusion that doing the practical calculation implies accurate knowledge of the theory. In fact, stating a formula in precise, formal terms may not always be the same as being able to apply it, since the act of applying it can be memorised as an algorithm, at least for routine cases.

Another important factor to consider is that students in 2017 had to do their problem within much stricter time limits and without the assistance of books or notes. Had the 2020 students been asked for the theoretical formula, they could have copied it directly from the textbook, since their exam was open book. And even the practical calculation can become much easier if one is able to look at analogous examples while one is writing one’s solution. So when all circumstances are taken into account, it may be that the earlier problem actually posed a greater challenge. Therefore, we cannot make any firm conclusions about the relative success of the students in 2017 versus those in 2020.
Chapter 4

New Program SLOs for the Master’s Degree Program in Mathematics

A revision of the Master’s Program in Mathematics was approved by the Chancellor’s Office in Fall 2019. Along with this revision, the Mathematics Department included a change to the Program SLOs. The new SLOs are as follows:

1. Communicate abstract mathematical ideas clearly and cogently.
2. Solve mathematical problems at the graduate level.
3. Demonstrate proficiency in algebraic methods.
4. Demonstrate proficiency in mathematical analysis.
5. Demonstrate proficiency in general topology, including metric spaces.

The following is a course alignment matrix for the required courses for the program.
Table 4.1: Course Alignment Matrix: I=Introduced, P=Practiced, D=Demonstrated

<table>
<thead>
<tr>
<th>Number / Course</th>
<th>SLO 1</th>
<th>SLO 2</th>
<th>SLO 3</th>
<th>SLO 4</th>
<th>SLO 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>501. Topology</td>
<td>I</td>
<td>I</td>
<td></td>
<td></td>
<td>IP</td>
</tr>
<tr>
<td>540. Regression Analysis</td>
<td>I</td>
<td>I</td>
<td></td>
<td></td>
<td>IP</td>
</tr>
<tr>
<td>541. Theoretical Statistical Inference</td>
<td>P</td>
<td>P</td>
<td></td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>543. Multivariate Statistics</td>
<td>IPD</td>
<td>IPD</td>
<td>P</td>
<td></td>
<td>IP</td>
</tr>
<tr>
<td>550. Calculus on Manifolds</td>
<td>P</td>
<td>P</td>
<td></td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>552. Real Analysis</td>
<td>IP</td>
<td>IP</td>
<td></td>
<td></td>
<td>IP</td>
</tr>
<tr>
<td>560. Abstract Algebra III</td>
<td>I</td>
<td>I</td>
<td></td>
<td></td>
<td>IP</td>
</tr>
<tr>
<td>581. Numerical Methods for Linear Systems</td>
<td>I</td>
<td>I</td>
<td></td>
<td></td>
<td>IP</td>
</tr>
<tr>
<td>582A. Topics in Numerical Analysis</td>
<td>IPD</td>
<td>IPD</td>
<td>P</td>
<td></td>
<td>IP</td>
</tr>
<tr>
<td>592A. Topics in Applied Mathematics</td>
<td>P</td>
<td>P</td>
<td></td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>655. Complex Analysis</td>
<td>IPD</td>
<td>IPD</td>
<td>P</td>
<td></td>
<td>IP</td>
</tr>
<tr>
<td>Electives</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>697A-C. Directed Comprehensive Studies</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>698A-C. Thesis or Graduate Project</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
</tbody>
</table>
Chapter 5

Spring 2020: Measurement and Analysis of Math 655 Class

5.1 SLO Assessed

The following SLO for the Mathematics Master’s Program was assessed:

SLO 4: Demonstrate proficiency in mathematical analysis.

5.2 Role in the Program

Math 655 is one of three courses that can be used to satisfy the Advanced Analytic Methods requirement for a Master’s Degree in Mathematics.

5.3 Section

One section of this course was offered in Spring 2020: it had 21 students. The instructor prepared lecture notes to serve as a textbook for this class.

5.4 Signature Assignment

The signature assignment consisted of two homework problems that were assigned before instruction shifted to an online format. Problem 1 asked the students to show that a previously established result, that holomorphic functions have vanishing
integrals along certain straightforward closed contours, can also be established using a familiar theorem from vector calculus. Problem 2 asked the students to use contour integration to compute an integral of a real-valued function on a real interval.

5.5 Results, Analysis, and Recommendations

Of the 21 students enrolled in the class, 19 turned in the homework that constituted the signature assignment. Two full time faculty of the Mathematics Department scored the signature assignment according to the rubric included in Appendix A.3. Because some of the scans were too faint for one of the scorers to read, that scorer only reported a score for 17 out of 19 assignments. Table 5.1 shows the mean and median score for each problem. Figures 5.1 and 5.2 show the distribution of scores for each problem.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Median</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3.0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Table 5.1: Math 655: Median and Mean Scores

Figure 5.1: Score distribution for Math 655 Problem 1
We conclude that the students have met expectations for this learning outcome. It may be that the very high success rate for Problem 1 was aided by the extensive hints that were provided. Although Problem 2 has no hints, it is a canonical example of a contour integral. Due to its historical importance, students should be exposed to it, but perhaps other examples that are less well known should be assigned to challenge the students.
Appendix A

Rubrics

A.1 Assessment Rubric for Math 450A (Fall 2019)

Both Problem 1 and Problem 2 were scored according to the same rubric.

- **Problem 1**: Students shall state the supremum of a given subset of the set of real numbers and prove that their claim is correct.

- **Problem 2**: Students shall state the infimum of a given subset of the set of real numbers and prove that their claim is correct.

For each part, the student will be given a score from 0 to 3 based on the following rubric:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Demonstrates no relevant idea about how to present the proof</td>
</tr>
<tr>
<td>1</td>
<td>Presents some ideas relevant to a proof, but falls short of what is needed to construct the complete argument.</td>
</tr>
<tr>
<td>2</td>
<td>Presents a proof that contains substantial correct ideas, but has some flaws in its logic or in presentation.¹</td>
</tr>
<tr>
<td>3</td>
<td>Presents a valid proof in a clear manner. The proof has no flaws or negligible flaws.</td>
</tr>
</tbody>
</table>

¹For example, the order of statements in the proof is such that the flow of the argument is partially obscured.
A.2 Assessment Rubric for Math 462 (Spring 2020)

Students shall find the matrix representation of a linear operator with respect to a pair of ordered bases.

Students shall be given a score from 0 to 3 based on the following rubric:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Demonstrates no relevant idea about how to use linear algebraic ideas to solve any part the problem.</td>
</tr>
<tr>
<td>1</td>
<td>Presents at least one relevant idea, but falls far short of what is needed to solve the problem.</td>
</tr>
<tr>
<td>2</td>
<td>Presents a solution that contains substantial correct ideas, but not a fully correct solution.</td>
</tr>
<tr>
<td>3</td>
<td>Presents a valid and clear solution, with no flaws or very minor flaws (e.g., simple calculation error).</td>
</tr>
</tbody>
</table>

A.3 Assessment Rubric for Math 655 (Spring 2020)

Problem 1: Show that a previously established result, that holomorphic functions have vanishing integrals along certain straightforward closed contours, can also be established using a familiar theorem from vector calculus.

Problem 2: Use contour integration to compute an integral of a real-valued function on a real interval.

For each problem, students shall be given a score from 0 to 3 based on the following rubric:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Demonstrates no relevant idea about how to solve any part of the problem.</td>
</tr>
<tr>
<td>1</td>
<td>Presents at least one relevant idea, but falls far short of what is needed to solve all parts of the problem.</td>
</tr>
<tr>
<td>2</td>
<td>Presents a solution that contains substantial correct ideas, but not a fully correct solution.</td>
</tr>
<tr>
<td>3</td>
<td>Presents valid and clear solutions to all parts, with no flaws or very minor flaws.</td>
</tr>
</tbody>
</table>