**Subject Area Committee Name:** MTH

[ Please note: All appendices are directly embedded at the end of this document. ]

**Contact Person:**

<table>
<thead>
<tr>
<th>Name</th>
<th>e-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas Songer</td>
<td><a href="mailto:thomas.songer@pcc.edu">thomas.songer@pcc.edu</a></td>
</tr>
</tbody>
</table>

Only one assessment report is required this year. Document your plan for this year’s assessment report(s) in the first sections of this form. This plan can be consistent with the Multi-Year Plan you have submitted to the LAC, though, this year, because PCC is engaging in a year-long exploration of our core outcomes and general education program, SACs are encouraged to explore/assess other potential outcomes. Complete each section of this form. In some cases, all of the information needed to complete the section may not be available at the time the report is being written. In those cases, include the missing information when submitting the completed report at the end of the year.

- Refer to the help document for guidance in filling-out this report. If this document does not address your question/concern, contact Chris Brooks to arrange for coaching assistance.
- Please attach all rubrics/assignments/etc. to your report submissions.
- **Subject Line of Email:** Assessment Report Form (or ARF) for <your SAC name> (Example: ARF for MTH)
- **File name:** SACInitials_ARF_2016 (Example: MTH_ARF_2016)
- SACs are encouraged to share this report with their LAC coach for feedback before submitting.
- Make all submissions to learningassessment@pcc.edu.

**Due Dates:**
- **Planning Sections of LAC Assessment or Reassessment Reports:** November 16th, 2015
- **Completed LAC Assessment or Reassessment Reports:** June 17th, 2016
Please Verify This Before Beginning this Report:

☐ This project is not the second stage of the assess/re-assess process (if this is a follow-up, re-assessment project, use the LAC Re-assessment Report Form LDC. Available at: http://www.pcc.edu/resources/academic/learning-assessment/LDC_Assessment_Templates.html

1. Outcome

1A. PCC Core Outcome or Exploratory Outcome:  Quantitative Literacy

1B. Briefly describe the outcome your SAC will be assessing this year.

Our Mathematics Learning Assessment Subcommittee (MTH LAS) chose the exploratory outcome of Quantitative Literacy (QL). This outcome describes the vital competency an individual needs to understand, communicate, and engage with the mathematical content of real-world problems and modern data-driven information settings.

1C. Briefly describe how this outcome is/might be important/useful to your students.

We specifically explored QL in the form of student learning and retention of prerequisite math skills considered crucial for success in PCC Statistics and CTE (Automotive, Machining) programs. In this context: We expect appropriate achievement of QL will enable students to demonstrate working retention of these prerequisite skills, up to (and through) the subsequent program entry points – thereby promoting success and completion of associated program coursework along these paths.

2. Project Description

2A. Assessment Context

Check and complete all the applicable items:

☐ Course based assessment.
Course names and number(s):

Expected number of sections offered in the term when the assessment project will be conducted:

Number of these sections taught by full-time instructors:

Number of these sections taught by part-time instructors:

Number of distance learning/hybrid sections:

Type of assessment (e.g., essay, exam, speech, project, etc.):

Are there course outcomes that align with this aspect of the core outcome being investigated? ☐ Yes ☐ No

If yes, include the course outcome(s) from the relevant CCOG(s):

☐ Common/embedded assignment in all relevant course sections. An embedded assignment is one that is already included as an element in the course as usually taught. Please attach the activity in an appendix. If the activity cannot be shared, indicate the type of assignment (e.g., essay, exam, speech, project, etc.):  

☐ Common – but not embedded - assignment used in all relevant course sections. Please attach the activity in an appendix. If the activity cannot be shared, indicate the type of assignment (e.g., essay, exam, speech, project, etc.):  

☐ Practicum/Clinical work. Please attach the activity/checklist/etc. in an appendix. If this cannot be shared, indicate the type of assessment (e.g., supervisor checklist, interview, essay, exam, speech, project, etc.):  

☐ External certification exam. Please attach sample questions for the relevant portions of the exam in an appendix (provided that publically revealing this information will not compromise test security). Also, briefly describe how the results of this exam are broken down in a way that leads to nuanced information about the aspect of the core outcome that is being investigated.

☐ SAC-created, non-course assessment. Please attach the assessment in an appendix. If the assessment cannot be shared, indicate the type of assignment (e.g., essay, exam, speech, project, etc.):  

☐ Portfolio. Please attach sample instructions/activities/etc. for the relevant portions of the portfolio submission in an appendix. Briefly describe how the results of this assessment are broken down in a way that leads to nuanced information about the aspect of the core outcome that is being investigated:

☐ Survey

☐ Interview

☒ Other. Please attach the activity/assessment in an appendix. If the activity cannot be shared, please briefly describe:
In the event publicly sharing your assessment documents will compromise future assessments or uses of the assignment, do not attach the actual assignment/document. Instead, please give as much detail about the activity as possible in an appendix.

<table>
<thead>
<tr>
<th>2B. How will you score/measure/quantify student performance?</th>
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<tbody>
<tr>
<td>☑ Rubric (used when student performance is on a continuum - if available, attach as an appendix – if in development - attach to the completed report that is submitted in June)</td>
</tr>
<tr>
<td>☑ Checklist (used when presence/absence rather than quality is being evaluated - if available, attach as an appendix – if in development - attach to the completed report that is submitted in June)</td>
</tr>
<tr>
<td>☑ Trend Analysis (often used to understand the ways in which students are, and are not, meeting expectations; trend analysis can complement rubrics and checklist)</td>
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<tr>
<td>☐ Objective Scoring (e.g., Scantron scored examinations)</td>
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<tr>
<td>☐ Other – briefly describe:</td>
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<tr>
<th>2C. Type of assessment (select one per column)</th>
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<tbody>
<tr>
<td>☑ Quantitative</td>
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<tr>
<td>☐ Qualitative</td>
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If you selected ‘Indirect Assessment’, please share your rationale:

Qualitative Measures: projects that analyze in-depth, non-numerical data via observer impression rather than via quantitative analysis. Generally, qualitative measures are used in exploratory, pilot projects rather than in true assessments of student attainment. Indirect assessments (e.g., surveys, focus groups, etc.) do not use measures of direct student work output. These types of assessments are also not able to truly document student attainment.

<table>
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<tr>
<th>2D. Check any of the following that were used by your SAC to create or select the assessment/scoring criteria/instruments used in this project:</th>
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<tr>
<td>☑ Committee or subcommittee of the SAC collaborated in its creation</td>
</tr>
<tr>
<td>☐ Standardized assessment</td>
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<tr>
<td>☐ Collaboration with external stakeholders (e.g., advisory board, transfer institution/program)</td>
</tr>
<tr>
<td>☐ Theoretical Model (e.g., Bloom’s Taxonomy)</td>
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<tr>
<td>☐ Aligned the assessment with standards from a professional body (for example, The American Psychological Association Undergraduate Guidelines, etc.)</td>
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<tr>
<td>☐ Aligned the benchmark with the Associate’s Degree level expectations of the Degree Qualifications Profile</td>
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</tbody>
</table>
Aligned the benchmark to within-discipline post-requisite course(s)
☑️ Aligned the benchmark to out-of-discipline post-requisite course(s)
☑️ Other (briefly explain: We performed a significant initial outreach to PCC Statistics and CTE Instructors (Automotive and Machining), in order to determine the specific prerequisite math skills deemed critically important to the success of students entering and pursuing these programs (our collaboration with CTE is a valuable and noteworthy distinction of this project). Our outreach identified seven critical math prerequisite skill areas, which thus became the learning outcome topics of our assessment. (These prerequisite skills are currently taught in PCC MTH 20 and MTH 58, in addition to any elementary and secondary school exposure.)

2E. In which quarter will student artifacts (examples of student work) be collected? If student artifacts will be collected in more than one term, check all that apply.

☐ Fall ☑️ Winter ☐ Spring ☐ Other (e.g., if work is collected between terms)

2F. When during the term will it be collected? If student artifacts will be collected more than once in a term, check all that apply.

☐ Early ☑️ Mid-term ☐ Late ☐ n/a

2G. What student group do you want to generalize the results of your assessment to? For example, if you are assessing performance in a course, the student group you want to generalize to is ‘all students taking this course.’

The most proximate math course for the majority of students heading into Statistics (MTH 243), is MTH 95 or MTH 98 (and frequently MTH 20 for CTE). Thus to assess working retention of the selected critical prerequisite math skills: The optimum assessment points were determined to be within MTH 95 or MTH 98 (for pre-Statistics), and within active program coursework (for CTE).

The target population was therefore defined as: All PCC students having 1) previously completed the prerequisite math courses (MTH 20, MTH 58 or equivalent) and 2) either continued into a math course immediately prior to Statistics (MTH 95 or MTH 98), or into select CTE program courses.

2H. There is no single, recommended assessment strategy. Each SAC is tasked with choosing appropriate methods for their purposes. Which best describes the purpose of this project?

☑️ To measure established outcomes and/or drive programmatic change (proceed to section H below)
☐ To participate in the Multi-State Collaborative for Learning Outcomes Assessment
☐ Preliminary/Exploratory investigation

If you selected ‘Preliminary/Exploratory’ (most often a ‘pilot study’), briefly describe why you opted to do a pilot study, along with your
rationale for selecting your sample of interest (skip section H below). For example: “The SAC intends to add a Cultural Awareness outcome to this course in the upcoming year. It is not currently taught in most sections of this course. 2 full-time faculty and 1 part-time faculty member will field-test 3 different activities/assessments intended to measure student attainment of this proposed course outcome. The 3 will be compared to see which work best.”

2I. Which will you measure?

☐ the population (all relevant students – e.g., all students enrolled in all currently offered sections of the course)
☒ a sample (a subset of students)

If you are using a sample, select all of the following that describe your sample/sampling strategy (refer to the Help Guide for assistance):

☐ Random Sample (student work selected completely randomly from all relevant students)
☐ Systematic Sample (student work selected through an arbitrary pattern, e.g., ‘start at student 7 on the roster and then select every 5th student following,’ repeating this in all relevant course sections)
☐ Stratified Sample (more complex, consult with an LAC coach if you need assistance)
☐ Cluster Sample (students are selected randomly from meaningful, naturally occurring groupings (e.g., SES, placement exam scores, etc.)
☒ Voluntary Response Sample (students submit their work/responses through voluntary submission, e.g., via a survey)
☒ Opportunity/Convenience Sample (only a few instructors are participating in a project taught via multiple sections, so, only those instructors’ students are included)

The last three options in bolded red have a high risk of introducing bias. If your SAC is using one or more of these sample/sampling strategies, please share your rationale: The prohibitively large number of course sections for MTH 95 and MTH 98 restricted us to a convenience sample involving only some of the associated target course Instructors and students. Participating Instructors responded as volunteers to a SAC-wide email from MTH LAS requesting assistance (and to a general inquiry to CTE Automotive and Machining). Additionally, students of these volunteer Instructors are neither compelled nor required to complete the assessment instrument, and thus only enter our assessment sample via voluntary response participation. As such, our results may be considered as potentially biased, when compared to a simple random sample which could otherwise be more easily generalized to the population of interest. However we do hope that the large size of our sample may still allow reasonable representation of the target population.
2J. Briefly describe the procedure you will use to select your sample (including a description of the procedures used to ensure student and instructor anonymity). For example:

“We chose to use a random sample. We asked our administrative assistant to assist us in this process and she was willing. All instructors teaching course XXX will turn-in all student work to her by the 9th week of Winter Quarter. She will check that instructor and student identifying information has been removed. Our SAC decided we wanted to see our students’ over-all performance with the rubric criteria. Our administrative assistant will code the work for each section so that the scored work can be returned to the instructors (but only she will know which sections belong to which instructor). Once all this is done, I will number the submitted work (e.g., 1-300) and use a random number generator to select 56 samples (which is the sample size given by the Raosoft sample size calculator for 300 pieces of student work). After the work is scored, the administrative assistant will return the student work to individual faculty members. After this, we will set up a face-to-face meeting for all of the SAC to discuss the aggregated results.”

As described above, we used a convenience sample with voluntary response. We solicited volunteer MTH 95, MTH 98, and select CTE Instructors (from Automotive, and Machining) with sufficient net student count to likely meet our minimum sample size requirement. We then provided each Instructor with support, instructions, and adequate copies of the assessment to give their students within a convenient time frame. To protect student anonymity, Instructors were asked to inform students not to write their names on the assessment. Support from the various campus Math Department Administrative Assistants (Admins) was secured via advance authorization from the associated campus Division Deans. To protect Instructor anonymity, Admins were asked to 1) print and serialize sufficient copies of the assessment documents; 2) directly supply the volunteer Instructors at their campus; and 3) to keep a private master log (available only to the given Admin) of the particular assessment serial numbers distributed to those Instructors. After all volunteer Instructors had returned the completed assessments (artifacts) to the Admins, the artifacts were delivered in aggregate to MTH LAS for scoring and dataset creation. Finally, the scored artifacts were delivered back in aggregate to the appropriate campus Admins, who returned them (using their private serial number log) to the volunteer Instructors along with MTH LAS thank-you cards in appreciation. At no time was any MTH LAS member able to know from which Instructor or student a particular artifact was sourced. Full anonymity of Instructors and students was very carefully preserved throughout each stage of our process, in accordance with PCC Learning Assessment Council guidelines.

2K. Follow this link to determine how many artifacts (samples of student work) you should include in your assessment: http://www.raosoft.com/samplesize.html (see screen shot below). Estimate the size of the group you will be measuring (either your sample or your population size [when you are measuring all relevant students]). Often, this can be based on recent enrollment information (last year, this term, etc.):
3. Project Mechanics

3A. Does your project utilize a rubric for scoring? ☑ Yes ☐ No

If ‘No’, proceed to section B. If ‘Yes’, complete the following.

Multiple raters should always be used in SAC assessment projects that utilize rubrics or checklists. SACs have several options for ensuring that ratings are similar across each rater. The most time consuming option is for all raters to collectively rate and discuss each artifact until they reach 100% agreement on each score (this is called consensus). In most cases, SACs should consider a more efficient strategy that divides the work (a norming or calibrating session). During a norming session, all raters participate in a training where the raters individually score pre-selected student work and then discuss their reasons for giving the scores they
Disagreements are resolved and the process is repeated. When the participants feel they are all rating student work consistently, they then independently score additional examples of student work in the norming session (often 4-6 artifacts). The ratings for these additional artifacts are checked to see what percentage of the scores are in agreement (the standard is 70% agreement or higher). When this standard is reached in the norming session, the raters can then divide-up the student work and rate it independently. If your SAC is unfamiliar with norming procedures, contact Chris Brooks to arrange for coaching help for your SAC’s norming session.

Which method of ensuring consistent scoring (inter-rater reliability) will your SAC use for this project?

- **Agreement** – the percentage of raters giving each artifact the same/similar score in a norming session

If you are using agreement, describe your plan for conducting the “norming” or “calibrating” session:

Note that we developed a checklist-style (rather than a continuum-style) rubric, to evaluate student performance on each assessment question with regard to 1) accuracy of answer; 2) appropriate shown work; and 3) inclusion of appropriate units in the stated answer. We held an initial norming session using trial-run artifacts generated by students in a Statistics class (taught by a MTH LAS Co-chair), in order to evaluate and gain valuable practice with our assessment instrument and rubric. We then held another norming activity at the start of our subsequent MTH LAS artifact scoring session. In the latter case, and for all artifacts: We were ultimately able to reach 100% inter-rater agreement on all but one checklist aspect. We then focused on the agreed-upon checklist aspects (those which achieved 100% inter-rater reliability) within our subsequent dataset analysis and findings report.

- **Consensus** - all raters score all artifacts and reach agreement on each score

Though rarely used at PCC, some SACs might occasionally use the consistency measure for determining the similarity of their ratings. Consistency is generally only recommended when measuring student improvement – not for showing outcome attainment (which explains its rarity). See the Help Guide for more information. Check here if you will be using consistency calculations in this assessment.

- **Consistency** – raters’ scores are correlated: this captures relative standing of the performance ratings - but not precise agreement – and then briefly describe your plan:

3B. Have performance benchmarks been specified?

The fundamental measure in educational assessment is the number of students who complete the work at the expected/required level. We are calling this SAC-determined performance expectation the ‘benchmark.’
### LAC Assessment Report - LDC 2015-2016

#### 10

| □ Yes (determined by faculty consensus – all instructors who currently teach the course) |
| □ Yes (determined by only some of the instructors who currently teach the course) |
| □ Yes (determined by alignment with an external standard: e.g., standards published by the discipline’s professional organization) |
| ☑ Yes (determined by post-requisite course expectations within PCC) |
| □ Yes (determined by post-requisite course expectations for transfer institution) |
| □ Yes (other). Describe briefly: |
| □ No |

If yes, briefly describe your performance benchmarks, being as specific as possible (if needed, attach as an appendix):

Our assessment instrument contained a series of questions, each designed to assess a specific critically-important prerequisite math skill. Our focus was on student performance for each individual question, independent from other questions (i.e. treating our instrument as a series of sub-assessments), rather than net correct-answer count.

Our parameter of interest was defined as the population proportion of students able to successfully complete each assessment question with regard to our rubric. To determine an acceptable benchmark value for this proportion, opinions were sought from Instructors of MTH 20, MTH 58, and MTH 60. These Instructors gave professional speculation on the proportion value for the target student population, for each assessment question. These speculations ranged from 100% to 60%. The lower-bound (60%) was conservatively chosen as the (minimum acceptable) benchmark parameter value for each question.

If no, what is the purpose of this assessment (for example, this assessment will provide information that will lead to developing benchmarks in the future; or, this assessment will lead to areas for more detailed study; etc.)?

3C. The purpose of this assessment is to have SAC-wide evaluation of student work, not to evaluate a particular instructor or student. Before evaluation, remove identifying student information (and, when possible remove instructor identifying information). If the SAC wishes to return instructor-specific results, see the Help Guide for suggestions on how to code and collate. Please share your process for ensuring that all identifying information has been removed.

(This has already been described earlier in this report -- please see item 2J above.)

| 3D. Will you be coding your data/artifacts in order to compare student sub-groups? |
| ☑ Yes | □ No |

If yes, select one of the boxes below:
<table>
<thead>
<tr>
<th></th>
<th>□ student’s total earned hours</th>
<th>□ previous coursework completed</th>
<th>□ ethnicity</th>
<th>□ other</th>
</tr>
</thead>
</table>

Briefly describe your coding plan and rationale (and if you selected ‘other’, identify the sub-groups you will be coding for:

3E. Ideally, student work is **evaluated** by both full-time and adjunct faculty, even if students being assessed are taught by only full-time and/or adjunct faculty. Further, more than one rater is needed to ensure inter-rater reliability. If you feel only one rater is feasible for your SAC, please consult with an LAC coach prior to submitting your plan/conducting your assessment.

Other groups may be appropriate depending on the assessment. Check all that apply.

- ✔ PCC Adjunct Faculty within the program/discipline
- ✔ PCC FT Faculty within the program/discipline
- □ PCC Faculty outside the program/discipline
- □ Program Advisory Board Members
- □ Non-PCC Faculty
- □ External Supervisors
- □ Other:

**End of Planning Section – Complete the remainder of this report after your assessment project is complete.**
Beginning of End of Year Reporting Section – complete the following sections after your assessment project is complete.

4. Changes to the Assessment Plan

Have there been changes to your project since you submitted the planning section of this report?  

- [ ] Yes  
- [ ] No

If so, note the changes in the planning section above.

5. Results of the Analysis of Assessment Project Data
5A. Quantitative Summary of Sample/Population
How many students were enrolled in all sections of the course(s) you assessed this year? approx. 2500 (includes MTH 95, MTH 98, and select CTE courses).
If you did not assess in a course, report the number of students that are in the group you intend to generalize your results to.

How many students did you actually assessed in this project? 331
Did you use a recommended sample size (see the Sample Size Calculator linked to above)? ☒ Yes ☐ No
If you did not use a recommended sample size in your assessment, briefly explain why:

5B. Did your project utilize a rubric for scoring? ☒ Yes ☐ No
If ‘No’, proceed to section C. If ‘Yes’, complete the following.

How was inter-rater reliability assured? (If help is needed, please contact your SAC’s LAC coach.)
☒ Agreement – the percentage of raters giving each artifact the same/similar score in a norming session
☐ Consensus - all raters score all artifacts and reach agreement on each score
☐ Consistency – raters’ scores are correlated: this captures relative standing of the performance ratings - but not precise agreement
☒ Inter-rater reliability was not assured.

If you utilized agreement or consistency measures of inter-rater reliability, report the level here: 100%

5C. Brief Summary of Your Results
In most cases, report the numbers of students who attain your benchmark level and the numbers who do not. **Do not average these numbers or combine dissimilar categories (e.g., do not combine ratings for communication and critical thinking together).** If your project measures how many students attain the overall benchmark level of performance, report the summary numbers below (choose one):

1. If you used frequencies (the actual number who attained the desired level(s) and the actual number who
did not), report those here for each of your criteria for this learning outcome. For example, “46 students attained the benchmark level over-all in written communication and 15 did not. Our SAC used 5 criteria within this rubric: 46 student achieved the benchmark level in idea expression (15 did not); 54 achieved the benchmark level for use of standard English (10 did not); etc.”

2. If your project used percentages of the total to identify the degree of benchmark attainment in this project, report those here for each of your criteria for this learning outcome. For example, “75% of 61 students attained the benchmark level over-all in written communication. Our SAC used 5 criteria within this rubric: 75% of students achieved the benchmark level in idea expression; 89% achieved the benchmark level for use of standard English; etc.”

Our research was designed to estimate (with approximately 95% confidence and ≤ 5% margin of error) the population proportion of PCC MTH 95, MTH 98, and CTE (Automotive, Machining) students able to successfully demonstrate working retention of seven specific critically important prerequisite math skills taught in PCC MTH 20 and MTH 58. The lowest math faculty speculation claim for this population success proportion was 60%.

In all but one case (Combining Fractions), we found statistically significant evidence against this claim [the sample proportions achieving answer accuracy for each of the seven critical skill areas (in decreasing order) were 68%, 53%, 49%, 47%, 45%, 38%, and 32%]. Instead, our evidence indicates that such students are unable (or inadequately prepared) to demonstrate working retention of these critical math skills at faculty-assumed minimally acceptable levels.

Our data further reveals a lowering proportion trend as the assessment depth increases. For instance, regarding our assessment item on Count-to-Percentage Conversion: With increasing assessment depth, the associated sample success proportions were 32% (accuracy of answer only); 26% (accuracy and appropriate shown work); and 20% (accuracy, appropriate shown work, and inclusion of appropriate units in the answer). Indeed, this same pattern of decreasing success proportions with increasing assessment depth is observed within all of the seven critical math skill category areas (please see Appendix D for full result details and breakdown).

5D. Attach a more detailed description or analysis of your results (e.g., rubric scores, trend analyses, etc.) as an appendix to this document. Appendix attached? ☒ Yes ☐ No

5E. What did the SAC learn about your students’ attainment of your important benchmarks from this
assessment? For example, “We are pleased that most of our students are using standard English in their writing, but want to improve our students’ ability to express ideas clearly....”

If our approach and premises are sound: Our findings suggest that PCC students about to enter Statistics, or already active within CTE Automotive and Machining, are unable (or inadequately prepared) to demonstrate minimally-acceptable working retention of select prerequisite-level mathematics skills deemed critically important for success in these study paths. This may imply that such students could significantly benefit from interventions designed to address these specific potential weaknesses -- thus improving overall rates of student success and completion within these PCC programs.

5F. Do the results of this project suggest that academic changes might be beneficial to your students (changes in curriculum, content, materials, instruction, pedagogy etc.)?  ☒ Yes  ☐ No

If you answered ‘Yes,’ briefly describe the changes to improve student learning below. If you answered ‘No’, detail why no changes are called for.

The MTH SAC is very large, and the proper MTH LAS role is to assess student learning rather than dictate change. Our results have been forwarded to the current MTH SAC Co-Chairs, and also to appropriate MTH CCOG Subcommittee Chairs (MTH 20, MTH 58) to evaluate this information, recommend any academic changes deemed reasonable and desirable, and to craft implementation (including timeline) of any such changes. These MTH CCOG Subcommittee Chairs have expressed interest in addressing these results within their subcommittees. Time will be required for those teams to appropriately pursue the matter.

If you are planning changes, when will these changes be fully implemented?
(Please see answer immediately above).

5G. Has all identifying information been removed from your documents? (Information includes student/instructor/supervisor names/identification numbers, names of external placement sites, etc.)  ☒ Yes  ☐ No

6. SAC Response to the Assessment Project Results

6A. Assessment Tools & Processes: Indicate how well each of the following worked for your assessment:

Tools (rubrics, test items, questionnaires, etc.):
☐ very well  ☒ some small problems/limitations to fix  ☐ notable problems/limitations to fix  ☐ tools completely inadequate/failure
Please comment briefly on any changes to assessment tools that would lead to more meaningful results if this assessment were to be repeated (or adapted to another outcome).

- We need to determine how to properly code answers left blank in otherwise completed artifacts -- i.e. should these be considered as "incorrect", or merely skipped (but not counted as incorrect).
- We should further explore certain rubric aspects for which we were unable to achieve full inter-rater reliability (and as such, those rubric aspects were not included in our subsequent results analysis).
- We should consider having associated MTH CCOG Subcommittees create questions and rubrics for MTH LAS assessment instruments. This could streamline project work, increase buy-in and participation, and open an avenue for subsequent evaluation and change actions (if any).

Processes (faculty involvement, sampling, norming, inter-rater reliability, etc.):
- very well
- some small problems/limitations to fix
- notable problems/limitations to fix
- tools completely inadequate/failure

Please comment briefly on any changes to assessment process that would lead to more meaningful results if this assessment were to be repeated (or adapted to another outcome).

- Depending upon existing goals and time availability: MTH LAS Chair/Co-chairs may wish to predetermine major project aspects (such as outcome selection and research questions), to optimize subsequent meeting productivity and streamline/accelerate group work efforts.
- We need to find appropriate ways to include online course sections/students in our assessment projects (very important).
- We should find improved ways to include and reward participation from part-time faculty members.

7. Follow-Up Plan

7A. How will the changes detailed in this report be shared with all FT/PT faculty in your SAC? (select all that apply)
- email
- campus mail
- phone call
- face-to-face meeting
- workshop
- other
The MTH SAC is very large. The current MTH SAC Co-Chairs, and appropriate MTH CCOG Subcommittees (MTH 20, MTH 58) have received and will review our project findings. Changes to curriculum content, instruction, pedagogy/andragogy, etc. (if any) will then be determined by these parties, along with appropriate methods for sharing such changes with the entire MTH SAC.

7B. Is further collaboration/training required to properly implement the identified changes?  ☑ Yes  ☐ No

If ‘Yes,’ briefly detail your plan/schedule below.

Further collaboration within the MTH SAC would likely be necessary to implement any identified changes. However, any such changes remain yet to be determined (see 7A above).

7C. Re-assessment is a critical part of the overall assessment process. This is especially important if academic changes have been implemented. How will you assess the effectiveness of the changes you plan to make?

☐ follow-up project in next year’s annual report  ☐ on-going informal assessment

☐ in a future assessment project  ☑ other

If ‘other,’ please describe briefly below.

If any changes are recommended and implemented by the appropriate parties (as described in 5F and 7A above), then we do currently intend to re-assess as part of a future project in order to measure the effectiveness of such changes.

7D. SACs are learning how to create and manage meaningful assessments in their courses. This development may require SAC discussion to support the assessment process (e.g., awareness, buy-in, communication, etc.). Please briefly describe any successful developments within your SAC that support the quality assessment of student learning. If challenges remain, these can also be shared.

- The MTH SAC has been instrumental in evolving PCC’s current approach and tools for accurate placement of students into appropriate math courses – which should make assessments more meaningful through a more refined sampling frame.
- Math course pathways have been shortened and customized for students headed in different goal directions (e.g. CTE, Statistics,
which should open myriad targeted assessment opportunities for these sub-populations.

- Course-level MTH Subcommittees form and meet on a regular schedule to continually re-examine CCOG documents, course materials, and new developments in our field -- all of which can inform and contribute to the assessment cycle.

- Exploring various innovative online tools and instructional technologies constitutes a lively and active process in the MTH SAC. These innovations offer valuable potential to support, enhance, and directly provide quality assessment of student learning.

Communicating and coordinating major actions throughout such a large number of FT and PT faculty remains an ongoing challenge for the MTH SAC. Finding new and better ways to involve and reward participation from all faculty members, and to foster and improve inter-disciplinary collaboration, are additional areas where we hope to grow and progress in the future.
Appendix A

Assessment Instrument
1) You have two same-size water buckets. The first is $\frac{5}{8}$ full. The second is $\frac{1}{7}$ full. If you pour the second bucket contents into the first, how full in total will this make the first bucket? Answer as a fully-reduced fraction.

2) The following set contains eight values written in various forms:

$$\left\{ \frac{17}{35}, \frac{1}{8}, \frac{2}{3}, \frac{1}{5}, 0.85, \frac{9}{10}, \frac{59}{100} \right\}$$

Place marks on the number line below, showing where each value is located. Underneath each mark, write the accompanying value in its original form. Do not draw lines from the values to the number line.
3) The outdoor temperature was 65 °F when you woke up. Three hours later, it was 83 °F. If the temperature rose at a constant rate, what was the temperature 90 minutes after you woke up?

4) A certain city has a population of 30,000 people.
   a) If 84% of the population has black hair, how many people in this city do we expect to have black hair?
   b) If 600 people in this same city have red hair, what percentage of the total city population has red hair?

5) At a constant speed, a bicyclist traveled 600 meters in 2 minutes. How fast was the bicyclist moving in meters per second?
Appendix B

Assessment Rubric
(Checklist-Style)
Assessment Tool Rubric

MTH LAS 2015-2016

Scoring Rubric

<table>
<thead>
<tr>
<th>1) Water buckets</th>
<th>yes = 1, no = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Result: 43/56</td>
</tr>
<tr>
<td>U</td>
<td>Units: “full”, “of a bucket”, or similar</td>
</tr>
<tr>
<td>P</td>
<td>Process?</td>
</tr>
<tr>
<td>S</td>
<td>Syntax?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2) Marks on number line</th>
<th>yes = 1, no = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Correct order: 0.1, 1/6, 1/3, 17/35, 59/100, 2/3, 0.85, 9/10</td>
</tr>
<tr>
<td>U</td>
<td>Approximately correct locations: Figure 1</td>
</tr>
</tbody>
</table>

Figure 1: Correct locations of marks on number line

<table>
<thead>
<tr>
<th>3) Temperature</th>
<th>yes = 1, no = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Result: 74</td>
</tr>
<tr>
<td>U</td>
<td>Units: degrees or degrees Fahrenheit</td>
</tr>
<tr>
<td>P</td>
<td>Process?</td>
</tr>
<tr>
<td>S</td>
<td>Syntax?</td>
</tr>
<tr>
<td>4a) Black hair</td>
<td>yes = 1, no = 0</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>R</strong></td>
<td>Result: 25,200</td>
</tr>
<tr>
<td><strong>U</strong></td>
<td>Units: people</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td>Process?</td>
</tr>
<tr>
<td><strong>S</strong></td>
<td>Syntax?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4b) Red hair</th>
<th>yes = 1, no = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R</strong></td>
<td>Result: 2%</td>
</tr>
<tr>
<td><strong>U</strong></td>
<td>Units: % of people</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td>Process?</td>
</tr>
<tr>
<td><strong>S</strong></td>
<td>Syntax?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5) Bicyclist</th>
<th>yes = 1, no = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R</strong></td>
<td>Result: 5</td>
</tr>
<tr>
<td><strong>U</strong></td>
<td>Units: meters per second</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td>Process?</td>
</tr>
<tr>
<td><strong>S</strong></td>
<td>Syntax?</td>
</tr>
</tbody>
</table>

**Guidelines**

- Result
  - “1” if correct
  - “0” otherwise, including
    - arithmetic error
- **Units**
  - “1” if student indicates units/meaning in a reasonable way
  - “0” otherwise
- **Process**
  - “1” if student has indicated her/his/their mathematical process
  - “0” otherwise
- **Syntax**
  - “1” if student has used mathematical syntax and notation correctly
  - “0” otherwise, including
    - use of an inappropriate process
    - incorrect mathematical notation or syntax
Appendix C

Sample-Size Calculation

(Screenshot)
<table>
<thead>
<tr>
<th>Question</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>What margin of error can you accept?</td>
<td>5%</td>
</tr>
<tr>
<td>What confidence level do you need?</td>
<td>95%</td>
</tr>
<tr>
<td>What is the population size?</td>
<td>2500</td>
</tr>
<tr>
<td>What is the response distribution?</td>
<td>50%</td>
</tr>
<tr>
<td>Your recommended sample size is</td>
<td>334</td>
</tr>
</tbody>
</table>

The margin of error is the amount of error that you can tolerate. If 90% of respondents answer yes, while 10% answer no, you may be able to tolerate a larger amount of error than if the respondents are split 50-50 or 45-55.

Lower margin of error requires a larger sample size.

The confidence level is the amount of uncertainty you can tolerate. Suppose that you have 20 yes-no questions in your survey. With a confidence level of 95%, you would expect that for one of the questions (1 in 20), the percentage of people who answer yes would be more than the margin of error away from the true answer. The true answer is the percentage you would get if you exhaustively interviewed everyone.

Higher confidence level requires a larger sample size.

How many people are there to choose your random sample from? The sample size doesn’t change much for populations larger than 20,000.

For each question, what do you expect the results will be? If the sample is skewed highly one way or the other, the population probably is, too. If you don’t know, use 50%, which gives the largest sample size. See below under More information if this is confusing.

This is the minimum recommended size of your survey. If you create a sample of this many people and get responses from everyone, you’re more likely to get a correct answer than you would from a large sample where only a small percentage of the sample responds to your survey.
Appendix D

Results Analysis

(Adapted from MTH SAC Presentation)
Percentage of Sample with Correct Result

(Population values lie within ± 5% margin with 95% confidence)

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combine Fractions</td>
<td>68%</td>
</tr>
<tr>
<td>Prop. (Linear)</td>
<td>53%</td>
</tr>
<tr>
<td>Number Location</td>
<td>49%</td>
</tr>
<tr>
<td>Dim. Analysis</td>
<td>47%</td>
</tr>
<tr>
<td>Number Ordering</td>
<td>45%</td>
</tr>
<tr>
<td>% to Count</td>
<td>38%</td>
</tr>
<tr>
<td>Count to %</td>
<td>32%</td>
</tr>
</tbody>
</table>
Initial Observations

- All areas but one, are below minimum acceptable level
- Only includes result accuracy
- What would a deeper-level assessment show?
Assessment Depth Levels

1. Result; or
2. Result & Process; or
3. Result, Process, Units
Proportional / Linear Reasoning

- Result: 53%
- Result, Process: 50%
- Result, Process, Units: 49%
Convert: % to Counts

- Result: 38%
- Result, Process: 36%
- Result, Process, Units: 24%
Convert: Counts to %

- Result: 32%
- Result, Process: 26%
- Result, Process, Units: 20%
Dimensional Analysis / Unit Conversion

- Result: 47%
- Result, Process: 45%
- Result, Process, Units: 43%
On Greater Assessment Depth...

- Rates get *progressively worse*
- Same pattern in every skill area
- All areas fall *significantly* under minimum acceptable levels