30-Day Due-Process Response to the ETAC-ABET Draft Statement

for the

Bachelor of Science in Mechanical Engineering Technology Program

at

Central Washington University Ellensburg, WA

Visit Dates: October 29-31, 2017
Draft Statement Date: December 11, 2017
Due-Process Response Date: January 22, 2018
Accreditation Cycle Criteria: 2017-2018

Introduction

A Draft Statement presenting the findings of the Engineering Technology Accreditation Commission of ABET was received on December 11, 2017. This document constitutes the 30-Day Response of CWU to the two (2) weaknesses identified in the Draft Statement.

Criterion 4. Continuous Improvement

This criterion states: "The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations much be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program."

Status: "This finding remains a Weakness until the program can demonstrate that: (1) the program uses appropriate and documented processes to assess student outcomes and evaluate the extent to which outcomes are attained; and (2) that the results of these evaluations are systematically utilized as input for the continuous improvement of the program."

Corrective Actions Taken to Date:

1. Enhanced indicators:
   It was recorded in the Draft Statement of findings by the ABET visiting team that Central Washington University (CWU) Mechanical Engineering Technology (MET) "assessments are very limited in their breadth and do not provide adequate data upon which to make decisions." This statement was due to MET's reliance on the MET 488 FE Practice course and the data provided by NCEES. This has been amended by adding assessments in MET course work. For ABET outcomes 3B a-k, the following assessments were added beginning academic year (AY) 2017-18:
   3a, MET 418 (Mechanical Design I) and MET 419 (Mechanical Design II).
   3b, MET 418 (Mechanical Design I).
   3c, MET 351 (Materials) and MET 426 (Applied Mechanics of Materials).
   3d, MET 418 (Mechanical Design I).
   3e, none as this did not rely on MET 488 or NCEES data.
   3f, MET 351 (Materials) and MET 426 (Applied Mechanics of Materials).
   3g, none as this did not rely on MET 488 or NCEES data.
   3h, MET 387 (Ethics).
   3i, MET 387 (Ethics).
   3j, MET 387 (Ethics).
   3k, MET 489A (Senior Project I)

   There are 12 new indicators and metrics beginning in AY2017-18. The additional metrics are highlighted in Exhibit 1. Six of the new metrics were assessed during fall quarter 2017. These six metrics were reviewed during the first three weeks of January 2018 by the MET Faculty and the MET Industrial Advisory Board (IAB). Documentation of this interaction is included in Exhibit 3.

2. Enhanced assessment and continuous improvement using Plan, Do, Check, Act (PDCA):
   The CWU MET faculty will implement the Plan, Do, Check, Act cycle for all student outcomes. This will entail:
   - Plan: Comments on assessment data and identification of problem(s).
   - Do: Development of action items to address comments or correct problem(s).
   - Check: Review of results of action items.
   - Act: Determination if action items were effective or if further action is required.

3. All student work to be included:
   The CWU MET program is not a large program. This will result in small samples sizes for the metric data being collected. This means the CWU MET program will utilize best practices and will not inappropriately remove student data.

4. Documented timeline of PDCA:
   In the Mechanical Engineering Technology (MET) program the faculty have direct control of curriculum and student outcome development. Review, by the faculty, of the Student Objectives (SOs) for ABET Criterion 3 baccalaureate and ABET Program Criteria for Mechanical Engineering Technology baccalaureate program happens at the end of each quarter.

   The instructors' place their ABET metric data in the appropriate file in the course outcomes data folder. These data are then used to generate the graphs of each assessment metric.

   At an MET program coordination meeting, the graphs are reviewed and discussed. The faculty then document the continuous improvement process in the ABET Continuous Improvement document (See Appendix A or B).

   The ABET Continuous Improvement document is then placed on a Google drive. An email is sent to the Industrial Advisory Board (IAB) notifying them there is outcome data to review. A review by date is also included.

   On the IAB review by date, a phone conference call is held (MET faculty and IAB) to review the outcome data. The MET faculty provide any additional information the IAB may need, and the IAB provides feedback to the MET Faculty for each of the outcomes being reviewed. The IAB feedback is recorded in the meeting notes and/or included in the Continuous Improvement document. For AY2017-18, the IAB is consulted for feedback at the end of every quarter. However, the review with the Industrial Advisory Board (IAB) will revert to the schedule shown in Exhibit 4 starting 2018-19. The IAB is a major influence and is counted on to provide input on the SO and program criteria review.

   After reviewing the data with the IAB, the MET faculty meet to discuss whether, based on the findings about student performance, changes need to be made to the curriculum, courses, assignments, data capture opportunities, etc. These changes are then put in place as soon as possible (e.g., a changed assignment the next time a given course is taught).

Example (3b):

In response to the poor scores for ABET Outcome 3b, the following continuous improvement cycle has been implemented.

20180105 Continuous Improvement:

Plan

MET 418 lever lab stress analysis data indicate that the students are not performing well.
Practice FE Statics data meet or exceed the threshold. The downward trend is noted.
Practice FE Dynamics data are stable and meeting the threshold.
Practice FE Mechanics of Materials data are stable but below the threshold.
NCEES Statics data meet or exceed the threshold.
NCEES Dynamics data meet or exceed the threshold.
NCEES Mechanics of Materials data meet or exceed the threshold.

The direct measure of all the MET students shows poor performance in basic mechanics of engineering. The NCEES scores are all above the threshold; however, better students were more likely to take the NCEES exam.

Do

The deficiencies in the MET 418 lever lab stress analysis and the Mechanics of Materials Practice FE scores need to be addressed. MET faculty are working with the faculty that teach Statics and Mechanics of Materials to institute changes. Beginning AY2017-18, there will be: 1) more free body diagram (FBD) quizzes in Statics; 2) at least one FBD quiz per week in Mechanics of Materials. There will also be a FBD and integration problem on the Statics and Mechanics of Materials final exams. These will be assessed using a rubric.

Check

The results of these efforts cannot be assessed until the end of fall quarter 2018. The MET faculty and the Industry Advisory Board will review the results.

Act

A course of action will be determined (winter quarter 2019) after reviewing the results of the actions described above.

The complete ABET Continuous Improvement document for ABET Outcome 3b is shown in Appendix A.

Corrective Actions to Be Taken:

The following corrective actions will be summarized in the Post 30-Day response NLT May 31, 2018:

1. Build out remaining indicators:
   Some of the new metrics are in courses that are not taught until winter or spring quarters. The assessment rubrics will be created and executed. The data will be deposited in the appropriate file in the course outcome data folder. This data will then be used to generate

the graphs of each assessment metric. At the MET program coordination meeting, the graphs will be reviewed and discussed. The faculty will then document the continuous improvement process in the ABET Continuous Improvement document (See Appendix A or B). The ABET Continuous Improvement document will then be placed on the IAB Google drive. An email will go out notifying the Industrial Advisory Board (IAB) there is something to review and by when it needs to be reviewed.

A phone conference call will be held (MET faculty and IAB) to review the outcome data. The MET faculty will provide any additional information the IAB needs, and the IAB will provide feedback to the MET faculty for each of the outcomes being reviewed. The IAB feedback will be recorded in the meeting notes and/or included in the Continuous Improvement document.

2. Plan, Do, Check, Act for each Student Outcome:
   As discussed above, the Plan, Do, Check, Act (PDCA) cycle will be the standard for the CWU MET program continuous improvement. An ABET Continuous Improvement document has been or will be created for each ABET Student Outcome. For AY2017-18 every metric will be reviewed each quarter and assessed using the PDCA cycle of documentation. Once the ABET Continuous Improvement document PDCA cycle is updated, the metric will be presented to the IAB for comment. After the AY2017-18, the review cycle will be as shown in Exhibit 4.

Program Criteria for Mechanical Engineering Technology and Similarly Named Programs:
"The mechanical engineering technology discipline encompasses the areas (and principles) of materials, applied mechanics, computer-aided drafting/design, manufacturing, experimental techniques/procedure, analysis of engineering data, machine/mechanical design/analysis, conventional or alternative energy system design/analysis, power generation, fluid power, thermal/fluid system design/analysis, plant operation, maintenance, technical sales, instrumentation/control systems, and heating, ventilation, and air conditioning (HVAC), among others. As such, programs outcomes, based on specific program objectives, may have a narrower focus with great depth, selecting fewer areas, or a broader spectrum approach with less depth, drawing form multiple areas. However, all programs must demonstrate an applied basis in engineering mechanics/sciences."

Status: "This finding remains a Weakness until the program can demonstrate that: (1) the program uses appropriate and documented processes to assess student outcomes and evaluate the extent to which outcomes are attained; and (2) that the results of these evaluations are systematically utilized as input for the continuous improvement of the program."

Corrective Actions Taken to Date:

1. Enhanced indicators:
   It was recorded in the Draft Statement of findings by the ABET visiting team that Central Washington University (CWU) Mechanical Engineering Technology (MET) "assessments are very limited in their breadth and do not provide adequate data upon which to make decisions." This statement was due to MET's reliance on the MET 488 FE Practice course and the data provided by NCEES. This has been amended by adding assessments in MET course work. For ABET Program Outcome (M) a-h, the following assessments were added beginning academic year (AY) 2017-18:
   Ma, none as this already had two assessments other than MET 488 and NCEES.
   Mb, MET 426 (Applied Mechanics of Materials).
   Mc, ETSC 311 (Statics) and ETSC 312 (Mechanics of Materials).
   Md, ETSC 311 (Statics), ETSC 312 (Mechanics of Materials), and MET 327 (Dynamics).
   Me, MET 351 (Materials).
   Mf, MET 314 (Thermodynamics) and MET 315 (Fluid Dynamics).
   Mg, EET 221 (Basic Electricity).
   Mh, none as this did not rely on MET 488 or NCEES data.

   There are 10 new metrics that began in academic year 2017-18. The additional metrics are highlighted in Exhibit 2. Five of the new metrics were assessed during fall quarter of 2017-18. These five metrics were reviewed during the first three weeks of January 2018 by the MET faculty and the MET Industrial Advisory Board (IAB). Documentation of this interaction is included in Exhibit 3.

Example (Mf):
In response to the poor scores for ABET Outcome Mf, the following continuous improvement cycle has been implemented.

20180105 Continuous Improvement:

Plan

MET 314 Student performance is dropping; Figure 1 (Rankine Steam simple cycle, final exam) shows a strongly declining trend. Figure 2 (Practice FE ratio score, all CWU MET students) shows downward trend and below standard; Figure 6 (NCEES ratio score, CWU vs. national average; for test takers only) values are stable and consistently above national average.
MET 315 Figure 2 is placeholder chart, data set not finalized yet; Figure 4 (Practice FE ratio score, all CWU MET students) shows stable values with values above standard (all students); Figure 7 (NCEES ratio score, CWU vs. national average; for test takers only) shows data stable and above standard.
MET 316 Figure 5 (Practice FE ratio score, all CWU MET students) is stable and above standard; Figure 8 (NCEES ratio score, CWU vs. national average; for test takers only) is stable and above standard.

Do

MET 314: Try incorporating online homework (McGraw Hill Connect) with immediate response and solutions. Students' weak point is usually integrating information into thermo cycles. This change was implemented in 2016.
MET 315: No corrective actions considered necessary; continuing with normal continuous improvement efforts.
MET 316: No corrective actions considered necessary; continuing with normal continuous improvement efforts.

Check

MET 314: Online homework appeared to help some students; however, they also got used to the tables being presented to them in the homework problem and did not realize the tables were in the text appendix. This adversely affected some test grades. The decrease in 2017 student performance (Figure 1) included the effect of class schedule changing so that thermo cycles were not introduced until almost Thanksgiving, with the related distractions and holiday schedule discontinuity.
MET 315: No corrective actions to review.
MET 316: No corrective actions to review.

Act

MET 314: Spend less time on properties and processes to get another week or more of cycles into schedule. For Fall 2018, develop worksheets for Otto, Diesel, Rankine steam and R134a cycles, psychrometric chart processes. Replace Dual Cycle homework problem that was confusing to students.
MET 315: No corrective actions to review.
MET 316: No corrective actions to review.

Corrective Actions to Be Taken:
The following corrective actions will be summarized in the Post 30-Day response NLT May 31, 2018:

1. Build out remaining indicators:
   Some of the new metrics are in courses that are not taught until winter or spring quarters. The assessment rubrics will be created and executed. The data will be deposited in the appropriate file in the course outcome data folder. This data will then be used to generate the graphs of each assessment metric. At the MET program coordination meeting, the graphs will be reviewed and discussed. The faculty will then document the continuous improvement process in the ABET Continuous Improvement document (See Appendix A or B). The ABET Continuous Improvement document will then be placed on the IAB Google drive. An email will go out notifying the Industrial Advisory Board (IAB) there is something to review and by when it needs to be reviewed.

   A phone conference call will be held (MET faculty and IAB) to review the outcome data. The MET faculty will provide any additional information the IAB needs, and the IAB will provide feedback to the MET faculty for each of the program criteria outcomes being reviewed. The IAB feedback will be recorded in the meeting notes or included in the Continuous Improvement document.

2. Plan, Do, Check, Act for each Program Criterion:
   As discussed above, the Plan, Do, Check, Act (PDCA) cycle will be the standard for the CWU MET program continuous improvement. A ABET Continuous Improvement document has been or will be created for each ABET Outcome. For AY2017-18 every metric will be reviewed each quarter and assessed using the PDCA cycle of documentation. Once the ABET Continuous Improvement document PDCA cycle is updated, the metric will be presented to the IAB for comment. After AY2017-18, the review cycle will be as shown in Exhibit 4.

Exhibit 1. Mapping of the Program's Student Outcomes to Criterion 3.

	3(a) an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;	3(b) an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies	3(c) an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes	3(d) an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives	3(e) an ability to function effectively as a member or leader on a technical team	3(f) an ability to identify, analyze, and solve broadly-defined engineering technology problems	3(g) an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature	3(h) an understanding of the need for and an ability to engage in self-directed continuing professional development	3(i) an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity	3(j) a knowledge of the impact of engineering technology solutions in a societal and global context	3(k) a commitment to quality, timeliness, and continuous improvement
EET 221											
ETSC 160											
ETSC 265											
ETSC 301											
ETSC 311											
ETSC 312											
MET 255	*	*				*					
MET 314	*	*	*		*	*	*			*	
MET 315	*	*	*		*	*	*			*	
MET 327	*	*	*	*	*	*	*				
MET 351		*	ABET		*	ABET	*			*	
MET 387	*	*			*			ABET	ABET	ABET	
MET 418	ABET	ABET		ABET	ABET	*					*
MET 419	ABET			*	ABET	*					*
MET 426			ABET			ABET	*			*	
MET 488	ABET	ABET	ABET			ABET		ABET	ABET	ABET	
MET 489A				ABET			ABET				ABET
MET 489B				ABET			ABET				ABET
MET 489C			ABET			ABET	ABET				ABET
NCEES	ABET	ABET	ABET			ABET		ABET	ABET	ABET	

Note: * = Topic assessed, ABET = Data collected.

Exhibit 2. Mapping the Program's Student Outcomes to Program Criteria.

	(a) geometric dimensioning and tolerancing; computer aided drafting and design; and a basic knowledge and familiarity with industry codes, specifications, and standards	(b) selection, set-up, and calibration of instrumentation and the preparation of laboratory reports and systems documentation associated with the development, installation, or maintenance of mechanical components and systems	(c) basic engineering mechanics	(d) differential and integral calculus	(e) manufacturing processes; material science and selection; solid mechanics (such as statics, dynamics, strength of materials, etc.) and mechanical system design	(f) thermal sciences, such as thermodynamics, fluid mechanics, heat transfer, etc.	(g) electrical circuits (ac and dc), and electronic controls	(h) application of industry codes, specifications, and standards; and using technical communications, oral and written, typical of those required to prepare and present proposals, reports, and specifications
EET 221							ABET	
ETSC 160	*							
ETSC 265	*							
ETSC 301								
ETSC 311			ABET	ABET				
ETSC 312			ABET	ABET				
MET 255								
MET 314		*				ABET		
MET 315		*				ABET		
MET 327		*		ABET				
MET 351					ABET			*
MET 387								
MET 418			*	*	*			ABET
MET 419			*		*			*
MET 426	*	ABET	*		ABET			ABET
MET 488	ABET	ABET	ABET	ABET	ABET	ABET	ABET	
MET 489A	ABET				*			*
MET 489B	ABET				*			*
MET 489C					*			ABET
NCEES	ABET	ABET	ABET	ABET	ABET	ABET	ABET	

Note: * = Topic assessed, ABET = Data collected.

Exhibit 3. IAB and MET Faculty Review of ABET Continuous Improvement document meeting notes.

From: Harmon-III, Charles H <charles.h.harmon-iii@boeing.com>
Sent: Thursday, January 18, 2018 10:31 AM
To: Patrick Kinney; Amanda Hede; Moravec, Bradford A; Bennett, Julie K; rosemary@hobartmachined.com; Charles Pringle; MET; 'ben.t.grogan@gmail.com'; Bernadette Jungblut
Subject: CWU IAB Meeting Minutes 01-17-18
Attachments: Patrick Kinney ABET Outcome Data Review Comments.docx

All,

I believe our meeting last night via 'freeconferencecall' was successful.

Attendees:
Ben Grogan
Charles Pringle
Bernadette Jungblut
Craig Johnson
Chuck Harmon (me)

We reviewed metrics 3a-3f and M{acfgh}. We asked questions and provided comments from our week of reviewing the documents. Charles Pringle captured our comments/markups real-time in the version of documents stored on the "S-Drive."

The suggestion was made to shift to a footnote style of metric description for each figure. Having the description and the figures on different pages was a drawback to the current format.

Minor corrections were made to some metric descriptions, Y-axis labels, and threshold placements, etc. In the future, I think the IAB should take responsibility for proofreading all aspects of the metrics
(Writing and charts). This will also give us more flexibility in developing our own metrics—recommendations of course ;-)

In general, all metrics which contained sufficient data to develop a trend were looked at closer than those which only contained a single data point. Metrics with more than one data point which showed negative sloping trends or below threshold trends had already been identified by faculty. For these metrics "PLAN" and "DO" actions were mostly already complete and the IAB members agreed with both. In some cases we captured additional details which we thought would help clarify the "PLAN" and
"DO."

Metrics which warranted action are as follows:
3b Figure 2 Statics
3b Figure 4 Mechanics of Materials

Mc Figure 3 Statics
Mc Figure 4 Mechanics of Materials
Mf Figure 1 Thermodynamics

Additional comments from Patrick Kinney who missed our meeting are attached this email.

Amanda,
I'm keeping you on the distribution list for the IAB. I think your excuse for bowing out weren't good enough. LOL. In all seriousness, the IAB participation has been weak and I'd like to keep you on the email distributions in case the stars align and you are able to attend a meeting. We value your opinion.

Everyone else,
Please be watching for our next meeting notice. I will be targeting middle to late February. If you have any questions feel free to contact me via email.

Thanks. -CH

Patrick Kinney ABET Outcome Data Review Comments
1.18.2018

General Notes:

- Figures in each metric: the sample size data doesn't appear to line up with the corresponding score data point. I would expect the sample size data point to line up vertically with the CWU scoring data?
- Titles could be renamed along the lines of "CWU ABET Criterion 3B Section A – Continuous Improvement" for additional clarity
- Description of Metrics section is typically a dense wall of text. Suggest bullets to help separate each figures descriptions or spaces added between.
- Figures in various sections often have different line weights/styles.

2017-18_ABET_3a

- Title of document should add missing letter to point to correct ABET criterion section "CWU ABET 3Ba Continuous Improvement"
- Description of metrics could use additional explanations for each figure
    - For example: "Figure 1 shows the average score of the MET 418 (Mechanical Design I) students solving a variety of topic problems ranging from springs to gears"

2017-18_ABET_3b

- I like the level of explanation included in the "Description of Metric" section. This should be carried to ABET 3a.

2017-18_ABET_3c

- Figure 4, since threshold and sample size are measuring the same thing as each other figure their colors should be changed to match (gray threshold, yellow sample size). With different colors it implies different metrics/definitions of measurement.
- Figure 4, the darker line should be moved behind the lighter line (black behind red) to aid in clarity

2017-18_ABET_3d

- In Description of Metrics section, Figure 1 could use added clarity/explanation along the lines of figure 2/3 descriptions. What is the lever? What parameters are they scored on? Etc.

2017-18_ABET_3e

- Figure 2 data points are hard to read when stacked on top of each other. It is clear they all scored the same, but the CWU_role and CWU_work are completely hidden. Maybe add transparency to a few of the data points to aid in seeing each data point?
- Figure 3, sample sizes are shown for various years without corresponding average score data. Not sure if this adds any detail when there is no score data. At first glance it makes the reader assume something is wrong with the graph the average score data just isn't shown.

2017-18_ABET_3f

- Figure 4, since threshold and sample size are measuring the same thing as each other figure their colors should be changed to match (gray threshold, yellow sample size). With different colors it implies different metrics/definitions of measurement.
- Figure 4, the darker line should be moved behind the lighter line (black behind red) to aid in clarity

2017-18_ABET_Ma

- Title of the document is non-intuitive for someone unfamiliar with the ETAC document as there is no section "M" in the document. Maybe changing the title to something along the lines of "CWU ABET MET Section A – Continuous Improvement" would be appropriate?
- Description of Metrics needs to be updated for Figures 2 and 3
- Figures 1-4, score/threshold line weights are not consistent

2017-18_ABET_Mc

- Description of Metric section needs to be updated
- Figure 1 threshold data line needs to be changed to gray. The data label also needs to be changed to gray.
- Figure 3 line weight is not consistent with the other figures

2017-18_ABET_Mf

- I like the spacing in the Description of Metric section. Please carry this through on the other documents.
- Review/Plan/Act section could potential benefit in readability if the text after the title was started on a new line or used a bullet.

2017-18_ABET_Mg

- No specific comments

2017-18 ABET Mh

- No specific comments

Exhibit 4. Student Outcomes review schedule.

	Schedule	
ABET Criterion 3 SO	Year 1,3,5 Fall	Year 2,4,6 Spr
3a.		X
3b.		X
3c.	X	
3d.		X
3e.		X
3f.	X	
3g.	X	
3h.		X
3i.		X
3j.		X
3k.	X	
Program Criterion SO		
Ma.		X
Mb.		X
Mc.	X	
Md.	X	
Me.		X
Mf.		X
Mg.	X	
Mh.	X	

Appendix A. ABET Continuous Improvement, Student Outcome 3b.

Student Outcome: 3 B b. “an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.”

Source: http://www.abet.org/wp-content/uploads/2016/12/T001-17-18-ETAC-Criteria-10-29-16-1.pdf

This document is organized in the following manner:

1. Presentation of assessment data.
2. Description of metric.
3. Plan: Comments on assessment data and identification of problem(s).
4. Do: Development of action items to address comments or correct problem(s).
5. Check: Review of results of action items.
6. Act: Determination if action items were effective or if further action is required.
7. Meta data

Assessment Data:

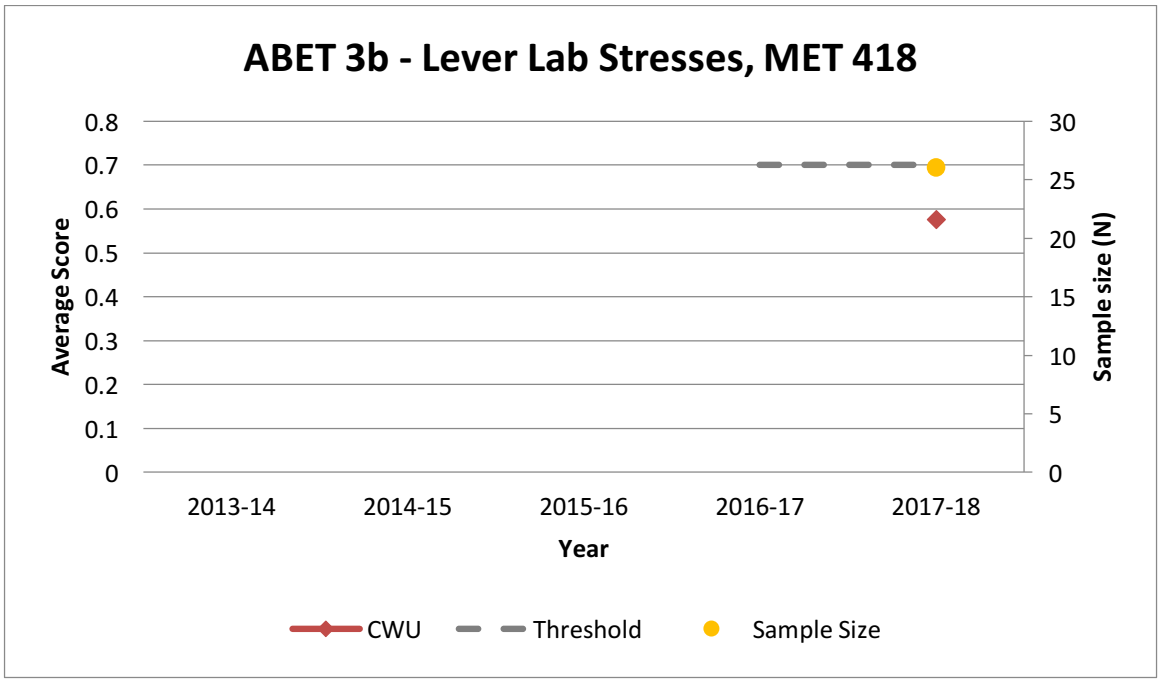

Figure 1. Students Knowledge of Calculating Stresses.

Figure 1 shows the average score for MET 418 – Mechanical Design I students (typically taken fall of senior year) on their ability to identify and calculate the various stresses (ie. Normal, flexure, direct shear) on a device.

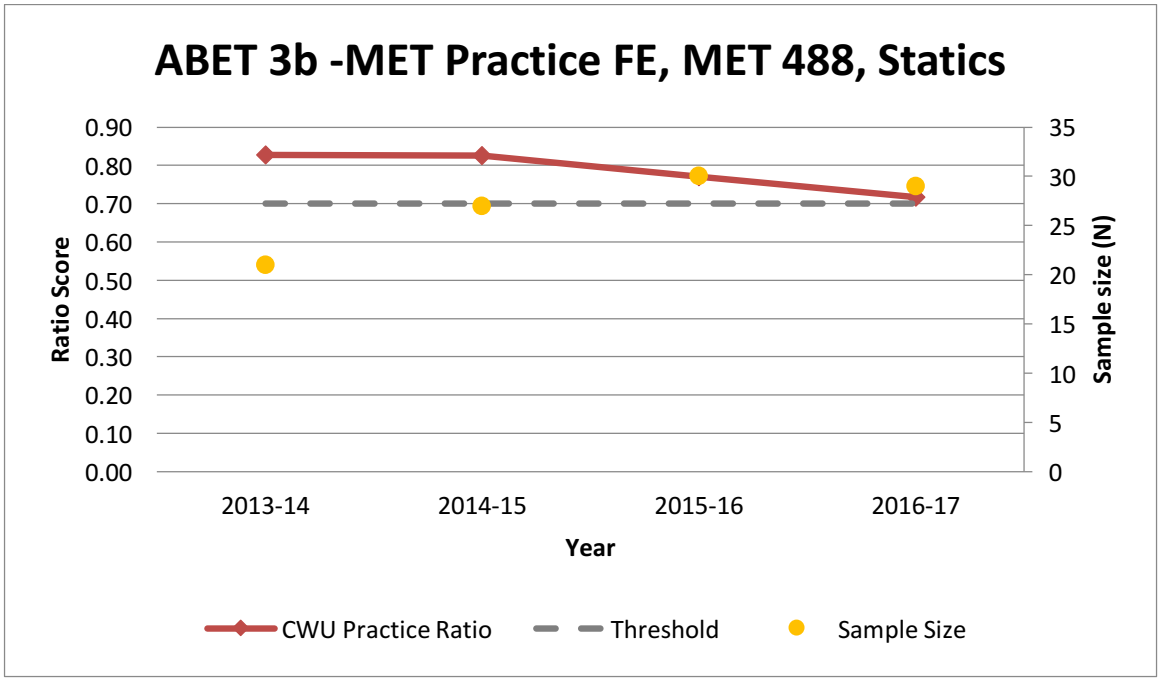

Figure 2. Practice FE Ratio Score in Statics.

Figure 2 shows students' capabilities in Statics on the MET 488 practice FE exam. These graphs are produced using the CWU practice FE exam ratio score – the ratio of the performance of CWU students on the practice FE exam to the NCEES comparator performance in each category. These are average scores.

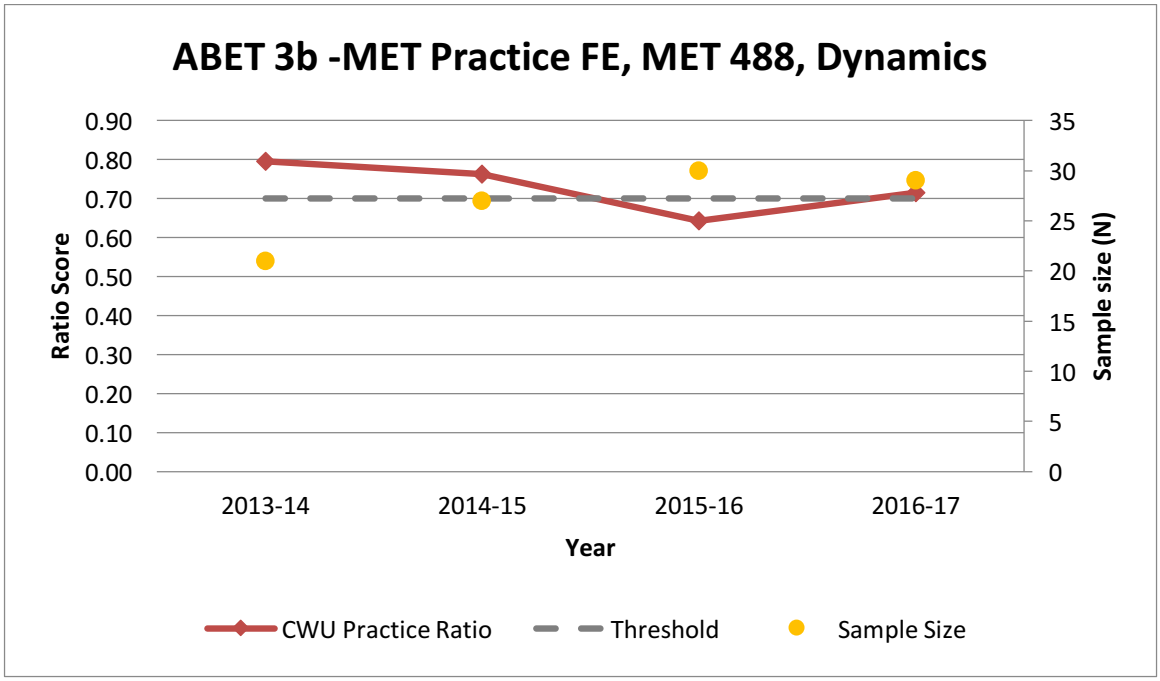

Figure 3. Practice FE Ratio Score in Dynamics.

Figure 3 shows students' capabilities in Dynamics on the MET 488 practice FE exam. These graphs are produced using the CWU practice FE exam ratio score – the ratio of the performance of CWU students on the practice FE exam to the NCEES comparator performance in each category. These are average scores.

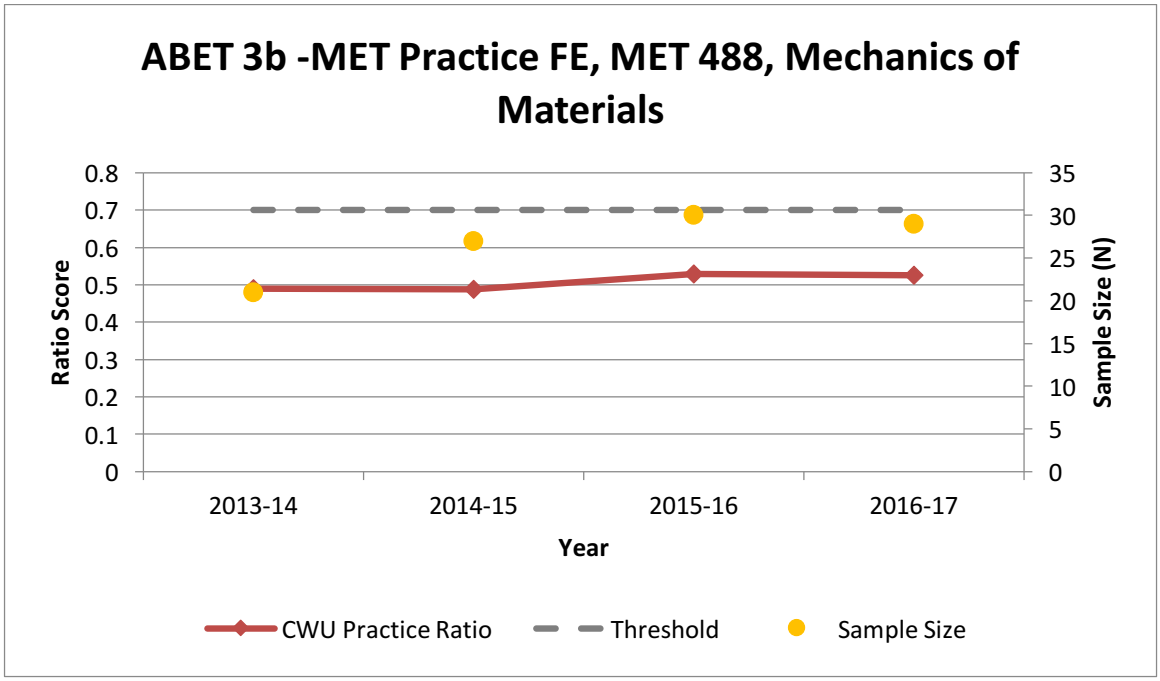

Figure 4. Practice FE Ratio Score in Mechanics of Materials.

Figure 4 shows students' capabilities in Mechanics of Materials on the MET 488 practice FE exam. These graphs are produced using the CWU practice FE exam ratio score – the ratio of the performance of CWU students on the practice FE exam to the NCEES comparator performance in each category. These are average scores.

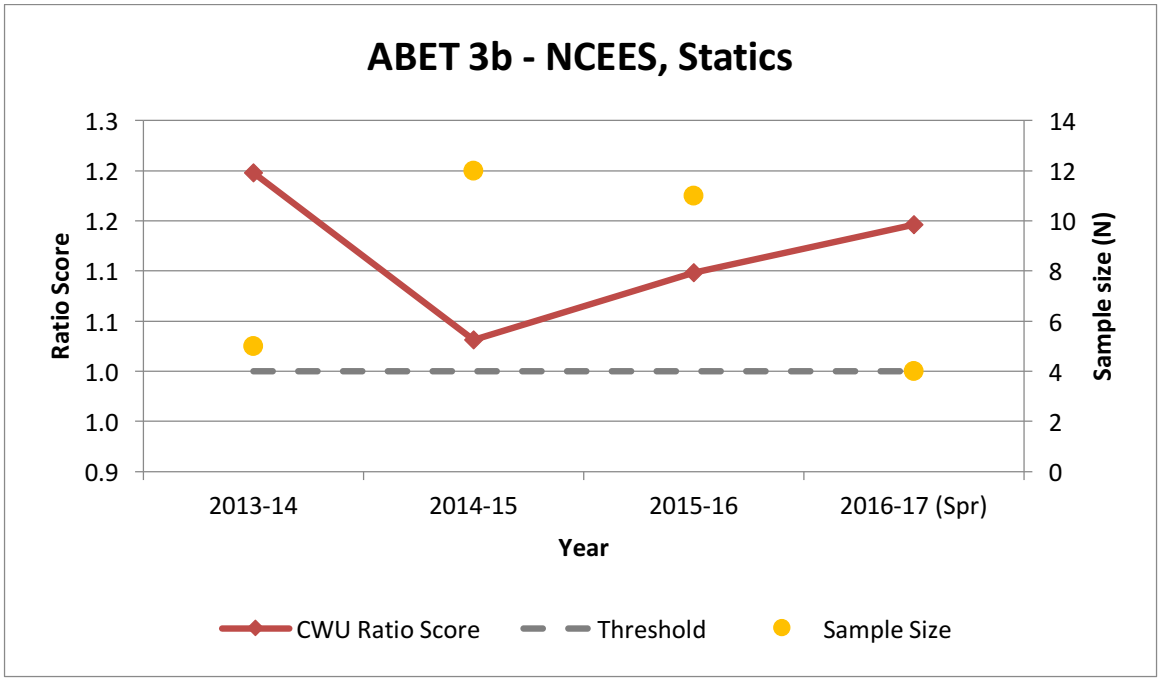

Figure 5. CWU Ratio Score in Statics.

Figure 5 shows students' capabilities in Statics on the NCEES FE exam. The graph is produced using the NCEES ratio score – the performance of CWU to the NCEES comparator performance in each category. These are average scores. Any score above one indicates that CWU is meeting or exceeding the NCEES score.

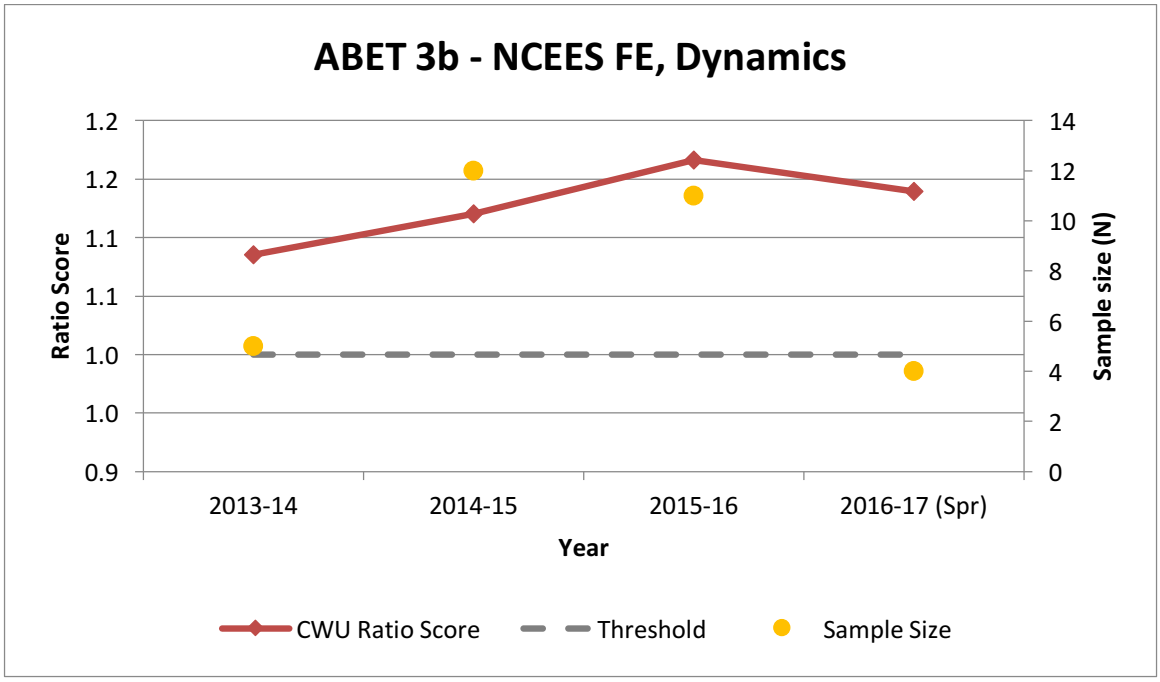

Figure 6. CWU Ratio Score in Dynamics.

Figure 6 shows students' capabilities in Dynamics on the NCEES FE exam. The graph is produced using the NCEES ratio score – the performance of CWU to the NCEES comparator performance in each category. These are average scores. Any score above one indicates that CWU is meeting or exceeding the NCEES score.

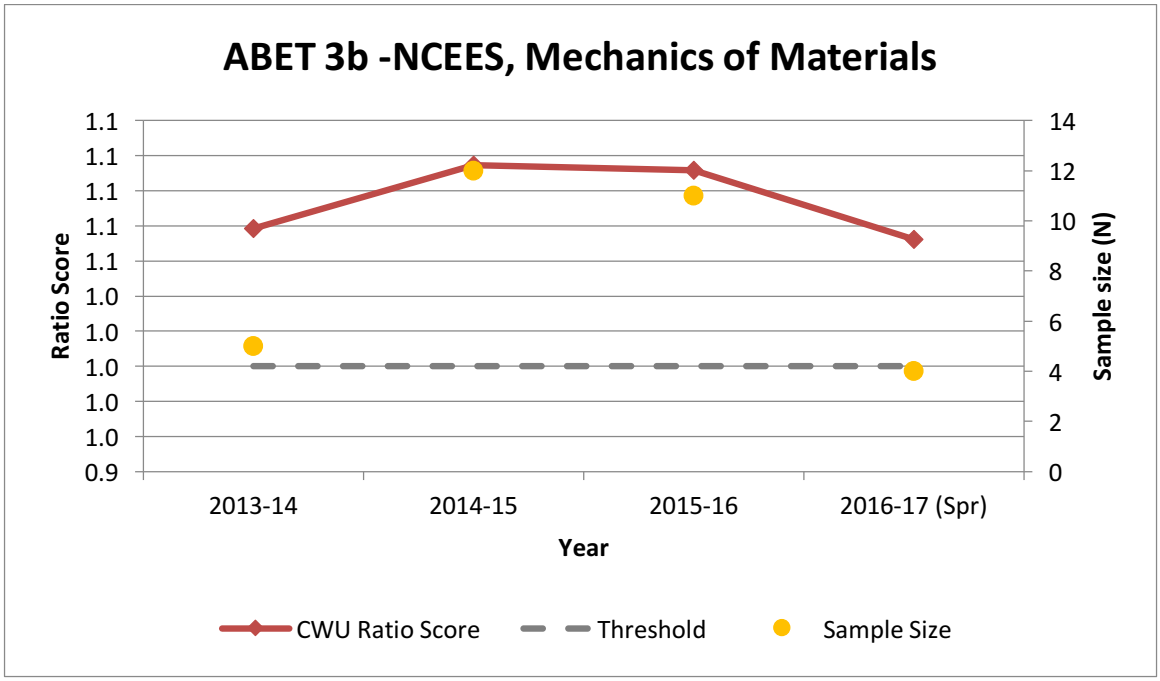

Figure 7. CWU Ratio Score in Mechanics of Materials.

Figure 7 shows students' capabilities in Mechanics of Materials on the NCEES FE exam. The graph is produced using the NCEES ratio score – the performance of CWU to the NCEES comparator performance in each category. These are average scores. Any score above one indicates that CWU is meeting or exceeding the NCEES score.

20180105 Continuous Improvement:

Plan

MET 418 lever lab stress analysis data indicates that the students are not performing well.
Practice FE Statics data meet or exceed the threshold. The downward trend is noted.
Practice FE Dynamics data are stable and meeting the threshold.
Practice FE Mechanics of Materials data are stable although below the threshold.
NCEES Statics data meet or exceed the threshold.
NCEES Dynamics data meet or exceed the threshold.
NCEES Mechanics of Materials data meet or exceed the threshold.

The direct measure of all the MET students shows poor performance in basic mechanics of engineering. The NCEES scores are all above the threshold, but these will tend to be the better students.

Do

The deficiencies in the MET 418 lever lab stress analysis and the Mechanics of Materials Practice FE scores need to be addressed. MET faculty are working with the faculty that teach Statics and Mechanics of Materials to institute changes. Beginning AY2017-18, there will be: 1) more free body diagram (FBD) quizzes in Statics; 2) at least one FBD quiz per week in Mechanics of Materials. There will also be a FBD and integration problem on the Statics and Mechanics of Materials final exams. These will be assessed using a rubric.

Check

The results of these efforts cannot be assessed until the end of fall quarter 2018. The MET faculty and the Industry Advisory Board will review the results.

Act

A course of action will be determined (winter quarter 2019) after reviewing the results of the actions described above.

METRIC

MET 418 – Lever Lab Stress

MET 488 – MET Practice FE Statics, Dynamics, Mechanics of Materials

NCEES FE Data – NCEES Statics, Dynamics, Mechanics of Materials

DATA CAPTURE AND GRAPH PRESENTATION:

Source: S:\IET\15. MET - Program Information\CourseOutcomeData\2017-18

MET418_1179_rosterTestScores.xlsx

201701_MET488.xlsx

2017_NCEES.xlsx

METADATA and DATA LIMITS:

Years and sample sizes shown on graphs

Lower limits shown: NCEES Nat'l Perf

Appendix B. ABET Continuous Improvement, Student Outcome Mf.

MET Program Criteria Outcome M f. “thermal sciences, such as thermodynamics, fluid mechanics, heat transfer, etc.;”

Source: http://www.abet.org/wp-content/uploads/2016/12/T001-17-18-ETAC-Criteria-10-29-16-1.pdf

This document is organized in the following manner:

1. Presentation of assessment data.
2. Description of metric.
3. Plan: Comments on assessment data and identification of problem(s).
4. Do: Development of action items to address comments or correct problem(s).
5. Check: Review of results of action items.
6. Act: Determination if action items were effective or if further action is required.
7. Meta data

Assessment Data:

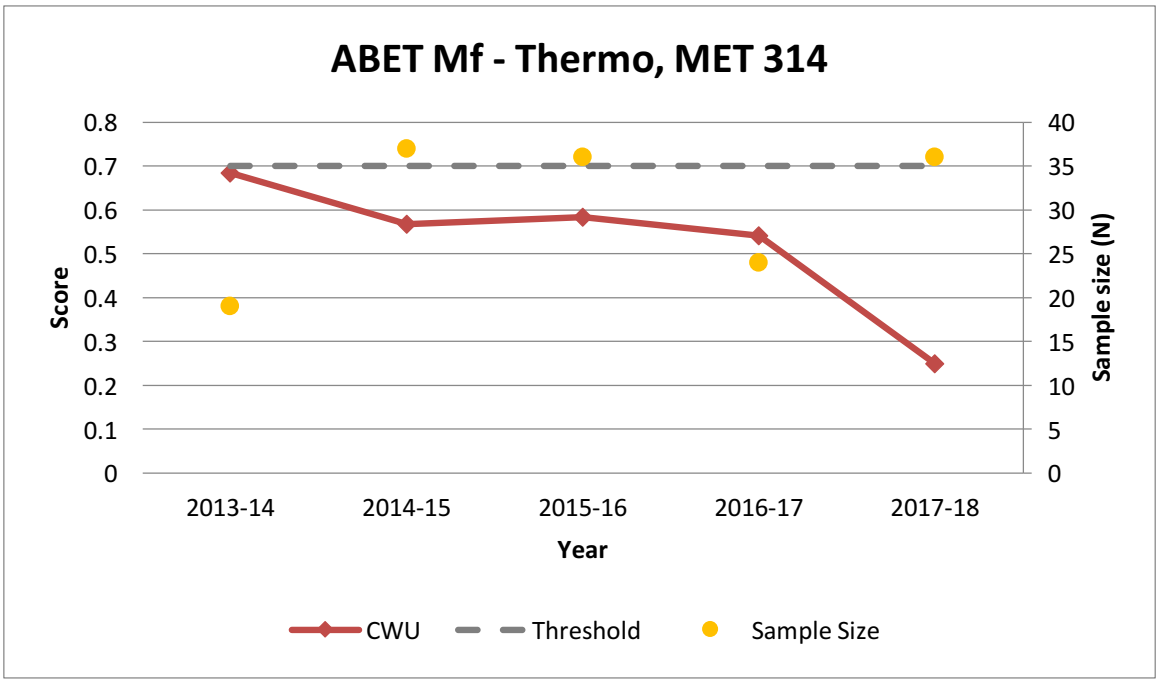

Figure 1. Scores in MET314 Thermo Final, Rankine Cycle problem.

Figure 1 shows number of students that met or exceeded 'satisfactory' score (74%) on Problem 1 of the MET314 Final (Rankine Steam simple cycle analysis).

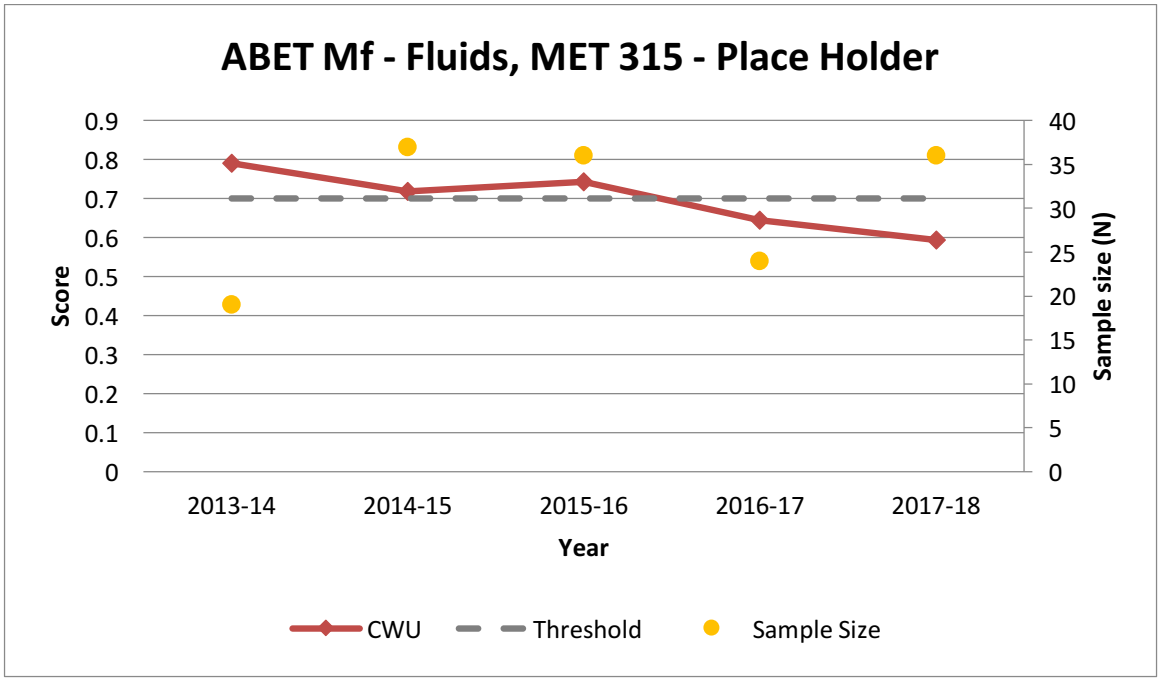

Figure 2. MET315 Fluids Final Exam Score Average.

Figure 2 shows average final exam score in MET315 Fluid Dynamics.

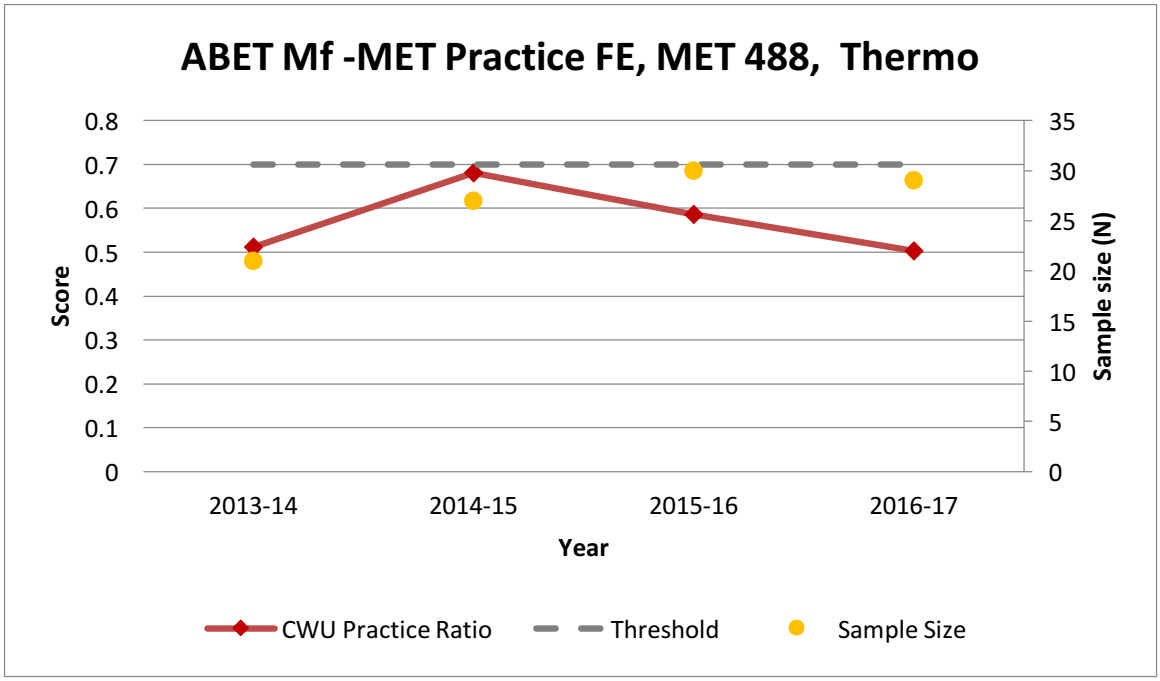

Figure 3. MET Practice FE Exam Ratio Score in Thermo

Figure 3 shows ratio score for thermodynamics questions of practice FE average divided by NCEES average national score. Note: Goal is 70% because FE practice test problems are intended to be more difficult than NCEES.

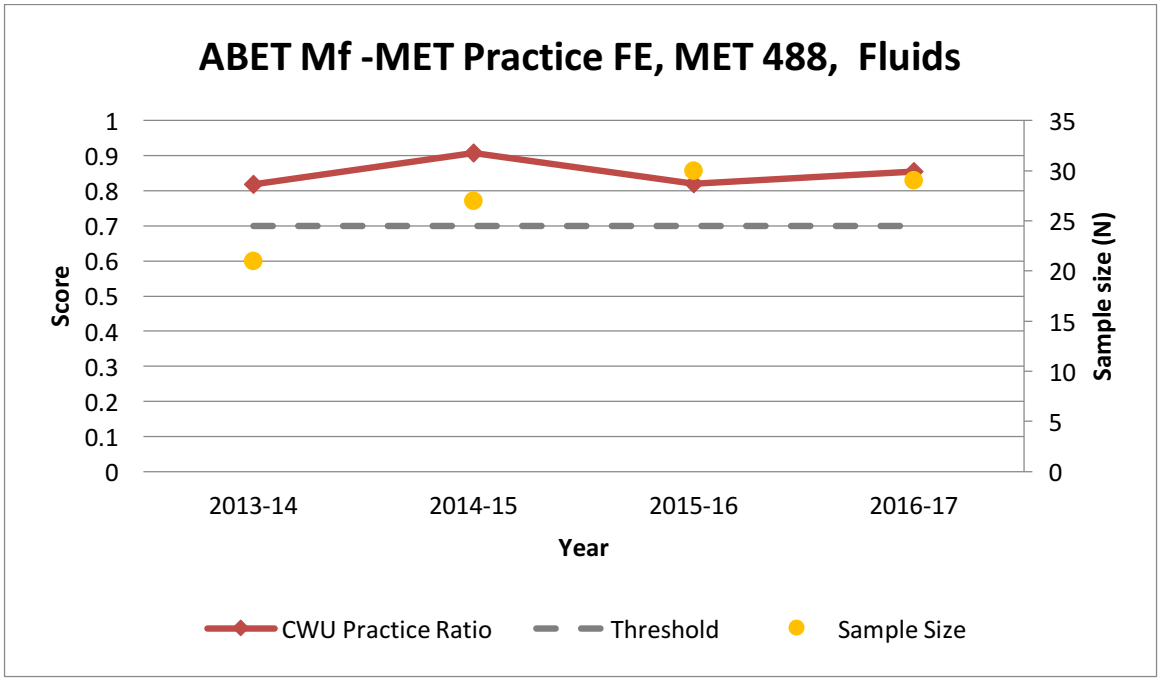

Figure 4. MET Practice FE Exam Ratio Score in Fluid Mechanics

Figure 4 shows ratio score for Fluid Mechanics questions of practice FE average divided by NCEES average national score. Note: Goal is 70% because FE practice test problems are intended to be more difficult than NCEES.

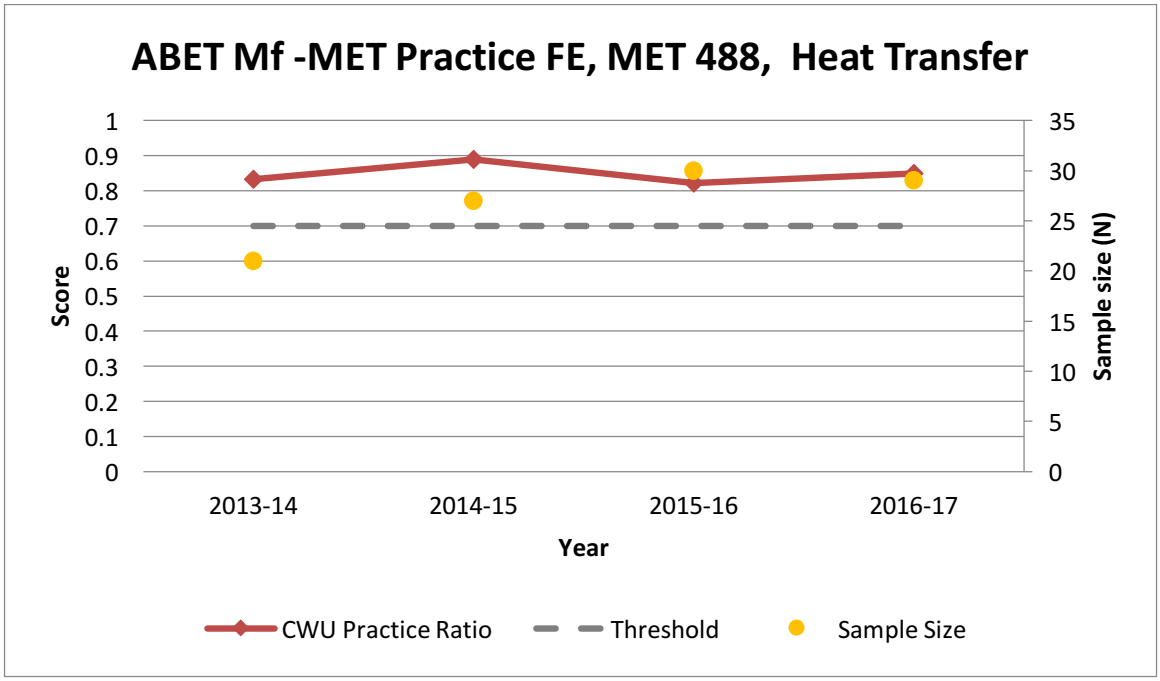

Figure 5. MET Practice FE Exam Ratio Score in Heat Transfer

Figure 5 shows ratio score for Heat Transfer questions of practice FE average divided by NCEES average national score. Note: Goal is 70% because FE practice test problems are intended to be more difficult than NCEES.

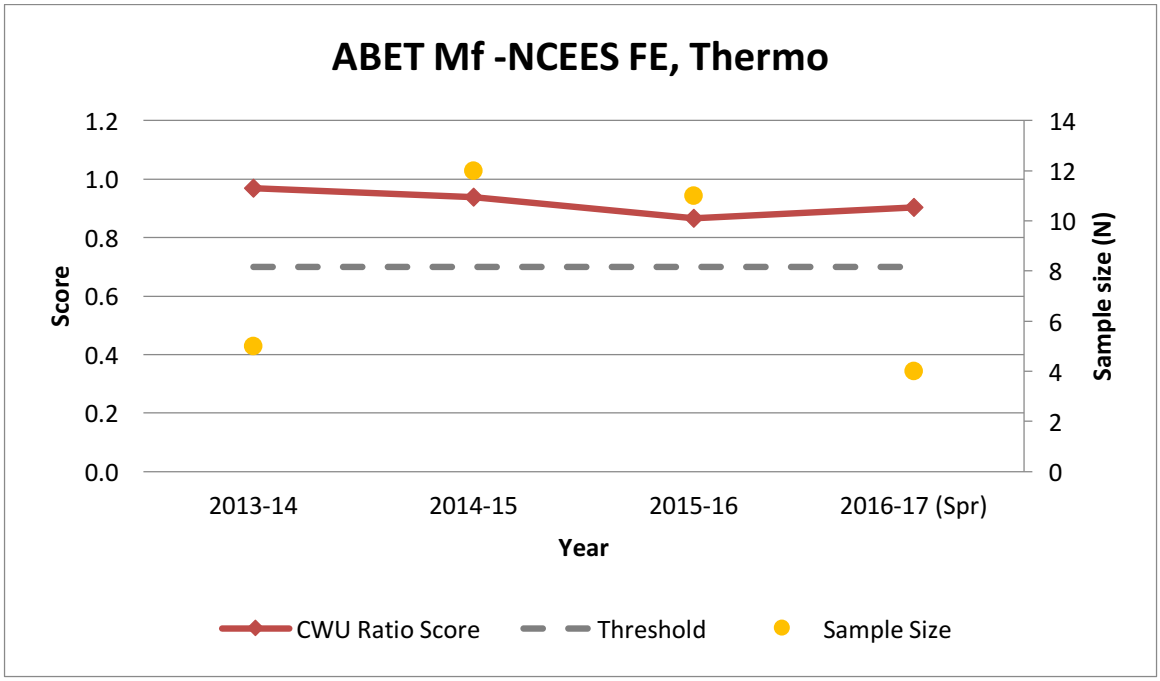

Figure 6. CWU/NCEES Ratio of average scores in Thermodynamics Topic.

Figure 6 shows Thermodynamics ratio scores for CWU students who took the NCEES FE test vs. NCEES national average for the topic (CWU score / NCEES national). Goal is set at 100% to meet or exceed national average.

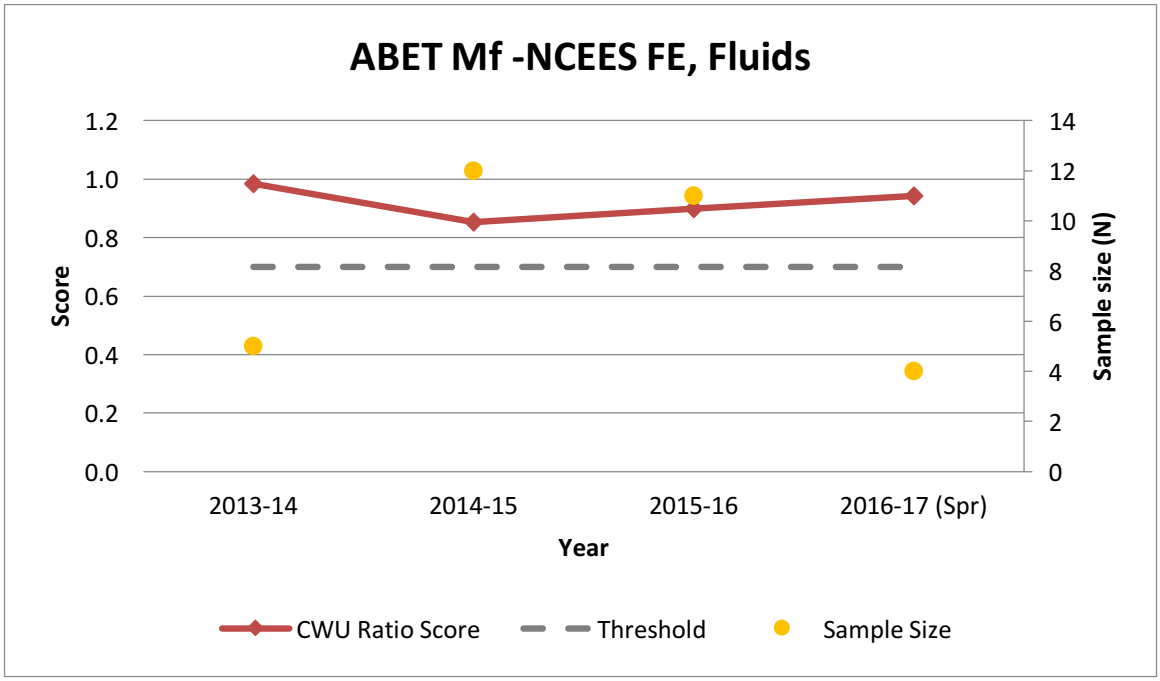

Figure 7. CWU/NCEES Ratio of average scores in Fluid Mechanics Topic

Figure 7 shows Fluid Mechanics ratio scores for CWU students who took the NCEES FE test vs. NCEES national average for the topic (CWU score / NCEES national). Goal is set at 100% to meet or exceed national average.

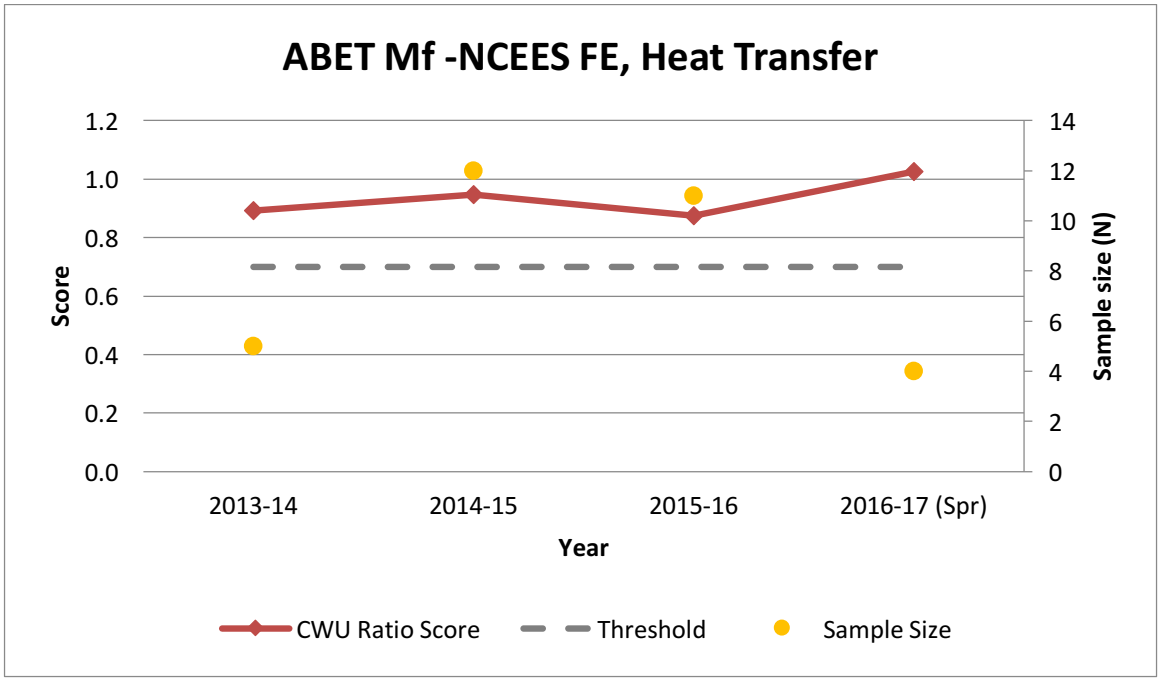

Figure 8. CWU/NCEES Ratio of average scores in Heat Transfer Topic

Figure 8 shows Heat Transfer ratio scores for CWU students who took the NCEES FE test vs. NCEES national average for the topic (CWU score / NCEES national). Goal is set at 100% to meet or exceed national average.

20180105 Continuous Improvement:

Plan

MET 314: Student performance is dropping. Figure 1 (Rankine Steam simple cycle, final exam) shows a strongly declining trend. Figure 2 (Practice FE ratio score, all CWU MET students) shows downward trend and below standard. Figure 6 (NCEES ratio score, CWU vs National average; for test takers only) values are stable and consistently above national average.

MET 315: Figure 2 is placeholder chart, data set not finalized yet. Figure 4 (Practice FE ratio score, all CWU MET students) shows stable values with values above standard (all students). Figure 7 (NCEES ratio score, CWU vs. national average; for test takers only) shows data stable and above standard.

MET 316: Figure 5 (Practice FE ratio score, all CWU MET students) is stable and above standard. Figure 8 (NCEES ratio score, CWU vs. national average; for test takers only) is stable and above standard.

Do

MET 314: Try incorporating online homework (McGraw Hill Connect) with immediate response and solutions. Student's weak point is usually integrating information into thermo cycles. This was implemented in 2016.

MET 315: No corrective actions considered necessary; continuing with normal continuous improvement efforts.

MET 316: No corrective actions considered necessary; continuing with normal continuous improvement efforts.

Check

MET 314: Online homework appeared to help some students; however, they also got used to the tables being presented to them in the homework problem and did not realize tables were in the text appendix. This adversely affected some test grades. The decrease in 2017 student performance (Figure 1) included the effect of class schedule changing so that thermo cycles were not introduced until almost Thanksgiving, with the related distractions and holiday schedule discontinuity.

MET 315: No corrective actions to review.

MET 316: No corrective actions to review.

Act

MET 314: Spend less time on properties and processes to get another week or more of cycles into schedule. For Fall 2018 develop worksheets for Otto, Diesel, Rankine steam and R134a cycles, psychrometric chart processes. Replace Dual Cycle homework problem that was confusing to students.

MET 315: No corrective actions to review.

MET 316: No corrective actions to review.

METRIC

DATA CAPTURE AND GRAPH PRESENTATION:

Source: S:\IET\15. MET - Program Information\CourseOutcomeData\2017-18

MET.FE.PracticeScores2017.RevJune22.xlsx

201709_MET314ABETM.f.xlsx

201801_MET315ABETM.f.xlsx

Note: Heat Transfer is an elective course in the CWU MET program, and so data from the class does not reflect all students. It is a topic in the FE, so all students pick up information during the FE review, and all students in each graduation cohort are included in the Practice FE results.

METADATA and DATA LIMITS:

Years and sample sizes shown on graphs