

Applicability of the FE Exam for Assessment

- It is a direct method of objective assessment with comparisons of institutional results against national results.
- Assessment does not utilize pass rates but how students perform on individual exam areas.
- Because there are over 55,000 FE examinees per year, it provides high reliability.

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Applicability (cont.)

- Should my institution require the FE exam as a graduation requirement?
 - Many institutions currently do this to measure their full graduating class.
 - This requires a good-faith effort, which is generally determinable only through the amount of time spent on the exam or the random-guessing analysis done by NCEES.

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Applicability (cont.)

- What if my institution doesn't require the FE exam as a graduation requirement?
 - A self-selecting group can still be useful for assessment.
 - Anecdotal information indicates that the self-selecting group doesn't change much at a given institution from exam to exam.
 - Criterion for assessment should focus more on the **changes** in results over time rather than just the comparisons to national data that will be presented today.

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Applicability (cont.)

- Thus,
 - The FE is the only nationally normed examination addressing specific engineering topics currently available.
 - The FE is the only assessment tool available to compare the performance of students in one program with students from other programs.
 - The FE can be used as an assessment tool with a pool of all graduates or with a self-selecting pool.

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ABET Outcomes Assessment Possible with FE Exam

- a) An ability to apply **knowledge of mathematics, science, and engineering**
- b) An ability to design and conduct experiments, as well as to **analyze and interpret data**
- c) An ability to **design a system, component, or process** to meet desired needs

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ABET Outcomes Assessment Possible with FE Exam (cont.)

- (e) An ability to **identify, formulate, and solve engineering problems**
- (f) An understanding of **professional and ethical responsibility**
- (k) An ability to use the techniques, skills, and modern **engineering tools** necessary for engineering practice

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ABET Outcomes Assessment Possible with FE Exam (cont.)

Because institutions also receive a Subject Matter Report on their graduates who attempt the various PE exams, they can utilize the number of graduates who are successful in passing the PE exam to allow the institution one method of measuring the following outcome:

- (i) A recognition of the need for and the ability to engage in **life-long learning**

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CBT Format

- The FE became a CBT exam in January 2014
 - Shorter in time and number of questions
 - Presented in a different format



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Why CBT?

- Candidate convenience
- Quicker score turnaround (7–10 days)
- Uniformity in testing conditions
- Enhanced security
- More innovative way to test

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CBT Format (cont.)

- Length
 - The appointment time at test centers is 6 hours.
 - Tutorial–8 minutes
 - Nondisclosure agreement–2 minutes
 - Exam time–5 hours, 20 minutes with a 25-minute scheduled break after approximately 55 questions
 - Brief post-exam survey
 - Total of 110 questions



CBT Format (cont.)

- Testing opportunities
 - Testing windows
 - January–March
 - April–June
 - July–September
 - October–December
- Test center locations
 - Pearson VUE test centers



Test Center Locations

- Nearly 300 Pearson VUE test center locations are available throughout the United States.
- Specific sites near your institution can be located from the NCEES website at the following URL:
 - nces.org/exams/cbt/testing-center-locations



CBT Format (cont.)

- *FE Reference Handbook*
 - Provided electronically with the exam as a searchable PDF
 - Available for free download and for purchase as a hard copy at ncees.org/exams (click on “FE exams”)
- *NCEES Examinee Guide*
- Computer-based practice exams



CBT Format (cont.)

The screenshot shows the 'FE REFERENCE HANDBOOK' software interface. It includes sections for 'UNITS', 'SI PREFIXES', 'COMMON CONVERSIONS', and 'SI-METRIC CONVERSIONS'. A graph on the right shows a sine wave with the equation $\sin(\omega t + \phi)$ and the text 'The minimum sample frequency required to properly represent the continuous signal is:'. Below the graph are three multiple-choice options: A. 1 sample per 4 sec, B. 1 sample per 2 sec, C. 1 sample per 1 sec.



CBT Format (cont.)

- **Content of the exam**
 - 7 free-standing discipline-specific exams
 - Chemical, Civil, Electrical and Computer, Environmental, Industrial, Mechanical, Other Disciplines
 - No longer has a common morning portion (breadth module)
 - Selected exam topics that were previously on the breadth module are now tested within each discipline-specific exam.



FE Electrical and Computer Engineering Exam Specification

- Mathematics
- Probability and Statistics
- Ethics and Professional Practice
- Engineering Economics
- Properties of Electrical Materials
- Engineering Sciences
- Circuit Analysis (DC and AC Steady State)
- Linear Systems
- Signal Processing
- Electronics
- Power
- Electromagnetics
- Control Systems
- Communications
- Computer Networks
- Digital Systems
- Computer Systems
- Software Development



Other Exam Specifications

- Available at www.ncees.org/exams (click "FE exam")



So, what actual data are available, and what can you do with the data?



Subject Matter Report (cont.)

- For each topic, the students' performance is given as a Performance Index on a scale of 0–15.
- The Performance Index is indirectly related to the average number of questions answered correctly.
- This is necessary because each examinee receives a different set of questions within each topic area.
 - Any one examinee's set of questions may be harder or easier than another examinee's set.



Subject Matter Report (cont.)

- Getting the data
 - NCEES sends links to reports directly to an institution via email.
 - If you don't know, NCEES can tell you who receives your institution's reports.
 - Reports also include information on the specific institution's examinees who took the FE or PE exam more than 12 months after graduation.



The specifics of using the FE exam for outcomes assessment



Getting Started

- **Faculty** should be involved.
- Identify areas of strength.
- Acknowledge areas that are not emphasized.
- Set program-specific goals for each area.

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Table from Self Study Showing the Use of the FE as One Measure for a Specific Outcome

Outcome	Applicable FE Exam Category
a. An ability to apply knowledge of mathematics through differential equations, science, ...	Math
b. An ability to design and conduct ...	None
c. An ability to design a system, component, ...	Structural Design
d. An ability to function on multidisciplinary teams	None
e. An ability to identify, formulate, and solve engineering problems	Engineering Mechanics, Strength of Materials, Fluid Mechanics, Structural Analysis
f. An understanding of professional and ethical responsibility	Ethics and Professional Practice
g. An ability to communicate effectively	None
h. The broad education necessary to understand the impact of engineering ...	None
i. A recognition of the need for, and an ability to engage in lifelong learning	None
j. A knowledge of contemporary issues	None
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Computational Tools, Surveying
l. An ability to apply knowledge of technical areas appropriate to civil engineering	Environmental Engineering, Hydrosystems/Technology, Soil Mechanics and Foundations, Structural Design, Transportation

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Suggested Analysis Techniques

- Choose your longitudinal time basis.
 - Performance from multiple examination windows
 - Academic year performance
- Choose your presentation method.
 - Ratio method
 - Scaled Score method

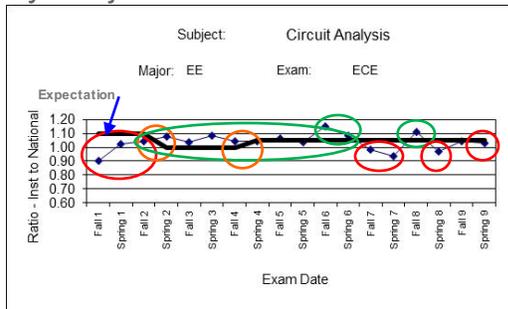
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Ratio Method

- The ratio score is simply the ratio between the program's performance index (P.I.) in any topic area and the P.I. of the comparator performance.
 - Ratio score = Program P.I./Comparator P.I.

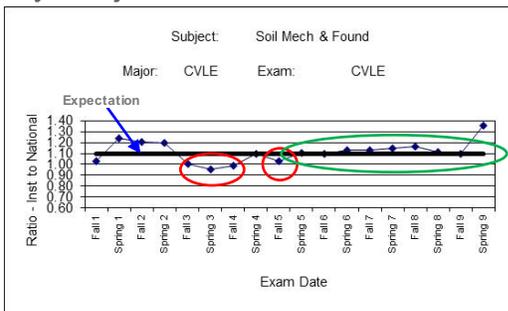
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Comparison of Ratios by Subject Area



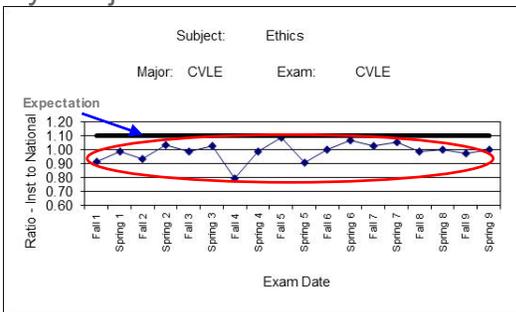
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Comparison of Ratios by Subject Area

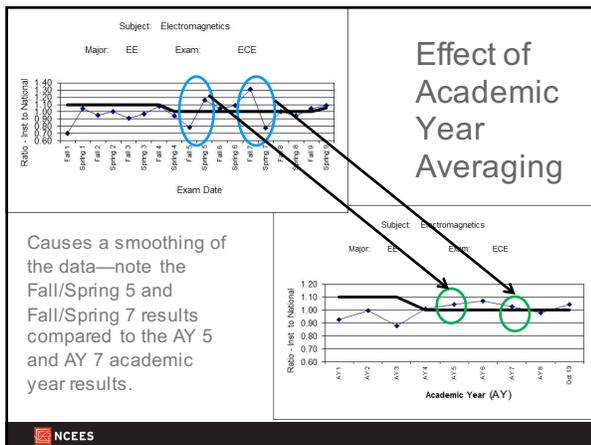


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Comparison of Ratios by Subject Area



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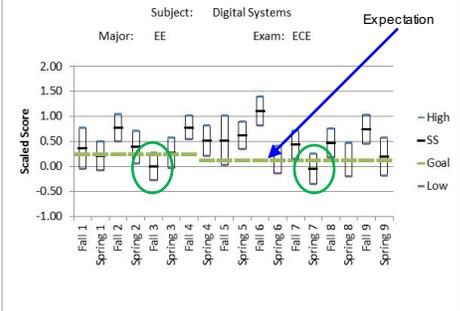
Scaled Score Method

Define Scaled Score (S.S.)

$$S.S. = \frac{PI \text{ for Univ X} - PI \text{ comparator}}{PI \text{ comparator standard deviation}} \pm \frac{1}{\sqrt{\# \text{ of takers at Univ X}}}$$

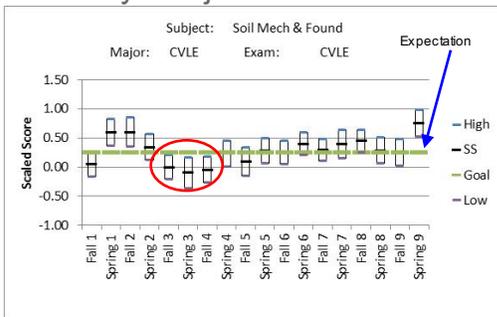
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Comparison Using Scaled Score by Subject Area

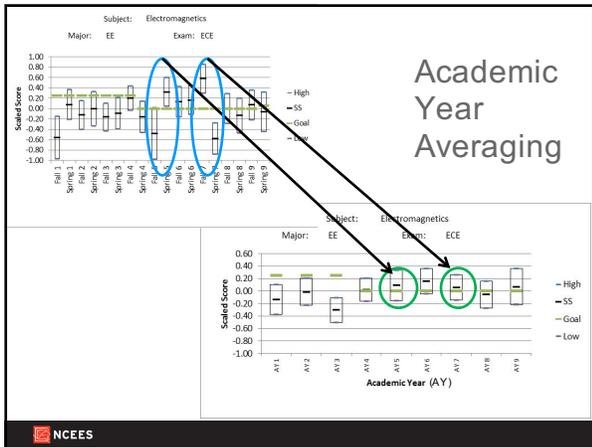


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Comparison Using Scaled Score by Subject Area



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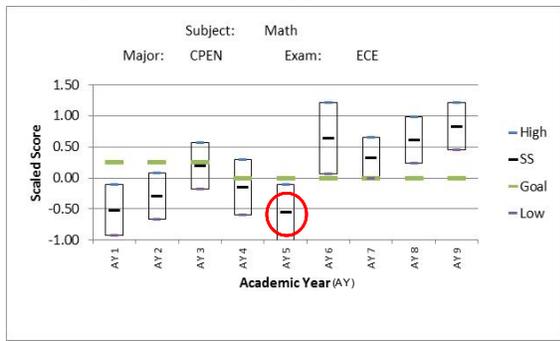


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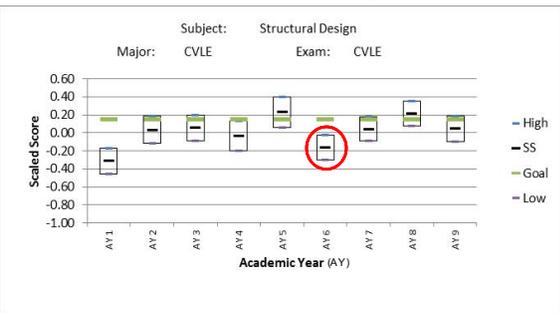
Examples of Assessing Some of the ABET (a) – (k) Outcomes



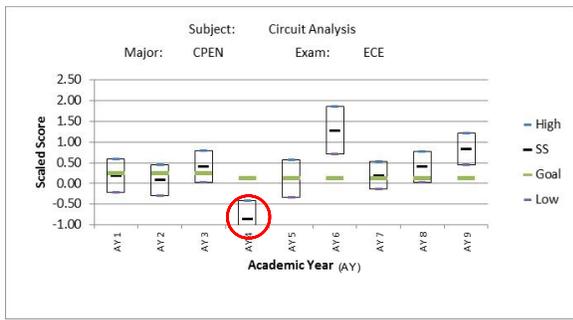
Ability to Measure ABET (a) Math and Science



Ability to Measure ABET (c) Design

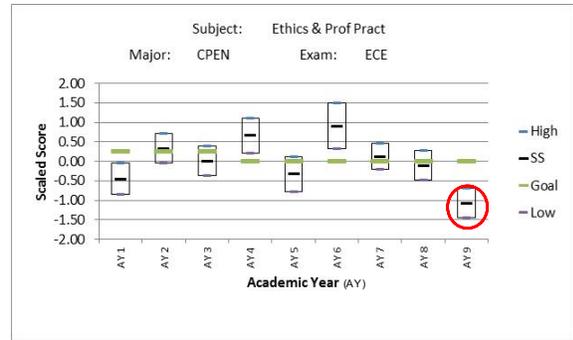


Ability to Measure ABET (e) Solve Engineering Problems



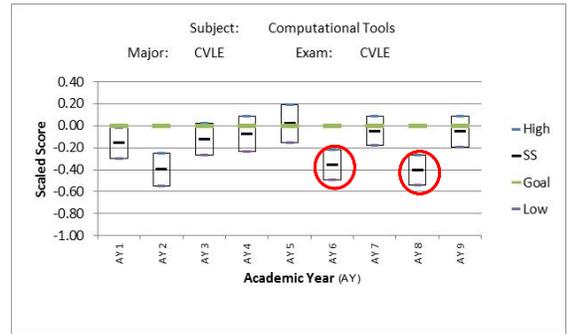
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Ability to Measure ABET (f) Ethical Responsibility



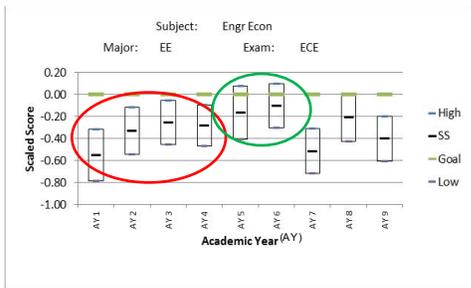
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Ability to Measure ABET (k) Engineering Tools



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Ability to Measure ABET (e) Solving Engineering Problems or (k) Engineering Tools Using Engineering Economics



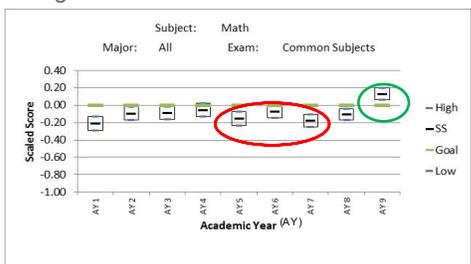
- Lectures on engineering economics were added to the senior design sequence during AY 5.



Collegewide Assessment Is Possible

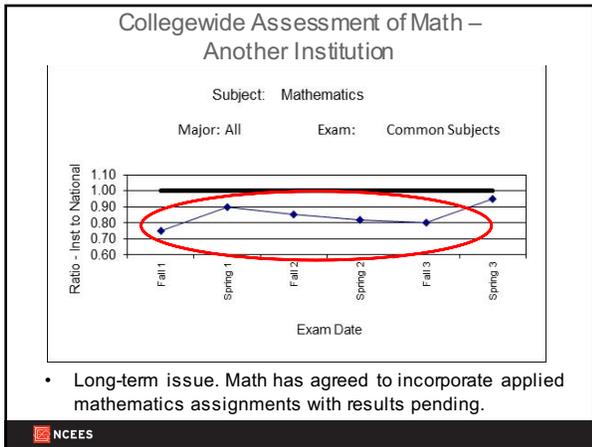


Collegewide Assessment of Math



- Math agreed in AY 6 to make changes to the calculus sequence, including discontinuing the use of graduate students as instructors. Took 3 years for positive results.





Conclusions

- Discipline-specific assessment information can be gleaned from this exam.
- FE exam provides a direct, quantitative assessment technique.
- The Subject Matter Report provides comparative data.
- NCEES sends a link to the Subject Matter Report directly to your institution via email.

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Conclusions (cont.)

- The FE exam is one effective assessment tool to be used as part of your institution's full assessment package.

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Additional Resources

For more information on reports, email
fereports@ncees.org

Download today's presentation at
ncees.org/licensure/educator-resources/



Additional Resources

For further information, contact:

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Questions?