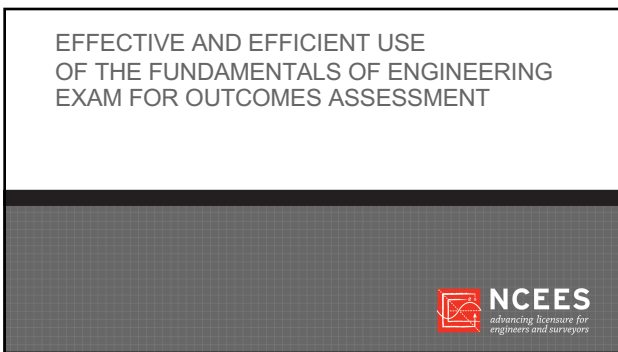
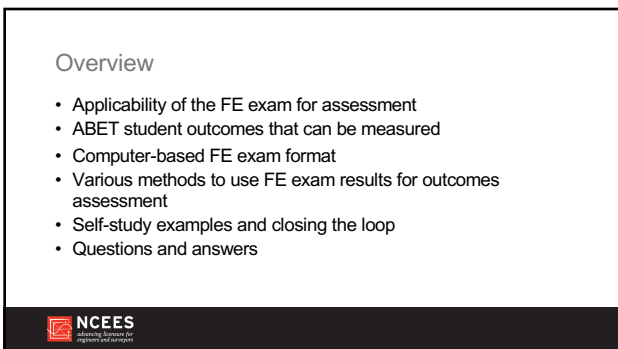


1



2



3

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 use pass rates but rather how students perform on individual exam areas.
- Because there are over 50,000 FE examinees per year, it provides high reliability.



4

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 through the random-guessing analysis done by NCEES.



5

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 does not change much at a given institution from exam to exam.
 - Criterion for assessment should focus more on the changes in results over time compared to program-set targets rather than just the comparisons to national data.



6

Applicability (cont.)

- Summary
 - 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.



7

Short Survey

- Please answer the following questions:
 1. Does your program currently use the FE exam as one of your assessment tools?
 - Yes
 - No
 2. Does your program require that all graduates take the FE exam, or do you just utilize the self-selecting group?
 - Require all graduates
 - Use a self-selecting group
 - Not applicable (do not use the FE exam for assessment)



8

ABET Outcomes Assessment Possible with FE Exam

- (1) An ability to **identify, formulate, and solve complex engineering problems** by applying principles of engineering, science, and mathematics
 - FE results can be used to show a program's ability to provide a foundation of technical knowledge in engineering, science, and mathematics that is necessary for solving complex problems.



9

ABET Outcomes Assessment Possible with FE Exam

- (2) An ability to **apply engineering design** to produce solutions that meet specified needs with consideration of the public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors



10

ABET Outcomes Assessment Possible with FE Exam (cont.)

- (4) An ability to **recognize ethical and professional responsibilities in engineering situations** and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts



11

FE Exam Format

- The FE uses a computer-based testing (CBT) format, with testing facilities provided by Pearson VUE testing centers.
- The FE exam is available to your students throughout the year.



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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:
 - <http://ncees.org/exams/test-center-locations/>



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FE Exam Format

- 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
 - Total of 110 questions



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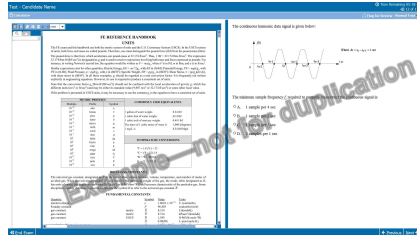
FE Exam Format (cont.)

- *FE Reference Handbook*
 - Provided electronically with the exam as a searchable PDF
 - Available for free download and for purchase as a hard copy at <http://ncees.org/engineering/fe/>
- *NCEES Examinee Guide*
- Practice exams available for each discipline



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FE Exam Format (cont.)



16

FE Exam Format (cont.)

- Content of the exam
 - 7 free-standing discipline-specific exams
 - Chemical
 - Civil
 - Electrical and Computer
 - Environmental
 - Industrial and Systems
 - Mechanical
 - Other Disciplines



17

FE Electrical and Computer Exam Specifications—Updated in 2020

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



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FE Civil Exam Specification—Example of Engineering Design

11. Structural Engineering

- G. Design of steel components (e.g., codes and design philosophies, beams, columns, tension members, connections)
- H. Design of reinforced concrete components (e.g., codes and design philosophies, beams, columns)



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Other Exam Specifications

- Available at <http://ncees.org/engineering/fe/>



20

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



21


[illegible]

22

[illegible]

Subject Matter Report (cont.)

- Reports are generated twice a year.
 - In July for the January–June testing period (spring)
 - In January for the July–December testing period (fall)
- The report is specific to the following:
 - An institution
 - Students within an engineering degree program at that institution
 - The discipline-specific exam that those students completed




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Engineering and Technology

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[illegible]

Subject Matter Report (cont.)

- Data are provided for all examinees testing within 12 months of graduation (either before or after graduating).
- Only first-time takers are included.
- Random guessers are removed from the report.
- National performance data, with standard deviation information, are also provided for the same degree program and same discipline-specific exam.

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[illegible]

Subject Matter Report (cont.)

- For each topic, the students' performance is given as a Performance Index on a scale of 0 to 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.



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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 examinee who took the FE or PE exam more than 12 months after graduation.



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Specifics of Using the FE Exam for Outcomes Assessment



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Getting Started

- Involve faculty.
- 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
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Mathematics and Statistics, Geotechnical Engineering, Transportation Engineering, Water Resources and Environmental Engineering
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and societal contexts	Structural Engineering, Engineering Economics
3. An ability to communicate effectively with a range of audiences	None
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Ethics and Professional Practice
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	None
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	None
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	None



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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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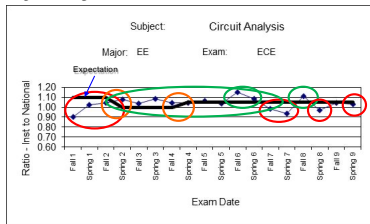
Ratio Method

- 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.



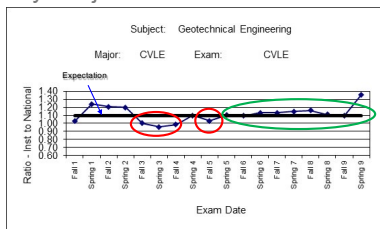
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Comparison of Ratios by Subject Area

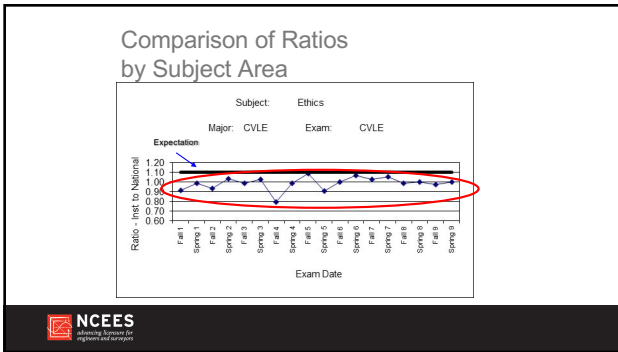


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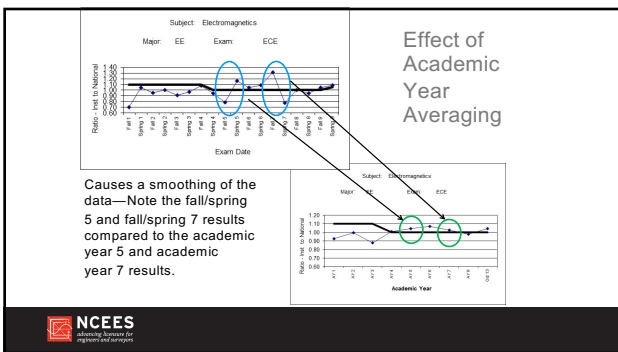
Comparison of Ratios by Subject Area



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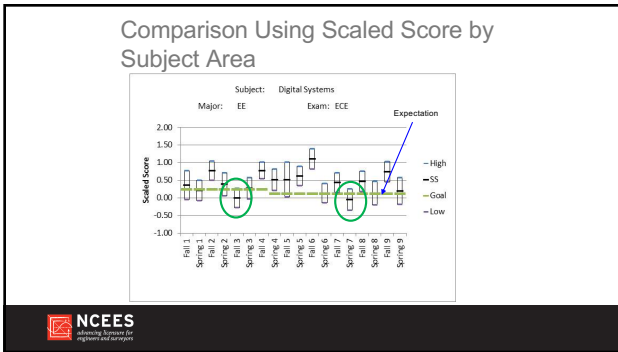
Scaled Score Method

$$S.S. = \frac{PI \text{ for Univ X} - PI \text{ comparator}}{PI \text{ comparator standard deviation}}$$

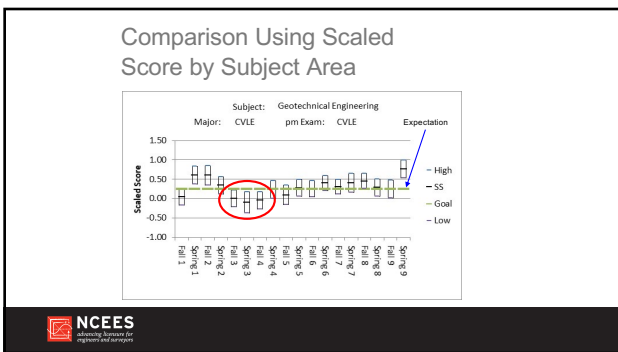
$$\pm \frac{1}{\sqrt{\# \text{ of takers at Univ X}}}$$

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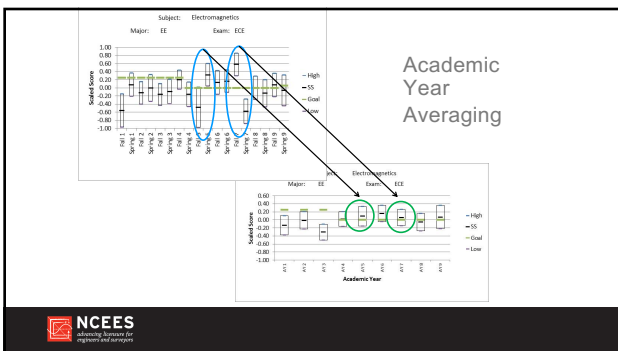
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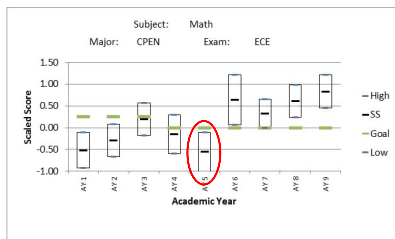
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Examples of Assessing Some of the ABET (1)–(7) Outcomes



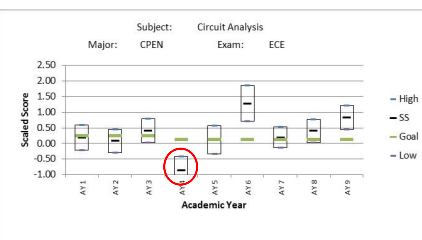
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Outcome 1: Ability to Apply Math and Science



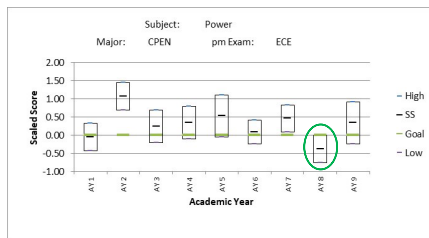
41

Outcome 1: Ability to Solve Engineering Problems



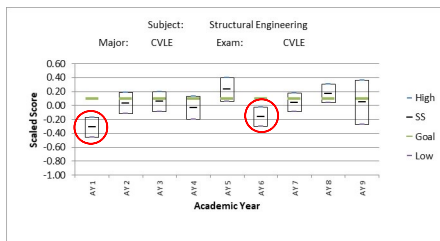
42

Outcome 1: Ability to Solve Engineering Problems



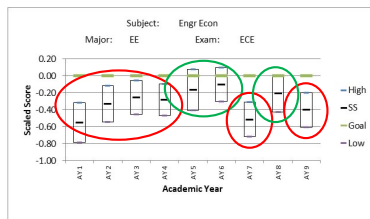
43

Outcome 2: Ability to Apply Engineering Design



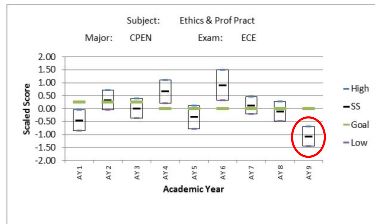
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Outcome 2: Ability to Apply Economic Factors in Design



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Outcome 4: Ability to Recognize Ethical Responsibility



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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.
- Thus, 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.
- NCEES publishes a white paper and several accompanying documents that describe in detail how engineering departments can use the FE exam to assess program outcomes.
- Available for free download at
 - <http://ncees.org/engineering/educator-resources/>



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Additional Resources

For further information, contact

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NCEES Exam Development Engineer
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email: cwarren@ncees.org



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Questions?



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