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About NCEES
NCEES is a nonprofit organization made up of the U.S. engineering and surveying licensing boards in all 50 states, U.S. territories, and the District of Columbia. We develop and score the exams used for engineering and surveying licensure in the United States. NCEES also promotes professional mobility through its services for licensees and its member boards.

Engineering licensure in the United States is regulated by licensing boards in each state and territory. These boards set and maintain the standards that protect the public they serve. As a result, licensing requirements and procedures vary by jurisdiction, so stay in touch with your board (ncees.org/licensing-boards).

Exam Format
The FE exam contains 110 questions and is administered year-round via computer at approved Pearson VUE test centers. A 6-hour appointment time includes a tutorial, the exam, and a break. You’ll have 5 hours and 20 minutes to complete the actual exam.

Beginning July 1, 2017, in addition to traditional multiple-choice questions with one correct answer, the FE exam will use common alternative item types such as

- Multiple correct options—allows multiple choices to be correct
- Point and click—requires examinees to click on part of a graphic to answer
- Drag and drop—requires examinees to click on and drag items to match, sort, rank, or label
- Fill in the blank—provides a space for examinees to enter a response to the question

To familiarize yourself with the format, style, and navigation of a computer-based exam, view the demo on ncees.org/ExamPrep.

Examinee Guide
The NCEES Examinee Guide is the official guide to policies and procedures for all NCEES exams. During exam registration and again on exam day, examinees must agree to abide by the conditions in the Examinee Guide, which includes the CBT Examinee Rules and Agreement. You can download the Examinee Guide at ncees.org/exams. It is your responsibility to make sure you have the current version.

Scoring and reporting
Exam results for computer-based exams are typically available 7–10 days after you take the exam. You will receive an email notification from NCEES with instructions to view your results in your MyNCEES account. All results are reported as pass or fail.

Updates on exam content and procedures
Visit us at ncees.org/exams for updates on everything exam-related, including specifications, exam-day policies, scoring, and corrections to published exam preparation materials. This is also where you will register for the exam and find additional steps you should follow in your state to be approved for the exam.
30. A series of measurements gave values of 11, 11, 11, 11, 12, 13, 13, 14, for which the arithmetic mean is 12. The population standard deviation is most nearly:

- A. 1.42
- B. 1.25
- C. 1.19
- D. 1.12

31. You wish to estimate the mean $M$ of a population from a sample of size $n$ drawn from the population. For the sample, the mean is $x$ and the standard deviation is $s$. The probable accuracy of the estimate improves with an increase in:

- A. $M$
- B. $n$
- C. $s$
- D. $M + s$
32. The following data have been collected:

<table>
<thead>
<tr>
<th>Test</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>85</td>
</tr>
<tr>
<td>2</td>
<td>87</td>
</tr>
<tr>
<td>3</td>
<td>95</td>
</tr>
<tr>
<td>4</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>85</td>
</tr>
<tr>
<td>6</td>
<td>88</td>
</tr>
<tr>
<td>7</td>
<td>90</td>
</tr>
<tr>
<td>8</td>
<td>90</td>
</tr>
<tr>
<td>9</td>
<td>91</td>
</tr>
</tbody>
</table>

Which of the following statements are true?

Select all that apply.

- □ A. The mean is larger than both the mode and the median.
- □ B. The mean and the median are equal.
- □ C. The mean and the mode are equal.
- □ D. The median and the mode are equal.
- □ E. The median is larger than both the mode and the mean.
- □ F. The mean is smaller than both the median and the mode.
38. The final value of Q in the following flowchart is ____________.

Answer to the nearest integer.
39. A spreadsheet display shows the following values in Column A:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>−2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>−1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Cell B1 contains the formula $A1^3 + A1^2 - 3$. The formula in Cell B1 is copied down in Column B with automatic cell referencing. The formula in Cell B5 will be:

- A. $A1^3 + A5^2 - 3$
- B. $A5^3 + B1^2 - 3$
- C. $A5^3 + A1^2 - 3$
- D. $A5^3 + A5^2 - 3$
SOLUTIONS
30. From Dispersion, Mean, Median, and Mode Values in the Mathematics section of the *FE Reference Handbook*:

\[ \sigma = \sqrt{\frac{1}{N} \sum (x_i - \mu)^2} \]

\[ \sigma = \sqrt{\frac{4(11-12)^2 + 1(12-12)^2 + 2(13-12)^2 + 1(14-12)^2}{8}} \]

\[ \sigma = 1.118 \]

**THE CORRECT ANSWER IS: D**

31. Accuracy increases with increasing sample size.

**THE CORRECT ANSWER IS: B**

32. Refer to the Engineering Probability and Statistics section of the *FE Reference Handbook*.

\[ \text{Mean} = \frac{1}{N} \sum_{i=1}^{N} x_i = \frac{801}{9} = 89 \]

<table>
<thead>
<tr>
<th>95</th>
<th>91</th>
<th>90</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>88</td>
<td>87</td>
<td>85</td>
</tr>
</tbody>
</table>

The mean of the sample is 89. The median of the sample is 90. The mode of the sample is 90. Therefore, the median and mode are equal, and both are larger than the mean.

**THE CORRECT ANSWERS ARE: D AND F**
33. Estimate of the mean $\mu = \bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = 9.0319$

Estimate of standard deviation $\hat{\sigma} = s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} = 0.004254$

THE CORRECT ANSWER IS: C

34. $8 - 15.5 = 7.5$

$\frac{7.5}{2.5} = 3$ standard deviations

From the Unit Normal Distribution table in the Engineering Probability and Statistics section of the FE Reference Handbook.

For $x = 3$, $R(x) = 0.0013$

THE CORRECT ANSWER IS: A

35. $P(\text{Life} > 1 \text{ yr}) = 1 - P(\text{Life} \leq 1 \text{ yr}) = 1 - F_T(8,760) = e^{-8,760/15,000} = 0.5577$

THE CORRECT ANSWER IS: C
36. First find the effects of the three factors, and then interpret these effects as follows:

(a) A positive effect means that the response is increased if the magnitude of the factor is increased.

(b) A negative effect means that the response is increased if the magnitude of the factor is decreased.

\[ E_1 = \frac{1}{4}(-20 + 11 - 12 + 22 - 10 + 9 - 21 + 10) = -2.75 \]

\[ E_2 = \frac{1}{4}(-20 - 11 + 12 + 22 - 10 - 9 + 21 + 10) = 3.75 \]

\[ E_3 = \frac{1}{4}(-20 - 11 - 12 - 22 + 10 + 9 + 21 + 10) = -3.75 \]

THE CORRECT ANSWER IS: B

37. 

<table>
<thead>
<tr>
<th>Step</th>
<th>VAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

EXIT LOOP

At the conclusion of the routine, VAR = 6.

THE CORRECT ANSWER IS: D

38. 

First Round  
Q = 1 + 2 = 3  
K = 2 \times 3 = 6  
3 > 3  NO!

Second Round  
Q = 3 + 2 = 5  
K = 6 \times 5 = 30  
5 > 3  YES!

\[ \therefore Q = 5 \]

THE CORRECT ANSWER IS: 5