1.A.
\[
\left\{ \frac{1}{i} \left[ \frac{\left(1+i\right)^n - 1}{i(1+i)^n} \right] - \frac{n}{(1+i)^n} \right\}
\]
(B) \( \left( \frac{1}{i} \right) \ast \left( \frac{\left(1+i\right)^n - 1}{i \ast \left(1+i\right)^n} \right) - \frac{n}{(1+i)^n} \)

1.B. The intention with this problem was for you to calculate the answer using \( i \) and \( n \) in whichever solution you provided in 1.A; however, since I didn’t provide a better problem statement – what each of you have done is correct. What follows are the calculated values for answer choices A through D. As you can see, B is the correct answer for problem 1.A.

\( i = \frac{6}{100} \)

\( n = 10 \)

A <- \( \frac{\left(1+i\right)^n - 1}{i \ast \left(1+i\right)^n} \) - \( \frac{n}{(1+i)^n} \)

A

## [1] -2.406793

B <- \( \frac{\left(1+i\right)^n - 1}{i \ast \left(1+i\right)^n} \) - \( \frac{n}{(1+i)^n} \)

B

## [1] 29.60232

C <- \( \frac{\left(1+i\right)^n - 1}{i \ast \left(1+i\right)^n} \) - \( \frac{n}{(1+i)^n} \)

C

## [1] -2.36048e-09

D <- \( \frac{\left(1+i\right)^n - 1}{i \ast \left(1+i\right)^n} \) - \( \frac{n}{(1+i)^n} \)

D

## [1] -560.676

2. Problem 7

Use the vector cross product function on your calculator.
3. Problem 9

Analytically solve for the 2nd derivative.
Use the polynomial equation solver on your calculator to find the roots.
Use the expression evaluator on your calculator to find the coordinates for the roots.

4. Problem 14

Use the statistical sample mean and sample variance functions on your calculator.

5. Problem 16

6. Problem 19

7. Problem 24

8. Problem 27

9. Problem 86

10. Problem 87

The manual solutions follow.
Vector Analysis

Problem 7 Solution:

For the cross product remember to cross out the row and column for each variable, i, j, k and multiply that respective variable by what’s left over in the matrix. Also, remember that the signs start with a positive at i, a negative at j, and then a positive at k, and so forth.

\[
\overrightarrow{A} \times \overrightarrow{B} = \begin{vmatrix} i & j & k \\ 8 & 1 & -2 \\ 3 & -1 & 3 \end{vmatrix} \\
= i \begin{vmatrix} 1 & -2 \\ -1 & 3 \end{vmatrix} - j \begin{vmatrix} 8 & -2 \\ 3 & 3 \end{vmatrix} + k \begin{vmatrix} 8 & 1 \\ 3 & -1 \end{vmatrix} \\
= i(-30) - j(-11) + k(11) \\
= i - 30j - 11k
\]

(Answer A)
Inflection Point

Problem 9 Solution:

Inflection point occurs when the second derivation of \( f(x) \) is 0.

\[
\begin{align*}
  f(x) &= x^4 - 12x^3 + 30x^2 \\
  f'(x) &= 4x^3 - 36x^2 + 60x \\
  f''(x) &= 12x^2 - 72x + 60
\end{align*}
\]

Solve for inflection point:

\[
\begin{align*}
  f''(x) &= 12x^2 - 72x + 60 = 0 \\
  12(x^2 - 6x + 5) &= 0 \\
  12(x - 1)(x - 5) &= 0 \\
  x_1 &= 1 \text{ and } x_2 = 5
\end{align*}
\]

\[
\begin{align*}
  x_1 &= 1 \rightarrow f(1) &= (1)^4 - 12(1)^3 + 30(1)^2 = 19 \\
  x_2 &= 5 \rightarrow f(5) &= (5)^4 - 12(5)^3 + 30(5)^2 = -125
\end{align*}
\]

The inflection points are \((1, 19)\) and \((5, -125)\).

(Answer B)
Mean and Standard Deviation

Problem 14 Solution:

The mean is determined by dividing the sum of data by the total number of data.

<table>
<thead>
<tr>
<th>$i$</th>
<th>$x_i$</th>
<th>$(x_i - \bar{x})^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2995</td>
<td>29.16</td>
</tr>
<tr>
<td>2</td>
<td>3005</td>
<td>21.16</td>
</tr>
<tr>
<td>3</td>
<td>3001</td>
<td>0.36</td>
</tr>
<tr>
<td>4</td>
<td>2991</td>
<td>88.36</td>
</tr>
<tr>
<td>5</td>
<td>2984</td>
<td>268.96</td>
</tr>
<tr>
<td>6</td>
<td>3004</td>
<td>12.96</td>
</tr>
<tr>
<td>7</td>
<td>3009</td>
<td>73.96</td>
</tr>
<tr>
<td>8</td>
<td>3015</td>
<td>213.16</td>
</tr>
<tr>
<td>9</td>
<td>2998</td>
<td>5.76</td>
</tr>
<tr>
<td>10</td>
<td>3002</td>
<td>2.56</td>
</tr>
<tr>
<td>Total</td>
<td>30004</td>
<td>716.4</td>
</tr>
</tbody>
</table>

\[ \bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{30004}{10} = 3000.4 \]

Variance is defined as:

\[ \sigma = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1} = \frac{716.4}{10-1} = 79.6 \]

(Answer A)
Programming - Looping Function

Problem 16 Solution:

“if ... else ... end” and “if ... elseif ... end” are the functions to create conditional statements.

“for ... end” is the function to create loopings for a certain specified number.

“while ... do” is the function to create loopings as long as a certain condition is true.

(Answer B)
Professional Practice

Problem 19 Solution:

You should not accept any kind of gifts from parties expecting special consideration, so you should reject the Rolex watch. As long as the contractor satisfies all the bid requirement and follows the bidding rules, the bid could be accepted.

(Answer C)
Depreciation Value

Problem 24 Solution:

Depreciation value is equal to the difference between initial cost $C$ and salvage value $S_n$, then divided by the life span $n$.

$$D = \frac{C - S_n}{n} = \frac{80,000 - 6,500}{10} = 7,350$$

(Answer B)
Effective Interest Rate Analysis
Problem 27 Solution:

\[ i = \left(1 + \frac{r}{m}\right)^m - 1 = \left(1 + \frac{0.025}{4}\right)^4 - 1 = 2.5235\% \]

(Answer C)
Vertical Curve

Problem 86 Solution:

$$PVC = PVI - \frac{L}{2} = (\text{sta 76 + 00}) - \frac{12 \text{ sta}}{2} = \text{sta 70 + 00}$$

$$x_m = \frac{G_1L}{G_1 - G_2} = \frac{(-0.02)(12 \text{ sta})}{-0.02 - 0.018} = 6.32 \text{ sta}$$

low point = $$PVC + x_m = (\text{sta 70 + 00}) + 6.32 \text{ sta} = \text{sta 76.32}$$

(Answer C)
Vertical Curve

Problem 87 Solution:

\[
elev_{\text{lowpoint}} = elev_{\text{PVC}} + G_1 x_m + \frac{(G_2 - G_1) x_m^2}{2L}
\]

\[
= (500 + 0.02 \times 6 \text{ sta}) + (-0.02)(6.32 \text{ sta}) + \frac{(0.018 + 0.02)(6.32 \text{ sta})^2}{2(12 \text{ sta})}
\]

\[
= 505.68 \approx 506 \text{ m}
\]

(Answer D)