Grade: Algebra II

Enduring Skill 1:

Develop an understanding of the structural similarities between the system of polynomials and the system of integers.

Demonstrators and Related Standards:

1. Perform arithmetic operations with complex numbers. (N.CN.1; N.CN.2)

2. Use complex numbers in polynomial identities and equations. (N.CN.2; N.CN.7; N.CN.8; N.CN.9)

3. Interpret the structure of expressions. (A.SSE.1; A.SSE.2)

4. Write expressions in equivalent forms to solve problems. (A.SSE.2; A.SSE. 4)

5. Perform arithmetic operations on polynomials. (A.APR.1)

6. Understand the relationship between zeros and factors of polynomials. (A.APR.2; A.APR.3)

7. Use polynomial identities to solve problems. (A.APR.4; A.APR.5)

8. Rewrite rational expressions. (A.APR.6; A.APR.7)

9. Understand solving equations as a process of reasoning and explain the reasoning. (A.REI.2)

10. Represent and solve equations and inequalities graphically. (A.REI.11)

11. Analyze functions using different representations. (F.IF.7)

Assessment Items:
1. ES 1, Demonstrator 1, Standards (N.CN.1; N.CN.2)

Let m and n be real numbers. Find the real and imaginary parts of $(3 + mi)(n - 2i)$.

A. Real: $(3n - 2m)$; Imaginary: $(6 - mn)i$
B. Real: $(3n - 2m)$; Imaginary: $(mn - 6)i$
C. Real: $(3n + 2m)$; Imaginary: $(mn - 6)i$
D. Real: $3n$; Imaginary: $2mi$

2. ES 1, Demonstrator 1, Standards (N.CN.1; N.CN.2)

What is $(8 - 18i) - (-3 -13i)$?

A. $5 -31i$
B. $5 -5i$
C. $11 - 31i$
D. $11 - 5i$

3. ES 1, Demonstrator 1, Standards (N.CN.1; N.CN.2)

What is $\left(-\frac{5}{6} - \frac{1}{3}i\right) + \left(\frac{1}{2} - \frac{1}{6}i\right)$?

A. $-\frac{1}{3} - \frac{1}{6}i$
B. $-\frac{1}{3} + \frac{1}{6}i$
C. $\frac{1}{3} - \frac{1}{6}i$
D. $\frac{1}{3} + \frac{1}{6}i$
4. ES 1, Demonstrator 1, Standards (N.CN.1; N.CN.2)

What is the product of \((5 - \sqrt{-6})\) and \((9 + \sqrt{-100})\)?

A. \(45 - 10\sqrt{6} + (50 - 9\sqrt{6})i\)
B. \(10\sqrt{6} + 45 + (50 + 9\sqrt{6})i\)
C. \(45 - 10\sqrt{6} + (50 + 9\sqrt{6})i\)
D. \(10\sqrt{6} + 45 + (50 - 9\sqrt{6})i\)

5. ES 1, Demonstrator 1, Standards (N.CN.1; N.CN.2)

Simplify the expression.

\[
\frac{-3 - 3i}{10 - 4i}
\]

A) \(\frac{-35 - 14i}{58}\)
B) \(\frac{-14 - 23i}{58}\)
C) \(\frac{-9 - 21i}{58}\)
D) \(\frac{-10 - 4i}{29}\)

6. ES 1, Demonstrator 2, Standards (N.CN.2; N.CN.7; N.CN.8; N.CN.9)

Solve the equation:

\[m^2 = -90\]

A) \(\{3i\sqrt{11}\}\)
B) \(\{3i\sqrt{10}, -3i\sqrt{10}\}\)
C) \(\{i\sqrt{2}, -i\sqrt{2}\}\)
D) \(\{3i\sqrt{11}, -3i\sqrt{11}\}\)
7. ES 1, Demonstrator 2, Standards (N.CN.2; N.CN.7; N.CN.8; N.CN.9)

Solve the equation:

\[ 7 - 6n^2 = -14 \]

A) \( \{i, -i\} \)
B) \( \left\{ \frac{2i\sqrt{42}}{3}, \frac{-2i\sqrt{42}}{3} \right\} \)
C) \( \left\{ \frac{\sqrt{14}}{2}, \frac{-\sqrt{14}}{2} \right\} \)
D) \( \left\{ \frac{5i\sqrt{6}}{3} \right\} \)

8. ES 1, Demonstrator 2, Standards (N.CN.2; N.CN.7; N.CN.8; N.CN.9)

Solve the equation:

\[ -9n^2 = 720 \]

A) \( \{4i\sqrt{5}, -4i\sqrt{5}\} \)
B) \( \{i\sqrt{21}, -i\sqrt{21}\} \)
C) \( \{4i\sqrt{5}\} \)
D) \( \{i\sqrt{3}, -i\sqrt{3}\} \)

9. ES 1, Demonstrator 3, Standards (A.SSE.1; A.SSE.2)

Factor the expression \( 9x^2 + 16 \)

A. \((3x + 4i)(3x - 4i)\)
B. \((3x + 4)(3x - 4)\)
C. \((9x + 4i)(x - 4i)\)
D. \((3x + 4i)^2\)
10. ES 1, Demonstrator 3, Standards (A.SSE.1; A.SSE.2)

State the possible number of real zeros of the function. Then find all rational zeros.

\[ f(x) = x^2 - 7x + 10 \]

A) Possible # of real zeros: 2 or 0  
Rational zeros: \{2, 5\}

B) Possible # of real zeros: 2 or 0  
Rational zeros: \{-2, 5\}

C) Possible # of real zeros: 4  
Rational zeros: \{0, 5\}

D) Possible # of real zeros: 3 or 1  
Rational zeros: \{2, 5\}
11. ES 1, Demonstrator 3, Standards (A.SSE.1; A.SSE.2)

State the number of complex zeros, the possible number of real and imaginary zeros, the possible number of positive and negative zeros, and the possible rational zeros for the function. Then find all rational zeros.

\[ f(x) = x^2 + 8x - 31 \]

A) # of complex zeros: 2
   Possible # of real zeros: 2 or 0
   Possible # of imaginary zeros: 2 or 0
   Possible # positive real zeros: 1
   Possible # negative real zeros: 1
   Possible rational zeros: \( \pm 1, \pm 31 \)
   Rational zeros: None

B) # of complex zeros: 2
   Possible # of real zeros: 3 or 1
   Possible # of imaginary zeros: 2
   Possible # positive real zeros: 3 or 1
   Possible # negative real zeros: 0
   Possible rational zeros: \( \pm 1, \pm 31 \)
   Rational zeros: None

C) # of complex zeros: 3
   Possible # of real zeros: 2 or 0
   Possible # of imaginary zeros: 2 or 0
   Possible # positive real zeros: 1
   Possible # negative real zeros: 1
   Possible rational zeros: \( \pm 1, \pm 31 \)
   Rational zeros: None

D) # of complex zeros: 2
   Possible # of real zeros: 2 or 0
   Possible # of imaginary zeros: 2 or 0
   Possible # positive real zeros: 2 or 0
   Possible # negative real zeros: 1
   Possible rational zeros: \( \pm 1, \pm 2, \pm 4, \pm \frac{1}{2} \)
   Rational zeros: None
12. ES 1, Demonstrator 3, Standards (A.SSE.1; A.SSE.2)

Find a value for $a$, a value for $k$, and a value for $n$ so that:

$$(3x + 2)(2x - 5) = ax^2 + kx + n$$

A. $a = 6, k = -19, n = -10$
B. $a = 6, k = 19, n = -10$
C. $a = 6, k = -11, n = -10$
D. $a = 6, k = 11, n = -10$

13. ES 1, Demonstrator 4, Standards (A.SSE.2; A.SSE. 4)

Which expression is equivalent to $y = x^4 - x^2 - 56$?

A. $y = (x^2 + 10)(x^2 + 7)$
B. $y = (x^2 - 8)(x^2 + 8)$
C. $y = 2(x^2 - 8)(x^2 + 4)$
D. $y = (x^2 - 8)(x^2 + 7)$

14. ES 1, Demonstrator 4, Standards (A.SSE.2; A.SSE. 4)

Factor completely: $x^2 - 2xy - 24y^2$

A. $(x - 6y)(x + 4y)$
B. $(x + 6y)(x + 4y)$
C. $(x + 6y)(x - 4y)$
D. $(x - 6y)(x - 4y)$

15. ES 1, Demonstrator 4, Standards (A.SSE.2; A.SSE. 4)

Factor $p^2 - 81$ completely.

A. $(p - 9)^2$
B. $(p + 9)(p - 9)$
C. $(p + 9)^2$
D. Not factorable
16. ES 1, Demonstrator 4, Standards (A.SSE.2; A.SSE.4)

How many terms are there in a geometric sequence if the first term is 14, the common ratio is 3, and the sum of the series is 1,240,022?

A. 88,573 terms  
B. 5 terms  
C. 14 terms  
D. 11 terms

17. ES 1, Demonstrator 5, Standards (A.APR.1)

\((-11 + 9v + 9v^4) + (11 + 10v^3 + 7v)\)

A. \(10v^4 + 10v^3 + 16v - 8\)  
B. \(9v^4 + 10v^3 + 16v - 8\)  
C. \(10v^4 + 2v^3 + 16v - 8\)  
D. \(9v^4 + 10v^3 + 16v\)

18. ES 1, Demonstrator 5, Standards (A.APR.1)

\((13r^4 - 4r + 9r^2) - (12r^4 + r^5 + r^2)\)

A. \(-r^5 + r^4 + 15r^2 + 9r\)  
B. \(-r^5 + r^4 + 8r^2 - 4r\)  
C. \(-r^5 + r^4 + 8r^2 + 9r\)  
D. \(-r^5 - 5r^4 + 8r^2 + 9r\)

19. ES 1, Demonstrator 5, Standards (A.APR.1)

Simplify \((8v^2 - v - 3)(-4v^2 + 4v + 2)\).

A. \(56v^4 + 17v^3 - 53v^2 + 14v - 16\)  
B. \(-32v^4 + 36v^3 + 24v^2 - 14v - 6\)  
C. \(-32v^4 - 4v^2 - 6\)  
D. \(56v^4 + 31v^3 - 47v^2 - 2v - 16\)
20. ES 1, Demonstrator 6, Standards (A.APR.2; A.APR.3)

Is the binomial \((k - 2)\) a factor of \((k^3 + 7k - 10k - 26)\)?

A. Yes  
B. No  
C. Cannot determine

21. ES 1, Demonstrator 6, Standards (A.APR.2; A.APR.3)

What is the remainder when \((a^4 - 2a^3 - 9a^2 - 33a + 5)\) is divided by \((a - 5)\)?

A. -9  
B. 11  
C. -10  
D. -7

22. ES 1, Demonstrator 6, Standards (A.APR.2; A.APR.3)

\[ y = -(x - 5)(x - 3) \]

A) x-int: 5 and 3  
B) x-int: None  
C) x-int: -5 and -3  
D) x-int: -3
23. ES 1, Demonstrator 7, Standards (A.APR.4; A.APR.5)

Find the coefficient described:

Coefficient of $x$ in expansion of $(4x - 1)^4$

A) 1 B) -256
C) -16 D) 96

24. ES 1, Demonstrator 7, Standards (A.APR.4; A.APR.5)

Find the coefficient described:

Coefficient of $m^3$ in expansion of $(m + 3)^4$

A) 12 B) 54
C) 108 D) 1

25. ES 1, Demonstrator 8, Standards (A.APR.6; A.APR.7)

Simplify:

$$\frac{7}{7b - 1} + \frac{5b}{b + 8}$$

A) \(\frac{2b + 56 + 35b^2}{(7b - 1)(b + 8)}\)

B) \(\frac{-2 + 5b}{2(-5 + 3b)}\)

C) \(\frac{7b - 14}{2(3b - 7)}\)

D) \(\frac{3b - 6}{3b - 7}\)
26. ES 1, Demonstrator 8, Standards (A.APR.6; A.APR.7)

Simplify:

\[
\frac{7}{2x - 10} - \frac{3}{4x}
\]

A) \(\frac{11x + 15}{4x(x - 5)}\)
B) \(\frac{21 + 3x}{8x(x - 5)}\)
C) \(\frac{8x + 3x^2 + 15}{4x(x - 5)}\)
D) \(\frac{3x^2 + 6x + 15}{4x(x - 5)}\)

27. ES 1, Demonstrator 8, Standards (A.APR.6; A.APR.7)

Simplify:

\[
\frac{n + 1}{n^2 - 9n - 10} + \frac{1}{n^2 + n - 12}
\]

A) \(\frac{n + 4}{n - 10}\)
B) \(\frac{(n - 3)(n + 4)}{n - 10}\)
C) \(n + 10\)
D) \(7\)

28. ES 1, Demonstrator 8, Standards (A.APR.6; A.APR.7)

Simplify:

\[
\frac{5n^2}{10n^2} \cdot \frac{10n^3 - 30n^2}{n - 3}
\]

A) \(\frac{9(n + 1)}{7n^2}\)
B) \(\frac{5n}{7}\)
C) \(n + 7\)
D) \(5n^2\)
29. **ES 1, Demonstrator 8, Standards (A.APR.6; A.APR.7)**

Divide \((x^4 + 10x^3 + 29x^2 + 32x + 27)\) by \((x + 3)\).

A. \(x^3 + 7x^2 + 8x + 11 + \frac{7}{(x + 3)}\)

B. \(x^3 + 7x^2 + 8x + 9 - \frac{1}{(x + 3)}\)

C. \(x^3 + 7x^2 + 8x + 8 + \frac{3}{(x + 3)}\)

D. \(x^3 + 7x^2 + 8x + 7 + \frac{3}{(x + 3)}\)

30. **ES 1, Demonstrator 9, Standards (A.REI.2)**

\[
\frac{v^2 - v - 6}{6v} = \frac{v - 6}{6} + \frac{1}{6}
\]

A) \(\left\{ \frac{3}{2}, 3 \right\} \)

B) \(\left\{ \frac{3}{2} \right\} \)

C) \(\{3\} \)

D) \(\left\{ \frac{3}{2}, -\frac{3}{2} \right\} \)

31. **ES 1, Demonstrator 9, Standards (A.REI.2)**

\[
2 + \sqrt{-3 - k} = \sqrt{9 - k}
\]

A) \(\{10, -7\} \)

B) \(\{-7\} \)

C) \(\{-4, -7\} \)

D) \(\{-7, 9\} \)
32. ES 1, Demonstrator 10, Standards (A. REL.11)

Find the real zeros of the function by graphing.

\[ f(x) = x^4 - 4x^2 - x + 1 \]

A) Real Zeros: -1.8, -0.7, 0.4, 2.1

B) Real Zeros: -2.3, -1

C) Real Zeros: -2.1, -1

D) Real Zeros: 0.4, 2.2
33. **ES 1, Demonstrator 10, Standards (A. REI.11)**

Find the real zeros of the function by graphing.

\[ f(x) = x^2 - 4x + 3 \]

A) Real Zeros: -3, -1

B) Real Zeros: None

C) Real Zeros: 1, 3

D) Real Zeros: -0.2, 4.2

34. **ES 1, Demonstrator 11, Standards (F.IF.7)**

Graph \( y = 5x + 7 \)

Graph \( y = |2x - 1| \)

Graph \( y = x^2 + 4x - 5 \)

Graph \( y = \frac{x+3}{4x-2} \)
35. ES 1, Demonstrator 10, Standards (A. REI.11)

Find the real zeros of the function by graphing.

\[ f(x) = x^3 + 5x^2 + 3x - 7 \]

A) Real Zeros: -3.7, -2.2, 0.9

B) Real Zeros: -1.2

C) Real Zeros: 2.4

D) Real Zeros: 2.6

36. ES 1, Demonstrator 10, Standards (A. REI.11)

Identify the graph of
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Enduring Skill 2:

Build on and extend previous work with functions, trigonometric ratios, and circles in Geometry to model periodic phenomena in the coordinate plane.

Demonstrators and Related Standards:

1. Extend the domain of trigonometric functions using the unit circle. (F.TF.1; F.TF.2)

2. Model periodic phenomena with trigonometric functions. (F.TF.5)

3. Prove and apply basic trigonometric identities. (F.TF.8)

Assessment Items:

1. ES 2, Demonstrator 1, Standards (F.TF.1; F.TF.2)
Find the length of the arc.

\[ \text{A)} \quad \frac{350\pi}{3} \text{ ft} \quad \text{B)} \quad \frac{40\pi}{3} \text{ ft} \]
\[ \text{C)} \quad \frac{160\pi}{3} \text{ ft} \quad \text{D)} \quad \frac{33\pi}{4} \text{ ft} \]

2. ES 2, Demonstrator 1, Standards (F.TF.1; F.TF.2)

Find the length of the arc.

\[ \text{A)} \quad \frac{539\pi}{6} \text{ ft} \quad \text{B)} \quad \frac{77\pi}{6} \text{ ft} \]
\[ \text{C)} \quad \frac{1445\pi}{12} \text{ ft} \quad \text{D)} \quad \frac{32\pi}{3} \text{ ft} \]

3. ES 2, Demonstrator 1, Standards (F.TF.1; F.TF.2)
Find the indicated trigonometric function.

\[ \sin \theta \]

\[ x \quad \frac{\pi}{6} \quad y \]

A) \( \frac{\sqrt{3}}{2} \)  
B) \( 2 \)  
C) \( \frac{1}{2} \)  
D) \( \frac{\sqrt{3}}{3} \)

4. ES 2, Demonstrator 1, Standards (F.TF.1; F.TF.2)

Find the indicated trigonometric function.

\[ \sin \theta \]

\[ x \quad \frac{2\pi}{6} \quad y \]

A) \( -\frac{\sqrt{2}}{2} \)  
B) \( \frac{1}{2} \)  
C) \( \frac{\sqrt{2}}{2} \)  
D) \( \sqrt{3} \)

5. ES 2, Demonstrator 2, Standard (F.TF.5)

Find the amplitude and period of each function. Then graph.
6. ES 2, Demonstrator 2, Standards (F.TF.5)

Find the amplitude and period of each function. Then graph

\[ y = \frac{1}{2} \cdot \tan \left( \frac{\theta}{3} - 60 \right) \]

7. ES 2, Demonstrator 3, Standards (F.TF.8)

Find an expression that completes the fundamental trigonometric identity: \( \csc(-x) \)

A. \( -\csc x \)
8. **ES 2, Demonstrator 3, Standards (F.TF.8)**

Which equation is NOT an identity?

- $\cos^2 \theta = 1 - \sin^2 \theta$
- $\cot^2 \theta = \csc^2 \theta - 1$
- $\sin^2 \theta = \cos^2 \theta - 1$
- $\tan^2 \theta = \sec^2 \theta - 1$

9. **ES 2, Demonstrator 3, Standards (F.TF.8)**

Which expression is equivalent to $\frac{\tan \theta}{\cos \theta - \sec \theta}$?

- A. $\csc \theta$
- B. $\sec \theta$
- C. $-\csc \theta$
- D. $\tan^2 \theta$

**Grade: Algebra II**

**Enduring Skill 3:**

Students synthesize and generalize what they have learned about a variety of function families.

**Demonstrators and Related Standards:**

1. Create equations that describe numbers or relationships. (A.CED.1; A.CED.2; A.CED.3; A.CED.4)
2. Interpret functions that arise in applications in terms of context. (F.IF.4; F.IF.5; F.IF.6)
3. Analyze functions using different representations, e.g. tables, graphs, equations. (F.IF.7, F.IF.8)
4. Build a function that models a relationship between two quantities. (F.BF.1)
5. Build new functions from existing functions. (F.BF.3, F.BF.4)
6. Construct and compare linear, quadratic, and exponential models and solve problems. (F.LE.4)

Assessment Items:

1. **ES 3, Demonstrator 1, Standards (A.CED.1; A.CED.2; A.CED.3; A.CED.4)**

   A repairman charges $60 for a service call, plus $35 per hour for labor. If your total bill was $173.75, how many hours did the repair take?
   
   a. 3 hours and 14 minutes 
   b. 3 hours and 25 minutes 
   c. 3 hours and 5 minutes 
   d. 3 hours and 15 minutes

2. **ES 3, Demonstrator 1, Standards (A.CED.1; A.CED.2; A.CED.3; A.CED.4)**

   A hallway requires 44 ft² of carpeting. The length of the hallway is 3 feet more than 2 times its width. How long is the hallway?
   
   a. 4 ft 
   b. 11 ft 
   c. 5.5 ft 
   d. 8 ft

3. **ES 3, Demonstrator 1, Standards (A.CED.1; A.CED.2; A.CED.3; A.CED.4)**

   You have earned $4577.70 in interest over a 20-year period in a savings account that had an initial investment of $5000. If the interest was compounded continuously at what rate was your saving account earning you money?
   
   a. 3.5% 
   b. 3.25% 
   c. 3% 
   d. 3.75%

4. **ES 3, Demonstrator 1, Standards (A.CED.1; A.CED.2; A.CED.3; A.CED.4)**
A boat traveled 378 miles downstream and back. The trip downstream took 14 hours. The trip back took 18 hours. Find the speed of the boat in still water and the speed of the current.

A) boat: 25 mph, current: 1 mph  
B) boat: 34 mph, current: 4 mph  
C) boat: 24 mph, current: 3 mph  
D) boat: 20 mph, current: 2 mph

5. **ES 3, Demonstrator 1, Standards (A.CED.1; A.CED.2; A.CED.3; A.CED.4)**

The school that Shreya goes to is selling tickets to a spring musical. On the first day of ticket sales the school sold 2 senior citizen tickets and 9 child tickets for a total of $98. The school took in $153 on the second day by selling 5 senior citizen tickets and 11 child tickets. Find the price of a senior citizen ticket and the price of a child ticket.

A) senior citizen ticket: $8, child ticket: $13  
B) senior citizen ticket: $21, child ticket: $3  
C) senior citizen ticket: $10, child ticket: $3  
D) senior citizen ticket: $13, child ticket: $8

6. **ES 3, Demonstrator 2, Standards (F.IF.4; F.IF.5; F.IF.6)**

What is the end behavior of the following function?

\[ f(x) = -x^3 + 4x^2 - 4 \]

A) \( f(x) \to -\infty \) as \( x \to -\infty \)  
B) \( f(x) \to +\infty \) as \( x \to -\infty \)  
C) \( f(x) \to +\infty \) as \( x \to -\infty \)  
D) \( f(x) \to -\infty \) as \( x \to -\infty \)

7. **ES 3, Demonstrator 3, Standards (F.IF.7; F.IF.8)**
8. ES 3, Demonstrator 3, Standards (F.IF.7; F.IF.8)

The table shown below represents a quadratic function. What is the interval where the function is increasing?

<table>
<thead>
<tr>
<th>x</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>11</td>
<td>1</td>
<td>-5</td>
<td>-7</td>
<td>-5</td>
<td>1</td>
<td>11</td>
</tr>
</tbody>
</table>

- **F** [−2, 1]
- **H** [−2, 4]
- **G** [1, 4]
- **I** [0, 4]
9. ES 3, Demonstrator 3 and 4, Standards (F.IF.7; F.IF.8; F.BF.1)

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
</tr>
</tbody>
</table>

Which equation models the data in the table?

- $\text{F} \quad y = x^2 - 1$
- $\text{G} \quad y = x^2 + 3$
- $\text{H} \quad y = -x^2 + 3$
- $\text{I} \quad y = x^2 + 1$

10. ES 3, Demonstrator 5, Standards (F.BF.3; F.BF.4)

What is an equation for the translation of $y = \frac{2}{x}$ that has asymptotes at $x = 3$ and $y = -5$?

- $\text{A} \quad y = \frac{2}{x - 3} - 5$
- $\text{B} \quad y = \frac{2}{x + 3} + 5$
- $\text{C} \quad y = \frac{2}{x + 5} - 3$
- $\text{D} \quad y = \frac{2}{x - 5} + 3$

11. ES 3, Demonstrator 5, Standards (F.BF.3; F.BF.4)

Which equation does the graph represent?

- $\text{A} \quad y = (x + 2)^2 - 1$
- $\text{B} \quad y = (x - 2)^2 - 1$
- $\text{C} \quad y = (x - 2)^2 + 1$
- $\text{D} \quad y = (x - 2)^4 - 1$
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Enduring Skill 4:

Students relate the visual displays and summary statistics from earlier grades to different types of data and to probability distributions.

Demonstrators and Related Standards:
1. Summarize, represent, and interpret data on a single count or measurement variable. (S.ID.4)

2. Understand and evaluate random processes underlying statistical experiments. (S.IC.1; S.IC.2)

3. Make inferences and justify conclusions from sample surveys, experiments, and observational studies. (S.IC.3, S.IC.4; S.IC.5; S.IC.6)

4. Use probability to evaluate outcomes of decisions. (S.MD.6; S.MD.7)

Assessment Items:

1. **ES 4, Demonstrator 1, Standards (S.ID.4)**

   For a daily airline flight between two cities, the number of pieces of checked luggage has a mean of 380 and a standard deviation of 20. On what percent of the flights would you expect from 340 to 420 pieces of checked luggage?
   
   - A. 34%
   - B. 47.5%
   - C. 68%
   - D. 95%

2. **ES 4, Demonstrator 1, Standards (S.ID.4)**

   In a normally distributed sample of the heights of 200 elementary school children, the mean height is 115.5cm and the standard deviation is found to be 9.8cm.

   How many children (by estimation) are less than 95.9cm tall?

   - A. 10
   - B. 5
   - C. 105
   - D. 126

3. **ES 4, Demonstrator 1, Standards (S.ID.4)**

   Andy Lee is the punter for the San Francisco 49ers. He had a stellar 2011 season with an average punt length of 50.9 yards with a standard deviation of 3.5. His punt distance follows a normal distribution. Determine the range of punt distances that covers 68% of the distances.

   - (A) 49.9 to 50.9 yards
   - (B) 48.9 to 51.9 yards
   - (C) 47.4 to 54.4 yards
   - (D) 43.9 to 57.9 yards
4. **ES 4, Demonstrator 2, Standards (S.IC.1; S.IC.2)**

The mayor of Crimeville wants to increase taxes to invest in public safety. A polling company decides to randomly select 2500 registered voters in the city and ask them whether or not they would approve of the tax increase. What is the population?

- (A) All U.S. citizens
- (B) The policemen and women in Crimeville
- (C) The registered voters in Crimeville
- (D) The citizens over the age of 50 in Crimeville

5. **ES 4, Demonstrator 2, Standards (S.IC.1; S.IC.2)**

In order to figure out how in the world Las Vegas, Nevada has survived in the middle of the desert, the mayor has decided that she must plan for the future. She must determine how much water Las Vegas uses per square foot per year. Which of the following would be the most accurate way to determine this information?

- (A) Requiring every building to report its the square footage and yearly water use
- (B) Surveying individuals, averaging their yearly water consumption, and multiplying it by the total number of residents of Las Vegas
- (C) Making an educated guess based on the water consumption of other major cities
- (D) Averaging the yearly rainfall from the last ten years

6. **ES 4, Demonstrator 2, Standards (S.IC.1; S.IC.2)**

To determine the most popular brands of tea consumed by Americans, a survey is conducted in a busy downtown location at lunchtime. Which of the following is NOT a potential bias in the sampling method?

- (A) Urban office employees are not representative of the general population.
- (B) The results could be influenced by national brand teas available in the area.
- (C) A lunchtime survey does not reflect peoples’ tastes at other times of the day.
- (D) The survey must include call-in and online responses.
7. ES 4, Demonstrator 3, Standards (S.IC.3; S.IC.4; S.IC.5; S.IC.6)

Which of the following is a random sample?

- (A) Picking out the best athletes from a track team to measure average performance
- (B) Selecting the closest people sitting next to you in class to determine the average GPA of the entire class
- (C) Neither (A) nor (B)
- (D) Both (A) and (B)

8. ES 4, Demonstrator 3, Standards (S.IC.3; S.IC.4; S.IC.5; S.IC.6)

A local candy store has found that kids prefer certain colors of candy regardless of their taste. For kids ages five to eight, the following data was collected:

<table>
<thead>
<tr>
<th>Color</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>67</td>
</tr>
<tr>
<td>Red</td>
<td>89</td>
</tr>
<tr>
<td>Yellow</td>
<td>27</td>
</tr>
<tr>
<td>Green</td>
<td>13</td>
</tr>
</tbody>
</table>

What is the estimated population proportion of the most preferred candy color from this sample?

- (A) 0.34
- (B) 0.45
- (C) 0.13
- (D) 0.06

9. ES 4, Demonstrator 3, Standards (S.IC.3; S.IC.4; S.IC.5; S.IC.6)

A study samples 100 Coca-Cola drinkers and finds that 99 of them really dislike the taste of the new cola drink. What inference can be drawn from this?

- (A) These are really Pepsi drinkers masquerading as Coca Cola lovers
- (B) 99% of all carbonate beverage drinkers will dislike the new cola drink as well
- (C) Most people who drink Coca Cola would dislike the new cola
- (D) Most people who don’t drink Pepsi would enjoy the new cola

10. ES 4, Demonstrator 4, Standards (S.MD.6; S.MD.7)
11. **ES 4, Demonstrator 4, Standards (S.MD.6; S.MD.7)**

Which of the following decision-making method is fair?

- (A) Tossing a fair coin and using a random number generator
- (B) Tossing a fair coin and spinning a slightly tilted roulette wheel
- (C) Tossing a fair coin and dropping a fair die
- (D) Tossing a fair coin and drawing from slips of paper of different sizes

You and your entire class are stranded on a desert island. A rescue boat can save all of you except for one. Who will be left on the island forever. You have all decided that whoever picks a number closest to the one that is randomly generated (luckily, someone brought a laptop) will stay behind. What should be done to ensure a fair result?

- (A) Make sure that everyone looks at each other while guessing
- (B) Make sure that everyone writes their guesses down
- (C) Allow people to talk to one another
- (D) All of the above

12. **ES 4, Demonstrator 4, Standards (S.MD.6; S.MD.7)**

When would a truly fair outcome statistically speaking be most unfair in reality?

- (A) When the outcome has serious consequences
- (B) When the outcome has minor consequences
- (C) All of the above
- (D) None of the above

13. **ES 4, Demonstrator 4, Standards (S.MD.6; S.MD.7)**
A tire manufacturer knows that out of every 100,000 tires, it will have 1 blowout on the highway. This will cost the company about $1,000,000 in claims damages per blown out tire. Is it a good strategy for the tire manufacturer to charge $10 per tire in order to cover the litigation?

- (A) Yes, the price per tire covers the amount of litigation
- (B) No, the price per tire does not cover the amount of litigation
- (C) No, because the tire company has expenses other than litigation
- (D) No, because the probability is theoretical and not empirical

14. **ES 4, Demonstrator 4, Standards (S.MD.6; S.MD.7)**

An oil company has hired a geologist to conduct a survey of newly purchased land. The geologist has never been to this part of the world and is unsure, given all the geological conditions, what the probability is of finding viable oil. To increase his chances of finding oil, which of the following should he not do?

- (A) Consult other geologists that have worked in the area
- (B) Use a random sample survey and drill wherever he can to collect data
- (C) Use his knowledge of similar places in the world to estimate the conditions in his new place
- (D) None of the above