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Standards Correlations

The standards correlations below support the implementation of the Common Core Standards. This book includes station activity sets for the Common Core domains of Number and Quantity, Algebra, Functions, and Statistics and Probability. This table provides a listing of the available station activities organized by Common Core standard.

The left column lists the standard codes. The first letter of the code represents the Common Core domain. The domain letter is followed by a dash and the initials of the cluster name, which is then followed by the standard number. The middle column lists the title of the station activity set that corresponds to the standard, and the right column lists the page number where the station activity set can be found.

The table indicates the standards that are heavily addressed in the station sets. If there are other standards that are addressed within the set, they can be found on the first page of each set.

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Standards Correlations

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Number and Quantity

Set 1: Matrices

Instruction

Goal: To provide opportunities for students to develop concepts and skills related to adding and subtracting matrices, scalar multiplication, and matrix multiplication

Common Core Standards

Number and Quantity: Vector and Matrix Quantities

Perform operations on matrices and use matrices in applications.

N-VM.7. (+) Multiply matrices by scalars to produce new matrices; e.g., as when all of the payoffs in a game are doubled.

N-VM.8. (+) Add, subtract, and multiply matrices of appropriate dimensions.

Student Activities Overview and Answer Key

Station 1

Students are given 18 index cards with the following integers written on them: –10, –7, –3, –1, 0, 1, 2, 4, 8, 9, 10, 12, 15, 20, 22, 25, 40, 100. Students draw the index cards from a pile to fill in the matrices. Then they work together to perform matrix addition. Students explain why matrix addition is not possible on matrices that are not the same size.

Answers

1. Answers will vary depending on which cards students draw. Possible answers:
$$\begin{bmatrix} -10 & -7 \\ 10 & 12 \end{bmatrix} + \begin{bmatrix} 15 & 22 \\ 8 & 9 \end{bmatrix} = \begin{bmatrix} 5 & 15 \\ 18 & 21 \end{bmatrix}$$

2. Answers will vary. Possible answers:
$$\begin{bmatrix} -3 & 8 & -10 \\ 0 & 4 & 40 \\ 1 & 9 & 100 \end{bmatrix} + \begin{bmatrix} -1 & 20 & -7 \\ 25 & 15 & 10 \\ 12 & 2 & 22 \end{bmatrix} = \begin{bmatrix} -4 & 28 & -17 \\ 25 & 19 & 50 \\ 13 & 11 & 122 \end{bmatrix}$$

3. $$\begin{bmatrix} 1 & 40 \\ 0 & -12 \end{bmatrix} + \begin{bmatrix} 100 & -5 \\ 88 & -7 \end{bmatrix} = \begin{bmatrix} 101 & 35 \\ 88 & -19 \end{bmatrix}$$

4. $$\begin{bmatrix} 14 & 0 & -14 \\ -6 & -7 & 12 \\ 18 & 24 & 88 \end{bmatrix} + \begin{bmatrix} 1 & 0 & -10 \\ 14 & 49 & 56 \\ -22 & -28 & 0 \end{bmatrix} = \begin{bmatrix} 15 & 0 & -24 \\ 8 & 42 & 68 \\ -4 & -4 & 88 \end{bmatrix}$$

5. Matrix addition is not possible because the matrices are different sizes.

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Instruction

Station 2

Students are given 18 index cards with the following integers written on them: –12, –11, –4, –1, 0, 1, 2, 4, 7, 9, 14, 16, 21, 30, 31, 38, 75, 90. Students draw the index cards from a pile to fill in the matrices. Then they work together to perform matrix subtraction. Students explain why matrix subtraction is not possible on matrices that are not the same size.

Answers

1. Answers will vary depending on the cards drawn. Possible answers:
$$\begin{bmatrix} 9 & 31 \\ -4 & 90 \end{bmatrix} - \begin{bmatrix} -12 & 16 \\ 4 & 7 \end{bmatrix} = \begin{bmatrix} 21 & 15 \\ -8 & 83 \end{bmatrix}$$

2. Answers will vary. Possible answers:
$$\begin{bmatrix} -12 & 4 & 1 \\ 14 & 0 & 21 \\ 9 & 31 & -11 \end{bmatrix} - \begin{bmatrix} 7 & 2 & -1 \\ 16 & -4 & 30 \\ 38 & 90 & 75 \end{bmatrix} = \begin{bmatrix} -19 & 2 & 2 \\ -2 & 4 & -9 \\ -29 & -59 & -86 \end{bmatrix}$$

3. $$\begin{bmatrix} 3 & -5 \\ 44 & 0 \end{bmatrix} - \begin{bmatrix} 1 & -25 \\ 12 & -18 \end{bmatrix} = \begin{bmatrix} 2 & 20 \\ 32 & 18 \end{bmatrix}$$

4. $$\begin{bmatrix} 0 & 22 & -11 \\ 15 & 44 & 72 \\ -16 & 8 & -1 \end{bmatrix} - \begin{bmatrix} 0 & 8 & -4 \\ -14 & 7 & 12 \\ 22 & 39 & -21 \end{bmatrix} = \begin{bmatrix} 0 & 14 & -7 \\ 29 & 37 & 60 \\ -38 & -31 & 20 \end{bmatrix}$$

5. Even though the matrices have the same amount of numbers, they are different sizes. Therefore, it is impossible to perform matrix subtraction.

Station 3

Students are given 12 index cards with the following scalars and matrices on them:

Scalars: –2, –3, 1, 3, 4, 5, 8, 12

Matrices: $\begin{bmatrix} 10 & -4 & 5 \end{bmatrix}, \begin{bmatrix} 12 & 7 \\ 8 & 3 \end{bmatrix}, \begin{bmatrix} 10 & 2 & 3 \\ -2 & 4 & 12 \\ 7 & 11 & 3 \end{bmatrix}, \begin{bmatrix} -5 & -8 \\ -9 & -3 \end{bmatrix}$

Students place the scalars in one pile and the matrices in another pile. One student draws a card from each pile. The students work together to perform scalar multiplication based on the two cards drawn. Students find scalar multiples of a matrix.

Instruction

Answers

1. Answers will vary depending on the cards drawn. Possible answers:
$$-3\begin{bmatrix} 10 & -4 & 5 \end{bmatrix} = \begin{bmatrix} -30 & 12 & -15 \end{bmatrix}$$
2. Answers will vary. Possible answers:
$$5\begin{bmatrix} 12 & 7 \\ 8 & 3 \end{bmatrix} = \begin{bmatrix} 60 & 35 \\ 40 & 15 \end{bmatrix}$$
3. Answers will vary. Possible answers:
$$1\begin{bmatrix} 10 & 2 & 3 \\ -2 & 4 & 12 \\ 7 & 11 & 3 \end{bmatrix} = \begin{bmatrix} 10 & 2 & 3 \\ -2 & 4 & 12 \\ 7 & 11 & 3 \end{bmatrix}$$
4. Scalar = –5; the numbers in the second matrix are –5 times the numbers in the first matrix.
5. Original matrix: $\begin{bmatrix} -1 & 9 \\ -5 & 4 \end{bmatrix}$

Station 4

Students will be given a number cube. As a group, they will determine how to perform matrix multiplication based on a given problem and answer. Then they will roll the dice to populate matrices and perform matrix multiplication.

Answers

1. If you have matrices *A* and *B*, then *AB* = multiplying the rows in matrix *A* by the columns in matrix *B* and then finding their sum. The number of columns in *A* must equal the number of rows in *B* in order for the matrix multiplication to be defined.
2. Answers will vary. Possible answers:
$$\begin{bmatrix} 4 & 1 \end{bmatrix}\begin{bmatrix} 3 \\ 6 \end{bmatrix} = \begin{bmatrix} 4(3) + 1(6) \end{bmatrix} = \begin{bmatrix} 12 + 6 \end{bmatrix} = \begin{bmatrix} 18 \end{bmatrix}$$
3. Answers will vary. Possible answers:
$$\begin{bmatrix} 2 & 3 & 1 \\ 6 & 1 & 4 \end{bmatrix}\begin{bmatrix} 3 & 5 \\ 2 & 5 \\ 4 & 6 \end{bmatrix} = \begin{bmatrix} 2(3) + (3)(2) + (1)(4) & 2(5) + (3)(5) + (1)(6) \\ 6(3) + (1)(2) + (4)(4) & 6(5) + (1)(5) + (4)(6) \end{bmatrix} = \begin{bmatrix} 16 & 31 \\ 36 & 59 \end{bmatrix}$$

Instruction

Materials List/Setup

Station 1 18 index cards with the following integers written on them:

–10, –7, –3, –1, 0, 1, 2, 4, 8, 9, 10, 12, 15, 20, 22, 25, 40, 100

Station 2 18 index cards with the following integers written on them:

–12, –11, –4, –1, 0, 1, 2, 4, 7, 9, 14, 16, 21, 30, 31, 38, 75, 90

Station 3 12 index cards with the following scalars and matrices on them:

Scalars: –2, –3, 1, 3, 4, 5, 8, 12

Matrices: $\begin{bmatrix} 10 & -4 & 5 \end{bmatrix}, \begin{bmatrix} 12 & 7 \\ 8 & 3 \end{bmatrix}, \begin{bmatrix} 10 & 2 & 3 \\ -2 & 4 & 12 \\ 7 & 11 & 3 \end{bmatrix}, \begin{bmatrix} -5 & -8 \\ -9 & -3 \end{bmatrix}$

Station 4 number cube

Instruction

Discussion Guide

To support students in reflecting on the activities and to gather formative information about student learning, use the following prompts to facilitate a class discussion to "debrief" the station activities.

Prompts/Questions

1. How do you perform matrix addition for two matrices $A + B$?
2. How do you perform matrix subtraction for two matrices $A - B$?
3. Why does the size of each matrix matter when performing addition or subtraction?
4. How do you perform scalar multiplication with matrices?
5. How do you perform matrix multiplication for two matrices, A and B?
6. What are real-world examples of matrices?

Think, Pair, Share

Have students jot down their own responses to questions, then discuss with a partner (who was not in their station group), and then discuss as a whole class.

Suggested Appropriate Responses

1. Add the element in row 1, column 1 of matrix A with the corresponding element in row 1, column 1 of matrix B. Repeat this process for the remaining corresponding elements.
2. Subtract the element in row 1, column 1 of matrix B from the corresponding element in row 1, column 1 of matrix A. Repeat this process for the remaining corresponding elements.
3. Matrix addition and subtraction relies on corresponding elements. Therefore, the matrices must be the same size to provide matches for all the corresponding elements.
4. Multiply the scalar by each element in the matrix.
5. If you have matrices A and B, then AB = multiplying the rows in matrix A by the columns in matrix B and then finding their sum. The number of columns in A must equal the number of rows in B in order for the matrix multiplication to be defined.
6. When you organize data in columns and rows, it is considered a matrix. Examples include students and their test scores, growth rates of plants, and populations of states.

Instruction

Possible Misunderstandings/Mistakes

- Incorrectly subtracting negative numbers during matrix subtraction
- Subtracting the matrices in the wrong order
- Trying to add or subtract two matrices that are not the same size
- Not keeping track of which row is multiplied by which column
- Mistakenly finding the sum instead of the product during matrix multiplication
- Not keeping track of which steps they take to find their answer
- Not keeping track of the signs of the numbers

Number and Quantity

Set 1: Matrices

Station 1

You will be given 18 index cards with the following numbers written on them:

–10, –7, –3, –1, 0, 1, 2, 4, 8, 9, 10, 12, 15, 20, 22, 25, 40, 100

Place the index cards in a pile. Take turns drawing a card from the top of the pile. Write the number from each card in one of the boxes in the matrix below. Repeat this process until all boxes of each matrix contain a number.

$$\begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix} + \begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix} =$$

1. Perform matrix addition on the matrices above. Show your work in the space below.

2. Place the cards back in the pile and shuffle. Take turns drawing one card at time. Fill in the boxes of the matrices with the numbers from the cards, and perform matrix addition.

$$\begin{bmatrix} \square & \square & \square \\ \square & \square & \square \\ \square & \square & \square \end{bmatrix} + \begin{bmatrix} \square & \square & \square \\ \square & \square & \square \\ \square & \square & \square \end{bmatrix} =$$

continued

Number and Quantity

Set 1: Matrices

As a group, perform matrix addition on the following matrices. If matrix addition is not possible, explain why. Discuss your answers.

3. $\begin{bmatrix} 1 & 40 \\ 0 & -12 \end{bmatrix} + \begin{bmatrix} 100 & -5 \\ 88 & -7 \end{bmatrix} =$

4. $\begin{bmatrix} 14 & 0 & -14 \\ -6 & -7 & 12 \\ 18 & 24 & 88 \end{bmatrix} + \begin{bmatrix} 1 & 0 & -10 \\ 14 & 49 & 56 \\ -22 & -28 & 0 \end{bmatrix} =$

5. $\begin{bmatrix} 2 \\ 25 \end{bmatrix} + \begin{bmatrix} 14 & 25 \\ 35 & 15 \end{bmatrix} =$

Number and Quantity

Set 1: Matrices

Station 2

You will be given 18 index cards with the following numbers written on them:

–12, –11, –4, –1, 0, 1, 2, 4, 7, 9, 14, 16, 21, 30, 31, 38, 75, 90

Place the index cards in a pile. Take turns drawing a card from the top of the pile. Write the number from each card in one of the boxes in the matrix below. Repeat this process until all boxes of each matrix contain a number.

$$\begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix} - \begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix} =$$

1. Perform matrix subtraction on the matrices above. Show your work in the space below.

2. Place the cards back in the pile and shuffle. Take turns drawing one card at time. Fill in the boxes of the matrices with the numbers from the cards, and perform matrix subtraction.

$$\begin{bmatrix} \square & \square & \square \\ \square & \square & \square \\ \square & \square & \square \end{bmatrix} - \begin{bmatrix} \square & \square & \square \\ \square & \square & \square \\ \square & \square & \square \end{bmatrix} =$$

continued

Number and Quantity

Set 1: Matrices

As a group, perform matrix subtraction on the following matrices. If matrix subtraction is not possible, explain why. Discuss your answers.

3. $\begin{bmatrix} 3 & -5 \\ 44 & 0 \end{bmatrix} - \begin{bmatrix} 1 & -25 \\ 12 & -18 \end{bmatrix} =$

4. $\begin{bmatrix} 0 & 22 & -11 \\ 15 & 44 & 72 \\ -16 & 8 & -1 \end{bmatrix} - \begin{bmatrix} 0 & 8 & -4 \\ -14 & 7 & 12 \\ 22 & 39 & -21 \end{bmatrix} =$

5. $\begin{bmatrix} 10 & 44 & 29 \end{bmatrix} - \begin{bmatrix} 2 \\ 15 \\ 7 \end{bmatrix} =$

Number and Quantity

Set 1: Matrices

Station 3

You will be given 12 index cards with the following scalars and matrices on them:

Scalars: –2, –3, 1, 3, 4, 5, 8, 12

Matrices: $\begin{bmatrix} 10 & -4 & 5 \end{bmatrix}, \begin{bmatrix} 12 & 7 \\ 8 & 3 \end{bmatrix}, \begin{bmatrix} 10 & 2 & 3 \\ -2 & 4 & 12 \\ 7 & 11 & 3 \end{bmatrix}, \begin{bmatrix} -5 & -8 \\ -9 & -3 \end{bmatrix}$

Place the scalars in one pile and the matrices in another pile. Have one student draw a card from each pile. Work together to perform scalar multiplication based on the two cards drawn. Repeat this process two more times and write the scalar, matrix, and your answer in the space below.

1. Draw two cards. Write down the scalar and matrix, then perform scalar multiplication. Show your work.

2. Draw two more cards. Write down the scalar and matrix, then perform scalar multiplication. Show your work.

3. Draw two more cards. Write down the scalar and matrix, then perform scalar multiplication. Show your work.

continued

4. What scalar was used in the following problem? Explain your answer.

$$Scalar\begin{bmatrix} -2 & 10 \\ 3 & 8 \end{bmatrix} = \begin{bmatrix} 10 & -50 \\ -15 & -40 \end{bmatrix}$$

5. What original matrix was used in the following problem? Explain your answer.

$$3\begin{bmatrix} & \\ & \end{bmatrix} = \begin{bmatrix} -3 & 27 \\ -15 & 12 \end{bmatrix}$$

Station 4

Use matrix multiplication to solve the problems. You will be given a number cube to solve problems 2 and 3.

1. As a group, determine how to perform matrix multiplication from the given problem and answer:

$$\begin{bmatrix} 2 & -5 & 9 \\ 10 & 4 & 1 \end{bmatrix}\begin{bmatrix} 7 & 12 \\ 8 & 3 \\ 11 & -1 \end{bmatrix} = \begin{bmatrix} 2(7)+(-5)(8)+(9)(11) & 2(12)+(-5)(3)+(9)(-1) \\ 10(7)+(4)(8)+(1)(11) & 10(12)+(4)(3)+(1)(-1) \end{bmatrix} =$$

$$\begin{bmatrix} 14-40+99 & 24-15-9 \\ 70+32+11 & 120+12-1 \end{bmatrix} = \begin{bmatrix} 73 & 0 \\ 113 & 131 \end{bmatrix}$$

Write your explanation of how to perform matrix multiplication below.

2. Take turns rolling the number cube, for a total of 4 rolls. Each time, record the result in a box in the matrix problem below. When all the boxes in the matrix problem contain a number, perform matrix multiplication and write your answer in the space below.

$$\begin{bmatrix} \square & \square \end{bmatrix}\begin{bmatrix} \square \\ \square \end{bmatrix} =$$

continued

Number and Quantity

Set 1: Matrices

3. Work as a group to roll the number cube and record the result in a box in the matrix problem below. Repeat this process until all the boxes in the matrix problem contain a number. Then perform matrix multiplication and write your answer in the space below.