Determinants Quiz Questions and Answers PDF

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Which operation does NOT change the determinant of a matrix?

- ◯ Swapping two rows
- ◯ Multiplying a row by a scalar
- ◯ **Adding a multiple of one row to another ✓**
- ◯ Transposing the matrix

> Adding a multiple of one row to another does not change the determinant.

What is the determinant of the identity matrix of size \(n \times n\)?

- ◯ 0
- ◯ **1 ✓**
- ◯ n
- ◯ n!

> The determinant of the identity matrix is always 1.

What is the determinant of a 2x2 matrix \(\begin{pmatrix} a & b \\ c & d \end{pmatrix}\)?

- ◯ a + d
- ◯ **ad - bc ✓**
- ◯ ab + cd
- ◯ ac - bd

> The determinant of a 2x2 matrix is calculated as ad - bc.

Explain why the determinant of a matrix is important in determining whether a matrix is invertible.

A matrix is invertible if and only if its determinant is non-zero. A zero determinant indicates that the matrix is singular and does not have an inverse.

Explain the process of calculating the determinant of a 3x3 matrix using cofactor expansion.

To calculate the determinant using cofactor expansion, choose a row or column, multiply each element by its cofactor, and sum the results. The cofactor is calculated as \((-1)^{i+j}\) times the determinant of the minor matrix obtained by removing the element's row and column.

Which of the following matrices has a determinant of zero?

- ◯ Identity matrix
- ◯ Diagonal matrix with all non-zero elements
- ◯ **Matrix with two identical rows ✓**
- ◯ Upper triangular matrix with non-zero diagonal elements

A matrix with two identical rows has a determinant of zero.

What does a determinant of zero indicate about a matrix?

- ◯ The matrix is invertible
- ◯ **The matrix is not invertible ✓**
- ◯ The matrix is symmetric
- ◯ The matrix is orthogonal

A zero determinant indicates that the matrix is not invertible.

Which method is commonly used to calculate the determinant of a 3x3 matrix?

- ◯ Gaussian elimination
- ◯ **Rule of Sarrus ✓**
- ◯ Matrix inversion
- ◯ Eigenvalue decomposition

The Rule of Sarrus is a common method for calculating the determinant of a 3x3 matrix.

Which of the following is true about the determinant of a matrix product \(AB\)?

- ◯ \(\det(AB) = \det(A) + \det(B)\)
- ◯ **\(\det(AB) = \det(A) \times \det(B)\) ✓**
- ◯ \(\det(AB) = \det(A) - \det(B)\)
- ◯ \(\det(AB) = \det(A) / \det(B)\)

The determinant of a product of matrices is the product of their determinants.

Which of the following properties are true for determinants? (Select all that apply)

- ☐ **Determinants are only defined for square matrices. ✓**
- ☐ **Swapping two rows of a matrix multiplies the determinant by -1. ✓**
- ☐ Adding a scalar to a row changes the determinant.
- ☐ The determinant of a matrix is always positive.

Determinants are defined for square matrices and swapping rows changes the sign of the determinant.

Which operations will result in a determinant of zero? (Select all that apply)

- ☐ **Making two rows identical ✓**
- ☐ Adding a multiple of one row to another
- ☐ **Having a row of zeros ✓**
- ☐ Transposing the matrix

Making two rows identical or having a row of zeros will result in a zero determinant.

For which of the following matrices is the determinant equal to the product of its diagonal elements? (Select all that apply)

- [ ] **Diagonal matrix ✓**
- [ ] **Upper triangular matrix ✓**
- [ ] **Lower triangular matrix ✓**
- [ ] Symmetric matrix

> The determinant equals the product of diagonal elements for diagonal, upper triangular, and lower triangular matrices.

Which of the following statements about determinants are correct? (Select all that apply)

- [ ] **The determinant of a matrix is a scalar. ✓**
- [ ] **Determinants can be used to find eigenvalues. ✓**
- [ ] The determinant of a matrix product is the sum of the determinants.
- [ ] **Determinants are used in Cramer's Rule. ✓**

> The determinant is a scalar, can be used to find eigenvalues, and is used in Cramer's Rule.

What are the consequences of a zero determinant? (Select all that apply)

- [ ] The matrix is invertible.
- [ ] The matrix has full rank.
- [ ] **The matrix is singular. ✓**
- [ ] **The system of equations has no unique solution. ✓**

> A zero determinant indicates that the matrix is singular and the system of equations has no unique solution.

Which of the following are methods to calculate the determinant of a matrix? (Select all that apply)

- [ ] **Cofactor expansion ✓**
- [ ] **Gaussian elimination ✓**
- [ ] Matrix multiplication
- [ ] **Rule of Sarrus ✓**

> Common methods to calculate determinants include cofactor expansion, Gaussian elimination, and the Rule of Sarrus.

Describe the geometric interpretation of the determinant of a 2x2 matrix.

> **The determinant of a 2x2 matrix represents the area of the parallelogram formed by its column vectors. A zero determinant indicates that the vectors are linearly dependent and lie on the same line.**

How does the determinant relate to the volume of a parallelepiped in three-dimensional space?

> **The absolute value of the determinant of a 3x3 matrix represents the volume of the parallelepiped formed by its column vectors. A zero determinant indicates that the vectors are coplanar.**

What is the significance of the determinant in solving systems of linear equations using Cramer's Rule?

> **Cramer's Rule uses determinants to find the solution of a system of linear equations. It requires that the determinant of the coefficient matrix is non-zero to ensure a unique solution.**

Discuss how row operations affect the determinant of a matrix and provide examples.

Swapping two rows multiplies the determinant by -1, multiplying a row by a scalar multiplies the determinant by that scalar, and adding a multiple of one row to another does not change the determinant.

In a triangular matrix, the determinant is equal to:

- ◯ The sum of the diagonal elements
- ◯ **The product of the diagonal elements ✓**
- ◯ Zero
- ◯ The sum of all elements

In a triangular matrix, the determinant is simply the product of the diagonal elements. This property holds true for both upper and lower triangular matrices.