# MATH211: Linear Methods I

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Determinants

Examples

Traditional determinants

Examples

# Last time

last time

# Determinants

# Two dimensional determinants

First algebra showing get the columns of matrix. Then picture in two dimensions. The signed area of the parallelogram. Calculate.

# Effect of scalar multiplication of row

Picture.

# Determinants of diagonal matrix and scalar multiple

Determinant of diagonal. Determinant of scalar multiple of a matrix.

# Effect of adding a multiple of one row to another

# Determinant of triangular matrix

We can reduce a triangular matrix to a diagonal one.

# Effect of swapping two rows

This essentially defines signed area in dimensions higher than three.

Questions?

# Examples

# Examples

## Example

Find

$$\begin{vmatrix} 1 & 2 & 3 \\ 0 & 5 & 6 \\ 0 & 0 & 9 \end{vmatrix}$$

## Example

Find

$$\begin{vmatrix} -3 & 5 & -6 \\ 1 & -1 & 3 \\ 2 & -4 & 1 \end{vmatrix}$$

# Examples

## Example

Find

$$\begin{vmatrix} 3 & 1 & 2 & 4 \\ -1 & -3 & 8 & 0 \\ 1 & -1 & 5 & 5 \\ 1 & 1 & 2 & -1 \end{vmatrix}$$

## Example

If

$$\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} = 4 \text{ find } \begin{vmatrix} -b_1 & -b_2 & -b_3 \\ a_1 + 2b_1 & a_2 + 2b_2 & a_3 + 2b_3 \\ 3c_1 & 3c_2 & 3c_3 \end{vmatrix}$$

# Examples

## Example

Find

$$\begin{vmatrix} 2 & 3 & 5 \\ 3 & 5 & 9 \\ 1 & 2 & 4 \end{vmatrix}$$

Questions?

# Traditional determinants

# Minors and cofactors

Definitions. Slide 6 of general notes.

# Recursive definition of determinant

In terms of cofactors.

Questions?

# Examples

# Examples

## Example

Find the (1,2)-minor of

$$\begin{bmatrix} 1 & 1 & 3 \\ 2 & 4 & 1 \\ 5 & 2 & 6 \end{bmatrix}$$

## Example

Find

$$\begin{vmatrix} 1 & 1 & 3 \\ 2 & 4 & 1 \\ 5 & 2 & 6 \end{vmatrix}$$

# Examples

## Example

Find

$$\begin{vmatrix} 0 & 1 & -2 & 1 \\ 5 & 0 & 0 & 7 \\ 0 & 1 & -1 & 0 \\ 3 & 0 & 0 & 2 \end{vmatrix}$$

## Example

Find

$$\begin{vmatrix} -8 & 1 & 0 & -4 \\ 5 & 7 & 0 & -7 \\ 12 & -3 & 0 & 8 \\ -3 & 11 & 0 & 2 \end{vmatrix}$$

Questions?