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Mathematics for Data Science

SSD23402

Chapter 7

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2024



Graph of Functions

Drawing Graphs of Functions

Graph of Inverse Functions

Different Types of Functions and Their Graphs

Algebraic Functions: Rational Functions

Constant Functions
Polynomial Functions
Rational Functions

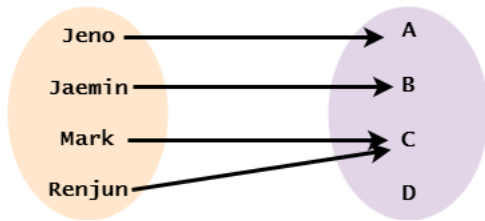
Algebraic Functions: Irrational Functions

Irrational Functions

Application Examples



Before discussing the concept of function graphs, let's review an illustration of the function $f : K \rightarrow N$ represented as follows:



$D_f = \{\text{Jeno, Jaemin, Mark, Renjun}\}$ and $K_f = \{A, B, C, D\}$.

The function values are

$f(\text{Jeno}) = A$, $f(\text{Jaemin}) = B$, $f(\text{Mark}) = C$, $f(\text{Renjun}) = C$ and $R_f = \{A, B, C\}$.



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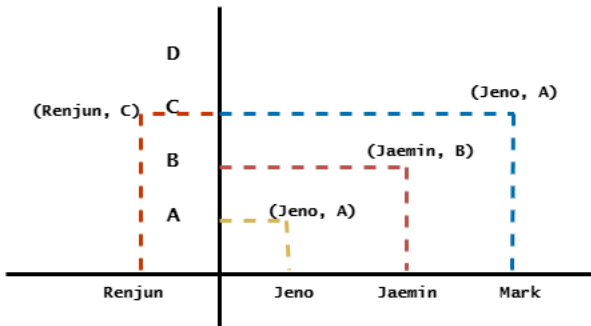
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Next, create a coordinate system with K as the horizontal axis and N as the vertical axis. The ordered pairs between points on K and N form points. The set of these points represents the graph of the function $f : K \rightarrow N$ as shown below:





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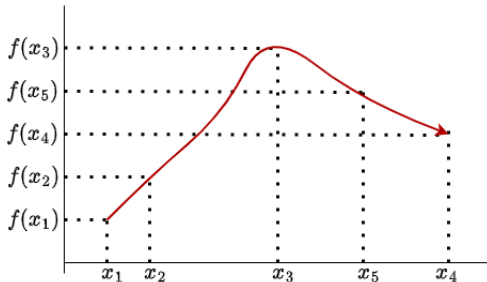
Application Examples



Definition

Let $y = f(x)$ be a function. The graph of function f is defined as the set of ordered pairs of points $(x, f(x)) \mid x \in D(f)$.

Generally, the graph of a function can be obtained by determining several ordered pairs $(x, f(x))$ in the xy -coordinate system, then connecting these points as shown in the following figure:





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Draw the graph of the function $y = f(x) = 2x$.



Graph of Inverse Functions

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There are two ways to draw the graph of an inverse function: the first is by plotting the inverse function itself, and the second is by reflecting the original function across the line $y = x$.

Example

Draw the inverse function of $y = 2x + 6$.



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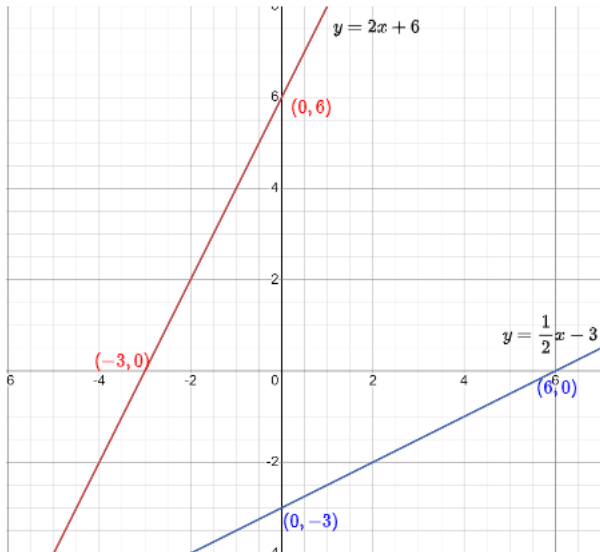
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Types of Functions

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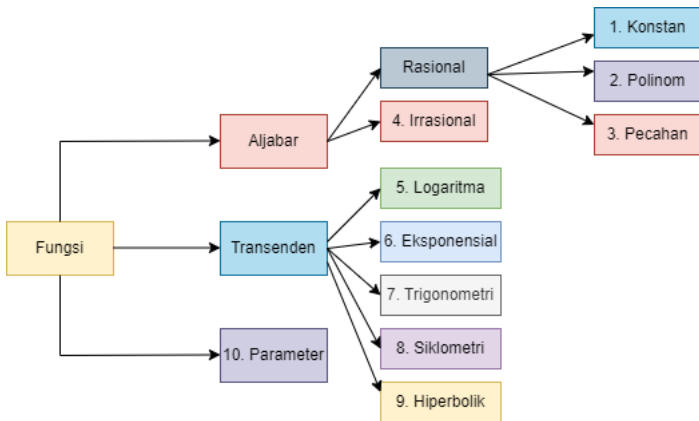
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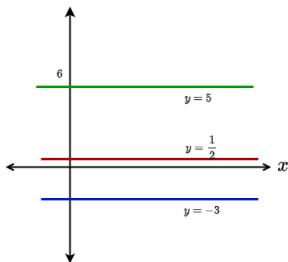


Constant Functions

Constant Function

A constant function is a mathematical function that provides the same result for every input (independent variable). In other words, this function does not depend on the independent variable and yields a fixed value.

The graph of a constant function $f(x) = c$ is a horizontal straight line parallel to the x -axis.



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Constant functions have the following properties:

- 1 The function value does not change: $f(x) = c$.
- 2 Its graph is a horizontal straight line parallel to the x -axis.
- 3 The derivative of a constant function is zero: $f'(x) = 0$.

Constant functions are often used in various mathematical and scientific contexts as a reference or to describe situations where the value does not change.



Polynomial Functions

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A polynomial function is an algebraic function with the general form:

$$f(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$$

where $a_n, a_{n-1}, \dots, a_1, a_0$ are coefficients and n is the highest exponent.

Example

$$f(x) = 2x^3 - 3x^2 + 5x - 1$$

This function is a polynomial of degree 3.



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Polynomial functions have several important properties:

- They have real or complex roots (solutions).
- Their graph can be straight, curved, or a combination of both, depending on the highest exponent.
- Their value is finite as $x \rightarrow \pm\infty$.

Polynomial functions are widely used in mathematics and various scientific applications.



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A rational function is an algebraic function that has the general form:

$$f(x) = \frac{p(x)}{q(x)}$$

where $p(x)$ and $q(x)$ are polynomials.

Example:

$$f(x) = \frac{x^2 - 4}{2x + 3}$$

This function is an example of a rational function with polynomial numerator and denominator.



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Rational functions have several important properties:

- They may have vertical asymptotes, which are vertical lines where the function approaches infinity.
- Their roots are solutions of $p(x) = 0$.
- Their graph can have holes if the denominator becomes zero at certain points.
- Their value can be finite or infinite as $x \rightarrow \pm\infty$, depending on the degree of the numerator and denominator polynomials.

Rational functions are important components in modeling various phenomena in science and engineering.



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An irrational function is an algebraic function that involves square roots or other even roots. The general form is:

$$f(x) = \sqrt[n]{p(x)}$$

where $p(x)$ is a polynomial and n is a positive integer.

Example

$$f(x) = \sqrt{x^2 - 4}$$

This function is an example of an irrational function with a square root.

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Application Examples



Mathematical relations are essential tools in data science modeling. They are used to:

- Model relationships between entities in a dataset.
- Describe the connection between variables.
- Identify correlations and dependencies among data.

An example of using relations is in analyzing correlations between variables in statistics.

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Application Examples



Mathematical functions are essential tools in data science. They are used to:

- Map data inputs to meaningful outputs.
- Identify patterns and trends in data.
- Calculate descriptive statistics such as mean, median, and others.

An example of using functions is in linear regression modeling to predict one variable based on another in a dataset.

Thank You.

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