The application of functions in daily life

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Abstract. Functions are fundamental tools in mathematics that describe relationships, changes, and trends, making them indispensable in the daily lives and in scientific research. The concept of functions has significantly contributed to the development of various fields, including technology and engineering, throughout history. Understanding how functions operate allows individuals to apply them effectively in both personal and professional contexts. This paper aims to explore the practical applications of functions in everyday life by following a structured approach: defining functions, practicing them, and exploring their real-life applications. The goal is to enhance students' understanding of functions, enabling them to apply this knowledge in solving real-world problems. By studying this paper, students will gain a deeper appreciation for the importance of functions, improving their ability to use them in their daily lives and future careers. This research highlights the value of learning functions and their relevance to both academic studies and practical endeavors.

Keywords: linear function, quadratic function, cubic function.

1. Introduction

The function is an important tool for us to describe the relationship of two variables. It plays a significant role in our modern society. First of all, the study of economy and business relies on doing some basic probability problems and some predictions. For example, in finance, linear functions are used to calculate the profits. The organic world cannot leave the function too. The relationship between the ear length of the long-eared hare and its habitat temperature is an example of the application of a function. As a fundamental knowledge of high school mathematics, the application of functions is ubiquitous, reflecting the close connection between the world and mathematics. There may be a special relationship between the whole world and the function [1].

Function has a long history that can be traced back to ancient mathematics. In ancient Greece, Function has already been one of the basic parts of mathematics analysis. The calculation method at that time was actually the early form of the function. Mathematicians at that time could still use the reciprocals, squares, square roots, cubic roots, and so on. It shows that the people at that time already could use a formula to describe the relationship of different events and numbers. The first mathematician who can give a similar definition of function in the modern system of maths is Oresme. His ideas of dependent and independent variables have a great effect on the process of development of the function. Newton, the famous physician and mathematician also play an important role in that. Especially, the infinite part of the function. As time goes by, the research of function never stops and it has a great contribution and deep effect on society [2].

This paper will focus on the study of the definition, example, and application in the real life of function by the scientific method. This paper will pay more attention to the application of the function. This paper aims to help students transform the knowledge they learn in the classroom into skills that can be practically applied in their future lives.

2. Definition of Functions

2.1. The Definition of the Linear Function

The linear function is the foundation of Algebra [3]. It can be described as this slope-intercept form:

$$y = kx + b \tag{1}$$

In this formula, y represents the dependent variable, which varies in response to changes in the independent variable——x value. K is a linear coefficient in this function. It's also the slope of the function. It uses a slope to identify the rate of change of the function. For example,$y = 2x + 1$ has a greater inclination that $y = x + 1$. If it knows the coordinates of two points on the function and their coordinates are (x_1,y_1)(x_2,y_2). It can use this formula to calculate the slope of the function:

$$k = \frac{\Delta y}{\Delta x} = \frac{y_1 - y_2}{x_1 - x_2} \tag{2}$$

The parallel lines have the same slope. The perpendicular lines have an opposite reciprocal slope. The b value is the constant of the function. It shows the transformation of the function.

There is a special situation, when the b value is equal to 0, it has a special linear function called the Direct proportional function:

$$y = kx \tag{3}$$

It mentioned that if it has the coordinates of two points on the function it can know the slope of the function. If it only has a point and a slope, it can also make the formula of the function. It can use another form of the linear function, the Point-slope form:

$$y - y_1 = k(x - x_1) \tag{4}$$

It also has another form called standard form. The A number should be a positive number and the A, B, C should be a integers [3]:

$$Ax + By = C \tag{5}$$

2.2. The Definition of the Quadratic Function

The quadratic function is an important function in middle school maths learning. Quadratic function also can be called parabola. The analytical formula(standard form) for the quadratic function is

$$y = ax^2 + bx + c(a \neq 0) \tag{6}$$

a is the quadratic coefficient, it can be used to find the opening direction and opening size of the quadratic function. If $a \geq 0$, so the opening direction upward. If $a \leq 0$, so the opening direction downward. The larger the absolute value of a, the smaller the opening size [4]. b is the linear coefficient. It can be used it to calculate the vertex coordinate. Which is the highest or the lowest point of the function.

$$\left(-\frac{2a}{b}, \frac{4ac - b^2}{4a}\right) \tag{7}$$

c is the constant, it can be used to find the y-intercept of the quadratic function. If it wants to make the vertex clear, it can change the standard form to the vertex form:

$$y = a(x - h)^2 + k \tag{8}$$

In the vertex form, the vertex coordinate is (h, k). Also, it can be known that the line that cuts the parabola into two equal parts, the axis of symmetry is $x = h$. If it wants to know the intersection of the quadratic function and the x-axis, it can transform the function to this form:

$$y = a(x - x_1)(x - x_2) \tag{9}$$

So from this formula it can know the x-intercept is (x_1,0) and (x_2,0).

3. Function Exercises

3.1. Linear Function

Example 1. Given the equation of the line,$y = 4x + 3$. What is the equation of the line that...

a) The line is parallel to the given line and passes through the point (2, -1).
b) The line is perpendicular to the given line and passes through the point (2, -1).
Answer:
a) If the functions are parallel, that means they have the same slope. So it can be known the k value of the linear function is 4. Now it can be assumed the function is:

$$y = 4x + b \tag{10}$$

Also, it knows the new function through the point (2,-1), and it can plug the corresponding x and y value into the function: $-1 = 4 * 2 + b$, $b = -9$. So the new function is:

$$y = 4x - 9 \tag{11}$$

b) If the function is perpendicular, it can know the product of t the two slopes are -1.so it can know the linear coefficient of the new function is $-\frac{1}{4}$. Now it can assume the new function is:

$$y = -\frac{1}{4}x + b \tag{12}$$

Also, it knows the new function through the point (2,-1), and it can plug the corresponding x and y values into the function.

$$-1 = -\frac{1}{4} * 2 + b$$

$$b = -\frac{1}{2} \tag{13}$$

So the new function is:

$$y = -\frac{1}{4}x - \frac{1}{2} \tag{14}$$

Example 2 Find the equation of the line through the following point(s)
a) The function through the (2, 5) and (6, 7)
b) the slope is 2, and the function through the (3, 1)
Answer:
Method 1:it knows the two points in the function so it can assume the function as Eq.(1). Plug in the $(x_1,y_1)(x_2,y_2)$ value into the function so it can get a system of equation:

$$\begin{cases} 7 = 6k + b \\ 5 = 2k + b \end{cases} \tag{15}$$

Solve the system of the equation so it can get the answer is

$$\begin{cases} k = \frac{1}{2} \\ b = 4 \end{cases} \tag{16}$$

So it can get the function:

$$y = \frac{1}{2}x + 4 \tag{17}$$

Method 2: because it has the two points in the function, it can find the slope of the function

$$k = \frac{\Delta y}{\Delta x} = \frac{7-5}{6-2} = \frac{1}{2} \tag{18}$$

So it can be assumed the point-slope form of the linear is:

$$y - 7 = \frac{1}{2}(x - 6) \tag{19}$$

If it knows the slope of the function is 2, and it also knows the function through the point(2,1), it can assume the function is:

$$y - 1 = 2(x - 2) \tag{20}$$

3.2. Quadratic Function

Example 1. Known the quadratic function $y = 2x^2 - ax - 3$ have the axis of the symmetry $x = 3$. Find the value of a. If the function is through the point A(m,n) and its symmetrical point B(m-4,n), what is the value of m and n?

Answer:

Because it knows axis of symmetry is x=3, so

$$x = -\frac{b}{2a} = -\frac{-a}{2*2} = 3 \tag{21}$$

After the calculation can get the value is 12. So the function formula is:

$$y = 2x^2 - 12x - 3 \tag{22}$$

Because It knows that A(m,n) and B(m-4,n) are symmetrical points so it can get this system of equations:

$$\begin{cases} 2m^2 - 12m - 3 = n \\ \frac{m+m-4}{2} = 3 \end{cases} \tag{23}$$

So it can get m=5 and n=-13. Example 2. for the function $y = -3x^2 + bx + c$,the vertex is (1,0).Find the unknown coefficient.

Answer:

Because It know the vertex of the function is (1,0), so it can:

$$x = \frac{b}{-2a} = \frac{b}{-2*-3} = 1 \tag{24}$$

So it can get a new function is:

$$y = -3x^2 + 6x + c \tag{25}$$

Plug the point (1,0) into the function, after the calculation, the function is:

$$y = -3x^2 + 6x - 3 \tag{26}$$

4. Daily Life Application

These functions play an important role in our daily lives. The linear function and the quadratic function are all basic functions in the whole function family. But still really useful and convenient in our lives and helps us solve questions.

For example, you go to the shopping mall and the shopping mall is holding a promotional activity, which stipulates that customers who buy a teapot will receive a teacup as a gift or customers can also choose to pay 92% of the total price. Each teapot costs 20 yuan and each teacup costs 5 yuan. If a customer wants to buy four teapots with four more tea cups so which method is more suitable [5]?

It needs to know that which method is more suitable depends on the different situations. So how can solve this question the key point is to find the Critical value. It can be assumed that method 1 is a linear function y_1 and method 2 is another linear function y_2. So the critical value means that $y_1 - y_2 = 0$. It sets each teapot to have the price x, so it can get a system of equations about this two functions.

$$\begin{cases} (20 * 4 - 5 * 4) + 5x \\ (20 * 4 + 5x) * 92\% \end{cases} \tag{27}$$

So after the calculation, t got this:

$$\begin{cases} 5x - 60(x \geq 4) \\ 0.4x - 13.6(x \geq 4) \end{cases} \tag{28}$$

Plug into $y_1 - y_2 = 0$. and it can know $\mathrm{x} = 34$.So when the number of tea cups that customers want to buy is less than 34, Choosing a buy one get one free promotion is more suitable. When the number of teacups you want to buy is greater than 34, choosing the second method is more suitable.

When observing a basketball player taking a shot, one might consider the optimal angle for the shot and the required force to apply to the ball. Indeed, the trajectory of the basketball follows a parabolic path, which can be described mathematically as a quadratic function. By applying principles from physics, particularly projectile motion, one can calculate the ideal parameters—such as the angle of release and the velocity needed—to successfully make the shot.

5. Conclusion

At the beginning, the paper introduces the history and importance of the function. Then it makes a specific definition of simple functions like linear functions, and quadratic functions. t introduce some information about the functions like the standard form of the linear function, how to find the slope by calculating, how to solve the system of the equations, and so on. To have a better understanding and practice, it shows 2-3 example questions for each function and gives the answer and analysis. So the works shown in the paper can help teachers prepare the class for students and offer some example questions.

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