

Math 150, Section 2.5

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Quadratic Functions; Maxima and Minima

In this section we learn quadratic functions, maxima and minima and learn to find local maxima and local minima using calculator. For a quadratic function you will learn to do the following: write it in its standard form, graph it, find its vertex, find its local maximum and minimum values.

Standard form of a quadratic function

Definition

A function of the form $f(x) = ax^2 + bx + c$ where $a \neq 0$ is called a quadratic function. A quadratic function f can be expressed in the **standard form**

$$f(x) = a(x - h)^2 + k$$

by completing the square. The graph of f is a parabola with **vertex** (h, k) ; the parabola opens upward if $a > 0$ or downward if $a < 0$.

Completing the square is a procedure that you are required to know for this class. Try problems 2.5.2a, 2.5.7a,c, 2.5.11a,c.

Maximum and Minimum Values of Quadratic Functions

Theorem

Let f be a quadratic function with standard form $f(x) = a(x - h)^2 + k$. The maximum or minimum value of f occurs at $x = h$. If $a > 0$, then the **minimum value** of f is $f(h) = k$. If $a < 0$, then the **maximum value** of f is $f(h) = k$.

Theorem

Let f be a quadratic function $f(x) = ax^2 + bx + c$. The maximum or minimum value of f occurs at $x = -\frac{b}{2a}$. If $a > 0$, then the **minimum value** of f is $f(-\frac{b}{2a})$. If $a < 0$, then the **maximum value** of f is $f(-\frac{b}{2a})$.

Try problems 2.5.19, 2.5.24, 2.5.33.

Local maximum and local minimum values

The point $(a, f(a))$ on the graph of a function f is called a **local maximum value** of f if $f(a) \geq f(x)$ for all numbers x which are "close" to a . The point $(a, f(a))$ on the graph of a function f is called a **local minimum value** of f if $f(a) \leq f(x)$ for all numbers x which are "close" to a .

You can use the calculator to find local maxima and local minima of a given function. The button which is used for this is the TRACE button.

Applications

There are problems in the book with applications of what we learn in this section, these are important as well. Try problems 2.5.59-2.5.61.