3 CLASS NOTES: Mon. 13 Jan.

LSS SMALL GROUP TUTORING.

Mondays 2:40 - 3:40 SÆE LIBRARY
4 - 5 214

Thursdays: 1:30 - 2:30 SÆE LIB 214

Fridays 10:40 - 11:40 MCHENRY

2.6 BUILDING QUADRATIC MODELS FROM DESCRIPTIONS AND FROM DATA

a) “WORD PROBLEMS”

f(x) = ax² + bx + c
a > 0

f(d) min

VALUE

f(x) = ax² + bx + c
a > 0

f(d) max

VALUE.

VERTEX

g

VERTEX

f(d) = VALUE.
Exercise: Build a fence along a river. Three sides needed. 300' fence available.

\[
\begin{align*}
\text{River} & \\
100' & \\
\text{A} = 100 \cdot 100 & = 10,000 \text{ square feet} \\
100' & \\
\end{align*}
\]

\[
\begin{align*}
\text{River} & \\
90' & \\
\text{A} = 90 \cdot 120 & = 10,800 \text{ square feet} \\
90' & \\
120' & \\
\end{align*}
\]

\[
\begin{align*}
\text{River} & \\
40' & \\
\text{A} = 40 \cdot 220 & = 8,800 \text{ square feet} \\
40' & \\
220' & \\
\end{align*}
\]

Maximize: \[ A = l \cdot w \]

\[
\begin{align*}
A &= (300 - 2w)w = 300w - 2w^2 \\
\end{align*}
\]

\[ w + l + w = 300 \]

\[ l + 2w = 300 \]

\[ l = 300 - 2w \]

Opens down

\[ a = -2 < 0 \]
$$A = -2w^2 + 300w$$
$$0 \leq w \leq 150$$
MAX OCCURS AT
VERTEX, WHEN
$$w = \frac{-b}{2a} = \frac{-300}{2(-2)} = \frac{-300}{-4} = 75$$

$$A_{max} = A(75) = -2(75)^2 + 300(75) = 11,250 \square$$
MAX AREA.

DIMENSIONS: $$W = 75'$$

EX (EX 4 IN TEXT)

MODEL:
$$f(x) = ax^2 + bx + c$$
$$f(0) = 0 \Rightarrow c = 0$$
VERTEX AT $$(0,0)$$; $$b = 0$$
\[ f(x) = a x^2 \quad \text{Find } a \quad (2100, 526) \]

\[ \frac{526}{2100^2} = a \quad \text{so } f(x) = \left( \frac{526}{2100^2} \right)x^2 \]

HT of cable \( f(1000) = \left( \frac{526}{2100^2} \right)(1000)^2 \approx 119.27' \)

CH 3 - POLYNOMIAL; RATIONAL FUNCTIONS

3.1 POLYNOMIAL FUNCTIONS

DEF: A POLYNOMIAL FUNCTION IS OF FORM.

\[ f(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_2 x^2 + a_1 x + a_0 \]

\[ f(x) = 3x^3 - 4x^6 + 9x^3 - 11x + 5 \]

\[ a_3 \quad \text{DEGREE 7} \]

DEGREE OF POLYNOMIAL

(one variable) \( \rightarrow \) LARGEST POWER OF X.

COEFFICIENT: NUMBER IN TERMS W/ POWER OF X.
LEAP COEFFICIENT: COEFF OF TERM WITH LARGEST DEGREE

\[ f(x) = 5x^3 - 7x^4 + 3x^2 - 9 \]

LEAP COEFF = -7

STANDARD FORM OF A POLYNOMIAL

DESCENDING ORDER OR DEGREE

\[ f(x) = -7x^4 + 5x^3 + 3x^2 - 9 \]

(or "standard") \[ f(x) = -9 + 3x^2 + 5x^3 - 7x^4 \]

DFN A POWER FUNCTION IS A POLYNOMIAL OF FORM

\[ f(x) = ax^n \quad n \geq 0 \quad (a \text{ a positive integer}) \]

\( a \in \mathbb{R} \)

\[ f(x) = x^2, \quad g(x) = \frac{2}{3}x^4, \quad h(x) = -7x^5 \]

NOTE: EVEN POWER FUNCTIONS

(\( n \) IS EVEN)

\[ f(x) = ax^n \]

\( a > 0 \)

\((0,0)\)
ODD POWER FUNCTIONS

\( n \text{ is odd} \)

\[ a > 0 \]

\[ f(x) = ax^n \quad n \text{ is odd} \]

\[ a < 0 \]

DEF: THE NUMBER \( r \) IS A ZERO (OR ROOT) OF A FUNCTION \( f(x) \) IN CASE \( f(r) = 0 \).

Ex: \( f(x) = x^2 + x - 20 \) 4 IS A ZERO OF \( f \)

\[ f(4) = (4)^2 + (4) - 20 = 0 \checkmark \]

THE FOLLOWING ARE EQUIVALENT:

1. \( r \) IS A ZERO OF \( f \)

2. \((r,0)\) IS AN X-INTERCEPT OF GRAPH OF \( f \)

*3. \( x-r \) IS A FACTOR OF \( f \) (POLYNOMIAL)

4. \( r \) IS A SOLUTION TO \( f(x) = 0 \)
To find zeroes of poly \( f(x) \)

Set \( f(x) = 0 \) \( \Rightarrow \) try to factor

\[
f(x) = (x - r) \cdot g(x)
\]

**Def:** If \((x - r)^m\) is a factor of \(f(x)\), and \((x - r)^{m+1}\)

is not a factor of \(f(x)\), then \(r\) is a zero of multiplicity \(m\) of \(f\).

Ex: \(f(x) = 7(x - 2)^3(x + 4)(x - 9)\)

Zeroes of \(f\): 2, -4, 9

Multiplicity: 3, 5, 1

Aid to graphing polynomials.

If \(r\) is a zero of \(f(x)\) of even multiplicity

then sign of \(f(x)\) does not change on either side of \(x = r\)

If \(r\) is a zero of odd multiplicity, the

sign of \(f(x)\) does change

sign on either side of \(x = r\)