Example 1 Perform a linear regression on the data below. Predict the consumption for the year 2015. $\Rightarrow x = 35$

The U.S. consumption of aspirin (in billions) is given by the table below.

years after 1980	0	5	10	15	20
aspirin in billions	631.5	615	525	487	480

$y = -8.62x + 633.9$

for 2015: $-8.62(35) + 633.9 =$ **332.2 billions**

Example 2 The population present in a bacteria culture over 5 days is given in the table below. Perform a cubic regression. Predict the population for day 7,

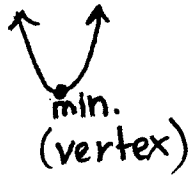
time (days)	0	1	2	3	4	5
population	30	133	214	337	527	819

$y = 6.435x^3 - 23.603x^2 + 114.858x + 31.230$

$x = 7$: $y =$ **1885 bacteria**

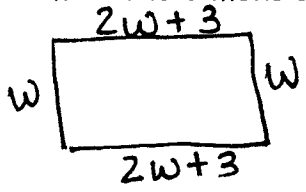
Quadratics

Example 3 The number of bacteria in a refrigerated food is given by $n(t) = 20t^2 - 20t + 120$ for $-2 \le t \le 14$ where t is the temperature of the food in degrees Celsius. At what temperature will the number of bacteria be minimal?



$t = -\frac{b}{2a} = -\frac{(-20)}{2(20)} =$ **$\frac{1}{2}$ °C**

Example 4 The length of a rectangle is three more than twice the width. Determine the dimensions that will give a total area of 27 m^2.



width = w

length = 2w + 3

area = lw

$(2w+3)w = 27$

$2w^2 + 3w - 27 = 0$

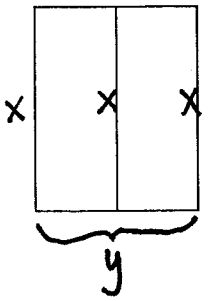
$(2w+9)(w-3) = 0$

$2w+9=0$ $\quad w-3=0$

$w = -\frac{9}{2}$ $\quad$ **$w = 3m$**

$l = 9m$

Example 5 Two rectangular corrals are to be made from 100 yds of fencing as seen below. If the rancher wants the total area to be maximum, what dimensions should be used to make the corrals?



perimeter $= 3x + 2y = 100 \rightarrow 2y = -3x + 100$

$y = -\frac{3}{2}x + 50$

area $= xy$

$A = x\left(-\frac{3}{2}x + 50\right) = -\frac{3}{2}x^2 + 50x$

max

vertex $(16.\overline{6}, 416.\overline{6})$

$16.\overline{6}$ ↓ x $416.\overline{6}$ ↓ area

$x = 16.\overline{6}$ yd

$y = -\frac{3}{2}(16.\overline{6}) + 50 = 25$ yd

The formula for a freely falling body ignoring any effects of air resistance is $s(t) = -16t^2 + v_0t + s_0$ feet $s(t) = -4.9t^2 + v_0t + s_0$ meters

- $s(t)$ represents the projectile's height at any time t
- v_0 represents initial velocity
- s_0 represents intial height from which the projectile is released
- t represents time in seconds after the projectile is released

Example 6 A baseball throwing machine is used to train little league players to catch pop-ups. The machine throws baseballs straight upward with an initial velocity of 48 ft/sec from a height of 3.5 feet.

a) Find an equation that models the height of the ball as a function of the ball t seconds after it is thrown. $s(t) = -16t^2 + 48t + 3.5$ feet

b) What is the maximum height the ball will reach? How many seconds will it take to reach this height? 39.5 ft, 1.5 sec

max

vertex (1.5, 39.5)

c) If the player misses the catch, how long will it take the ball to hit the ground? height = 0

zero at (3.071, 0) 3.07 sec