Group Project: Question 19

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Data Point	A	B	C	D
Year	2007	2008	2009	2010
Net Profit	14,065	17,681	14,596	18,760

Year	2011	2012	2013	2014
Net Profit	23,150	23,171	22,453	22,074

Problem 19:

- The table shows the net profit (in millions of dollars) for Microsoft from 2007 through 2014.
- A) Set up a system of equations to fit the data for the years 2007, 2008, 2009, and 2010 to a cubic model.
- B) Solve the system. Does the solution produce a reasonable model for determining net profits after 2010? Explain

Polynomial Curve Fitting

- One degree less than data points (cubic equation)
- Use equation:
  - $p(x) = a_0 + a_1x + a_2x^2 + a_3x^3 + \cdots + a_nx^n$
- Horizontal Shift (2007 = 0)

Equations for Data Points

Using equation: $p(x) = a_0 + a_1x + a_2x^2 + a_3x^3$

$$p(a) = a_0 + a_1(0) + a_2(0)^2 + a_3(0)^3 = 14{,}065$$
$$p(\ b) = a_0 + a_1(1) + a_2(1)^2 + a_3(1)^3 = 17{,}681$$
$$p(c) = a_0 + a_1(2) + a_2(2)^2 + a_3(2)^3 = 14{,}569$$
$$p(d) = a_0 + a_1(3) + a_2(3)^2 + a_3(3)^3 = 18{,}760$$

Part A: Gauss/Jordan Elimination

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 14{,}065 \\ 1 & 1 & 1 & 1 & 17{,}681 \\ 1 & 2 & 4 & 8 & 14{,}569 \\ 1 & 3 & 9 & 27 & 18{,}760 \end{bmatrix}$$

$$R_2 - R_1 \to R_2$$
$$R_3 - R_1 \to R_3$$
$$R_4 - R_1 \to R_4$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 14{,}065 \\ 0 & 1 & 1 & 1 & 3{,}616 \\ 0 & 2 & 4 & 8 & 504 \\ 0 & 3 & 9 & 27 & 4{,}695 \end{bmatrix}$$

$$R_3 - 2R_2 \to R_3$$
$$\frac{1}{2}R_3 \to R_3$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 14{,}065 \\ 0 & 1 & 1 & 1 & 3{,}616 \\ 0 & 0 & 1 & 3 & -3{,}364 \\ 0 & 3 & 9 & 27 & 4{,}695 \end{bmatrix}$$

$$\frac{1}{3}R_3 \to R_3$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 14{,}065 \\ 0 & 1 & 1 & 1 & 3{,}616 \\ 0 & 0 & 1 & 3 & -3{,}364 \\ 0 & 1 & 3 & 9 & 1{,}565 \end{bmatrix}$$

$$R_4 - R_2 \to R_4$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 14{,}065 \\ 0 & 1 & 1 & 1 & 3{,}616 \\ 0 & 0 & 1 & 3 & -3{,}364 \\ 0 & 0 & 2 & 8 & -2{,}051 \end{bmatrix}$$

$$R_4 - 2R_3 \to R_4$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 14{,}065 \\ 0 & 1 & 1 & 1 & 3{,}616 \\ 0 & 0 & 1 & 3 & -3{,}364 \\ 0 & 0 & 0 & 2 & 4{,}677 \end{bmatrix}$$

$$\frac{1}{2}R_4 \to R_4$$

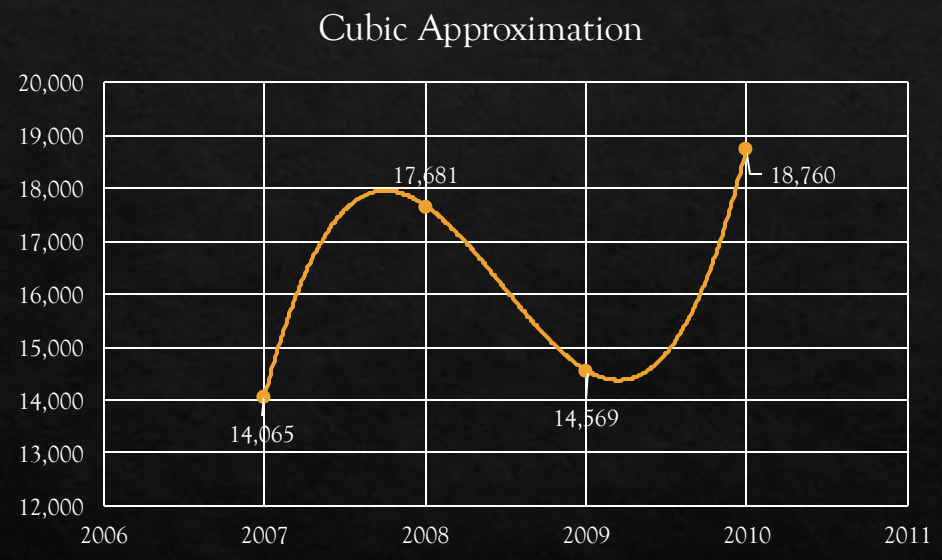
Part B: Back Substitution

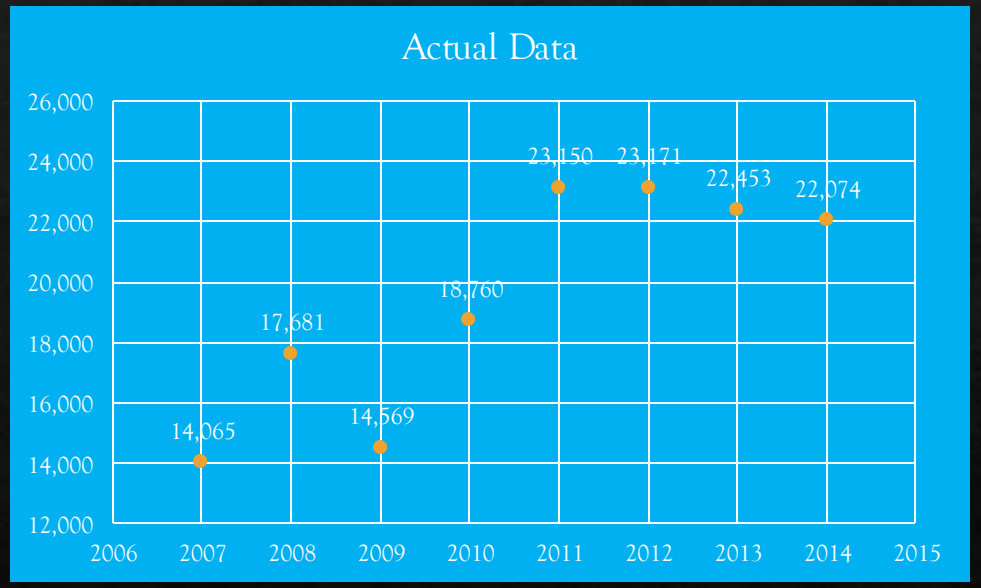
$$\begin{bmatrix} 1 & 0 & 0 & 0 & 14{,}065 \\ 0 & 1 & 1 & 1 & 3{,}616 \\ 0 & 0 & 1 & 3 & -3{,}364 \\ 0 & 0 & 0 & 1 & 2{,}338.5 \end{bmatrix}$$

$$a_3 = 2{,}338.5$$
$$a_2 = -10{,}379.5$$
$$a_1 = 11{,}657$$
$$a_0 = 14{,}065$$

$$p(a) = 14{,}065 + 11{,}657(x - 2007) - 10{,}379.5(x - 2007)^2 + 2{,}338.5(x - 2007)^3$$

Graphing the Solution





$p(2011) = 44285$
$p(2012) = 105175$
$p(2013) = 215461$
$p(2014) = 389174$