Features and Polynomial Regression

Multivariate Linear Regression

Linear Regression with Multiple Variables

Housing prices prediction

$$h_\theta(x) = \theta_0 + \theta_1 \times frontage + \theta_2 \times depth$$

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$$h_\theta(x) = \theta_0 + \theta_1 \times \underbrace{frontage}_{x_1} + \theta_2 \times \underbrace{depth}_{x_2}$$

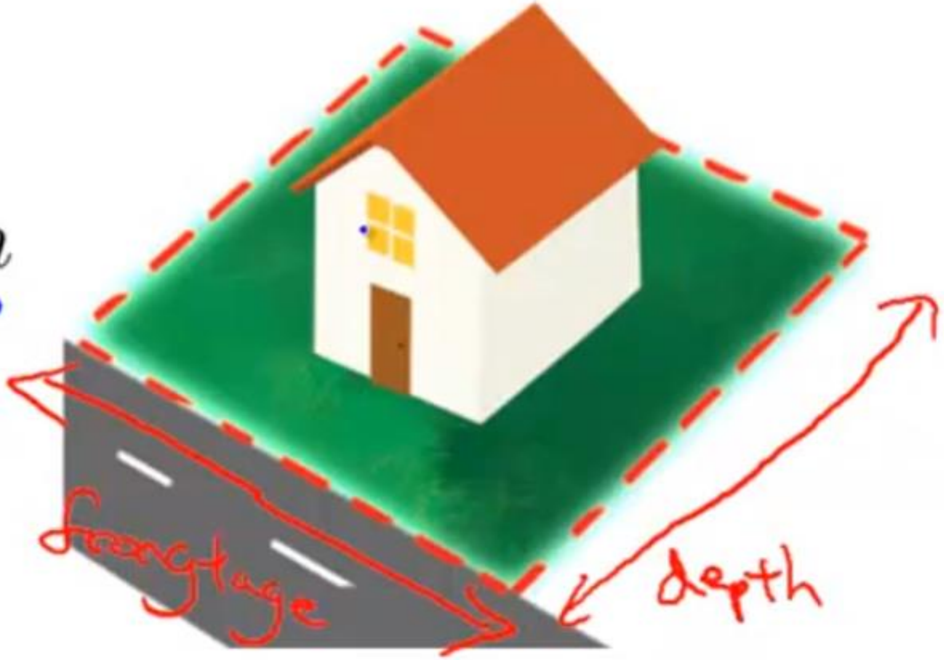
Housing prices prediction

$$h_\theta(x) = \theta_0 + \theta_1 \times \underbrace{frontage}_{\underline{x_1}} + \theta_2 \times \underbrace{depth}_{\underline{x_2}}$$

Area

Housing prices prediction

$$h_\theta(x) = \theta_0 + \theta_1 \times \underbrace{frontage}_{\underline{x_1}} + \theta_2 \times \underbrace{depth}_{\underline{x_2}}$$



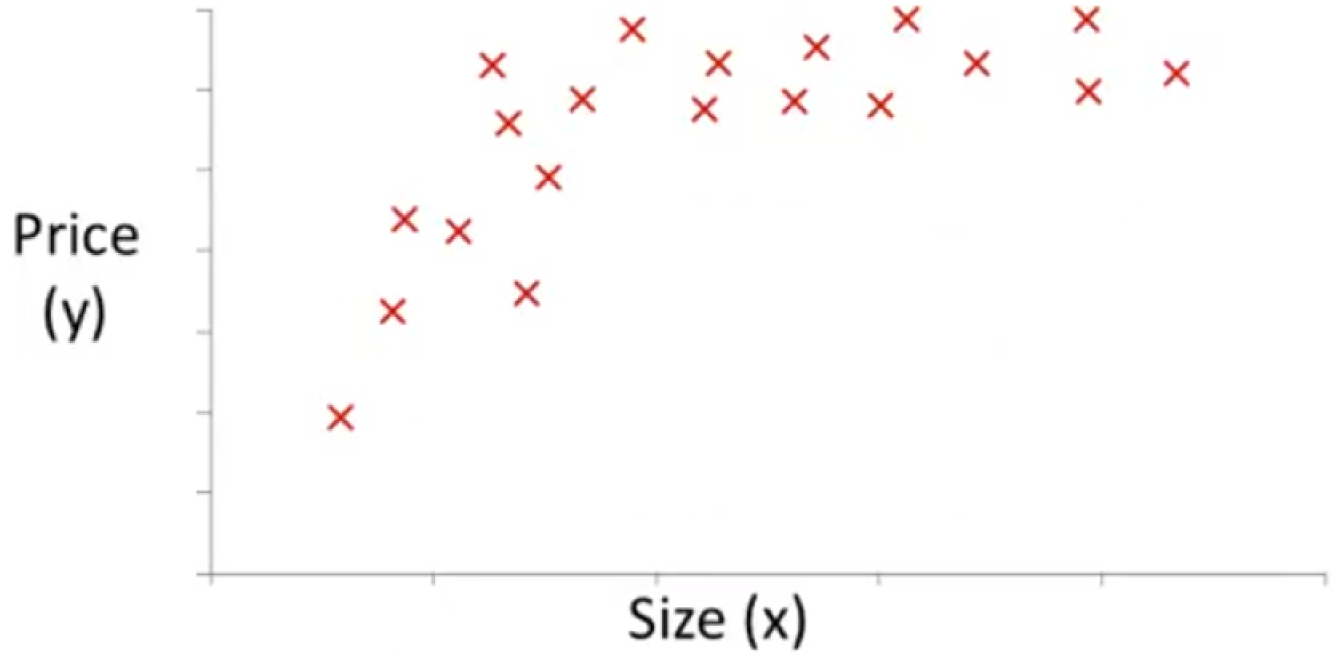
Area

$x = \underline{frontage * depth}$

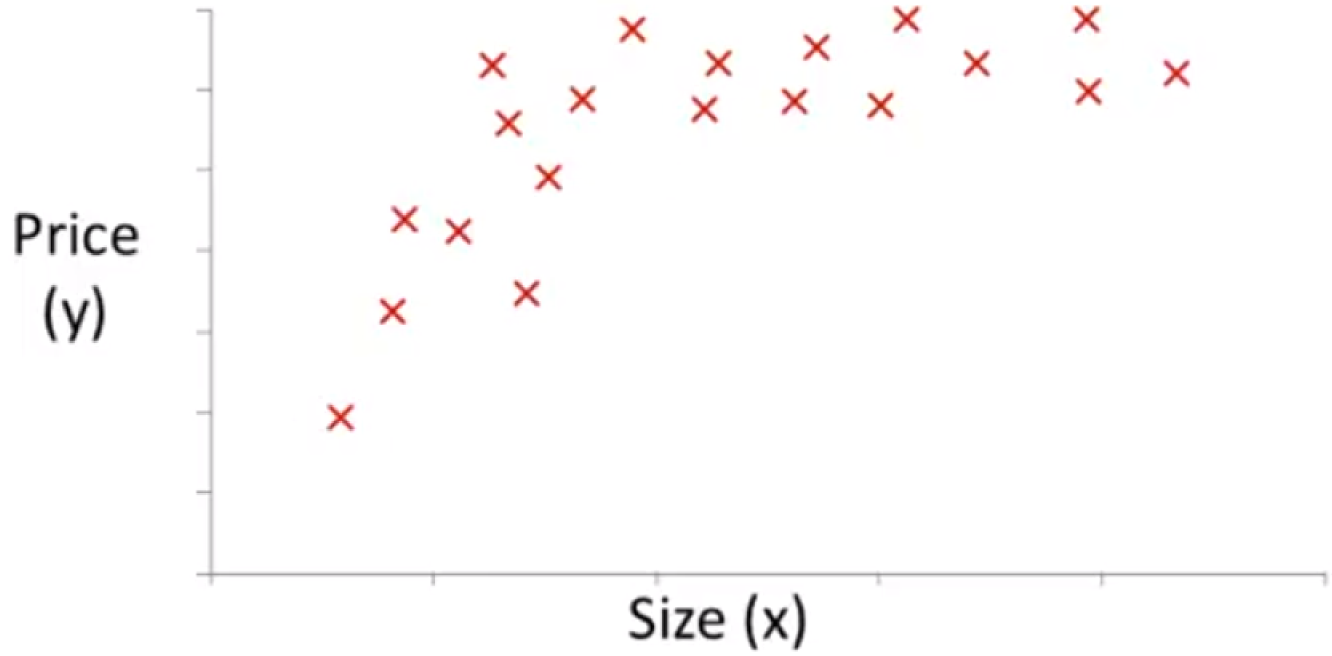
$h_\theta(x) = \Theta_0 + \Theta_1 x$

land area

Polynomial regression

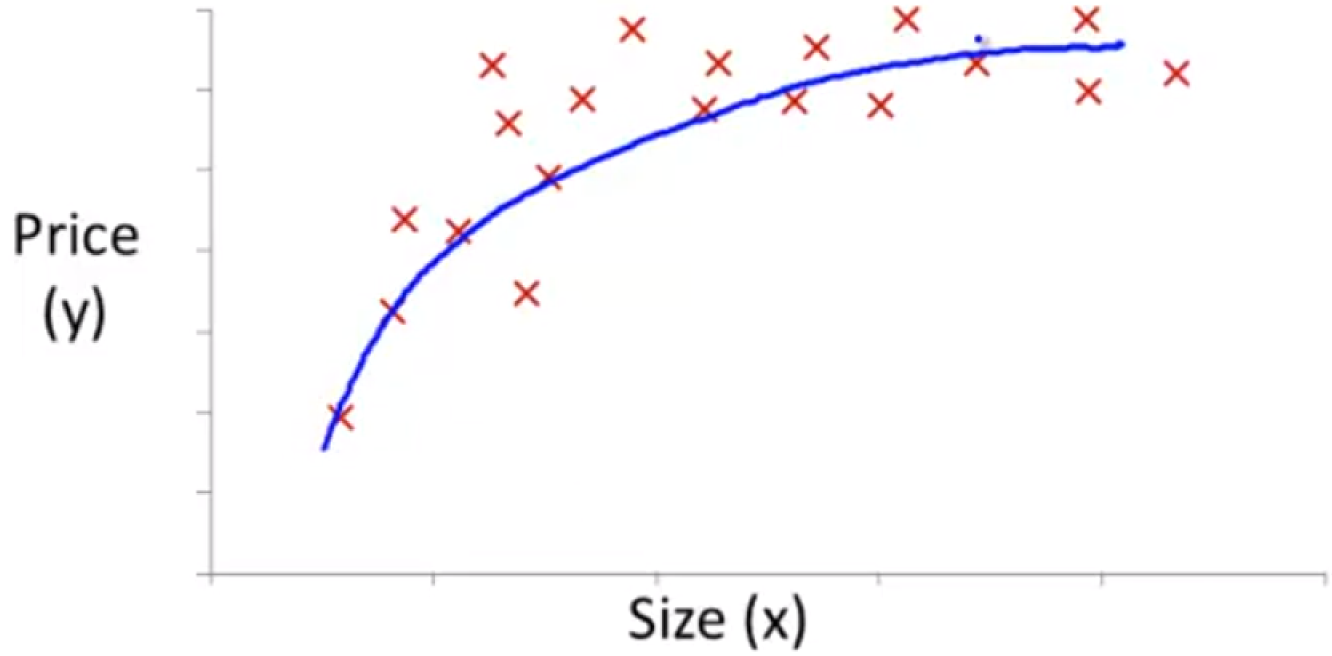


Polynomial regression



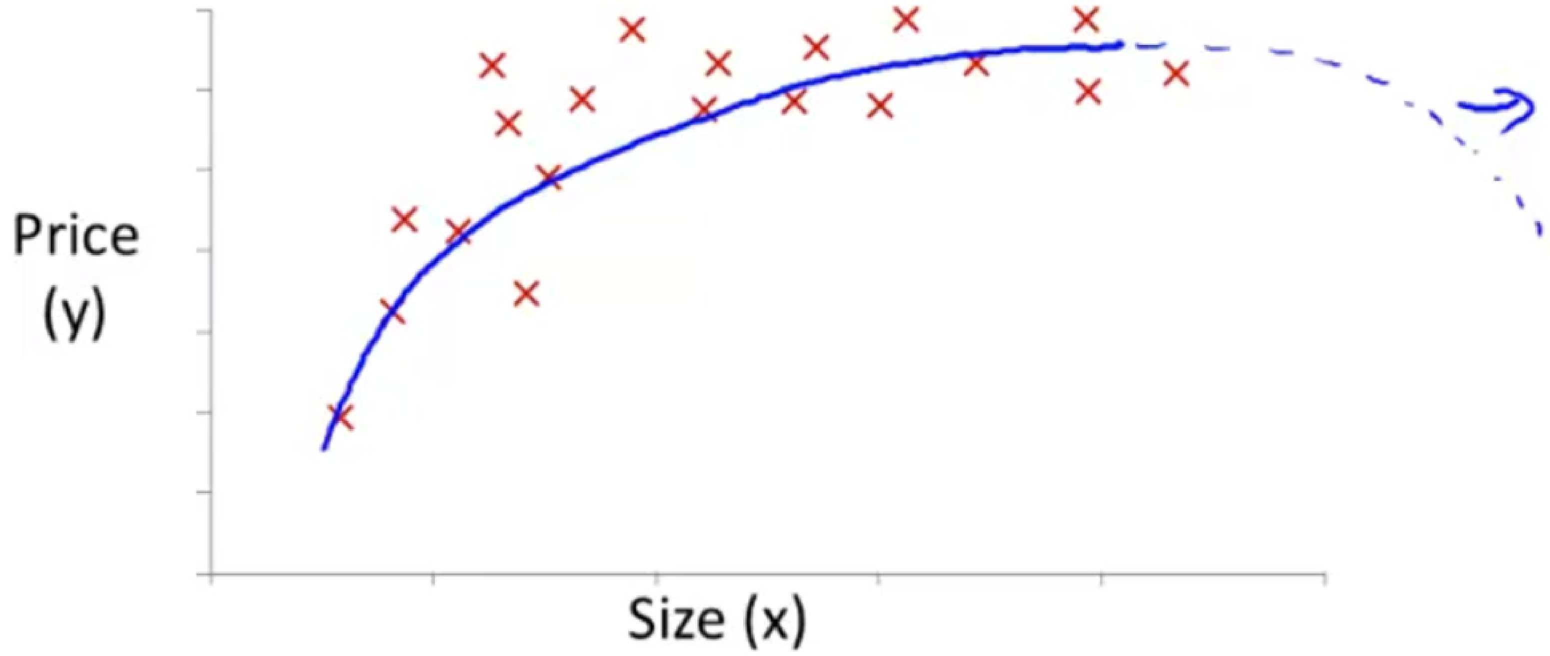
$$\theta_0 + \theta_1 x + \theta_2 x^2$$

Polynomial regression



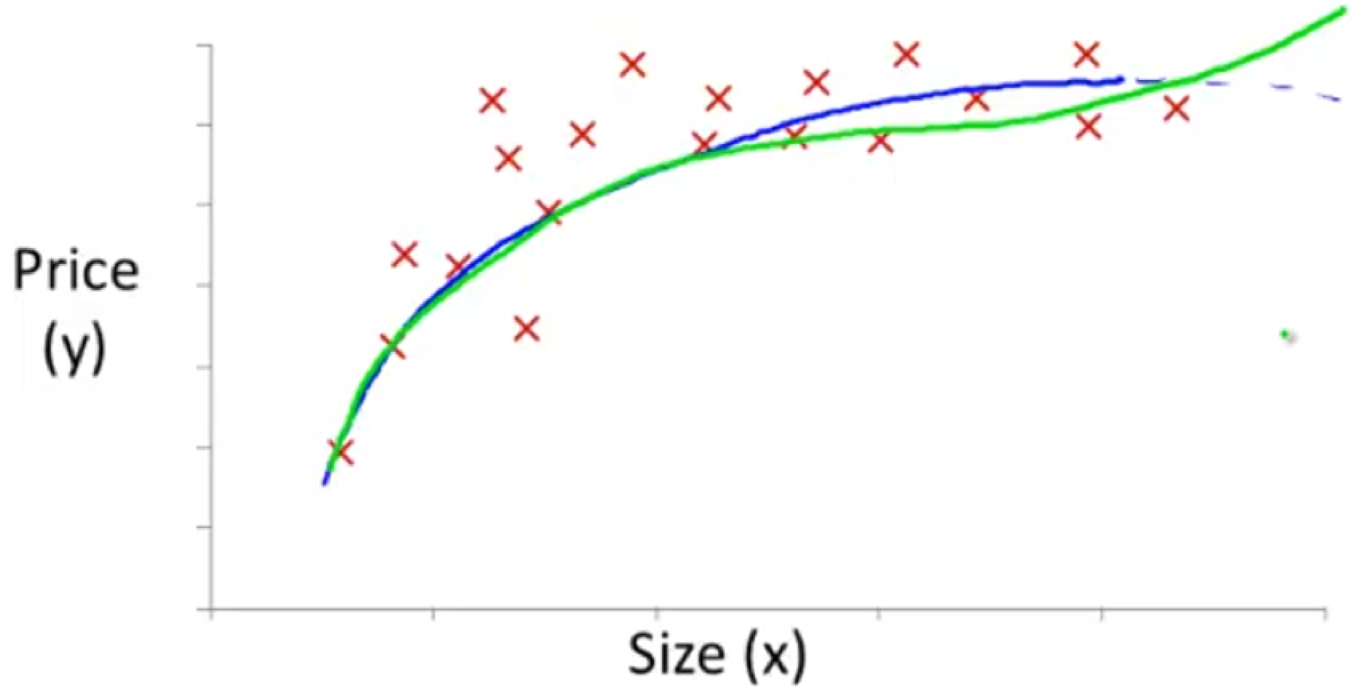
$\theta_0 + \theta_1 x + \theta_2 x^2$

Polynomial regression



$$\theta_0 + \theta_1 x + \theta_2 x^2$$

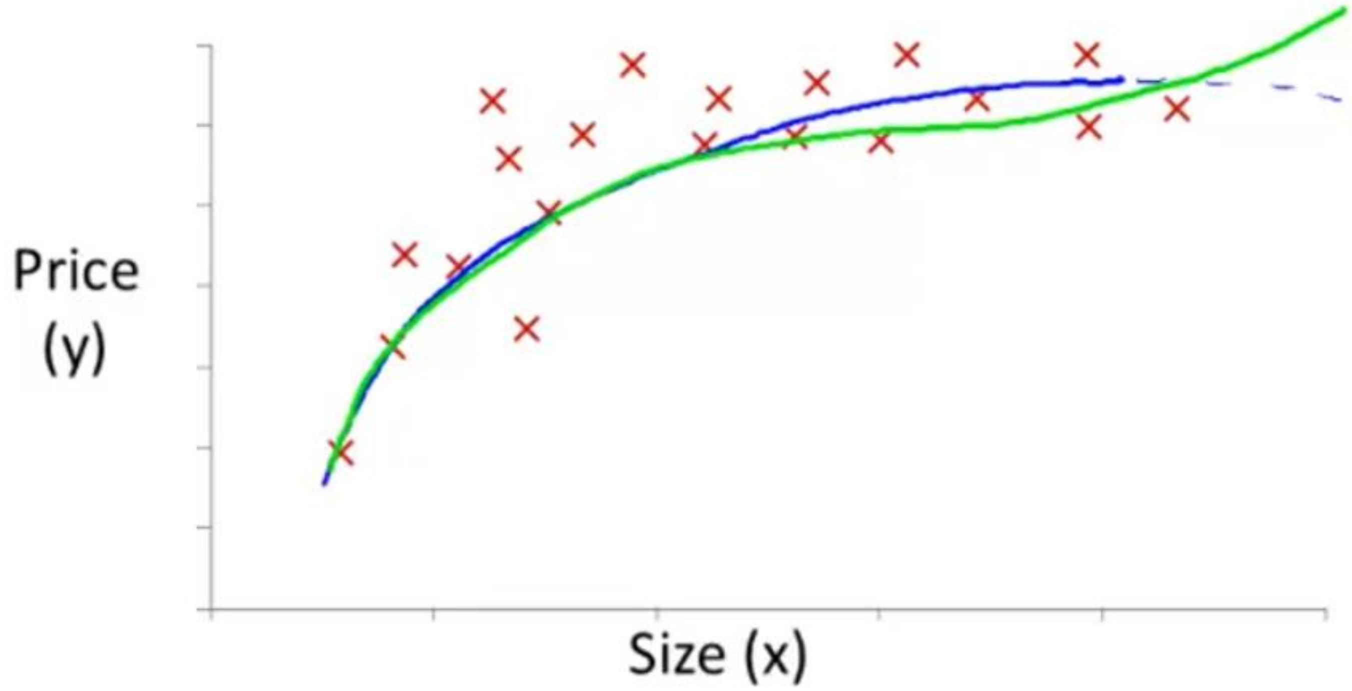
Polynomial regression



$$\theta_0 + \theta_1 x + \theta_2 x^2$$

$$\boxed{\theta_0 + \theta_1 x + \theta_2 x^2 + \theta_3 x^3}$$

Polynomial regression

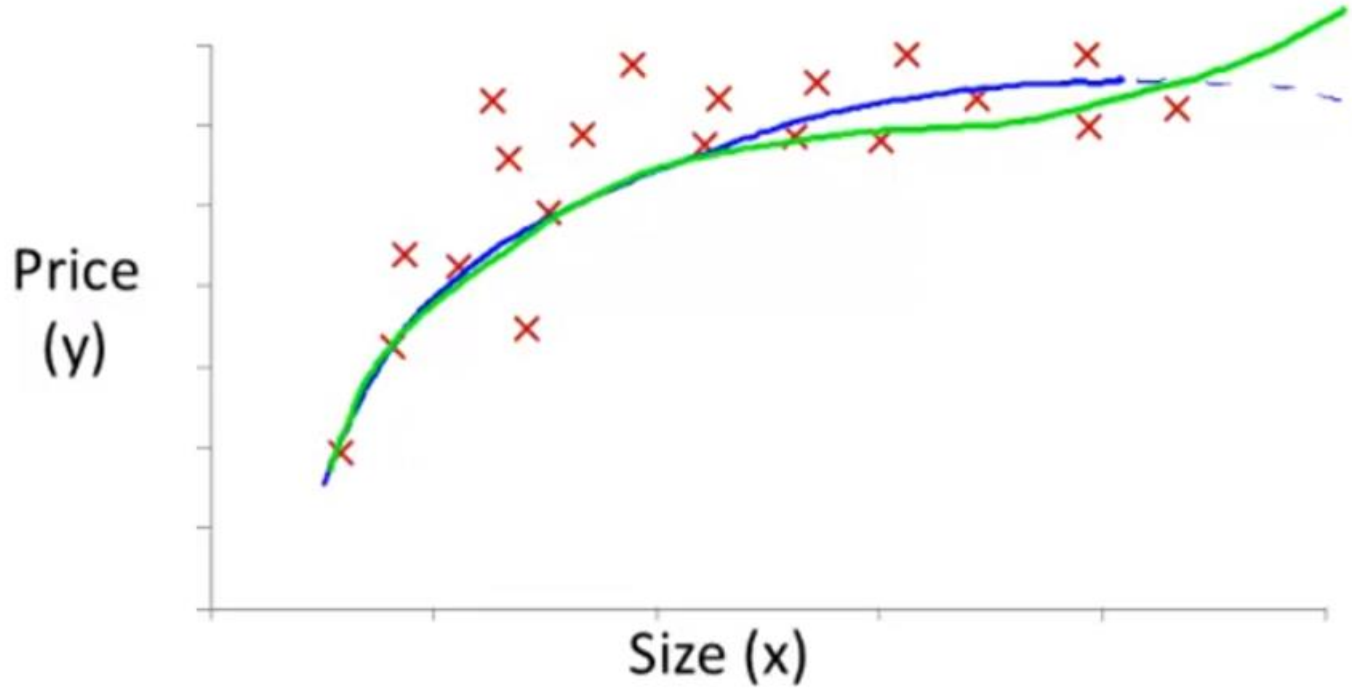


$$\theta_0 + \theta_1 x + \theta_2 x^2$$

$$\boxed{\theta_0 + \theta_1 x + \theta_2 x^2 + \theta_3 x^3}$$

$$\begin{aligned} h_\theta(x) &= \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3 \\ &= \theta_0 + \theta_1 (size) + \theta_2 (size)^2 + \theta_3 (size)^3 \end{aligned}$$

Polynomial regression



$\rightarrow \theta_0 + \theta_1 x + \theta_2 x^2$

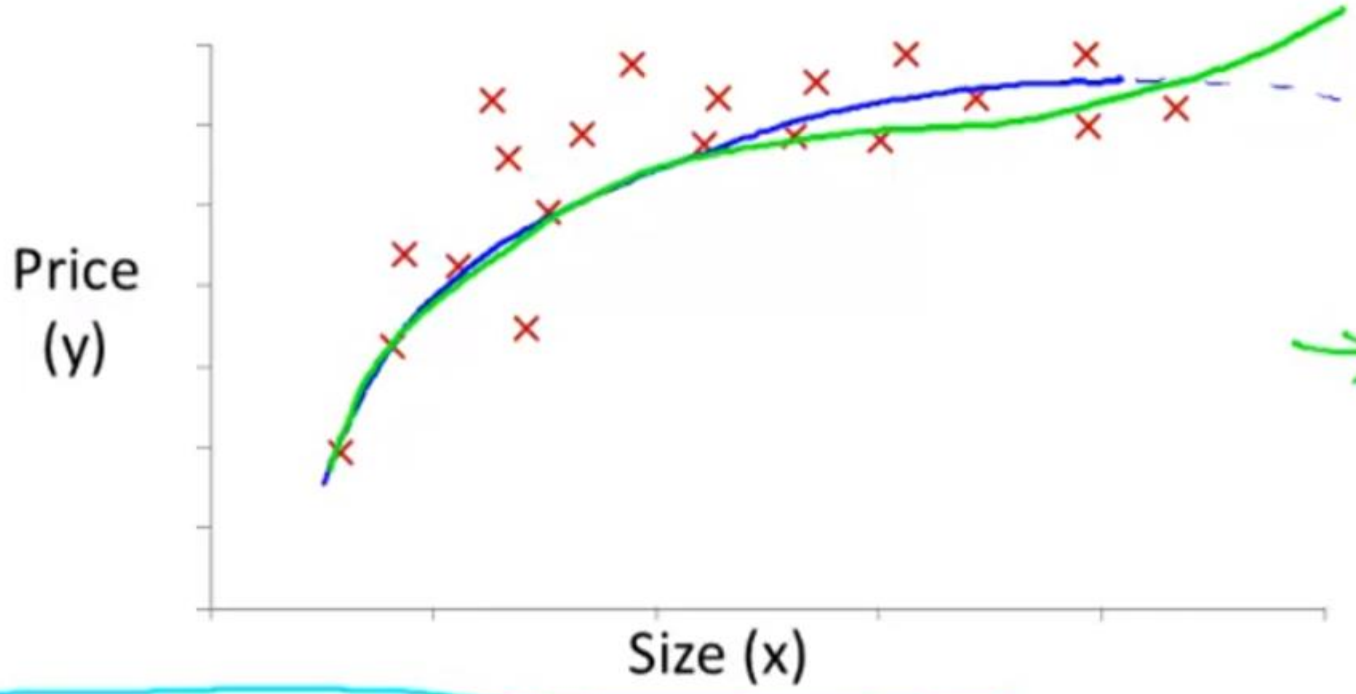
$\rightarrow \boxed{\theta_0 + \theta_1 x + \theta_2 x^2 + \theta_3 x^3}$

$$h_\theta(x) = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3$$
$$= \theta_0 + \theta_1(size) + \theta_2(size)^2 + \theta_3(size)^3$$

$$x_1 = (size)$$
$$x_2 = (size)^2$$
$$x_3 = (size)^3$$

Then, feature scaling is very important…

Polynomial regression



$$\theta_0 + \theta_1 x + \theta_2 x^2$$

$$\boxed{\theta_0 + \theta_1 x + \theta_2 x^2 + \theta_3 x^3}$$

$$\boxed{h_\theta(x) = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3}$$
$$= \theta_0 + \theta_1 (size) + \theta_2 (size)^2 + \theta_3 (size)^3$$

$$x_1 = (size)$$
$$x_2 = (size)^2$$
$$x_3 = (size)^3$$

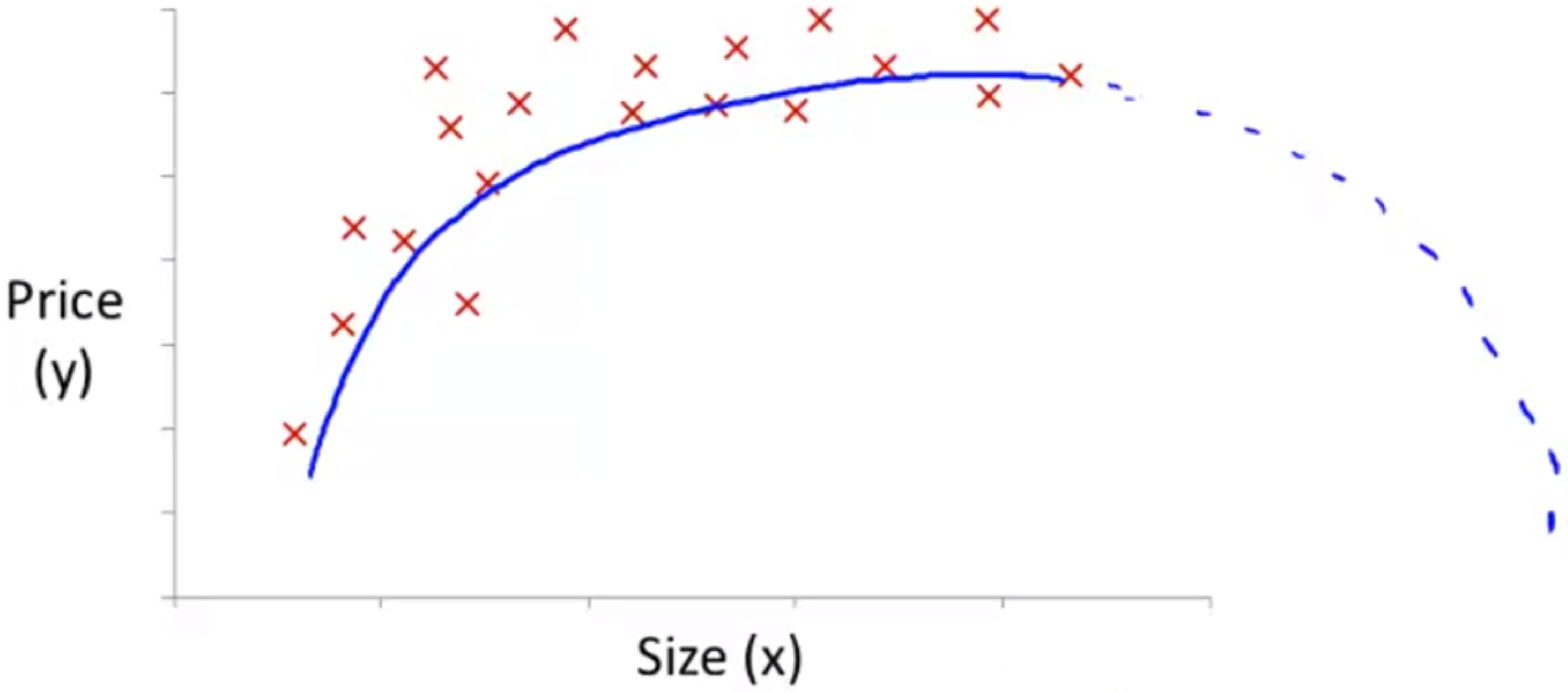
Size: 1-1000

Size^2: 1-1000,000

Size^3: $1-10^9$

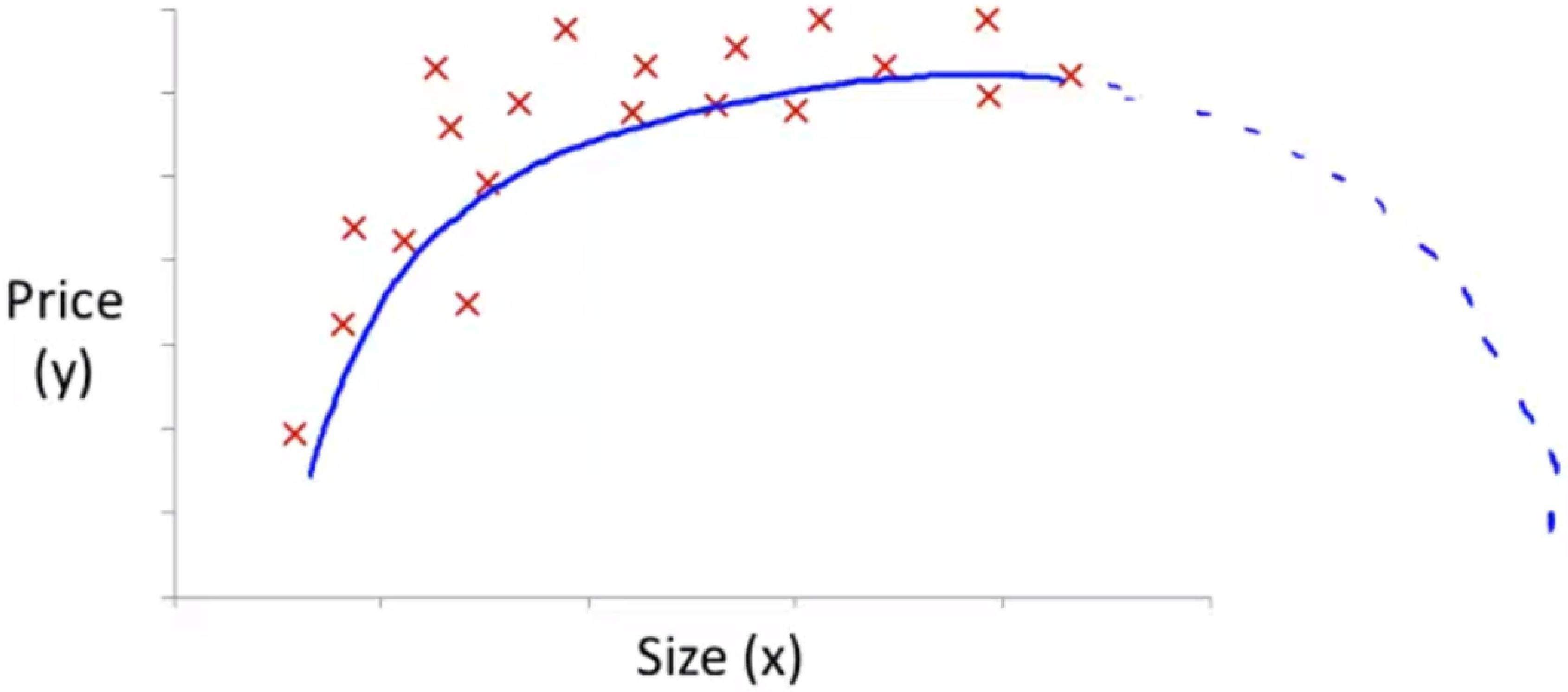
Andrew Ng

Choice of features



$$\rightarrow \quad h_\theta(x) = \theta_0 + \theta_1(size) + \theta_2(size)^2$$

Choice of features

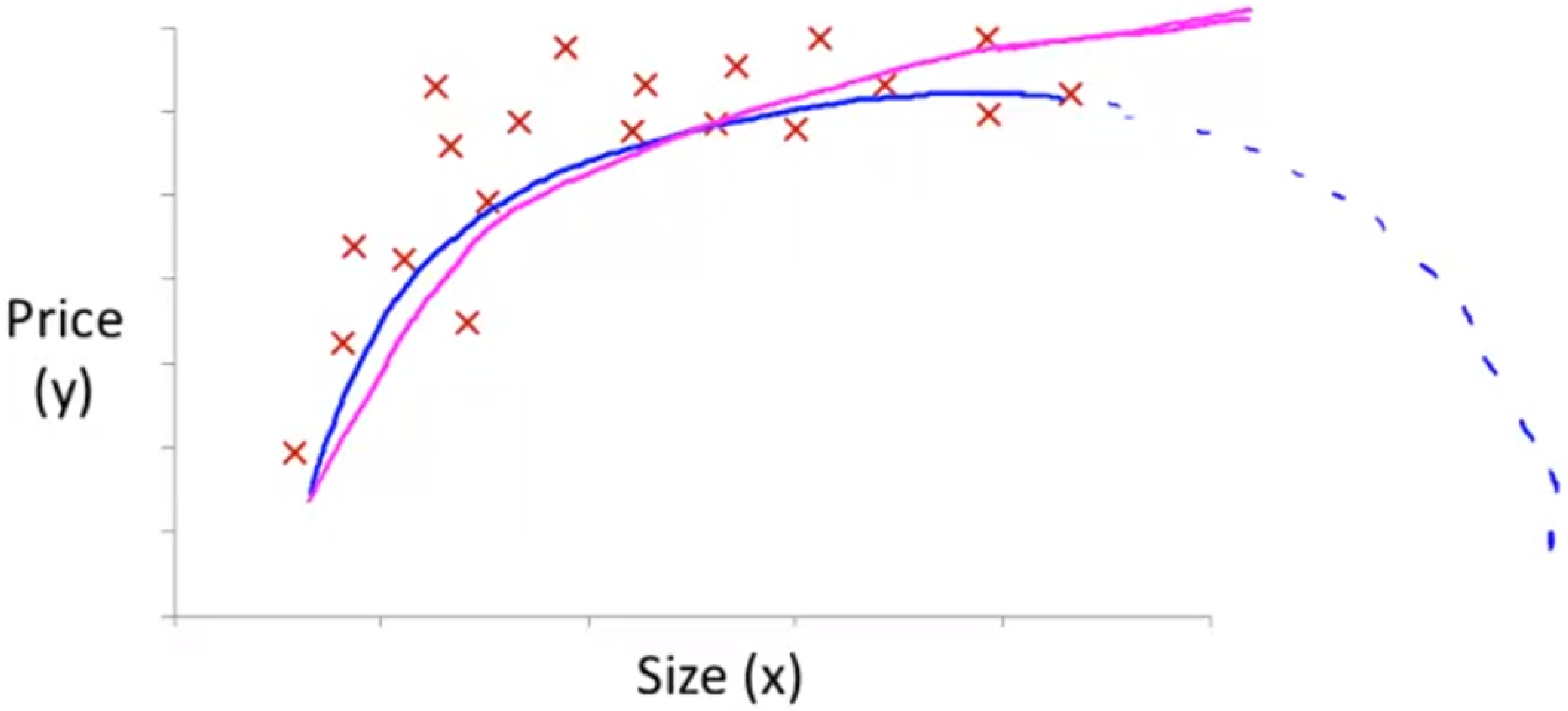


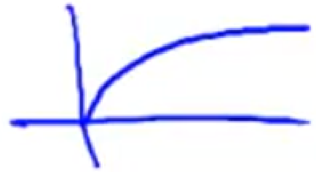
$$h_\theta(x) = \theta_0 + \theta_1(size) + \theta_2(size)^2$$

$$h_\theta(x) = \theta_0 + \theta_1(size) + \theta_2\sqrt{(size)}$$

Andrew Ng

Choice of features





$$h_\theta(x) = \theta_0 + \theta_1(size) + \theta_2(size)^2$$

$$\boxed{h_\theta(x) = \theta_0 + \theta_1(size) + \theta_2\sqrt{(size)}}$$

An exercise

- Suppose you want to predict a house's price as a function of its size. Your model is
- $h(\theta_0) + \theta_1(size) + \theta_2\sqrt{size}$
- Suppose size ranges from 1 to 1000 (feet^22).
- You will implement this by fitting a model
- $h(\theta_0) = \theta_1 x_1 + \theta_2 x_2$
- Finally, suppose you want to use feature scaling (without mean normalization).

- Which of the following choices for x_1 and x_2 should you use?
- X1 = size, x2 = 32 $\sqrt{size}$
- X1 = 32(size) x2 = $\sqrt{size}$
- X1 = size/1000, x2 = $\sqrt{size}$ /32
- X1 = size/32, x2 = $\sqrt{size}$