CUSTOMER ANALYTICS

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Regression Analysis

Wharton UNIVERSITY *of* PENNSYLVANIA ONLINE

What is the purpose of regression?

- Quantify the relationship among two or more variables.
  - Explain a dependent variable, from a set of predictor variables, called the independent variables

  - Uses a linear additive relation between the dependent and independent variables

Example 1: Demand Analysis

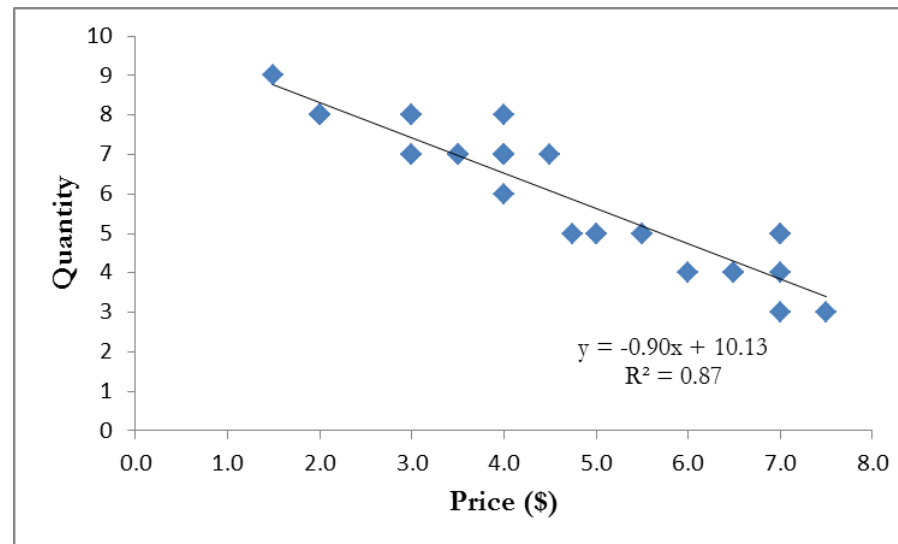| Price ($)	Demand
4.0	7
3.5	7
5.0	5
6.0	4
6.5	4
7.0	4
2.0	8
4.0	6
5.5	5
3.0	7
3.5	7
2.0	8
2.0	8
3.0	8
3.0	7
1.5	9
3.0	8
4.8	5
5.0	5
4.0	7
4.5	7
4.0	8
7.5	3
4.0	7
6.5	4
4.0	7
7.0	3
5.5	5
7.0	5
3.5	7
7.0	5
2.0	8

Demand Analysis –Plot
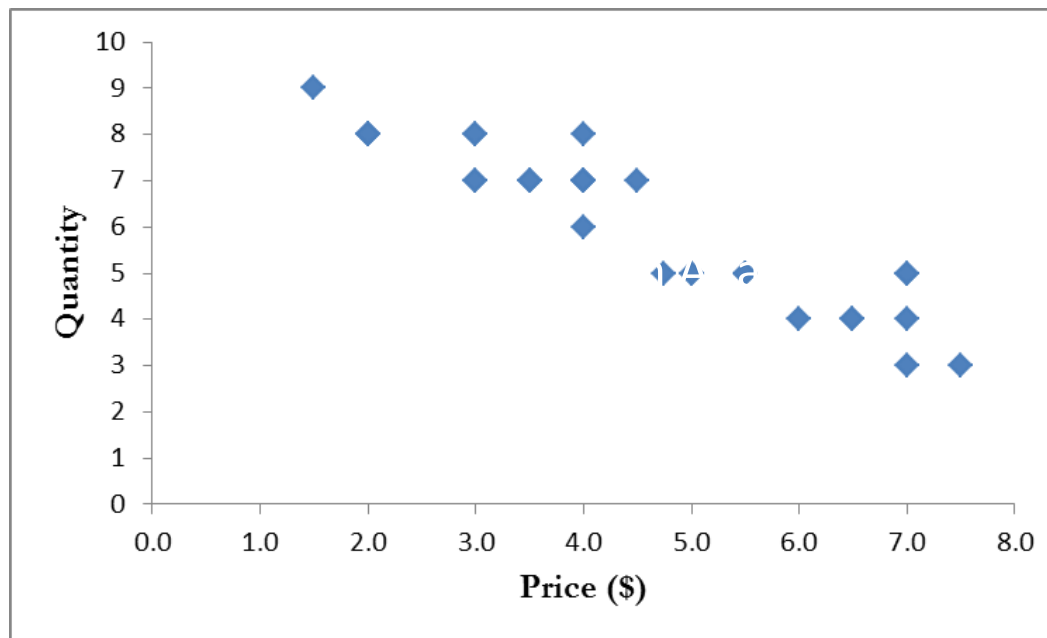
Regression

- Demand Analysis

  – $\text{Sales}_t = a + b_1 \, \text{Price}_t + e_t$

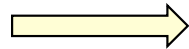- Simple Regression

$$Y_t = a + b_1 \times X_{1t} + e_t$$

Demand Curve

The regression line can be used to make demand predictions

Regression Analysis

Demand Prediction

Price ($)	Demand
4.0	7
3.5	7
5.0	5
6.0	4
6.5	4
7.0	4
2.0	8
4.0	6
5.5	5
3.0	7
3.5	7
2.0	8
2.0	8
3.0	8
3.0	7
1.5	9
3.0	8
4.8	5
5.0	5
4.0	7
4.5	7
4.0	8
7.5	3
4.0	7
6.5	4
4.0	7
7.0	3
5.5	5
7.0	5
3.5	7
7.0	5
2.0	8

Regression →

Price ($)	Demand	Prediction
4.0	7	6.5
3.5	7	7.0
5.0	5	5.6
6.0	4	4.7
6.5	4	4.3
7.0	4	3.8
2.0	8	8.3
4.0	6	6.5
5.5	5	5.2
3.0	7	7.4
3.5	7	7.0
2.0	8	8.3
2.0	8	8.3
3.0	8	7.4
3.0	7	7.4
1.5	9	8.8
3.0	8	7.4
4.8	5	5.9
5.0	5	5.6
4.0	7	6.5
4.5	7	6.1
4.0	8	6.5
7.5	3	3.4
4.0	7	6.5
6.5	4	4.3
4.0	7	6.5
7.0	3	3.8
5.5	5	5.2
7.0	5	3.8
3.5	7	7.0
7.0	5	3.8
2.0	8	8.3

Future Prices

Price
2.75
1.50
5.75
6.75
7.10
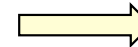
Regression →

Prediction
7.66
8.78
4.96
4.06
3.74

Regression

Optimal Pricing

- As predictions can be done for different prices, we can also determine optimal price

- Optimal price - price that maximizes overall profit
    - Intuition – for each price, we predict demand
    - Demand $\rightarrow$ revenue and profit

Multiple Regression

$$Y_i = a + b_1 \times X_{1i} + b_2 \times X_{2i} + ... + b_\kappa \times X_{ki} + e_i$$

- Multiple independent variables

- Example
  - $Sales_t = a + b_1 \, Price_t + b_2 * Adv_t + e_t$

Regression Analysis

Summary

- Regression is an ideal tool for understanding the drivers of demand and for demand prediction.

- It can be used for determining optimal prices.

From Regression to Data mining

- Regression is one way of doing predictive analytics

- Lots of different approaches are present
  - CART
  - MARS
  - Neural Networks