

III. Simple Regression.

- A. Introduction
- B. Population Regression Equation
- C. Sample Regression Equation
- D. Ordinary Least Squares
  - 1. Estimation – estimate what?
  - 2. Fitting a Line – what do we want to do?
  - 3. Errors – what’s an error?
  - 4. OLS Objective or Criterion
  - 5. Choices – what do we choose (Dan’s OLS Live!)
  - 6. OLS Estimators – what process used to derive?
  - 7. OLS Estimates – interpretations.

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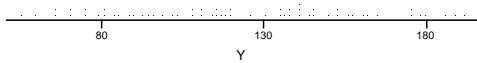
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**“Univariate Statistics”**  
What we did.

Distribution of Weekly Family Expenditures



Where’s the center? (Estimate mean)  
What’s the variation? (Estimate standard deviation.)

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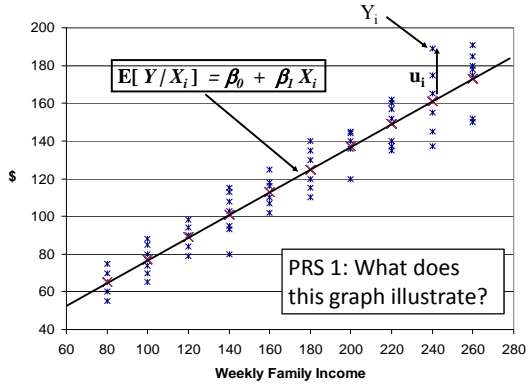
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Weekly Family Consumption Expenditures



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### C. Sample Regression Equation

1. Sample version of the PRE:
  - An estimate of the economic relationship.
  - Statistical or random relationship
  - SRE:
2. Two basic parts:
  - Estimated part:
  - **Errors:**

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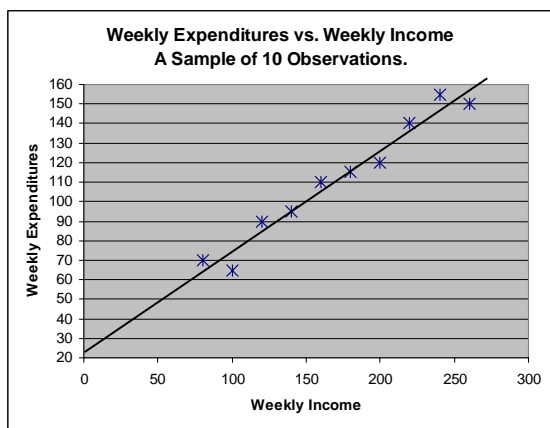
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3. **Estimators** – there are three population values to estimate:
  - Population parameters:
  - Population Mean of **Y**:
  - Population Value of **Y**:

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D. Ordinary Least Squares – **OLS**.

1. *Estimation* –

2. *Fitting a line* –

3. *Errors*

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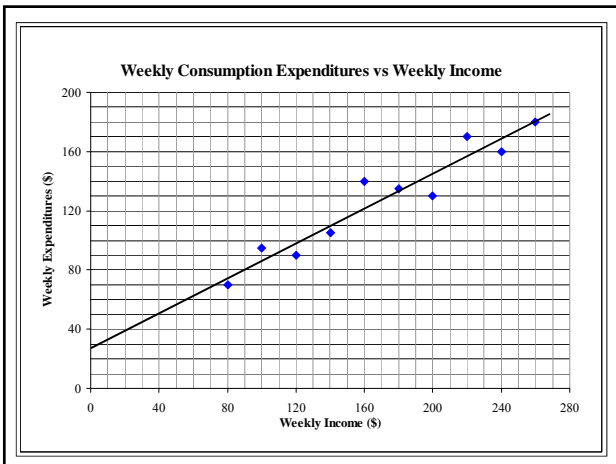
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D. Ordinary Least Squares – **OLS**

4. **OLS Objective or Criterion:**

$$\text{Min: } \sum e_i^2 = \sum (Y_i - \hat{\beta}_0 + \hat{\beta}_1 X_i)^2$$

5. **Choices** – what do we choose in order to minimize the sum of the squared errors?

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**6. OLS Estimators**

- Rules that tell us how to estimate  $\beta_0$  and  $\beta_1$ .

$$\hat{\beta}_1 = \frac{\sum X_i Y_i - n \bar{X} \bar{Y}}{\sum X_i^2 - n \bar{X}^2} = \frac{\sum x_i Y_i}{\sum x_i^2} = \frac{\sum x_i y_i}{\sum x_i^2}$$

$$\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}$$

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