Methodology of Econometrics. Introduction to Linear Regression Models.

Presentation 1

The Econometrics Subject

- Literally interpreted, *econometrics* means “economic measurement.”
- Uses Statistical Methods and Models
- Is Based on Economic Data
- The Analysis Results are Applied for Political or Management Decision Making

Methodology of Econometrics

1. Statement of theory or hypothesis.
2. Specification of the mathematical model of the theory
3. Specification of the statistical, or econometric, model
4. Obtaining the data
5. Estimation of the parameters of the econometric model
6. Hypothesis testing
7. Forecasting or prediction
8. Using the model for control or policy purposes.

Example: Keynesian theory of consumption

1. “The fundamental psychological law . . . is that men [women] are disposed, as a rule and on average, to increase their consumption as their income increases, but not as much as the increase in their income.”

Example: Keynesian theory of consumption

2. The marginal propensity to consume (MPC), the rate of change of consumption for a unit (say, a dollar) change in income, is greater than zero but less than 1

$$Y = \beta_1 + \beta_2 X \quad 0 < \beta_2 < 1$$

Example: Keynesian theory of consumption

3. The purely mathematical model of the consumption function assumes that there is an exact or deterministic relationship between consumption and income. But relationships between consumption and income may vary and depends on consumption patterns of the households. That's why we introduce random variable ***u***.

$$Y = \beta_1 + \beta_2 X + u$$

Example: Keynesian theory of consumption

4. Obtain appropriate data : The U.S. economy for the period 1980–1991. The Y variable in this table is the aggregate personal consumption expenditure (PCE) and the X variable is gross domestic product (GDP).

Example: Personal consumption expenditure (Y) in relation to GDP (X)

Year	X	Y
1980	3776.3	2447.1
1981	3843.1	2476.9
1982	3760.3	2503.7
1983	3906.6	2619.4
1984	4148.5	2746.1
1985	4279.8	2865.8
1986	4404.5	2969.1
1987	4539.9	3052.2
1988	4718.6	3162.4
1989	4838.0	3223.3
1990	4877.5	3260.4
1991	4821.0	3240.8

Example: Personal consumption expenditure (Y) in relation to GDP (X)

5. Model Estimation

$$\hat{Y} = -231.795 + 0.7194X$$

Example: Personal consumption expenditure (Y) in relation to GDP (X)

6. Hypothesis testing: are the estimated parameters statistically significant?

Example: Personal consumption expenditure (Y) in relation to GDP (X)

7. GDP Forecast for 1994 г. is $6000 billions. How much will be the Consumption?

Example: Personal consumption expenditure (Y) in relation to GDP (X)

8. Suppose that the Government finds $4000 billions consumption optimal. How much the GDP should be in this case?

Introduction to Linear Regression Models

- **Hypothetical example:**
  We consider economy of 60 families in a hypothetical community and have data about their weekly income (*X*) and weekly consumption expenditure (*Y*), both in dollars.

Introduction to Linear Regression Models

- The 60 families are divided into 10 income groups (from $80 to $260) and the weekly expenditures of each family in the various groups are as shown in the following table.

Hypothetical example

Y\X	80	100	120	140	160	180	200	220	240	260
	55	65	79	80	102	110	120	135	137	150
	60	70	84	93	107	115	136	137	145	152
	65	74	90	95	110	120	140	140	155	175
	70	80	94	103	116	130	144	152	165	178
	75	85	98	108	118	135	145	157	175	180
		88		113	125	140		160	189	185
				115				162		191

Basic concepts:

- **Conditional probabilities** $p(Y \mid X_i)$
- **Conditional distribution**
- **Conditional mathematical expectation** $E(Y \mid X = X_i)$ $E(Y \mid X_i)$

Population Regression Function

- **Population Regression Function**

$$E(Y \mid X_i) = f(X_i)$$

- **Linear Population Regression Function**

$$E(Y \mid X_i) = \beta_1 + \beta_2 X_i$$

Basic concepts:

- The deviations of an individual *Yi* from its expected values are called stochastic disturbances (residuals, errors, innovations)
- The individual *Yi* values have deterministic and stochastic component

$$u_i = Y_i - E(Y \mid X_i)$$

$$Y_i = \beta_1 + \beta_2 X_i + u_i$$

Basic concepts:

- **Sample Regression Function:** when we have data about only one sample from the whole population

$$Y_i = \hat{\beta}_1 + \hat{\beta}_2 X_i + \hat{u}_i$$