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Introduction to Econometrics

Eg: Govt Exp Multiplier (Keynesian Th) :=> $\frac{dY}{dG} = \frac{1}{1-MPC} = \frac{1}{MPS} > 1$.

If dG = Rs. 10 crore, dY = actual how much? [In numerics]

In order to empirically evaluate dY we need to know MPC for the economy.

∴ To know this we need to know the consumption, income pattern of individuals for the entire economy.

∴ $Y = \alpha + \beta X$ ... [Based on "data" from entire economy (population), we will be able to obtain β = MPC of the economy].

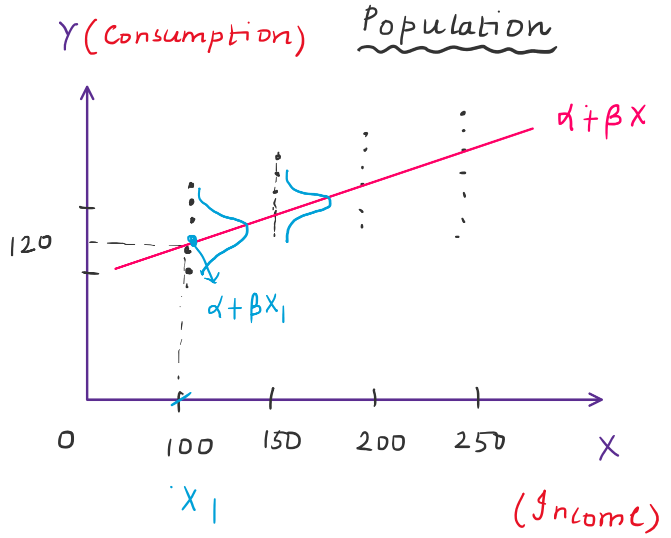
Y → [Consumption] X → [Income]

After collected data from entire popln: $\beta = 0.615$ => Evaluate $\frac{dY}{dG}$

Eg: From Macro Th:

we get: $C = 100 + 0.2Y$.

$Y = 100$, $C = 120$.



∴ But in reality, there might be "random" factors that influence the level of Y for any given value of X.

∴ Economic Model: $Y = \alpha + \beta X$ ... [Deterministic Relationship].

& Econometric Model: $Y = \alpha + \beta X + U$ → Random Disturbance

& Econometric Model: $Y = \underbrace{\alpha + \beta X}_{\text{Deterministic part}} + \underbrace{U}_{\text{Random part}} \rightarrow$ Random Disturbance Term.

Random part ... [Stochastic Relationship].

$\therefore$ U : Stochastic Variable .. [i.e U has a probality distn]

X : Non-stochastic / deterministic variable.

$Y = \alpha + \beta X + U$ ... [Y is also a stochastic variable].

Eg: $(Y_1, X_1, U_1) \rightarrow f(u_1)$. $\quad (Y_i, X_i, u_i) \rightarrow f(u_i)$

$$\therefore E(U_1) = \int_{-\infty}^{+\infty} u_1 f(u_1)\, du_1$$

$$E(X_1) = X_1$$

$$E(Y_1) = E(\alpha + \beta X_1 + u_1)$$

α, β → population parameters.

$$= E(\alpha) + E(\beta X_1) + E(u_1)$$

$$= \alpha + \beta X_1 + E(u_1) \quad [\because X_1 \text{ is non-stochastic}].$$

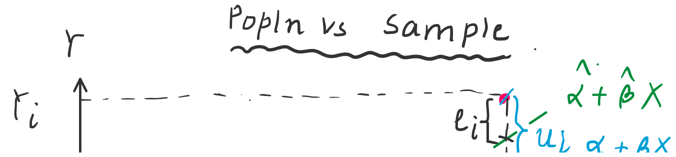
$$\therefore \boxed{Y_i = \alpha + \beta X_i + u_i} \text{ ...... Population Regression Fn (PRF)}$$

Population vs Sample:

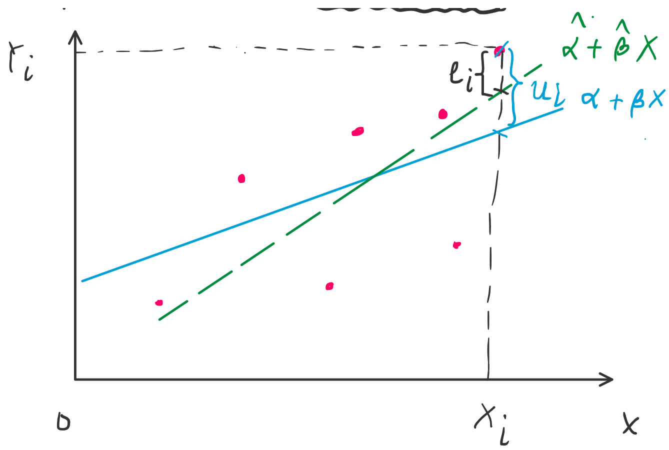
Consider a sample from the popln to "estimate" the relationship under study.

Let $(Y_i, X_i)^n$ be a sample.

Popln vs sample



Let $(Y_i, X_i)_{i=1}^{n}$ be a sample.



Denote $\hat{\alpha}$: Estimate of α

$\hat{\beta}$: Estimate of β.

$\therefore$ Based on the sample,

Estimated Relationship: $\hat{Y}_i = \hat{\alpha} + \hat{\beta} X_i$ --- [Sample Reg. Equation (SRE)]

Denote: e_i = error in estimation $= (Y_i - \hat{Y}_i)$

Note: Difference b/w u_i, e_i :-

u_i : → Random Disturbance Term.

→ Arising because of the nature of population

→ Since popln is unknown (so u_i's are unknown as well), we need to take some assumptions of u_i.

e_i : → error in estimation.

→ Arising because of the method of estimation [$\therefore$ For a given sample, this is not random]

→ No assumptions are reqd as it arises out of estimation process.