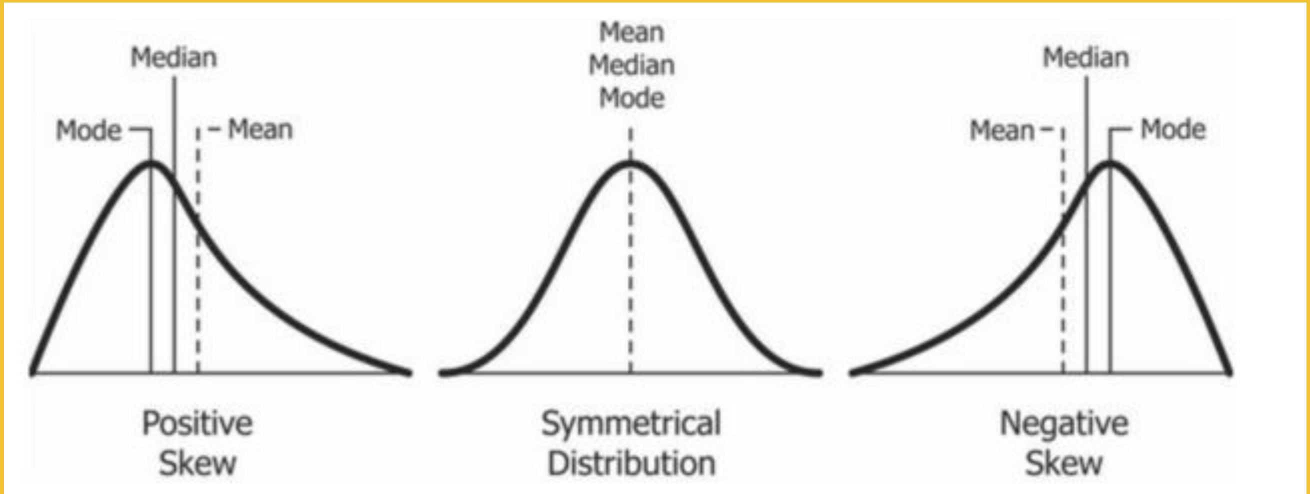


Econ 2250: Stats for Econ

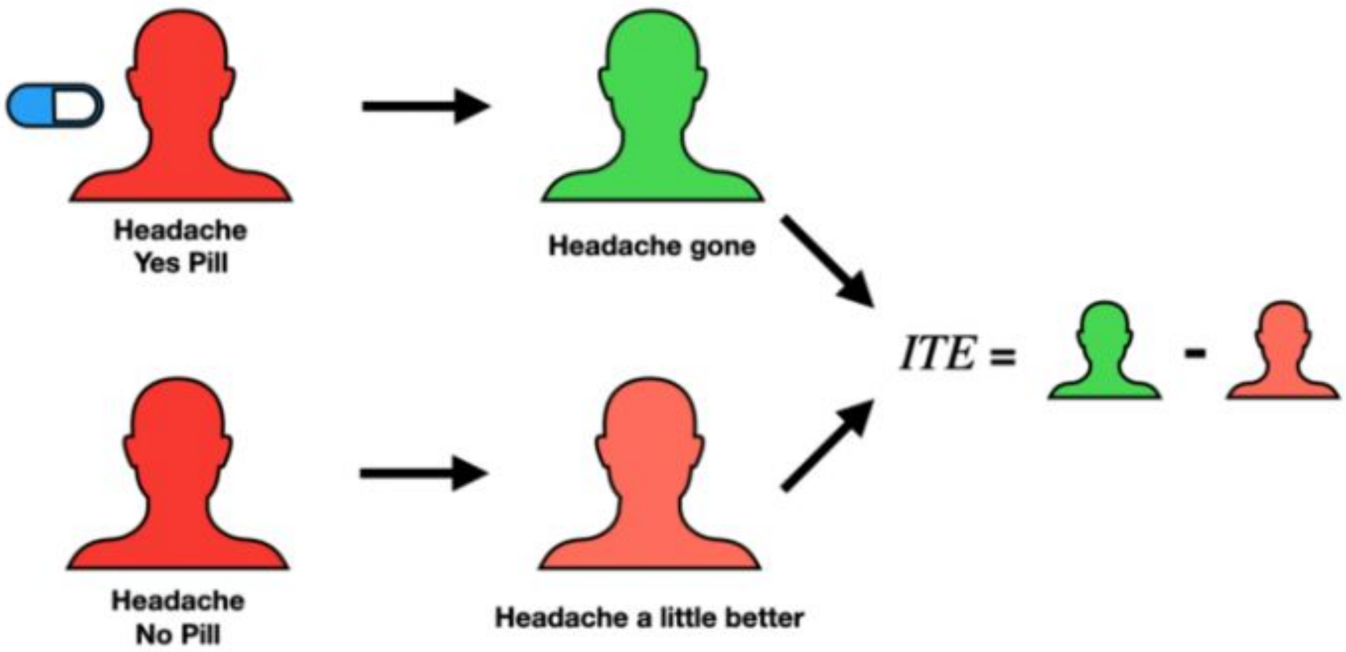
Fall 2022

[Source for pic stats above.]

Agenda

- Average Treatment Effect
  - Notes borrowed from here
- Review CDF and PDF

Individual Treatment Effect (ITE)



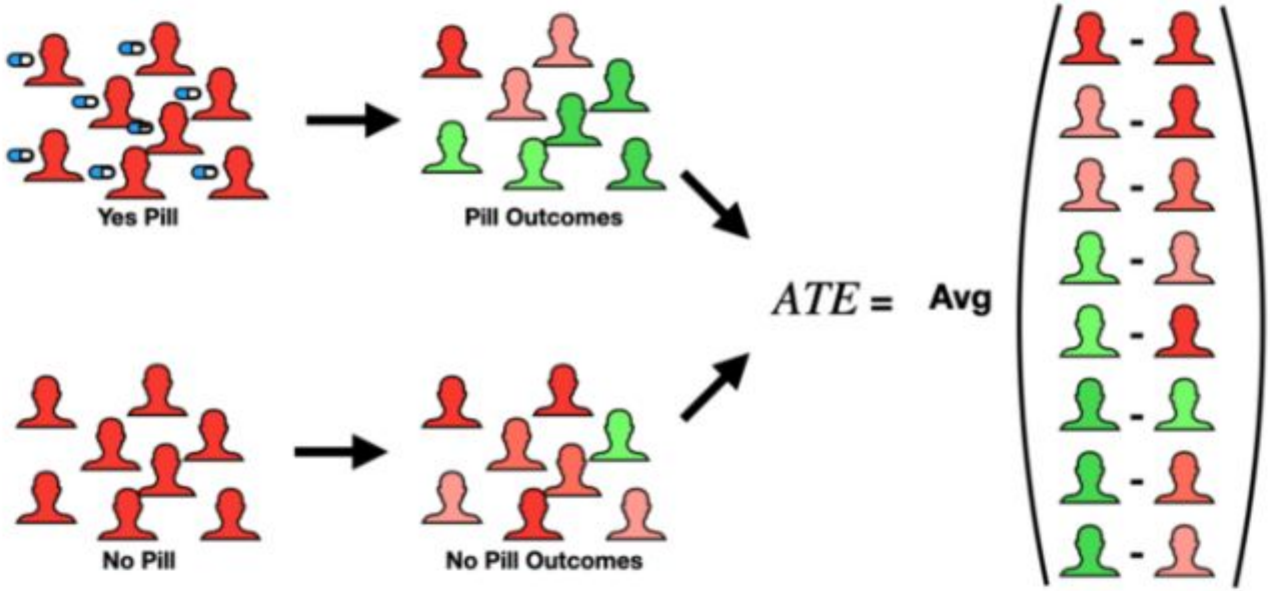
$$
\begin{aligned}
ITE &= Y(X = 1) - Y(X = 0) \\
&\equiv Y(1) - Y(0)
\end{aligned}
$$

$$ITE = Y(X = 1) - Y(X = 0)$$
$$\equiv Y(1) - Y(0)$$

Y(1) represents the outcome value for the pill scenario (i.e. *X*=1) and

Y(0) represents the outcome of the no pill scenario (i.e. *X*=0).

Average Treatment Effect (ATE)



$$ATE = E\{Y_i(1) - Y_i(0)\}$$

Expected Value Operator E()

The expectation operator, $E(X)$, takes the weighted sum of a random variable.

In the case where there are two outcomes $\{x_1, x_2\}$, $E(X)$ takes $p_1x_1 + p_2x_2$,

where p_1 and p_2 are the respective probabilities of the two outcomes.

Rules

$$E(a) = a$$
$$E(a + bX) = a + bE(X)$$
$$E(X + Y) = E(X) + E(Y)$$
$$E(bX)^2 = E(b^2X^2) = b^2E(X^2)$$

$$ATE = E\{Y_i(1) - Y_i(0)\}$$

E{V} represents the expectation value (i.e. average) of some variable *V*.

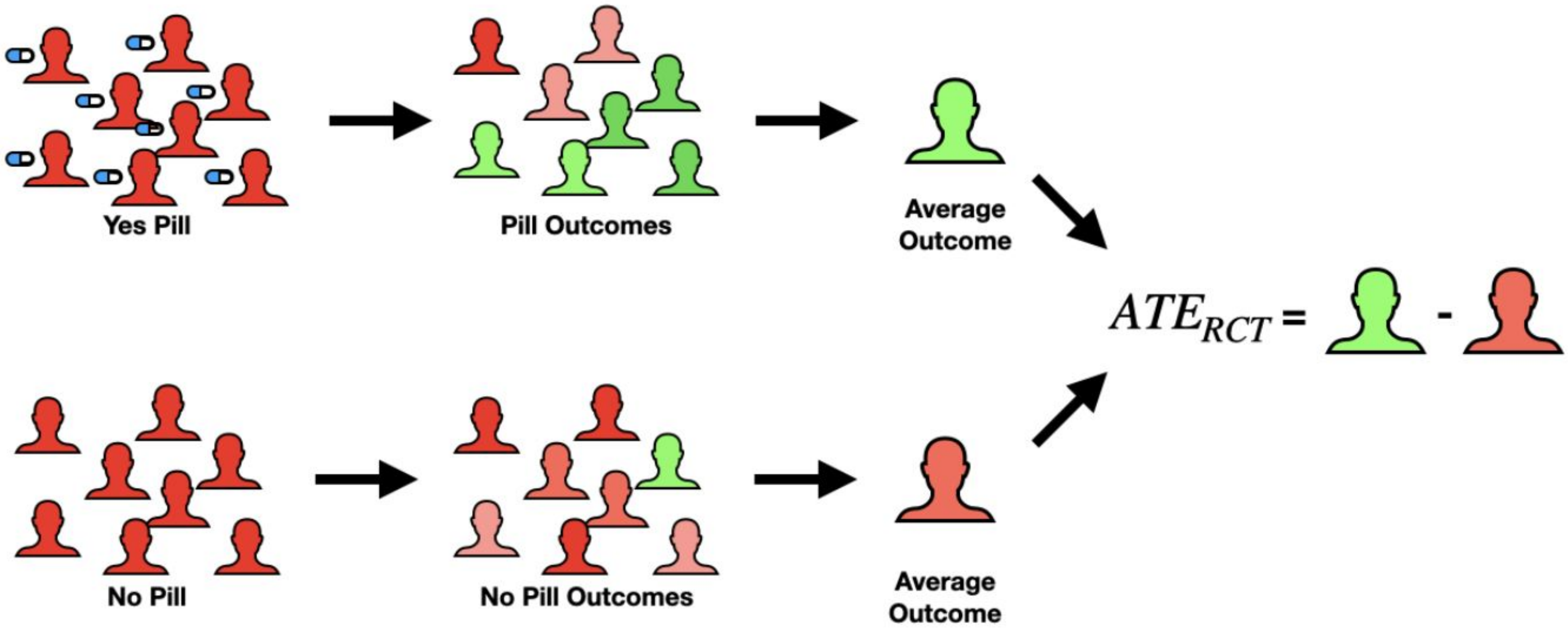
$Y_i(1)$ represents the ith subject's outcome value for the pill scenario.

And, $Y_i(0)$ represents the ith subject's outcome value for the no pill scenario.

$$ATE_{RCT} = E\{Y_j(1) - Y_k(0)\} = E\{Y_j(1)\} - E\{Y_k(0)\}$$

Where, j indexes the treatment group and k indexes the control group.

In other words, the ATE can be directly computed by comparing the average outcome value for each of the two sub-populations.



Yes Pill
Pill Outcomes
Average Outcome
ATE_{RCT} = -
No Pill
No Pill Outcomes
Average Outcome

Average Treatment Effect for the Treated (or Controls)

$$ATT = E\{Y_i(1) - Y_i(0) \mid X = 1\}$$

ATT is the **expected treatment effect given the treatment (*X*=1) was observed**.

Average Treatment Effect for the Controls (ATC)

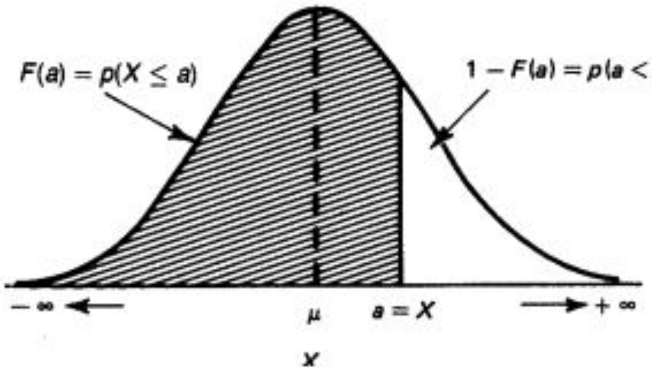
$$ATC = E\{Y_i(1) - Y_i(0) \mid X = 0\}$$

Review CDF and PDF

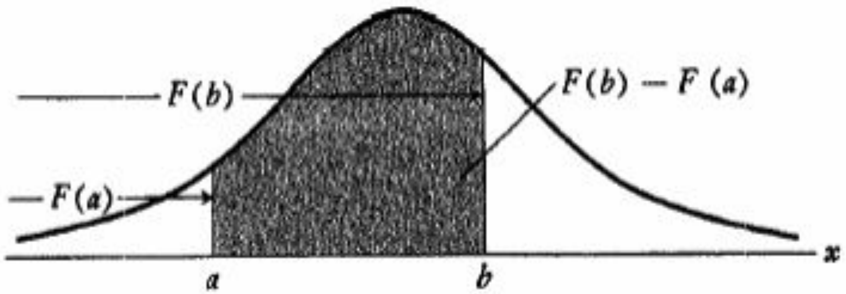
Probability Distribution Function (PDF): specification of the probability associated with each value of a random variable.

For continuous r.v.s:

$$F(a) = p(X \le a) = \int_{-\infty}^{a} f(x)\,dx = \text{Area up to } X = a$$



$$p(a \le X \le b) = F(b) - F(a)$$



Probability Mass Function (PMF)

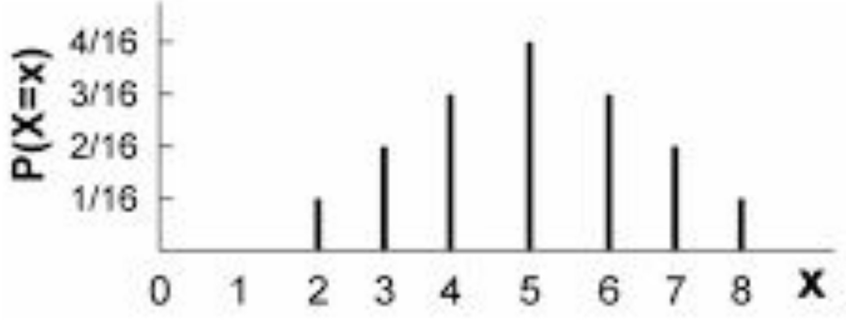
A probability distribution involving only discrete values of X. Aggregates different possible values of X, and the different possible values of P(x).

Properties:

$0 \leq P(X = x) \leq 1$

$\Sigma P(X = x) = 1.$

x	P(x)
2	1/16
3	2/16
4	3/16
5	4/16
6	3/16
7	2/16
8	1/16

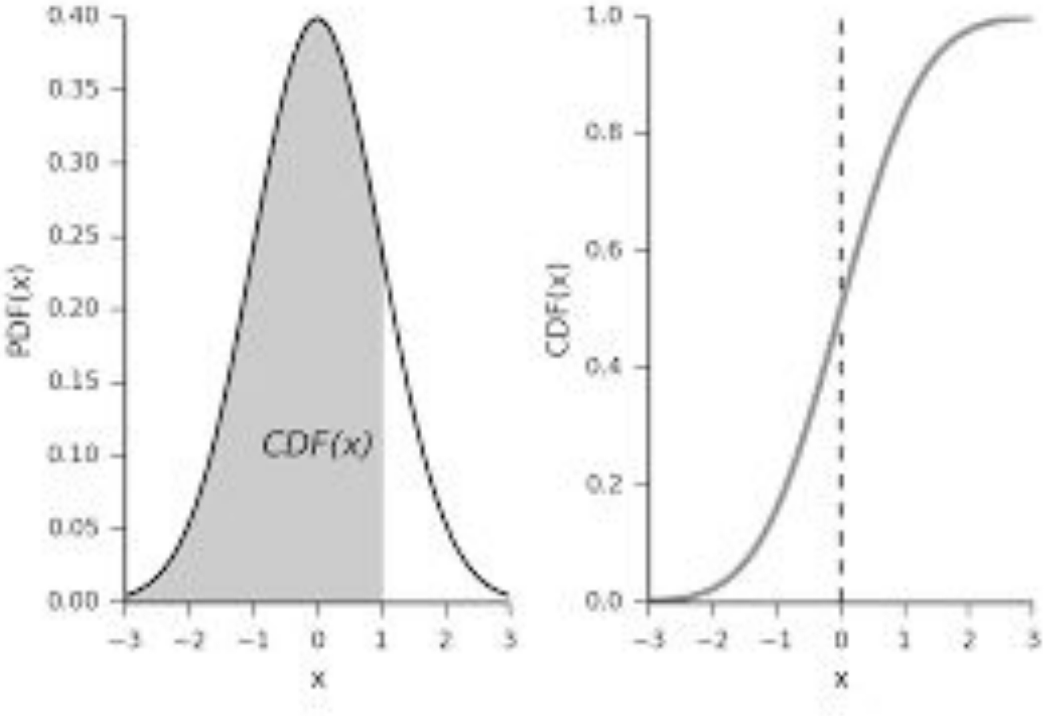


Cumulative Density Function (CDF)

The probability that a random variable X takes on a value less than or equal to some particular value a is often written as

$$F(a) = p(X \le a) = \sum_{X \le a} p(x)$$

(for discrete variables, integral for continuous)



End of class form

https://forms.gle/My9wHi2QFKNLedGC7