

Central Limit Theorem

The background is a solid teal color. On the right side, there are several decorative elements: a large, semi-transparent pie chart with three segments, a smaller pie chart above it, another smaller pie chart to the right, and a bar chart at the bottom right with four bars of increasing height. The text is white and positioned on the left side of the slide.

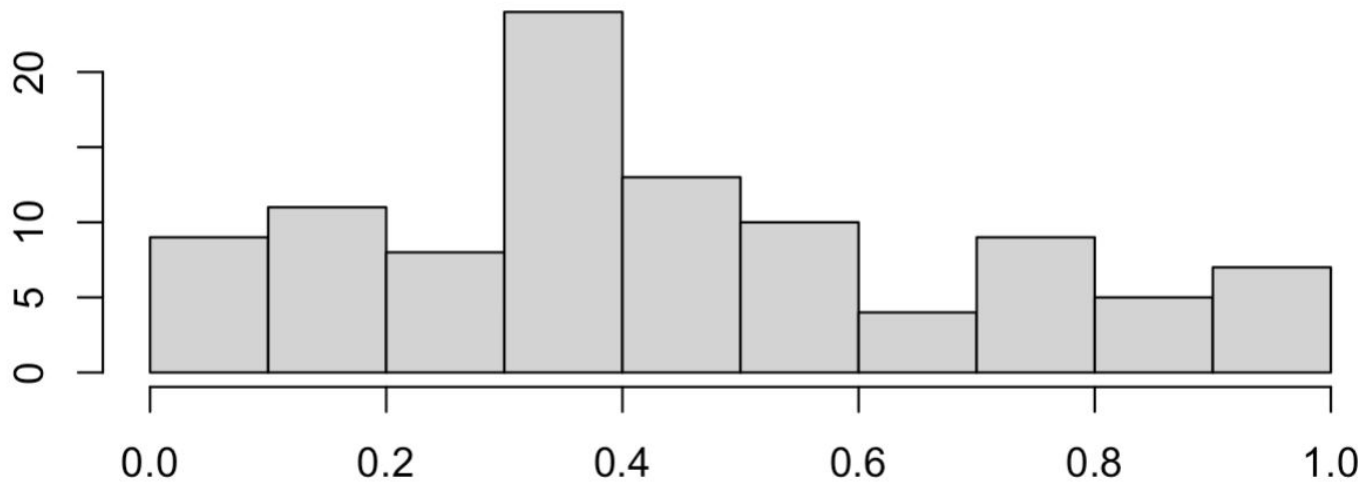
Pranav Madhukar
Mentored by Ronan Perry



Town X

What is my friend's political preference?

$\mathbb{E}[Y]$





Take a Sample!

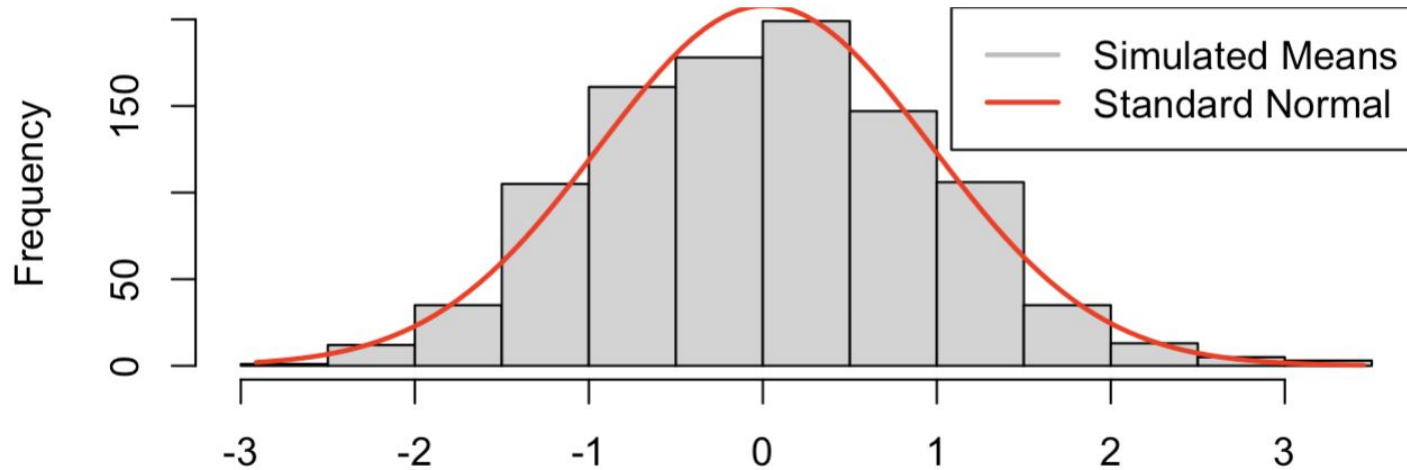
Take 10 people from the population and find the mean of their political opinion. But how does this relate to the population mean?

Central Limit Theorem! Bam! Holds regardless of the population distribution.

$$\frac{\sqrt{n}}{\sigma}(\hat{\mu} - \mu) = N(0, 1)$$



Histogram of simulated_means





What if we knew my friend's age?

(Without loss of generality for multivariate X)

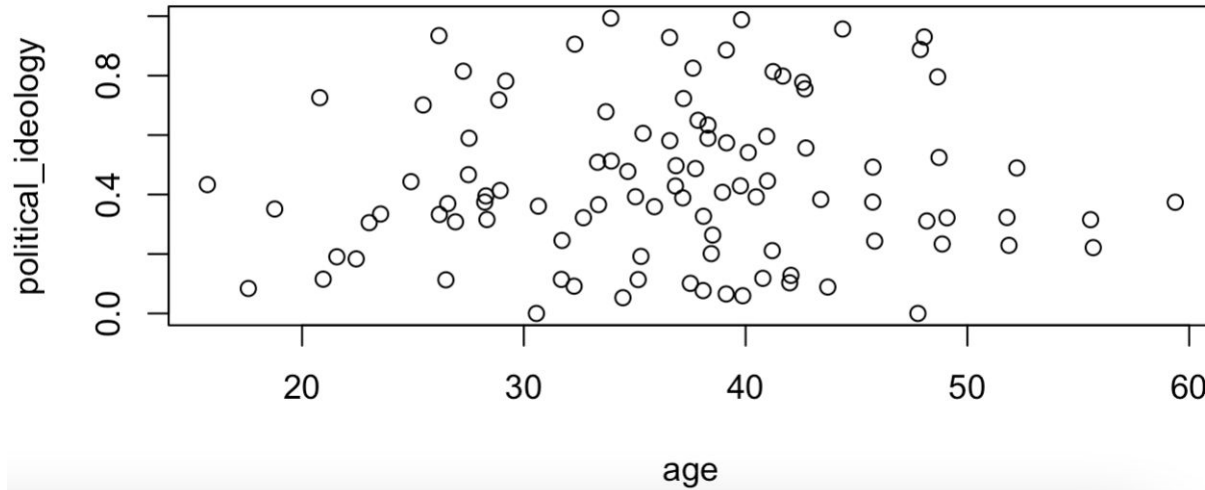
$$\mathbb{E}[Y|X]$$

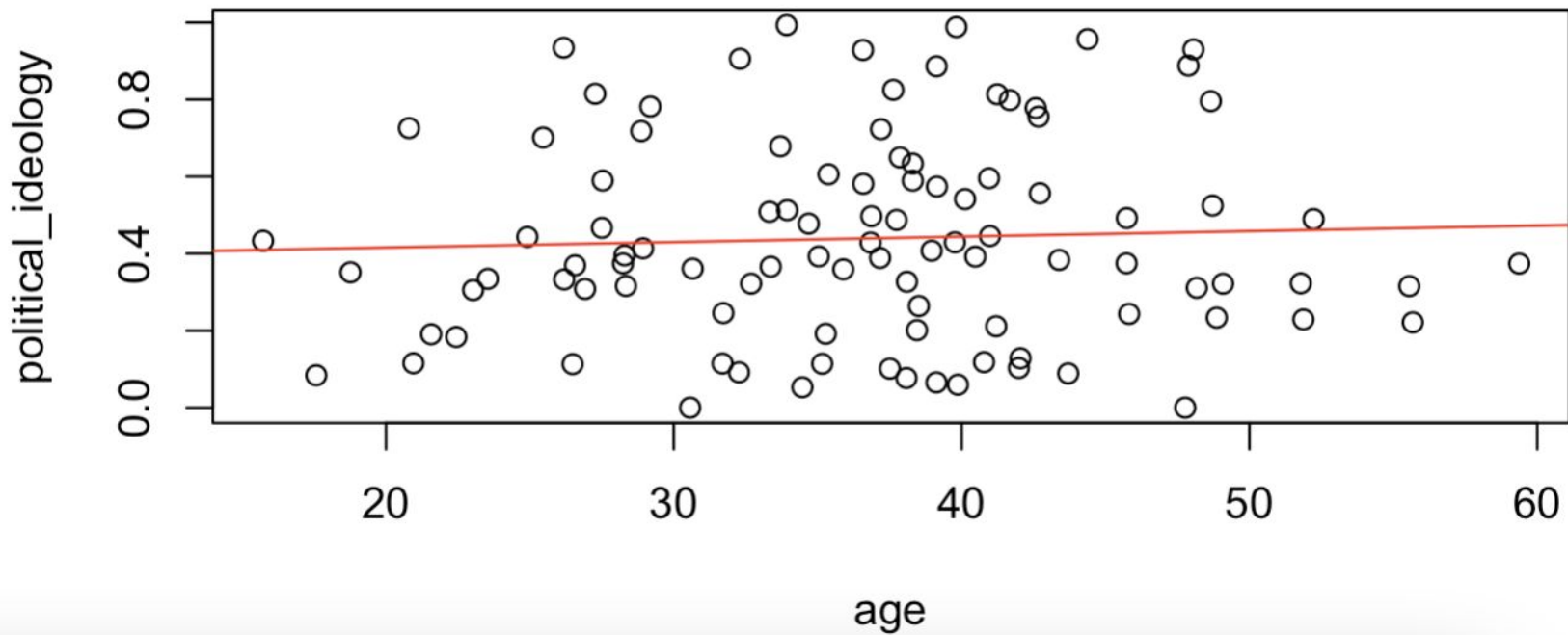
Working model:

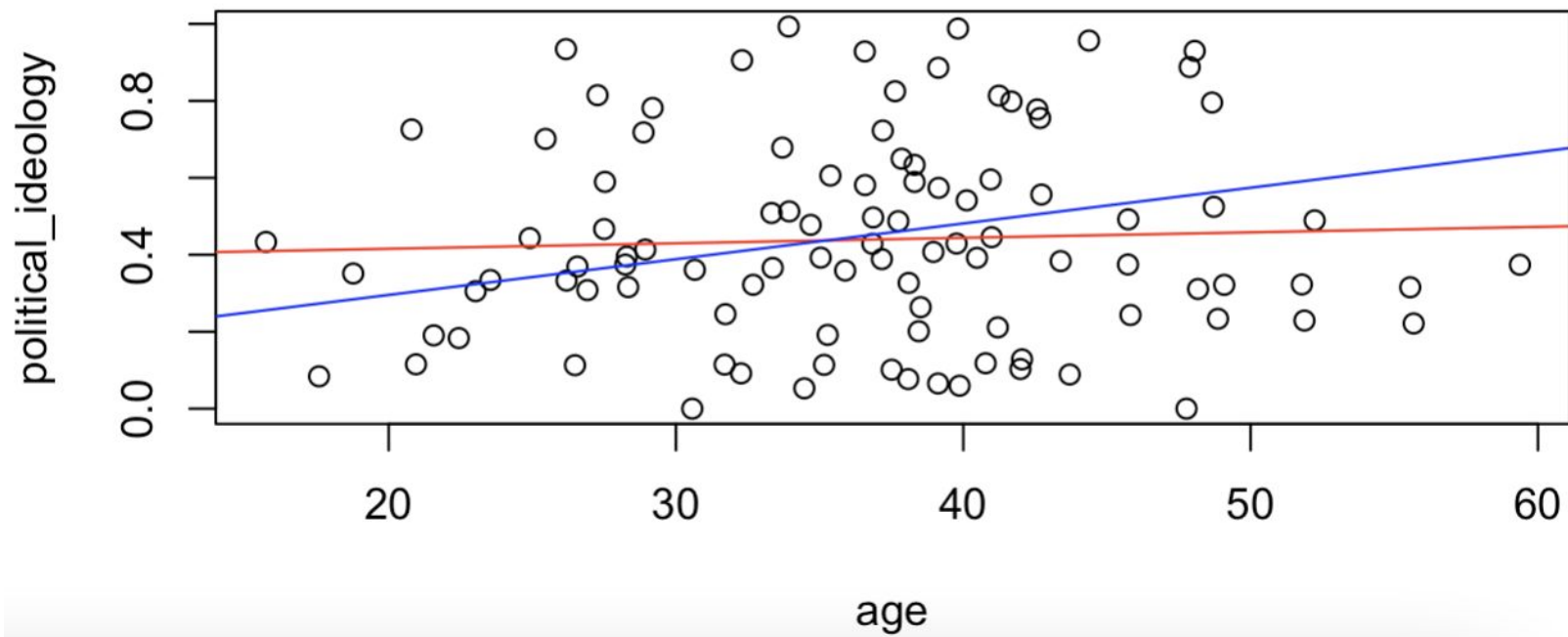
$$Y = X\beta + \epsilon$$



Case 1: Political Opinion and Age are Independent





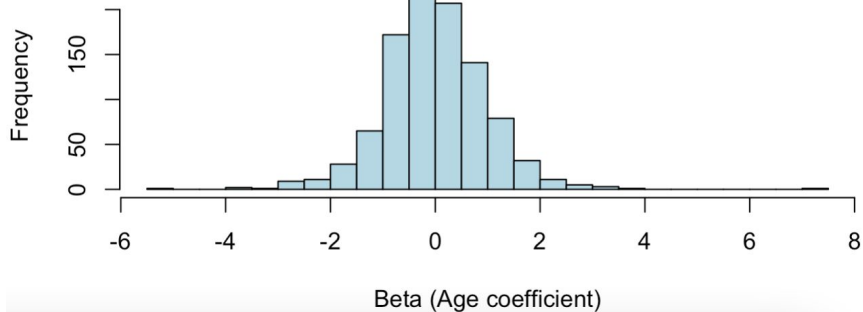




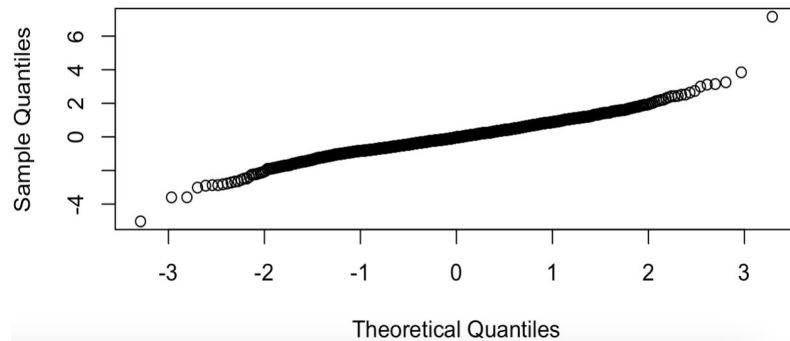
But how does these two lines relate to each other? How good is our prediction?

Central Limit Theorem! Bam! Holds regardless of the population distribution.

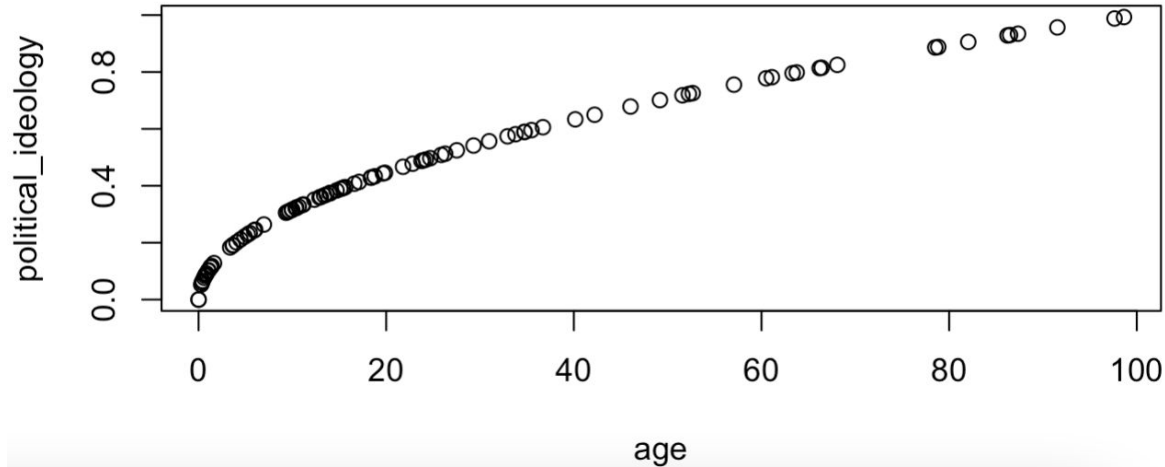
Distribution of Beta from Linear Regression

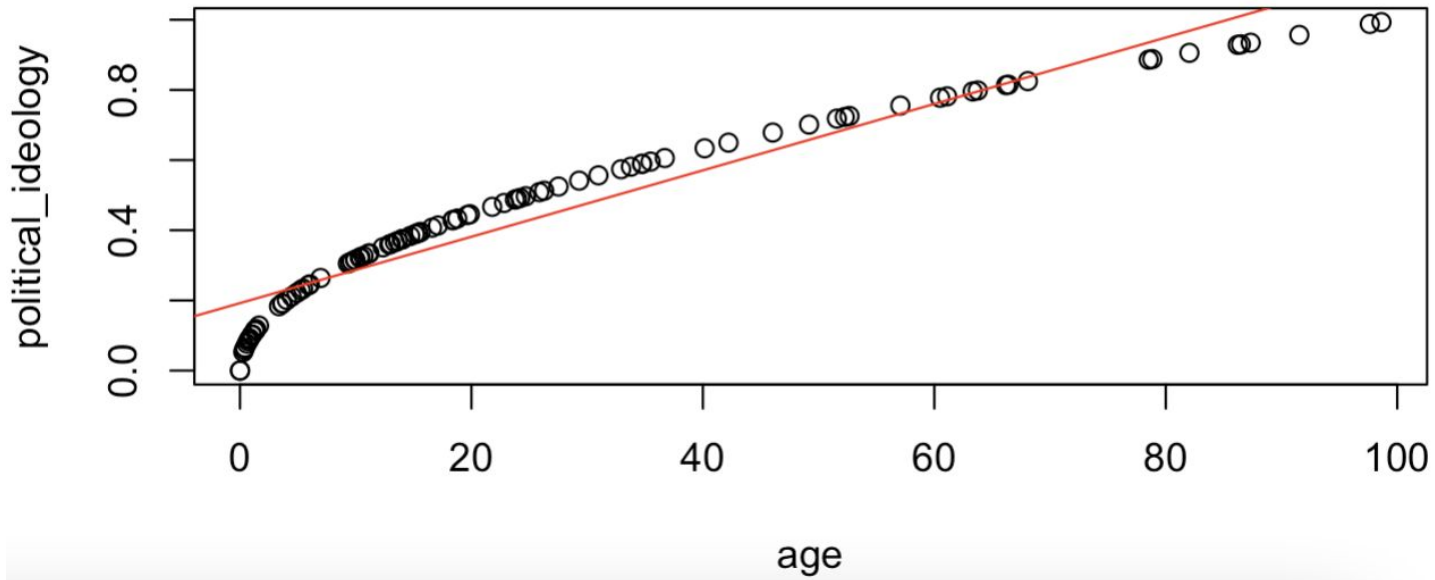


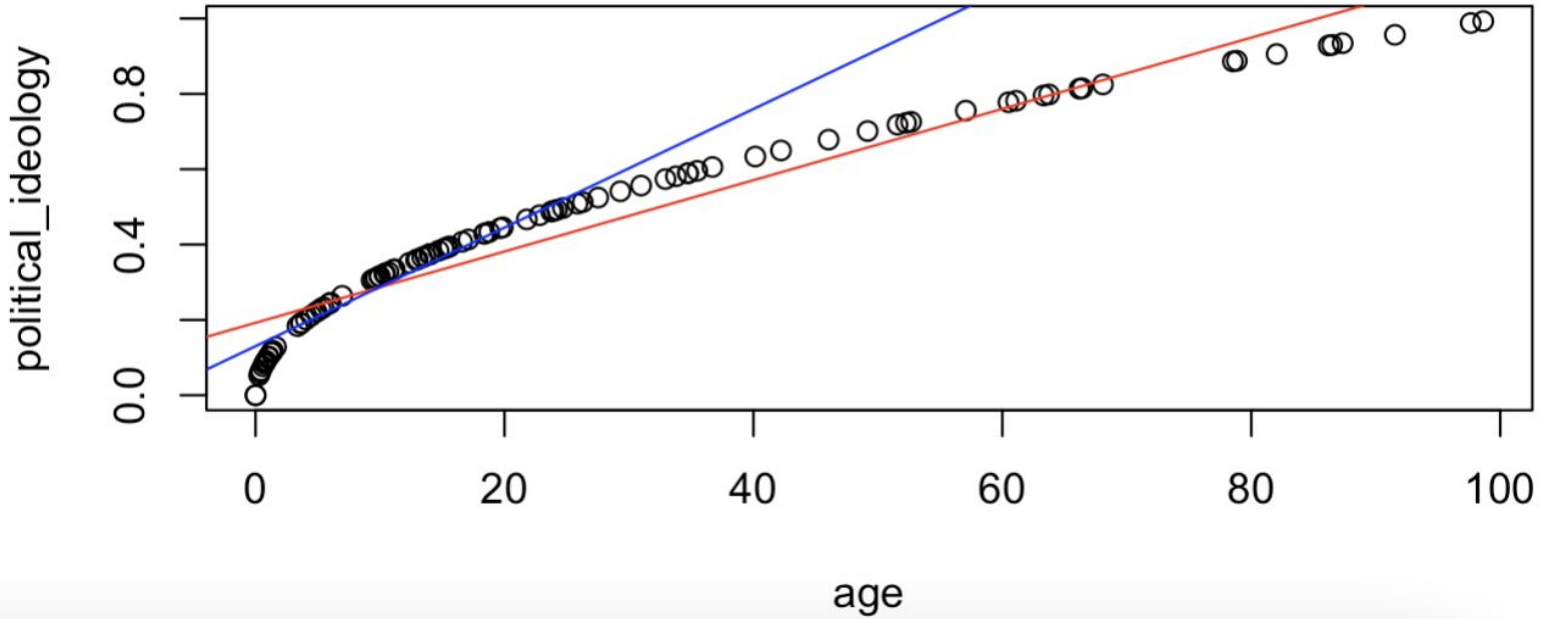
Normal Q-Q Plot



Case 2: Political Opinion and Age are related





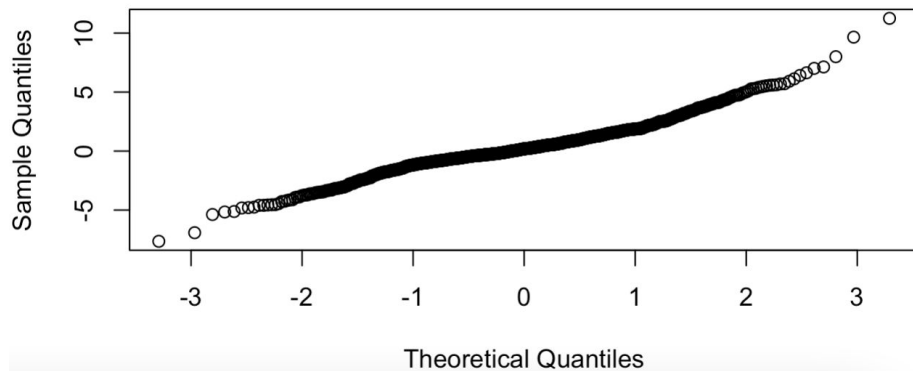
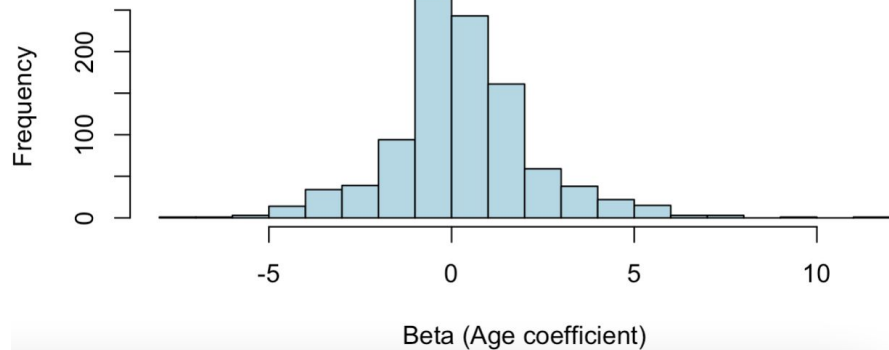




But how does these two lines relate to each other? How good is our prediction?

Central Limit Theorem! Bam! Holds regardless of the population distribution.

Distribution of Beta from Linear Regression





Thank you!