- Our system of equations of interest are the least squares normal equations:

$$\underbrace{(X^TX)}\, b^\circ = \underbrace{X^Ty}$$

$$A \cdot b = r$$

- For a generalized inverse $(X^TX)^-$ of X^TX;

$$b^\circ = (X^TX)^- X^Ty \quad \text{is a solution}$$

- (1) Generalized inverse $(X^TX)^-$ is not unique
- (2) For any given $(X^TX)^-$; there can be an infinite number of solutions for the least squares normal equation

$$\tilde{b} = (X^TX)^- X^Ty + \left[\left((X^TX)^- X^TX - I\right) z\right]$$

for any vector z

$$(X^TX)\tilde{b} = (X^TX)\cdot(X^TX)^- X^Ty + \left[\underbrace{(X^TX)(X^TX)^-(X^TX)} - (X^TX)\right]\cdot z$$

$$\left[\cancel{X^TX} \quad - \cancel{X^TX}\right]\cdot z$$