BLUE of β and BLUP of u have the following properties:

- Linear function of y
- Unbiased $\Rightarrow E[\hat{\beta}] = E[\beta]$; $E[\hat{u}] = E[u]$
- Best: $\underbrace{var(\beta - \hat{\beta})}$ and $var(u - \hat{u})$ minimal

  ↳ $var(\beta - \hat{\beta}) = var(\beta) + var(\hat{\beta}) - 2cov(\beta, \hat{\beta}) = var(\hat{\beta})$

β is fix $\Rightarrow var(\beta) = 0$
$cov(\beta, \hat{\beta}) = 0$

with $\hat{\beta} = \underbrace{(X^T X)^{-1} X^T y}$ → linear y^1
quadratic $y^T y$
y^n

$$var(\hat{\beta}) = var\left[(X^T X)^{-1} X^T y\right]$$

$$= (X^T X)^{-1} X^T \underbrace{var(y)}_{I \cdot \sigma^2} \left[(X^T X)^{-1} X^T\right]^T = (X^T X)^{-1} X^T V X (X^T X)^{-1}$$

$$= (X^T X)^{-1} \sigma^2$$