N | $\bar{y}_2$ | $\bar{y}_N$

Goal: Predict $\hat{u}_i$ based on $\bar{y}_i$

$$\hat{u}_i = b(\bar{y}_i - \mu)$$

$$b = \frac{\text{cov}(u, \bar{y}_i)}{\text{var}(\bar{y})}$$

- What is $\bar{y}_i$? $\bar{y}_i = \frac{1}{n}\sum_{k=1}^{n} y_{ik}$
- Use $y_{ik} = \mu + u_k + e_k$

$$= \mu + \underbrace{\tfrac{1}{2}u_i + \tfrac{1}{2}u_{dk} + m_k}_{u_k} + e_k$$

$$\bar{y}_i = \frac{1}{n}\sum_{k=1}^{n}\left(\mu + \tfrac{1}{2}u_i + \tfrac{1}{2}u_{dk} + m_k + e_k\right)$$

$$\mu + \tfrac{1}{2}u_i + \frac{1}{2n}\sum_{k=1}^{n} u_{dk} + \frac{1}{n}\sum_{k=1}^{n} m_k + \frac{1}{n}\sum_{k=1}^{n} e_k \quad (*)$$

$$\text{cov}(u_i, \bar{y}_i) = \text{cov}\left(u_i, \left[\mu + \tfrac{1}{2}u_i + \frac{1}{2n}\sum_{k=1}^{n} u_{dk} + \frac{1}{n}\sum_{k=1}^{n} m_k + \frac{1}{n}\sum_{k=1}^{n} e_k\right]\right)$$