

$$\text{var}\left(\frac{1}{M} \sum_{k=1}^M t_{ik}\right) = \frac{1}{M^2} \text{var}\left(\sum_{k=1}^M t_{ik}\right) \quad (16)$$

$$= \frac{1}{M^2} \text{var}(t_{i1} + t_{i2} + \dots + t_{iM})$$

$$= \frac{1}{M^2} \left\{ \underbrace{\text{var}(t_{i1}) + \text{var}(t_{i2}) + \dots + \text{var}(t_{iM})}_{= \text{var}(t_{ci})} + 2 \text{cov}(\dots) \right\}$$

$$= \frac{1}{M^2} \cdot M \cdot \text{var}(t_{ci}) = \frac{1}{M} \text{var}(t_{ci})$$

$$y_{ik} = \mu + u_i + p_{ci} + t_{ik}$$

$$\begin{aligned} \text{var}(y_{ik}) &= \text{var}(\mu + u_i + p_{ci} + t_{ik}) \\ &= \underbrace{\text{var}(u_i) + \text{var}(p_{ci})}_{\text{permanent}} + \text{var}(t_{ik}) = \sigma_y^2 \end{aligned}$$

$$\text{Repeatability } t = \frac{\text{var}(u_i) + \text{var}(p_{ci})}{\sigma_y^2}$$