

2.

(1) Factors	Rand / Fixed	Nested / Crossed.
gender	Fixed	> Crossed.
group	Fixed.	
runner	Random	Nested in gender and group.

Thus, we use 2-way Complete Model

$$Y_{ijt} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijt}, \quad \varepsilon_{ijt} \sim N(0, \sigma^2)$$

Y_{ijt} = the difference between before and after race times.

gender is factor A at $a = 2$ levels.

group is factor B at $b = 3$ levels (endurance, strength, cross)

$r = 5$ people (experiment units) assigned at random to each group combination

$i = 1, \dots, a \quad j = 1, \dots, b \quad t = 1, \dots, r$

(2) Factors	Rand / Fixed	Nested / Crossed.
Major	Fixed	> Student is nested in Major
Student	Random	
Day	Random	> Day is nested in Student

Thus, we use 2-way Nested Model:

$$Y_{ijt} = \mu + \alpha_i + \beta_{ji} + \varepsilon_{ijt}, \quad \varepsilon_{ijt} \sim N(0, \sigma^2)$$

Y_{ijt} = studying time of t^{th} day of student j in major i .

Major is factor A at $a = 2$ levels (Statistics, Humanities)

Student is factor B at $b = 3$ levels

$r = 3$ days (experiment units) assigned at random to each student combination

$i = 1, \dots, a \quad j = 1, \dots, b \quad t = 1, \dots, r$

(C) Factor	Rand/Fixed	Nested/Crossed.
machine	Fixed	> heads is nested in machine
heads	Fixed	
glass support	Random	> glass support is nested in heads.

Thus, we use 2-way Nested Model:

$$Y_{ijt} = \mu + \alpha_i + \beta_{ji} + \epsilon_{ijt}, \quad \epsilon_{ijt} \text{ iid } N(0, \sigma^2)$$

Y_{ijt} = the strength of t^{th} glass support of heads i in machine j .

machine is factor A at $a = 5$ levels

heads is factor B at $b = 4$ levels

$r = 4$ glass supports (experiment units) assigned at random to each heads combination.

$$i = 1, \dots, a$$

$$j = 1, \dots, b$$

$$t = 1, \dots, r$$