Reason To use:

- In RCB, we assume there exists an nusicance variable may affect the experiment design. If we cannot control it, then we should block it. But, if there is more than one nusicance variable, then we may want to use Latin Design. A Latin Design can contain two blocking. But the restriction is that the table need to be square. If there are "a" levels for blocking B, then there should be "a" levels for blocking Γ. For each row & column, there should be "a" different treatments. A level should be unique to a row and a column.

to be more precise for a format of Latin Design, a Latin Design will arrange treatment in a square grid. Each row and column will assign these treatment unique.

↳ This could reduce the confounding effect

Question. Would this be fair.

Model:

Note that, in latin design, we can use two script to identity particular cell.

we don't need a script to represent ith unit in a cell because there is only one experiment unit in a cell in latin design.

$$y_{ijk} = \mu_T + \alpha_i + \beta_j + \gamma_k + \varepsilon_{ijk}$$

y_{ijk} := represent the response value of i level of factor A with jth level of Blocking B and kth level of Blocking Γ.

μ_T := grand mean

α_i := the effect of ith level of factor A.

β_j := the blocking effect of jth level of blocking B.

γ_j := the blocking effect of kth level of blocking Γ.

ε_{ijk} := random error where $\varepsilon_{ijk} \overset{iid}{\sim} \text{Normal}(0, \sigma^2)$.

Analysis:

- If one of Blocking effect is not significant, we may turns it into RCB.
- α_j is significant if the effect exist.

ANOVA:

	df	SS	MS
Treatment	$a-1$	SSA	MSA
Row	$a-1$	SSR	MSR
Column	$a-1$	SSC	MSC
Error	$N-3(a-1)-1$	SSE	
Total	$N-1$		

This is because each row or column have no duplicate for a treatment.

$$SSA = a\sum_{i=1}^{a}(\bar{y}_{Ai} - \bar{y}_T)^2$$

$$SSR = a\sum_{j=1}^{a}(\bar{y}_{Bj} - \bar{y}_T)^2$$

$$SSC = a\sum_{k=1}^{a}(\bar{y}_{Tk} - \bar{y}_T)^2$$

$$SSE = SST - SSA - SSR - SSC.$$

$$SST = \sum_{j=1}^{a}\sum_{k=1}^{a}(\bar{y}_{ijk} - \bar{y}_T)^2$$

↖ Reduce a dimension because 2 out of 3 can locate a cell.