A company wish to compare the performance four different tires (A, B, C, and D). There are four cars available for this study. It is believe that tires wearing out in a different rate at different location of a car. Tires are installed in four different locations: Right-Front, Left-Front, Right-Rear and Left-Rear.

Your Tasks: Design the study. You must take into account what type of design you would use, data collection, assignment of tires to cars, and analysis. Latin Square Design (Incomplete Block Design)

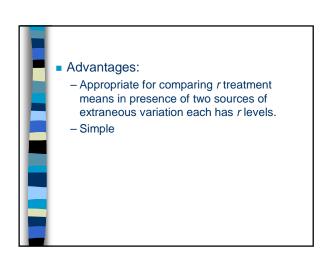
 Suppose in an experiment that we have two blocking factors. If there are r treatment levels and both block factors has r levels, then we would need r³ experimental units.

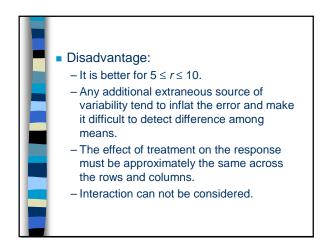
A rx r Latin Square Design will reduce the number experiment units to r². $r \times r$ Latin Square Design

It is a design that contain r rows and r columns. The r treatments are randomly assigned to experimental units within the rows and columns so that each treatment appears in every row and in every column (exactly once).

_		RF	LF	RR	LR
	1	Α	В	С	D
	2	В	С	D	Α
	3	С	D	Α	В
	4	D	Α	В	С
	<u> </u>		_		

- Standard Latin Squares are the squares in which the elements of the first row and the first column are arranged alphabetically.
- Randomization procedure: select a standard square at random and arrange its rows and columns at random.





:	Data	from s	studyi	ng tire	es
			Positio	ns	
		RF	LF	RR	LR
	1	A(32)	B(33)	C(47)	D(53)
Cars	2	B(36)	D(53)	A(42)	C(54)
	3	C(51)	A(44)	D(62)	B(49)
	4	D(81)	C(78)	B(72)	A(73)
				•	

ŀ	Statistical Model $Y_{ij(k)} = \mu + \rho_i + \kappa_j + \tau_k + \varepsilon_{ii(k)}$
	μ : overall mean ρ_i : main effect of the i -th row κ_j : main effect of the j -th column τ_k : main effect of the k -th treatment
	$\varepsilon_{ii(k)} \sim i.i.d \ Normal(0, \sigma^2)$ $\Sigma \ \rho_i = \Sigma \ \kappa_j = \Sigma \ \tau_k = 0$

	Latin S Summa			⁷ A
Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Row	r - 1	SSR	MSR	MSR MSE
Column	r – 1	SSC	MSC	MSC MSE
Treatment	r – 1	SST	MST	MST
Error	(r-1)(r-2)	SSE	MSE	
Total	r² - 1	SS(Total)	Corre SSTot	

	Tests	of Between	-Subjects Effec	ts	
Dependent \	/ariable: TIREW	EAR			
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	49854.500a	10	4985.450	19941.800	.00
CAR	2850.500	3	950.167	3800.667	.00
POSITION	133.500	3	44.500	178.000	.00
TIRE	645.500	3	215.167	860.667	.0
Error	1.500	6	.250		
Total	49856,000	16			

