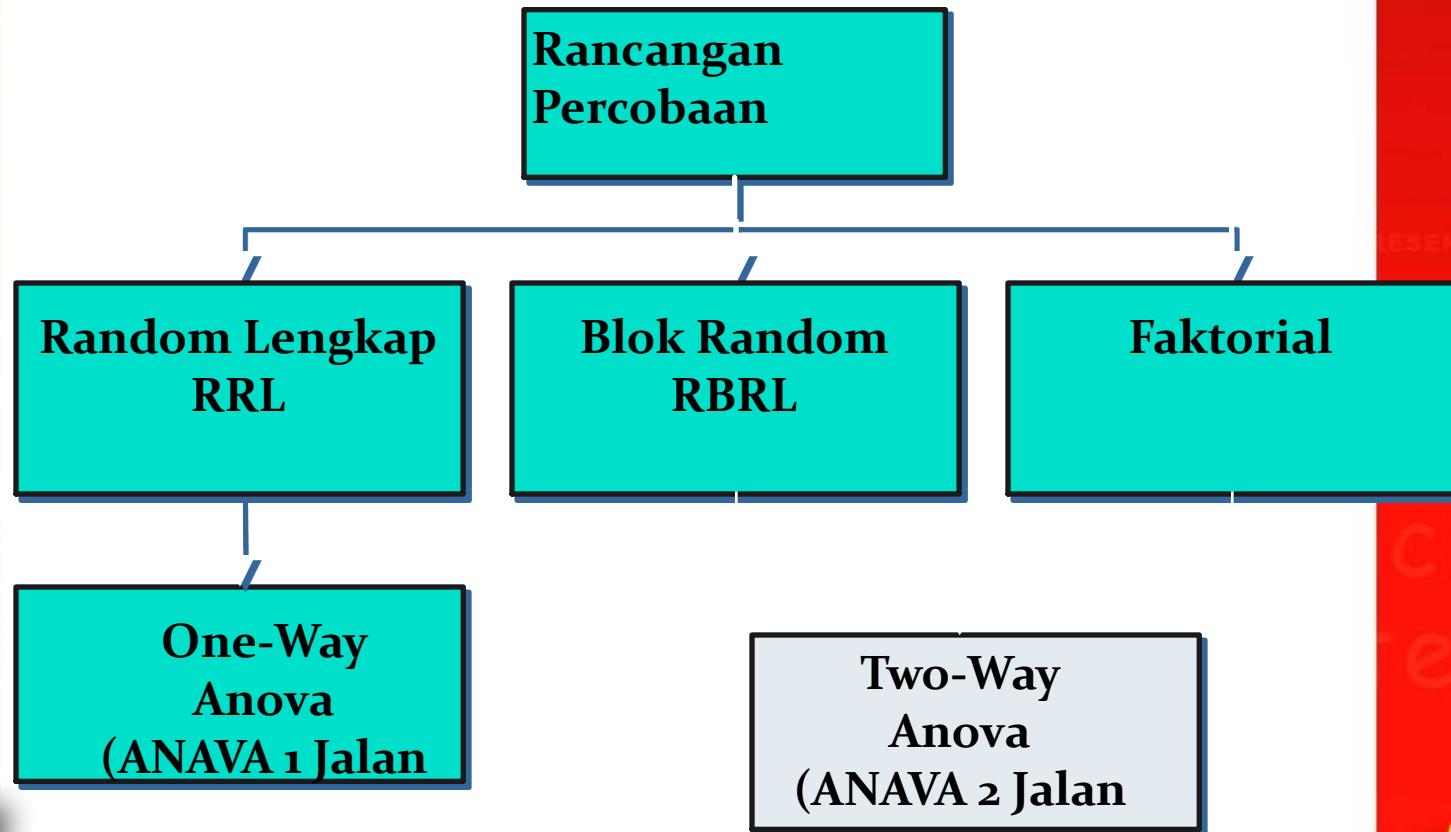


ANAVA 2 Jalan

**Jumlah sampel dalam sel tak
sama**



Types of Regression Models



Review ... Interaction

- Occurs When Effects of One Factor Vary According to Levels of Other Factor
- When Significant, Interpretation of Main Effects (A & B) Is Complicated
- Can Be Detected
 - In Data Table, Pattern of Cell Means in One Row Differs From Another Row
 - In Graph of Cell Means, Lines Cross
- The **interaction** between two factor A and B is the tendency for one factor to behave differently, depending on the particular level setting of the other variable.
- Interaction describes the effect of one factor on the behavior of the other. If there is **no interaction**, the two factors behave **independently**.



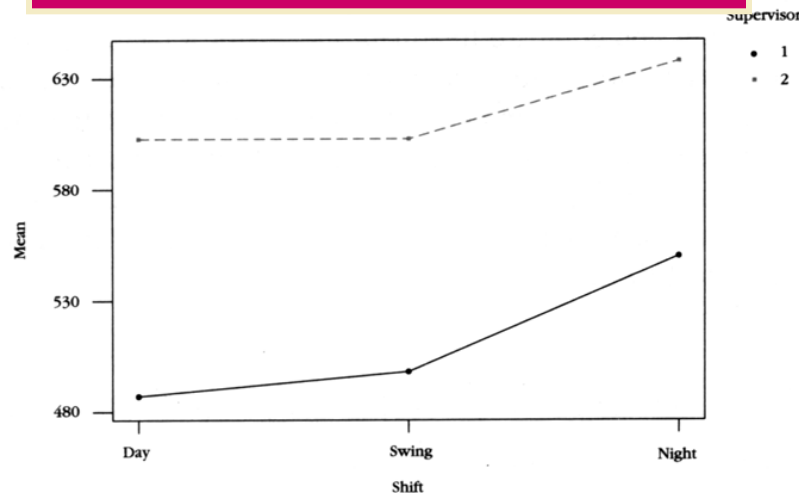
Example



A drug manufacturer has three supervisors who work at each of three

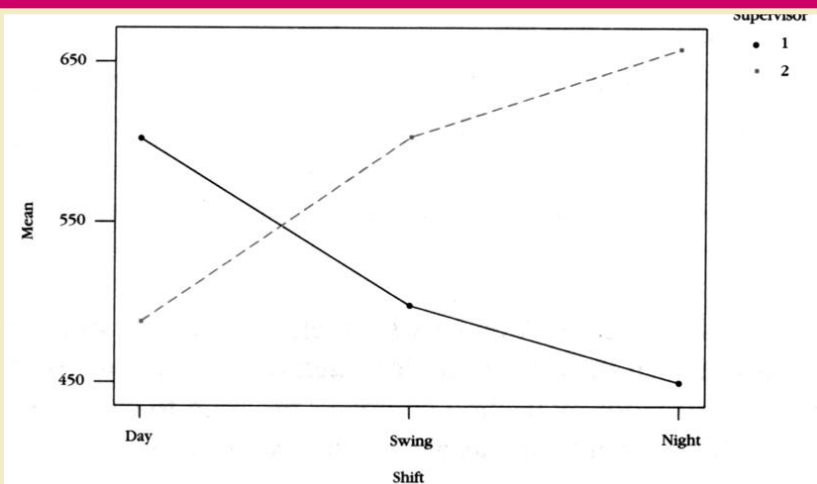
Supervisor 1 always does better than 2, regardless of the shift.

(No Interaction)



Supervisor 1 does better earlier in the day, while supervisor 2 does better at night.

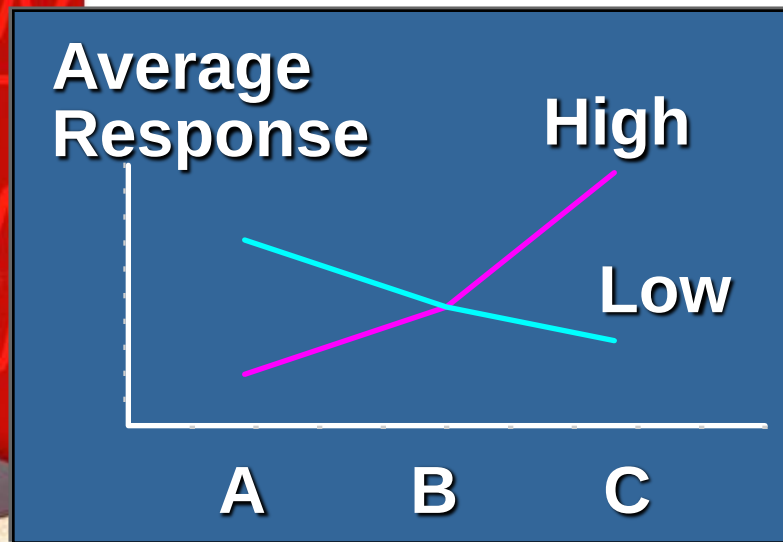
(Interaction)



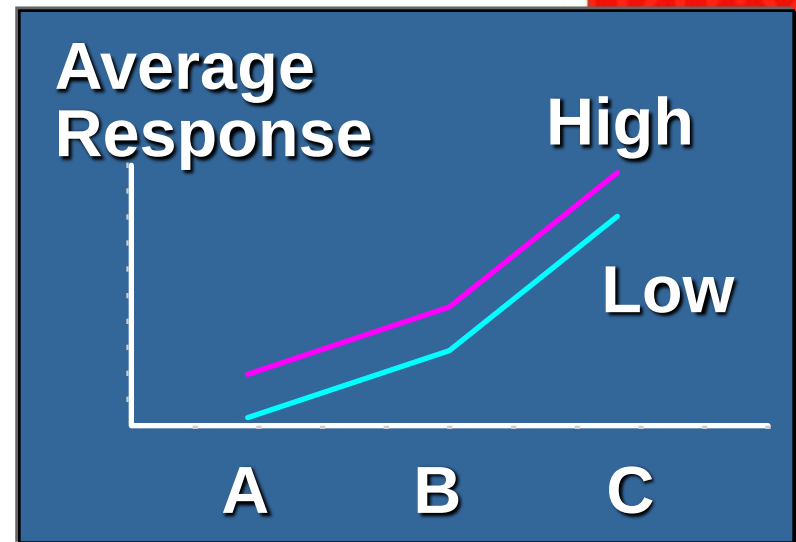
Graphs of Interaction

Effects of Motivation (High or Low) & Training Method (A, B, C) on Mean Learning Time

Interaction



No Interaction



Contoh Kasus

Seorang eksperimenter ingin mengetahui pengaruh 3 material (A) pada 3 tingkat temperatur (B) 15, 70 dan 125 derajat F. Karena tidak setiap faktor diambil replikasi dengan jumlah yang sama maka digunakan rancangan dengan jumlah data pada tiap sel tidak sama. Data seperti Tabel di bawah ini.

Material	<u>Temperatur</u>		
	1	2	3
1	130	34	70
	74	80	58
	155	40	
	180	75	
2	159	136	45
	126	115	
3	138	150	96
	160	139	



Step-step uji Anava 2 jalan tak sama

1. Susun Hipotesis

$$H_{0A} : \tau_1 = \tau_2 = \dots = \tau_a = 0$$

$$H_{1A} : \text{paling tidak ada satu } \tau_i \neq 0$$

$$H_{0B} : \beta_1 = \beta_2 = \dots = \beta_b = 0$$

$$H_{1B} : \text{paling tidak ada satu } \beta_j \neq 0$$

$$H_{0AB} : (\tau\beta)_{ij} = 0, \forall ij$$

$$H_{1AB} : \text{paling tidak ada satu } (\tau\beta)_{ij} \neq 0$$

2. Pilih tingkat signifikansi

3. Susun Tabel ANAVA 2 Jalan



Partisi JKT

$$\begin{aligned}
 & \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^n (y_{ijk} - \bar{y}_{...})^2 \\
 &= \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^n [(\bar{y}_{i..} - \bar{y}_{...}) + (\bar{y}_{.j.} - \bar{y}_{...}) + (\bar{y}_{ij.} - \bar{y}_{i..} - \bar{y}_{.j.} + \bar{y}_{...}) + (y_{ijk} - \bar{y}_{ij.})]^2 \\
 &= \underbrace{bn \sum_{i=1}^a (\bar{y}_{i..} - \bar{y}_{...})^2}_{JK_A} + \underbrace{an \sum_{j=1}^b (\bar{y}_{.j.} - \bar{y}_{...})^2}_{JK_B} + \underbrace{n \sum_{i=1}^a \sum_{j=1}^b (\bar{y}_{ij.} - \bar{y}_{i..} - \bar{y}_{.j.} + \bar{y}_{...})^2}_{JK_{AB}} + \underbrace{\sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^n (y_{ijk} - \bar{y}_{ij.})^2}_{JK_S} \\
 &JK_T = JK_A + JK_B + JK_{AB} + JK_S
 \end{aligned}$$



dengan

$$JK_T = \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^{n_{ij}} y_{ijk}^2 - \frac{y_{\dots}^2}{n_{\dots}}$$

$$JK_A = \sum_{i=1}^a \frac{y_{i\cdot\cdot}^2}{n_{i\cdot}} - \frac{y_{\dots}^2}{n_{\dots}}$$

$$JK_B = \sum_{j=1}^b \frac{y_{\cdot j \cdot}^2}{n_{\cdot j}} - \frac{y_{\dots}^2}{n_{\dots}}$$

$$JK_{\text{Sub total}} = \sum_{i=1}^a \sum_{j=1}^b \frac{y_{ij\cdot}^2}{n_{ij}} - \frac{y_{\dots}^2}{n_{\dots}}$$

$$JK_{AB} = JK_{\text{Sub total}} - JK_A - JK_B$$

$$JK_S = JK_T - JK_{AB} - JK_A - JK_B$$



Tabel ANAVA ukuran sampel tidak sama

SV	db	JK	RK	F
A	a-1	JKA	$RKA = JKA / dbA$	FA
B	b-1	JKB	$RKB = JKB / dbB$	FB
AB	(a-1)(b-1)	JK(AB)	$RK(AB) = JK(AB) / db(AB)$	FAB
Sesatan	ab(n-1)	JKS	$RKS = JKS / db(S)$	
Total	abn-1	JKT		



Kembali ke contoh ...

Material	1	2	3	
1	130 74 155 180 $n_{11}=4$	34 80 40 75 $n_{12}=4$	70 58 $n_{13}=2$	$y_{1\cdot}=896$ $n_{1\cdot}=10$
2	159 126 $n_{21}=2$	136 115 $n_{22}=2$	45 $n_{23}=1$	$y_{2\cdot}=581$ $n_{2\cdot}=5$
3	138 160 $n_{31}=2$	150 139 $n_{32}=2$	96 $n_{33}=1$	$y_{3\cdot}=683$ $n_{3\cdot}=5$
$y_{\cdot j}$	1122 $n_{\cdot 1}=8$	769 $n_{\cdot 2}=8$	269 $n_{\cdot 3}=4$	$y_{\cdot\cdot}=2160$ $n_{\cdot\cdot}=20$

$$JK_T = \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^{n_{ij}} y_{ijk}^2 - \frac{y_{\cdot\cdot}^2}{n_{\cdot\cdot}} = 130^2 + \dots + 96^2 - \frac{2160^2}{20} = 39150$$

$$JK_A = \sum_{i=1}^a \frac{y_{i\cdot}^2}{n_{i\cdot}} - \frac{y_{\cdot\cdot}^2}{n_{\cdot\cdot}} = \frac{896^2}{10} + \frac{581^2}{5} + \frac{683^2}{5} - \frac{2160^2}{20} = 7811.6$$

$$JK_B = \sum_{j=1}^b \frac{y_{\cdot j}^2}{n_{\cdot j}} - \frac{y_{\cdot\cdot}^2}{n_{\cdot\cdot}} = \frac{1122^2}{8} + \frac{769^2}{8} + \frac{269^2}{4} - \frac{2160^2}{20} = 8045.44$$

Material	1	2	3
1	130	34	70
	74	80	58
	155	40	
	180	75	
	$y_{11}=539$	$y_{12}=229$	$y_{13}=128$
2	159	136	45
	126	115	
	$y_{21}=285$	$y_{22}=251$	$y_{23}=45$
3	138	150	96
	160	139	
	$y_{31}=298$	$y_{32}=289$	$y_{33}=96$

$$JK_{\text{Subtotal}} = \sum_{i=1}^a \sum_{j=1}^b \frac{539^2}{4} + \frac{229^2}{4} + \dots + \frac{96^2}{1} - \frac{2160}{20} = 30169$$

$$JK_{AB} = JK_{\text{Subtotal}} - JK_A - JK_B = 30169 - 7811.6 - 16090.88 = 6266.525$$

$$JK_S = JK_T - JK_{AB} - JK_A - JK_B = 8980.995$$



Tabel ANAVA

SV	db	JK	RK	F	<u>Ftabel</u>	<u>Kesimpulan</u>
A	2	7811.6	3905.8	4.783857	$F_{0.05,2,11}=3.98$	<u>Ditolak</u>
B	2	16090.88	8045.44	9.854124	$F_{0.05,2,11}=3.98$	<u>Ditolak</u>
AB	4	6266.525	1566.631	1.918823	$F_{0.05,4,11}=3.36$	<u>Diterima</u>
SESATAN	11	8980.995	816.4541			
TOTAL	19	39150				

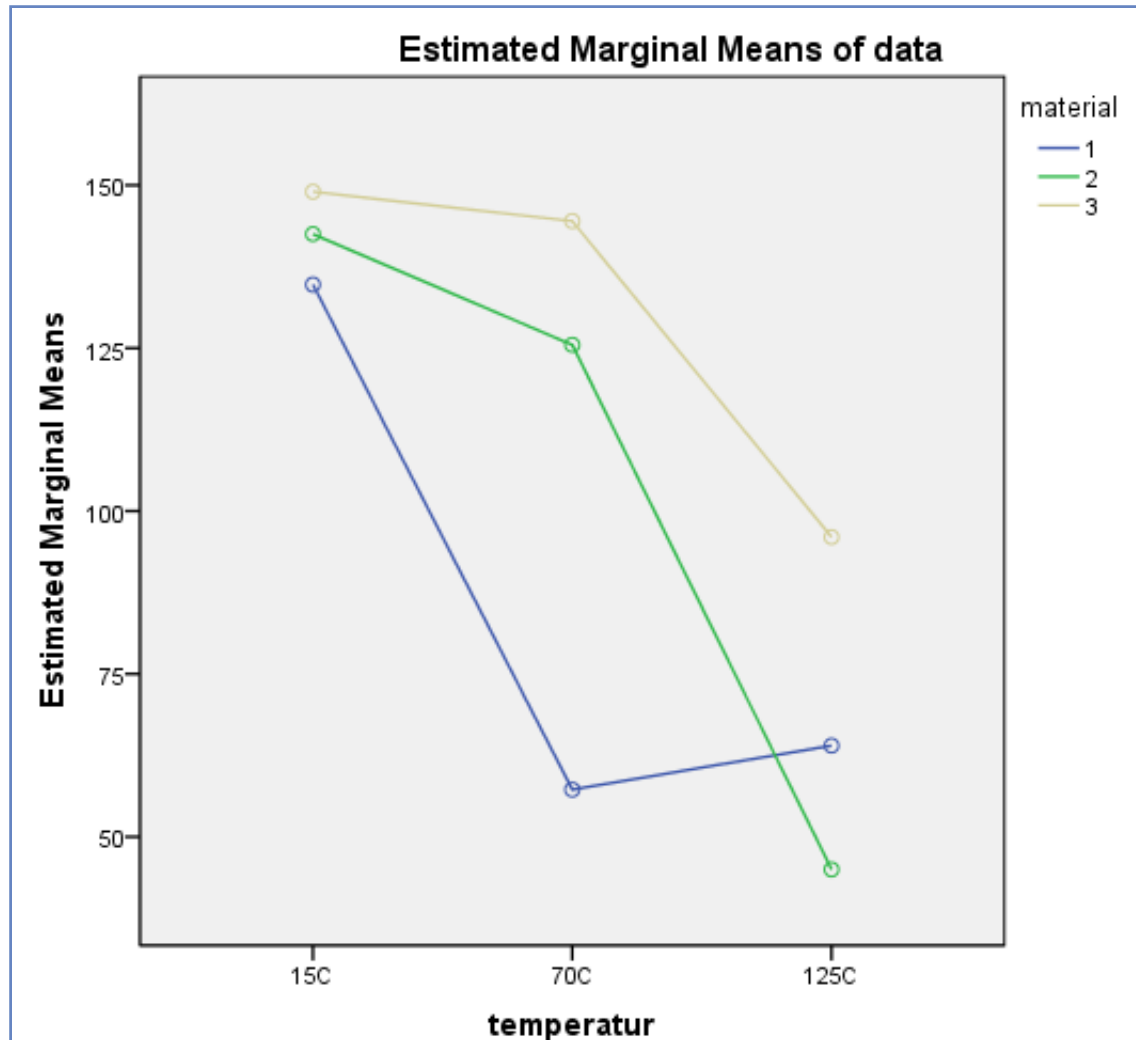
Ada pengaruh faktor A (material) terhadap daya hidup baterai

Ada pengaruh faktor B (temperatur) terhadap daya hidup baterai

Tidak ada ketergantungan pengaruh faktor A (material) dan B terhadap daya hidup baterai



plot



Metode Scheffe

Anava 2 jalan



- Uji Scheffe dikembangkan oleh Henry Scheffe (1959)
- Digunakan untuk pembandingan yang tidak perlu ortogonal
- Dapat digunakan untuk sampel sama atau tidak sama



Kontras Ortoghonal

Hipotesis

$$H_{01} : \mu_4 = \mu_5$$

$$H_{02} : \mu_1 + \mu_3 = \mu_4 + \mu_5$$

Contras

$$C_1 = -y_{4\bullet} + y_{5\bullet}$$

$$C_2 = y_{1\bullet} + y_{3\bullet} - y_{4\bullet} - y_{5\bullet}$$



STEP-STEP UJI SCHEFFE

1. Susun Hipotesis
2. Pilih tingkat signifikansi

3. Hitung F

$$F = \frac{(\bar{X}_i - \bar{X}_j)^2}{RK_s \left(\frac{1}{n_i} + \frac{1}{n_j} \right)}$$

4. Tarik Kesimpulan

DK. Tolah H_0 jika $F > (ab-1)F(\alpha, b-1, N-ab)$



Contoh 2

Seorang eksperimenter ingin mengetahui pengaruh antara model pembelajaran (konvensional dengan LC5E), aktivitas (Tinggi, Sedang dan Rendah) terhadap prestasi belajar mereka. Tabel data di bawah ini.

		AKTIVITAS belajar matematika SISWA (B)											
		Tinggi (b ₁)				Sedang (b ₂)				Rendah (b ₃)			
Model Pembelajaran (A)	LC5E (a ₁)	100	96	96	88	96	92	88	88	76	72	72	68
		88	84	72		88	84	80	80	68	64	64	60
						76	76	76	76	60	60		
						76							
Model Pembelajaran (A)	Konvensional (a ₂)	92	88	88	84	84	84	80	80	84	76	76	64
		80	80	76		80	76	72	72	68	68	64	64
						72	72	68	68	56			
						68	68	68	62				

Step-step uji Anava 2 jalan tak sama

1. Susun Hipotesis

$$H_{0A} : \tau_1 = \tau_2 = \dots = \tau_a = 0$$

$$H_{1A} : \text{paling tidak ada satu } \tau_i \neq 0$$

$$H_{0B} : \beta_1 = \beta_2 = \dots = \beta_b = 0$$

$$H_{1B} : \text{paling tidak ada satu } \beta_j \neq 0$$

$$H_{0AB} : (\tau\beta)_{ij} = 0, \forall ij$$

$$H_{1AB} : \text{paling tidak ada satu } (\tau\beta)_{ij} \neq 0$$

2. Pilih tingkat signifikansi $= \alpha$

3. Susun Tabel ANAVA 2 Jalan



Dengan cara yang sama diperoleh

<u>Sumber Variansi</u>	JK	DK	RK	F_{obs}	F_{tab}	<u>Keputusan uji</u>
A (Model)	228,15	1	228,15	4,52	4,02	H_{0A} ditolak
B (Aktivitas)	3389,90	2	1694,95	33,61	3,17	H_{0B} ditolak
AB	341,89	2	170,94	3,39	3,17	H_{0AB} ditolak
<u>Sesatan</u>	2824,20	56	50,43	-	-	-
Total	6784,15	61	-	-	-	-

- Model pembelajaran berpengaruh terhadap prestasi
→ Tidak perlu uji komparasi ganda,
→ Karena hanya 2 tingkat ; model konvensional & LC5E
- Aktivitas dan interaksi berpengaruh signifikan terhadap prestasi
→ Dapat dilakukan uji komparasi ganda



Uji Komparasi Scheffe...

1. Hipotesis :

$$H_{0.11-21} : \mu_{11} = \mu_{21}$$

$$H_{0.12-22} : \mu_{12} = \mu_{22}$$

$$H_{0.13-23} : \mu_{13} = \mu_{23}$$

$$H_{0.11-12} : \mu_{11} = \mu_{12}$$

$$H_{0.11-13} : \mu_{11} = \mu_{13}$$

$$H_{0.12-13} : \mu_{12} = \mu_{13}$$

$$H_{0.21-22} : \mu_{21} = \mu_{22}$$

$$H_{0.21-23} : \mu_{21} = \mu_{23}$$

$$H_{0.22-23} : \mu_{22} = \mu_{23}$$

2. Dipilih $\alpha=5\%$



	T	S	R
LC5E	89.1429 (7)	82.76923 (13)	66.4 (10)
KONV	84 (7)	73.375 (16)	68.88889 (9)

Misal akan diuji $H_{0.11-21} : \mu_{11} = \mu_{21}$

3. Hitung
$$F_{11-21} = \frac{(89.1429 - 84)^2}{50.43 \left(\frac{1}{7} + \frac{1}{7} \right)} = 1.835644$$

4. Tarik kesimpulan

$$F_{\text{tabel}} = F_{0.05, 3-1, 62-6} = F_{0.05, 2, 56}$$

Karena $F = 1.835644 < 5 \times 3.16$ maka $H_{0.11-21}$ diterima, artinya siswa dengan aktivitas tinggi baik dengan LC5E maupun konvensional mempunyai rerata prestasi belajar yang relatif sama

Contoh Kasus

Seorang peneliti tertarik untuk mengetahui pengaruh faktor ukuran Kelas (Besar dan Kecil) dengan faktor jam mengajar (Pagi, Siang dan Sore) terhadap prestasi anak didiknya. Ukuran kelas dianggap besar jika lebih dari 40 siswa. Adapun prestasi siswa diukur dalam skala 10.

A/B	<u>Pagi</u>	Siang	Sore
<u>Besar</u>	10	5	7
	5	3	6
	6	4	5
	7	6	6
		6	6
		5	
Kecil	9	7	8
	8	8	7
	10	7	10
	8	8	8
	7		



Tests of Between-Subjects Effects

Dependent Variable: prestasi

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	1366.217 ^a	6	227.703	148.282	.000
ukuran	30.304	1	30.304	19.734	.000
waktu	11.145	2	5.572	3.629	.043
ukuran * waktu	1.907	2	.953	.621	.547
Error	33.783	22	1.536		
Total	1400.000	28			

a. R Squared = .976 (Adjusted R Squared = .969)

Estimated Marginal Means of prestasi

