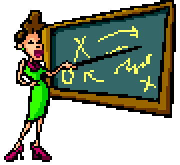
Bab 1

Perbandingan Ganda Untuk ANAVA 1 Jalan

Komparasi Ganda

- Analisis variansi hanya menentukan ada yang beda, tetapi tidak diketahui mana saja yang beda.
- Cara untuk mengetahuinya dilakukan melalui komparasi ganda
- Pada μ_1, μ_2, μ_3 misalnya, komparasi ganda memeriksa semua pasangan $\mu_1 - \mu_2$ $\mu_1 - \mu$ $\mu_2 - \mu_3$



Metoda Komparasi Ganda

Ada beberapa metoda komparansi ganda, berupa

- Uji LSD (least significant difference) Fisher
- Uji Scheffe
- Uji HSD (honestly significant difference) Tukey
- Uji Duncan
- Uji Newman-Keuls
- Uji Tukey

Hasilnya bisa berbeda.

Uji Scheffe <u>paling konservatif</u>.

Kontras

Kontras merupakan kombinasi linier parameter dengan bentuk :

$$\Gamma = \sum_{i=1}^{a} c_i \mu_i$$

Dimana kontras konstan $\sum_{i=1}^{a} c_i = 0$

Hipotesis yang disusun :

$$H_0 : \sum_{i=1}^{a} c_i \mu_i = 0$$

$$H_1 : \sum_{i=1}^{a} c_i \mu_i \neq 0$$

Scheffe untuk membandingkan semua kontras Montgomery (2001:108)

Misalkan ada sekumpulan m kontras

$$\Gamma_u = c_{1u}\mu_1 + c_{2u}\mu_2 + \cdots + c_{au}\mu_a, \quad u = 1,2,\ldots,m$$

maka rata-rata perlakuan $\bar{y}_{i\bullet}$ adalah :

$$C_u = c_{1u}\bar{y}_{1\bullet} + c_{2u}\bar{y}_{2\bullet} + \cdots + c_{au}\bar{y}_{a\bullet}, \quad u = 1,2,\ldots,m$$

dan sesatan baku dari kontras adalah :

$$S_{C_u} = \sqrt{RK_S \sum_{i=1}^{a} \left(c_{iu}^2 / n_i\right)}$$

dimana n_i adalah jumlah observasi dalam perlakuan ke - i

Jika $|C_u| > S_{\alpha,u}$ maka tolak $H_0 : \Gamma_u = 0$

dengan

$$S_{\alpha,u} = S_{C_u}\sqrt{(a-1)F_{\alpha,a-1,N-a}}$$

i=1	i=2	i=3	
25.4	23.4	20	
26.31	21.8	22.2	
24.1	23.5	19.75	
23.74	22.75	20.6	
25.1	21.6	20.4	
$y_{1\bullet}$ =124.65	$y_{2\bullet}$ =113.05	$y_{3\bullet}$ 102.95	$y_{\bullet\bullet}$ =340.65
$\bar{y}_{1\bullet}$ =24.93	$\bar{y}_{2\bullet}$ = 22.61	$\bar{y}_{3\bullet}$ 20.59	
C_1=2.32	C_2 =2.02	C_3 =4.34	

$$H_{0_{1-2}} : \mu_1 = \mu_2 \Rightarrow \Gamma_1 = \mu_1 - \mu_2, \quad C_1 = \bar{y}_{1\bullet} - \bar{y}_{2\bullet} = 2.32$$

$$H_{1_{1-2}} : \mu_1 \neq \mu_2$$

$$H_{0_{2-3}} : \mu_2 = \mu_3 \Rightarrow \Gamma_2 = \mu_2 - \mu_3, \quad C_2 = \bar{y}_{2\bullet} - \bar{y}_{3\bullet} = 2.02$$

$$H_{1_{2-3}} : \mu_2 \neq \mu_3$$

$$H_{0_{1-3}} : \mu_1 = \mu_3 \Rightarrow \Gamma_3 = \mu_1 - \mu_3, \quad C_3 = \bar{y}_{1\bullet} - \bar{y}_{3\bullet} = 4.34$$

$$H_{1_{1-3}} : \mu_1 \neq \mu_3$$

$$RK_S = 0.921 \text{ dengan } S_{C_u} = \sqrt{RK_S \sum_{i=1}^{a} \left(C_{i1}^2 / n_i \right)}$$

$$S_{C_1} = \sqrt{0.921(1+1)/5} = 0.60696 = S_{C_2} = S_{C_3}$$

$$S_{\alpha,u} = S_{C_u} \sqrt{(a-1) F_{\alpha,a-1,N-a}}$$

$$S_{0.05,1} = S_{C_1} \sqrt{(3-1) F_{0.05,3-1,15-3}}$$

$$= S_{C_1} \sqrt{2 F_{0.05,2,12}} = 0.60696 \sqrt{2 \, x 3.89} = 1.692972$$

$$S_{0.05,1} = S_{0.05,2} = S_{0.05,3} = 1.692972$$

karena $\left|C_1\right| = 2.32, \quad \left|C_2\right| = 2.02, \quad \left|C_3\right| = 4.34$

dan $S_{0.05,1} = S_{0.05,2} = S_{0.05,3} = 1.692971$

1. Karena $2.32 > 1.692972$ maka tolak $\mu_1 - \mu_2 = 0$ artinya $\mu_1 \neq \mu_2$
2. Karena $2.02 > 1.692972$ maka tolak $\mu_2 - \mu_3 = 0$ artinya $\mu_2 \neq \mu_3$
3. Karena $4.34 > 1.692972$ maka tolak $\mu_1 - \mu_3 = 0$ artinya $\mu_1 \neq \mu_3$

Rata-rata waktu pengisian mesin 1 dan 2 berbeda signifikan
Rata-rata waktu pengisian mesin 2 dan 3 berbeda signifikan
Rata-rata waktu pengisian mesin 1 dan 3 berbeda signifikan

Dengan spss….cont

Multiple Comparisons

Dependent Variable:waktu

	(I) mesin	(J) mesin	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Scheffe	mesin 1	mesin 2	2.320*	.607	.008	.63	4.01
		mesin 3	4.340*	.607	.000	2.65	6.03
	mesin 2	mesin 1	-2.320*	.607	.008	-4.01	-.63
		mesin 3	2.020*	.607	.020	.33	3.71
	mesin 3	mesin 1	-4.340*	.607	.000	-6.03	-2.65
		mesin 2	-2.020*	.607	.020	-3.71	-.33
LSD	mesin 1	mesin 2	2.320*	.607	.002	1.00	3.64
		mesin 3	4.340*	.607	.000	3.02	5.66
	mesin 2	mesin 1	-2.320*	.607	.002	-3.64	-1.00
		mesin 3	2.020*	.607	.006	.70	3.34
	mesin 3	mesin 1	-4.340*	.607	.000	-5.66	-3.02
		mesin 2	-2.020*	.607	.006	-3.34	-.70

*. The mean difference is significant at the 0.05 level.

Metode Fisher Least Significant Difference (LSD)

→ **Untuk menguji** $H_0 : \mu_i = \mu_j$

$$t_0 = \frac{\bar{y}_{i\bullet} - \bar{y}_{j\bullet}}{\sqrt{RK_S\left(\frac{1}{n_i} + \frac{1}{n_j}\right)}}$$

$$\text{tolak H}_0 \text{ jika } \left|\bar{y}_{i\bullet} - \bar{y}_{j\bullet}\right| > t_{\alpha/2, N-a}\sqrt{RK_S\left(\frac{1}{n_i} + \frac{1}{n_j}\right)} = \text{LSD}$$

$$\text{jika } n_1 = n_2 = \ldots = n_a = n \text{ maka LSD} = t_{\alpha/2, N-a}\sqrt{\frac{2RK_S}{n}}$$

$$\text{Jika } \left|\bar{y}_{i\bullet} - \bar{y}_{j\bullet}\right| > \text{LSD maka tolak H}_0$$

i=1	i=2	i=3	
25.4	23.4	20	
26.31	21.8	22.2	
24.1	23.5	19.75	
23.74	22.75	20.6	
25.1	21.6	20.4	
$y_{1\bullet}$ =124.65	$y_{2\bullet}$ =113.05	$y_{3\bullet}$ 102.95	$y_{\bullet\bullet}$ =340.65
$\bar{y}_{1\bullet}$ =24.93	$\bar{y}_{2\bullet}$ = 22.61	$\bar{y}_{3\bullet}$ 20.59	
C_1=2.32	C_2 =2.02	C_3 =4.34	

$$\bar{y}_{1\bullet} - \bar{y}_{2\bullet} = 2.32$$
$$\bar{y}_{2\bullet} - \bar{y}_{3\bullet} = 2.02$$
$$\bar{y}_{1\bullet} - \bar{y}_{3\bullet} = 4.34$$

$$\text{LSD} = t_{\alpha/2, N-a}\sqrt{\frac{2RK_S}{n}} = t_{0.05/2,12} = t_{0.025,12} = 2.179\sqrt{\frac{2x0.921}{5}}$$

Jika $\left|\bar{y}_{i\bullet} - \bar{y}_{j\bullet}\right| > \text{LSD}$ maka tolak H_0

1. Karena $|2.32| > \text{LSD} = 1.322565$ maka $H_{01\text{-}2}$ ditolak
2. Karena $|2.02| > \text{LSD} = 1.322565$ maka $H_{02\text{-}3}$ ditolak
3. Karena $|4.34| > \text{LSD} = 1.322565$ maka $H_{01\text{-}3}$ ditolak

Note : t 0.25