

UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua

Sidang 1989/90

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MKT261 - Kaedah Statistik Gunaan

Masa: [3 jam]

Jawab soalan 1 dan EMPAT soalan yang lain. Semua soalan mesti dijawab dalam Bahasa Malaysia. Satu set lampiran dikepilkan.

1. (a) Sebuah kertas dalam majalah Journal of Nervous and Mental Disorders, 1968, Jilid 146, pp. 136 - 146 melaporkan amaun dadah dextroamphetamine dibuangkan oleh suatu sampel kanak-kanak dengan penyakit yang berdasarkan organik dan suatu sampel kanak-kanak dengan penyakit yang bukan berdasarkan organik.

Output daripada prosedur T-TEST ditunjukkan di bawah. Group 1 terdiri daripada kanak-kanak dengan penyakit yang berdasarkan organik dan Group 2 terdiri daripada kanak-kanak dengan penyakit yang bukan berdasarkan organik.

Huraikan kesimpulan anda.

Independent samples of DISORDER type of disorder  
 Group 1: DISORDER EQ 1                      Group 2: DISORDER EQ 2  
 t-test for: DRUG percentage of dextroamphetamine

	Number of Cases	Mean	Standard Deviation	Standard Error
Group 1	5	22.3560	5.351	2.393
Group 2	5	13.7820	1.341	.600

F Value	2-Tail Prob.	Pooled Variance Estimate			Separate Variance Estimate		
		t Value	Degrees of Freedom	2-Tail Prob.	t Value	Degrees of Freedom	2-Tail Prob.
15.91	.020	3.48	8	.008	3.48	4.50	.021

(20/100)  
 .../2

- (b) Suatu eksperimen pertanian dijalankan untuk mengkaji kekesanan empat jenis baja (iaitu A,B,C dan D) pada hasil daripada ubi kentang. Sebuah ladang digunakan untuk eksperimen ini. Ladang itu dibahagi kepada 20 plot yang sama. Penyelidik mensyaki pengaliran tanah berubah dalam arah utara-selatan, maka 20 plot itu sebenarnya dibahagi kepada lima blok, setiap blok terdiri daripada suatu baris dengan empat plot yang sehalu dengan arah timur-barat.

Data dikutip diproses dengan menggunakan prosedur SPSS, ANOVA dengan OPTION 3.

Output daripada prosedur ini ditunjukkan di bawah:

ANALYSIS OF VARIANCE

Source of Variation	HASIL		Hasil ubi kentang				
	BY	BLOK	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects			431.800	7	61.686	43.037	.000
BLOK			38.000	4	9.500	6.628	.005
BAJA			393.800	3	131.267	91.581	.000
Explained			431.800	7	61.686	43.037	.000
Residual			17.200	12	1.433		
Total			449.000	19	23.632		

Berikan kesimpulan-kesimpulan anda untuk eksperimen ini. Gunakan  $\alpha = .05$ .

(20/100)

- (c) Kertas "The Significance of the Coat in Heat Tolerance of Cattle," Australian Journal of Agriculture Research, 1959, pp. 744-748, melaporkan suatu eksperimen yang mengkaji tolerensi haba dari lembu-lembu. Sukatan suhu badan dibuat pada empat masa berbeza (Faktor A) pada dua jenis lembu berbeza (Faktor B) yang mempunyai empat jenis kulit berbeza (Faktor C). Tiga cerapan dikutip bagi setiap gabungan rawatan di dalam eksperimen itu.

.../3

Data daripada eksperimen ini diproses melalui prosedur SPSS, ANOVA dan output yang didapati ditunjukkan di bawah:

ANALISIS OF VARIANCE

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
BY SUHU suhu badan lembu - 100 darjah F					
MASA					
JENIS jenis lembu					
KULIT jenis kulit lembu					
Main effects	55.906	7	7.987	85.190	.000
MASA	.281	3	.094	1.000	.399
JENIS	12.760	1	12.760	136.111	.000
KULIT	42.865	3	14.288	152.407	.000
2-way					
Interactions	3.406	15	.227	2.422	.007
MASA JENIS	.115	3	.038	.407	.748
MASA KULIT	1.094	9	.122	1.296	.257
JENIS KULIT	2.198	3	.733	7.815	.000
3-way					
Interactions	.427	9	.047	.506	.865
MASA JENIS KULIT	.427	9	.047	.506	.865
Explained	59.740	31	1.927	20.556	0.0
Residual	6.000	64	.094		
Total	65.740	95	.692		

Berikan kesimpulan-kesimpulan anda. Gunakan  $\alpha = .05$ .

(20/100)

- (d) Setiap orang di dalam suatu sampel rawak pelajar-pelajar sekolah menengah dan maktab dikelaskan terhadap kedua-dua pembolehubah pendapat politik dan penggunaan ganja ("Attitudes About Marijuana and Political Views", Psychological Reports, 1973, pp. 1051 - 1054).

.../4

Proses SPSS, CROSSTABS digunakan untuk memproses data diperoleh. Output didapati diberikan di bawah:

Crosstabulation: By PENDAPAT pendapat politik  
GUNA paras penggunaan ganja

GUNA→	Count	tak pernah 1	jarang 2	kerapkali 3	Row Total
PENDAPAT					771
Liberal	1	479	173	119	57.2
Konser- vatif	2	214	47	15	276 20.5
Lain	3	172	45	85	302 22.4
Column Total		865 64.1	265 19.6	219 16.2	1349 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F. < 5
64.65417	4	.0000	44.807	None

Berikan kesimpulan-kesimpulan anda. Gunakan  $\alpha = .05$ .

(20/100)

- (e) Di dalam kertas "New Acetylene Process Uses Hydrogen Dilution", Chem. Eng. Prog., 1961, Jilid 57, pp 43-49, T. Kunugi, T. Tamura dan T. Naito mengkaji peratus penukaran n-Heptane kepada acetylene bersama dengan tiga pembolehubah penjelasan, iaitu, suhu reaktor (dalam darjah C), nisbah hidrogen kepada n-Heptane (nisbah mol) dan masa menyentuh (dalam saat).

Seorang penyiasat menggunakan prosedur SPSS, REGRESSION dan memperoleh output yang ditunjukkan di bawah:

.../5

MULTIPLE REGRESSION

Equation      Dependent Variable Y      % penukaran kepada Acetylene  
Number 1

Variable(s) Entered on Step Number  
 1.        X3        masa menyentuh  
 2.        X2        nisbah H<sub>2</sub>/n-Heptane  
 3.        X1        suhu reaktor dalam darjah C

Multiple R                    .95907  
 R Square                      .91981  
 Adjusted R Square        .89977  
 Standard Error            3.76707

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	3	1953.41932	651.13977
Residual	12	170.29005	14.19084

F = 45.88452                      Signif F = .0000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
X3	-19.02170	107.92824	-.05058	-.176	.8630
X2	.34816	.17702	.16567	1.967	.0728
X1	.12685	.04218	.85952	3.007	.0109
(Constant)	-121.26962	55.43571		-2.188	.0492

Huraikan kesimpulan-kesimpulan yang boleh didapati oleh penyiasat itu. Gunakan  $\alpha = .05$  (jika diperlukan).

(20/100)

2. Suatu eksperimen dijalankan untuk menentukan kesan suhu storan pada potensi ubat antibiotik. Limabelas sampel antibiotik tersebut diperolehi dan tiga sampel, dipilih secara rawak, disimpan pada setiap daripada lima suhu: 10°, 30°, 50°, 70° dan 90° C. Selepas 30 hari storan, sampel-sampel itu diujikan bagi potensi. Hasil-hasil yang didapati diberikan di bawah:

.../6

Suhu				
10°	30°	50°	70°	90°
62	26	16	10	13
55	36	15	11	11
57	31	23	18	9

$\Sigma :$     174            93            54            39            33

$y_{..} = 393$

$\Sigma \Sigma y_{ij}^2 = 14,977$

- (a) Dapatkan suatu jadual analisis varians.
- (b) Adakah terdapat perbezaan yang bererti di antara suhu storan terhadap potensi ubat antibiotik itu?

Gunakan  $\alpha = .05$ .  
Nyatakan semua anggapan yang digunakan.

- (c) Katakan suhu storan ditandakan x dan potensi ubat antibiotik ditandakan y.

Andaikan

$\Sigma x_i = 750$                        $\Sigma x_i^2 = 49,500$

$\Sigma y_i = 393$                        $\Sigma y_i^2 = 14,977$

$\Sigma x_i y_i = 12,930$                        $n = 15$

Dapatkan garis regresi linear mudah yang mengkaitkan y dengan x.

Ujikan sama ada model regresi linear mudah di atas bererti atau tidak. Gunakan  $\alpha = .05$ .

- (d) Sebenarnya, penyiasat bagi eksperimen ini berpendapat bahawa mungkin kesan suhu storan pada potensi ubat antibiotik itu tak linear. Jadi, prosedur SPSS, ONEWAY telah dijalankan dengan option POLYNOMIAL.

.../7

Output didapati ditunjukkan di bawah:

ONEWAY

Variable POTENSI kemujaraban antibiotik  
By Variable SUHU

<u>Analysis of Variance</u>					
<u>Source</u>	<u>D.F.</u>	<u>Sum of Squares</u>	<u>Mean Squares</u>	<u>F Ratio</u>	<u>F Prob.</u>
Between Groups	4	4520.4000	1130.1000	70.6313	.0000
Linear Term	1	3763.2000	3763.2000	235.2000	.0000
Deviation from Linear	3	757.2000	252.4000	15.7750	.0004
Quad. Term	1	720.8571	720.8571	45.0536	.0001
Deviation from Quad.	2	36.3429	18.1714	1.1357	.3594
Cubic term	1	36.3000	36.3000	2.2688	.1629
Deviation from Cubic	1	.0429	.0429	.0027	.9597
Within Groups	10	160.0000	16.0000		
Total	14	4680.4000			

Huraikan kesimpulan-kesimpulan penyiasat. Gunakan  $\alpha = .05$ .

(100/100)

- Seorang Jurutera seramik ingin menguji kekuatan insulator "high tension" dibuat daripada empat campuran tanah liat baru, A, B, C, D dan suatu kawalan, E. Beliau membuat lima insulator daripada setiap campuran tanah liat. Disangka terdapat kelerengan suhu dari depan ke belakang dan dari atas ke bawah di dalam dapurnya. Jadi, beliau memutuskan untuk menggunakan suatu rekabentuk segiempat sama Latin dengan rak-rak (atas ke bawah) sebagai baris dan kedudukan-kedudukan pada rak (depan ke belakang) sebagai lajur. Insulator-insulator itu diletak di dalam dapur itu dengan susunan segiempat sama Latin. Selepas dibakar pada suhu yang tinggi, kekuatan setiap insulator disukatkan. Data yang didapati ditunjukkan di bawah:

.../8

	Depan		Belakang		Jumlah	
Atas	A 33.8	B 33.7	D 30.4	C 32.7	E 24.4	155.0
	D 37.0	E 28.8	B 33.5	A 26.7	C 33.4	167.3
	C 35.8	D 35.6	A 36.9	E 26.7	B 35.1	170.1
	E 33.2	A 37.1	C 37.4	B 38.1	D 34.1	179.9
	B 34.8	C 39.1	E 32.7	D 37.4	A 36.4	180.4

Bawah

Jumlah 174.6    174.3    170.9    169.5    163.4

$$\sum \sum y_{ijk}^2 = 29,380.55 \quad y_{...} = 852.7$$

- (a) Adakah terdapat perbezaan di antara campuran-campuran tanah liat di atas terhadap kekuatan insulator yang dibuat daripada campuran-campuran itu? Gunakan  $\alpha = .05$ .
- (b) Jika terdapat perbezaan di antara campuran-campuran tanah liat dalam (a), gunakan ujian Duncan dengan  $\alpha = .05$  untuk mendapati semua pasangan campuran tanah liat yang berbeza secara bererti.
- (c) Berikan suatu set kontras ortogon yang bermakna bagi eksperimen ini. Bagi set kontras ortogon anda, hitungkan min kuasa dua untuk setiap kontras. Adakah terdapat kontras yang bererti secara statistik pada  $\alpha = .05$ ?

Tafsirkan hasil anda.

(100/100)

.../9

4. (a) Adakah wujudnya tindakan bersaling di antara dua faktor A dan B di dalam dua eksperimen faktorial 4 x 4 berikut? Terangkan dengan menggunakan graf-graf tanpa pengiraan.

(i)

Faktor B \ Faktor A	1	2	3	4
1	9	11	14	15
2	12	14	17	18
3	10	12	15	16
4	13	15	18	19

(ii)

Faktor B \ Faktor A	1	2	3	4
1	14	16	14	16
2	15	13	18	14
3	12	15	16	17
4	19	16	12	13

(30/100)

- (b) Tiga jenis pokok tomato berbeza (iaitu Harvester, Pusa Early Dwarf dan Ife No. 1) dan empat densiti menanam berbeza (iaitu 10, 20, 30 dan 40 ribu pokok per hektar) dipertimbangkan untuk menanam di sebuah kawasan tertentu. Untuk mengkaji sama ada jenis atau densiti pokok mempengaruhi hasil, setiap gabungan jenis tomato dan densiti pokok digunakan dalam tiga plot berbeza. Hasil-hasil yang didapati ditunjukkan di bawah (berdasarkan kertas "Effects of Plant Density on Tomato Yields in Western Nigeria", Experimental Agriculture, 1976, pp. 43 - 47):

.../10

Densiti Menanam \ Jenis	10,000	20,000	30,000	40,000
Harvester	10.5	12.8	12.1	10.8
	9.2	11.2	12.6	9.1
	7.9	13.3	14.0	12.5
Ife No. 1	8.1	12.7	14.4	11.3
	8.6	13.7	15.4	12.5
	10.1	11.5	13.7	14.5
Pusa Early Dwarf	16.1	16.6	20.8	18.4
	15.3	19.2	18.0	18.9
	17.5	18.5	21.0	17.2

(i) Adakah terdapat tindakan bersaling yang bererti? Gunakan  $\alpha = .05$ .

(ii) Adakah terdapat perbezaan yang bererti di antara jenis tomato? Di antara densiti pokok yang digunakan? Gunakan  $\alpha = .05$ .

(iii) Nyatakan semua anggapan yang digunakan.

Perhatian: Jumlah nilai-nilai di dalam setiap sel ditunjukkan di bawah.

Densiti Menanam \ Jenis	10,000	20,000	30,000	40,000	Jumlah
Harvester	27.6	37.3	38.7	32.4	136.0
Ife No. 1	26.8	37.9	43.5	38.3	146.5
Pusa Early Dwarf	48.9	54.3	59.8	54.5	217.5
Jumlah	103.3	129.5	142.0	125.2	500.0

$$\text{Juga, } \sum \sum \sum y_{ijk}^2 = 7,404.8$$

(70/100)

.../11

5. (a) Di dalam suatu eksperimen genetik, penyiasat-penyiasat mengkaji 300 kromosom daripada suatu jenis tertentu dan membilangkan bilangan penukaran "sister-chromatid" pada setiap kromosom. ("On the Nature of Sister-Chromatid Exchange in 5-Bromodeoxyuridine - Substituted Chromosomes", Genetics, 1979, pp. 1251 - 1264).

Data yang didapati ditunjukkan di bawah:

X = bilangan penukaran	0	1	2	3	4	5	6	7	8	9
Bilangan di- perhatikan	6	24	42	59	62	44	41	14	6	2

Suatu model Poisson dihipotesiskan bagi taburan untuk bilangan penukaran.

- (i) Anggarkan min bagi taburan Poisson.
- (ii) Ujikan sama ada model Poisson adalah sesuai atau tak sesuai bagi data ini. Gunakan  $\alpha = .05$ .

(40/100)

- (b) Data berikut dikutip daripada suatu sampel 10 keluarga. Pembolehubah-pembolehubah yang berkaitan ialah:

y (perbelanjaan tahunan untuk barangan seperti Video, TV, dan lain-lain - dalam ratus-ratus ringgit).

$x_1$  (pendapatan tahunan net - dalam ribu-ribu ringgit)  
dan  $x_2$  (saiz keluarga).

y	$x_1$	$x_2$
23	10	7
7	2	3
15	4	2
17	6	4
23	8	6
22	7	5
10	4	3
14	6	3
20	7	4
19	6	3

.../12

$$\begin{aligned} \sum y_j &= 170 & \sum x_{j1} &= 60 & \sum x_{j2} &= 40 \\ \sum y_j^2 &= 3162 & \sum x_{j1}^2 &= 406 & \sum x_{j2}^2 &= 182 \\ \sum x_{j1}y_j &= 1122 & \sum x_{j2}y_j &= 737 & \sum x_{j1}x_{j2} &= 267 \\ \hat{\beta}_0 &= 3.9187 & \hat{\beta}_1 &= 2.4912 & \hat{\beta}_2 &= -0.4664 \end{aligned}$$

- (i) Tuliskan persamaan regresi linear berganda bagi sampel yang diperolehi.
- (ii) Adakah model yang diperolehi bererti? Gunakan  $\alpha = .05$ . Nyatakan anggapan-anggapan yang diperlukan.
- (iii) Jika pendapatan tahunan net ialah \$5,000.00 dan saiz keluarga ialah 4, apakah perbelanjaan tahunan yang diramalkan?
- (iv) Dapatkan nilai koefisien penentuan berganda,  $R^2$ . Berikan tafsiran anda.
- (v) Jika  $SSR(\beta_0, \beta_1) = 226.174$  dan  $SSR(\beta_0, \beta_2) = 147.682$ , ujikan setiap hipotesis berikut:
  - (a)  $H_0 : \beta_1 = 0$ ,
  - (b)  $H_0 : \beta_2 = 0$ ,

pada paras keertian 5%.

Berikan tafsiran anda.

(60/100)

6. Tuliskan nota-nota pendek mengenai topik-topik yang berikut:

- (a) Kebaikan dan keburukan SPSS sebagai suatu pakej statistik.
- (b) Peranan analisis residual di dalam analisis data.

(100/100)

- ooo00ooo -

BERBAGAI RUMUS (Tatatanda seperti di dalam nota kuliah)

- 1.
- Dua sampel tak bersandar
- (
- $n_1 < 25$
- atau
- $n_2 < 25$
- )

$$s_p^2 = \frac{\sum_i (x_i - \bar{x})^2 + \sum_j (y_j - \bar{y})^2}{n_1 + n_2 - 2}$$

$$= \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

- 2.
- Sampel berpasangan

$$s_d^2 = \frac{\sum_i (d_i - \bar{d})^2}{n - 1}$$

$$= \frac{\sum_i d_i^2 - \frac{(\sum d_i)^2}{n}}{n - 1}$$

- 3.
- Analisis varian satu hala

$$SST = \sum_i \sum_j y_{ij}^2 - \frac{y_{..}^2}{N}$$

$$SSA = \sum_i \frac{y_{i.}^2}{n_i} - \frac{y_{..}^2}{N}$$

$$SSE = SST - SSA$$

$$\text{Bagi sebarang kontras } L = \sum_i c_i y_{i.}$$

$$SSL = \frac{(\sum_i c_i y_{i.})^2}{(n \sum_i c_i^2)}$$

4. Rekabentuk blok rawakan

$$SST = \sum_i \sum_j y_{ij}^2 - \frac{y_{..}^2}{N}$$

$$SSA = \sum_i \frac{y_{i.}^2}{b} - \frac{y_{..}^2}{N}$$

$$SSB = \sum_j \frac{y_{.j}^2}{a} - \frac{y_{..}^2}{N}$$

$$SSE = SST - SSA - SSB$$

5. Rekabentuk segiempat sama Latin

$$SST = \sum_i \sum_j y_{ijk}^2 - \frac{y_{...}^2}{N}$$

$$SSR = \sum_i \frac{y_{i..}^2}{P} - \frac{y_{...}^2}{N}$$

$$SSC = \sum_k \frac{y_{..k}^2}{P} - \frac{y_{...}^2}{N}$$

$$SSA = \sum_j \frac{y_{.j.}^2}{P} - \frac{y_{...}^2}{N}$$

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

6. Rekabentuk faktorial (dua faktor)

$$SST = \sum_i \sum_j \sum_k y_{ijk}^2 - \frac{y_{...}^2}{N}$$

$$SSA = \sum_i \frac{y_{i..}^2}{bn} - \frac{y_{...}^2}{N}$$

.../3

$$SSB = \sum_j \frac{y_{.j}^2}{n_j} - \frac{y_{...}^2}{N}$$

$$SS_{\text{sub-jumlah}} = \sum_i \sum_j \frac{y_{ij}^2}{n} - \frac{y_{...}^2}{N}$$

$$SSAB = SS_{\text{sub-jumlah}} - SSA - SSB$$

$$SSE = SST - SS_{\text{sub-jumlah}}$$

### 7. Korelasi dan regresi linear mudah

$$r^2 = \frac{\left( \sum_i x_i y_i - \frac{(\sum_i x_i)(\sum_i y_i)}{n} \right)^2}{\left[ \sum_i x_i^2 - \frac{(\sum_i x_i)^2}{n} \right] \left[ \sum_i y_i^2 - \frac{(\sum_i y_i)^2}{n} \right]}$$

$$\hat{\beta}_1 = \frac{\sum_i x_i y_i - \frac{(\sum_i x_i)(\sum_i y_i)}{n}}{\sum_i x_i^2 - \frac{(\sum_i x_i)^2}{n}}$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

$$\begin{aligned} SSE &= s_{yy} - \hat{\beta}_1^2 s_{xx} \\ &= s_{yy} - \hat{\beta}_1 s_{xy} \end{aligned}$$

$$s_{Y \cdot X}^2 = \frac{SSE}{n-2}$$

Anggaran ralat piawai bagi  $\hat{\beta}_0$  ialah

$$\sqrt{\text{MSE} \left( \frac{1}{n} + \frac{\bar{x}^2}{s_{xx}} \right)}$$

Anggaran ralat piawai bagi  $\hat{\beta}_1$  ialah

$$\sqrt{\text{MSE}/s_{xx}}$$

Selang peramalan  $100(1 - \alpha)\%$  pada  $x = x_0$ :

$$\hat{y} \pm t_{\alpha/2} \sqrt{\text{MSE} \left( 1 + \frac{1}{n} + \frac{(x_0 - \bar{x})^2}{S_{xx}} \right)}$$

Selang keyakinan  $100(1 - \alpha)\%$  pada  $x = x_0$  bagi  $\mu_{Y \cdot X_0}$  ialah

$$\hat{y} \pm t_{\alpha/2} \sqrt{\text{MSE} \left( \frac{1}{n} + \frac{(x_0 - \bar{x})^2}{S_{xx}} \right)}$$

### 8. Regresi linear berganda

$$\underline{y} = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix}, \quad \underline{x} = \begin{pmatrix} 1 & x_{11} & x_{12} & \cdots & x_{1k} \\ 1 & x_{21} & x_{22} & \cdots & x_{2k} \\ \vdots & \vdots & \vdots & & \vdots \\ 1 & x_{n1} & x_{n2} & \cdots & x_{nk} \end{pmatrix}$$

$$\underline{\beta} = \begin{pmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_k \end{pmatrix}, \quad \underline{\epsilon} = \begin{pmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_n \end{pmatrix}$$

$$\hat{\underline{\beta}} = (\underline{x}'\underline{x})^{-1} \underline{x}'\underline{y}$$

$$\text{SSE} = \underline{y}'\underline{y} - \hat{\underline{\beta}}'\underline{x}'\underline{y}$$

$$\text{SSR} = \hat{\underline{\beta}}'\underline{x}'\underline{y} - (\sum y_i)^2/n$$

$$r_{12.3}^2 = \frac{(r_{12} - r_{13} r_{23})^2}{(1 - r_{13}^2)(1 - r_{23}^2)}$$

$$\text{MSE} = \frac{\text{SSE}}{n-p}, \quad p = k+1.$$

9. Polinomial ortogon

$$P_0(x) = 1$$

$$P_1(x) = \lambda_1 \left[ \frac{x-\bar{x}}{d} \right]$$

$$P_2(x) = \lambda_2 \left[ \left( \frac{x-\bar{x}}{d} \right)^2 - \left( \frac{n^2-1}{12} \right) \right]$$

$$P_3(x) = \lambda_3 \left[ \left( \frac{x-\bar{x}}{d} \right)^3 - \left( \frac{x-\bar{x}}{d} \right) \left( \frac{3n^2-7}{20} \right) \right]$$

$$P_4(x) = \lambda_4 \left[ \left( \frac{x-\bar{x}}{d} \right)^4 - \left( \frac{x-\bar{x}}{d} \right)^2 \left( \frac{3n^2-13}{14} \right) + \frac{3(n^2-1)(n^2-9)}{560} \right]$$

$$\hat{\alpha}_j = \frac{\sum_{i=1}^n P_j(x_i) y_i}{\sum_{i=1}^n P_j^2(x_i)}, \quad j = 0, 1, \dots, k$$

$$SSR(\alpha_j) = \hat{\alpha}_j \sum_{i=1}^n P_j(x_i) y_i$$

$$SSE(k) = S_{yy} - \sum_{j=1}^k \hat{\alpha}_j \left[ \sum_{i=1}^n P_j(x_i) y_i \right]$$

10. Pemilihan pembolehubah dan pembangunan model dalam regresi

$$R_p^2 = \frac{SSR(p)}{S_{yy}} = 1 - \frac{SSE(p)}{S_{yy}}$$

$$\overline{R_p^2} = 1 - \left( \frac{n-1}{n-p} \right) (1 - R_p^2)$$

$$MSE(p) = \frac{SSE(p)}{n-p}$$

$$C_p = \frac{SSE(p)}{\hat{\sigma}^2} - (n-2p), \quad \text{di mana } \hat{\sigma}^2 \text{ adalah suatu anggaran } \sigma^2.$$

VII. Significant Ranges for Duncan's Multiple Range Test<sup>a</sup>

f	$r_{01}(\rho, f)$											
	$\rho$											
	2	3	4	5	6	7	8	9	10	20	50	100
1	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0
2	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
3	8.26	8.5	8.6	8.7	8.8	8.9	8.9	9.0	9.0	9.3	9.3	9.3
4	6.51	6.8	6.9	7.0	7.1	7.1	7.2	7.2	7.3	7.5	7.5	7.5
5	5.70	5.96	6.11	6.18	6.26	6.33	6.40	6.44	6.5	6.8	6.8	6.8
6	5.24	5.51	5.65	5.73	5.81	5.88	5.95	6.00	6.0	6.3	6.3	6.3
7	4.95	5.22	5.37	5.45	5.53	5.61	5.69	5.73	5.8	6.0	6.0	6.0
8	4.74	5.00	5.14	5.23	5.32	5.40	5.47	5.51	5.5	5.8	5.8	5.8
9	4.60	4.86	4.99	5.08	5.17	5.25	5.32	5.36	5.4	5.7	5.7	5.7
10	4.48	4.73	4.88	4.96	5.06	5.13	5.20	5.24	5.28	5.55	5.55	5.55
11	4.39	4.63	4.77	4.86	4.94	5.01	5.06	5.12	5.15	5.39	5.39	5.39
12	4.32	4.55	4.68	4.76	4.84	4.92	4.96	5.02	5.07	5.26	5.26	5.26
13	4.26	4.48	4.62	4.69	4.74	4.84	4.88	4.94	4.98	5.15	5.15	5.15
14	4.21	4.42	4.55	4.63	4.70	4.78	4.83	4.87	4.91	5.07	5.07	5.07
15	4.17	4.37	4.50	4.58	4.64	4.72	4.77	4.81	4.84	5.00	5.00	5.00
16	4.13	4.34	4.45	4.54	4.60	4.67	4.72	4.76	4.79	4.94	4.94	4.94
17	4.10	4.30	4.41	4.50	4.56	4.63	4.68	4.73	4.75	4.89	4.89	4.89
18	4.07	4.27	4.38	4.46	4.53	4.59	4.64	4.68	4.71	4.85	4.85	4.85
19	4.05	4.24	4.35	4.43	4.50	4.56	4.61	4.64	4.67	4.82	4.82	4.82
20	4.02	4.22	4.33	4.40	4.47	4.53	4.58	4.61	4.65	4.79	4.79	4.79
30	3.89	4.06	4.16	4.22	4.32	4.36	4.41	4.45	4.48	4.65	4.71	4.71
40	3.82	3.99	4.10	4.17	4.24	4.30	4.34	4.37	4.41	4.59	4.69	4.69
60	3.76	3.92	4.03	4.12	4.17	4.23	4.27	4.31	4.34	4.53	4.66	4.66
100	3.71	3.86	3.98	4.06	4.11	4.17	4.21	4.25	4.29	4.48	4.64	4.65
$\infty$	3.64	3.80	3.90	3.98	4.04	4.09	4.14	4.17	4.20	4.41	4.60	4.68

f = degrees of freedom.

<sup>a</sup>Reproduced with permission from "Multiple Range and Multiple F Tests," by D. B. Duncan, *Biometrics*, Vol. 1, No. 1, pp. 1-42, 1955

.../7

VII. Significant Ranges for Duncan's Multiple Range Test (*continued*)

f	$r_{05}(p, f)$											
	p											
	2	3	4	5	6	7	8	9	10	20	50	100
1	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
2	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09
3	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
4	3.93	4.01	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02
5	3.64	3.74	3.79	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
6	3.46	3.58	3.64	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68
7	3.35	3.47	3.54	3.58	3.60	3.61	3.61	3.61	3.61	3.61	3.61	3.61
8	3.26	3.39	3.47	3.52	3.55	3.56	3.56	3.56	3.56	3.56	3.56	3.56
9	3.20	3.34	3.41	3.47	3.50	3.52	3.52	3.52	3.52	3.52	3.52	3.52
10	3.15	3.30	3.37	3.43	3.46	3.47	3.47	3.47	3.47	3.48	3.48	3.48
11	3.11	3.27	3.35	3.39	3.43	3.44	3.45	3.46	3.46	3.48	3.48	3.48
12	3.08	3.23	3.33	3.36	3.40	3.42	3.44	3.44	3.46	3.48	3.48	3.48
13	3.06	3.21	3.30	3.35	3.38	3.41	3.42	3.44	3.45	3.47	3.47	3.47
14	3.03	3.18	3.27	3.33	3.37	3.39	3.41	3.42	3.44	3.47	3.47	3.47
15	3.01	3.16	3.25	3.31	3.36	3.38	3.40	3.42	3.43	3.47	3.47	3.47
16	3.00	3.15	3.23	3.30	3.34	3.37	3.39	3.41	3.43	3.47	3.47	3.47
17	2.98	3.13	3.22	3.28	3.33	3.36	3.38	3.40	3.42	3.47	3.47	3.47
18	2.97	3.12	3.21	3.27	3.32	3.35	3.37	3.39	3.41	3.47	3.47	3.47
19	2.96	3.11	3.19	3.26	3.31	3.35	3.37	3.39	3.41	3.47	3.47	3.47
20	2.95	3.10	3.18	3.25	3.30	3.34	3.36	3.38	3.40	3.47	3.47	3.47
30	2.89	3.04	3.12	3.20	3.25	3.29	3.32	3.35	3.37	3.47	3.47	3.47
40	2.86	3.01	3.10	3.17	3.22	3.27	3.30	3.33	3.35	3.47	3.47	3.47
60	2.83	2.98	3.08	3.14	3.20	3.24	3.28	3.31	3.33	3.47	3.48	3.48
100	2.80	2.95	3.05	3.12	3.18	3.22	3.26	3.29	3.32	3.47	3.53	3.53
$\infty$	2.77	2.92	3.02	3.09	3.15	3.19	3.23	3.26	3.29	3.47	3.61	3.67

f = degrees of freedom.

TABLE III

Transformation of  $r$  to  $Z$  (i.e.,  $Z = \frac{1}{2} \log \frac{1+r}{1-r}$ )

$r$	$Z$	$r$	$Z$	$r$	$Z$
.00	.000				
.01	.010	.36	.377	.71	.887
.02	.020	.37	.388	.72	.908
.03	.030	.38	.400	.73	.929
.04	.040	.39	.412	.74	.950
.05	.050	.40	.424	.75	.973
.06	.060	.41	.436	.76	.996
.07	.070	.42	.448	.77	1.020
.08	.080	.43	.460	.78	1.045
.09	.090	.44	.472	.79	1.071
.10	.100	.45	.485	.80	1.099
.11	.110	.46	.497	.81	1.127
.12	.121	.47	.510	.82	1.157
.13	.131	.48	.523	.83	1.188
.14	.141	.49	.536	.84	1.221
.15	.151	.50	.549	.85	1.256
.16	.161	.51	.563	.86	1.293
.17	.172	.52	.576	.87	1.333
.18	.182	.53	.590	.88	1.376
.19	.192	.54	.604	.89	1.422
.20	.203	.55	.618	.90	1.472
.21	.213	.56	.633	.91	1.528
.22	.224	.57	.648	.92	1.589
.23	.234	.58	.662	.93	1.658
.24	.245	.59	.678	.94	1.738
.25	.255	.60	.693	.95	1.832
.26	.266	.61	.709	.96	1.946
.27	.277	.62	.725	.97	2.092
.28	.288	.63	.741	.98	2.298
.29	.299	.64	.758	.99	2.647
.30	.310	.65	.775		
.31	.321	.66	.793		
.32	.332	.67	.811		
.33	.343	.68	.829		
.34	.354	.69	.848		
.35	.365	.70	.867		

Table III is abridged from Table VII of Fisher and Yates: *Statistical Tables for Biological, Agricultural, and Medical Research*, published by Oliver and Boyd Limited, Edinburgh, by permission of the authors and publishers.

X. Coefficients of Orthogonal Polynomials<sup>a</sup>

$X_j$	$n = 3$						$n = 4$			$n = 5$			$n = 6$			$n = 7$				
	$P_1$	$P_2$	$P_3$	$P_4$	$P_5$	$P_6$	$P_1$	$P_2$	$P_3$	$P_4$	$P_5$	$P_6$	$P_7$	$P_8$	$P_9$	$P_{10}$	$P_{11}$			
1	-1	1	-3	1	-1	-2	2	-1	1	-5	5	-5	1	-1	-3	5	-1	3	-1	
2	0	-2	-1	-1	3	-1	-1	2	-4	-3	-1	7	-3	5	-2	0	1	-7	4	-6
3	1	1	1	-1	-3	0	-2	0	6	-1	-4	4	2	-10	-1	-3	1	1	-5	15
4			3	1	1	1	-1	-2	-4	1	-4	-4	2	10	0	-4	0	6	0	-20
5						2	2	1	1	3	-1	-7	-3	-5	1	-3	-1	1	5	15
6										5	5	5	1	1	2	0	-1	-7	-4	-6
7															3	5	1	3	1	1
$\sum_{j=1}^n \{P_j(X_j)\}^2$	2	6	20	4	20	10	14	10	70	70	84	180	28	252	28	84	6	154	84	924
$\lambda$	1	3	8	1	$\frac{10}{3}$	1	1	$\frac{5}{6}$	$\frac{35}{12}$	2	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{7}{12}$	$\frac{21}{10}$	1	1	$\frac{1}{6}$	$\frac{7}{12}$	$\frac{7}{20}$	$\frac{77}{60}$

$X_j$	$n = 8$						$n = 9$						$n = 10$								
	$P_1$	$P_2$	$P_3$	$P_4$	$P_5$	$P_6$	$P_1$	$P_2$	$P_3$	$P_4$	$P_5$	$P_6$	$P_7$	$P_8$	$P_9$	$P_{10}$	$P_{11}$	$P_{12}$	$P_{13}$	$P_{14}$	
1	-7	7	-7	7	-7	1	-4	28	-14	14	-4	4	-9	6	-42	18	-6	3			
2	-5	1	5	-13	23	-5	-3	7	7	-21	11	-17	-7	2	14	-22	14	-11			
3	-3	-3	7	-3	-17	9	-2	-8	13	-11	-4	22	-5	-1	35	-17	-1	10			
4	-1	-5	3	9	-15	-5	-1	-17	9	9	-9	1	-3	-3	31	3	-11	6			
5	1	-5	-3	9	15	-5	0	-20	0	18	0	-20	-1	-4	12	18	-6	-8			
6	3	-3	-7	-3	17	9	1	-17	-9	9	9	1	1	-4	-12	18	6	-8			
7	5	1	-5	-13	-23	-5	2	-8	-13	-11	4	22	3	-3	-31	3	11	6			
8	7	7	7	7	7	1	3	7	-7	-21	-11	-17	5	-1	-35	-17	1	10			
9						4	28	14	14	4	4	4	7	2	-14	-22	-14	-11			
$\sum_{j=1}^n \{P_j(X_j)\}^2$	168	168	264	616	2184	264	60	2772	990	2002	468	1980	330	132	8580	2860	780	660			
$\lambda$	2	1	$\frac{3}{2}$	$\frac{7}{12}$	$\frac{7}{10}$	$\frac{11}{60}$	1	.3	$\frac{5}{6}$	$\frac{7}{12}$	$\frac{3}{20}$	$\frac{11}{60}$	2	$\frac{1}{2}$	$\frac{3}{2}$	$\frac{7}{12}$	$\frac{1}{10}$	$\frac{11}{20}$			

<sup>a</sup> Adapted with permission from *Biometrika Tables for Statisticians*, Vol. 1, 3rd edition by E. S. Pearson and H. O. Hartley, Cambridge University Press, Cambridge, 1966.

# SPSS/PC+™ Reference Card

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This card provides a convenient reference to the SPSS/PC+™ System for the IBM PC/XT and PC/AT. Command diagrams appear in alphabetical order and are constructed according to the following conventions:

**Square brackets** enclose optional specifications not necessary to the correct completion of the command. **Braces** enclose alternative specifications. One of these specifications must be entered in order to complete the command. The brackets and braces themselves are not part of the specification.

**Ellipses** indicate that an element may be repeated.

**Uppercase** elements must be entered as they appear in the diagrams.

**Lowercase** elements describe information to be filled in by the user, such as the word "varlist" to indicate a list of user-specified variables.

**Boldface** elements are defaults. Two asterisks (\*\*) indicate that a specification is a default when its associated subcommand is not specified.

## AGGREGATE

```
AGGREGATE OUTFILE='filename'
  [ /PRESORTED ]
  /BREAK=varlist { { (A) } { (D) } } ...
  [ /MISSING=COLUMNWISE ]
  /AGGVAR 'label' AGGVAR 'label' ...
  =function(varlist[,arguments])
  [ /AGGVAR ... ]
```

## ANOVA

```
ANOVA [VARIABLES=] varlist BY varlist (min,max) [WITH varlist]
  [ /{VARIABLES=} varlist ... ]
  [ /OPTIONS=option numbers ]
  [ /STATISTICS={statistic numbers} ]
  [ ALL ]
```

### Options:

- |                                  |                                 |
|----------------------------------|---------------------------------|
| 1 Include user-missing values    | 7 Covariates with main effects  |
| 2 Suppress labels                | 8 Covariates after main effects |
| 3 Suppress all interaction terms | 9 Regression approach           |
| 4 Suppress three-way terms       | 10 Hierarchical approach        |
| 5 Suppress four-way terms        | 11 Narrow format                |
| 6 Suppress five-way terms        |                                 |

### Statistics:

- MCA table
- Unstandardized regression coefficients for covariates
- Display cell means and counts

## BEGIN DATA—END DATA

```
BEGIN DATA
lines of data
END DATA
```

## COMMENT

\* text

## COMPUTE

```
COMPUTE target variable-expression
```

### Arithmetic Operators:

- + Addition - Subtraction
- \* Multiplication / Division
- \*\* Exponentiation

### Numeric Functions:

ABS	Absolute value	RND	Round
TRUNC	Truncate	MOD10	Modulus
SQRT	Square root	EXP	Exponential
LG10	Base 10 logarithm	LN	Natural logarithm
SIN	Sine	COS	Cosine
ATAN	Arctangent		

### Missing-Value Functions:

VALUE Treat user-missing as valid  
 SYSMIS Return 1 if system-missing  
 MISSING Return 1 if missing

### Cross-case Function:

LAG Lag

### Random-Number Functions:

UNIFORM Uniform pseudo-random number  
 NORMAL Normal pseudo-random number

### Date Function:

YRMODA Date function

## CORRELATION

```
CORRELATION [VARIABLES=] {varlist} [WITH varlist] [/varlist ...]
  [ ALL ]
  [ /OPTIONS=option numbers ]
  [ /STATISTICS={statistic numbers} ]
  [ ALL ]
```

### Options:

- |                                   |                                      |
|-----------------------------------|--------------------------------------|
| 1 Include user-missing values     | 4 Write count and correlation matrix |
| 2 Exclude missing values pairwise | 5 Display count and probability      |
| 3 Two-tailed probability          |                                      |

### Statistics:

- Univariate mean, standard deviation, and count
- Cross-product deviations and covariance

## COUNT

```
COUNT varname=varlist (value list) varlist (value list)
  [ /varname=... ]
```

### Keywords available for numeric value lists:

LO LOWEST HI HIGHEST THRU SYSMIS MISSING

## CROSSTABS

```
CROSSTABS [TABLES=] {varlist} BY varlist [BY...]
  [ /{TABLES=} varlist ... ]
  [ /OPTIONS=option numbers ]
  [ /STATISTICS={statistic numbers} ]
  [ ALL ]
```

### Options:

- |   |  |
|---|--|
| 1 Include user-missing values             | 13 Suppress cell counts                                |
| 2 Suppress all labels                     | 14 Display expected frequencies                        |
| 3 Display row percentages                 | 15 Display chi-square residuals*                       |
| 4 Display column percentages              | 16 Display standardized chi-square residuals           |
| 5 Display two-way table total percentages | 17 Display adjusted standardized, chi-square residuals |
| 6 Suppress value labels                   | 18 Display all cell information value                  |
| 8 Order rows by descending value          | 19 Suppress values                                     |
| 12 Suppress tables                        |  |

### Statistics:

- |  |                   |
|--|-------------------|
| 1 Chi-square   | 6 Kendall's tau-b |
| 2 Phi for 2 x 2 tables, Cramér's V for larger tables | 7 Kendall's tau-c |
| 3 Contingency coefficient                            | 8 Gamma           |
| 4 Lambda   | 9 Somers' d       |
| 5 Uncertainty coefficient                            | 10 Eta            |
|  | 11 Pearson's r    |

## DATA LIST: Fixed Format

```
DATA LIST [FILE='filename'] [FIXED] [TABLE]
  /varlist columns { { (n) } } {varlist columns ...} [ / ... ] [ / ... ]
  { (A) }
```

### Format Meaning

- (n) Implied decimal places for numeric variables  
 (A) String variable

## DATA LIST: Freefield Format

```
DATA LIST [FILE='filename'] FREE
  /variable { { (A) } } varlist
  { (Aw) }
```

### Format Meaning

- (Aw) String of width w

## DATA LIST: Matrix Materials

```
DATA LIST [FILE='filename'] MATRIX { { [FIXED] } } /varlist
  [ FREE ]
```

## DESCRIPTIVES

```
DESCRIPTIVES [VARIABLES=] {varlist}
  [ ALL ]
  [ /OPTIONS=option numbers ]
  [ /STATISTICS={statistic numbers} ]
  [ ALL ]
```

### Options:

- |                                   |                           |
|-----------------------------------|---------------------------|
| 1 Include user-missing values     | 6 Serial format           |
| 2 Suppress variable labels        | 7 Narrow format           |
| 3 Save Z scores on active file    | 8 Suppress variable names |
| 5 Exclude missing values listwise |                           |

### Statistics:

- |                          |   |
|--------------------------|---|
| 1 Mean                   | 9 Range   |
| 2 Standard error of mean | 10 Minimum  |
| 5 Standard deviation     | 11 Maximum  |
| 6 Variance               | 12 Sum  |
| 7 Kurtosis               | 13 Mean, standard deviation, minimum, and maximum |
| 8 Skewness               |   |

## DISPLAY

```
DISPLAY { { varlist } }
  [ ALL ]
```

**EXECUTE**

EXECUTE {path\filename{.ext}} {'parameters'}  
DOS

**EXPORT**

EXPORT OUTFILE='filename' [/KEEP={ALL  
varlist}] [/DROP=varlist]  
[/RENAME=(old varlist=new varlist)...] [/MAP]  
[/DIGITS=number]

**FINISH**

FINISH

**FORMATS**

FORMATS variable (format) [variable ...]

Format Meaning

Fw.d Numeric of width w and d decimal places  
COMMAw.d Numeric with commas and decimal places  
DOLLARw.d Numeric with dollar sign, commas, and decimal places

**FREQUENCIES**

FREQUENCIES [VARIABLES=] {varlist}  
ALL  
[/FORMAT={CONDENSE} | {NOTABLE} | {NOLABELS}  
ONEPAGE | LIMIT(n) | PERCENT(n) |  
DVALUE | DOUBLE | NEWPAGE |  
AFREQ | DFREQ }  
[/MISSING=INCLUDE]  
[/BARCHART={MINIMUM(n) | MAXIMUM(n) | {FREQ(n) |  
PERCENT(n) }  
/HISTOGRAM={MINIMUM(n) | MAXIMUM(n) | {FREQ(n) |  
PERCENT(n) }  
{NONORMAL} | INCREMENT(n) |  
NORMAL }  
[/HBAR=same keywords as HISTOGRAM]  
[/HTILES=n] [/PERCENTILES=value list]  
[/STATISTICS={DEFAULT} | MEAN | STDDEV | MINIMUM | MAXIMUM |  
SEMEAN | VARIANCE | SKEWNESS | SESKEW | RANGE | MODE |  
KURTOSIS | SEKURT | MEDIAN | SUM | ALL | NONE }

**GET**

GET {FILE='SPSS.SYS'...} [/DROP=varlist]  
'filename'

**HELP**

HELP {ALL} | TOPICS | NEWS  
{command} | {subcommand} | {topic}

**IF**

IF (logical expression) target variable=assignment expression

**Relational Operators:**

EQ or = Equal to NE or ~= or <> Not equal to  
LT or < Less than LE or <= Less than or equal to  
GT or > Greater than GE or >= Greater than or equal to

**Logical Operators:**

AND or & OR or | NOT or ~

**Missing-Value Functions:**

SYSTEMS Returns 1 (true) if value is system-missing  
MISSING Returns 1 (true) if value is system- or user-missing  
VALUE Returns the value itself, ignoring user-missing flags

**IMPORT**

IMPORT FILE='filename' [/KEEP={ALL  
varlist}] [/DROP=varlist]  
[/RENAME=(old varlist=new varlist)...] [/MAP]

**INCLUDE**

{INCLUDE 'filename'}  
{@filename}

**JOIN**

{JOIN} {MATCH  
ADD}  
[/FILE={file specification}  
TABLE} ]  
[/KEEP=varlist] [/DROP=varlist]  
[/RENAME (old varlist=new varlist) [{old varlist=...}] ]  
/FILE=...  
...  
[/FILE=... ]  
...  
[/MAP] [/BY=varlist]

**LIST**

LIST [{VARIABLES=} {ALL\*\* }  
varlist]  
[/CASES={FROM {n} } TO {eof} ] [BY {n} ] ]  
[/FORMAT={UNNUMBERED\*\* } | {WRAP\*\* } | WEIGHT ]  
{NUMBER\*\* } | {SINGLE }

**MEANS**

MEANS [TABLES=] {varlist} BY varlist [BY varlist ...]  
ALL  
[/varlist...]  
[/OPTIONS=option numbers]  
[/STATISTICS={statistic numbers}]  
ALL

**Options:**

- 1 Include user-missing values
- 2 Exclude cases with user-missing dependent values
- 3 Suppress all labels
- 5 Suppress group counts
- 6 Display group sums
- 7 Suppress group standard deviations
- 8 Suppress value labels
- 9 Suppress independent variable names
- 10 Suppress independent variable values
- 11 Suppress group means
- 12 Display group variances

**Statistics:**

- 1 One-way analysis of variance
- 2 Test of linearity

**MISSING VALUE**

MISSING VALUE {varlist} [{value}] [{/varlist ...}]  
ALL

**N**

N n [ESTIMATED]

**NPAR TESTS**

NPAR TESTS [CHISQUARE=varlist [{lo,hi}]]  
[/EXPECTED={EQUAL\*\* }  
{f1, f2, ... fn }]  
[/K-S ({UNIFORM {lo,hi} }=varlist  
NORMAL {m, sd }  
POISSON {m }  
/RUNS {MEAN  
MEDIAN  
MODE  
value }=varlist ]  
[/BINOMIAL ({.p})=varlist [{value, value2}]  
value ]  
[/MCNEMAR=varlist] [WITH varlist]  
[/SIGN=varlist] [WITH varlist]  
[/WILCOXON=varlist] [WITH varlist]  
[/COCHRAN=varlist]  
[/FRIEDMAN=varlist]  
[/KENDALL=varlist]  
[/MEDIAN {(value)=varlist BY var {value, value2}}  
/M-W=varlist BY var {value, value2}]  
[/K-S=varlist BY var {value, value2}]  
[/W-W=varlist BY var {value, value2}]  
[/MOSES(n)=varlist BY var {value, value2}]  
[/K-W=varlist BY var {value, value2}]  
[/OPTIONS=option numbers]  
[/STATISTICS=statistic numbers]

**Options:**

- 1 Include user-missing values
- 2 Exclude missing values listwise
- 3 Sequential pairing of variables for two related samples
- 4 Random sampling

**Statistics:**

- 1 Mean, maximum, minimum, standard deviation, and count
- 2 Quartiles and count

**ONEWAY**

ONEWAY [VARIABLES=] varlist BY varname(min, max)  
[/POLYNOMIAL=n]  
[/CONTRAST={coefficient list} ] [CONTRAST=...]  
[/RANGES={SNK  
BTUKEY  
TUKEY  
range values  
LSD  
DUNCAN  
MODLSD  
SCHEFFE } ] [RANGES=...]  
[/OPTIONS=option numbers]  
[/STATISTICS={statistic numbers}]  
ALL

**Options:**

- 1 Include user-missing values
- 2 Exclude missing values listwise
- 3 Suppress variable labels
- 4 Write matrix of counts, means, and standard deviations
- 6 Use value labels as group labels
- 7 Read matrix of counts, means, and standard deviations
- 8 Read matrix of counts, means, pooled variance, and degrees of freedom
- 10 Harmonic mean of all group sizes as sample sizes in range tests

**Statistics:**

- 1 Group descriptive statistics
- 2 Fixed- and random effects statistics
- 3 Homogeneity-of-variance tests

**PLOT**

```

PLOT [MISSING={PLOTWISE**} [INCLUDE]]
      [LISTWISE]
  [/HSIZE={38**} [VSIZE={16**}
  [/CUTPOINT={EVERY({n})}
      value list]
  [/SYMBOLS={ALPHANUMERIC**
      NUMERIC
      'symbols' {'overplot symbols'}
      'hexasyms' {'overplot hexasyms'}}]
  [/HORIZONTAL={ 'title' } [STANDARDIZE] [REFERENCE(vector)]
      [MIN(min)] [MAX(max)]
      [UNIFORM]
  [/VERTICAL={ 'title' } [STANDARDIZE] [REFERENCE(vector)]
      [MIN(min)] [MAX(max)]
      [UNIFORM]
  [/FORMAT={DEFAULT**
      CONTOUR({n})
      OVERLAY
      REGRESSION
  [/TITLE='title']
  /PLOT={varlist} [WITH varlist [(PAIR)] [BY varname] [:varlist...]]
  [/PLOT=...]

```

**PROCESS IF**

```

PROCESS IF ([variable] [relational operator] value[])

Relational Operators:
EQ or = NE or <> or <>
LT or < LE or <=
GT or > GE or >=

```

**RECODE**

```

Numeric Recodes:
RECODE varlist (value list=value)...(value list=value)
      [/varlist...]

Input keywords available for numeric recodes are:
LO LOWEST HI HIGHEST THRU MISSING SYSMIS ELSE

Output keywords available for numeric recodes are:
SYSMIS

String Recodes:
RECODE varlist ('string'..'string'...'-'string')
      [varlist...]

Input keywords available for string recodes are:
ELSE

```

**REGRESSION**

```

REGRESSION VARIABLES={varlist
      ALL
      [COLLECT]}
  [/STATISTICS={DEFAULT**} [N] [COEFF] [ANOVA] [OUTS]
      [ZPP] [CHA] [CI] [F] [BCOV] [SES] [TOL]
      [COND] [XTX] [HISTORY] [END] [LINE] [ALL]]
  [/CRITERIA={DEFAULT**} [TOLERANCE({0.01})] [MAXSTEPS({20})]
      [(PIN({0.05})] [(POUT({0.1})]
      [(FIN({3.84})] [(FOUT({2.71})]
      [value] [value]
      [value] [value])
  [/NOORIGIN={
      [ORIGIN]
  /DEPENDENT=varlist
  /METHOD={STEPWISE [varlist] } [METHOD=...]
      FORWARD [-varlist]
      BACKWARD [-varlist]
      ENTER [-varlist]
      REMOVE=varlist
      TEST=varlist (varlist)
  /DESCRIPTIVES={DEFAULTS [MEAN] [STDDEV] [CORR]
      [VARIANCE] [XPROD] [SIG] [N] [BADCORR]
      [COV] [ALL] [NONE**]}
  /SELECT={ALL**
      [varname relation value]}
  /MISSING={LISTWISE** [INCLUDE]]
      PAIRWISE
      MEANSUBSTITUTION}
  [/WIDTH={value on SET**}
      n]

```

**REGRESSION: Matrix Materials**

```

REGRESSION [READ={DEFAULTS} [MEAN] [STDDEV]
      [VARIANCE] [CORR] [N]]
  [/WRITE={DEFAULTS} [MEAN] [STDDEV]
      [VARIANCE] [CORR] [COV]
      [N] [NONE**]]
  /VARIABLES=varlist/DEPENDENT=varlist/METHOD=method

```

**REGRESSION: Residuals**

```

REGRESSION VARIABLES=varlist/DEPENDENT=varname/ METHOD=method
  [/RESIDUALS={DEFAULTS} [DURBIN]
      [OUTLIERS({ZRESID } [ID (varname)]
      [tempvarlist])
      [NORMPROB({ZRESID } [HISTOGRAM({ZRESID }
      [tempvarlist])
      [SIZE] [SMALL] [SEPARATE]
      [LARGE] [POOLED]
  [/CASEWISE={DEFAULTS} [OUTLIERS({3 value})]
      ALL
      [PLOT({ZRESID } [(DEPENDENT PRED RESID)]
      [tempvar] [tempvarlist])
  [/SCATTERPLOT=(varname.*tempvarname)... [SIZE] [SMALL]
      [LARGE]
  [/PARTIALPLOT={ALL
      [varname,varname,...]} [SIZE] [SMALL]
      [LARGE]
  [/SAVE=tempvar(newname) [tempvar(newname)... ]

```

Temporary residual variables are:

PRED ADJPRED SRESID MAHAL RESID ZPRED SRESID  
COOK DRESID ZRESID SEPRD LEVER

**REPORT**

```

REPORT
  [FORMAT={TSPACE({1})} [CHDSPACE({1})]
      [BRKSPACE({1})] [PTSPACE({1})]
      [LENGTH({SET length})] [MARGIN({SET width})]
      [NOLIST] [SUMSPACE({1})]
      [LIST({n})] [MISSING {'.'}]
  [/STRING=stringname ([varname] [(width)] [(BLANK)]
      'string'...'stringname...)]
  /VARIABLES={var TO var} [(VALUE)] ['col head'] [(width)]
      [LABEL]
      [DUMMY]
      [(OFFSET({0})] [var...
      n]
  [/MISSING={VAR
      NONE
      [LIST(varlist({1})]
      n]
  [/TITLE='line1' 'line2'...' [FOOTNOTE='line1' 'line2'...'
      Or
      Or
  [/LITTLE='line1' 'line2'...' [LFOOTNOTE='line1' 'line2'...'
  /CITITLE='line1' 'line2'...' [CFOOTNOTE='line1' 'line2'...'
  /RTITLE='line1' 'line2'...' [RFOOTNOTE='line1' 'line2'...'
  /BREAK=varlist [(VALUE)] ['col head'] [(width)]
      [LABEL]
      [(OFFSET({0})] [(NOTOTAL)]
      [TOTAL]
      [(NONAME)] [(SKIP({1})]
      [NAME] [PAGE]
  Or
  /BREAK=(NOBREAK) [(width)] [(OFFSET({0})] [(SKIP({1})]
      n]
  [/SUMMARY=function...'summary title'[(break col #)]
      [SKIP({0})]
      n]
  Or
  [/SUMMARY=PREVIOUS({n})]
  where function is
  aggregate [(varname({d})] [(PLAIN)] [varname...)]
      [DOLLAR]
      [COMMA]
  Or
  composite(agg(varname)...)[report col({d})] [(PLAIN)]
      [DOLLAR]
      [COMMA]

```

**Aggregate Functions:**

VALIDN VARIANCE PCGT(n)  
 SUM KURTOSIS PCLT(n)  
 MIN SKEWNESS PCIN(min,max)  
 MAX MEDIAN(min,max) ABFREQ(min,max)  
 MEAN MODE(min,max) RELFREQ(min,max)  
 STDEV

**Composite Functions:**

DIVIDE(agg(varname) agg(varname) [factor])  
 PCT(agg(varname) agg(varname))  
 SUBTRACT(agg(varname) agg(varname))  
 ADD(agg(varname) agg(varname) .)  
 GREAT(agg(varname) agg(varname) )  
 LEAST(agg(varname) agg(varname) )  
 AVERAGE(agg(varname) agg(varname) .)  
 MULTIPLY(agg(varname) agg(varname) )



Table VI VALUES OF THE EXPONENTIAL FUNCTION  $e^{-\lambda}$

$\lambda$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	1.000	0.990	0.980	0.970	0.961	0.951	0.942	0.932	0.923	0.914
0.10	0.905	0.896	0.887	0.878	0.869	0.861	0.852	0.844	0.835	0.827
0.20	0.819	0.811	0.803	0.795	0.787	0.779	0.771	0.763	0.755	0.748
0.30	0.741	0.733	0.726	0.719	0.712	0.705	0.698	0.691	0.684	0.677
0.40	0.670	0.664	0.657	0.651	0.644	0.638	0.631	0.625	0.619	0.613
0.50	0.607	0.600	0.595	0.589	0.583	0.577	0.571	0.565	0.560	0.554
0.60	0.549	0.543	0.538	0.533	0.527	0.522	0.517	0.512	0.507	0.502
0.70	0.497	0.492	0.487	0.482	0.477	0.472	0.468	0.463	0.458	0.454
0.80	0.449	0.445	0.440	0.436	0.432	0.427	0.423	0.419	0.415	0.411
0.90	0.407	0.403	0.399	0.395	0.391	0.387	0.383	0.379	0.375	0.372
1.00	0.368	0.364	0.361	0.357	0.353	0.350	0.346	0.343	0.340	0.336
1.10	0.333	0.330	0.326	0.323	0.320	0.317	0.313	0.310	0.307	0.304
1.20	0.301	0.298	0.295	0.292	0.289	0.287	0.284	0.281	0.278	0.275
1.30	0.273	0.270	0.267	0.264	0.262	0.259	0.257	0.254	0.252	0.249
1.40	0.247	0.244	0.242	0.239	0.237	0.235	0.232	0.230	0.228	0.225
1.50	0.223	0.221	0.219	0.217	0.214	0.212	0.210	0.208	0.206	0.204
1.60	0.202	0.200	0.198	0.196	0.194	0.192	0.190	0.188	0.186	0.185
1.70	0.183	0.181	0.179	0.177	0.176	0.174	0.172	0.170	0.169	0.167
1.80	0.165	0.164	0.162	0.160	0.159	0.157	0.156	0.154	0.153	0.151
1.90	0.150	0.148	0.147	0.145	0.144	0.142	0.141	0.139	0.138	0.137
2.00	0.135	0.134	0.133	0.131	0.130	0.129	0.127	0.126	0.125	0.124
2.10	0.122	0.121	0.120	0.119	0.118	0.116	0.115	0.114	0.113	0.112
2.20	0.111	0.110	0.109	0.108	0.106	0.105	0.104	0.103	0.102	0.101
2.30	0.100	0.0992	0.0983	0.0973	0.0963	0.0953	0.0944	0.0935	0.0926	0.0916
2.40	0.0907	0.0898	0.0889	0.0880	0.0872	0.0863	0.0854	0.0845	0.0837	0.0829
2.50	0.0821	0.0813	0.0805	0.0797	0.0789	0.0781	0.0773	0.0765	0.0758	0.0750
2.60	0.0743	0.0735	0.0728	0.0721	0.0714	0.0707	0.0699	0.0693	0.0686	0.0679
2.70	0.0672	0.0665	0.0659	0.0652	0.0645	0.0639	0.0633	0.0627	0.0620	0.0614
2.80	0.0608	0.0602	0.0596	0.0590	0.0584	0.0578	0.0573	0.0567	0.0561	0.0556
2.90	0.0550	0.0545	0.0539	0.0534	0.0529	0.0523	0.0518	0.0513	0.0508	0.0503

From Avram Goldstein, *Bionometrics*. New York: Macmillan, 1964. Reprinted by permission.