

Nomor Observasi	Pendapatan Pribadi yang dibelanjakan	Harga	Investasi Modal	Biaya Penjualan	Penjualan Perusahaan
1	398	56.2058	49.895	76.8621	5540.39
2	369	59.0443	16.595	88.8056	5439.04
3	268	56.7236	89.182	51.2972	4290.00
4	484	57.8627	106.738	39.6473	5502.34
5	394	59.1178	142.552	51.6517	4871.77
6	332	60.1113	61.287	20.5476	4708.08
7	336	59.8398	-30.385	40.1534	4627.81
8	383	60.0523	-44.856	31.6456	4110.24
9	285	63.1415	-28.373	12.4570	4122.69
10	277	62.3026	75.723	68.3076	4842.25
11	456	64.9220	144.030	52.4536	5740.65
12	355	64.8577	112.904	76.6778	5094.10
13	364	63.5919	128.347	96.0677	5383.20
14	320	65.6145	10.097	47.9795	4888.17
15	311	67.0228	-24.760	27.2319	4033.13
16	362	66.9049	116.748	72.6681	4941.96
17	408	66.1843	120.406	62.3129	5312.80
18	433	67.8651	121.823	24.7122	5139.87
19	359	68.8892	71.055	73.9126	4397.36
20	476	71.4177	4.186	63.2737	5149.47
21	415	69.2775	46.935	28.6762	5150.83
22	420	69.7334	7.621	91.3635	4989.02
23	536	73.1628	127.509	74.0169	5926.86
24	432	73.3650	-49.574	16.1628	4703.88
25	436	73.0500	100.098	42.9984	5365.59
26	415	74.9102	-40.185	41.1346	4630.09
27	462	73.2007	68.153	92.5180	5711.86
28	429	74.1615	87.963	83.2870	5095.48
29	517	74.2838	27.088	74.8921	6124.37
30	328	77.1409	59.343	87.5103	4787.34
31	418	78.5910	141.969	74.4712	5035.62
32	515	77.0938	126.420	21.2711	5288.01
33	412	78.2313	29.558	26.4941	4647.01
34	455	77.9296	18.007	94.6311	5315.63
35	554	81.0394	42.352	92.5448	6180.06
36	441	79.8485	-21.558	50.0480	4800.97
37	417	80.6394	148.450	83.1803	5512.13
38	461	82.2843	-17.584	91.2214	5272.21

Dari Buku, Sypros Makridakis dan Steven C. Whellwright(1991),
 Metode-metode peramalan untuk Manajemen, Bina Rupa Aksara
 Crogol, Jakarta Barat.

File data dengan ekstension .PRN
 Dengan kolom pertama sebagai kolom identitas

1	398	56,2058	49,895	76,8621	5540,39
1	369	59,0443	16,595	88,8056	5439,04
1	268	56,7236	89,182	51,2972	4290,00
1	484	57,8627	106,738	39,6473	5502,34
1	394	59,1178	142,552	51,6517	4871,77
1	332	60,1113	61,287	20,5476	4708,08
1	336	59,8398	-30,385	40,1534	4627,81
1	383	60,0523	-44,856	31,6456	4110,24
1	285	63,1415	-28,373	12,4570	4122,69
1	277	62,3026	75,723	68,3076	4842,25
1	456	64,9220	144,030	52,4536	5740,65
1	355	64,8577	112,904	76,6778	5094,10
1	364	63,5919	128,347	96,0677	5383,20
1	320	65,6145	10,097	47,9795	4888,17
1	311	67,0228	-24,760	27,2319	4033,13
1	362	66,9049	116,748	72,6681	4941,96
1	408	66,1843	120,406	62,3129	5212,80
1	433	67,8651	121,823	24,7122	5139,87
1	359	68,8892	71,055	73,9126	4397,36
1	476	71,4177	4,186	63,2737	5149,47
1	415	69,2775	46,935	28,6762	5150,83
1	420	69,7334	7,621	91,3635	4989,02
1	536	73,1628	127,509	74,0169	5926,86
1	432	73,3650	-49,574	16,1628	4703,88
1	436	73,0500	100,098	42,9984	5365,59
1	415	74,9102	-40,185	41,1346	4630,09
1	462	73,2007	68,153	92,5180	5711,86
1	429	74,1615	87,963	83,2870	5095,48
1	517	74,2838	27,088	74,8921	6124,37
1	328	77,1409	59,343	87,5103	4787,34
1	418	78,5910	141,969	74,4712	5035,62
1	515	77,0938	126,420	21,2711	5288,01
1	412	78,2313	29,558	26,4941	4647,01
1	455	77,9296	18,007	94,6311	5315,63
1	554	81,0394	42,352	92,5448	6180,06
1	441	79,8485	-21,558	50,0480	4800,97
1	417	80,6394	148,450	83,1803	5512,13
1	461	82,2843	-17,584	91,2214	5272,21

Lampiran 3: Program Komputasi Regresi Dalam MathCAD

data := READPRN(data)

M := rows(data)

P := cols(data)

xo0 := data<0> xo1 := data<1> xo2 := data<2> xo3 := data<3>

xo4 := data<4> yo := data<5>

i := 0.. M - 1

xo := augment(xo0 , augment(xo1 , augment(xo2 , augment(xo3 , xo4))))

$\beta_0 := (xo^T \cdot xo)^{-1} \cdot xo^T \cdot yo$

$ya_i := \beta_0 \cdot xo_{i,0} + \beta_1 \cdot xo_{i,1} + \beta_2 \cdot xo_{i,2} + \beta_3 \cdot xo_{i,3} + \beta_4 \cdot xo_{i,4}$

R := 10

j := 0.. R

$rnd_{i,j} := \text{floor}(rnd(M - 1))$

$x0_{i,j} := xo0(rnd_{i,j}) \quad x1_{i,j} := xo1(rnd_{i,j}) \quad x2_{i,j} := xo2(rnd_{i,j})$

$x3_{i,j} := xo3(rnd_{i,j}) \quad x4_{i,j} := xo4(rnd_{i,j}) \quad y_{i,j} := yo(rnd_{i,j})$

$x(j) := \text{augment}(x0^{<j>}, \text{augment}(x1^{<j>}, \text{augment}(x2^{<j>}, \text{augment}(x3^{<j>}, x4^{<j>}))))$

$y(j) := y^{<j>}$

$\beta(j) := \beta_0 + (xo^T \cdot xo)^{-1} \cdot xo^T \cdot y(j) - (xo^T \cdot xo)^{-1} \cdot xo^T \cdot x(j) \cdot \beta_0$

$yb_{i,j} := \beta(j)_0 \cdot x(j)_{i,0} + \beta(j)_1 \cdot x(j)_{i,1} + \beta(j)_2 \cdot x(j)_{i,2} + \beta(j)_3 \cdot x(j)_{i,3} + \beta(j)_4 \cdot x(j)_{i,4}$

Residu

$ea_i := yo_i - ya_i$

$eb_{i,j} := y(j)_i - (yb^{<j>})_i$

Lampiran 3: Program Komputasi Regresi Dalam MathCAD

$$sse := \sum_{i=0}^{M-1} (ea_i)^2 \quad MSe := \frac{sse}{M-P+1} \quad MSe = 6.425512 \cdot 10^4$$

$$ssr := \beta_o^T \cdot x_o^T \cdot y_o - \frac{\left(\sum_{i=0}^{M-1} y_{o_i} \right)^2}{M} \quad MSr := \frac{ssr}{P-2} \quad MSr = 2.014894 \cdot 10^6$$

$$syy := sse + ssr$$

$$syy = 1.017999 \cdot 10^7$$

F Hitung

Koefisien Determinasi R^2

$$F_o := \frac{MSr}{MSe}$$

$$r := \frac{|ssr|}{|syy|}$$

$$F_o = 31.357715$$

$$r = 0.791707$$

Parameter Bootstrap

$$sse_{b_j} := \sum_{i=0}^{M-1} \left[(eb^{<j>})_i \right]^2 \quad MSe_{b_j} := \frac{sse_{b_j}}{M-P+1}$$

$$ssr_{b(j)} := \beta(j)^T \cdot x(j)^T \cdot y(j) - \frac{\left(\sum_{i=0}^{M-1} y(j)_i \right)^2}{M} \quad MSr_{b(j)} := \frac{ssr_{b(j)}}{P-2}$$

$$syy(j) := sse_{b_j} + ssr_{b(j)}$$

$$F_{b_j} := \frac{|MSr_{b(j)}|}{|MSe_{b_j}|} \quad r_{b_j} := \frac{|ssr_{b(j)}|}{|syy(j)|}$$

**** MULTIPLE REGRESSION ****

Equation Number 1 Dependent Variable.. Y

Block Number 1. Method: Enter X1 X2 X3 X4

Variable(s) Entered on Step Number

- 1.. X4
- 2.. X1
- 3.. X3
- 4.. X2

Multiple R .88978
 R Square .79171
 Adjusted R Square .76646
 Standard Error 253.48593

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	4	8059574.84388	2014893.71097
Residual	33	2120418.90494	64255.11833

F = 31.35772 Signif F = .0000

**** MULTIPLE REGRESSION ****

Equation Number 1 Dependent Variable.. Y

----- Variables in the Equation -----

Variable	B	SE B	95% Confidnce Intrvl B	Beta
X1	5.612795	.728523	4.130603 7.094987	.753768
X2	-14.634205	6.799390	-28.467668 -.800742	-.214033
X3	1.841453	.708507	.399985 3.282921	.219317
X4	7.584108	1.712013	4.100992 11.067223	.377360
(Constant)	3251.422270	384.411213	2469.331772 4033.512768	

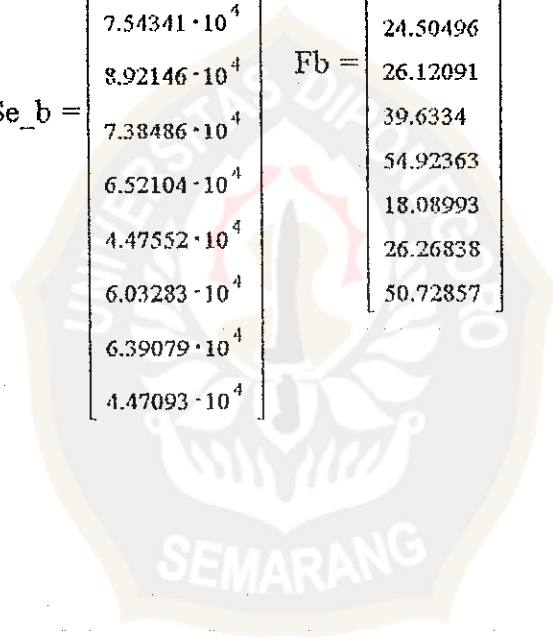
Variable	T	Sig T
X1	7.704	.0000
X2	-2.152	.0388
X3	2.599	.0139
X4	4.430	.0001
(Constant)	8.458	.0000

Output komputasi regresi bootstrap berupa:
Residu, Rata-rata kuadrat error, F hitung dan koefisien determinasi

$$\min(\text{sse_b}) = 1.47541 \cdot 10^6$$

$$\max(\text{sse_b}) = 2.94408 \cdot 10^6$$

sse_b =	$2.744004 \cdot 10^6$	MSe_b =	$8.31516 \cdot 10^4$	Fb =	20.20128	r_b =	0.71003
	$2.487106 \cdot 10^6$		$7.53668 \cdot 10^4$		31.71073		0.79355
	$2.619679 \cdot 10^6$		$7.93842 \cdot 10^4$		16.589		0.66786
	$2.489325 \cdot 10^6$		$7.54341 \cdot 10^4$		22.80996		0.73438
	$2.944081 \cdot 10^6$		$8.92146 \cdot 10^4$		24.50496		0.74813
	$2.437003 \cdot 10^6$		$7.38486 \cdot 10^4$		26.12091		0.75997
	$2.151942 \cdot 10^6$		$6.52104 \cdot 10^4$		39.6334		0.82771
	$1.476922 \cdot 10^6$		$4.47552 \cdot 10^4$		54.92363		0.86941
	$1.990834 \cdot 10^6$		$6.03283 \cdot 10^4$		18.08993		0.68679
	$2.108962 \cdot 10^6$		$6.39079 \cdot 10^4$		26.26838		0.761
	$1.475408 \cdot 10^6$		$4.47093 \cdot 10^4$		50.72857		0.86012



Nilai Koefisien regresi metode klasik dan
metode bootstrap

$$\begin{aligned}
 b_0 &= \begin{bmatrix} 3.25142 \cdot 10^3 \\ 5.61279 \\ -14.63409 \\ 1.84146 \\ 7.58408 \end{bmatrix} & b(0) &= \begin{bmatrix} 2.54073 \cdot 10^3 \\ 6.02136 \\ -6.40467 \\ 2.24078 \\ 7.44043 \end{bmatrix} & b(1) &= \begin{bmatrix} 3.24016 \cdot 10^3 \\ 4.68264 \\ -12.5444 \\ 1.5135 \\ 10.86118 \end{bmatrix} & b(2) &= \begin{bmatrix} 2.55854 \cdot 10^3 \\ 5.16368 \\ -3.06159 \\ 1.50478 \\ 8.14497 \end{bmatrix} \\
 b(3) &= \begin{bmatrix} 2.90835 \cdot 10^3 \\ 5.30713 \\ -8.28988 \\ 1.6503 \\ 8.60784 \end{bmatrix} & b(4) &= \begin{bmatrix} 2.78715 \cdot 10^3 \\ 5.32613 \\ -5.41654 \\ 1.67019 \\ 6.0388 \end{bmatrix} & b(5) &= \begin{bmatrix} 2.54737 \cdot 10^3 \\ 6.69388 \\ -13.42993 \\ 2.02182 \\ 9.94389 \end{bmatrix} & b(6) &= \begin{bmatrix} 2.98466 \cdot 10^3 \\ 5.00085 \\ -5.5382 \\ 2.30986 \\ 5.18911 \end{bmatrix} \\
 b(7) &= \begin{bmatrix} 3.24699 \cdot 10^3 \\ 5.53627 \\ -16.15146 \\ 1.93729 \\ 10.30963 \end{bmatrix} & b(8) &= \begin{bmatrix} 2.99945 \cdot 10^3 \\ 4.90585 \\ -7.92922 \\ 2.7203 \\ 7.48963 \end{bmatrix} & b(9) &= \begin{bmatrix} 3.12901 \cdot 10^3 \\ 5.12168 \\ -9.65772 \\ 0.85119 \\ 7.45193 \end{bmatrix} & b(10) &= \begin{bmatrix} 3.19948 \cdot 10^3 \\ 6.60379 \\ -18.7707 \\ 1.60015 \\ 7.62754 \end{bmatrix}
 \end{aligned}$$

Resampel 1

Variabel	B	Uji kecocokan model
konstanta	$b(0)_0 = 2.5407274 \cdot 10^3$	F Hitung = $Fb_0 = 20.2012775$
X1	$b(0)_1 = 6.021357$	$R^2 = r_{b_0} = 0.7100306$
X2	$b(0)_2 = -6.4046676$	MSe = $MSe_{b_0} = 8.3151633 \cdot 10^4$
X3	$b(0)_3 = 2.2407828$	Residu $sse_{b_0} = 2.7440039 \cdot 10^6$
X4	$b(0)_4 = 7.4404295$	

Resampel 2

Variabel	B	Uji kecocokan model
konstanta	$b(1)_0 = 3.2401557 \cdot 10^3$	F Hitung = $Fb_1 = 31.7107338$
X1	$b(1)_1 = 4.6826367$	$R^2 = r_{b_1} = 0.7935473$
X2	$b(1)_2 = -12.5443998$	MSe = $MSe_{b_1} = 7.5366843 \cdot 10^4$
X3	$b(1)_3 = 1.5134971$	Residu $sse_{b_1} = 2.4871058 \cdot 10^6$
X4	$b(1)_4 = 10.8611849$	

Resampel 3

Variabel	B	Uji kecocokan model
konstanta	$b(2)_0 = 2.5585404 \cdot 10^3$	F Hitung = $Fb_2 = 16.5889975$
X1	$b(2)_1 = 5.1636829$	$R^2 = r_{b_2} = 0.667861$
X2	$b(2)_2 = -3.0615869$	MSe = $MSe_{b_2} = 7.9384202 \cdot 10^4$
X3	$b(2)_3 = 1.504776$	Residu $sse_{b_2} = 2.6196787 \cdot 10^6$
X4	$b(2)_4 = 8.1449713$	

Resampel 4

Variabel	B	Uji kecocokan model
konstanta	$b(3)_0 = 2.9083516 \cdot 10^3$	F Hitung = $Fb_3 = 22.8099598$
X1	$b(3)_1 = 5.3071265$	$R^2 = r_{b_3} = 0.7343847$
X2	$b(3)_2 = -8.289879$	MSe = $MSe_{b_3} = 7.5434081 \cdot 10^4$
X3	$b(3)_3 = 1.6502978$	Residu $sse_{b_3} = 2.4893247 \cdot 10^6$
X4	$b(3)_4 = 8.6078373$	

Resampel 5

Variabel	B	Uji kecocokan model
konstanta	$b(4)_0 = 2.7871534 \cdot 10^3$	F Hitung = $Fb_4 = 24.504963$
X1	$b(4)_1 = 5.3261802$	$R^2 = r_{b_4} = 0.7481298$
X2	$b(4)_2 = -5.4165408$	MSe = $MSe_{b_4} = 8.9214563 \cdot 10^{-4}$
X3	$b(4)_3 = 1.6701914$	Residu $sse_{b_4} = 2.9440806 \cdot 10^{-6}$
X4	$b(4)_4 = 6.0388014$	

Resampel 6

Variabel	B	Uji kecocokan model
konstanta	$b(5)_0 = 2.5473739 \cdot 10^3$	F Hitung = $Fb_5 = 26.1209076$
X1	$b(5)_1 = 6.6938804$	$R^2 = r_{b_5} = 0.7599714$
X2	$b(5)_2 = -13.4299269$	MSe = $MSe_{b_5} = 7.3848573 \cdot 10^{-4}$
X3	$b(5)_3 = 2.0218177$	Residu $sse_{b_5} = 2.4370029 \cdot 10^{-6}$
X4	$b(5)_4 = 9.9438919$	

Resampel 7

Variabel	B	Uji kecocokan model
konstanta	$b(6)_0 = 2.9846629 \cdot 10^3$	F Hitung = $Fb_6 = 39.6334001$
X1	$b(6)_1 = 5.0008491$	$R^2 = r_{b_6} = 0.8277065$
X2	$b(6)_2 = -5.5382014$	MSe = $MSe_{b_6} = 6.5210365 \cdot 10^{-4}$
X3	$b(6)_3 = 2.3098646$	Residu $sse_{b_6} = 2.151942 \cdot 10^{-6}$
X4	$b(6)_4 = 5.1891116$	

Resampel 8

Variabel	B	Uji kecocokan model
konstanta	$b(7)_0 = 3.2469918 \cdot 10^3$	F Hitung = $Fb_7 = 54.9236251$
X1	$b(7)_1 = 5.5362743$	$R^2 = r_{b_7} = 0.8694075$
X2	$b(7)_2 = -16.1514615$	MSe = $MSe_{b_7} = 4.4755202 \cdot 10^{-4}$
X3	$b(7)_3 = 1.9372869$	Residu $sse_{b_7} = 1.4769217 \cdot 10^{-6}$
X4	$b(7)_4 = 10.3096346$	

Resampel 9

Variabel	B	Uji kecocokan model	
konstanta	$b(8)_0 = 3.0608595 \cdot 10^3$	F Hitung =	$Fb_g = 35.4538049$
X1	$b(8)_1 = 6.3484772$	$R^2 =$	$r_{b_g} = 0.8112293$
X2	$b(8)_2 = -15.5902817$	MSe =	$MSe_{b_g} = 5.1382447 \cdot 10^4$
X3	$b(8)_3 = 1.4101425$	Residu	$sse_{b_g} = 1.6956208 \cdot 10^6$
X4	$b(8)_4 = 7.299582$		

Resampel 10

Variabel	B	Uji kecocokan model	
konstanta	$b(9)_0 = 3.2269963 \cdot 10^3$	F Hitung =	$Fb_9 = 32.6840667$
X1	$b(9)_1 = 5.4917404$	$R^2 =$	$r_{b_9} = 0.7984564$
X2	$b(9)_2 = -13.4416105$	MSe =	$MSe_{b_9} = 5.4035114 \cdot 10^4$
X3	$b(9)_3 = 1.767496$	Residu	$sse_{b_9} = 1.7831588 \cdot 10^6$
X4	$b(9)_4 = 8.1069154$		

Resampel 11

Variabel	B	Uji kecocokan model	
konstanta	$b(10)_0 = 3.0369837 \cdot 10^3$	F Hitung =	$Fb_{10} = 26.5729258$
X1	$b(10)_1 = 4.624713$	$R^2 =$	$r_{b_{10}} = 0.7630871$
X2	$b(10)_2 = -6.8517567$	MSe =	$MSe_{b_{10}} = 8.3750009 \cdot 10^4$
X3	$b(10)_3 = 1.5046061$	Residu	$sse_{b_{10}} = 2.7637503 \cdot 10^6$
X4	$b(10)_4 = 8.251108$		

Uji kecocokan model terhadap parameter B untuk metode klasik

Variabel	B	Uji kecocokan model	
konstanta	$bo_0 = 3.2514155 \cdot 10^3$	F Hitung =	$fo = 31.3576234$
X1	$bo_1 = 5.6127934$	$R^2 =$	$r = 0.7917068$
X2	$bo_2 = -14.634088$	MSe =	$MSe = 6.4255268 \cdot 10^4$
X3	$bo_3 = 1.8414625$	Residu	$sse = 2.1204238 \cdot 10^6$
X4	$bo_4 = 7.5840791$		

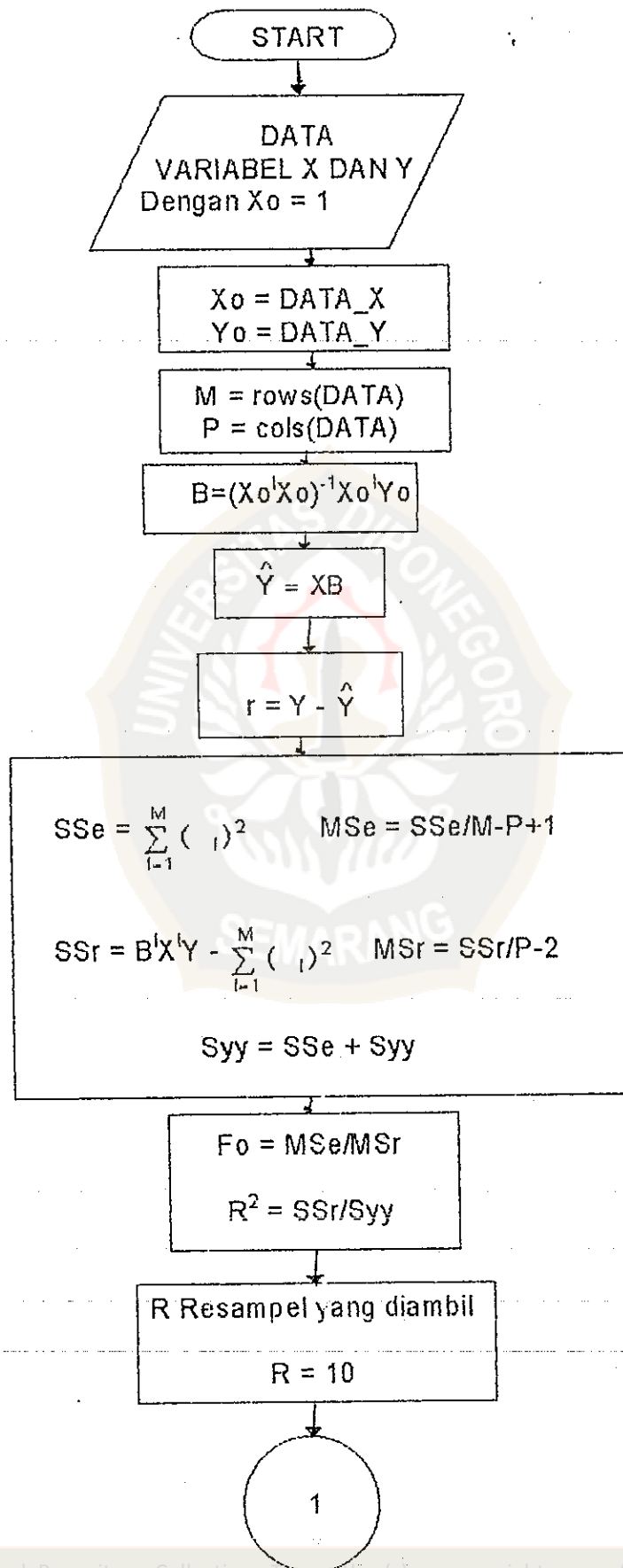
Output Komputasi regresi bootstrap berupa matriks pembangkit bilangan acak dengan randomize seed value = 1

Resampel secara random digambarkan dengan bilangan-bilangan pada kolom dalam matriks. Bilangan integer tersebut merupakan nomor record dari data pengamatan

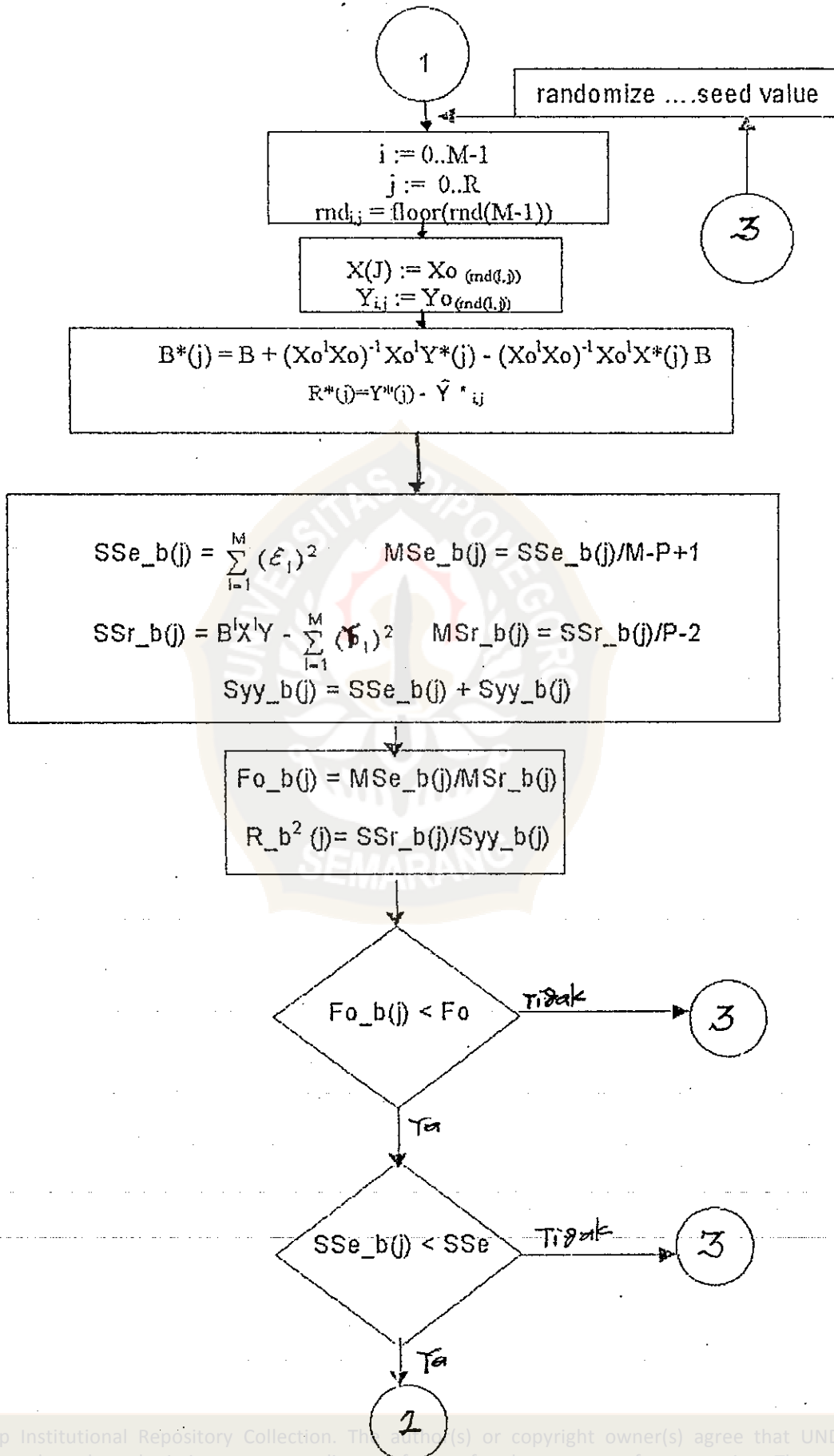
rnd =

0	7	21	12	30	6	26	11	3	5	36
4	0	19	22	6	16	2	28	19	32	35
19	17	31	28	36	22	9	31	13	25	0
10	21	30	17	27	16	27	22	27	21	5
15	19	27	6	18	25	5	5	25	15	35
5	30	7	30	5	27	10	25	26	4	30
19	15	35	20	17	31	16	36	27	7	31
18	1	21	19	31	24	31	4	11	10	5
30	22	9	0	29	7	20	4	27	20	16
25	16	21	23	18	25	7	6	16	3	3
34	33	8	15	23	16	22	31	23	20	6
20	8	22	21	18	27	22	29	21	33	26
24	11	11	4	31	5	2	23	20	15	17
5	27	30	32	11	4	29	22	2	24	3
8	34	24	18	18	18	25	22	0	3	31
27	14	20	35	6	4	35	1	2	4	31
26	0	26	8	6	12	13	29	19	29	5
14	5	2	21	20	11	29	10	33	27	13
8	8	20	1	19	3	32	5	34	1	12
14	35	19	25	9	19	14	21	25	16	0
22	21	8	0	3	31	30	25	19	5	26
1	23	3	35	10	36	10	13	8	8	33
33	2	6	28	7	0	4	11	1	7	5
32	7	23	33	34	5	21	34	21	9	12
29	2	21	7	23	22	16	14	21	35	14
6	21	23	1	9	33	26	14	33	14	13
27	27	7	25	13	4	7	24	25	2	1
11	5	2	26	25	24	3	1	17	26	25
13	1	6	11	7	17	16	22	14	31	23
1	31	11	0	14	1	31	14	22	32	22
29	21	21	24	0	12	28	32	26	33	19
28	7	29	31	23	22	9	29	26	3	31
11	17	7	36	23	6	10	31	13	8	8
35	0	5	0	23	15	3	25	24	19	1
9	31	3	26	31	10	23	30	32	33	16
13	15	0	28	3	25	5	1	0	23	33
15	8	24	0	5	20	17	11	12	22	36
5	26	28	22	25	20	20	9	18	24	23

Lampiran 6



Lampiran 6



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