CB-SEM DENGAN STATCAL (PACKAGE LAVAAN)

**DISERTAI PERBANDINGAN HASIL DENGAN
SOFTWARE LISREL & AMOS**

(10 Maret 2018: Versi I)

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Sitasi (Bila Ingin Dicantumkan dalam Daftar Pustaka Anda):

1. Gio, Prana U., 2018. "CB-SEM Dengan STATCAL Disertai Perbandingan Hasil Software AMOS Dan LISREL". INA-Rxiv. March 10. osf.io/preprints/inarxiv/7tcsh.
2. Gio, Prana U., 2018. "Perbandingan STATCAL, Smartpls Dan Warppls (PLS-PM)". INA-Rxiv. March 10. osf.io/preprints/inarxiv/ep47w.
3. Gio, Prana U, Rezzy E Caraka, RIZKI SYAHPUTRA, Anil H Syofra, Dina Nazriani, Meigia N Sari, and puteri a lubis. 2018. "Panduan Mengolah Data Dengan STATCAL (Disertai Perbandingan Hasil Dengan SPSS, Minitab, EViews, Amos, LISREL, SmartPLS & WarpPLS)." Open Science Framework. March 4. osf.io/huxaj.

Segala informasi dan modul tentang STATCAL dapat diperoleh di:

<http://statcal.info/>

<http://www.learningstatcal.com/>

1. Model

Gambar 1 merupakan model yang akan diuji.

Gambar 1 Model dengan 3 Variabel Laten (STATCAL)

Berdasarkan Gambar 1, diketahui:

- ⇒ Terdapat 3 variabel laten, yakni X, Y, dan Z.
- ⇒ Variabel laten X memiliki 3 indikator, yakni x1, x2, dan x3.
- ⇒ Variabel laten Y memiliki 3 indikator, yakni y1, y2 dan y3.
- ⇒ Variabel laten Z memiliki 3 indikator, yakni z1, z2 dan z3.

Gambar 2 Model dengan 3 Variabel Laten (AMOS)

Gambar 3 Model dengan 3 Variabel Laten (LISREL)

2. Hipotesis

Berikut hipotesis yang akan diuji.

- ⇒ X berpengaruh positif dan signifikan terhadap Y.
- ⇒ X berpengaruh positif dan signifikan terhadap Z.
- ⇒ Y berpengaruh positif dan signifikan terhadap Z.

3. Data

Data disajikan pada Tabel 1.

Tabel 1 Contoh Data

No	x1	x2	x3	y1	y2	y3	z1	z2	z3
1	2	4	4	4	4	4	4	4	4
2	4	2	4	4	3	4	3	4	4
3	4	4	2	3	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4
5	4	4	4	4	4	4	3	4	3
6	2	2	2	4	4	4	4	4	4
7	4	4	4	2	2	2	5	4	4
8	4	4	4	4	4	4	2	2	2
9	2	4	4	4	4	4	4	4	4
10	4	2	4	4	4	4	4	4	4
11	4	4	2	4	4	4	4	4	4
12	2	2	2	4	4	4	4	4	4
13	4	4	4	2	2	2	4	4	4
14	3	3	3	3	3	3	3	3	3
15	3	3	3	3	3	3	3	3	3
16	3	3	3	3	3	3	3	3	3
17	3	3	3	3	3	3	3	3	3
18	3	3	3	3	3	3	3	3	3
19	3	3	3	3	3	3	3	3	3
20	3	3	3	3	3	3	3	3	3
21	3	3	3	3	3	3	3	3	3
22	3	3	3	3	3	3	3	3	3
23	3	3	3	3	3	3	3	3	3
24	5	5	5	2	5	5	5	5	5
25	5	5	5	5	2	5	5	5	5
26	5	5	4	5	5	2	5	5	5
27	5	5	5	5	5	5	2	2	2
28	4	5	4	5	4	5	4	5	5
29	5	5	5	5	5	5	5	4	5
30	5	5	4	5	5	5	5	5	5
31	5	5	5	4	5	5	5	4	5
32	5	5	5	5	5	5	5	5	5
33	2	2	3	2	2	2	2	2	2
34	2	3	2	2	3	2	2	3	2
35	2	2	2	2	2	2	3	2	2
36	2	2	2	4	4	4	4	4	4

37	4	3	4	4	4	4	4	4	4
38	4	4	4	4	3	4	2	4	4
39	4	4	3	4	4	4	4	2	4
40	4	4	4	4	3	4	4	4	2
41	4	4	4	4	4	3	4	4	4
42	4	4	4	4	4	4	3	4	4
43	4	4	4	4	4	4	4	3	4
44	4	4	4	4	4	4	4	4	3
45	4	4	4	4	4	4	4	4	4
46	4	4	4	4	4	4	4	4	4
47	5	5	5	5	5	5	4	5	5
48	5	4	4	5	5	5	5	5	5
49	5	5	5	5	4	5	5	5	5
50	5	5	5	5	5	5	5	4	5
51	2	4	4	4	4	4	4	4	4
52	4	2	4	4	3	4	3	4	4
53	4	4	2	3	4	4	4	4	4
54	4	4	4	4	4	4	4	4	4
55	4	4	4	4	4	4	3	4	3
56	2	2	2	4	4	4	4	4	4
57	4	4	4	2	2	2	5	4	4
58	4	4	4	4	4	4	2	2	2
59	2	4	4	4	4	4	4	4	4
60	4	2	4	4	4	4	4	4	4
61	4	4	2	4	4	4	4	4	4
62	4	4	4	4	4	4	4	4	4
63	4	4	4	4	4	4	4	4	4
64	3	3	3	3	3	3	3	3	3
65	3	3	3	3	3	3	3	3	3
66	3	3	3	3	3	3	3	3	3
67	3	3	3	3	3	3	3	3	3
68	3	3	3	3	3	3	3	3	3
69	3	3	3	3	3	3	3	3	3
70	3	3	3	3	3	3	3	3	3
71	3	3	3	3	3	3	3	3	3
72	3	3	3	3	3	3	3	3	3
73	3	3	3	3	3	3	3	3	3
74	5	5	5	2	5	5	5	5	5
75	2	2	2	5	2	5	5	5	5
76	5	5	4	5	5	2	5	5	5
77	5	5	5	5	5	5	5	5	5
78	4	5	4	5	4	5	4	5	5
79	5	5	5	5	5	5	5	4	5
80	5	5	4	5	5	5	5	5	5
81	5	5	5	4	5	5	5	4	5

82	5	5	5	5	5	5	5	5	5
83	2	2	3	2	2	2	2	2	2
84	2	3	2	2	3	2	2	3	2
85	2	2	2	2	2	2	3	2	2
86	4	4	4	4	4	4	4	4	4
87	4	3	4	4	4	4	4	4	4
88	4	4	4	4	3	4	2	4	4
89	4	4	3	4	4	4	4	2	4
90	4	4	4	4	3	4	4	4	2
91	4	4	4	4	4	3	4	4	4
92	4	4	4	4	4	4	3	4	4
93	4	4	4	4	4	4	4	3	4
94	4	4	4	4	4	4	4	4	3
95	4	4	4	2	2	2	4	4	4
96	4	4	4	4	4	4	4	4	4
97	5	5	5	5	5	5	2	2	2
98	5	4	4	5	5	5	5	5	5
99	5	5	5	5	4	5	5	5	5
100	5	5	5	5	5	5	5	4	5

Berdasarkan data pada Tabel 1, diketahui jumlah pengamatan sebanyak 100.

4. CB-SEM dengan STATCAL

Untuk melakukan CB-SEM dengan STATCAL, pilih **Statistics => Covariance Based Structural Equation Modeling (CB-SEM) Using Lavaan Package (Alternative of AMOS & LISREL)**, seperti pada Gambar 4.

Gambar 4 CB-SEM dalam STATCAL

Pada Gambar 5, *copy* data, dimulai dari **x1** sampai dengan **z3**, kemudian *paste* di bagian **Put Your Data Below** (Gambar 6).

Gambar 5 *Copy* Data di Microsoft Excel

Covariance Based Structural Equation Modeling (CB-SEM) Using Lavaan Package (Alternative of AMOS & LISREL)

Gambar 6 *Paste* Data di Bagian Put Your Data Below

Model:

```
1 X =~ x1+x2+x3
2 Y =~ y1+y2+y3
3 Z =~ z1+z2+z3
4 Y ~ X
5 Z ~ Y + X
```

Gambar 7 Mendefinisikan Model SEM

Pada Gambar 7, definisikan model SEM.

⇒ Perhatikan bahwa pernyataan

$$X = \sim x1 + x2 + x3$$

berarti X merupakan variabel laten dengan indikator-indikatornya adalah x1, x2, dan x3

$$Y = \sim y1 + y2 + y3$$

berarti Y merupakan variabel laten dengan indikator-indikatornya adalah y1, y2 dan y3, dan seterusnya.

⇒ Perhatikan bahwa pernyataan

$$Y \sim X$$

berarti variabel laten Y sebagai variabel endogen, sementara variabel laten X sebagai variabel eksogen. Dengan kata lain, membuat jalur dari X menuju Y.

⇒ Perhatikan bahwa pernyataan

$$Z \sim Y + X$$

berarti variabel laten Z sebagai variabel endogen, sementara variabel laten Y dan X sebagai variabel eksogen. Dengan kata lain, membuat jalur dari Y menuju Z, dan dari X menuju Z. Gambar 6 disajikan diagram jalurnya.

Gambar 8 Diagram Jalur

5. Pemeriksaan Nilai SLF, AVE, CR, dan *Discriminant Validity*

Berikut disajikan hasil *loading factor* (LF), *standardized loading factor* (SLF), *Error* dan *Standardized Error* berdasarkan STATCAL.

Gambar 9 Nilai SLF, Kovarians dan Koefisien Jalur

Loading Factor, Standardized Loading Factor, Error, Standardized Error

Show 10 entries

Search:

Indicator	Loading Factor	Standardized Loading Factor	Error	Standardized Error
x1	1	0.9081	0.1679	0.1754
x2	0.9393	0.8713	0.2208	0.2408
x3	0.8597	0.8429	0.2377	0.2895
y1	1	0.8501	0.2392	0.2774
y2	0.9342	0.8237	0.2577	0.3215
y3	1.0454	0.874	0.2106	0.2362
z1	1	0.8704	0.2055	0.2424
z2	0.9303	0.8594	0.1967	0.2615
z3	1.1377	0.9596	0.0714	0.0792

Gambar 10 LF, SLF, *Error* dan *Standardized Error*

Berdasarkan Gambar 10, diketahui nilai SLF dari indikator x1 adalah 0,9081, nilai SLF dari indikator x2 adalah 0,8713, dan seterusnya. Diketahui nilai SLF dari seluruh indikator > 0,5. Gambar 11 disajikan grafik berdasarkan nilai SLF untuk setiap indikator.

Gambar 11 Grafik SLF untuk Setiap Indikator

Gambar 12 disajikan nilai AVE dan CR untuk masing-masing variabel laten. Diketahui seluruh nilai AVE > 0,5 dan juga seluruh nilai CR > 0,7.

Average Variance Extracted (AVE) and Construct Reliability (CR)

Show entries
Search:

Latent Variable	Average Variance Extracted (AVE)	Construct Reliability (CR)
X	0.7648	0.9069
Y	0.7216	0.886
Z	0.8056	0.9254

Gambar 12 Nilai AVE dan CR untuk Setiap Variabel Laten

Gambar 13 dan Gambar 14 disajikan grafik batang yang menyajikan nilai AVE dan CR.

Gambar 13 Grafik Batang AVE

Gambar 14 Grafik Batang CR

Gambar 15 disajikan hasil perhitungan untuk pemeriksaan *discriminant validity*.

Discriminant Validity

Show 10 entries

Search:

	X	Y	Z
X	0.87453	0.81082	0.67578
Y	0.81082	0.84947	0.73505
Z	0.67578	0.73505	0.89755

Gambar 15 Pemeriksaan *Discriminant Validity*

Berdasarkan Gambar 15, diketahui:

⇒ $\sqrt{AVE_X} = 0,87453$ yang mana lebih besar dari korelasi antara variabel laten X dengan variabel laten lainnya (korelasi antara X dan Y = 0,81082; korelasi antara X dan Z = 0,67578).

⇒ $\sqrt{AVE_Y} = 0,84947$ yang mana lebih besar dari korelasi antara variabel laten Y dengan variabel laten lainnya (korelasi antara Y dan X = 0,81082; korelasi antara Y dan Z = 0,73505).

⇒ $\sqrt{AVE_Z} = 0,89755$ yang mana lebih besar dari korelasi antara variabel laten Z dengan variabel laten lainnya (korelasi antara Z dan X = 0,67578; korelasi antara Z dan Y = 0,73505).

6. Pengujian Kecocokkan Model secara Keseluruhan (*Goodness of Fit Model*)

Gambar 16 disajikan hasil STATCAL untuk pengujian kecocokkan model secara keseluruhan.

Goodness of Fit Model (Overall)

Show 10 entries

Search:

result

P-Value of Chi-Square	0.79488087
RMSEA	0
NFI	0.975452
CFI	1
GFI	0.960664
AGFI	0.926244
SRMR	0.025386

Gambar 16 Pengujian Model secara Keseluruhan

Berdasarkan hasil pada Gambar 16, diketahui RMSEA $0,000 < 0,1$, NFI $0,9754 > 0,9$, CFI $1 > 0,9$, GFI $0,9606 > 0,9$, AGFI $0,9262 > 0,9$, yang berarti bahwa secara keseluruhan model SEM memiliki kemampuan yang baik dalam hal mencocokkan data sampel (*good fit*).

7. Pengujian Signifikansi (Pengujian Model Struktural)

Gambar 17 disajikan hasil STATCAL untuk pengujian signifikansi.

Test of Significance

Show 10 entries

Search:

Variable	Effect	Variable	Path Coefficient (standarized)	P- Value	z- value	Result
X	->	Y	0.7509	0	13.4651	The Effect is Significant at level of significance 5% (P-Value < 0.05)
Y	->	Z	0.4809	0.0003	3.6104	The Effect is Significant at level of significance 5% (P-Value < 0.05)
X	->	Z	0.273	0.0446	2.0087	The Effect is Significant at level of significance 5% (P-Value < 0.05)

Gambar 17 Pengujian Signifikansi

Berdasarkan Gambar 17, diperoleh hasil sebagai berikut.

- ⇒ Nilai koefisien jalur X menuju Y adalah 0,7509 yakni bernilai positif. Nilai tersebut dapat diartikan bahwa X berpengaruh positif terhadap Y. Diketahui nilai p-value 0,000 < tingkat signifikansi 0,05, maka X berpengaruh signifikan terhadap Y.
- ⇒ Nilai koefisien jalur Y menuju Z adalah 0,4809 yakni bernilai positif. Nilai tersebut dapat diartikan bahwa Y berpengaruh positif terhadap Z. Diketahui nilai p-value 0,0003 < tingkat signifikansi 0,05, maka Y berpengaruh signifikan terhadap Z.
- ⇒ Nilai koefisien jalur X menuju Z adalah 0,273 yakni bernilai positif. Nilai tersebut dapat diartikan bahwa X berpengaruh positif terhadap Z. Diketahui nilai p-value 0,0446 < tingkat signifikansi 0,05, maka X berpengaruh signifikan terhadap Z.

Gambar 18 disajikan nilai koefisien determinasi.

The image shows a screenshot of the R-Square website. At the top, the title "R-Square" is displayed in a large, bold, red font. Below the title, there is a search bar with the text "Search:" and a dropdown menu showing "25" entries. Below the search bar, there is a table with two columns: the first column lists variables (x1, x2, x3, y1, y2, y3, z1, z2, z3, Y, Z) and the second column shows their corresponding R-squared values. The table has an orange header and orange rows. The R-squared values are: x1 (0.8246), x2 (0.7592), x3 (0.7105), y1 (0.7226), y2 (0.6785), y3 (0.7638), z1 (0.7576), z2 (0.7385), z3 (0.9208), Y (0.5638), and Z (0.5031).

	R-Square ↕
x1	0.8246
x2	0.7592
x3	0.7105
y1	0.7226
y2	0.6785
y3	0.7638
z1	0.7576
z2	0.7385
z3	0.9208
Y	0.5638
Z	0.5031

Gambar 18 R-Square

Berdasarkan Gambar 18, diketahui:

- ⇒ Nilai *r-square* pada variabel laten Y adalah 0,5638. Nilai tersebut dapat diartikan variabel laten X mampu menjelaskan Y sebesar 56,38%.
- ⇒ Diketahui nilai *r-square* pada variabel laten Z adalah 0,5031. Nilai tersebut dapat diartikan variabel laten X dan Y mampu menjelaskan Z sebesar 50,31%.

8. Perbandingan Nilai SLF antara STATCAL, LISREL dan AMOS

Tabel 2 disajikan hasil perbandingan SLF antara STATCAL, LISREL dan AMOS.

Tabel 2 Perbandingan SLF antara STATCAL, LISREL, dan AMOS

SLF	STATCAL	AMOS	LISREL
x1	0.9081	0.908	0.9081
x2	0.8713	0.871	0.8713
x3	0.8429	0.843	0.8429
y1	0.8501	0.85	0.8501
y2	0.8237	0.824	0.8237
y3	0.874	0.874	0.874
z1	0.8704	0.87	0.8704
z2	0.8594	0.859	0.8594
z3	0.9596	0.96	0.9596

9. Perbandingan Nilai Goodness of Fit antara STATCAL, LISREL dan AMOS

Tabel 3 disajikan hasil perbandingan *goodness of fit* antara STATCAL, LISREL dan AMOS.

Tabel 3 Perbandingan Nilai Goodness of Fit antara STATCAL, LISREL, dan AMOS

Goodness of Fit	STATCAL	AMOS	LISREL
P-Value	0.7948 mendekati 0.80	0.804	0.8038
RMSEA	0	0	0
NFI	0.975452	0.975	0.9755
CFI	1	1	1
GFI	0.960664	0.961	0.9607

AGFI	0.926244	0.926	0.9262
SRMR	0.025386		0.02539

10. *Standardized Path Coefficient* antara STATCAL, LISREL dan AMOS

Tabel 5 disajikan hasil perbandingan *standardized path coefficient* antara STATCAL, LISREL dan AMOS.

Tabel 4 Perbandingan *Standardized Path Coefficient*

Perbandingan	STATCAL	AMOS	LISREL
Path Coef. Standardized X -> Y	0.7509 (P-Value = 0.000; Z-Value = 13.4651)	0.751	0.75
Path Coef. Standardized Y -> Z	0.4809 (P-Value = 0.0003; Z-Value = 3.6104)	0.481	0.48
Path Coef. Standardized Y -> Z	0.273 (P-Value = 0.0446; Z-Value = 2.0087)	0.273	0.27
R-Square Y	0.5638	0.564	0.5638
R-Square Z	0.5031	0.503	0.5031
Path Coef. Unstandardized X -> Y	0.667 (Z-Value = 7.651; P-Value = 0.000)	0.667 (C.R. = 7.612; P = 0.000)	0.6672 (T-Value = 7.6125)
Path Coef. Unstandardized Y -> Z	0.488 (Z-Value = 3.327; P-Value = 0.001)	0.488 (C.R. = 3.310; P = 0.000)	0.4882 (T-Value = 3.3100)
Path Coef. Unstandardized X -> Z	0.246 (Z-Value = 1.965; P-Value = 0.049)	.0246 (C.R. = 1.955; P = 0.051)	0.2463 (T-Value = 1,955)

11. Lampiran Hasil AMOS

P-Value = \p
 RMSEA = \RMSEA
 GFI = \GFI
 AGFI = \AGFI
 TLI = \TLI
 NFI = \NFI
 NNFI = \NNFI
 RMR = \RMR

P-Value = ,804
 RMSEA = ,000
 GFI = ,961
 AGFI = ,926
 TLI = 1,013
 NFI = ,975
 NNFI = ,975
 RMR = ,022

Estimates (Group number 1 - Default model)**Scalar Estimates (Group number 1 - Default model)****Maximum Likelihood Estimates****Regression Weights: (Group number 1 - Default model)**

	Estimate	S.E.	C.R.	P	Label
Y <--- X	,667	,088	7,612	***	par_7
Z <--- Y	,488	,147	3,310	***	par_8
Z <--- X	,246	,126	1,955	,051	par_9
x1 <--- X	1,000				
x2 <--- X	,939	,077	12,132	***	par_1
x3 <--- X	,860	,075	11,426	***	par_2
y1 <--- Y	1,000				
y2 <--- Y	,934	,096	9,772	***	par_3
y3 <--- Y	1,045	,099	10,593	***	par_4
z1 <--- Z	1,000				
z2 <--- Z	,930	,080	11,663	***	par_5
z3 <--- Z	1,138	,082	13,956	***	par_6

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
Y <--- X	,751
Z <--- Y	,481
Z <--- X	,273
x1 <--- X	,908
x2 <--- X	,871
x3 <--- X	,843
y1 <--- Y	,850
y2 <--- Y	,824
y3 <--- Y	,874
z1 <--- Z	,870
z2 <--- Z	,859
z3 <--- Z	,960

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Y	,564
Z	,503
z3	,921
z2	,739
z1	,758
y3	,764
y2	,679
y1	,723
x3	,710
x2	,759
x1	,825

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	21	17,984	24	,804	,749
Saturated model	45	,000	0		
Independence model	9	732,608	36	,000	20,350

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	,022	,961	,926	,512
Saturated model	,000	1,000		
Independence model	,459	,261	,077	,209

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	,975	,963	1,008	1,013	1,000
Saturated model	1,000		1,000		1,000
Independence model	,000	,000	,000	,000	,000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	,667	,650	,667
Saturated model	,000	,000	,000
Independence model	1,000	,000	,000

NCP

Activ
Go to

Independence model	1,000	,000	,000
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NCP

Model	NCP	LO 90	HI 90
Default model	,000	,000	6,772
Saturated model	,000	,000	,000
Independence model	696,608	612,336	788,297

FMN

Model	FMN	F0	LO 90	HI 90
Default model	,182	,000	,000	,068
Saturated model	,000	,000	,000	,000
Independence model	7,400	7,036	6,185	7,963

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	,000	,000	,053	,940
Independence model	,442	,415	,470	,000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	59,984	64,703	114,693	135,693
Saturated model	90,000	100,112	207,233	252,233
Independence model	750,608	752,630	774,054	783,054

ECVI

Model	ECVI	LO 90	HI 90	MECVI
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12. Lampiran Hasil LISREL

```
OBSERVED VARIABLE
x1-x3 y1-y3 z1-z3
COVARIANCE MATRIX FROM FILE D:\LISREL_PERBANDINGAN_STATCAL\X_Y_Z\data.COV
```

```
LATENT VARIABLE X Y Z
SAMPLE SIZE 100
RELATIONSHIP
```

```
x1 = 1*X
x2-x3 = X
```

```
y1 = 1*Y
y2-y3 = Y
```

```
z1 = 1*Z
z2-z3 = Z
```

```
Y = X
Z = X Y
```

```
OPTIONS=SS SC EF RS ND=4
PATH DIAGRAM
END OF PROGRAM
```

The screenshot shows the LISREL Windows Application window titled "LISREL Windows Application - [kode lisrel X Y Z.LS8]". The window has a menu bar with "File", "Edit", "Options", "Window", and "Help". Below the menu bar is a toolbar with various icons. The main text area contains the same text as the previous blocks, including the observed variables, covariance matrix, latent variables, sample size, relationships, and options.

```
LISREL Windows Application - [kode lisrel X Y Z.LS8]
File Edit Options Window Help

OBSERVED VARIABLE
x1-x3 y1-y3 z1-z3
COVARIANCE MATRIX FROM FILE D:\LISREL_PERBANDINGAN_STATCAL\X_Y_Z\data.COV

LATENT VARIABLE X Y Z
SAMPLE SIZE 100
RELATIONSHIP

x1 = 1*X
x2-x3 = X

y1 = 1*Y
y2-y3 = Y

z1 = 1*Z
z2-z3 = Z

Y = X
Z = X Y

OPTIONS=SS SC EF RS ND=4
PATH DIAGRAM
END OF PROGRAM
```

Number of Iterations = 6

LISREL Estimates (Maximum Likelihood)

Measurement Equations

$$y1 = 1.0000 \cdot Y, \text{ Errorvar.} = 0.2416, R^2 = 0.7226$$

(0.04850)
4.9813

$$y2 = 0.9342 \cdot Y, \text{ Errorvar.} = 0.2603, R^2 = 0.6785$$

(0.09560) (0.04831)
9.7719 5.3884

$$y3 = 1.0454 \cdot Y, \text{ Errorvar.} = 0.2127, R^2 = 0.7638$$

(0.09869) (0.04733)
10.5926 4.4937

$$z1 = 1.0000 \cdot Z, \text{ Errorvar.} = 0.2076, R^2 = 0.7576$$

(0.03798)
5.4654

$$z2 = 0.9303 \cdot Z, \text{ Errorvar.} = 0.1987, R^2 = 0.7385$$

(0.07977) (0.03515)
11.6624 5.6531

$$z3 = 1.1377 \cdot Z, \text{ Errorvar.} = 0.07215, R^2 = 0.9208$$

(0.08152) (0.03123)
13.9560 2.3101

$$x1 = 1.0000 \cdot X, \text{ Errorvar.} = 0.1696, R^2 = 0.8246$$

(0.04283)
3.9585

x2 = 0.9393*X, Errorvar.= 0.2231 , R² = 0.7592
 (0.07742) (0.04527)
 12.1320 4.9275

x3 = 0.8597*X, Errorvar.= 0.2401 , R² = 0.7105
 (0.07524) (0.04421)
 11.4265 5.4320

Structural Equations

Y = 0.6672*X, Errorvar.= 0.2746 , R² = 0.5638
 (0.08765) (0.06397)
 7.6125 4.2923

Z = 0.4882*Y + 0.2463*X, Errorvar.= 0.3223 , R² = 0.5031
 (0.1475) (0.1259) (0.06455)
 3.3100 1.9554 4.9926

Reduced Form Equations

Y = 0.6672*X, Errorvar.= 0.2746, R² = 0.5638
 (0.08765)
 7.6125

Z = 0.5720*X, Errorvar.= 0.3877, R² = 0.4022
 (0.08895)
 6.4302

Variances of Independent Variables

X

 0.7972
 (0.1398)
 5.7009

Covariance Matrix of Latent Variables

	Y	Z	X
	-----	-----	-----
Y	0.6295		
Z	0.4383	0.6485	
X	0.5319	0.4560	0.7972

Goodness of Fit Statistics

Degrees of Freedom = 24
 Minimum Fit Function Chi-Square = 17.9841 (P = 0.8038)
 Normal Theory Weighted Least Squares Chi-Square = 18.2417 (P = 0.7911)
 Estimated Non-centrality Parameter (NCP) = 0.0
 90 Percent Confidence Interval for NCP = (0.0 ; 7.1730)

Minimum Fit Function Value = 0.1817
 Population Discrepancy Function Value (F0) = 0.0
 90 Percent Confidence Interval for F0 = (0.0 ; 0.07245)
 Root Mean Square Error of Approximation (RMSEA) = 0.0
 90 Percent Confidence Interval for RMSEA = (0.0 ; 0.05494)
 P-Value for Test of Close Fit (RMSEA < 0.05) = 0.9350

Expected Cross-Validation Index (ECVI) = 0.6667
 90 Percent Confidence Interval for ECVI = (0.6667 ; 0.7391)
 ECVI for Saturated Model = 0.9091
 ECVI for Independence Model = 7.5819

Chi-Square for Independence Model with 36 Degrees of Freedom =
 732.6075

Independence AIC = 750.6075
 Model AIC = 60.2417
 Saturated AIC = 90.0000
 Independence CAIC = 783.0540
 Model CAIC = 135.9503
 Saturated CAIC = 252.2327

Normed Fit Index (NFI) = 0.9755
 Non-Normed Fit Index (NNFI) = 1.0130
 Parsimony Normed Fit Index (PNFI) = 0.6503
 Comparative Fit Index (CFI) = 1.0000
 Incremental Fit Index (IFI) = 1.0085
 Relative Fit Index (RFI) = 0.9632

Critical N (CN) = 237.5986

Root Mean Square Residual (RMR) = 0.02206
 Standardized RMR = 0.02539
 Goodness of Fit Index (GFI) = 0.9607
 Adjusted Goodness of Fit Index (AGFI) = 0.9262
 Parsimony Goodness of Fit Index (PGFI) = 0.5124

Fitted Covariance Matrix

	y1	y2	y3	z1	z2	z3
y1	0.8711					
y2	0.5881	0.8097				
y3	0.6581	0.6148	0.9006			
z1	0.4383	0.4095	0.4582	0.8561		
z2	0.4077	0.3809	0.4262	0.6033	0.7600	
z3	0.4986	0.4658	0.5212	0.7378	0.6864	0.9115
x1	0.5319	0.4969	0.5561	0.4560	0.4242	0.5188
x2	0.4996	0.4668	0.5223	0.4283	0.3985	0.4873
x3	0.4573	0.4272	0.4781	0.3920	0.3647	0.4460

Fitted Covariance Matrix

	x1	x2	x3
x1	0.9668		
x2	0.7488	0.9264	

x3	0.6854	0.6438	0.8294
----	--------	--------	--------

Fitted Residuals

	y1	y2	y3	z1	z2	z3
	-----	-----	-----	-----	-----	-----
y1	0.0000					
y2	-0.0095	0.0000				
y3	0.0159	-0.0103	0.0000			
z1	-0.0443	-0.0054	-0.0390	0.0000		
z2	0.0141	-0.0302	0.0008	0.0078	0.0000	
z3	0.0088	0.0118	0.0113	-0.0004	-0.0019	0.0000
x1	-0.0216	0.0530	-0.0201	0.0213	-0.0002	0.0117
x2	-0.0297	0.0831	-0.0267	0.0288	0.0054	0.0028
x3	-0.0222	0.0047	0.0042	-0.0309	-0.0170	-0.0310

Fitted Residuals

	x1	x2	x3
	-----	-----	-----
x1	0.0000		
x2	-0.0042	0.0000	
x3	0.0024	0.0036	0.0000

Summary Statistics for Fitted Residuals

Smallest Fitted Residual = -0.0443
Median Fitted Residual = 0.0000
Largest Fitted Residual = 0.0831

Stemleaf Plot

```

- 4|4
- 2|911007220
- 0|709542000000000000
  0|12344558912246
  2|19
  4|3
  6|
  8|3

```

Standardized Residuals

	y1	y2	y3	z1	z2	z3
	-----	-----	-----	-----	-----	-----
y1	- -					
y2	-0.6776	- -				
y3	1.5958	-0.8822	- -			
z1	-1.1892	-0.1411	-1.0974	- -		
z2	0.3882	-0.8135	0.0237	0.7290	- -	
z3	0.3200	0.3912	0.4595	-0.1544	-0.6759	- -
x1	-0.7200	1.6570	-0.7298	0.5833	-0.0050	0.4987
x2	-0.8822	2.3674	-0.8446	0.7232	0.1394	0.0963
x3	-0.6358	0.1303	0.1251	-0.7640	-0.4353	-0.9683

Standardized Residuals

	x1	x2	x3
	-----	-----	-----
x1	- -		
x2	-0.6259	- -	

x3 0.2893 0.3026 - -

Summary Statistics for Standardized Residuals

Smallest Standardized Residual = -1.1892
 Median Standardized Residual = 0.0000
 Largest Standardized Residual = 2.3674

Stemleaf Plot

```
- 1|210
- 0|99888777766
- 0|4210000000000
  0|111133344
  0|55677
  1|
  1|67
  2|4
```

Qplot of Standardized Residuals

Standardized Solution

LAMBDA-Y

	Y	Z
	-----	-----
y1	0.7934	- -
y2	0.7412	- -
y3	0.8294	- -
z1	- -	0.8053
z2	- -	0.7492
z3	- -	0.9162

LAMBDA-X

	X

x1	0.8929
x2	0.8386
x3	0.7676

BETA

	Y	Z
	-----	-----
Y	- -	- -
Z	0.4809	- -

GAMMA

	X

Y	0.7509
Z	0.2730

Correlation Matrix of ETA and KSI

	Y	Z	X
	-----	-----	-----
Y	1.0000		
Z	0.6860	1.0000	
X	0.7509	0.6342	1.0000

PSI

Note: This matrix is diagonal.

	Y	Z
	-----	-----
	0.4362	0.4969

Regression Matrix ETA on KSI (Standardized)

	X

Y	0.7509
Z	0.6342

Completely Standardized Solution

LAMBDA-Y

	Y	Z
	-----	-----
y1	0.8501	- -
y2	0.8237	- -
y3	0.8740	- -
z1	- -	0.8704
z2	- -	0.8594
z3	- -	0.9596

LAMBDA-X

	X

x1	0.9081
x2	0.8713
x3	0.8429

BETA

	Y	Z
	-----	-----
Y	- -	- -
Z	0.4809	- -

GAMMA

	X

Y	0.7509
Z	0.2730

Correlation Matrix of ETA and KSI

	Y	Z	X
	-----	-----	-----
Y	1.0000		
Z	0.6860	1.0000	
X	0.7509	0.6342	1.0000

PSI

Note: This matrix is diagonal.

Y	Z
-----	-----
0.4362	0.4969

THETA-EPS

y1	y2	y3	z1	z2	z3
-----	-----	-----	-----	-----	-----
0.2774	0.3215	0.2362	0.2424	0.2615	0.0792

THETA-DELTA

x1	x2	x3
-----	-----	-----
0.1754	0.2408	0.2895

Regression Matrix ETA on KSI (Standardized)

	X

Y	0.7509
Z	0.6342

Total and Indirect Effects

Total Effects of KSI on ETA

	X

Y	0.6672 (0.0877) 7.6125
Z	0.5720 (0.0890) 6.4302

Indirect Effects of KSI on ETA

	X

Y	- -
Z	0.3257 (0.1030) 3.1618

Total Effects of ETA on ETA

	Y	Z
-----	-----	-----
Y	- -	- -
Z	0.4882 (0.1475) 3.3100	- -

Largest Eigenvalue of B*B' (Stability Index) is 0.238

Total Effects of ETA on Y

	Y	Z
-----	-----	-----
y1	1.0000	- -
y2	0.9342 (0.0956) 9.7719	- -
y3	1.0454 (0.0987)	- -

	10.5926	
z1	0.4882 (0.1475) 3.3100	1.0000
z2	0.4541 (0.1375) 3.3037	0.9303 (0.0798) 11.6624
z3	0.5554 (0.1652) 3.3617	1.1377 (0.0815) 13.9560

Indirect Effects of ETA on Y

	Y -----	Z -----
y1	- -	- -
y2	- -	- -
y3	- -	- -
z1	0.4882 (0.1475) 3.3100	- -
z2	0.4541 (0.1375) 3.3037	- -
z3	0.5554 (0.1652) 3.3617	- -

Total Effects of KSI on Y

	X -----
y1	0.6672 (0.0877) 7.6125
y2	0.6234 (0.0842) 7.3992
y3	0.6975 (0.0892) 7.8157
z1	0.5720 (0.0890) 6.4302

z2	0.5321
	(0.0833)
	6.3848
z3	0.6507
	(0.0952)
	6.8362

Standardized Total and Indirect Effects

Standardized Total Effects of KSI on ETA

	X

Y	0.7509
Z	0.6342

Standardized Indirect Effects of KSI on ETA

	X

Y	- -
Z	0.3611

Standardized Total Effects of ETA on ETA

	Y	Z
	-----	-----
Y	- -	- -
Z	0.4809	- -

Standardized Total Effects of ETA on Y

	Y	Z
	-----	-----
y1	0.7934	- -
y2	0.7412	- -
y3	0.8294	- -
z1	0.3873	0.8053
z2	0.3603	0.7492
z3	0.4406	0.9162

Completely Standardized Total Effects of ETA on Y

	Y	Z
	-----	-----
y1	0.8501	- -
y2	0.8237	- -
y3	0.8740	- -
z1	0.4186	0.8704
z2	0.4133	0.8594
z3	0.4615	0.9596

Standardized Indirect Effects of ETA on Y

	Y	Z
	-----	-----
y1	- -	- -

y2	- -	- -
y3	- -	- -
z1	0.3873	- -
z2	0.3603	- -
z3	0.4406	- -

Completely Standardized Indirect Effects of ETA on Y

	Y	Z
	-----	-----
y1	- -	- -
y2	- -	- -
y3	- -	- -
z1	0.4186	- -
z2	0.4133	- -
z3	0.4615	- -

Standardized Total Effects of KSI on Y

	X

y1	0.5958
y2	0.5566
y3	0.6228
z1	0.5107
z2	0.4751
z3	0.5810

Completely Standardized Total Effects of KSI on Y

	X

y1	0.6383
y2	0.6185
y3	0.6563
z1	0.5520
z2	0.5450
z3	0.6086

Time used: 0.016 Seconds

Referensi

Yves Rosseel (2012). lavaan: An R Package for Structural Equation Modeling. Journal of Statistical Software, 48(2), 1-36. URL <http://www.jstatsoft.org/v48/i02/>.

Gio, Prana U, Rezzy E Caraka, RIZKI SYAHPUTRA, Anil H Syofra, Dina Nazriani, Meigia N Sari, and puteri a lubis. 2018. "Panduan Mengolah Data Dengan STATCAL (Disertai Perbandingan Hasil Dengan SPSS, Minitab, EViews, Amos, LISREL, SmartPLS & WarpPLS)." Open Science Framework. March 4. osf.io/huxaj.

Gio, Prana U. 2018. "Perbandingan STATCAL, SmartPLS Dan WarpPLS (PLS-PM)." Open Science Framework. March 10. osf.io/a7gzf.