

MODUL PELATIHAN

STRUCTURAL EQUATION MODEL BASED PARTIAL LEAST SQUARE (SEM-PLS) Menggunakan SmartPLS

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TEKNIK MENGINSTAL SmartPLS

Azuar Juliandi

SISTEM OPERASI KOMPUTER

SmartPLS dapat diinstal dan untuk 2 jenis sistem operasi:

- (1) Mac OS X
- (2) Windows

Khusus untuk sistem operasi “Windows”, SmartPLS menyediakan 2 jenis file instalasi aplikasi yang harus dipilih, yakni:

- (1) Sistem operasi Windows 32 Bit;
- (2) Sistem operasi Windows 64 Bit.

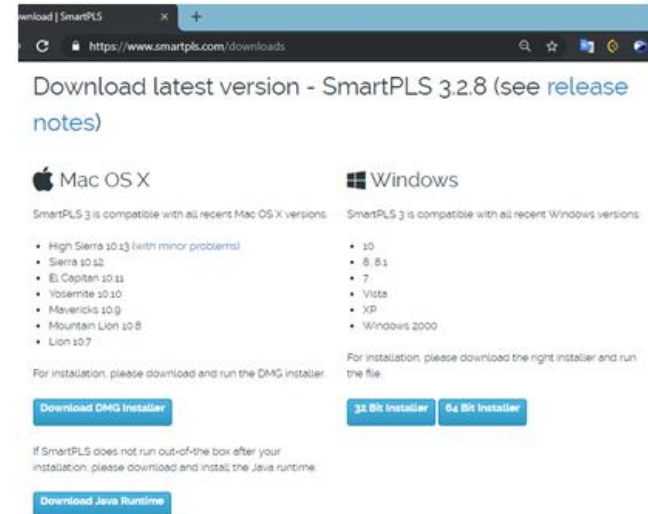
DOWNLOAD

Download terlebih dahulu software SmartPLS di alamat: <https://www.smartpls.com>

Download-lah salah satu file yang sesuai dengan sistem operasi Windows Anda, apakah:

- ❑ [Windows 32 Bit](#)
- ❑ [Windows 64 Bit](#)
- ❑ [Mac-OS](#)

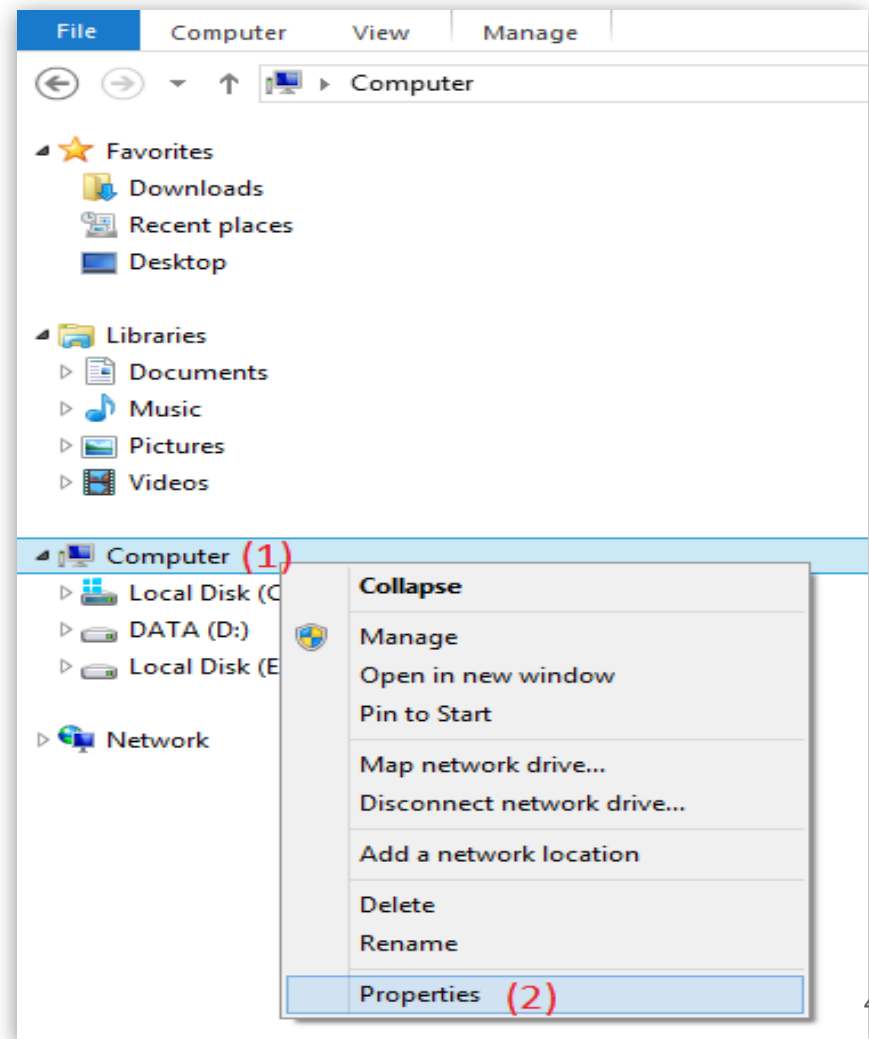
Jika SmartPLS tidak dapat dijalankan setelah diinstal, maka perlu mendownload dan menginstal “Java Runtime”. File instalasi java runtime terlihat pada link “[Download Java Runtime](#)” seperti di dalam gambar.



Untuk mengetahui secara pasti sistem operasi Windows, lakukan langkah-langkah berikut ini:

Buka Windows Explorer

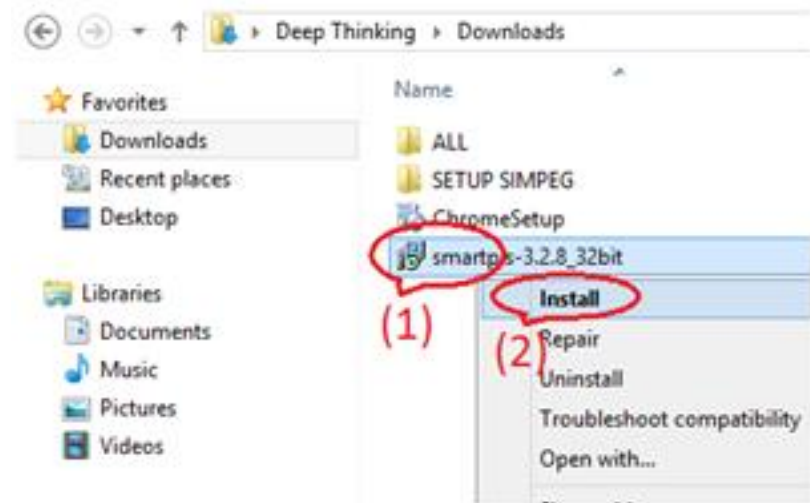
- 1) Klik kanan pada “Computer”
- 2) Klik kiri “Properties”



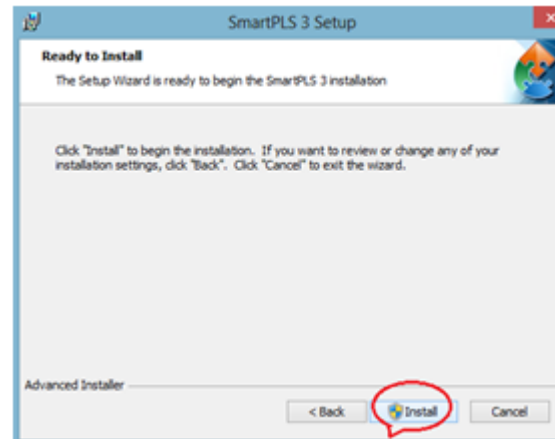
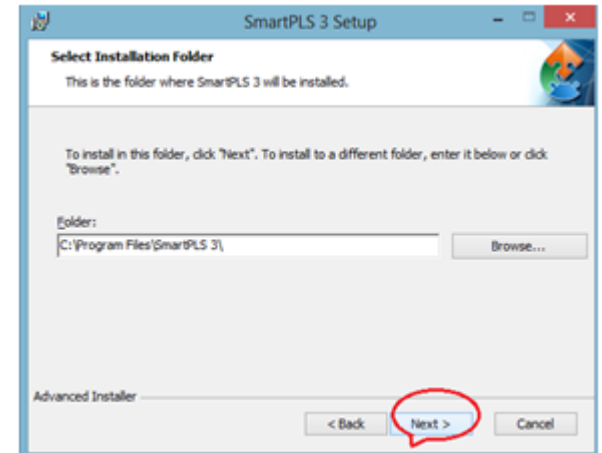
INSTALL APLIKASI

Buka windows explorer

- 1) Klik kanan pada file yang telah didownload, contohnya “Smartpls-3.2.8”
- 2) Klik “install”



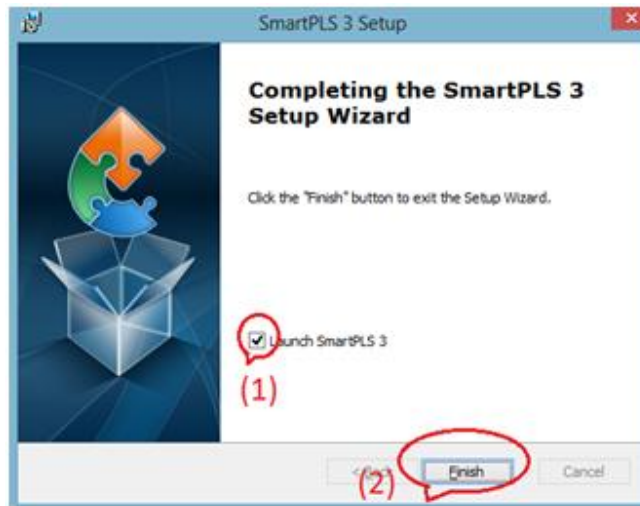
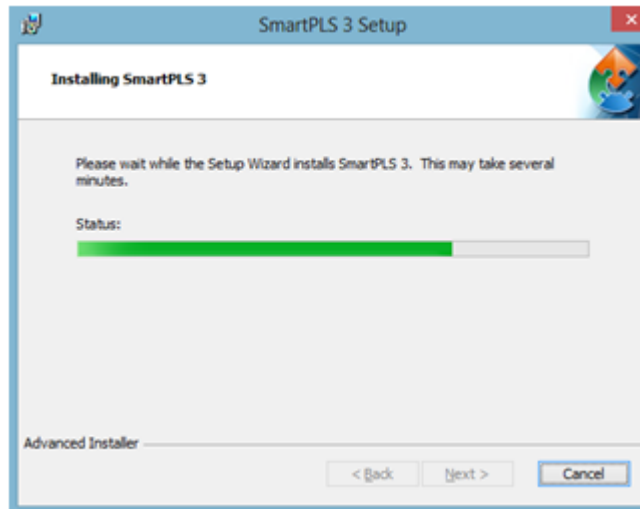
Selanjutnya, klik setiap muncul “Next” dan “Install”



Proses instalasi membutuhkan waktu beberapa menit. Tunggu proses instalasi selesai.

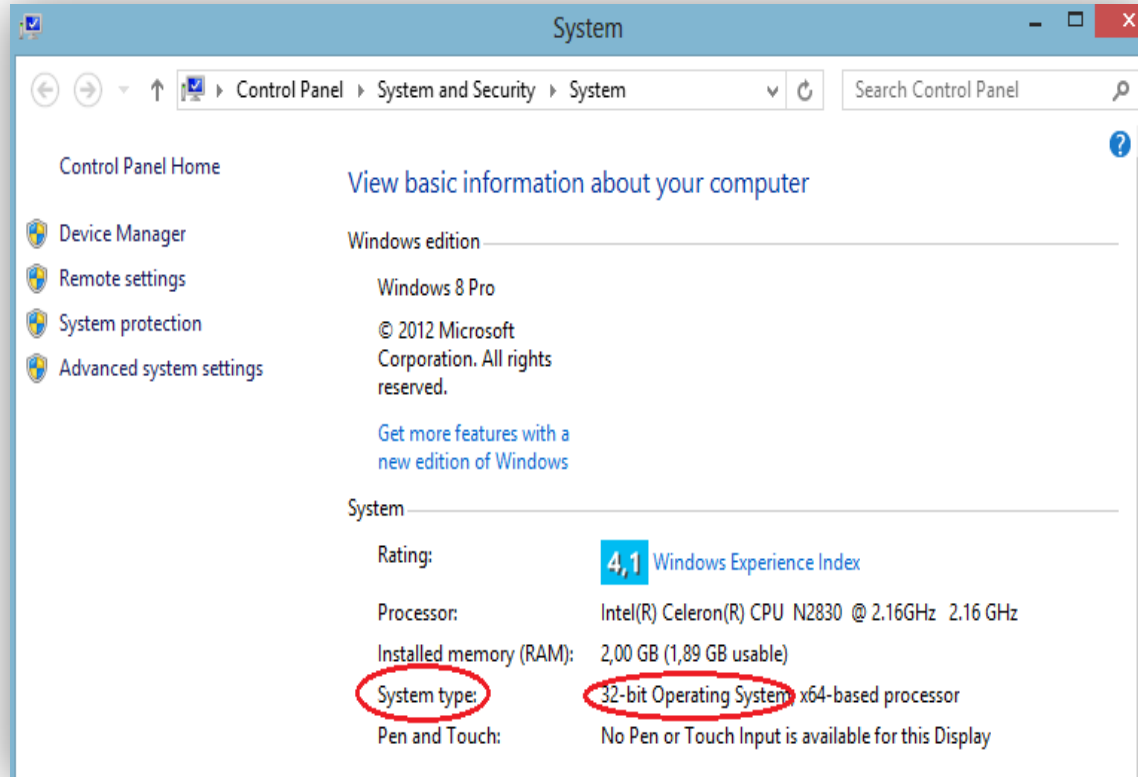
Jika proses instalasi sudah selesai:

- 1) Pastikan “Launch SmartPLS” terceklis
- 2) Klik “Finish”



Pada “System Type” terlihat sistem operasi. Contoh di dalam gambar adalah “32-bit operating system”.

Berdasarkan tipe sistem operasi di atas, maka pengguna perlu mendownload aplikasi SmartPLS yang sesuai dengan sistem operasinya.



PILIHAN LISENSI PENGGUNAAN

SmartPLS akan memberikan 4 pilihan lisensi penggunaan:

	Student	Profesional (1)	Profesional (2)	Profesional (3)
Batas waktu	Selamanya	30 hari	Selamanya	Selamanya
Kelengkapan fitur	Terbatas	Lengkap	Lengkap	Lengkap
Pembayaran	Gratis	Gratis	Berbayar	Berbayar

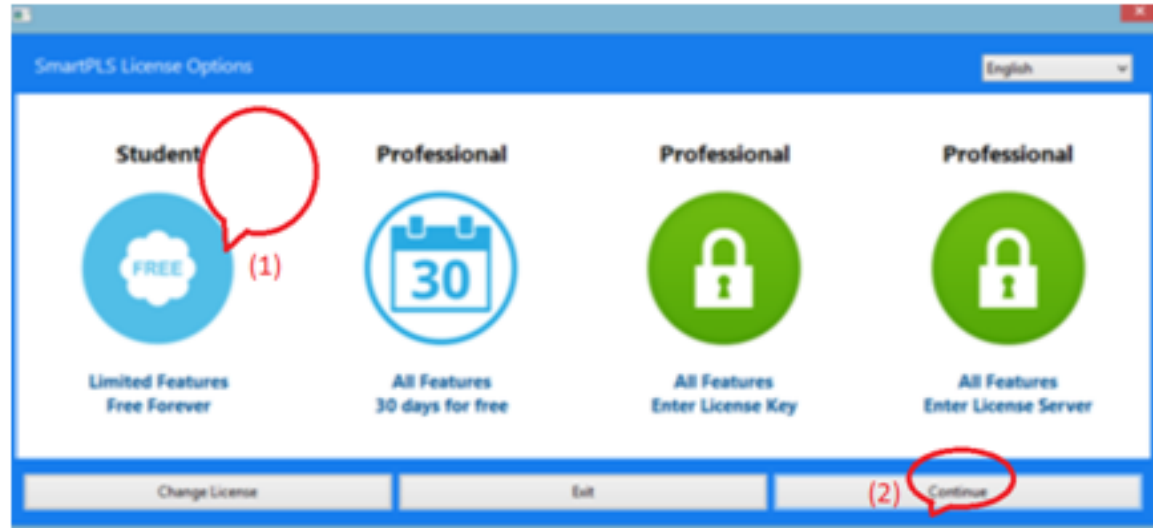
Untuk versi Student, jumlah sampel yang dapat dianalisis hanya 100

Untuk proses lisensi, pengguna harus terhubung ke internet.

Ketika SmartPLS meminta untuk memilih lisensi:

- (1) Pilihlah versi “Student”
- (2) Klik “Continue”

Tunggu hingga proses instalasi selesai.



Terms of Use

The 'Student License' is a single-computer license with limited functionalities. It is, unless otherwise announced by SmartPLS, free but does not give you access to all the functionalities of the software. For example, it does not allow you to use datasets with more than 100 observations, customize colors, fonts and borders, export results to Excel, R and HTML.

Change License

Exit

Continue

Requesting Student license from licensing server. Process may take up to 30s. Please wait ...

Change License

Exit

Continue



Student

Your license is valid

Licensee

SmartPLS (Student)

Expires

never

License Key

SmartPLS Student

Change License

Exit

START

KONSEP PARTIAL LEAST SQUARE (PLS)

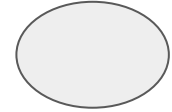
AZUAR JULIANDI

Analisis Multivariat

1) Analisis univariat

Analisis statistik untuk penelitian yang hanya menggunakan satu variabel. Umumnya hanya menggunakan statistik-statistik deskriptif, contohnya:

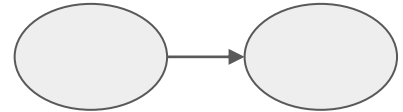
- Mean, Median, Modus, Max, Min, Sum.
- Grafik-grafik, Dsb.



1) Analisis bivariat

Analisis statistik untuk penelitian yang hanya menggunakan dua variabel, contohnya:

- Korelasi sederhana (simple correlation)
- Regresi sederhana (simple regression), Dsb.

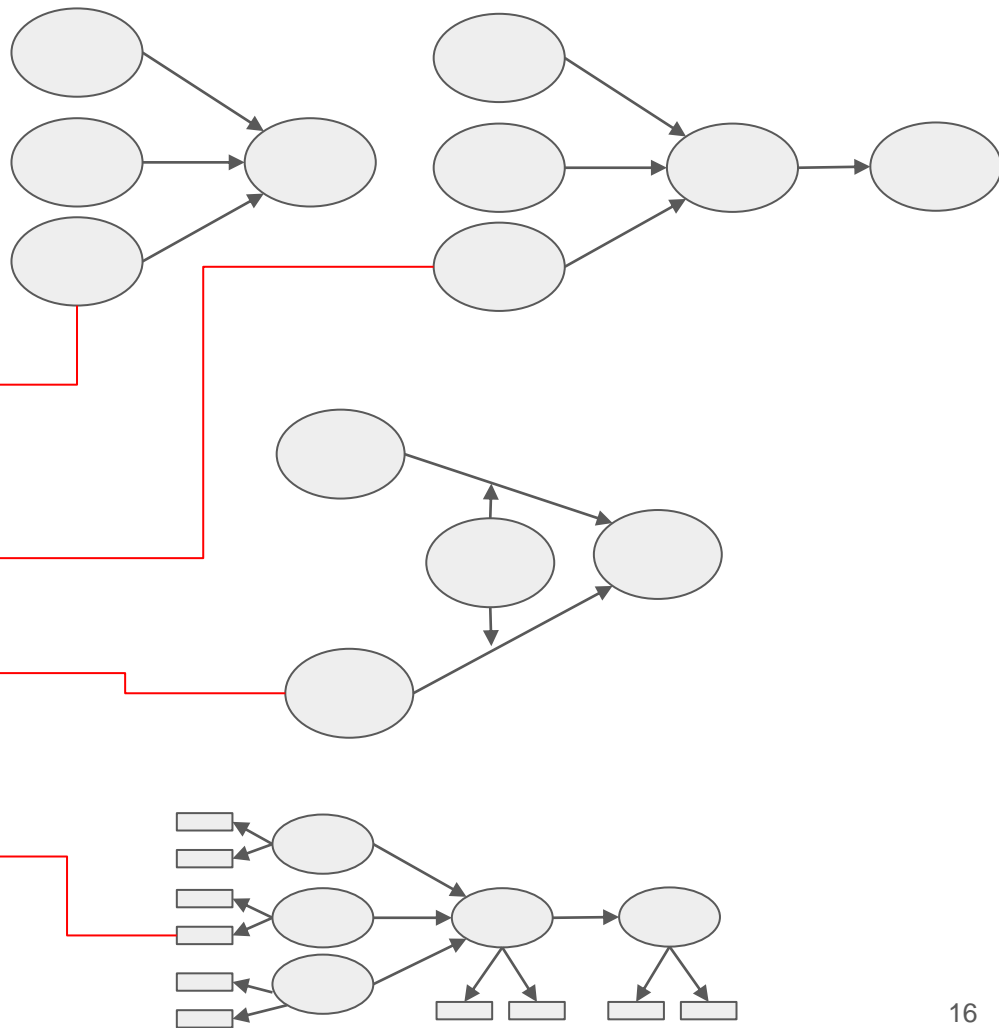


3)

Analisis multivariat

Analisis statistik untuk penelitian yang menggunakan lebih dari dua variabel, contohnya:

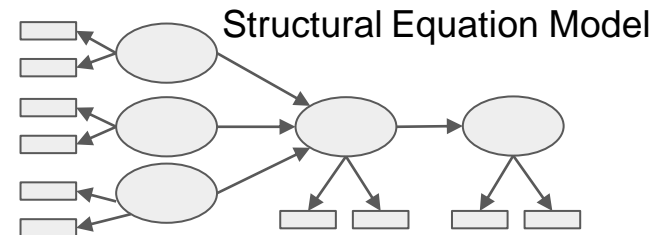
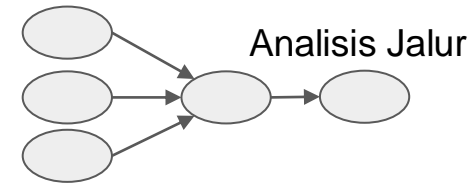
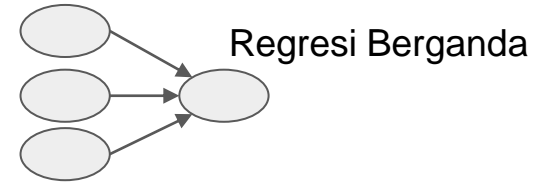
- Korelasi dan regresi berganda
- Analisis jalur (path analysis)
- Moderated Regression Analysis (MRA)
- Structural Equation Model (SEM) atau Model Persamaan Struktural



Model Persamaan Struktural / Structural Equation Modeling (SEM)

Analisis multivariat generasi pertama, hanya mampu menganalisis suatu variabel secara serempak (misalnya regresi berganda, analisis jalur), namun tidak mampu menganalisis sekaligus variabel-variabel dan indikator-indikatornya. Untuk keperluan seperti itu, itu diperlukan SEM.

SEM (Structural Equation Model) atau **Model Persamaan Struktural** adalah analisis statistik untuk penelitian yang membutuhkan analisis secara “serempak/sekaligus” seluruh variabel-variabel dan indikator-indikatornya.



Penelitian terdiri dari 2 pendekatan dan masing-masing memiliki teknik analisis tersendiri:

- ❑ Exploratory research: Penelitian eksploratif, teori sedikit, kurang memadai, atau belum kuat.
- ❑ Confirmatory research: Penelitian konfirmatif, teori banyak, memadai, atau sudah kuat.

	EXPLORATORY Teori yang mendukung penelitian tidak harus kuat, bisa belum memadai	CONFIRMATORY Teori yang mendukung penelitian harus cukup kuat/memadai
Teknik generasi pertama	<ul style="list-style-type: none"> ❑ Cluster analysis ❑ Exploratory factor analysis ❑ Multidimensional scaling 	<ul style="list-style-type: none"> ❑ Analysis of variance (Anava) ❑ Logistic regression ❑ Multiple regression
Teknik generasi kedua	<ul style="list-style-type: none"> ❑ Partial Least Square - Structural Equational Modeling (PLS-SEM) → Software: SmartPLS, Warp PLS, Tetrad, PLS-PM 	<ul style="list-style-type: none"> ❑ Covariance-based Structural Equational Modeling (CB-SEM) → Software: AMOS, Lisrell, EQS, M-Plus

Perbedaan PLS dan CB-SEM

	PLS Partial Least Square	CB-SEM Covariance Based SEM
Tujuan	Prediksi	Konfirmasi teori
Asumsi Normalitas Data	Tidak diperlukan	Diperlukan
Jumlah Sampel	Boleh kecil (≥ 30)	Harus besar (≥ 100)
Bentuk Konstruk	Reflektif & Formatif	Formatif
Jumlah Indikator	Maksimum 1000	Maksimum 100
Software	SmartPLS, Warp PLS, Tetrad, PLS-PM	AMOS, Lisrell, EQS, M-Plus

Kriteria PLS

- ❑ Tidak terpengaruh oleh kekurangan data. Tidak ada masalah dengan sampel yang kecil. Namun ukuran sampel yang lebih besar akan meningkatkan ketepatan estimasi PLS.
- ❑ Tidak memerlukan asumsi distribusi (asumsi normalitas), karena PLS tergolong statistik non-parametrik.
- ❑ Skala pengukuran dapat berupa data berskala metrik (rasio dan interval), data berskala kuasi metrik (ordinal), atau binary (nominal).
- ❑ Mudah menggabungkan model pengukuran reflektif dan formatif.
- ❑ Menangani model yang kompleks dengan banyak hubungan model struktural.
- ❑ Dapat digunakan untuk tujuan prediksi
- ❑ Dapat digunakan sebagai masukan untuk analisis selanjutnya
- ❑ Memiliki kekuatan statistik yang tinggi (High levels of statistical power)

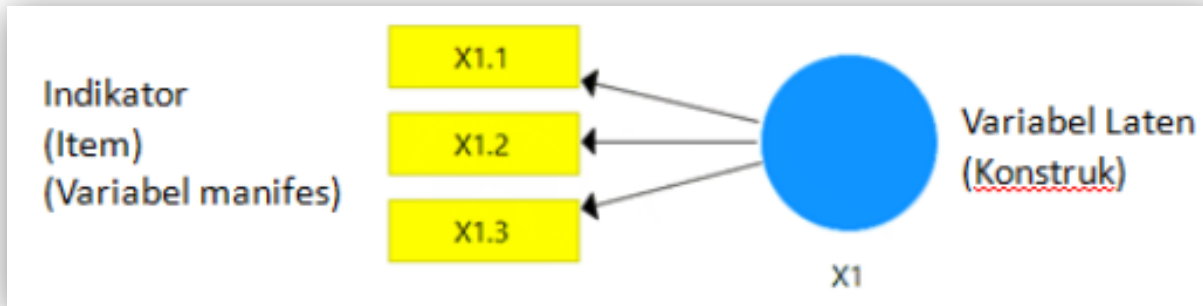
Variabel Dalam PLS

❑ Konstruk:

- ❑ Disebut juga variabel laten
- ❑ Konstruk adalah suatu ukuran yang abstrak, tidak dapat diamati langsung.
- ❑ Di dalam model jalur, konstruk direpresentasikan dengan gambar lingkaran atau oval
- ❑ Jenis variabel laten:
 - ❑ Variabel eksogen: sama dengan variabel independen/variabel bebas, yakni variabel yang bersifat mempengaruhi variabel lain
 - ❑ Variabel endogen: sama dengan variabel dependen/variabel terikat. Namun demikian, variabel endogen juga dapat berperan ganda, yakni berperan sebagai variabel bebas, sekaligus juga variabel terikat

❑ Indikator:

- ❑ Umumnya disebut sebagai item atau variabel manifes atau observed variables.
- ❑ indikator adalah pengamatan yang terukur langsung (data mentah).
- ❑ Direpresentasikan dalam model jalur dengan gambar persegi panjang.



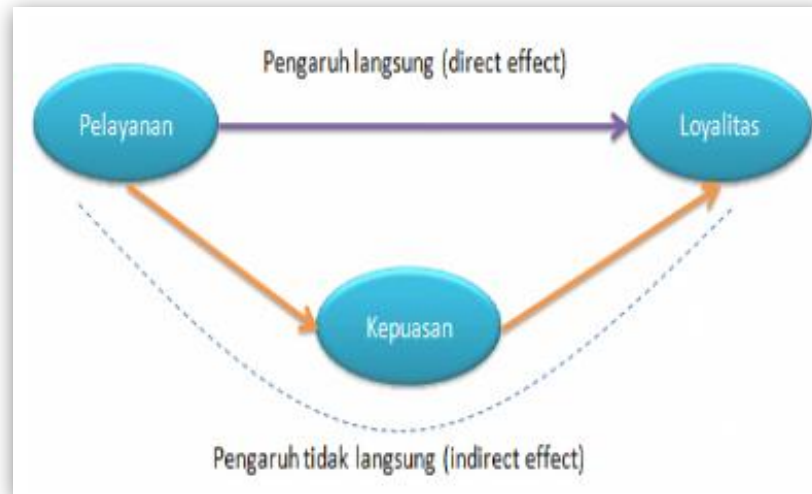
Model Struktural (Inner Models)

- ❑ Model struktural adalah model yang mendeskripsikan hubungan antar variabel laten (konstruk)
- ❑ Hubungan variabel laten didasarkan kepada teori, logika, atau pengalaman praktis yang diamati para peneliti sebelumnya
- ❑ *Contoh: Pengaruh pelayanan terhadap kepuasan, berlanjut terhadap loyalitas*
 - *Pelayanan berperan sebagai variabel laten “eksogen” (variabel bebas)*
 - *Loyalitas berperan sebagai variabel laten “endogen” (variabel terikat)*
 - *Disebut juga variabel laten endogen, jika berperan sekaligus sebagai variabel laten eksogen (variabel bebas) dan endogen (variabel terikat), contohnya kepuasan.*



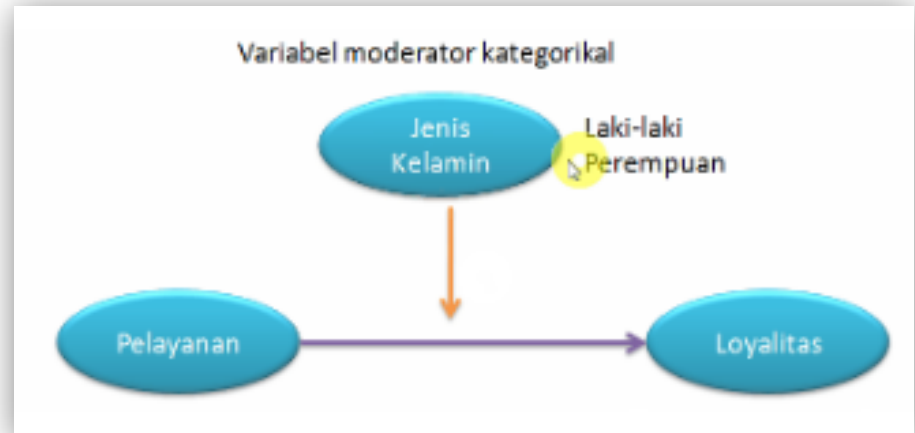
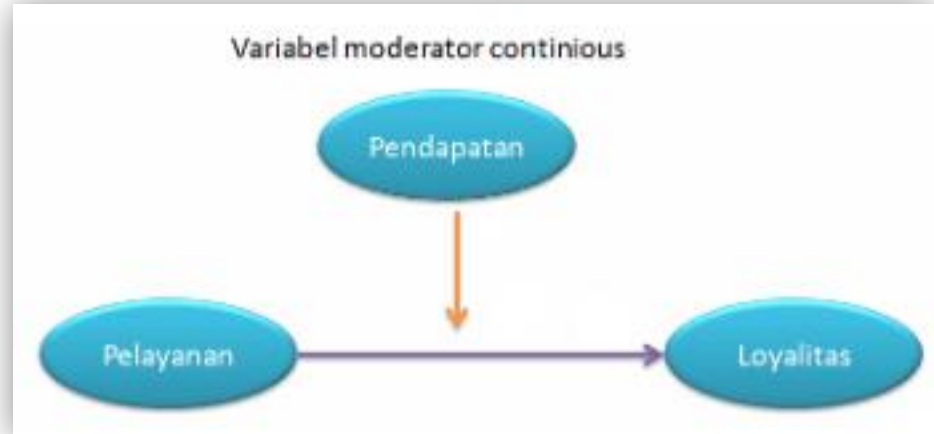
Contoh model struktural yang mengandung variabel mediator/mediasi/intervening

- ❑ Variabel mediator/intervening adalah variabel yang mengantarai hubungan variabel eksogen (bebas) dan endogen (terikat).
- ❑ Ada 2 pengaruh yang terjadi:
 - ❑ Pengaruh Langsung (direct effect)
 - ❑ Pengaruh Tidak langsung (indirect effect)
- ❑ Contoh:
 - ❑ Kepuasan berperan sebagai variabel laten endogen (terikat), yakni dipengaruhi pelayanan
 - ❑ Kepuasan juga berperan sebagai variabel laten endogen (bebas), yakni mempengaruhi loyalitas
 - ❑ Kepuasan juga berperan sebagai variabel mediasi/intervening, karena mengantarai hubungan pelayanan (variabel eksogen/bebas) dan loyalitas (variabel endogen/terikat).



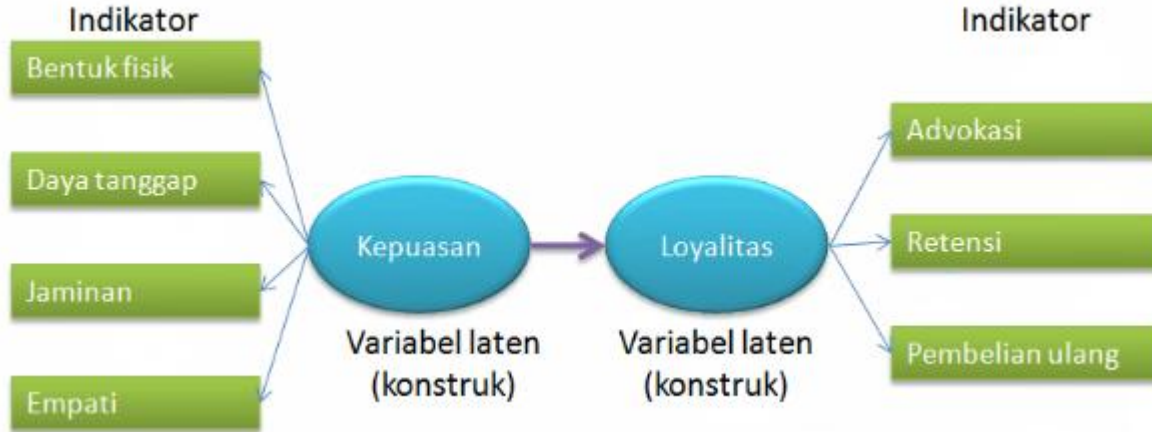
Contoh model struktural yang mengandung variabel moderator

- ❑ Variabel moderator adalah variabel yang dapat merubah kekuatan atau bahkan arah hubungan variabel eksogen (bebas) dan endogen (terikat).
- ❑ Ada 2 jenis variabel moderator:
 - ❑ Continuous: ketika variabel moderator diukur secara metrik
 - ❑ Contoh: Pendapatan mempengaruhi hubungan pelayanan dengan loyalitas
 - ❑ Categorical: ketika variabel moderator diukur secara kategori
 - ❑ Contoh: jenis kelamin (laki-laki dan perempuan) mempengaruhi hubungan pelayanan dengan loyalitas



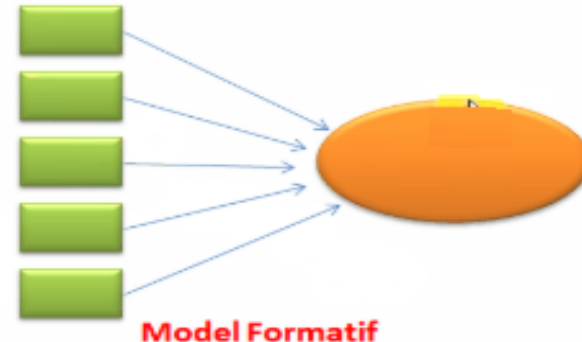
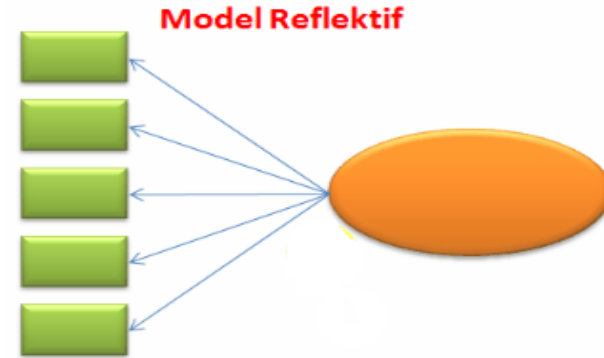
Model Pengukuran (Outer Models)

- ❑ Model pengukuran adalah model yang mendeskripsikan hubungan antar variabel laten (konstruk) dengan indikatornya
- ❑ Hubungan variabel tersebut kepada teori pengukuran.
- ❑ *Contoh:*
 - *Kepuasan (laten) mempunyai indikator bentuk fisik, daya tanggap, jaminan dan empati*
 - *Loyalitas mempunyai indikator advokasi, retensi dan pembelian ulang*



Model Hubungan Reflektif dan Formatif

- ❑ Model reflektif:
 - ❑ Arah panah berawal dari variabel laten menuju kepada Indikator
 - ❑ Artinya, indikator (secara teori) merupakan cerminan/ukuran/aspek dari variabelnya. Dengan demikian, indikator tidak mempengaruhi variabel.
- ❑ Model formatif:
 - ❑ Arah panah berawal dari Indikator menuju kepada variabel laten
 - ❑ Artinya, indikator (secara teori) merupakan cerminan/ukuran/aspek dari variabelnya, namun sekaligus juga merupakan sesuatu yang dapat mempengaruhi variabel

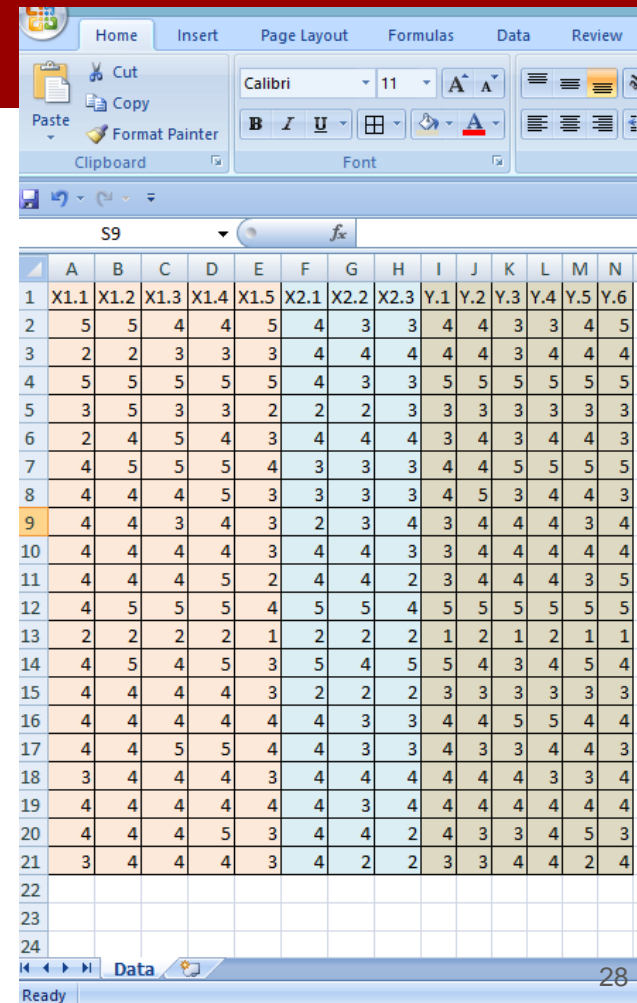


Membangun Model PLS di SmartPLS

Persiapan Data di Excel

- ❑ Kemaslah rekap data di Excel.
(Catatan: Untuk SmartPLS versi Student, maksimal sampel hanya 100). Misalnya di dalam gambar, terdapat:
 - ❑ Sampel: 20 sampel
 - ❑ Variabel: ada 3 (X1, X2, dan Y)
 - ❑ Variabel X1: terdiri dari 5 item indikator: X1.1 s.d. X1.5
 - ❑ Variabel X2: terdiri dari 3 item indikator: X2.1 s.d. X2.3
 - ❑ Variabel Y: terdiri dari 6 item indikator: Y.1 s.d. Y.6.

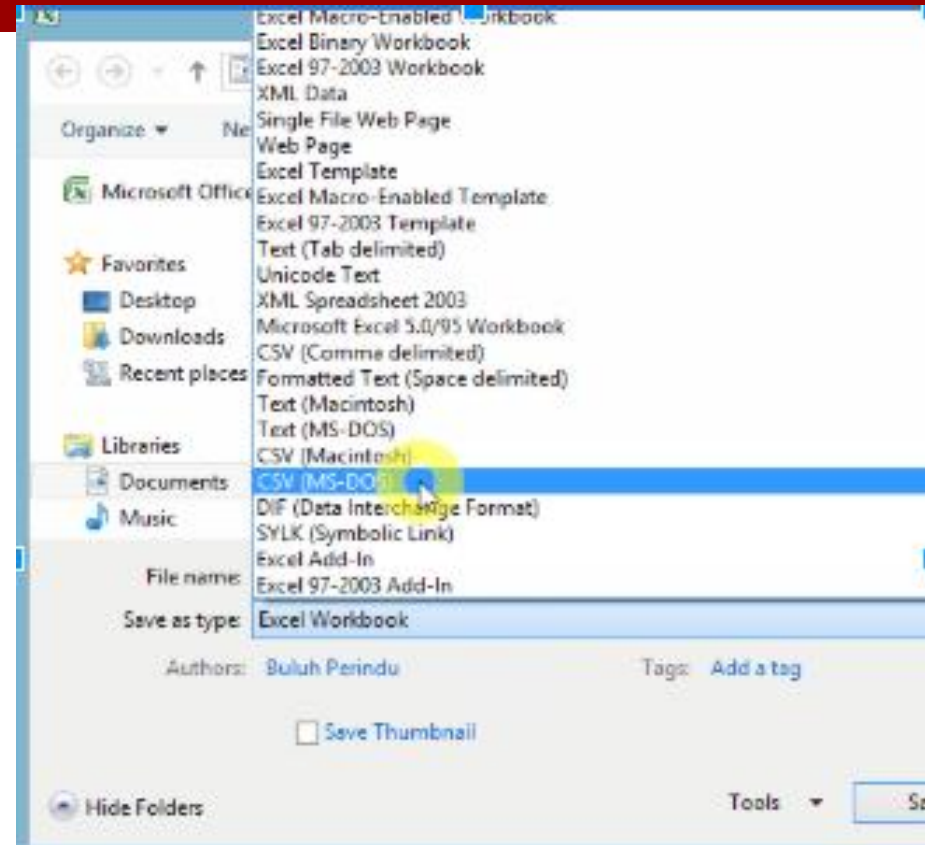
[DOWNLOAD CONTOH](#)



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	X1.1	X1.2	X1.3	X1.4	X1.5	X2.1	X2.2	X2.3	Y.1	Y.2	Y.3	Y.4	Y.5	Y.6
2	5	5	4	4	5	4	3	3	4	4	3	3	4	5
3	2	2	3	3	3	4	4	4	4	4	3	4	4	4
4	5	5	5	5	5	4	3	3	5	5	5	5	5	5
5	3	5	3	3	2	2	2	3	3	3	3	3	3	3
6	2	4	5	4	3	4	4	4	3	4	3	4	4	3
7	4	5	5	5	4	3	3	3	4	4	5	5	5	5
8	4	4	4	5	3	3	3	3	4	5	3	4	4	3
9	4	4	3	4	3	2	3	4	3	4	4	4	4	4
10	4	4	4	4	3	4	4	3	3	4	4	4	4	4
11	4	4	4	5	2	4	4	2	3	4	4	4	3	5
12	4	5	5	5	4	5	5	4	5	5	5	5	5	5
13	2	2	2	2	1	2	2	2	1	2	1	2	1	1
14	4	5	4	5	3	5	4	5	5	4	3	4	5	4
15	4	4	4	4	3	2	2	2	3	3	3	3	3	3
16	4	4	4	4	4	4	3	3	4	4	5	5	4	4
17	4	4	5	5	4	4	3	3	4	3	3	4	4	3
18	3	4	4	4	3	4	4	4	4	4	4	4	3	4
19	4	4	4	4	4	4	3	4	4	4	4	4	4	4
20	4	4	4	5	3	4	4	2	4	3	3	4	5	3
21	3	4	4	4	3	4	2	2	3	3	4	4	2	4
22														
23														
24														

Persiapan Data di Excel

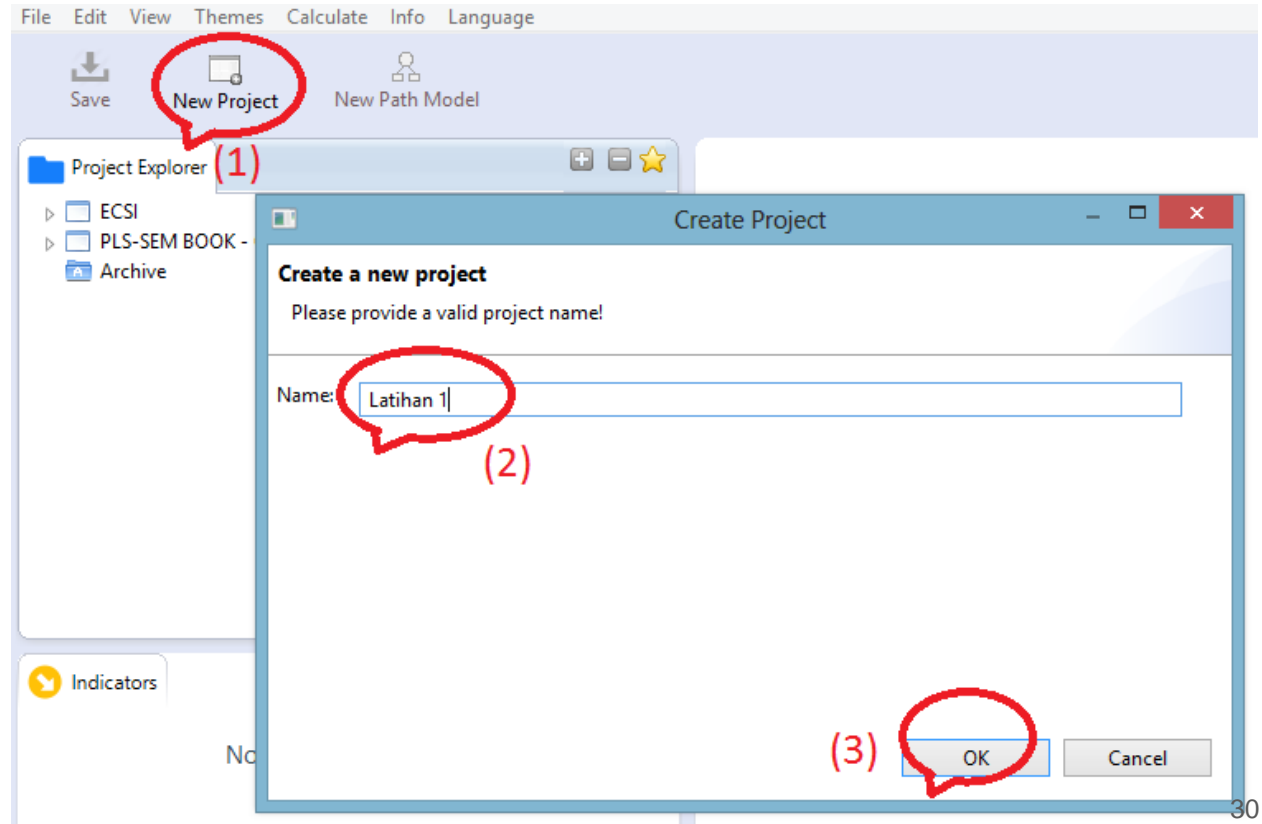
- Simpan data tersebut:
 - Pada “File name”, ketikkan nama file Anda, misalnya “Data”
 - Pada “Save as type”, pilih “CSV (MS-Dos)”, dan “SAVE”
 - Jika muncul dialog, klik “OK”; “YES”;



New Project (Membuat proyek analisis yang baru)

Membuat Project Baru:

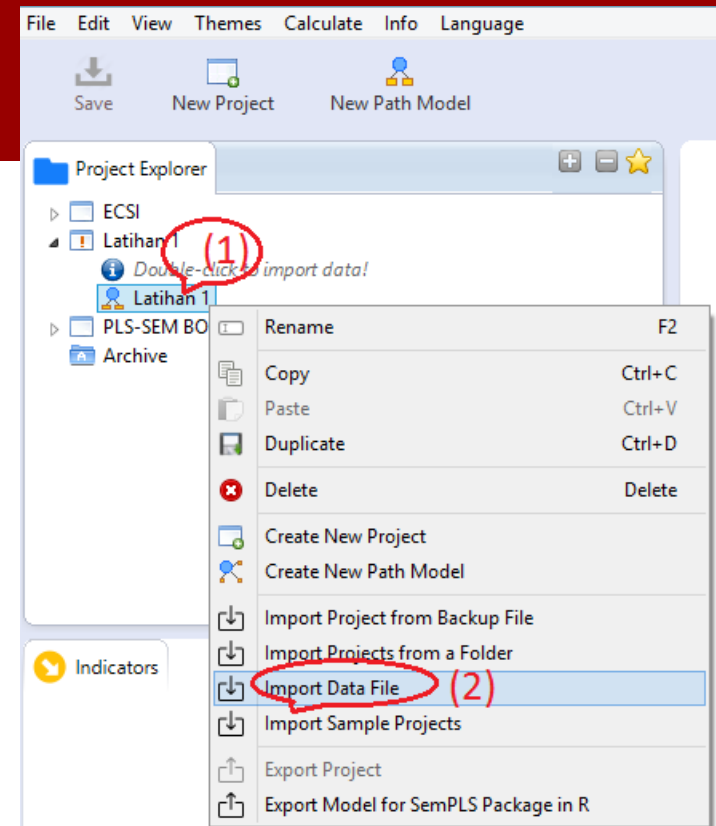
- 1) Klik "New Project"
- 2) Ketikkan nama project, misalnya "Latihan 1", lalu klik OK



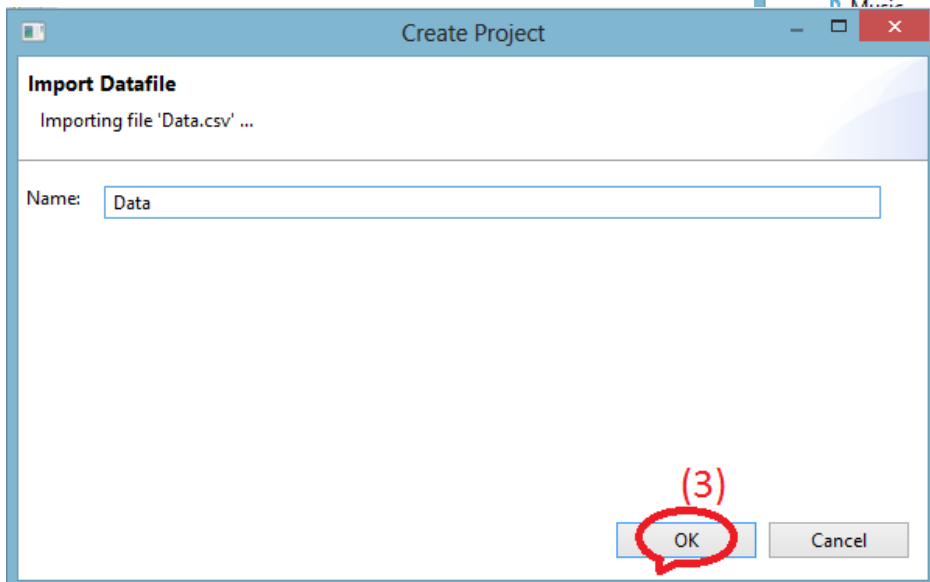
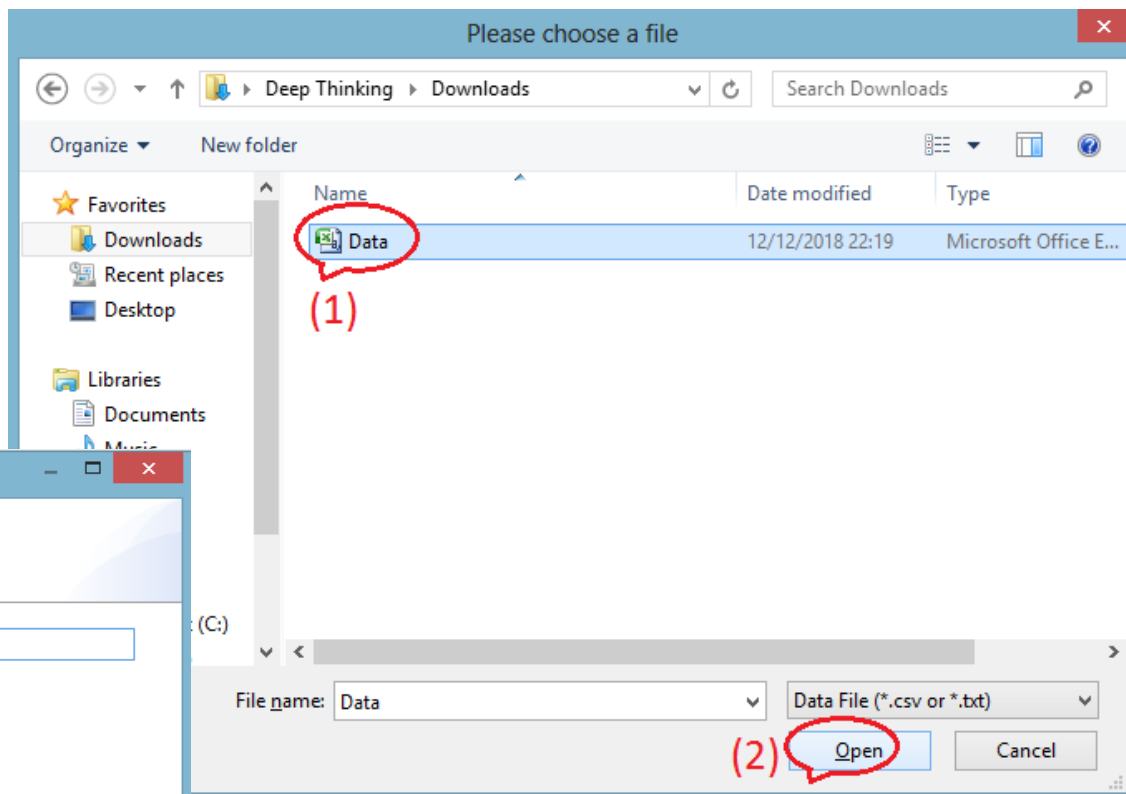
Mengimport Data

Mengimport data:

- 1) Klik kanan pada “Latihan 1”
- 2) Import data file



- 1) Pilih file yang telah disimpan di Excel,
- 2) klik OPEN
- 3) Klik OK



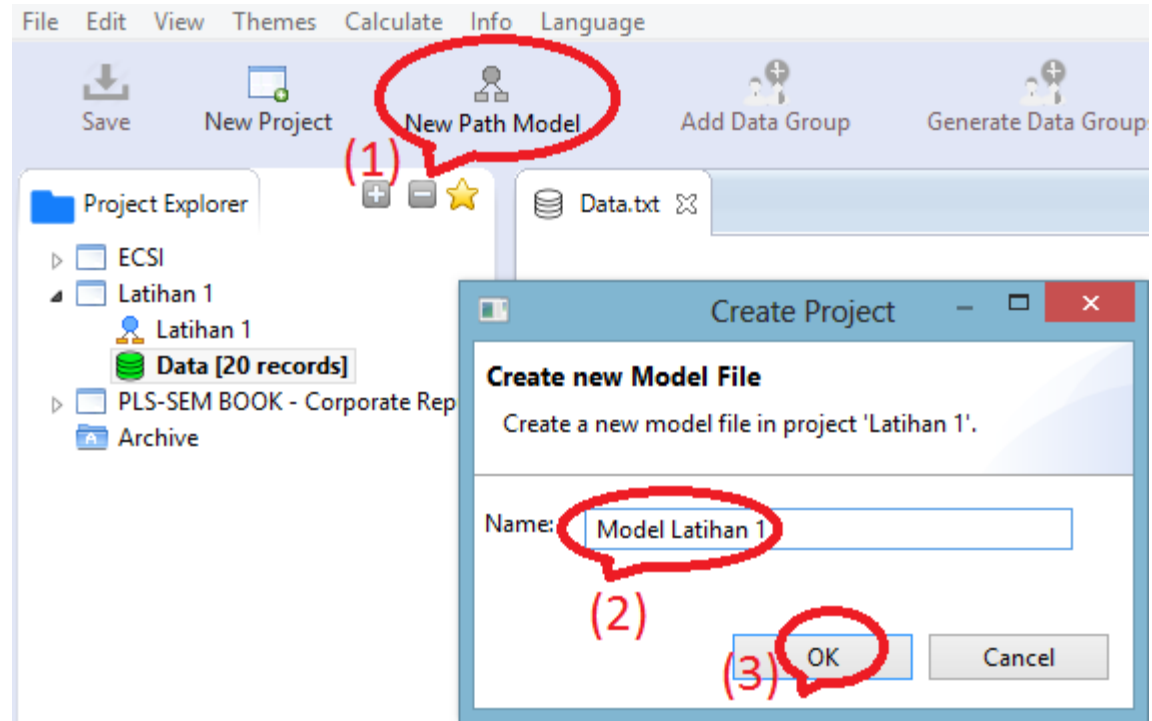
Hasil impor data akan diperlihatkan

The screenshot displays the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar contains icons for Save, New Project, New Path Model, Add Data Group, Generate Data Groups, and Clear Data Groups. The Project Explorer on the left shows a folder structure with 'Data [20 records]' highlighted in red. The main window shows the 'Data.txt' file settings: Delimiter: Semicolon, Encoding: UTF-8, Value Quote Character: None, Sample size: 20, Number Format: US (e.g. 1.000.23), Indicators: 14, and Missing Value Marker: None. Below the settings is a table of indicators with columns for No., Missing, Mean, Median, and Min. The table is circled in red.


Indicators:	Indicator	Correlations	Raw File	No.	Missing	Mean	Median	Min
X1.1				1	0	3.650	4.000	2.000
X1.2				2	0	4.100	4.000	2.000
X1.3				3	0	4.000	4.000	2.000
X1.4				4	0	4.200	4.000	2.000
X1.5				5	0	3.250	3.000	1.000
X2.1				6	0	3.600	4.000	2.000
X2.2				7	0	3.250	3.000	2.000
X2.3				8	0	3.150	3.000	2.000
Y.1				9	0	3.650	4.000	1.000
Y.2				10	0	3.800	4.000	2.000

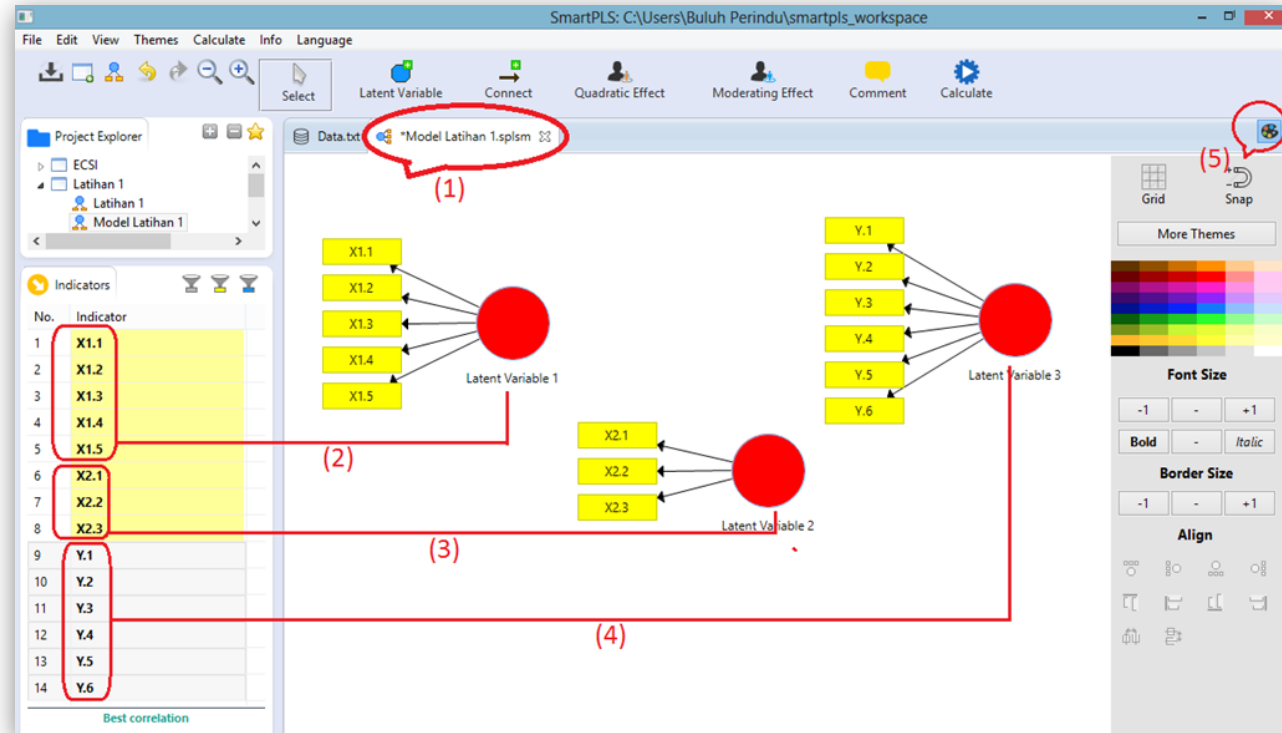
New Path Model (Membuat Gambar Model Jalur untuk Analisis yang Baru)

- 1) Klik “New Path Model”
- 2) Pada “Name”, namai gambar model, misalnya : Model Latihan 1
- 3) Klik “OK”



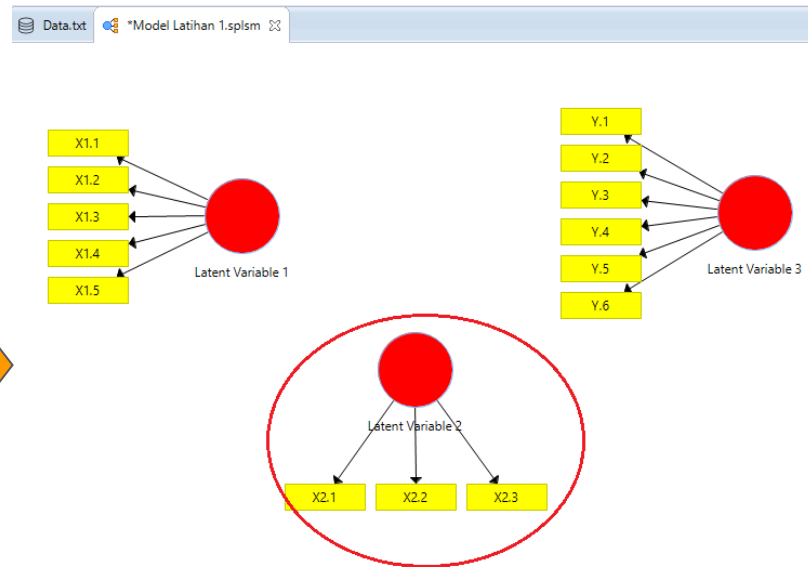
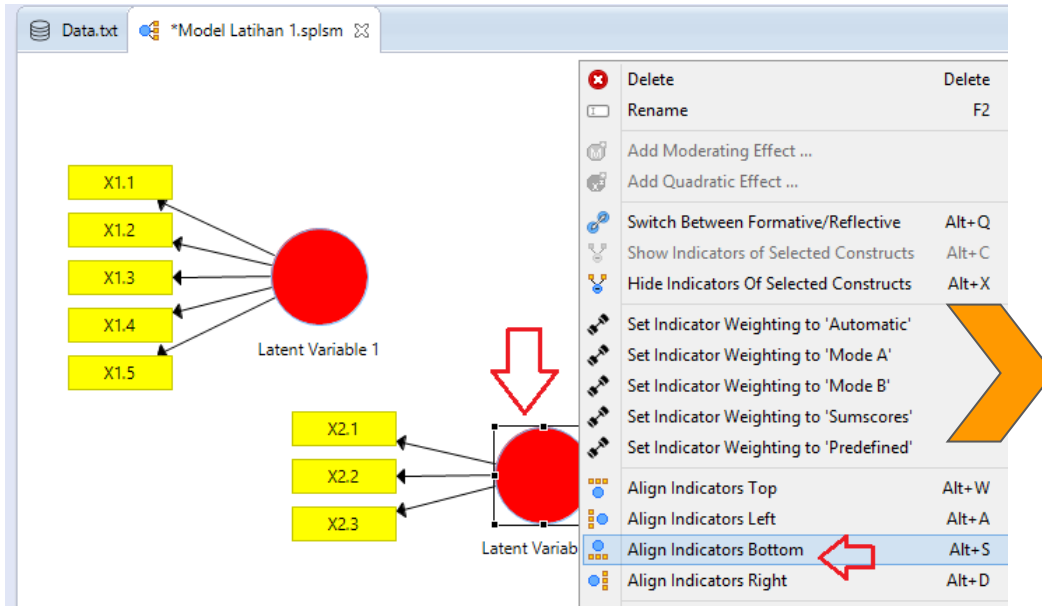
Blok indikator. Caranya adalah untuk suatu variabel (misanya X1) klik pada indikator pertama dari variabe X1 (yakni X1.1), pada keyboard komputer tekan "Shift" , lalu klik pada indikator terakhir dari variabel X1 (yakni X1.5).

- 1) Blok nama-nama indikator X1, yakni X1.1 s.d. X1.5, lalu drag/pindahkan ke kanan
- 2) Blok nama-nama indikator X2, yakni X2.1 s.d. X2.3, lalu drag/pindahkan ke kanan
- 3) Blok nama-nama indikator Y, yakni Y.1 s.d. Y.6, lalu drag/pindahkan ke kanan
- 4) Jika perlu, klik icon  jika menu warna mengganggu

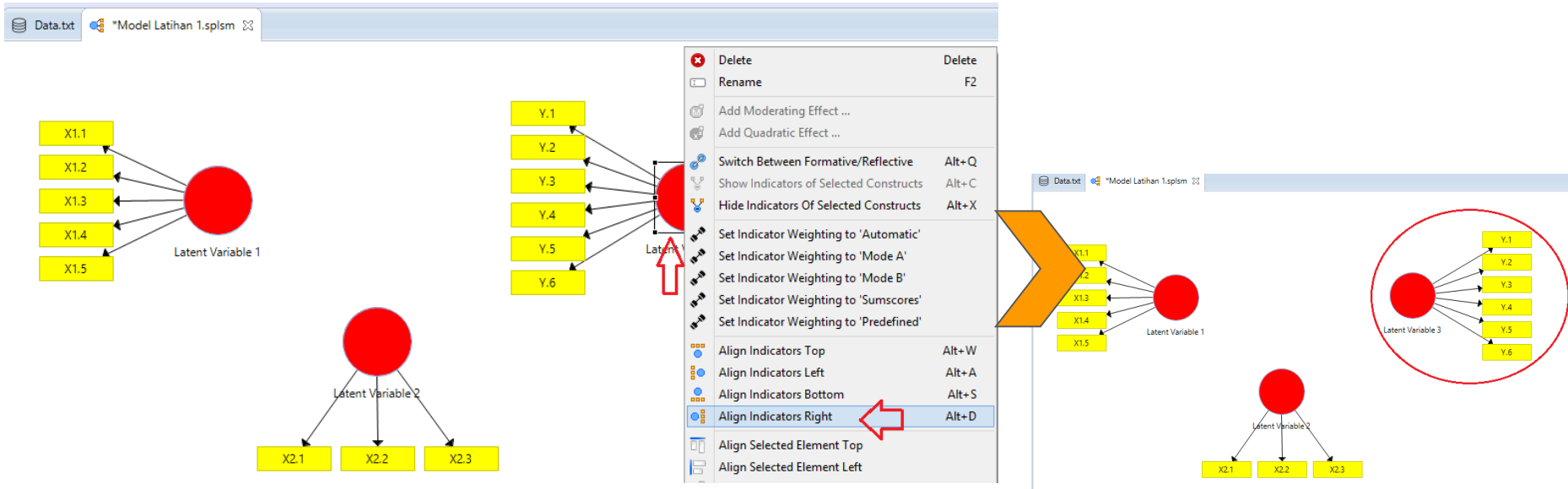


Merapikan gambar model

- ❑ Latent Variable 1: Tidak perlu dirapikan
- ❑ Latent Variable 2: Klik kanan pada gambar Latent variable 2, pilih “Align Indicators Bottom” untuk memposisikan indikator-indikator berada di bawah variabel laten 2



- Latent Variables 3: Klik kanan pada gambar Latent variable 3, pilih “Align Indicators Right” untuk memposisikan indikator-indikator berada di kanan variabel laten 3

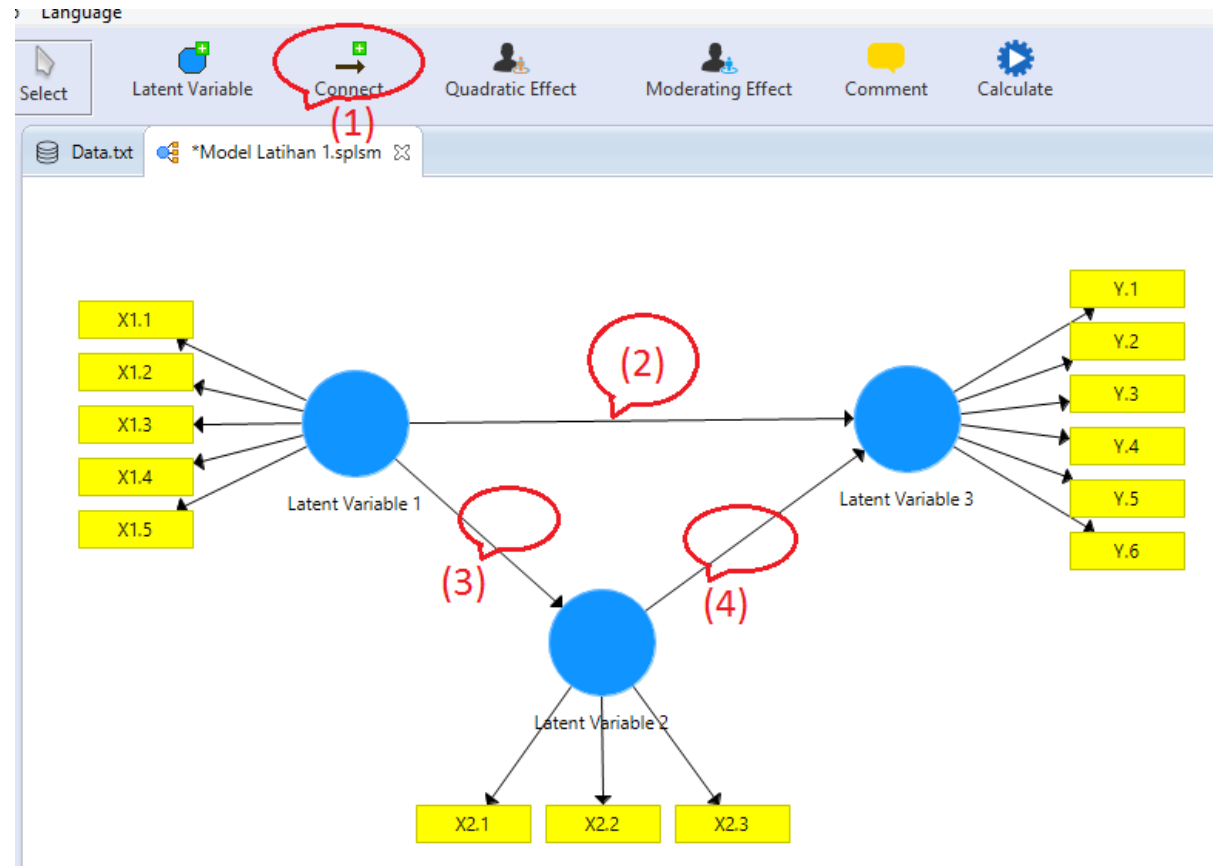


- Geser posisi variabel (latent variable 1, latent variable 2, latent variable 3), pada posisi yang sesuai jika terlihat belum rapi/belum simetris.

Connect (Membuat Garis Penghubung Antar Variabel)

- 1) Klik “Connect” untuk mengaktifkan pembuatan garis penghubung
- 2) Klik pada X1 dan klik pada X2
- 3) Klik pada X2 dan klik pada Y
- 4) Klik pada X1 dan klik pada Y

Klik kembali “Connect” untuk “menonaktifkan” pembuatan garis, atau tekan “Esc” pada sudut kiri “keyboard komputer”



Rename (Merubah Nama Variabel Laten menjadi Nama Simbol Variabel)

Rubah nama Latent Variable 1 menjadi X1:

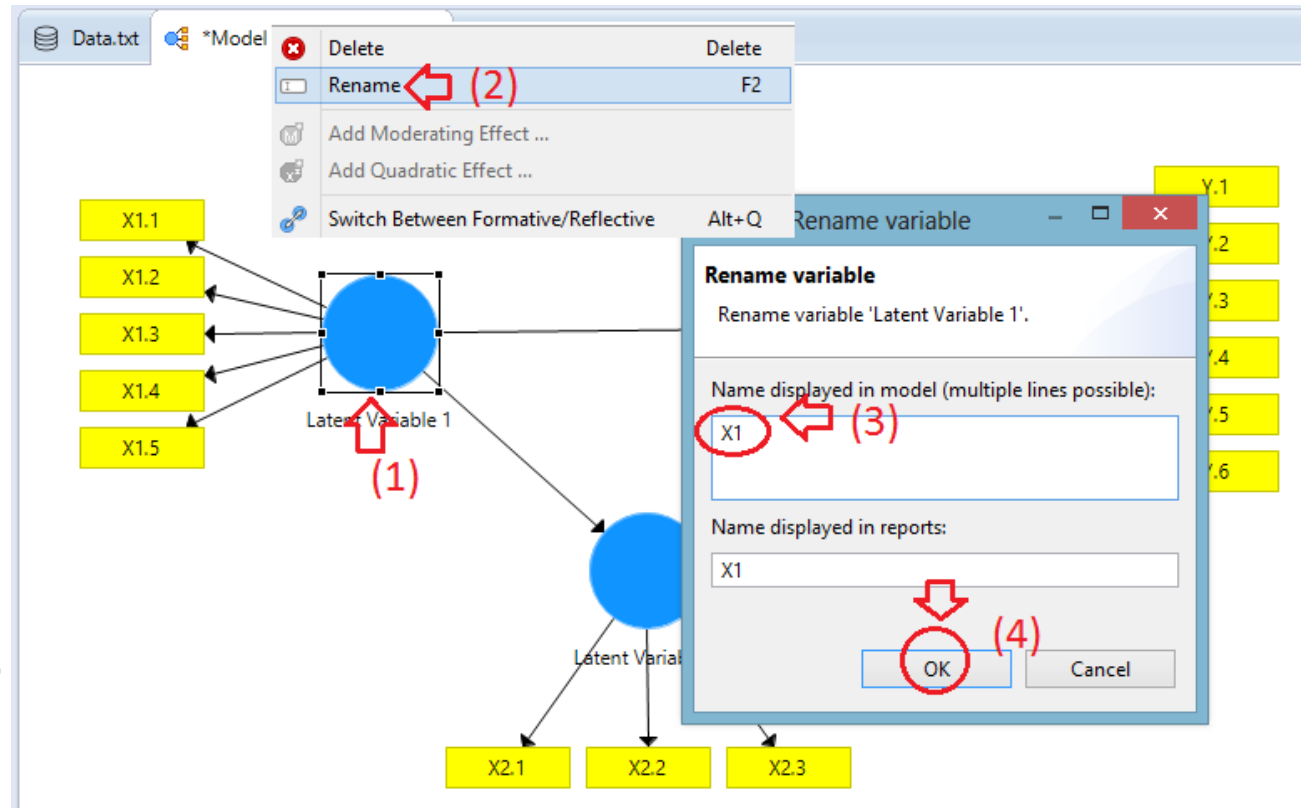
- 1) Klik kanan pada gambar “Latent Variable 1”
- 2) Klik “Rename”
- 3) Ketikkan X1,
- 4) Klik OK

Lakukan cara yang sama untuk merubah nama variabel lainnya:

Latent Variable 2 menjadi X2
Latent Variable 3 menjadi Y

Catatan:

Untuk nama variabel, anda boleh saha menggunakan simbol X, Y, Z, atau simbol lainnya, seperti singkatan nama variabel, contoh: Kepuasan Pelanggan, rubah menjadi KP, dsb.



Kalkulasi PLS Algorithm & Bootstrap

Azuar Juliandi

PLS Algorithm

Algoritma Partial Least Squares

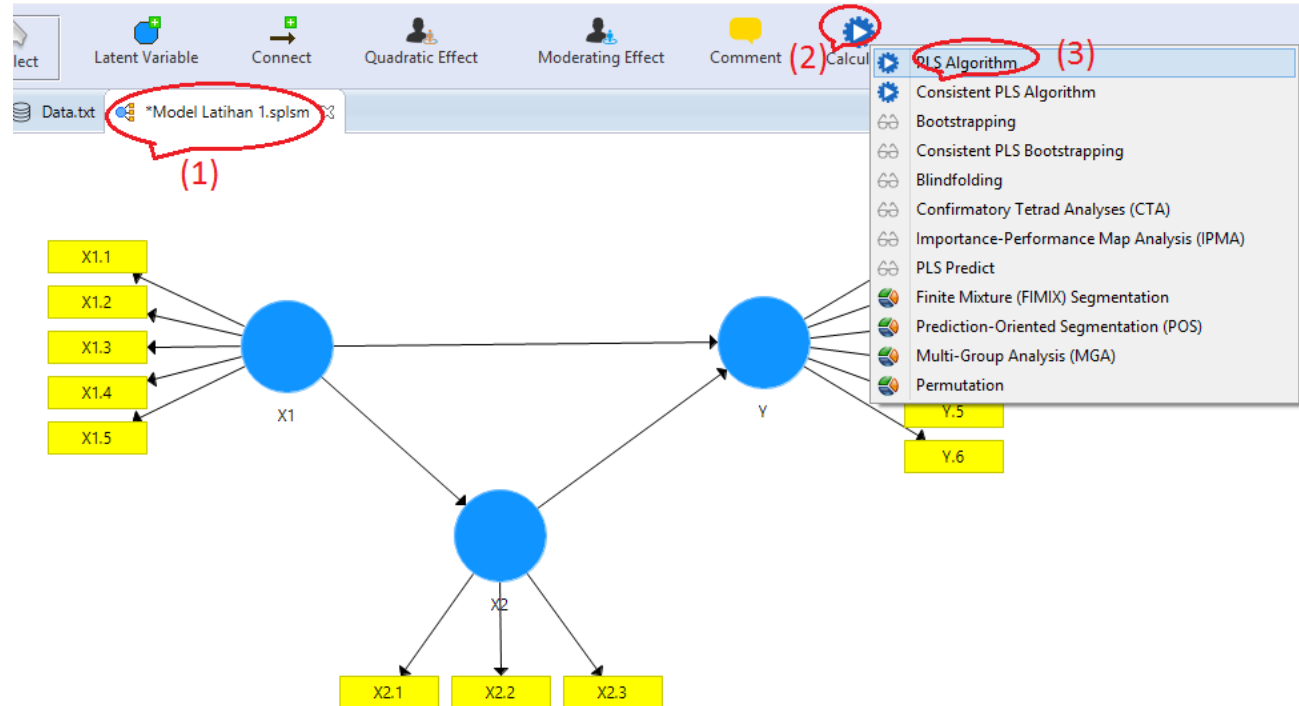
Metode PLS Path Modeling ini dikembangkan oleh Wold (1982). Pada dasarnya, algoritma PLS adalah rangkaian regresi.

Dengan melakukan kalkulasi PLS Algorithm, maka akan diperoleh informasi yang akan digunakan untuk menganalisis data penelitian, khususnya untuk melihat nilai-nilai yang biasa digunakan untuk analisis PLS-SEM:

- ❑ Outer model (pengujian indikator):
 - ❑ Validitas & reliabilitas konstruk (construct reliability & validity)
 - ❑ Validitas diskriminan (discriminant validity)
 - ❑ Dsb
- ❑ Inner model (pengujian hipotesis antarvariabel)
 - ❑ Koefisien jalur/pengaruh langsung (path coefficient/direct effect),
 - ❑ Pengaruh tidak langsung (indirect effect)
 - ❑ Dsb.

Final Results	Quality Criteria
Path Coefficients	R Square
Indirect Effects	f Square
Total Effects	Construct Reliability and Validity
Outer Loadings	Discriminant Validity
Outer Weights	Collinearity Statistics (VIF)
Latent Variable	Model Fit
Residuals	Model Selection Criteria

PLS Algorithm



- 1) Klik tab gambar, misalnya “Model Latihan 1.splsm”
- 2) Klik “Calculate”
- 3) Klik “PLS Algorithm”

Klik “Start Calculation”. Abaikan yang lain

Partial Least Squares Algorithm

The PLS path modeling method was developed by Wold (1982). In essence, the PLS algorithm is a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations (see Dijkstra, 2010, for a general analysis of these equations).

[Read more](#)

Setup | **Weighting**

Basic Settings

Weighting Scheme: Centroid Factor Path

Maximum Iterations: 300

Stop Criterion (10^{-X}): 7

Advanced Settings

Configure [individual initial weights](#)

Basic Settings

Weighting Scheme

PLS-SEM allows the user to apply three structural model weighting schemes:

- (1) centroid weighting scheme,
- (2) factor weighting scheme, and
- (3) path weighting scheme (default).

While the results differ little for the alternative weighting schemes, path weighting is the recommended approach. This weighting scheme provides the highest R^2 value for endogenous latent variables and is generally applicable for all kinds of PLS path model specifications and estimations. Moreover, when the path model includes higher-order constructs (often called second-order models), researchers should usually not use the centroid weighting scheme.

Maximum Iterations

This parameter represents the maximum number of iterations that will be used for calculating the PLS results. This number should be sufficiently large (e.g., 300 iterations). When checking the PLS-SEM result, one must make sure that the algorithm did not stop because the maximum number of iterations was reached but due to the stop criterion. Note: The selection of 0 for the maximum number of iterations allows you to obtain results of the sum scores approach.

After Calculation: [Open Full Report](#) [Close](#) [Start Calculation](#)

Hasil perhitungan PLS
Algorithm akan diperlihatkan.

The screenshot shows the SmartPLS software interface. At the top, there are several utility buttons: 'Hide Zero Values', 'Increase Decimals', 'Decrease Decimals', 'Export to Excel', and 'Export to Web'. Below these are file tabs: 'Data.txt', '*Model Latihan 1.splsm', and 'PLS Algorithm (Run No. 3)'. The 'PLS Algorithm (Run No. 3)' tab is circled in red. The main content area is titled 'Path Coefficients' and contains a table with the following data:

	X1	X2	Y
X1		0,416	0,661
X2			0,382
Y			

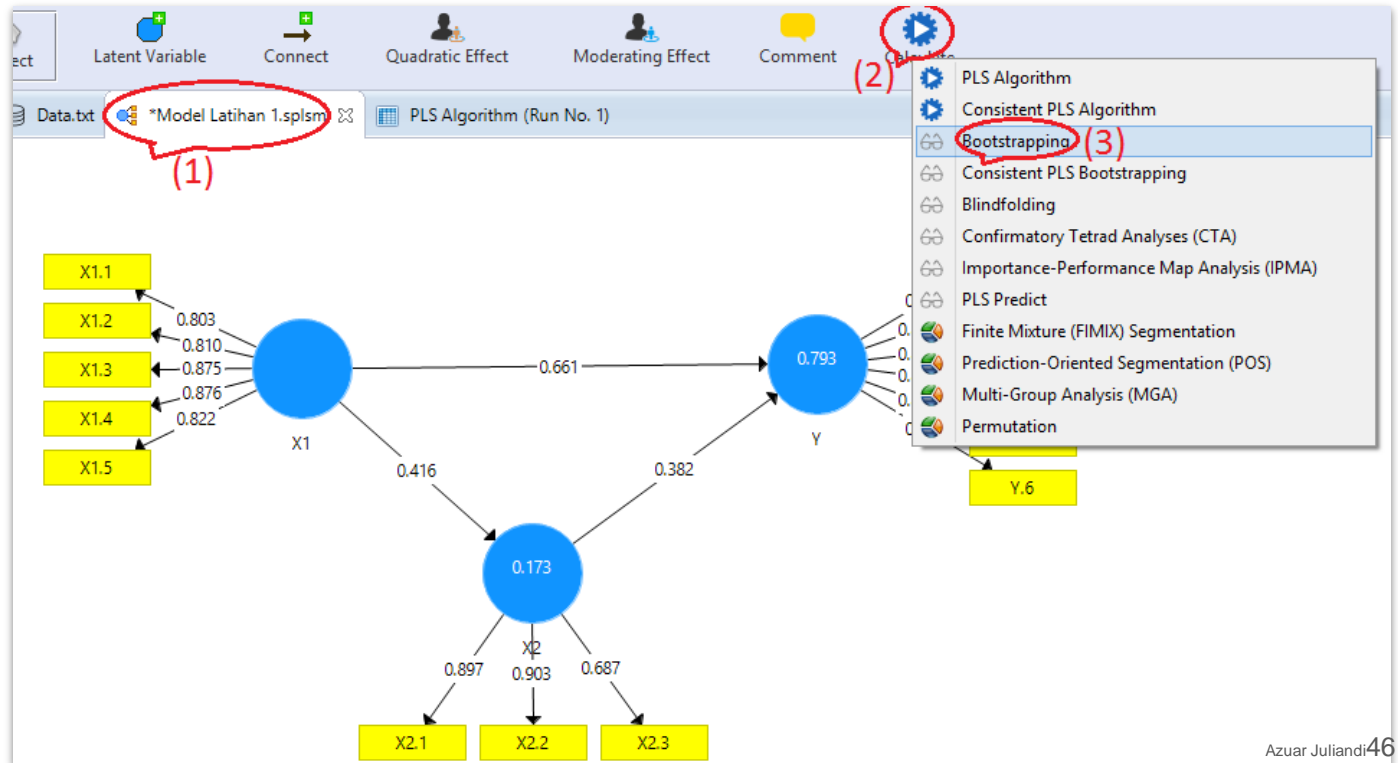
Below the table is a navigation menu with four columns: 'Final Results', 'Quality Criteria', 'Interim Results', and 'Base Data'. Each column contains several links. A red circle highlights the 'Final Results' column links.

Final Results	Quality Criteria	Interim Results	Base Data
Path Coefficients	R Square	Stop Criterion Changes	Setting
Indirect Effects	f Square		Inner Model
Total Effects	Construct Reliability and Validity		Outer Model
Outer Loadings	Discriminant Validity		Indicator Data (Original)
Outer Weights	Collinearity Statistics (VIF)		Indicator Data (Standardized)
Latent Variable	Model Fit		Indicator Data (Correlations)
Residuals	Model Selection Criteria		

Bootstrapping

- ❑ Bootstrapping merupakan prosedur resampling (pen-sample-an kembali/pengulangan sampel)
- ❑ Bootstrapping adalah suatu prosedur non-parametrik, merupakan metode untuk memecahkan masalah data yang tidak normal terutama jika sampelnya hanya kecil/sedikit.
- ❑ Bootstrapping memungkinkan pengujian signifikansi statistik dari berbagai hasil PLS-SEM seperti koefisien jalur, Cronbach's alpha, HTMT dan nilai R^2 .
- ❑ Di dalam bootstrapping, sub-sampel diciptakan dengan pengamatan acak diambil (dengan penggantian) dari data set asli. Untuk memastikan stabilitas hasil, jumlah sub-sampel harus menjadi besar. Untuk pemeriksaan awal, kita dapat menggunakan sejumlah kecil bootstrap sub-sampel (misalnya, 500). Untuk persiapan hasil akhir, bagaimanapun, peneliti harus menggunakan sejumlah besar bootstrap sub-sampel (misalnya, 5.000).

- 1) Klik tab gambar, misalnya “Model Latihan 1.splsm”
- 2) Klik “Calculate”
- 3) Klik “Boostrapping”



- 1) Klik pada tab Setup
- 2) Ketikkan “5000” pada “Subsamples”
- 3) Klik/ceklis “Complete Boot Straping”
- 4) Klik “Start Calculation”

Bootstrapping
Bootstrapping is a nonparametric procedure that allows testing the statistical significance of various PLS-SEM results such path coefficients, Cronbach's alpha, HTMT, and R² values. [Read more!](#)

Setup Partial Least Squares Weighting

Basic Settings

Subsamples: 5000

Do Parallel Processing

Amount of Results: Basic Bootstrapping Complete Bootstrapping

Advanced Settings

Confidence Interval Method: Percentile Bootstrap Studentized Bootstrap Bias-Corrected and Accelerated (BCa) Bootstrap

Test Type: One Tailed Two Tailed

Significance Level: 0,05

Basic Settings

Subsamples

In bootstrapping, subsamples are created with observations randomly drawn (with replacement) from the original set of data. To ensure stability of results, the number of subsamples should be large. For an initial assessment, one may use a smaller number of bootstrap subsamples (e.g., 500). For the final results preparation, however, one should use a large number of bootstrap subsamples (e.g., 5,000).
Note: Larger numbers of bootstrap subsamples increase the computation time.

Do Parallel Processing

This option runs the bootstrapping routine on multiple processors (if your computer device offers more than one core). Using parallel computing will reduce computation time.

Amount of Results

(1) Basic Bootstrapping (default)
Only a basic set of results for bootstrapping is assembled. This includes: Path Coefficients, Indirect Effects, Total Effects, Outer Loadings, and Outer Weights. This option is much faster if a large number of resamples is drawn and useful for preliminary data analysis.

(2) Complete Bootstrapping

After Calculation: Open Full Report Close **Start Calculation**

Hasil perhitungan bootstrapping akan ditampilkan

Data.txt *Model Latihan 1.splsm PLS Algorithm (Run No. 3) **Bootstrapping (Run No. 3)**

Path Coefficients

	Mean, STDEV, T-Values, P-Values	Confidence Intervals	Confidence Intervals Bias Corrected	Samples	Cc
	Original Sampl...	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
X1 -> X2	0.416	0.414	0.250	1.662	0.097
X1 -> Y	0.661	0.669	0.147	4.492	0.000
X2 -> Y	0.382	0.368	0.167	2.283	0.022

Final Results

[Path Coefficients](#)

[Total Indirect Effects](#)

[Specific Indirect Effects](#)

[Total Effects](#)

[Outer Loadings](#)

[Outer Weights](#)

Quality Criteria

[R Square](#)

[R Square Adjusted](#)

[f Square](#)

[Average Variance Extracted \(AVE\)](#)

[Composite Reliability](#)

[rho A](#)

[Cronbach's Alpha](#)

[Heterotrait-Monotrait Ratio \(HTMT\)](#)

[Latent Variable Correlations](#)

Model Fit

[SRMR](#)

[d ULS](#)

[d G](#)

Histograms

[Path Coefficients Histogram](#)

[Indirect Effects Histogram](#)

[Total Effects Histogram](#)

Base Data

[Setting](#)

[Inner Model](#)

[Outer Model](#)

[Indicator Data \(Original\)](#)

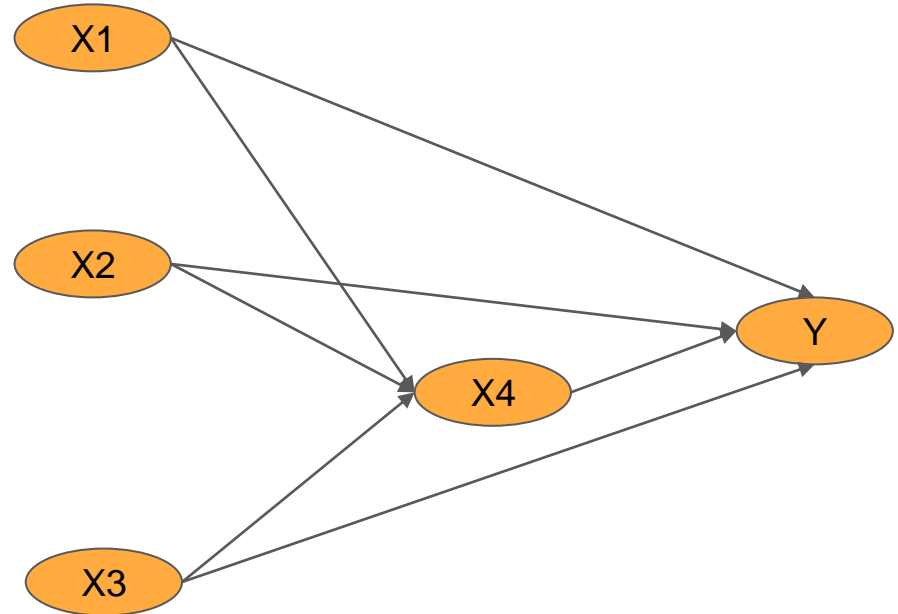
[Indicator Data \(Standardized\)](#)

Contoh Analisis PLS ber-Variabel Intervening

Azuar Juliandi

SEM Bervariabel Intervening

- ❑ Variabel intervening adalah variabel yang mengantari (**memediasi**) hubungan variabel eksogen (bebas) dengan variabel endogen (terikat)
- ❑ Contoh: Variabel eksogen/bebas ada 3 (X1, X2, X3), variabel intervening ada 1 (X4), variabel endogen/terikat ada 1 (Y),



Rumusan Masalah/Tujuan Penelitian/Hipotesis

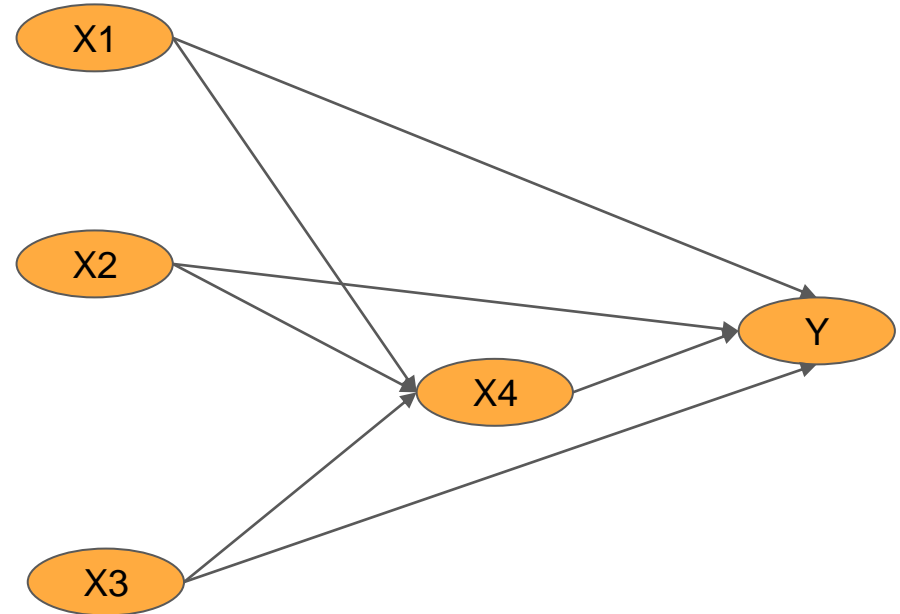
Rumusan Masalah/Tujuan Penelitian/Hipotesis:

A. Pengaruh Langsung:

- 1) $X1 \rightarrow X4$
- 2) $X2 \rightarrow X4$
- 3) $X3 \rightarrow X4$
- 4) $X1 \rightarrow Y$
- 5) $X2 \rightarrow Y$
- 6) $X3 \rightarrow Y$
- 7) $X4 \rightarrow Y$

B. Pengaruh Tidak Langsung

- 1) $X1 \rightarrow X4 \rightarrow Y$ atau $X1 \rightarrow Y$ yang dimediasi $X4$
- 2) $X2 \rightarrow X4 \rightarrow Y$ atau $X2 \rightarrow Y$ yang dimediasi $X4$
- 3) $X3 \rightarrow X4 \rightarrow Y$ atau $X3 \rightarrow Y$ yang dimediasi $X4$



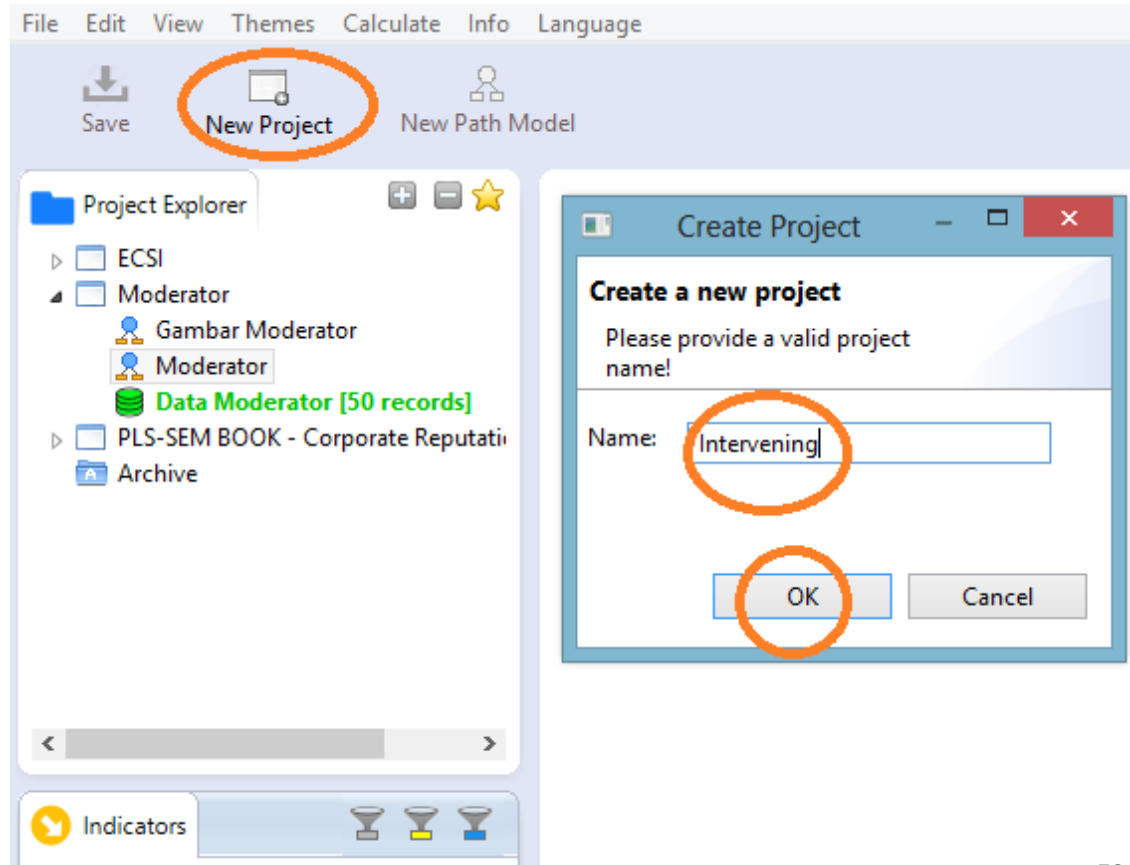
Data

- ❑ [Download Contoh Data](#) (Data dikemas dalam di Excel dengan save as type: CSV-MS DOS)
- ❑ Sampel: 50
- ❑ Variabel terdiri dari 4:
 - ❑ Variabel eksogen/bebas (X1, X2, X3), indikatornya:
 - ❑ X1.1; X1.2; X1.3
 - ❑ X2.1; X2.2; X2.3
 - ❑ X3.1; X3.2; X3.3
 - ❑ Variabel intervening (X4), indikatornya:
 - ❑ X4.1; X4.2; X4.3
 - ❑ Variabel endogen/terikat (Y), indikatornya:
 - ❑ Y.1; Y.2; Y.3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	X1.1	X1.2	X1.3	X2.1	X2.2	X2.3	X3.1	X3.2	X3.3	X4.1	X4.2	X4.3	Y.1	Y.2	Y.3
2	2	3	3	2	2	2	2	2	3	2	2	2	3	3	3
3	4	4	4	5	4	5	4	5	5	4	5	4	5	4	4
4	3	3	3	5	5	4	2	2	2	3	4	3	3	3	4
5	4	3	4	5	4	5	5	4	5	4	4	4	3	5	4
6	3	4	3	5	4	5	4	4	4	3	3	3	4	4	5
7	3	4	3	4	4	5	5	3	3	3	4	3	3	3	5
8	4	4	4	4	5	5	4	5	4	4	4	3	5	4	4
9	4	4	3	4	4	4	4	3	4	4	4	5	4	5	5
10	5	4	4	4	2	4	4	4	4	3	4	4	5	3	5
11	3	3	3	3	2	3	3	5	3	4	3	2	3	3	2
12	2	3	2	2	2	2	2	3	2	3	2	2	2	2	2
13	4	4	4	4	4	5	4	4	4	3	4	4	4	4	5
14	3	4	5	3	4	5	2	4	4	3	2	3	3	3	5
15	4	4	4	5	5	4	4	4	4	4	4	4	4	4	4
16	2	3	4	2	2	2	2	3	2	2	3	2	2	2	2
17	4	4	2	5	2	2	5	5	4	4	4	3	4	5	5
18	4	2	2	4	2	2	3	3	4	4	3	4	3	3	3

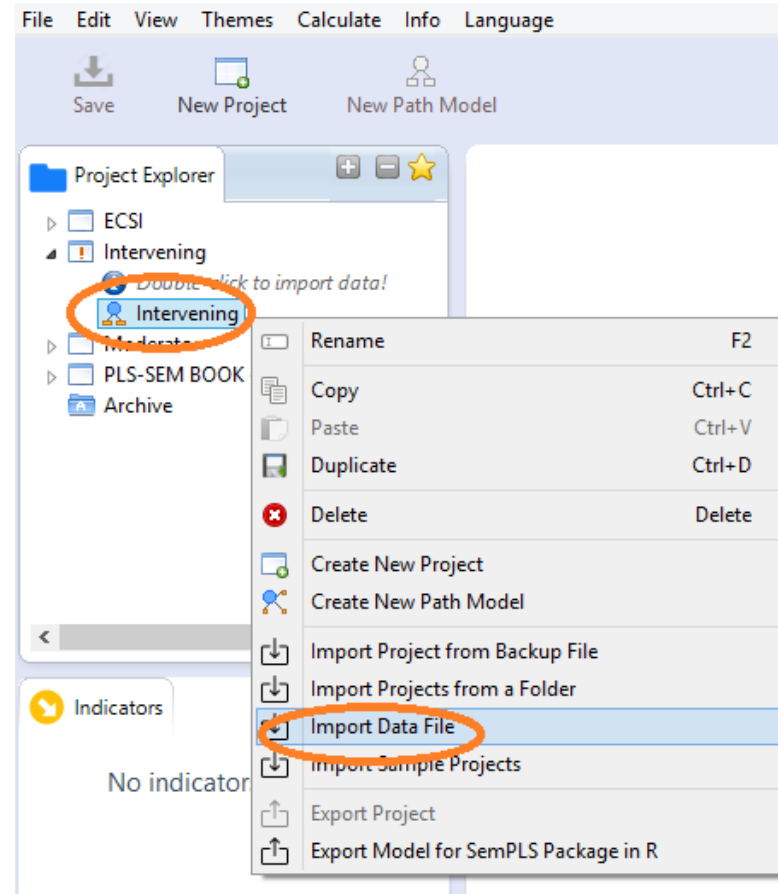
New Project

- ❑ New Project
- ❑ Name: Intervening
- ❑ OK

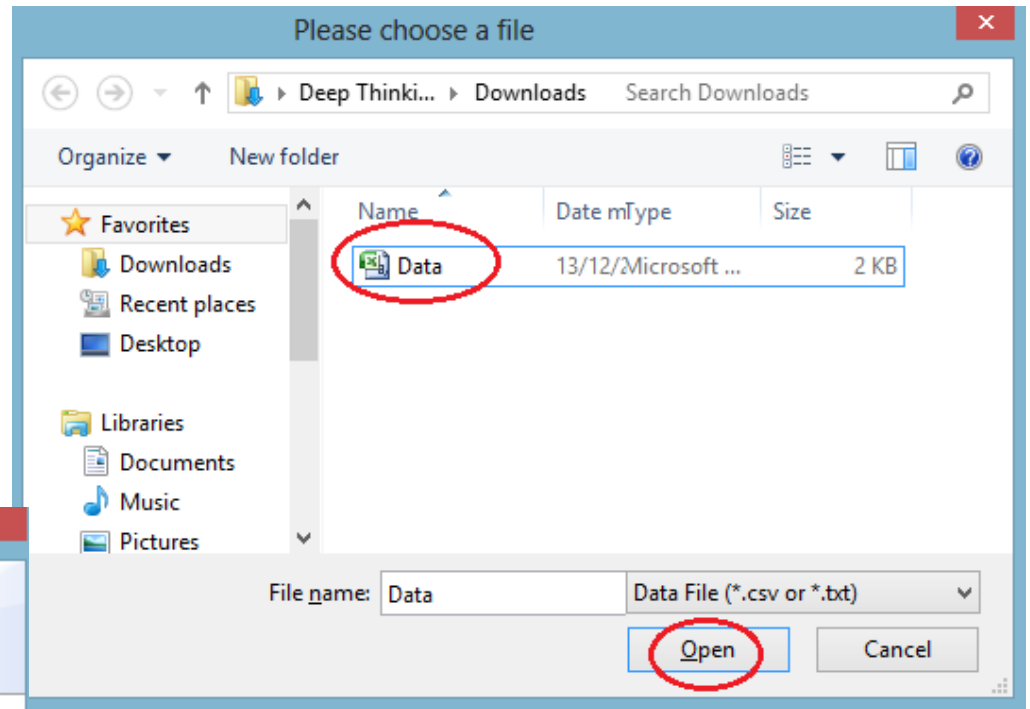
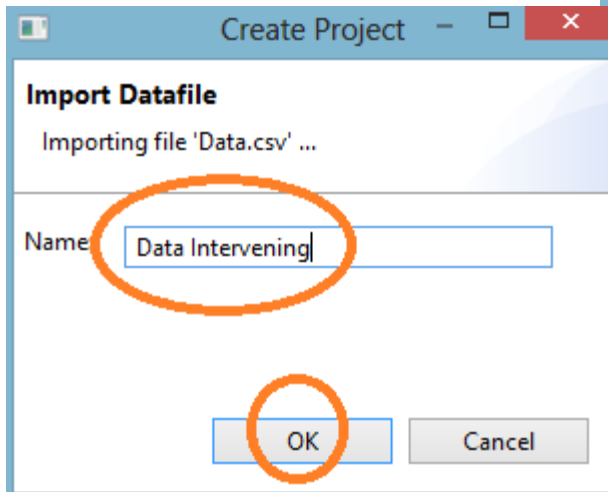


Import Data File

- ❑ Klik “**kanan**” di Intervening
- ❑ Import Data File



- ❑ Klik “Data”
- ❑ Open
- ❑ Ketikkan “Data Intervening” di “Name”
- ❑ OK

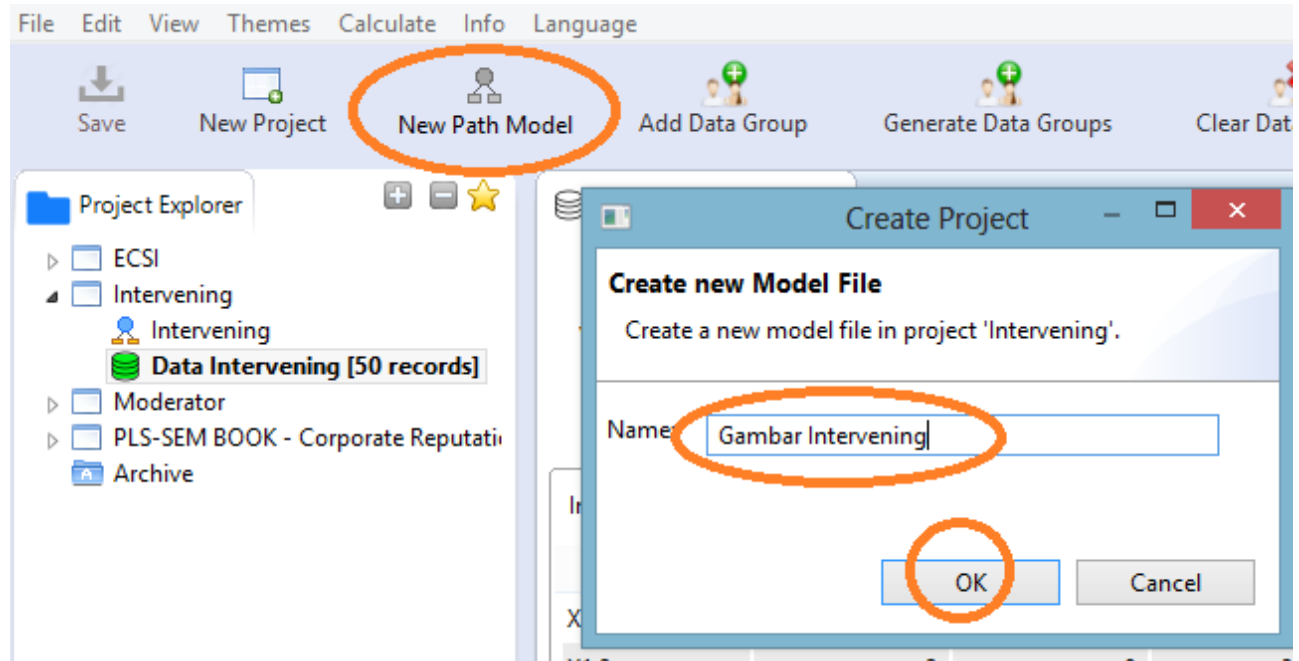


Data akan ditampilkan

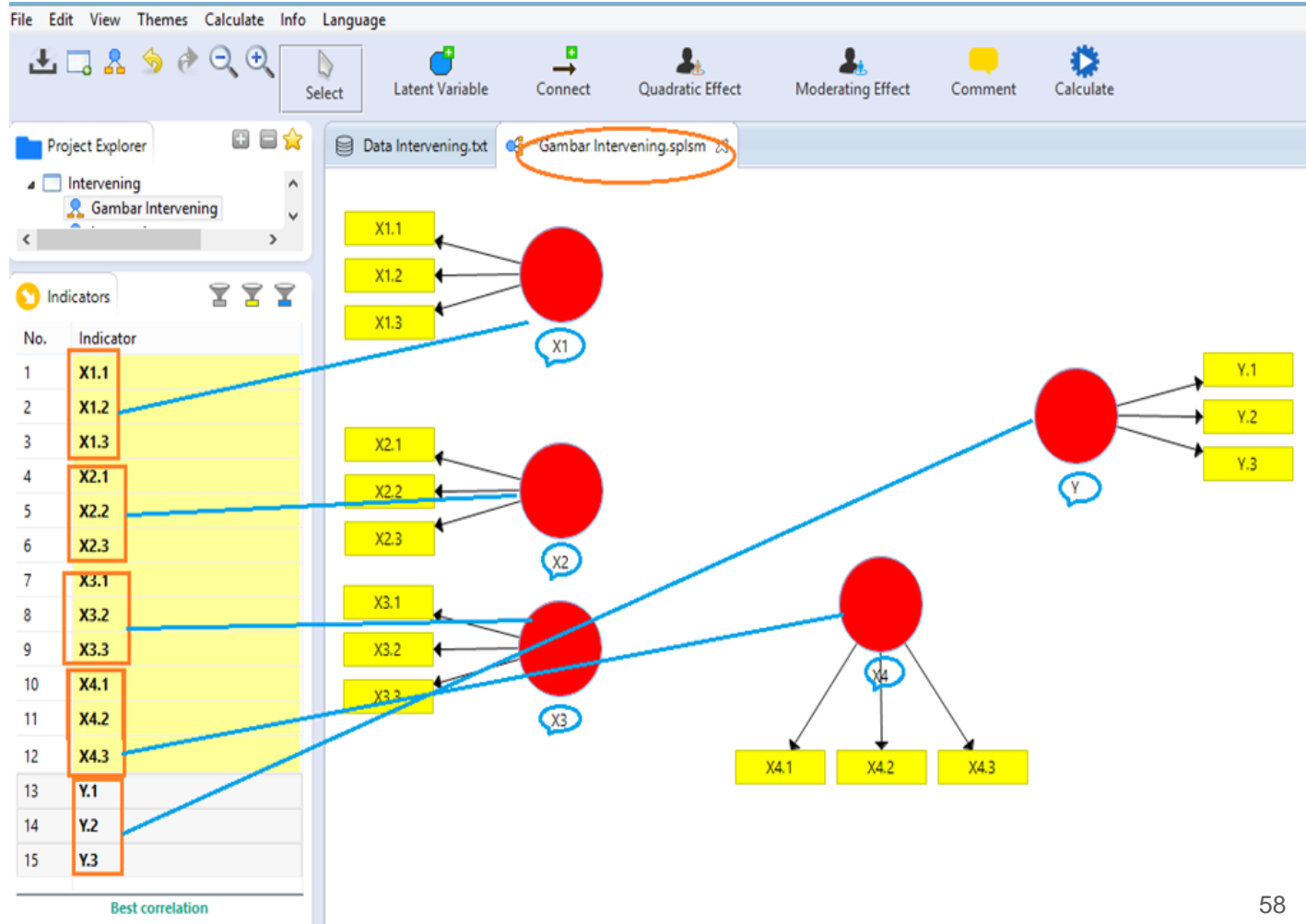
The screenshot displays the SmartPLS software interface. At the top, there is a menu bar with 'File', 'Edit', 'View', 'Themes', 'Calculate', 'Info', and 'Language'. Below the menu is a toolbar with icons for 'Save', 'New Project', 'New Path Model', 'Add Data Group', 'Generate Data Groups', and 'Clear Data Groups'. On the left side, the 'Project Explorer' shows a tree view with folders like 'ECSI', 'Intervening', and 'Moderator'. The 'Intervening' folder is expanded, and a file named 'Data Intervening [50 records]' is highlighted with an orange circle. The main workspace shows the 'Data Intervening.txt' file selected, with its import settings: Delimiter: Semicolon, Encoding: UTF-8, Value Quote Character: None, Sample size: 50, Number Format: US (e.g. 1,000.23), Indicators: 15, Missing Value Marker: None, and Missing Values: 0. Below the settings is a table with columns for 'Indicators', 'Indicator Correlations', and 'Raw File'. The table contains 11 rows of data, with the entire table area circled in orange. The 'Indicators' column lists X1.1 through X4.2, 'No.' lists 1 through 11, 'Missing' is 0 for all, 'Mean' ranges from 3.400 to 3.560, 'Median' is 4.000 for all, and 'M' is 2.00 for all.

Indicators	Indicator Correlations	Raw File	No.	Missing	Mean	Median	M
X1.1			1	0	3.520	4.000	2.00
X1.2			2	0	3.540	4.000	2.00
X1.3			3	0	3.480	4.000	2.00
X2.1			4	0	3.860	4.000	2.00
X2.2			5	0	3.700	4.000	2.00
X2.3			6	0	3.860	4.000	2.00
X3.1			7	0	3.400	4.000	2.00
X3.2			8	0	3.560	4.000	2.00
X3.3			9	0	3.480	4.000	2.00
X4.1			10	0	3.540	4.000	2.00
X4.2			11	0	3.600	4.000	2.00

- ❑ Klik “New Path Project”
- ❑ Ketikkan “Gambar Intervening” pada Name
- ❑ OK



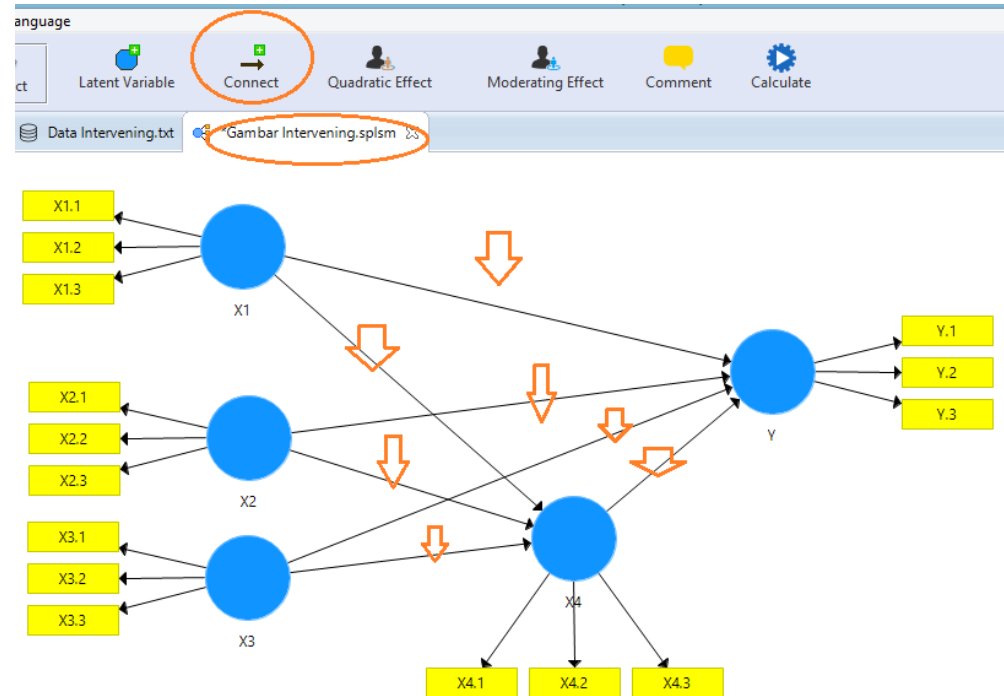
- Untuk masing-masing variabel, pindahkan seluruh indikator ke kanan (ikuti bentuk seperti contoh)
- Ganti nama untuk masing-masing variabel (rename), menjadi X1, X2, X3, X4, Y
- Atur posisi indikator (seperti contoh di gambar)



Connect

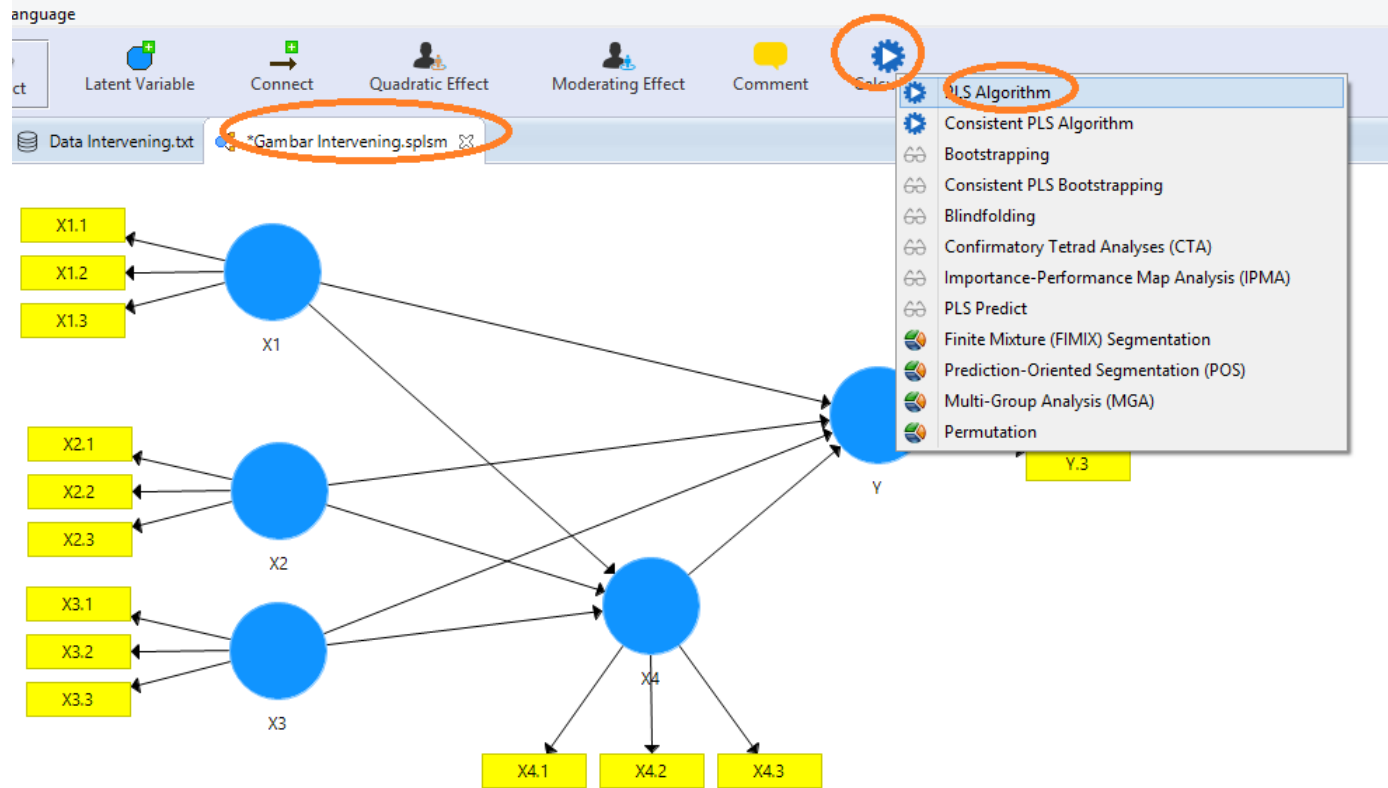
Klik “Connect” untuk menghubungkan variabel-variabel:

- ❑ X1 ke X4
- ❑ X2 ke X4
- ❑ X3 ke X4
- ❑ X1 ke Y
- ❑ X2 ke Y
- ❑ X3 ke Y
- ❑ X4 ke Y



Calculate-PLS Algorithm

- Calculate
- PLS Algorithm



Klik Start Calculation

Partial Least Squares Algorithm

The PLS path modeling method was developed by Wold (1982). In essence, the PLS algorithm is a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations (see Dijkstra, 2010, for a general analysis of these equations).

[Read more!](#)

Setup **Weighting**

Basic Settings

Weighting Scheme Centroid Factor Path

Maximum Iterations: 300

Stop Criterion (10^{-X}): 7

Advanced Settings

Initial Weights Use Lohmoeller Settings
or configure [individual initial weights](#)

Basic Settings

Weighting Scheme

PLS-SEM allows the user to apply three structural model weighting schemes:

- (1) centroid weighting scheme,
- (2) factor weighting scheme, and
- (3) path weighting scheme (default).

While the results differ little for the alternative weighting schemes, path weighting is the recommended approach. This weighting scheme provides the highest R^2 value for endogenous latent variables and is generally applicable for all kinds of PLS path model specifications and estimations. Moreover, when the path model includes higher-order constructs (often called second-order models), researchers should usually not use the centroid weighting scheme.

Maximum Iterations

This parameter represents the maximum number of iterations that will be used for calculating the PLS results. This number should be sufficiently large (e.g., 300 iterations). When checking the PLS-SEM result, one must make sure that the algorithm did not stop because the maximum number of iterations was reached but due to the stop criterion. Note: The selection of 0 for the maximum number of iterations allows you to obtain results of the sum scores approach.

After Calculation:

Hasil PLS Algorithm akan diperlihatkan

0.110
30.12

0,0
0,00

0,00
0,0

Hide Zero Values

Increase Decimals

Decrease Decimals

Export to Excel

Export to

Data Intervening.txt

*Gambar Intervening.splsm

PLS Algorithm (Run No. 1)

Path Coefficients

	X1	X2	X3	X4	Y
X1				0.345	0.344
X2				0.302	0.350
X3				0.352	0.270
X4					0.056
Y					

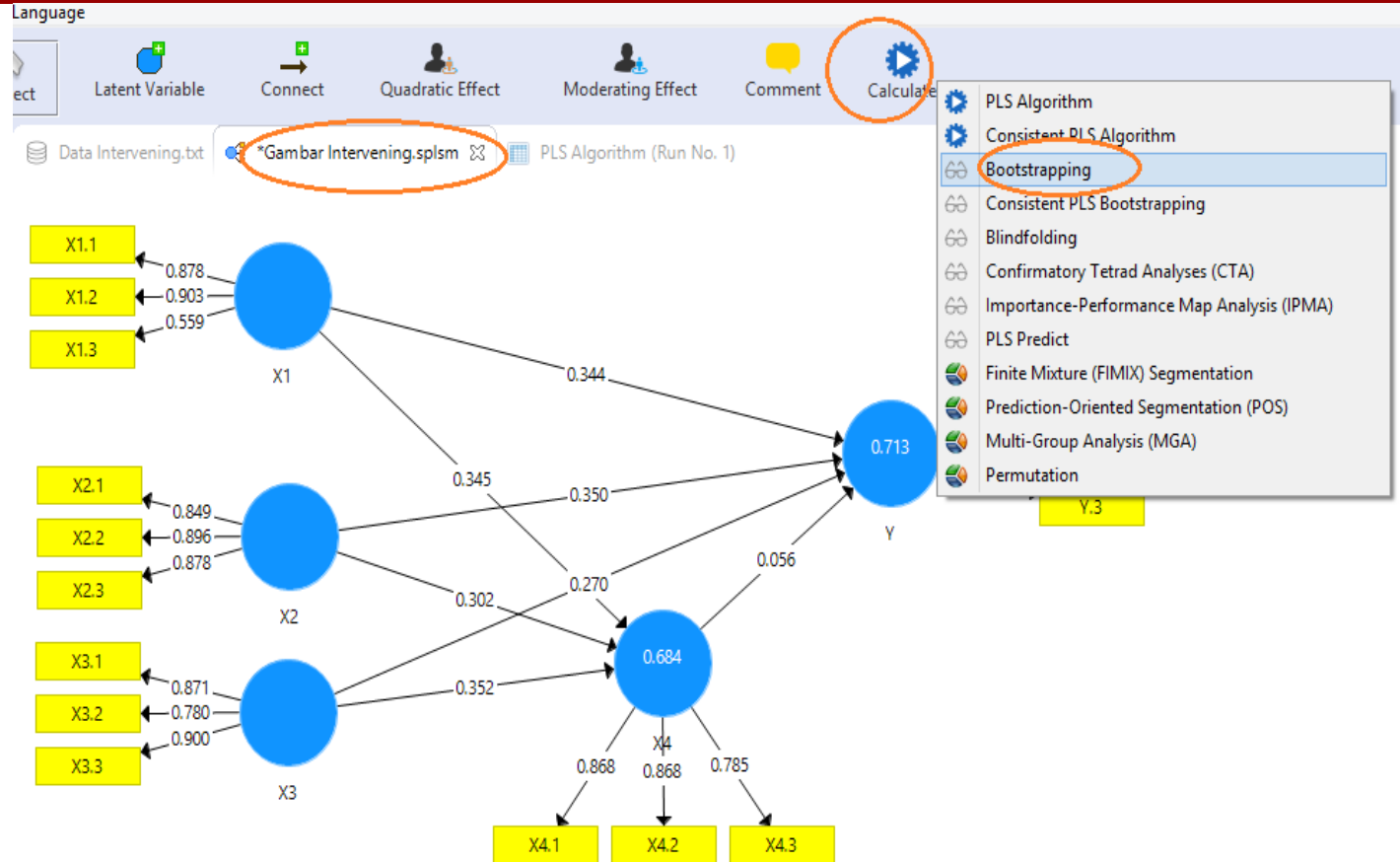
Final Results	Quality Criteria	Interim Results	Base Data
Path Coefficients	R Square	Stop Criterion Changes	Setting
Indirect Effects	f Square		Inner Model
Total Effects	Construct Reliability and Validity		Outer Model
Outer Loadings	Discriminant Validity		Indicator Data (Original)
Outer Weights	Collinearity Statistics (VIF)		Indicator Data (Standardized)
Latent Variable	Model Fit		Indicator Data (Correlations)
Residuals			

Hasil PLS Algorithm ini diperlukan khususnya untuk menganalisis kriteria kualitas dari model, yakni:

- R-Square
- f-Square
- Construct Reliability and Validity
- Discriminant Validity
- Colinearity Statistic (VIF)
- dan Model Fit

Calculate-Bootstrapping

- ❑ Pada tab “Gambar Intervening”
- ❑ Klik Calculate
- ❑ Bootstrapping



- ❑ Ketikkan 5000 pada “Subsamples”
- ❑ Klik “Complete Bootstrapping”
- ❑ Start Calculation

Bootstrapping
Bootstrapping is a nonparametric procedure that allows testing the statistical significance of various PLS-SEM results such path coefficients, Cronbach's alpha, HTMT, and R² values. [Read more!](#)

Setup Partial Least Squares Weighting

Basic Settings

Subsamples: 5000

Do Parallel Processing

Sign Changes: No Sign Changes, Construct Level Changes, Individual Changes

Amount of Results: Basic Bootstrapping, Complete Bootstrapping

Advanced Settings

Confidence Interval Method: Percentile Bootstrap, Studentized Bootstrap, Bias-Corrected and Accelerated (BCa) Bootstrap, Davison Hinkley's Double Bootstrap, Shi's Double Bootstrap

Test Type: One Tailed, Two Tailed

Basic Settings

Subsamples
In bootstrapping, subsamples are created with observations randomly drawn (with replacement) from the original set of data. To ensure stability of results, the number of subsamples should be large. For an initial assessment, one may use a smaller number of bootstrap subsamples (e.g., 500). For the final results preparation, however, one should use a large number of bootstrap subsamples (e.g., 5,000).
Note: Larger numbers of bootstrap subsamples increase the computation time.

Do Parallel Processing
This option runs the bootstrapping routine on multiple processors (if your computer device offers more than one core). Using parallel computing will reduce computation time.

Sign Changes
Sets the method for dealing with sign changes during the bootstrap iterations. The following options are available:
(1) No Sign Changes (default)
Sign changes in the resamples will be ignored and the results are taken as they are. This is the most conservative estimation option and the recommended choice when running the bootstrapping routine.

After Calculation: [Open Full Report](#) [Close](#) [Start Calculation](#)

Hasil Bootstraping akan diperlihatkan

The screenshot displays the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar contains icons for Save, New Project, New Path Model, Hide Zero Values, Increase Decimals, Decrease Decimals, Export to Excel, Export to Web, and Export to R. The Project Explorer on the left shows a project named 'Intervening' with a sub-project 'Gambar Intervening'. The Indicators and Calculation Results panels are visible, with 'Bootstrapping (Run No. 1)' selected. The main window displays the 'Path Coefficients' table, which is circled in orange. Below the table, there are four sections: Final Results, Quality Criteria, Histograms, and Base Data, each with a list of links to various statistical outputs.

Path Coefficients

	Mean, STDEV, T-Values, P-Values	Confidence Intervals	Confidence Intervals Bias Corrected	Samples	
	Original Sampl...	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
X1 -> X4	0.345	0.338	0.120	2.871	0.004
X1 -> Y	0.344	0.347	0.157	2.194	0.028
X2 -> X4	0.302	0.311	0.090	3.352	0.001
X2 -> Y	0.350	0.351	0.153	2.297	0.022
X3 -> X4	0.352	0.352	0.087	4.048	0.000
X3 -> Y	0.270	0.289	0.141	1.918	0.055
X4 -> Y	0.056	0.040	0.136	0.412	0.680

Final Results

- [Path Coefficients](#)
- [Total Indirect Effects](#)
- [Specific Indirect Effects](#)
- [Total Effects](#)
- [Outer Loadings](#)
- [Outer Weights](#)

Quality Criteria

- [R Square](#)
- [R Square Adjusted](#)
- [f Square](#)
- [Average Variance Extracted \(AVE\)](#)
- [Composite Reliability](#)
- [rho_A](#)
- [Cronbach's Alpha](#)

Histograms

- [Path Coefficients Histogram](#)
- [Indirect Effects Histogram](#)
- [Total Effects Histogram](#)

Base Data

- [Setting](#)
- [Inner Model](#)
- [Outer Model](#)
- [Indicator Data \(Original\)](#)
- [Indicator Data \(Standardized\)](#)

ANALISIS QUALITY CRITERIA

Analisis Quality Criteria pada dasarnya adalah untuk menganalisis model pengukuran (Inner Model).

Hasil yang dapat digunakan utamanya adalah hasil dari “PLS Algorithm”, khususnya pada “Quality Criteria”, antara lain:

- ❑ R-Square
- ❑ f-Square
- ❑ Construct Reliability and Validity
- ❑ Discriminant Validity
- ❑ Collinearity Statistic (VIF)
- ❑ Model Fit

Namun demikian, R-Square, f-Square, Collinearity Statistic (VIF), dan Model Fit, sesungguhnya lebih sesuai ditempatkan pada analisis model struktural (inner model) karena berbicara tentang hubungan antar konstruk (variabel) bukan berbicara tentang indikator

The screenshot shows the SmartPLS software interface. The top menu bar includes 'Data Intervening.txt', '*Gambar Intervening.splsm', 'PLS Algorithm (Run No. 1)', and 'Bootstrapping'. The 'R Square' window is open, displaying a table with the following data:

Matrix	R Square	R Square Adjusted
X4	0.684	0.664
Y	0.713	0.687

Below the table, there are four main sections: 'Final Results', 'Quality Criteria', 'Interim Results', and 'Base Data'. The 'Quality Criteria' section is highlighted with an orange box and contains the following links: R Square, f Square, Construct Reliability and Validity, Discriminant Validity, Collinearity Statistics (VIF), and Model Fit.

1. R-Square

R-Square adalah ukuran proporsi variasi nilai variabel yang dipengaruhi (endogen) yang dapat dijelaskan oleh variabel yang mempengaruhinya (eksogen).

Kriterianya:

- Jika nilai $R^2 = 0,75$ → substansial (besar/kuat)
- Jika nilai $R^2 = 0,50$ → moderate (sedang)
- Jika nilai $R^2 = 0,25$ → lemah (kecil)

Kesimpulan:

- R-Square Model Jalur I = 0,684. Artinya kemampuan variabel X1, X2, X3 dalam menjelaskan X4 adalah sebesar 68.4% (sedang).
- R-Square Model Jalur II = 0,713. Artinya kemampuan X1, X2, X3, X4 dalam menjelaskan Y sebesar 71.13% (sedang).

Catatan: SmartPLS memberi indikasi dari warna: nilai berwarna hijau (mengindikasikan efek yang baik), hitam (sedang), merah (buruk)

The screenshot shows the SmartPLS software interface. At the top, there are tabs for 'Data Intervening.txt', '*Gambar Intervening.splsm', and 'PLS Algorithm (Run No. 1)'. Below this, the 'R Square' section is displayed. It contains a table with columns for 'R Square' and 'R Square Adjusted'. The 'R Square' column is highlighted in green, and the 'R Square Adjusted' column is highlighted in black. The table shows the following values:

	R Square	R Square Adjusted
X4	0.684	0.664
Y	0.713	0.687

Below the R Square table, there is a navigation menu with four main categories: 'Final Results', 'Quality Criteria', 'Interim Results', and 'Base Data'. Under 'Quality Criteria', 'R Square' is highlighted in green. Other items in the menu include 'Path Coefficients', 'Indirect Effects', 'Total Effects', 'Outer Loadings', 'Outer Weights', 'Latent Variable', 'Residuals', 'f Square', 'Construct Reliability and Validity', 'Discriminant Validity', 'Collinearity Statistics (VIF)', 'Model Fit', 'Stop Criterion Changes', 'Setting', 'Inner Model', 'Outer Model', 'Indicator Data', and 'Indicator Data'.

Project Explorer

- Gambar Intervening
- Intervening

Indicators | Calculation Results

PLS Algorithm (Run No. 1) [Remove]

Report | Excel | HTML | R

Data Group: Complete

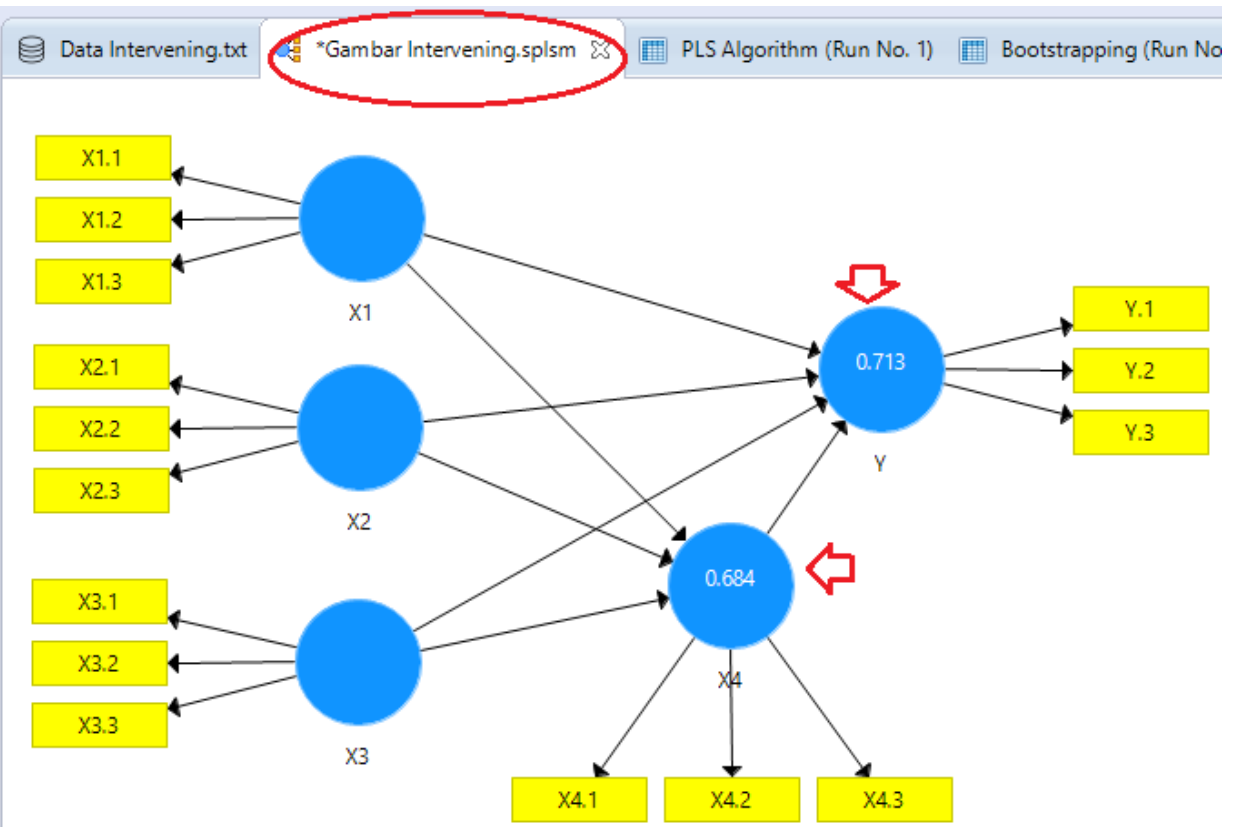
Inner model: -- Blank --

Outer model: -- Blank --

Constructs: R Square

Highlight Paths: off

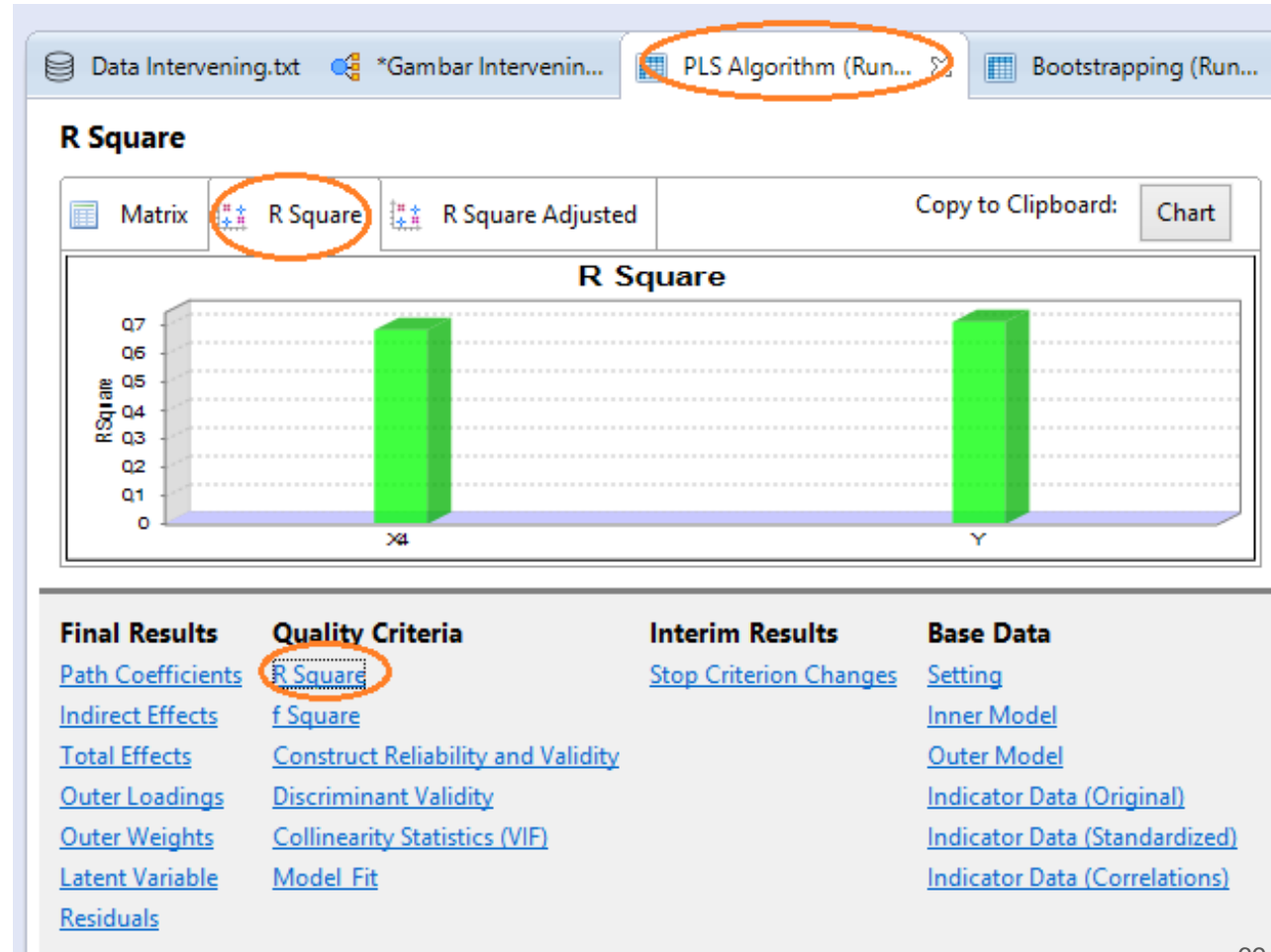
[Show defaults](#)



Catatan: SmartPLS memberi indikasi R-Square dari warna grafik: berwarna hijau (mengindikasikan efek yang baik), merah (buruk)

Dengan demikian,

- R-Square Model Jalur I = 0,684, berwarna hijau (baik)
- R-Square Model Jalur II = 0,713 berwarna hijau (baik)



2.f² (f-Square)

f² effect size (F-Square): adalah ukuran yang digunakan untuk menilai dampak relatif dari suatu variabel yang mempengaruhi (eksogen) terhadap variabel yang dipengaruhi (endogen).

Kriterianya (Cohen, 1988):

- ❑ Jika nilai f² = 0,02 → Kecil/buruk
- ❑ Jika nilai f² = 0,15 → Sedang
- ❑ Jika nilai f² = 0,35 → Besar/baik

Kesimpulan:

- ❑ X1→X4=0,220 (sedang)
- ❑ X2→X4=0,201 (sedang)
- ❑ X3→X4=0,239 (sedang)
- ❑ X1→Y= 0,197 (sedang)
- ❑ X2→Y=0,247 (sedang)
- ❑ X3→Y=0,125 (kecil)
- ❑ X4→Y=0,003 (kecil)

The screenshot shows the SmartPLS software interface. At the top, the 'PLS Algorithm (Run No. 1)' tab is selected. Below it, the 'f Square' section displays a table of results. The table has columns for X1, X2, X3, X4, and Y. The values for X1→X4, X2→X4, and X3→X4 are highlighted in green, indicating a moderate effect size. The values for X1→Y and X2→Y are also highlighted in green. The values for X3→Y and X4→Y are highlighted in red, indicating a small effect size. The 'Matrix' tab is selected in the top left of the table area. Below the table, there is a navigation menu with four main sections: 'Final Results', 'Quality Criteria', 'Interim Results', and 'Base Data'. The 'f Square' link under 'Quality Criteria' is circled in orange.

	X1	X2	X3	X4	Y
X1				0.220	0.197
X2				0.201	0.247
X3				0.239	0.125
X4					0.003
Y					

Final Results
[Path Coefficients](#)
[Indirect Effects](#)
[Total Effects](#)
[Outer Loadings](#)
[Outer Weights](#)
[Latent Variable](#)
[Residuals](#)

Quality Criteria
[R Square](#)
f Square
[Construct Reliability and Validity](#)
[Discriminant Validity](#)
[Collinearity Statistics \(VIF\)](#)
[Model Fit](#)

Interim Results
[Stop Criterion Changes](#)

Base Data
[Setting](#)
[Inner Model](#)
[Outer Model](#)
[Indicator Data \(Original\)](#)
[Indicator Data \(Standardized\)](#)
[Indicator Data \(Correlations\)](#)

Catatan: SmartPLS memberi indikasi dari warna: nilai berwarna hijau (mengindikasikan efek yang baik), hitam (sedang), merah (buruk)

Project Explorer

- Gambar Intervening
- Intervening

Indicators

Calculation Results

PLS Algorithm (Run No. 1) Remove

Report Excel HTML R

Data Group Complete

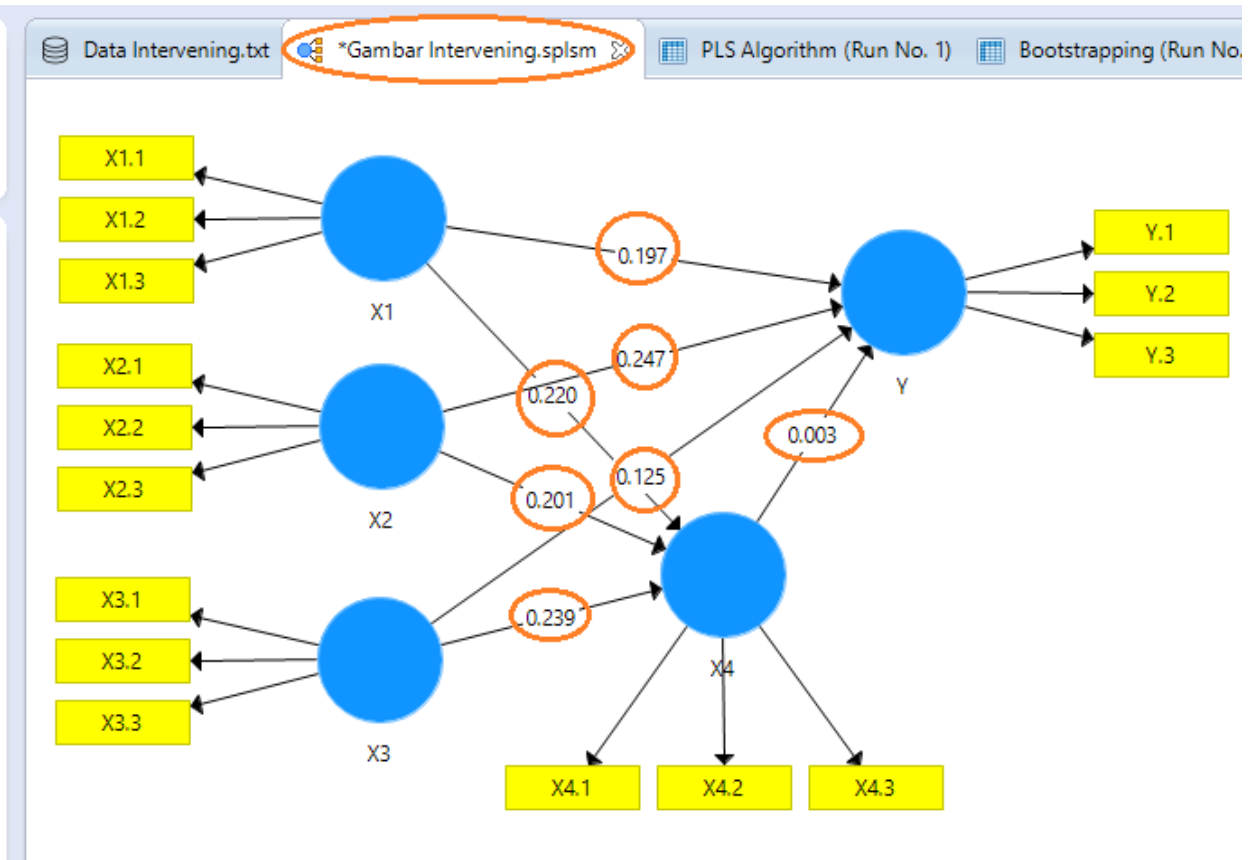
Inner model f Square

Outer model -- Blank --

Constructs -- Blank --

Highlight Paths off

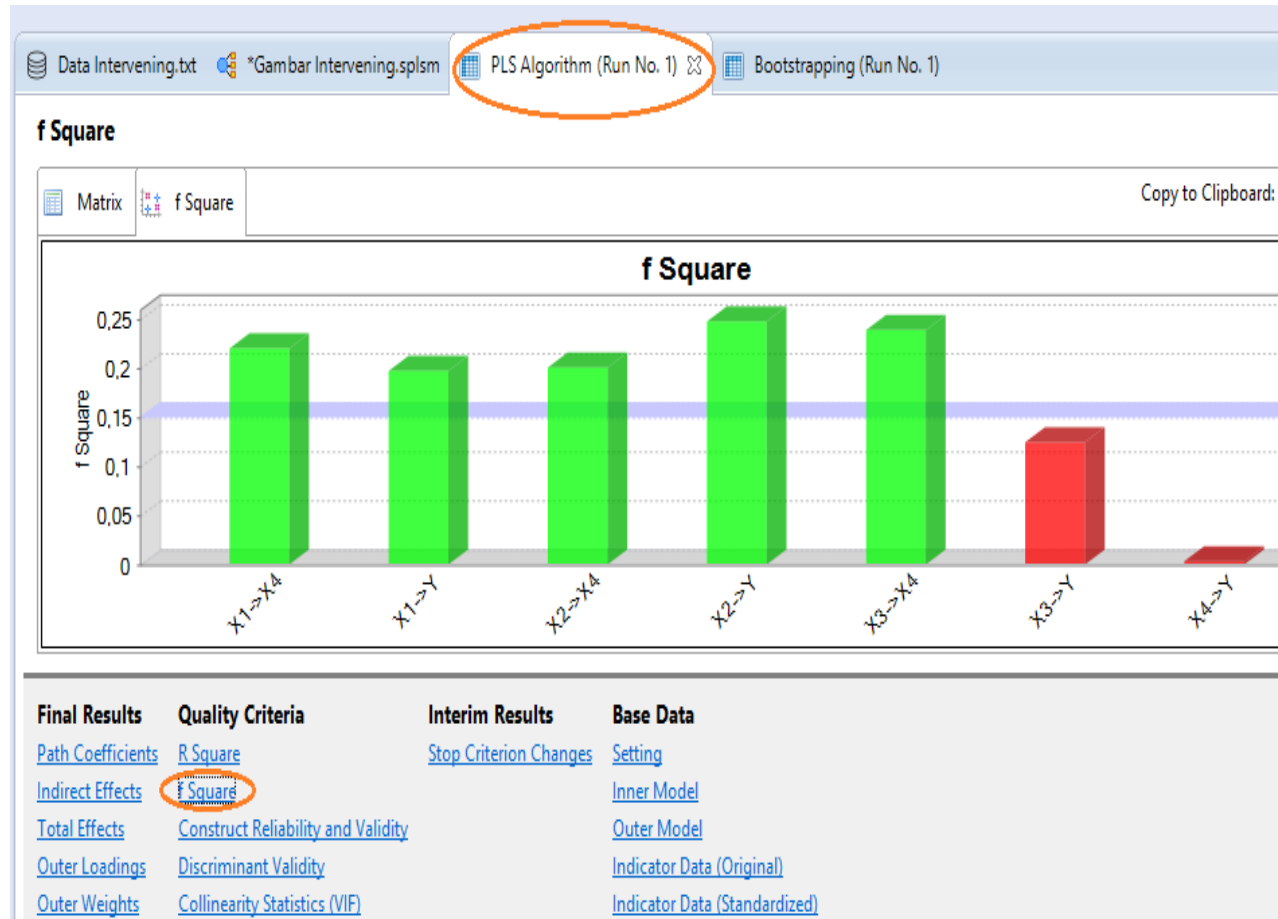
[Show defaults](#)



Catatan: SmartPLS memberi indikasi f-Square dari warna grafik: berwarna hijau (mengindikasikan efek yang baik), merah (buruk)

Dengan demikian, f-Square untuk:

- $X1 \rightarrow X4$ (hijau)=baik
- $X2 \rightarrow X4$ (hijau)=baik
- $X3 \rightarrow X4$ (hijau)=baik
- $X1 \rightarrow Y$ (hijau)=baik
- $X2 \rightarrow Y$ (hijau)=baik
- $X3 \rightarrow Y$ (merah)=buruk
- $X4 \rightarrow Y$ (merah)=buruk



3. Construct Reliability and Validity

Construct reliability and validity (validitas dan reliabilitas konstruk) adalah pengujian untuk mengukur validitas dan reliabilitas suatu konstruk.

Kriteria construct reliability and validity yang baik dapat dilihat dari:

1. Cronbach Alpha: $> 0,7$ (Vinzi, Trinchera, & Amato, 2010)
2. rho_A: $>0,7$ (Vinzi, Trinchera, & Amato, 2010)
3. Composite Reliability: $>0,6$ (Bagozzi dan Yi, 1988; Chin & Dibbern, 2010)
4. Average Variance Extracted (AVE): $> 0,5$ (Bagozzi dan Yi, 1988; Chin & Dibbern, 2010)

Kesimpulan:

- ❑ Cronbach Alpha: Seluruh konstruk variabel $> 0,7$
- ❑ rho_A: Seluruh variabel $>0,7$
- ❑ Composite Reliability: Seluruh variabel $>0,6$
- ❑ Average Variance Extracted (AVE) Seluruh variabel $> 0,5$

Data Intervening.txt *Gambar Intervening.splsm PLS Algorithm (Run No. 1) Bootstrapping (Run No. 1)

Construct Reliability and Validity

Matrix	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	Cop
	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	
X1	0.731	0.839	0.832	0.633	
X2	0.846	0.846	0.907	0.765	
X3	0.812	0.845	0.887	0.725	
X4	0.795	0.812	0.879	0.708	
Y	0.832	0.834	0.899	0.749	

Final Results **Quality Criteria** **Interim Results** **Base Data**

[Path Coefficients](#) [R Square](#) [Stop Criterion Changes](#) [Setting](#)

[Indirect Effects](#) [f Square](#) [Inner Model](#)

[Total Effects](#) [Construct Reliability and Validity](#) [Outer Model](#)

[Outer Loadings](#) [Discriminant Validity](#) [Indicator Data \(Original\)](#)

[Outer Weights](#) [Collinearity Statistics \(VIF\)](#) [Indicator Data \(Standardized\)](#)

[Latent Variable](#) [Model Fit](#) [Indicator Data \(Correlations\)](#)

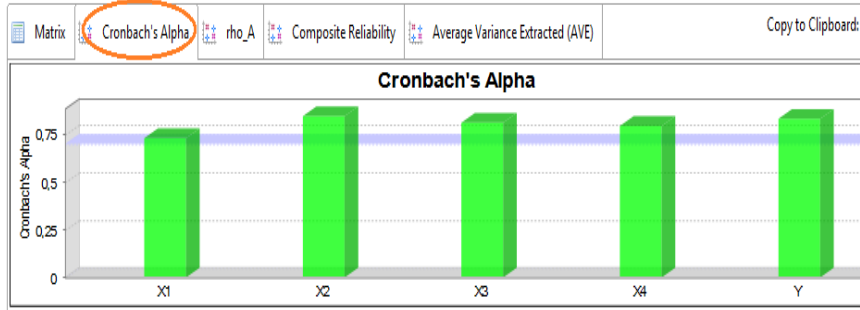
[Residuals](#)

Catatan: SmartPLS memberi indikasi dari warna: nilai berwarna hijau (mengindikasikan konstruk baik), merah (konstruk buruk)

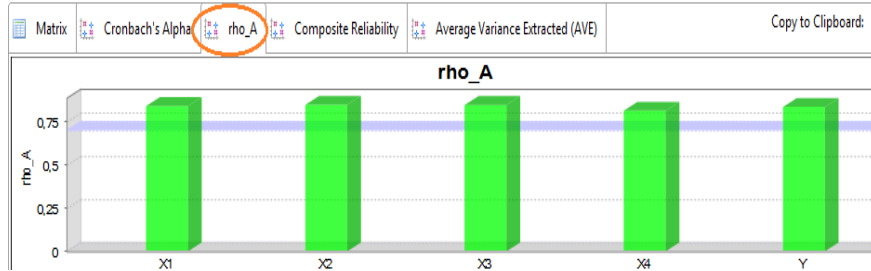
Catatan:

SmartPLS juga memberi indikasi dari warna grafik: nilai berwarna hijau (mengindikasikan konstruk baik), merah (konstruk buruk)

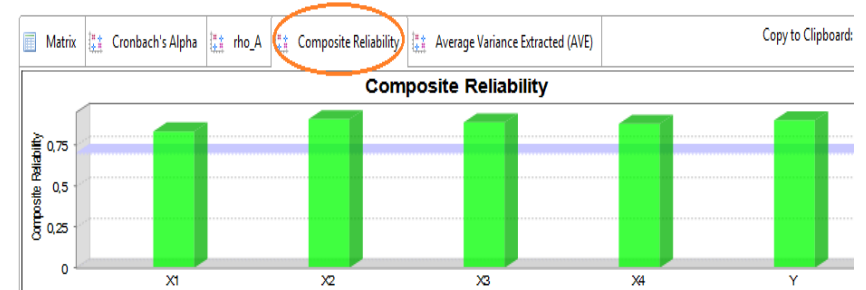
Construct Reliability and Validity



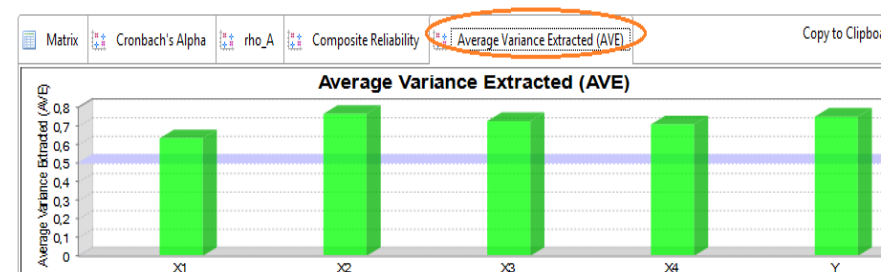
Construct Reliability and Validity



Construct Reliability and Validity



Construct Reliability and Validity



4. Discriminant Validity

Discriminant validity (validitas diskriminan) adalah sejauh mana suatu konstruk benar-benar berbeda dari konstruksi lain (konstruk adalah unik).

Untuk mengukur validitas diskriminan dapat dilihat dari:

- ❑ Fornell-Larcker Cirteiron
- ❑ Cross Loadings
- ❑ Heretroit-Monotrait Ratio (HTMT)

Namun demikian, dalam website SmartPLS, pengukuran terbaru yang terbaik adalah melihat nilai Heretroit-Monotrait Ratio (HTM). Jika nilai HTMT di bawah 0,90 maka suatu konstruk memiliki validitas diskriminan yang baik (Jörg Henseler Christian; M. Ringle; Marko Sarsted; 2015).

Discriminant Validity



Kesimpulan:

X2 -> X1	0.571	<0,90 (Valid)
X3 -> X1	0.693	<0,90 (Valid)
X3 -> X2	0.568	<0,90 (Valid)
X4 -> X1	0.812	<0,90 (Valid)
X4 -> X2	0.780	<0,90 (Valid)
X4 -> X3	0.834	<0,90 (Valid)
Y -> X1	0.800	<0,90 (Valid)
Y -> X2	0.822	<0,90 (Valid)
Y -> X3	0.808	<0,90 (Valid)
Y -> X4	0.864	<0,90 (Valid)

Discriminant Validity

	X1	X2	X3	X4	Y
X1					
X2	0.571				
X3	0.693	0.568			
X4	0.812	0.780	0.834		
Y	0.800	0.822	0.808	0.864	

Final Results

[Path Coefficients](#)

[Indirect Effects](#)

[Total Effects](#)

[Outer Loadings](#)

[Outer Weights](#)

[Latent Variable](#)

[Residuals](#)

Quality Criteria

[R Square](#)

[f Square](#)

[Construct Reliability and Validity](#)

[Discriminant Validity](#)

[Collinearity Statistics \(VIF\)](#)

[Model Fit](#)

Interim Results

[Stop Criterion Changes](#)

Base Data

[Setting](#)

[Inner Model](#)

[Outer Model](#)

[Indicator Data \(Original\)](#)

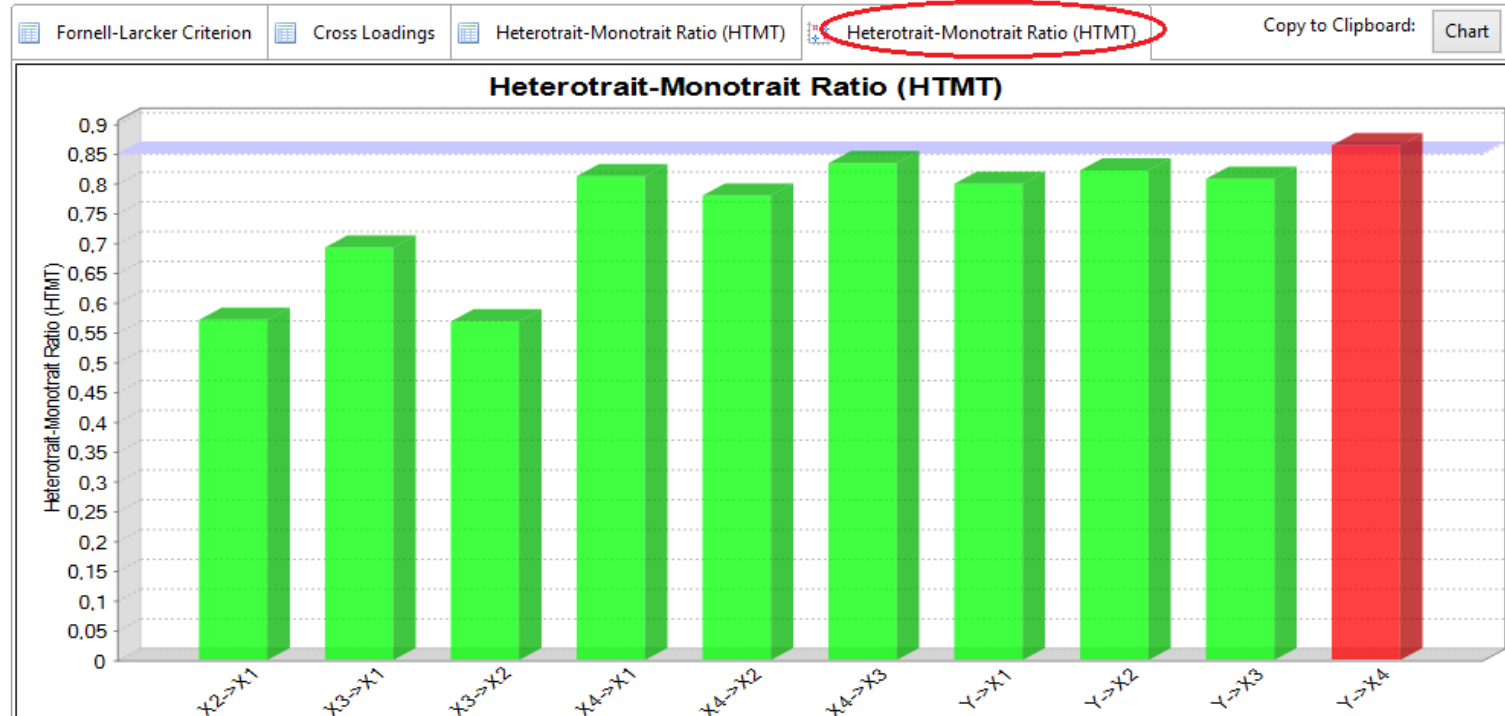
[Indicator Data \(Standardized\)](#)

[Indicator Data \(Correlations\)](#)

Dari warna grafik juga dapat mengindikasikan discriminant validity yang baik (valid). Warna hijau menunjukkan yang baik (valid), dan merah menunjukkan tidak baik

Data Intervening.txt *Gambar Intervening.splsm Bootstrapping (Run No. 1) **PLS Algorithm (Run No. 1)**

Discriminant Validity



5. Collinearity dan Model Fit

Pengujian kolinearitas adalah untuk membuktikan korelasi antar konstruk apakah kuat atau tidak. Jika terdapat korelasi yang kuat berarti model mengandung masalah. Masalah ini disebut dengan kolinearitas (colinearity).

Nilai yang digunakan untuk menganalisisnya adalah dengan melihat nilai Variance Inflation Factor (VIF). (Hair, Hult, Ringle, & Sarstedt, 2014; Garson, 2016):

- ❑ Nilai VIF $> 5,00$: ada masalah kolinearitas
- ❑ Nilai VIF $< 5,00$: tidak ada masalah kolinearitas (Hair, Hult, Ringle, & Sarstedt, 2014).

Kesimpulan:

Dilihat dari “Outer VIF Values”, nilai VIF $< 5,0$.

Dengan demikian tidak ada masalah kolinearitas untuk seluruh indikator.

Collinearity Statistics (VIF)

	VIF
X1.1	1.639
X1.2	1.722
X1.3	1.264
X2.1	1.781
X2.2	2.358
X2.3	2.206
X3.1	1.955
X3.2	1.566
X3.3	2.018
X4.1	1.752
X4.2	1.819
X4.3	1.555
Y.1	2.150
Y.2	2.292
Y.3	1.646

Final Results Quality Criteria Interim Results Base Data

- [Path Coefficients](#) [R Square](#) [Stop Criterion Changes](#) [Setting](#)
- [Indirect Effects](#) [f Square](#) [Indicator Data \(Original\)](#)
- [Total Effects](#) [Construct Reliability and Validity](#) [Indicator Data \(Standardized\)](#)
- [Outer Loadings](#) [Discriminant Validity](#) [Indicator Data \(Correlations\)](#)
- [Outer Weights](#) [Collinearity Statistics \(VIF\)](#)
- [Latent Variable](#) [Model Fit](#)
- [Residuals](#)

Collinearity Statistics (VIF)

	X1	X2	X3	X4	Y
X1				1.715	2.092
X2				1.438	1.726
X3				1.640	2.032
X4					3.166
Y					

Final Results	Quality Criteria	Interim Results	Base Data
Path Coefficients	R Square	Stop Criterion Changes	Setting
Indirect Effects	f Square		Inner Model
Total Effects	Construct Reliability and Validity		Outer Model
Outer Loadings	Discriminant Validity		Indicator Data (Original)
Outer Weights	Collinearity Statistics (VIF)		Indicator Data (Standardized)
Latent Variable	Model Fit		Indicator Data (Correlations)
Residuals			

Kesimpulan:

Dilihat dari “Inner VIF Values”, seluruh nilai VIF < 5,0.

Dengan demikian tidak ada masalah kolinearitas untuk seluruh variabel.

6. Model of Fit

Model of fit tidak disarankan oleh SmartPLS karena model of fit hanya meniru CB-SEM, dan sering tidak berguna untuk PLS-SEM. Sejauh ini, kriteria model of fit biasanya tidak boleh dilaporkan dan digunakan untuk penilaian hasil PLS-SEM.

Silahkan baca di:

<https://www.smartpls.com/documentation/functionalities/model-fit>

FINAL RESULTS

Final Results pada dasarnya adalah untuk menganalisis model struktural.

Untuk menganalisisnya, dapat digunakan hasil dari “Bootstrap”, khususnya:

- ❑ Path Coefficients
- ❑ Indirect Coefficient

Direct Effect (Path Coefficient/Koefisien Jalur)

Analisis direct effect berguna untuk menguji hipotesis pengaruh langsung suatu variabel yang mempengaruhi (eksogen) terhadap variabel yang dipengaruhi (endogen).

Kriterianya:

- ❑ Koefisien jalur (Path Coefficient):
 - ❑ Jika nilai koefisien jalur (path coefficient) adalah positif, maka pengaruh suatu variabel terhadap adalah searah, jika nilai suatu variabel eksogen meningkat/naik, maka nilai variabel endogen juga meningkat/naik
 - ❑ Jika nilai koefisien jalur (path coefficient) adalah negatif, maka pengaruh suatu variabel terhadap adalah berlawanan arah, jika nilai suatu variabel eksogen meningkat/naik, maka nilai variabel endogen menurun.
- ❑ Nilai Probabilitas/Signifikansi (P-Value):
 - ❑ Jika nilai P-Values < 0,05, maka signifikan
 - ❑ Jika nilai P-Values > 0,05, maka tidak signifikan

Kesimpulan:

- ❑ Koefisien jalur (Path Coefficient): Seluruh nilai koefisien jalur adalah positif (catatan: lihat pada original sample)
- ❑ Nilai Probabilitas/Signifikan (P-Value): Semua jalur adalah signifikan kecuali pengaruh X3 terhadap Y, dan pengaruh X4 terhadap Y

The screenshot shows the SmartPLS software interface. At the top, there are tabs for 'Data Intervening.txt', '*Gambar Intervening.splsm', 'Bootstrapping (Run No. 1)', and 'PLS Algorithm (Run No. 1)'. The 'Bootstrapping (Run No. 1)' tab is highlighted with a red circle. Below the tabs is the 'Path Coefficients' section, which contains a table with columns for 'Original Sample', 'Sample Mean (...)', 'Standard Devia...', 'T Statistics (|O...', and 'P Values'. The 'Original Sample' column is highlighted with a red box. Below the table is a navigation menu with four sections: 'Final Results', 'Quality Criteria', 'Histograms', and 'Base Data'. The 'Path Coefficients' link under 'Final Results' is highlighted with a red circle.

	Original Sampl...	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
X1 -> X4	0.345	0.338	0.120	2.871	0.004
X1 -> Y	0.344	0.347	0.157	2.194	0.028
X2 -> X4	0.302	0.311	0.090	3.352	0.001
X2 -> Y	0.350	0.351	0.153	2.297	0.022
X3 -> X4	0.352	0.352	0.087	4.048	0.000
X3 -> Y	0.270	0.289	0.141	1.918	0.055
X4 -> Y	0.056	0.040	0.136	0.412	0.680

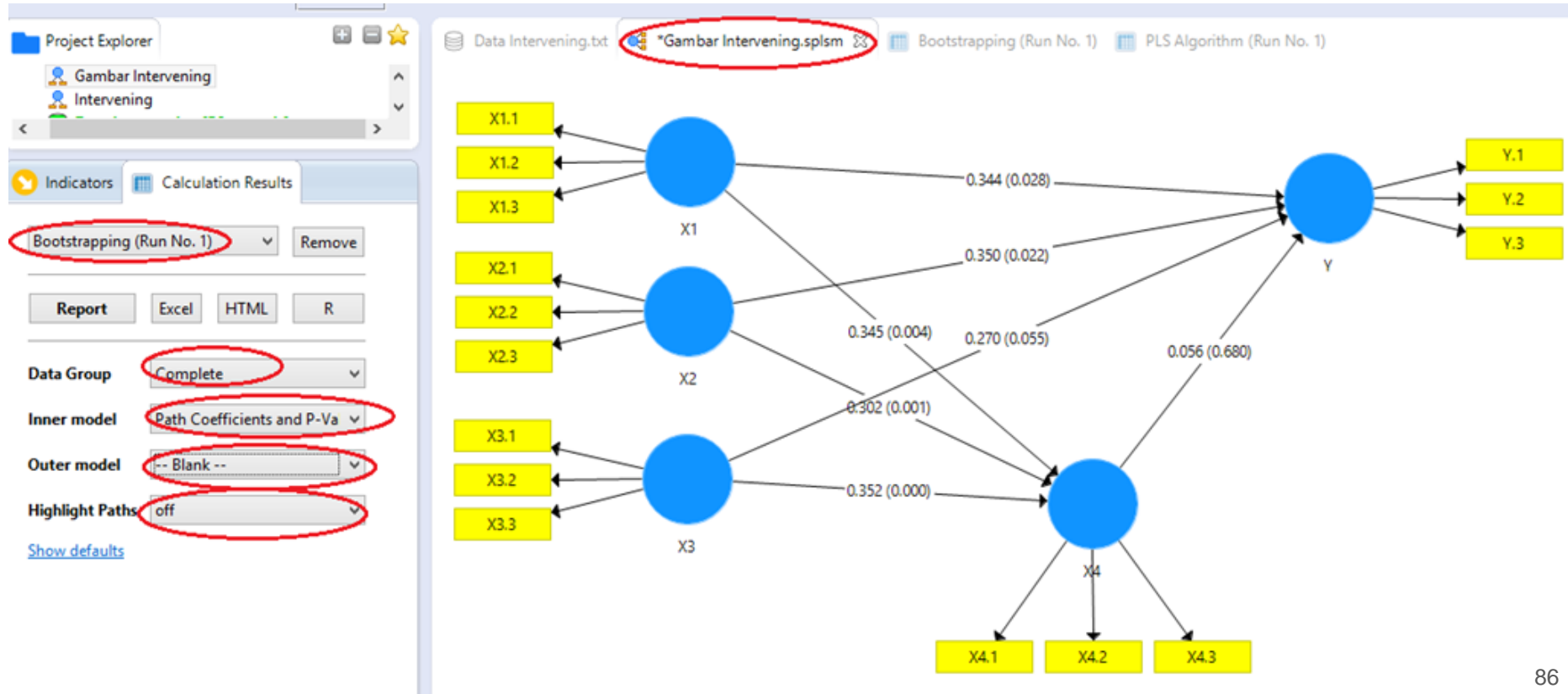
Final Results
[Path Coefficients](#)
[Total Indirect Effects](#)
[Specific Indirect Effects](#)
[Total Effects](#)
[Outer Loadings](#)

Quality Criteria
[R Square](#)
[R Square Adjusted](#)
[f Square](#)
[Average Variance Extracted \(AVE\)](#)
[Composite Reliability](#)

Histograms
[Path Coefficients Histogram](#)
[Indirect Effects Histogram](#)
[Total Effects Histogram](#)

Base Data
[Setting](#)
[Inner Model](#)
[Outer Model](#)
[Indicator Data \(Original\)](#)
[Indicator Data \(Standardized\)](#)

Dari gambar jalur juga akan sangat mudah menentukan nilai positif/negatif dari suatu jalur, dan signifikan/tidak signifikan dari suatu jalur.



Indirect Effect (Pengaruh Tidak Langsung)

Analisis indirect effect berguna untuk menguji hipotesis pengaruh tidak langsung suatu variabel yang mempengaruhi (eksogen) terhadap variabel yang dipengaruhi (endogen) yang diantarai/dimediasi oleh suatu variabel intervening (variabel mediator).

Kriterianya:

- ❑ Jika nilai $P\text{-Values} < 0,05$, maka signifikan (pengaruhnya adalah tidak langsung), artinya variabel intervening “berperan” dalam mengantarai/memediasi hubungan suatu variabel eksogen terhadap suatu variabel endogen.
- ❑ Jika nilai $P\text{-Values} > 0,05$, maka tidak signifikan (pengaruhnya adalah langsung), artinya variabel intervening “tidak berperan” dalam mengantarai/memediasi hubungan suatu variabel eksogen terhadap suatu variabel endogen.

Kesimpulan:

- ❑ Pengaruh tidak langsung $X1 \rightarrow X4 \rightarrow Y$ adalah 0,019, dengan P-Values $0,693 > 0,05$ (tidak signifikan)
- ❑ Pengaruh tidak langsung $X2 \rightarrow X4 \rightarrow Y$ adalah 0,017, dengan P-Values $0,712 > 0,05$ (tidak signifikan)
- ❑ Pengaruh tidak langsung $X1 \rightarrow X4 \rightarrow Y$ adalah 0,020, dengan P-Values $0,692 > 0,05$ (tidak signifikan)

Specific Indirect Effects

	Original Sample (O)	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
X1 -> X4 -> Y	0.019	0.013	0.049	0.395	0.693
X2 -> X4 -> Y	0.017	0.014	0.046	0.369	0.712
X3 -> X4 -> Y	0.020	0.013	0.050	0.396	0.692

Final Results: [Path Coefficients](#), [Total Indirect Effects](#), [Specific Indirect Effects](#), [Total Effects](#), [Outer Loadings](#)

Quality Criteria: [R Square](#), [R Square Adjusted](#), [f Square](#), [Average Variance Extracted \(AVE\)](#), [Composite Reliability](#)

Histograms: [Path Coefficients Histogram](#), [Indirect Effects Histogram](#), [Total Effects Histogram](#)

Base Data: [Setting](#), [Inner Model](#), [Outer Model](#), [Indicator Data \(Original\)](#), [Indicator Data \(Standardized\)](#)

Catatan:

Jika Anda membandingkan cara klasik analisis jalur, hasilnya akan sama dengan cara membandingkan nilai P-Value seperti di atas.

Contohnya:

Pengaruh langsung (PL) $X1 \rightarrow Y$ (0,344) dengan pengaruh tidak langsung (PTL) $X1 \rightarrow X4 \rightarrow Y$ (0,019): Maka $PL > PTL$ ($X4$ tidak memediasi pengaruh $X1$ terhadap Y)

Pengaruh langsung (PL) $X2 \rightarrow Y$ (0,350) dengan pengaruh tidak langsung (PTL) $X2 \rightarrow X4 \rightarrow Y$ (0,017): : Maka $PL > PTL$ ($X4$ tidak memediasi pengaruh $X2$ terhadap Y)

Pengaruh langsung (PL) $X3 \rightarrow Y$ (0,270) dengan pengaruh tidak langsung (PTL) $X3 \rightarrow X4 \rightarrow Y$ (0,020): : Maka $PL > PTL$ ($X4$ tidak memediasi pengaruh $X3$ terhadap Y)

	Original Sampl...	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
$X1 \rightarrow X4$	0.345	0.338	0.120	2.871	0.004
$X1 \rightarrow Y$	0.344	0.347	0.157	2.194	0.028
$X2 \rightarrow X4$	0.302	0.311	0.090	3.352	0.001
$X2 \rightarrow Y$	0.350	0.351	0.153	2.297	0.022
$X3 \rightarrow X4$	0.352	0.352	0.087	4.048	0.000
$X3 \rightarrow Y$	0.270	0.289	0.141	1.918	0.055
$X4 \rightarrow Y$	0.056	0.040	0.136	0.412	0.680

	Original Sample (O)	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
$X1 \rightarrow X4 \rightarrow Y$	0.019	0.013	0.049	0.395	0.693
$X2 \rightarrow X4 \rightarrow Y$	0.017	0.014	0.046	0.369	0.712
$X3 \rightarrow X4 \rightarrow Y$	0.020	0.013	0.050	0.396	0.692

STRUKTUR PEMBAHASAN YANG DISARANKAN

1. Analisis Outer Model (Model Pengukuran)
 - Construct Reliability and Validity
 - Discriminant Validity
1. Analisis Inner Model (Model Struktural)
 - R-Square
 - f-Square
 - Collinearity Statistic (VIF)
 - Direct Effect
 - Indirect Effect

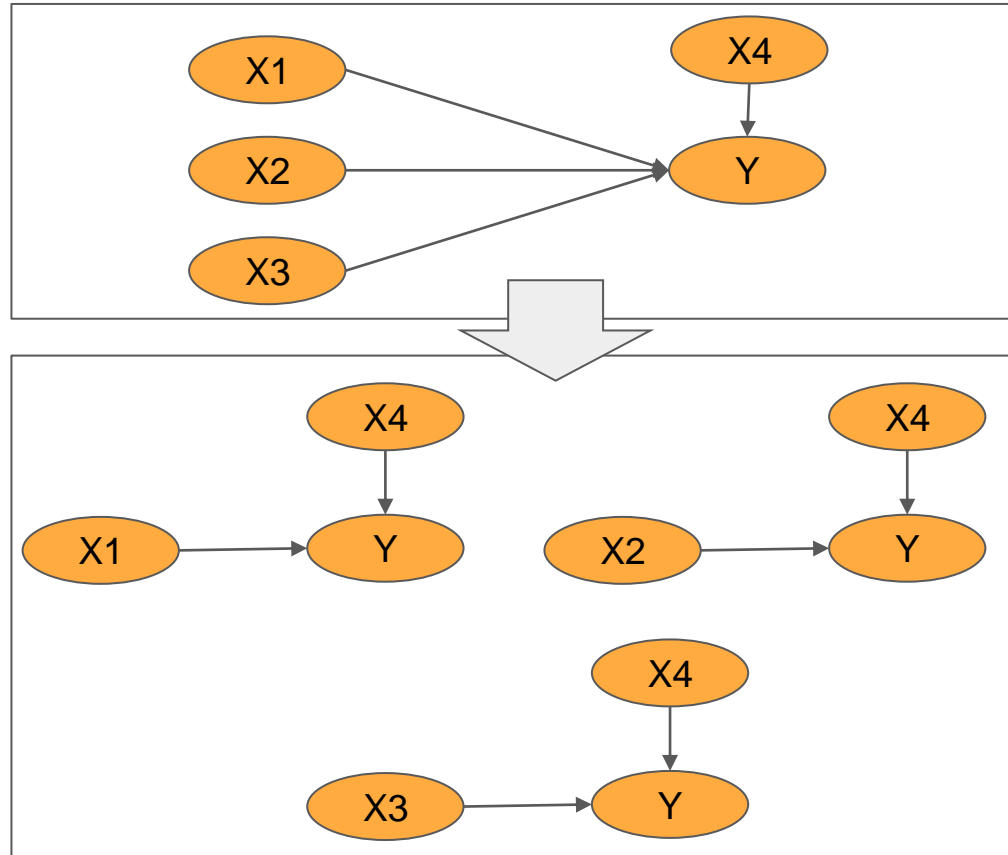
Contoh Analisis PLS ber-Variabel Moderator

Azuar Juliandi

SEM Bervariabel Moderator

- ❑ Variabel moderator adalah variabel yang mempengaruhi hubungan variabel eksogen (bebas) dengan variabel endogen (terikat)
- ❑ Jika variabel eksogen (bebas) lebih dari satu, maka analisis harus dipisah masing-masing.
- ❑ Contoh: Variabel eksogen/bebas ada 3 (X1, X2, X3), variabel moderator ada 1 (X4), variabel endogen/terikat ada 1 (Y), maka analisisnya adalah masing-masing:
 - ❑ $X1 \rightarrow Y$ dimoderasi X4
 - ❑ $X2 \rightarrow Y$ dimoderasi X4
 - ❑ $X3 \rightarrow Y$ dimoderasi X4

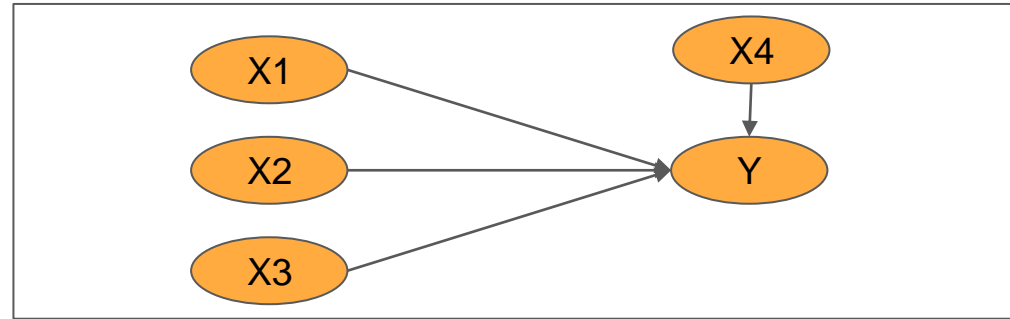
Dengan demikian, running untuk SmartPLS ada 3 kali



Rumusan Masalah/Tujuan Penelitian/Hipotesis

Rumusan Masalah/Tujuan
Penelitian/Hipotesis:

- 1) $X1 \rightarrow Y$ yang dimoderasi $X4$
- 2) $X2 \rightarrow Y$ yang dimoderasi $X4$
- 3) $X3 \rightarrow Y$ yang dimoderasi $X4$



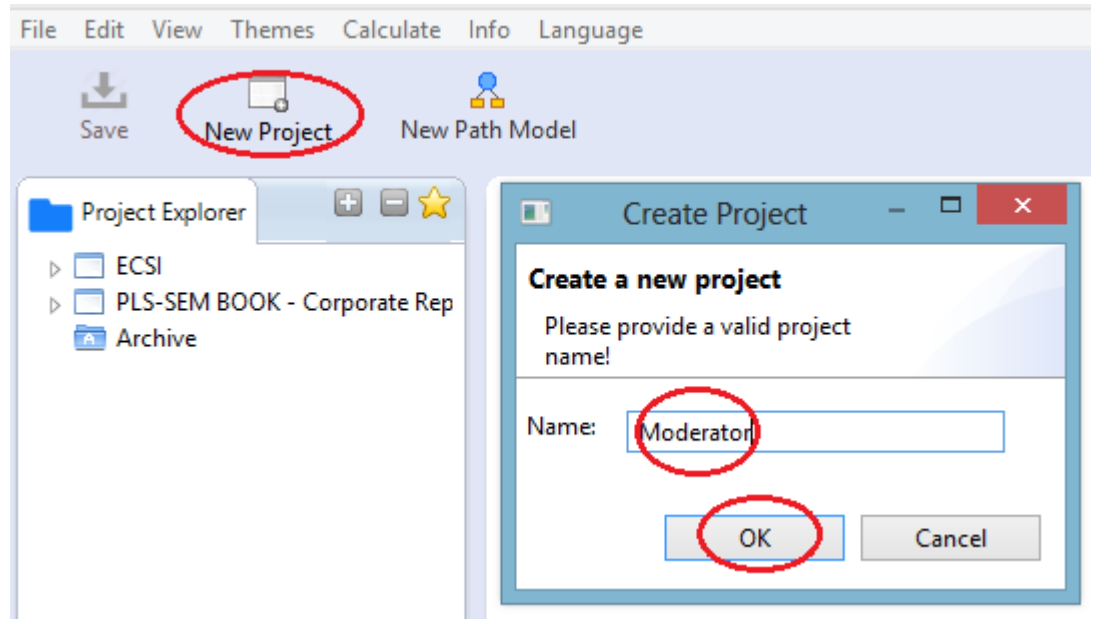
Data

- ❑ [Download Contoh Data](#) (Data dikemas dalam di Excel dengan save as type: CSV-MS DOS)
- ❑ Sampel: 50
- ❑ Variabel terdiri dari 4:
 - ❑ Variabel eksogen/bebas (X1, X2, X3), indikatornya:
 - ❑ X1.1; X1.2; X1.3
 - ❑ X2.1; X2.2; X2.3
 - ❑ X3.1; X3.2; X3.3
 - ❑ Variabel moderator (X4), indikatornya:
 - ❑ X4.1; X4.2; X4.3
 - ❑ Variabel endogen/Terikat (Y), indikatornya:
 - ❑ Y.1; Y.2; Y.3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	X1.1	X1.2	X1.3	X2.1	X2.2	X2.3	X3.1	X3.2	X3.3	X4.1	X4.2	X4.3	Y.1	Y.2	Y.3
2	2	3	3	2	2	2	2	2	3	2	2	2	3	3	3
3	4	4	4	5	4	5	4	5	5	4	5	4	5	4	4
4	3	3	3	5	5	4	2	2	2	3	4	3	3	3	4
5	4	3	4	5	4	5	5	4	5	4	4	4	3	5	4
6	3	4	3	5	4	5	4	4	4	3	3	3	4	4	5
7	3	4	3	4	4	5	5	3	3	3	4	3	3	3	5
8	4	4	4	4	5	5	4	5	4	4	4	3	5	4	4
9	4	4	3	4	4	4	4	3	4	4	4	5	4	5	5
10	5	4	4	4	2	4	4	4	4	3	4	4	5	3	5
11	3	3	3	3	2	3	3	5	3	4	3	2	3	3	2
12	2	3	2	2	2	2	2	3	2	3	2	2	2	2	2
13	4	4	4	4	4	5	4	4	4	3	4	4	4	4	5
14	3	4	5	3	4	5	2	4	4	3	2	3	3	3	5
15	4	4	4	5	5	4	4	4	4	4	4	4	4	4	4
16	2	3	4	2	2	2	2	3	2	2	3	2	2	2	2
17	4	4	2	5	2	2	5	5	4	4	4	3	4	5	5
18	4	2	2	4	2	2	3	3	4	4	3	4	3	3	3

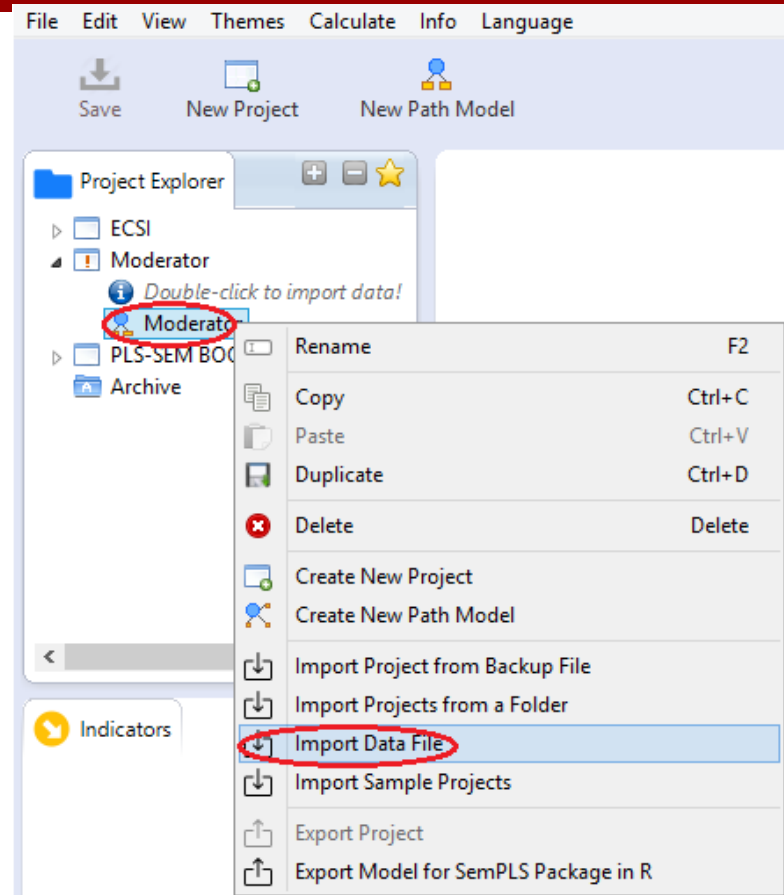
New Project

- ❑ New Project
- ❑ Name: Moderator
- ❑ OK

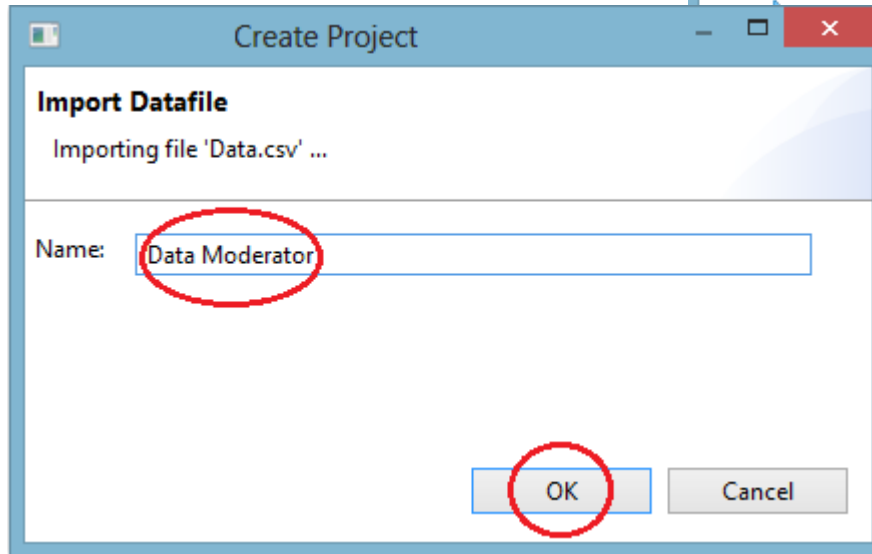
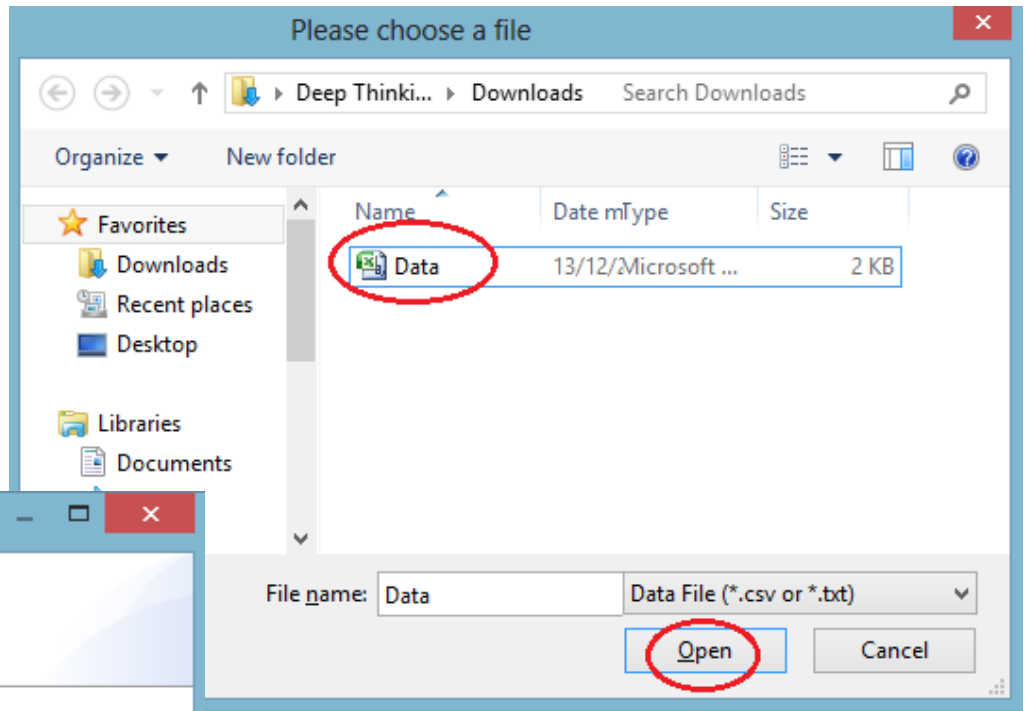


Import Data File

- ❑ Klik “kanan” di Moderator
- ❑ Import Data File



- ❑ Klik “Data”
- ❑ Open
- ❑ Ketikkan “Data Moderator” di “Name”
- ❑ OK

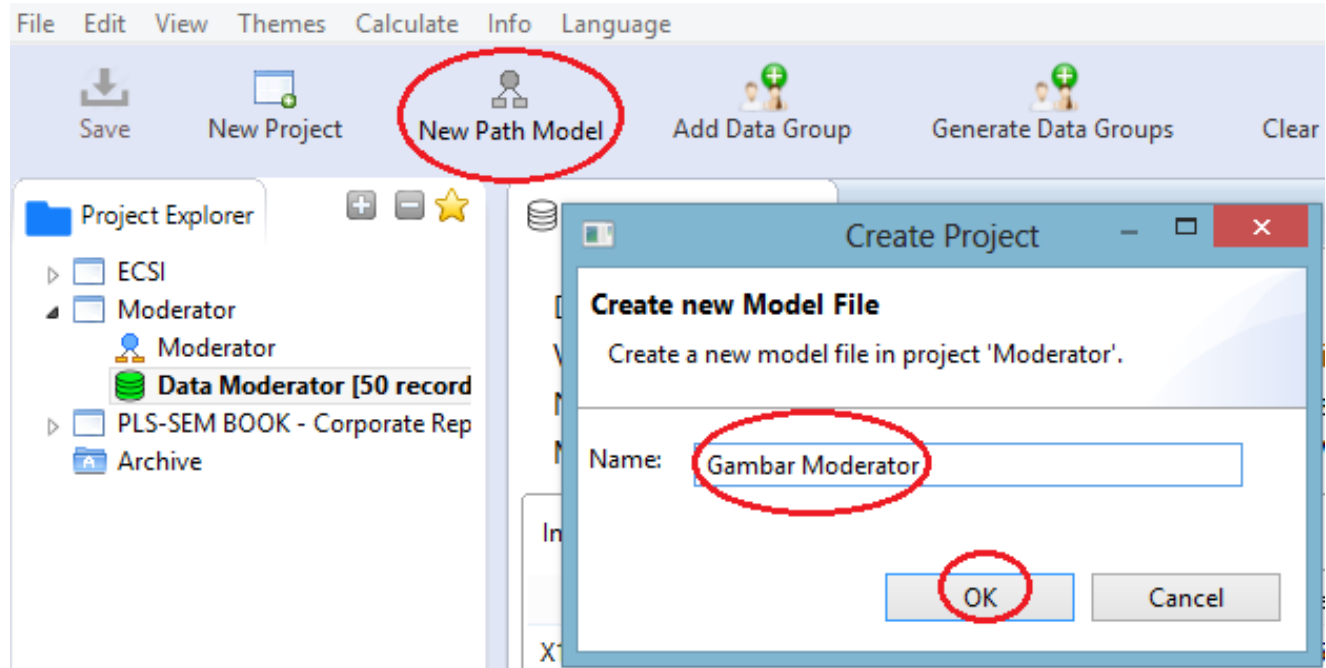


Data akan ditampilkan

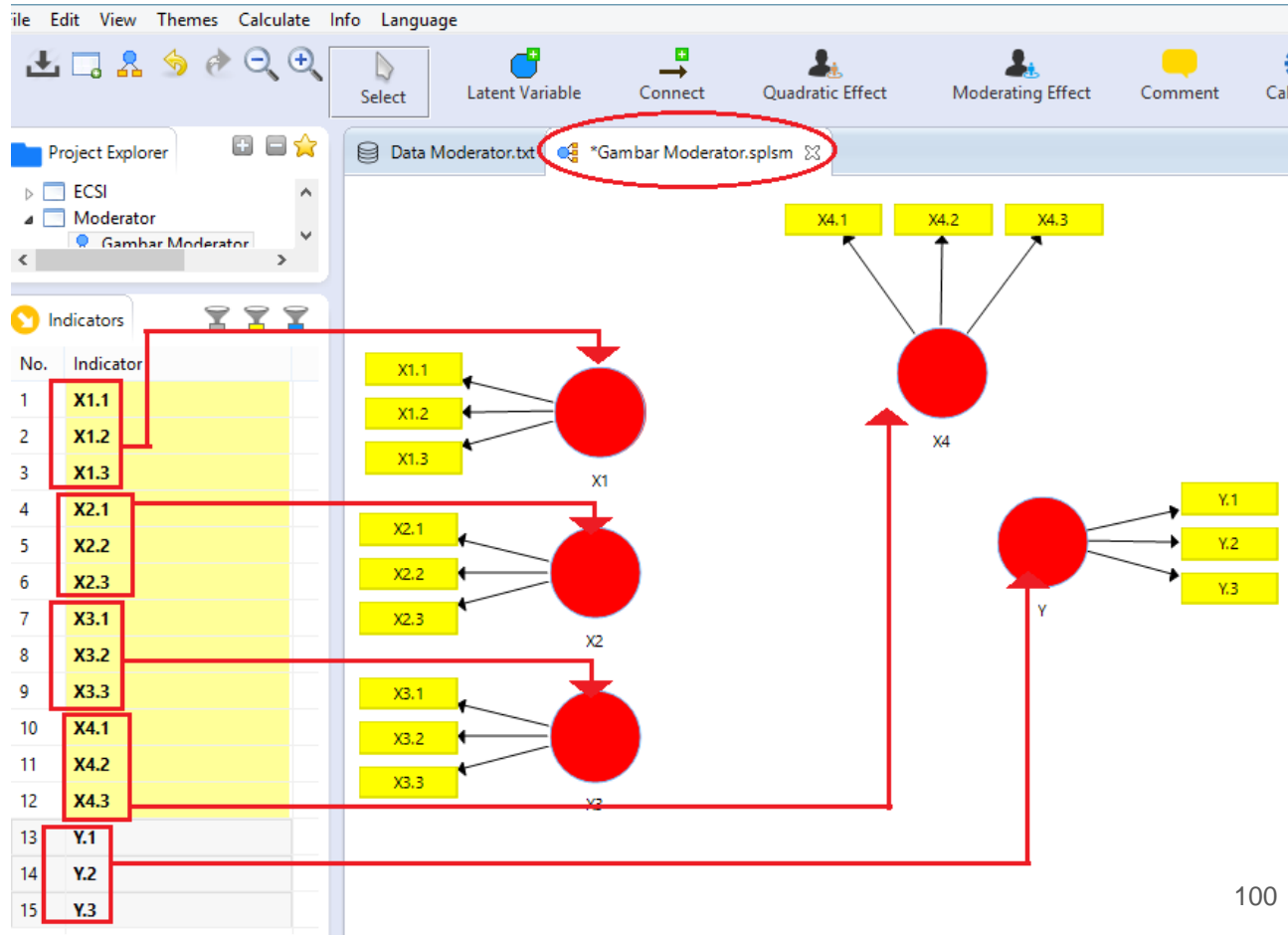
The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. Below the menu is a toolbar with icons for Save, New Project, New Path Model, Add Data Group, Generate Data Groups, and Clear Data Groups. On the left, the Project Explorer shows a tree view with folders for ECSI, Moderator, PLS-SEM BOOK - Corporate Rep, and Archive. The main workspace displays the settings for 'Data Moderator.txt', which are: Delimiter: Semicolon, Encoding: UTF-8, Value Quote Character: None, Sample size: 50, Number Format: US (e.g. 1,000.23), Indicators: 15, and Missing Value Marker: None. Below the settings is a table with columns for Indicators, Indicator Correlations, and Raw File. The table contains 15 rows of indicator data, with the first 10 rows circled in red. The table data is as follows:

Indicators	Indicator Correlations	Raw File	No.	Missing	Mean	Median	Min	Max	Standard Devia...
X1.1			1	0	3.520	4.000	2.000	5.000	0.854
X1.2			2	0	3.540	4.000	2.000	4.000	0.727
X1.3			3	0	3.480	4.000	2.000	5.000	0.830
X2.1			4	0	3.860	4.000	2.000	5.000	1.096
X2.2			5	0	3.700	4.000	2.000	5.000	1.100
X2.3			6	0	3.860	4.000	2.000	5.000	1.166
X3.1			7	0	3.400	4.000	2.000	5.000	1.000
X3.2			8	0	3.560	4.000	2.000	5.000	0.920
v2.1			9	0	3.400	4.000	2.000	5.000	0.977

- ❑ Klik “New Path Project”
- ❑ Ketikkan “Gambar Moderator” pada Name
- ❑ OK



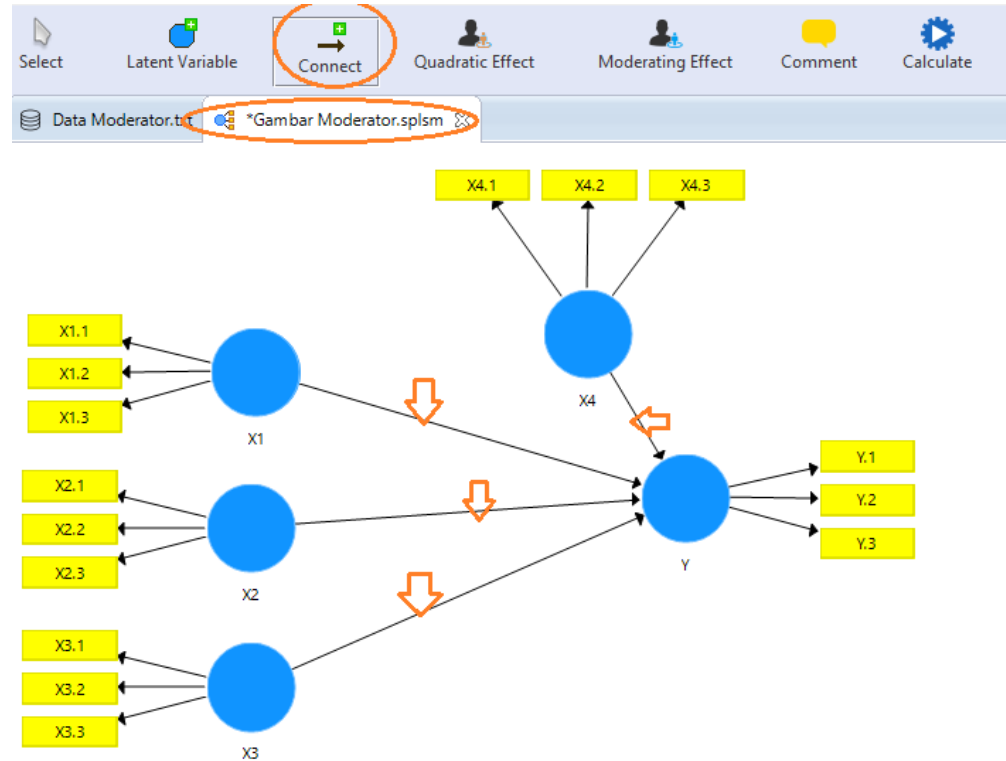
- Untuk masing-masing variabel, pindahkan seluruh indikator ke kanan (ikuti bentuk seperti contoh)
- Ganti nama untuk masing-masing variabel (rename), menjadi X1, X2, X3, X4, Y
- Atur posisi indikator (seperti contoh di gambar)



Connect

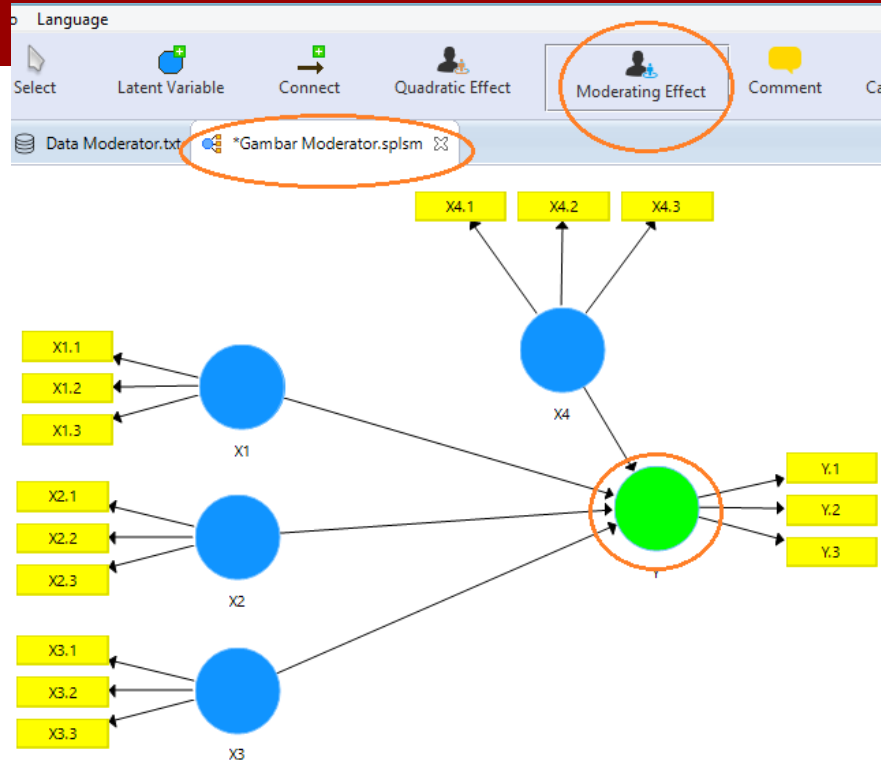
Klik “Connect” untuk menghubungkan variabel-variabel:

- ❑ X1 ke Y
- ❑ X2 ke Y
- ❑ X3 ke Y
- ❑ X4 ke Y



Moderating Effect

- ❑ Klik “Moderating Effect”
- ❑ Klik pada variabel Y (warna hijau)



Sesuaikan seperti berikut ini:

- ❑ Dependent variabel: Y
- ❑ Moderator variable: X4
- ❑ Independent variable: X1
- ❑ Calculation Method: Pilih Product Indicator
- ❑ OK

Moderating Effect

Basic Settings

Dependent Variable: Y

Moderator Variable: X4

Independent Variable: X1

Calculation Method: Product Indicator
 Two Stage
 Orthogonalization

Advanced Settings

Product Term Generation: Unstandardized
 Mean Centered
 Standardized

Weighing Mode: Automatic
 Mode A
 Mode B
 Sumscores
 Pre Defined

Basic Settings

Dependent Variable
The selected dependent variable is: Y

Predictor Variable
Field to define the predictor variable: X1

Moderator Variable
Field to define the moderator variable: X4

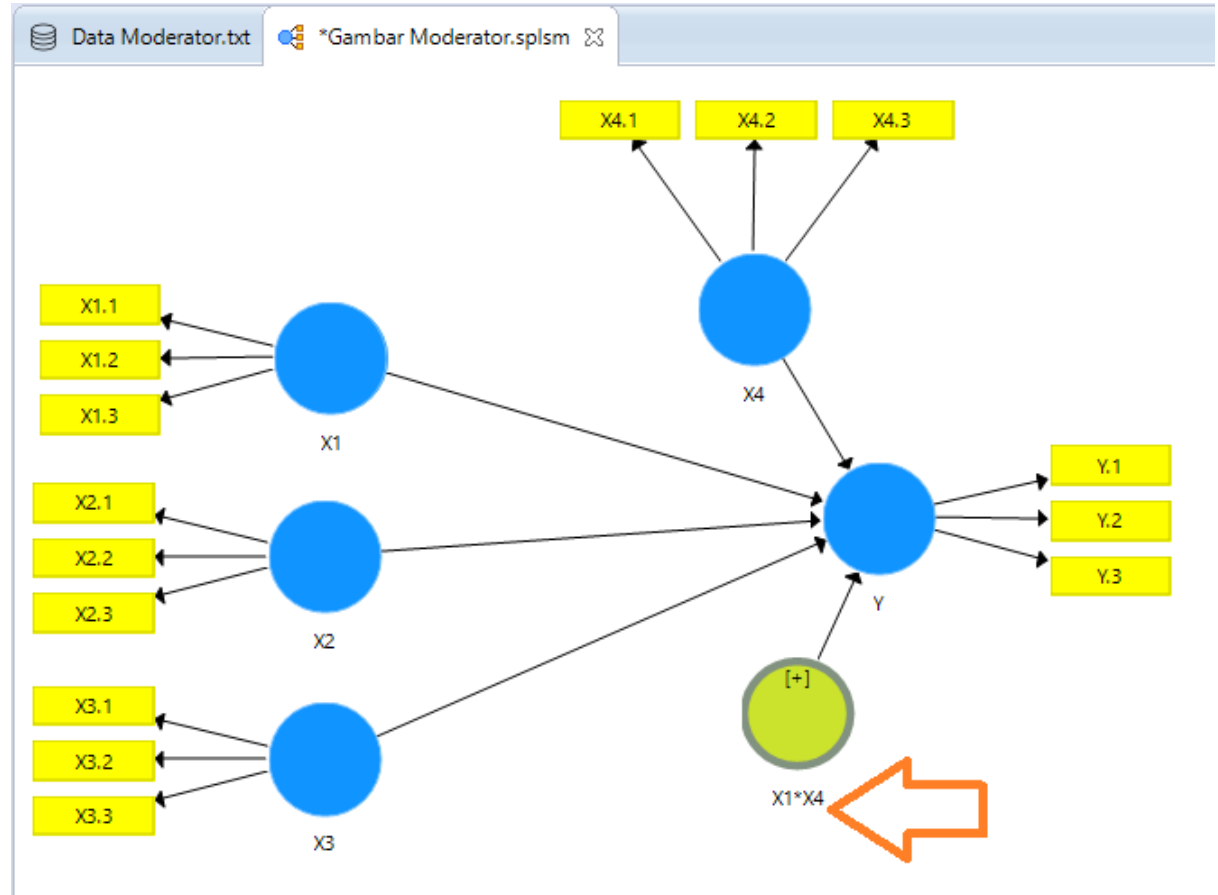
Calculation Method
Selects the method of interaction options:
(1) Product Indicator
This approach uses all predictor and the latent indicators ("product indicator")
(2) Two-stage (default)
This approach uses the moderator variable from the selected predictor variable

OK Cancel

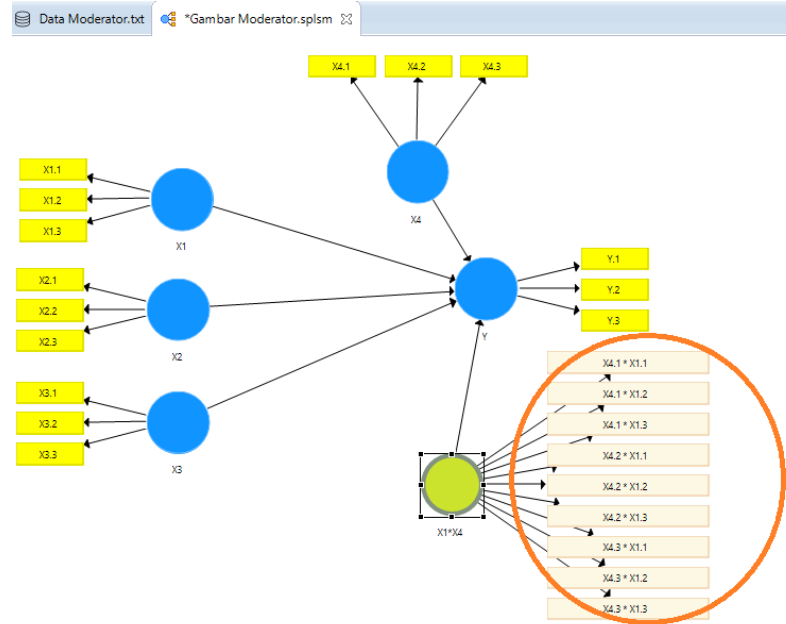
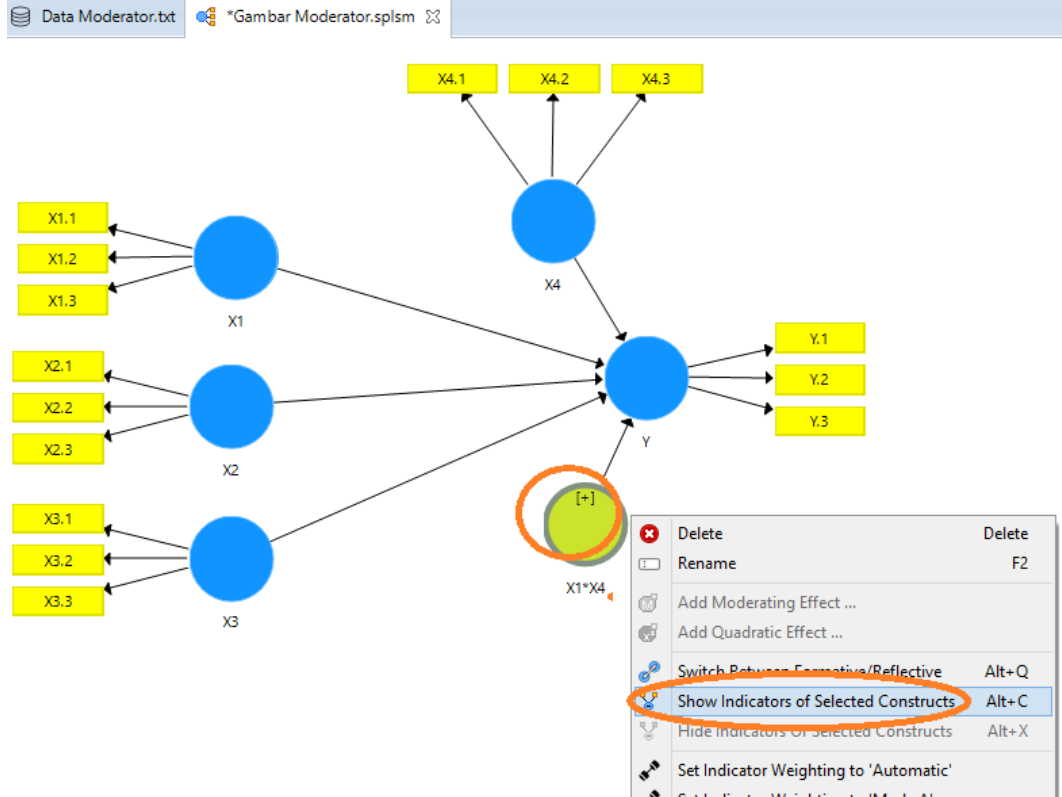
- ❑ Variabel baru akan ditampilkan (Moderating Effect)
- ❑ Klik kanan pada variabel baru (warna hijau), Rename, Ganti menjadi X1*X4
- ❑ OK

The screenshot displays the SmartPLS software interface. At the top, the file explorer shows 'Data Moderator.txt' and '*Gambar Moderator.splsm'. The main area contains a path diagram with latent variables X1, X2, X3, X4, and Y, and their respective indicators (X1.1-X1.3, X2.1-X2.3, X3.1-X3.3, X4.1-X4.3, Y.1-Y.3). A green circle representing a moderating effect is positioned between X1 and X4. A right-click context menu is open over this moderating effect, with the 'Rename' option highlighted. A red arrow points to the 'Rename' option. To the right, a 'Rename variable' dialog box is open, showing the current name 'Moderating Effect 1' and the new name 'X1*X4' entered in both the 'Name displayed in model' and 'Name displayed in reports' fields. The 'OK' button is also highlighted with a red circle.

Nama variabel telah berubah menjadi $X1*X4$

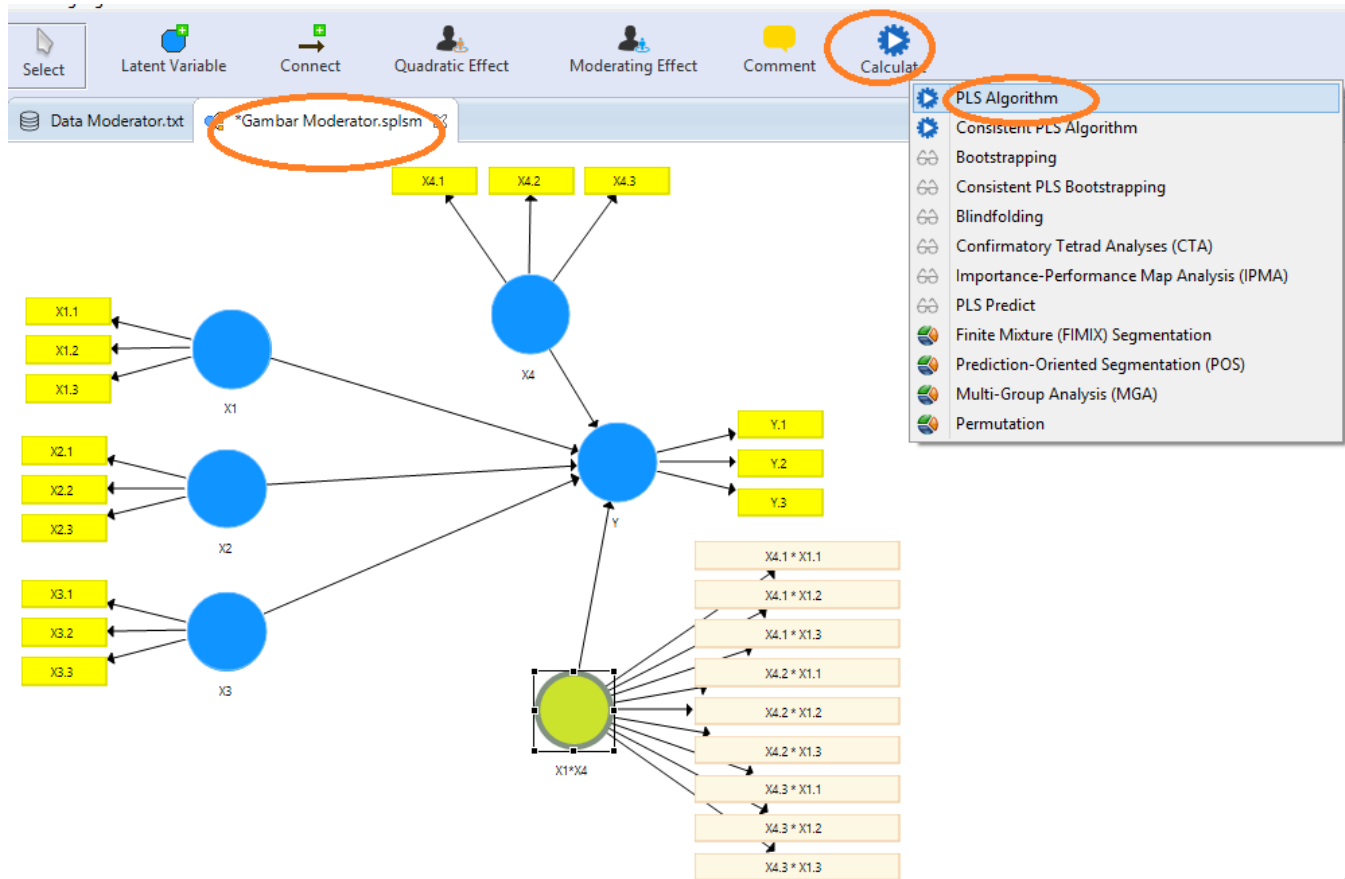


- ❑ Klik “kanan” pada variabel interaksi ($X1 \cdot X4$) yang berwarna hijau
- ❑ Klik “Show indicators of selected construct”
- ❑ Indikator akan ditampilkan



Calculate-PLS Algorithm (X1 terhadap Y yang Dimoderasi X4)

- Calculate
- PLS Algorithm



Klik Start Calculation

Partial Least Squares Algorithm

The PLS path modeling method was developed by Wold (1982). In essence, the PLS algorithm is a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations (see Dijkstra, 2010, for a general analysis of these equations).

[Read more!](#)

Setup **Weighting**

Basic Settings

Weighting Scheme Centroid Factor Path

Maximum Iterations:

Stop Criterion (10^{-X}):

Advanced Settings

Initial Weights Use Lohmoeller Settings
or configure [individual initial weights](#)

Basic Settings

Weighting Scheme

PLS-SEM allows the user to apply three structural model weighting schemes:

- (1) centroid weighting scheme,
- (2) factor weighting scheme, and
- (3) path weighting scheme (default).




While the results differ little for the alternative weighting schemes, path weighting is the recommended approach. This weighting scheme provides the highest R^2 value for endogenous latent variables and is generally applicable for all kinds of PLS path model specifications and estimations. Moreover, when the path model includes higher-order constructs (often called second-order models), researchers should usually not use the centroid weighting scheme.





Maximum Iterations

This parameter represents the maximum number of iterations that will be used for calculating the PLS results. This number should be sufficiently large (e.g., 300 iterations). When checking the PLS-SEM result, one must make sure that the algorithm did not stop because the maximum number of iterations was reached but due to the stop criterion. Note: The selection of 0 for the maximum number of iterations allows you to obtain results of the sum scores approach.

After Calculation:

Hasil PLS Algorithm akan diperlihatkan

←0,0
0,00 Increase Decimals 0,00
0,00 Decrease Decimals  Export to Excel  Export to Web  Export to R

 Moderator.splsm  *Gambar Moderator.splsm  **PLS Algorithm (Run No. 1)** 

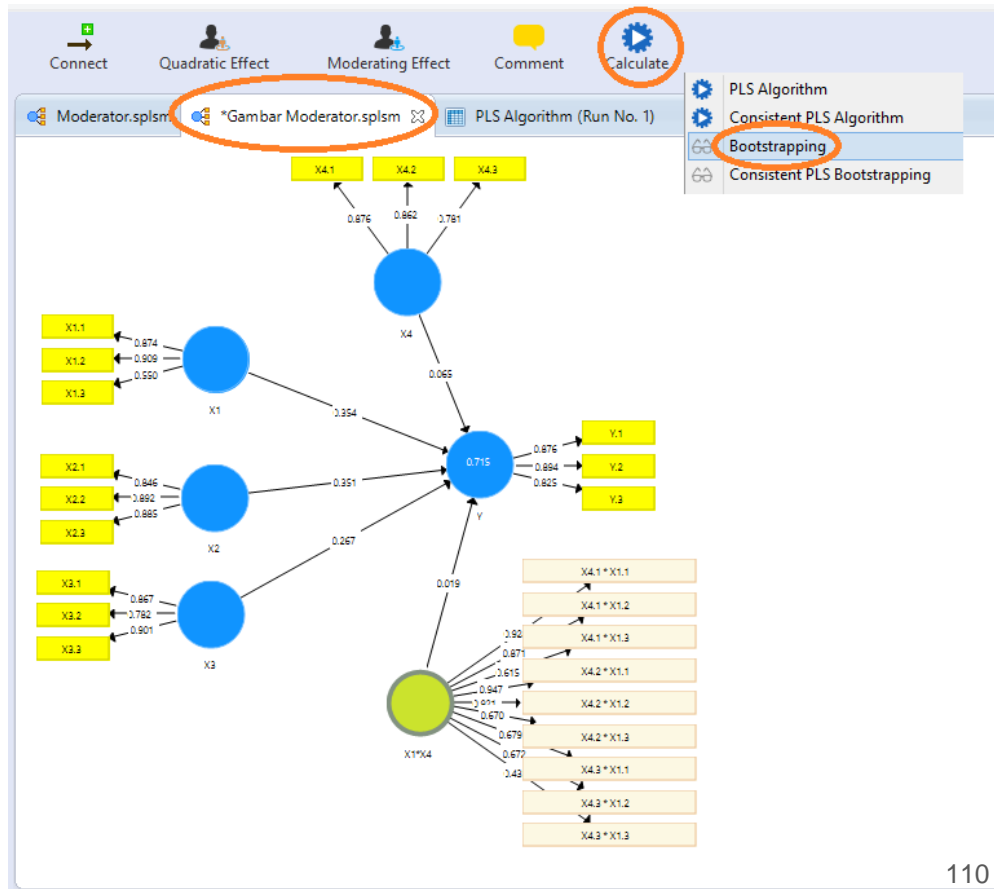
Path Coefficients

Matrix	Path Coefficients	Copy to Clipbo				
	X1	X1*X4	X2	X3	X4	Y
X1						0.354
X1*X4						0.019
X2						0.351
X3						0.267
X4						0.065
Y						

Final Results	Quality Criteria	Interim Results	Base Data
Path Coefficients	R Square	Stop Criterion Changes	Setting
Indirect Effects	f Square		Inner Model
Total Effects	Construct Reliability and Validity		Outer Model
Outer Loadings	Discriminant Validity		Indicator Data (Original)
Outer Weights	Collinearity Statistics (VIF)		Indicator Data (Standardized)
Latent Variable	Model Fit		Indicator Data (Correlations)
Residuals			

Calculate-Bootstrapping (X1 terhadap Y yang Dimoderasi X4)

- ❑ Pada tab “Gambar Moderator”
- ❑ Klik Calculate
- ❑ Bootstrapping



- ❑ Ketikkan 5000 pada “Subsamples”
- ❑ Klik “Complete Bootstrapping”
- ❑ Start Calculation

Bootstrapping
Bootstrapping is a nonparametric procedure that allows testing the statistical significance of various PLS-SEM results such path coefficients, Cronbac HTMT, and R² values.

Setup Partial Least Squares Weighting

Basic Settings

Subsamples

Do Parallel Processing

Sign Changes No Sign Changes
 Construct Level Changes
 Individual Changes

Amount of Results Basic Bootstrapping
 Complete Bootstrapping

Advanced Settings

Confidence Interval Method Percentile Bootstrap
 Studentized Bootstrap
 Bias-Corrected and Accelerated (BCa) Bootstrap
 Davision Hinkley's Double Bootstrap
 Shi's Double Bootstrap

Test Type One Tailed Two Tailed

Basic Settings

Subsamples

In bootstrapping, subsamples are created with observ. from the original set of data. To ensure stability of rest large. For an initial assessment, one may use a small 500). For the final results preparation, however, one sl subsamples (e.g., 5,000).

Note: Larger numbers of bootstrap subsamples incre

Do Parallel Processing

This option runs the bootstrapping routine on multiple more than one core). Using parallel computing will red

Sign Changes

Sets the method for dealing with sign changes during are available:

(1) No Sign Changes (default)

Sign changes in the resamples will be ignored and This is the most conservative estimation option an running the bootstrapping routine.

After Calculation:

Hasil Bootstrapping akan diperlihatkan

Kesimpulan:

Nilai interaksi $X1 * X4$ terhadap Y adalah tidak signifikan ($0,868 > 0,05$).

Dengan demikian, variabel X4 tidak memoderasi pengaruh X1 terhadap Y

The screenshot shows the SmartPLS software interface. At the top, there are buttons for 'Increase Decimals', 'Decrease Decimals', 'Export to Excel', 'Export to Web', and 'Export to R'. Below these are file names: 'Moderator.splsm', '*Gambar Moderator.splsm', and 'Bootstrapping (Run No. ...)' which is circled in orange. The main section is titled 'Path Coefficients' and contains a table with columns for 'Original Sampl...', 'Sample Mean (...)', 'Standard Devia...', 'T Statistics (|O...', and 'P Values'. The row for 'X1*X4 -> Y' is circled in orange, and its P-value of 0.868 is also circled in orange. Below the table, there are four sections: 'Final Results' (with 'Path Coefficients' circled in orange), 'Quality Criteria', 'Histograms', and 'Base Data'. The 'Final Results' section lists various metrics like 'Total Indirect Effects', 'Specific Indirect Effects', 'Total Effects', 'Outer Loadings', and 'Outer Weights'. The 'Quality Criteria' section lists 'R Square', 'R Square Adjusted', 'f Square', 'Average Variance Extracted (AVE)', 'Composite Reliability', 'rho A', 'Cronbach's Alpha', 'Heterotrait-Monotrait Ratio (HTMT)', 'SRMR', 'd ULS', 'd G1', and 'd G2'. The 'Histograms' section lists 'Path Coefficients Histogram', 'Indirect Effects Histogram', and 'Total Effects Histogram'. The 'Base Data' section lists 'Setting', 'Inner Model', 'Outer Model', 'Indicator Data (Original)', and 'Indicator Data (Standardized)'.

	Original Sampl...	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
X1 -> Y	0.354	0.361	0.169	2.097	0.036
X1*X4 -> Y	0.019	-0.003	0.114	0.167	0.868
X2 -> Y	0.351	0.346	0.162	2.175	0.030
X3 -> Y	0.267	0.278	0.140	1.908	0.056
X4 -> Y	0.065	0.041	0.133	0.490	0.624

Lakukan Calculate untuk hubungan X2→ Y yang Dimoderasi X4

Lakukan cara yang sama seperti di atas, untuk menganalisis hubungan-hubungan X2→ Y yang dimoderasi X4

- ❑ Klik “kanan” pada variabel interaksi (X1*X4)
- ❑ Rename
- ❑ Ganti menjadi X2*X4
- ❑ OK

The screenshot displays the SmartPLS interface with a path model and a 'Rename variable' dialog box. The path model shows latent variables X1, X2, X3, X4, and Y. X1, X2, and X3 are measured by indicators X1.1-X1.3, X2.1-X2.3, and X3.1-X3.3 respectively. X4 is measured by indicators X4.1, X4.2, and X4.3. Y is measured by indicators Y.1, Y.2, and Y.3. Path coefficients are shown for X1→Y (1.097), X2→Y (2.175), X3→Y (1.908), and X4→Y (0.490). A context menu is open over the X1*X4 interaction variable, with 'Rename' selected. The 'Rename variable' dialog box is open, showing the variable name 'X2*X4' in both the 'Name displayed in model' and 'Name displayed in reports' fields. The 'OK' button is also highlighted.

Moderator.splsm *Gambar Moderator.splsm Bootstrapping (Run No. 3)

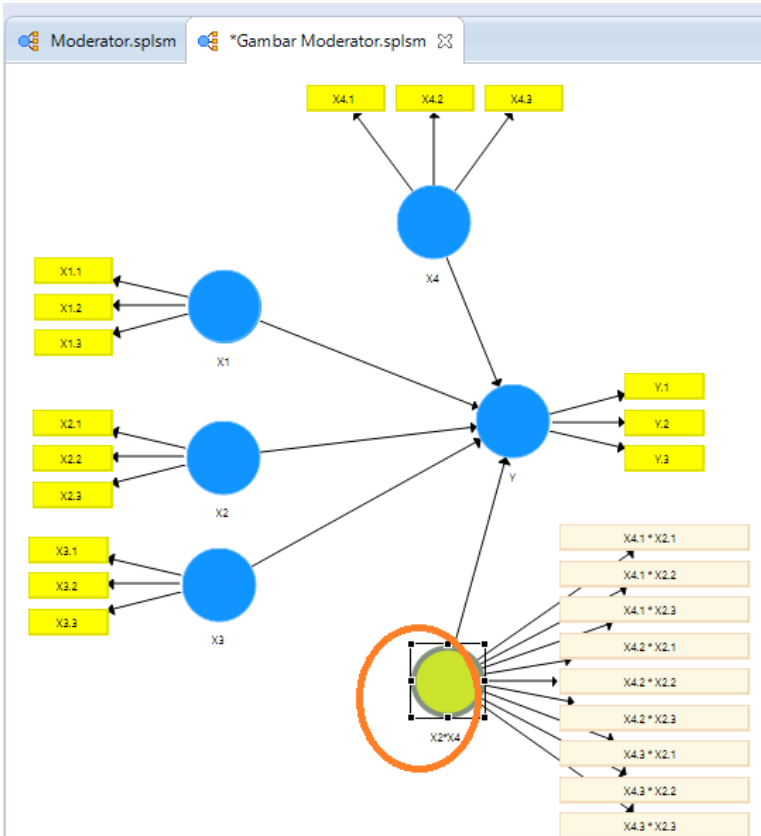
Rename variable
Rename variable 'X1*X4'.
Name displayed in model (multiple lines possible):
X2*X4
Name displayed in reports:
X2*X4
OK Cancel

Path	Coefficient
X1 → Y	1.097
X2 → Y	2.175
X3 → Y	1.908
X4 → Y	0.490

Indicator	Mean	SD
X1.1	18.353	3.112
X1.2	39.990	3.112
X1.3	3.112	3.112
X2.1	16.619	28.079
X2.2	28.079	21.361
X2.3	21.361	21.361
X3.1	17.962	9.557
X3.2	9.557	35.356
X3.3	35.356	35.356
X4.1	24.443	25.520
X4.2	25.520	10.075
X4.3	10.075	10.075
Y.1	30.185	18.962
Y.2	18.962	13.200
Y.3	13.200	13.200

Interaction	Coefficient
X4.1 * X1.1	7.24
X4.1 * X1.2	5.187
X4.1 * X1.3	2.484
X4.2 * X1.1	0.167

Klik 2 kali pada variabel interaksi ($X2 * X4$), pada independent variable pilih X2, Calculation Method, pilih "Production Indicator", dan OK



Moderating Effect

Basic Settings

- Dependent Variable: Y
- Moderator Variable: X4
- Independent Variable: X2
- Calculation Method:
 - Product Indicator
 - Two-stage
 - Orthogonalization

Advanced Settings

- Product Term Generation:
 - Unstandardized
 - Mean Centered
 - Standardized
- Weighing Mode:
 - Automatic
 - Mode A
 - Mode B
 - Sumscores
 - Pre Defined

Basic Settings

Dependent Variable

The selected dependent variable for which a moderating effect will be estimated.

Predictor Variable

Field to define the predictor variable for which a moderating effect will be estimated.

Moderator Variable

Field to define the moderator variable for which a moderating effect will be estimated.

Calculation Method

Selects the method of interaction term construct in PLS path modeling. There are three options:

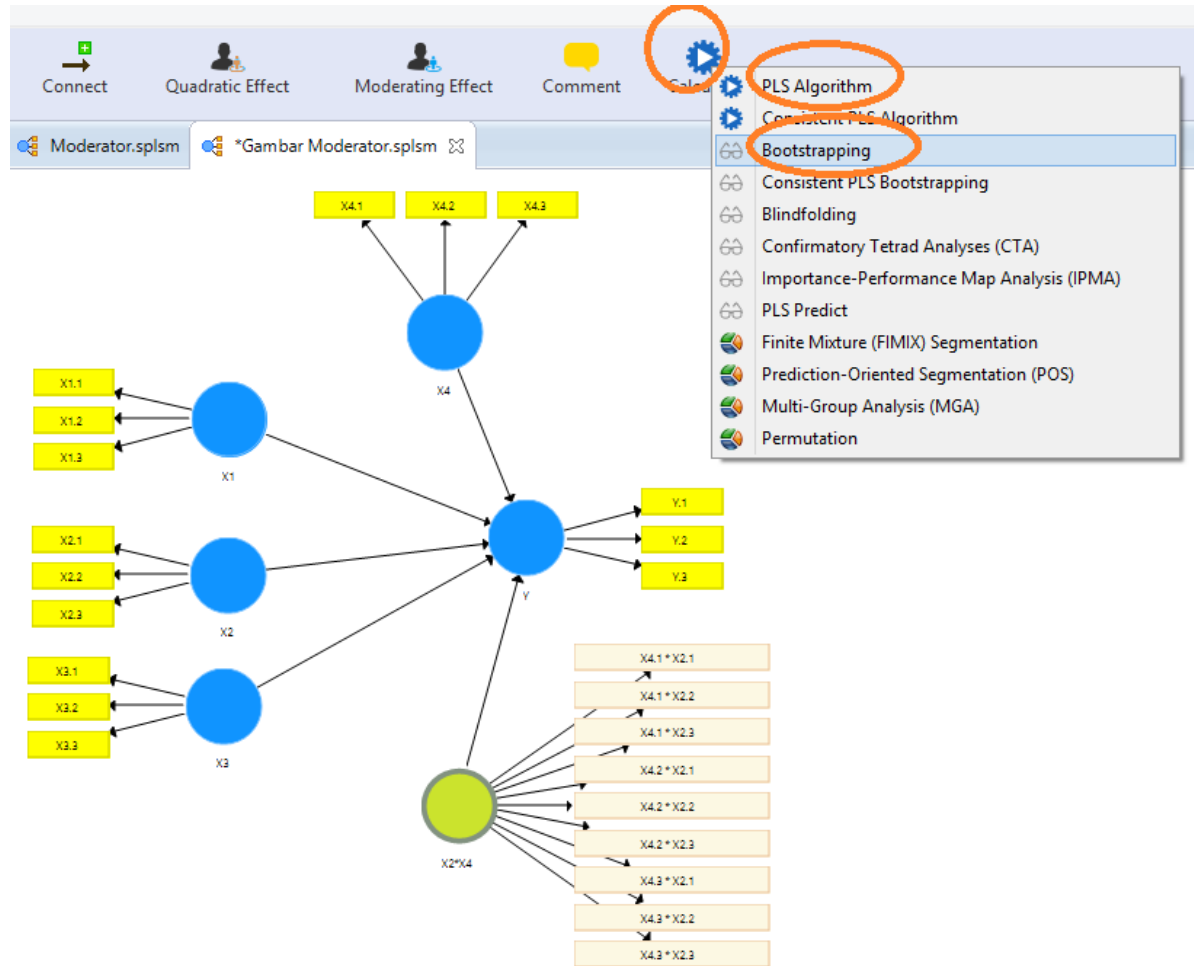
- Product Indicator**
This approach uses all possible pair combinations of the indicators of the latent predictor and the latent moderator variable. These product terms serve as indicators ("product indicators") of the interaction term in the structural model.
- Two-stage (default)**
This approach uses the latent variable scores of the latent predictor and latent moderator variable from the main effects model (without the interaction term). These latent variable scores are saved and used to calculate the product indicator for the second stage analysis that involves the interaction term in addition to the predictor and moderator variable.
- Orthogonalization**
This approach uses residuals that are calculated by regressing all possible pairwise product terms of the indicators of the latent predictor and the latent moderator variable (i.e., product indicators) on all indicators of the latent predictor and the latent moderator variable. These residuals serve as indicators of the interaction term in the structural model.

OK **Cancel**

Lalu lakukanlah kalkulasi (Calculation):

- ☐ PLS Algorithm
- ☐ Bootstrapping

Lakukan satu persatu/bertahap



Hasil akan diperlihatkan

PLS Algorithm

Moderator.splsm *Gambar Moderator.splsm PLS Algorithm (Run No. 2)

Path Coefficients

Matrix Path Coefficients Copy to Clipboard:

	X1	X2	X2*X4	X3	X4	Y
X1						0.289
X2						0.287
X2*X4						-0.167
X3						0.278
X4						0.043
Y						

Final Results
[Path Coefficients](#)
[Indirect Effects](#)
[Total Effects](#)
[Outer Loadings](#)
[Outer Weights](#)
[Latent Variable](#)
[Residuals](#)
[Simple Slope Analysis](#)

Quality Criteria
[R Square](#)
[f Square](#)
[Construct Reliability and Validity](#)
[Discriminant Validity](#)
[Collinearity Statistics \(VIF\)](#)
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Interim Results
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Base Data
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[Indicator Data \(Correlations\)](#)

Bootstrapping

The screenshot shows the SmartPLS interface with the 'Bootstrapping (Run No. 4)' window active. The 'Path Coefficients' table is displayed, showing results for various paths. The interaction term 'X2*X4 -> Y' is highlighted with a red circle, showing a p-value of 0.202. The 'Final Results' section is also visible, listing various quality criteria and histograms.

	Original Sampl...	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
X1 -> Y	0.289	0.304	0.159	1.818	0.069
X2 -> Y	0.287	0.279	0.139	2.059	0.040
X2*X4 -> Y	-0.167	-0.148	0.131	1.276	0.202
X3 -> Y	0.278	0.293	0.125	2.219	0.027
X4 -> Y	0.043	0.045	0.131	0.316	0.752

Final Results

- [Path Coefficients](#)
- [Total Indirect Effects](#)
- [Specific Indirect Effects](#)
- [Total Effects](#)
- [Outer Loadings](#)
- [Outer Weights](#)

Quality Criteria

- [R Square](#)
- [R Square Adjusted](#)
- [f Square](#)
- [Average Variance Extracted \(AVE\)](#)
- [Composite Reliability](#)
- [rho A](#)
- [Cronbach's Alpha](#)
- [Heterotrait-Monotrait Ratio \(HTMT\)](#)
- [SRMR](#)
- [d ULS](#)
- [d G1](#)
- [d G2](#)

Histograms

- [Path Coefficients Histogram](#)
- [Indirect Effects Histogram](#)
- [Total Effects Histogram](#)

Base Data

- [Setting](#)
- [Inner Model](#)
- [Outer Model](#)
- [Indicator Data \(Original\)](#)
- [Indicator Data \(Standardized\)](#)

Hasil Bootstrapping akan diperlihatkan

Kesimpulan:

Nilai interaksi X2*X4 terhadap Y adalah tidak signifikan ($0,202 > 0,05$).

Dengan demikian, variabel X4 tidak memoderasi pengaruh X2 terhadap Y

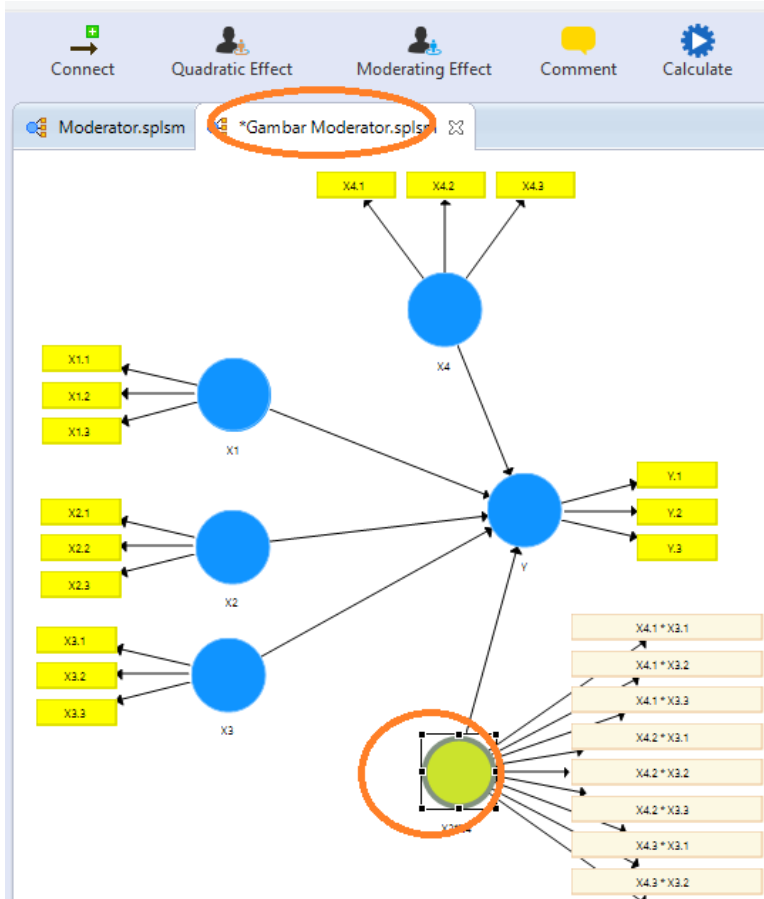
Lakukan Calculate untuk hubungan $X3 \rightarrow Y$ yang Dimoderasi $X4$

Lakukan cara yang sama seperti di atas, untuk menganalisis hubungan-hubungan $X3 \rightarrow Y$ yang dimoderasi $X4$

- ❑ Klik “kanan” pada variabel interaksi ($X2 * X4$)
- ❑ Rename
- ❑ Ganti menjadi $X3 * X4$
- ❑ OK

The screenshot displays the SmartPLS interface with a path diagram and a 'Rename variable' dialog box. The path diagram shows three latent variables (X1, X2, X3) and one (X4) influencing a manifest variable (Y). X1 is measured by indicators X1.1, X1.2, and X1.3. X2 is measured by X2.1, X2.2, and X2.3. X3 is measured by X3.1, X3.2, and X3.3. X4 is measured by X4.1, X4.2, and X4.3. A green circle highlights the interaction variable X2*X4, which is circled in orange. A context menu is open over X2*X4, with 'Rename' selected and circled in orange. The 'Rename variable' dialog box is open, showing the current name 'X2*X4' and the new name 'X3*X4' in both the 'Name displayed in model' and 'Name displayed in reports' fields. The 'OK' button is also circled in orange.

Klik 2 kali pada variabel interaksi ($X3 \times X4$), pada independent variable pilih X3, Calculation Method, pilih “Production Indicator”, dan OK



Moderating Effect

Basic Settings

Dependent Variable: Y

Moderator Variable: X4

Independent Variable: X3

Calculation Method: Product Indicator

Two-Stage

Orthogonalization

Advanced Settings

Product Term Generation: Unstandardized, Mean Centered, Standardized

Weighing Mode: Automatic, Mode A, Mode B, Sumscores, Pre Defined

Basic Settings

Dependent Variable

The selected dependent will be estimated.

Predictor Variable

Field to define the predictor will be estimated.

Moderator Variable

Field to define the moderator will be estimated.

Calculation Method

Selects the method of centering. There are three options:

(1) Product Indicator

This approach uses indicators of the latent predictor and the latent moderator serve as indicators ("product structural model").

(2) Two-stage (default)

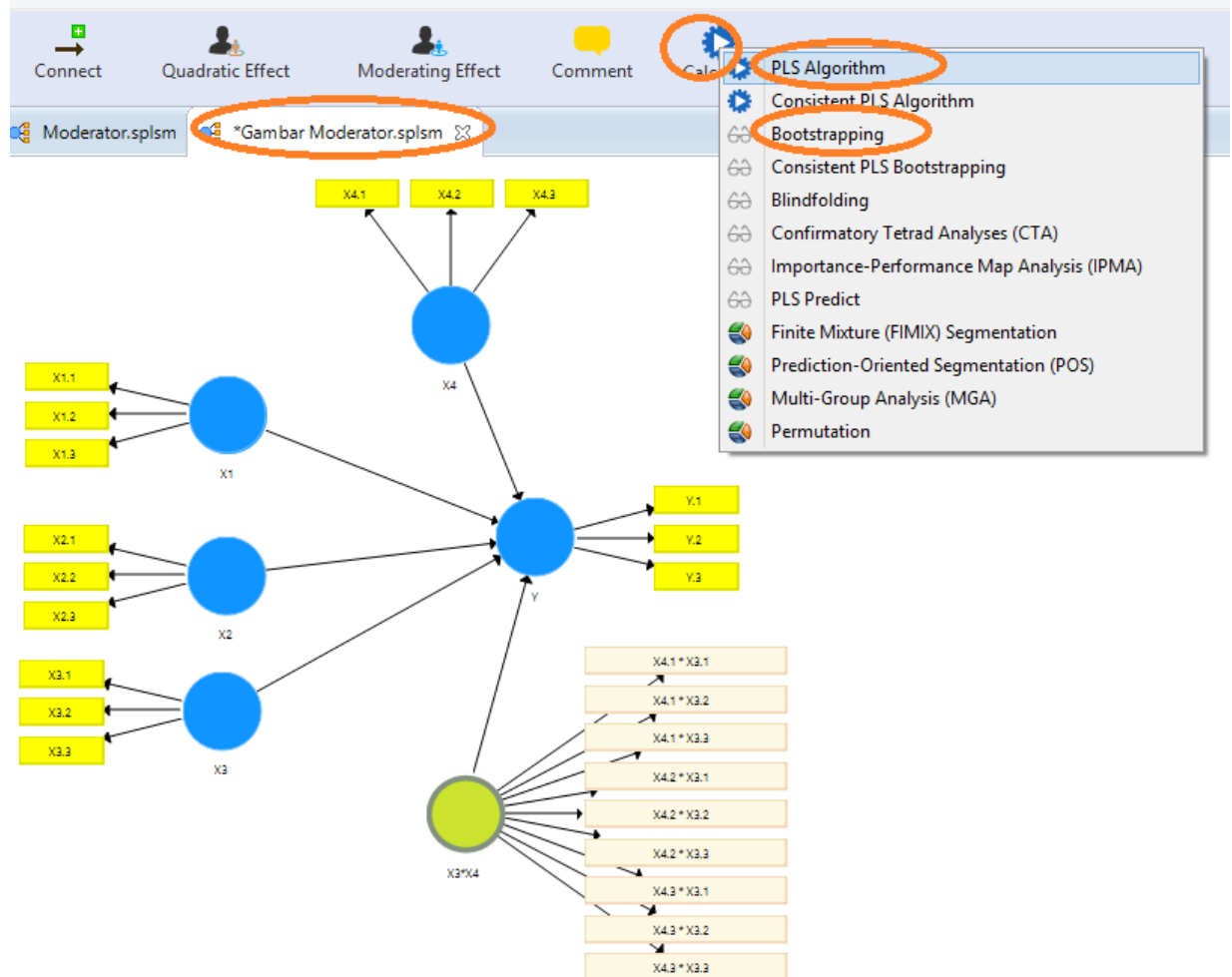
This approach uses indicator and latent moderator variable interaction term.

OK Cancel

Lalu lakukanlah
kalkulasi (Calculation):

- ☐ PLS Algorithm
- ☐ Bootstrapping

Lakukan satu
persatu/bertahap



Hasil akan diperlihatkan

PLS Algorithm

The screenshot shows the SmartPLS software interface. At the top, there are buttons for 'Increase Decimals', 'Decrease Decimals', 'Export to Excel', 'Export to Web', and 'Export to R'. Below these are tabs for 'Moderator.splsm', '*Gambar Moderator.splsm', 'PLS Algorithm (Run No. 3)', and 'Bootstrapping (Run No. 5)'. The 'PLS Algorithm (Run No. 3)' tab is circled in orange. Below the tabs, the 'Path Coefficients' section is active, showing a table with the following data:

	X1	X2	X3	X3*X4	X4	Y
X1						0.393
X2						0.355
X3						0.259
X3*X4						0.079
X4						0.067
Y						

Below the table, there are four columns of links: 'Final Results', 'Quality Criteria', 'Interim Results', and 'Base Data'. The 'Path Coefficients' link under 'Final Results' is circled in orange.

Final Results

- [Path Coefficients](#)
- [Indirect Effects](#)
- [Total Effects](#)
- [Outer Loadings](#)
- [Outer Weights](#)
- [Latent Variable](#)
- [Residuals](#)
- [Simple Slope Analysis](#)

Quality Criteria

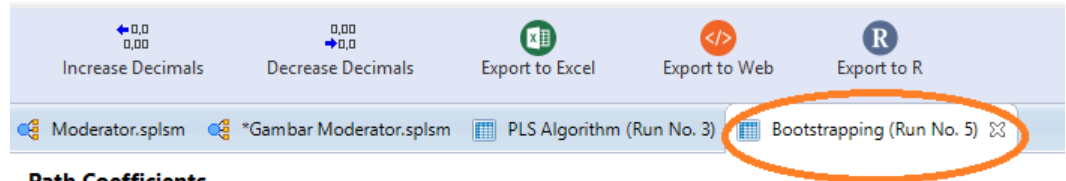
- [R Square](#)
- [f Square](#)
- [Construct Reliability and Validity](#)
- [Discriminant Validity](#)
- [Collinearity Statistics \(VIF\)](#)
- [Model Fit](#)

Interim Results

- [Stop Criterion Changes](#)

Base Data

- [Setting](#)
- [Inner Model](#)
- [Outer Model](#)
- [Indicator Data \(Original\)](#)
- [Indicator Data \(Standardized\)](#)
- [Indicator Data \(Correlations\)](#)



Path Coefficients

	Mean, STDEV, T-Values, P-Value...	Confidence Intervals	Confidence Intervals Bias C...	Samples	Copy to Clip
	Original Sampl...	Sample Mean (...)	Standard Devia...	T Statistics (O...	P Values
X1 -> Y	0.393	0.387	0.184	2.133	0.033
X2 -> Y	0.355	0.350	0.163	2.174	0.030
X3 -> Y	0.259	0.276	0.141	1.843	0.065
X3*X4 -> Y	0.079	0.048	0.141	0.560	0.575
X4 -> Y	0.067	0.048	0.142	0.470	0.639

Final Results

[Path Coefficients](#)
[Total Indirect Effects](#)
[Specific Indirect Effects](#)
[Total Effects](#)
[Outer Loadings](#)
[Outer Weights](#)

Quality Criteria

[R Square](#)
[R Square Adjusted](#)
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[Heterotrait-Monotrait Ratio \(HTMT\)](#)
[SRMR](#)
[d_ULS](#)
[d_G1](#)
[d_G2](#)

Histograms

[Path Coefficients Histogram](#)
[Indirect Effects Histogram](#)
[Total Effects Histogram](#)

Base Data

[Setting](#)
[Inner Model](#)
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[Indicator Data \(Original\)](#)
[Indicator Data \(Standardized\)](#)

Hasil Bootstrapping akan diperlihatkan

Kesimpulan:

Nilai interaksi X3*X4 terhadap Y adalah tidak signifikan ($0,575 > 0,05$).

Dengan demikian, variabel X4 tidak memoderasi pengaruh X3 terhadap Y