



Processing, Analyzing And Testing Quantitative Research Hypotheses With *Smartpls Software3*

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Abstract

The method used in this paper is seen as the nature of exploration as applied research, the nature of the explanation of non-causality research, while the method used is qualitative. The purpose of this paper is to introduce statistical computer software. There are many computer statistics software, the author introduces SmartPLS3. SmartPLS3, compared to other computer statistical software; If used to analyze linear regression, multiple regression, especially path analysis models, has advantages. In the path analysis research model, SmartPLS3 is superior when compared to SPSS. If analyzing using SPSS to test hypotheses with moderation variables or through mediation variables, it is necessary to calculate the value of the regression coefficient using the Sobel test. The path analysis research moderation model, mediation model and combined model of mediation moderation (modmed) if analyzed using SmartPLS3 only needs to juxtapose the results of the analysis in the direct influence, moderation effect (in the path coefficient table), and in the indirect influence table (table specific indirect effect); Based on hypothesis test criteria with moderation or through mediation variables.

Keywords : path analysis path coefficients specific indirect effect SmartPLS3

INTRODUCTION

The development of computer technology, especially statistical computers in the form of *software*, makes it easier for a researcher to process and analyze quantitative research data. Statistical computer experts understand the need for researchers to process, analyze and test research hypotheses by developing various types of appropriate and suitable *software*. With statistical computer *software*, *researchers just have to choose the software* they want. Currently, various *software is available that can be used to process and analyze research* results, including: ***Statistical Package for the Social Sciences (SPSS)***, ***S tructural Equation M odeling Analysis of M oment S tructure (SEM AMOS)***, ***Li nier S tructural Relationships (LISREL)***, ***Partial Least Square (SmartPLS3)*** (Harahap, 2020).

The choice of *software* used to analyze research data must be considered according to the research model and objectives, so that the resulting analysis results appropriately answer the research problem. There are two types of SEM (*structural equation modeling*) *software*, namely *covariance-based structural equation modeling (CB-SEM)* and *partial least squares path modeling (PLS-SEM (Pering, 2020))*, often also called *variance-based structural equation modeling (VB-SEM)*. *Covariance-based structural equation modeling* is represented by *software* such as *AMOS, EQS, LISREL*, while *variance-based structural equation modeling* is represented by *PLS-Graph, SmartPLS3, VisualPLS* and so on (Ghozali & Latan, 2020). PLS

is an alternative approach that shifts from a covariance-based SEM (CB-SEM) to a variance-based (VB-SEM) approach (Rino Tri Hermawan, nd) . The most popular and frequently used *software* in quantitative research with linear regression models and multiple regression in theological/religious education environments is SPSS *software* , in fact quantitative research is identical to processing research data using SPSS. The development of statistical computer technology has provided various *software* to process and analyze research results according to the research model used. As *software*, SPSS cannot answer all research models. SPSS is appropriate when used to process and analyze linear regression and multiple regression models, but has limitations when used to process and analyze regression analysis models, factor analysis and path analysis (Ganga Anuraga, Edy Sulistiyawan, 2017) (*path analysis* models of direct influence and influence indirectly, with moderating variables and through mediating variables). An analysis method that can solve problems without having to create several regression equations, because analyzing them separately is not appropriate. One of the analytical methods that can be used to analyze path equation models is *Structural Equation Modeling* (SEM) (Hamid & Suhardi M Anwar, 2019) . According to the author, if the research model, structural model, is appropriate if analyzed with CB-type *software* SEM (*covariance-based structural equation modeling*) is *software* AMOS , LISREL and SmartPLS3 ; Meanwhile, if the research model is a *path analysis model* , linear regression or multiple regression, it is very efficient and effective if you use VB-SEM (*variance-based structural equation modeling*) type *software* or also called *partial least squares path modeling* (PLS-SEM) such as *SmartPLS3 software* (Pering, 2020) . For the *path analysis research model* , if analyzed using SPSS, to find out the indirect effect, you have to calculate it using the Sobel test (Rato, 2018) ; by multiplying the coefficient value of the influence of the exogenous variable on the endogenous variable directly by the coefficient value of the influence of the mediating variable on the endogenous variable directly (Sarwono, 2011) . Meanwhile, if you use *SmartPLS 3*, then with one *click* you will get the results of direct influence (*path coefficient table*) and indirect influence (*specific indirect effect table*). By comparing the *path coefficient table data* and the *specific indirect effect table* , the mediation model hypothesis test can be decided.

As computer statistical *software* , *SmartPLS3*, as quoted by Ghazali, has the following advantages:

Partial Least Square (PLS) is a powerful analysis method , because it eliminates the assumptions that the data must be normally distributed, there are no multicollinearity problems between exogenous variables; The sample size does not have to be large, it can be used to test weak theories and weak data (small

samples and data normality problems). Can be used to explain whether there is a relationship between latent variables (*prediction*) and to confirm theory. PLS uses *algorithm* literacy, so that the problem of model identification is not a problem for *recursive models* (models that have one direction of causality) and avoids problems for *nonrecursive models*. PLS focuses on data with limited estimation procedures, the problem of model *misspecification* does not really influence parameter estimates (Ghozali & Latan, 2020).

Meanwhile, according to Jogiyanto as quoted by Hamid and Suhardi Anwar (Hamid & Suhardi M Anwar, 2019), the advantages of PLS are:

1. Able to model many dependent variables and independent variables (group model).
2. Able to manage multicollinearity problems between independent variables.
3. The results remain robust, even though there is abnormal data and missing values.
4. Generating independent latent variables directly on a cross-product basis involving dependent latent variables as predictive power.
5. Can be used in reflective and formative constructs.
6. Can be used on small samples.
7. Does not require data to be normally distributed.
8. Can be used on data with different scale types, namely nominal, ordinal and continuous

SmartPLS3 as *software* used to analyze data, produces data analysis in the form of (Ghozali & Latan, 2020): Evaluating *the outer model* (validity, reliability); Evaluate *the inner model* (direct influence, moderating influence and mediating influence) according to the research model; Analyzing the combined influence of exogenous variables on endogenous variables (R Square); Assessing the suitability/goodness of the model (model fit); as well as assessing *relevant predictivity* (level of observation in research). As *software* that is simple to operate, *SmartPLS3* has the advantage (Ghozali & Latan, 2020) because it can be used for hypothesis testing in regression models, *multiple* regression; hypothesis testing of *path analysis models* (path analysis) both moderation models (*moderating*) and mediation models (*intervening*). So far, *SmartPLS3 software has not been widely used* (Pering, 2020) in research in Christian

Religious Higher Education so that it can be used as a guide in research for theses, theses and dissertations. This is in line with the expectations of Mumtaz Ali et al. (Mumtaz Ali Memona et al., 2021) " *We hope this editorial will serve as a manual for users to understand the unique characteristics of each PLS-SEM application and make informed decisions on the most appropriate application for their research* ". Through this article, the author hopes that researchers, both for theses, theses, dissertations and journals, can analyze quantitative research using *software. SmartPLS3* .

RESEARCH METHODS

The writing of the results of this research, if seen from its exploratory nature, is included in the type of applied research. As applied research, the results of this research can be used to answer and resolve problems and develop policies (Ferdinand, 2014) related to the choice of statistical *computer software* for analyzing quantitative data in theological research. Meanwhile, if we look at the nature of explanation, it is a type of non-causality research. As non-causality research, this research seeks to provide an explanation by comparing two or more (Ferdinand, 2014) several statistical *computer software* as software for analyzing research data. If seen from the method used, this research uses qualitative methods by conducting library research to obtain various theories resulting from reviewing various literature (Ferdinand, 2014) . By reviewing the literature, you can gain an understanding of various types of *software* that are appropriate, efficient and effective for analyzing quantitative data. From the results of this study, the author found *SmartPLS3 software* (Ghozali & Latan, 2020) to analyze linear regression research models, multiple regression, and specifically path *analysis* . Based on the results of the study and literature review, according to the author, *SmartPLS3 software* (Hamid & Suhardi M Anwar, 2019) is appropriate, efficient and effective *software for analyzing linear regression model data, multiple regression, especially path analysis* .

GET TO KNOW *THE SOFTWARE SMARTPLS3*

Understanding *SmartPLS3* _

Partial Least Square, abbreviated as *SmartPLS*, has several series, especially series 3 , is software that is easy to use and has an intuitive interface and provides a variety of features that make it easier to build models, test hypotheses, and interpret results for decision making (Muzaki, 2022) . So that the results are accurate, researchers must ensure that the data used is clean and valid. *SmartPLS3* is a multivariate statistical technique that can handle many variables response and explanatory variables at the same time. This analysis is a good

alternative to the multiple regression analysis method because the analysis method is more *robust* or immune; model parameters do not change much when new samples are taken from the total population (Hidayat, 2018) . *SmartPLS3* is a *powerful* analysis method that does not require normality testing and multicollinearity; The data does not have to be normally distributed, data with an ordinal data scale , intervals to ratios can be used, and the sample size does not have to be large (Hidayat, 2018) . *SmartPLS3* can be described as an analysis that combines factor analysis approaches , structural models *and* path analysis (Harahap , 2020) .

PLS algorithm

SmartPLS3 as statistical *software* , analyzes data using operational algorithms. To make it easier to understand the algorithm used, it is necessary to create a mathematical equation. If X is a matrix of size $n \times p$ and Y is a matrix of size $n \times q$. So the *SmartPLS3 procedure* will extract factors from X and Y successively so that the extracted factors have maximum covariance. To find a linear decomposition of X and Y, use the following formula (Hidayat, 2018) :

$$X = TP^T + E$$

$$Y = UQ^T + F$$

dimana:

$T_{n \times g}$ = X-scores	$U_{n \times g} = Y\text{-scores}$
$P_{p \times g} = X\text{-loadings}$	$Q_{q \times g} = Y\text{-loadings}$
$E_{n \times p} = X\text{-residual}$	$F_{n \times q} = Y\text{-residual}$

This formula can be explained as follows (Hidayat, 2018) :

The column of T is a latent vector, and $U = TB$, which is a regression of the latent vector t so that: $Y = TBQ^T + F$. In the equation above, any set of orthogonal vectors forming the column space of X can be used. To determine T, additional conditions are needed. For PLS regression, namely looking for two sets of weights denoted by w and c in order to create a linear combination in the X and Y columns so that this linear combination has maximum covariance. Specifically, the goal is to obtain pairs of vectors.

As inferential statistics, *SmartPLS3* is used to analyze or test *the inner model* (*structural model*) and *outer model* (*measurement model*). In testing ***The inner model*** (*inner relationship structural model and substantive theory*) describes the relationship between latent variables based on *substantive theory* . To obtain the magnitude of the influence of exogenous

variables on endogenous variables, both directly and indirectly. The formula for the *recursive* model (a model that describes the causal relationship between exogenous latent variables and endogenous latent variables), the mathematical equation is as follows (Rachmawati, 2023) :

$$\eta = \beta\eta + \Gamma\xi + \zeta$$

Information:

η = endogenous latent variable matrix

β = coefficient of endogenous variable matrix

ξ = exogenous latent construct matrix

Γ = exogenous variable matrix coefficient

ζ = inner model residual matrix

To test/analyze **Outer model** (*outer relation or measurement model*) where each indicator block is related to its latent variable. Reflection indicator block formula with the following equation (Rachmawati, 2023) :

$$x = \Lambda_x \xi + \varepsilon_x$$

$$y = \Lambda_y \eta + \varepsilon_y$$

From this formula it is explained: The residuals measured by ε_x and ε_y can be interpreted as measurement level errors . Meanwhile the formula for Formative indicators are as follows (Rachmawati, 2023) :

$$\xi = \pi_\xi x + \delta_\xi$$

$$\eta = \pi_\eta y + \delta_\eta$$

The formula is explained as follows: ξ as an exogenous latent variable, η as an endogenous latent variable, x as an indicator for an exogenous latent variable, y as an indicator for an endogenous latent variable, π_ξ and π_η as multiple regression coefficients of the latent variable and block of indicators , and as regression residuals.

Model specifications in *the outer model* and *inner model* at the conceptual level do not actually know the value of a latent variable, so **a weight relation is needed** for PLS estimated scores. Estimate the latent variable score using the following formula (Rachmawati, 2023) :

$$\xi_b = \sum_{k=1}^{k_i} W_{bk} X_{bk}$$

$$\eta_j = \sum_{k=1}^{k_i} W_{jk} Y_{jk}$$

With k_i the number of indicator variables for each latent variable, W_{bk} and W_{jk} are the k weights used to form latent variables ξ_b and η_j .

To estimate PLS parameters, the calculation uses the *least squares* method. The calculation process is carried out by iteration; where the iteration stops if a convergent condition has been reached. Parameter estimation in PLS3 includes 3 things, namely (Rachmawati, 2023):

1. *Weight estimate* is used to create latent variable scores
2. Path estimation *that* connects latent variables and loading estimates between latent variables and their indicators.
3. *Means* and location of parameters (regression constant values, intercept) for indicators and latent variables.

To estimate the *SmartPLS3 algorithm*, it takes place in three steps. The first step in *SmartPLS3 estimation* consists of an iterative procedure of simple regression or multiple regression by taking into account the relationship between the structural model/ *inner model*, the measurement model/ *outer model* and the estimated weights/ *weight relations* (Rachmawati, 2023). After the estimated latent variable scores are obtained, the second and third steps involve estimating the coefficients of the structural model (*inner model*) and the coefficients of each measurement model (*outer model*). The *SmartPLS3 algorithm* is a series of simple and multiple regressions with *ordinary least squares estimation* (Rachmawati, 2023).

PLS MODEL EVALUATION

Structural Model Evaluation (*inner model*)

The structural model was evaluated using R^2 (*R-square*) for the dependent construct, the *Stone-Geisser Q-square test* for *predictive relevance*, and the t test and the significance of the structural path parameter coefficients. The $R^{2 \text{ value}}$ can be calculated using the following formula (Rachmawati, 2023):

$$R^2 = \sum_{h=1}^H \tilde{\beta}_{jh} \text{COR}(X_{jh}, Y_j)$$

R^2 is used to assess the influence of certain independent latent variables on the dependent latent variable. The R^2 result is 0.67; 0.33; and 0.19 indicates that the model is "good", "moderate", and "weak" (Ganga Anuraga, Edy Sulistiyawan, 2017).

SmartPLS3 was also evaluated by looking at Q^2 (*Q-square*) predictive relevance by the model and also parameter estimation. The quantity Q^2 has a value in the range $0 < Q^2 < 1$, where the closer to 1 means the better (Gangga Anuraga, Edy Sulistiyawan, 2017). In other words, a *Q-square value* > 0 indicates the model has *predictive relevance*, whereas if the *Q-square value* ≤ 0 indicates the model lacks *predictive relevance*. The *Q-square value* can be calculated using the formula (Rachmawati, 2023):

$$Q^2 = 1 - (1 - R_1^2)(1 - R_2^2) \dots (1 - R_p^2)$$

Dimana $R_1^2, R_2^2, \dots, R_p^2$ adalah R square variable endogen.

Evaluation of the Measurement Model (*outer model*)

Outer model testing is carried out by specifying the relationship between latent variables and their indicators, or defining each indicator in relation to its latent variable (Pering, 2020). *Outer model* testing is testing the measurement model by testing construct validity and instrument reliability. Validity tests are carried out to measure the ability of research instruments to measure what must be measured. Construct validity testing is carried out through *convergent validity*, *discriminant validity* and *average extracted (AVE)* tests. Whereas reliability test to measure the consistency of measuring instruments in measuring concepts or the consistency of respondents in answering instruments. An instrument is said to be reliable if a person's answer to a statement is consistent or stable over time. Reliability testing in *SmartPLS3* can use *the composite reliability* and *Cronbach's alpha methods*. An instrument meets the *composite reliability criteria* if the results of the *SmartPLS3 analysis composite reliability* value are > 0.7 . To strengthen the reliability test, it was also carried out using the *Cronbach alpha value*. If the *Cronbach alpha value* is > 0.7 for all constructs, it means it has high reliability (Pering, 2020).

Convergent validity, the convergent validity value is based on the *loading factor/outer loading value* on the latent variable with indicators > 0.7 (Pering, 2020). Variables with reflective model indicators are assessed based on the correlation between the item *component score* and *the construct score* calculated by the *SmartPLS3 algorithm*. A reflective measure is said to be high if it correlates more than 0.70 (Ghozali & Latan, 2020) with the construct you

want to measure. However, for initial research, *the loading factor / outer value loading* 0.5 to 0.6 is considered sufficient (Rachmawati, 2023) . If the *convergent validity test* is based on the AVE value. The *AVE* value must be more than 0.50. To obtain the *AVE value* , it can be calculated using the following formula (Rachmawati, 2023) :

$$AVE = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum_i var(\epsilon_i)}$$

Keterangan:

λ_i^2 = factor loading

$var(\epsilon_i) = 1 - \lambda_i^2$

Discriminant validity is a factor *cross loading* value to determine whether a construct has adequate discriminant by comparing the *loading value* on the targeted construct which must be greater than the *loading value* of the other construct (Pering, 2020, p. 35) . If the value of the variable in question is greater, it meets the *discriminant validity criteria* . To test *discriminant validity*, it can also be done by comparing *the square root of average variance extracted (AVE root)* of each construct with correlation between other constructs in the model. If the *AVE root value* for each construct is greater (Ghozali & Latan, 2020, p. 40) than the correlation value between the construct and other constructs (Ghozali & Latan, 2020, p. 39) in the model, then it is said to have a good *discriminant validity value*.

Composite reliability is a group of indicators that measure a variable as having good composite reliability if it has *composite reliability* ≥ 0.7 (Ghozali & Latan, 2020, p. 41) , calculated using the formula:

$$\rho_c = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum_i var(\epsilon_i)}$$

HYPOTHESIS TEST

Hypothesis testing (β , γ , and λ) was carried out using the *Bootstrap resampling method* developed by Geisser & Stone (Rachmawati, 2023) .

a. Statistical hypothesis for *the outer model*

$$H_0: \lambda_i = 0$$

$$H_0: \lambda_i \neq 0$$

b. Statistical hypothesis for *the inner model*: exogenous versus endogenous variables

$$H_0: \gamma_i = 0$$

$$H_0: \gamma_i \neq 0$$

c. Statistical hypothesis for *the inner model*: endogenous to endogenous variables

$$H_0: \beta_i = 0$$

$$H_0: \beta_i \neq 0$$

d. Test statistics: t-test; $p\text{-value} \leq 0.05$ (alpha 5%); significant

e. Outer *model is* significant: indicators are valid and reliable

f. *Inner model is* significant: T-statistic value > 196 , there is a significant influence

When we discuss and study the algorithm used by *SmartPLS3* to analyze research data, it may be difficult to understand and even imagine how difficult it is to use *SmartPLS3*. The formulas used are intended to provide understanding, but if researchers find it difficult to understand various formulas and algorithmic calculations manually, don't be afraid and give up. By using *the SmartPLS3 software*, the calculation and analysis process is carried out by *the software*. The user just needs to receive the results of the analysis carried out by *the software*. Researchers who use *SmartPLS3* for data analysis just need to enter the research data and give commands to *the software* to carry out the analysis. After the analysis process is carried out by *software*, the results are presented in pictures or tables, so the researcher just needs to take a picture or table of the results of *the SmartPLS3 analysis*. From analysis in the form of images or tables, researchers can test *inner models* and *outer models* and test hypotheses as a basis for drawing research conclusions.

Operate *SmartPLS3 Software*

As statistical computer *software*, *the operation of SmartPLS3* is very simple. The steps to operate *SmartPLS 3 Software* are as follows:

Prepare research data in Microsoft Excel files in CSV format (*comma delimited* (Sofyani, nd)).

Collecting questionnaire data from survey research via *Google Form* greatly speeds up the data processing process. Survey results using *Google form* are collected in Excel format; editing and changing the format is necessary. Editing is done on the first line. The first row of the data collection contains questions or questionnaire statements which are filled in by respondents and then converted into variable abbreviations with indicators according to serial numbers such as the serial number of questions/statements. After the editing process on the first line is complete, *copy* and *paste* it into the Excel file, then save it in the file in *comma delimited*

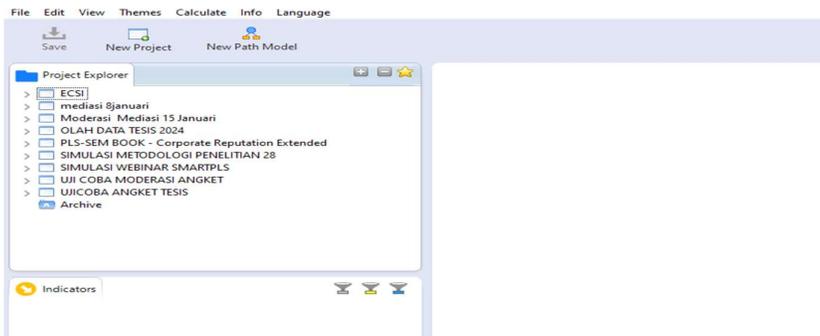
format and give the file a title and save it so it is easy to find again. The following table is an example of data.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
FP1	FP2	FP3	FP4	FP5	FP6	FP7	MI1	MI2	MI3	MI4	MI5	MI6	KPK1	KPK2	KPK3	KPK4	KPK5	KPK6	KPK7	CG1	CG2	CG3	CG4	CG5	CG6	CG7
5	5	5	5	5	5	4	5	5	5	5	5	5	4	5	5	5	5	5	5	4	5	5	5	5	5	5
4	5	4	5	5	4	4	4	5	5	4	5	4	4	4	5	4	4	5	4	5	5	5	5	5	5	5
5	5	5	5	5	5	4	5	5	5	5	5	5	4	5	5	5	5	5	5	5	4	5	5	5	5	5
5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	4	5	5	5	5	5
4	4	4	4	4	4	2	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4
3	3	4	4	3	4	3	5	5	4	5	5	5	4	4	4	4	5	5	4	5	4	5	5	4	5	5
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3	4	3	4	4	4	4	4	4	4	4	4	4	3	3	5	5	5	4	5	5	4	5	5	5	5	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5
4	4	4	4	4	5	4	5	5	5	5	5	3	4	4	4	4	4	4	4	4	5	4	5	5	5	4
5	4	4	5	5	4	4	5	5	4	5	5	4	4	4	4	4	4	4	4	4	4	4	5	5	5	4
4	4	3	3	4	4	4	5	5	3	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4
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4	5	5	4	4	5	4	4	5	5	5	5	5	4	5	5	4	5	5	5	4	5	5	5	5	5	4
3	3	4	3	4	4	3	4	4	3	4	5	2	3	4	4	3	4	5	5	3	5	4	5	5	5	5
4	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	4	3	4	4	4	4	4	4	4	4
4	4	4	4	4	4	3	4	5	5	5	5	4	3	5	4	3	4	5	4	4	5	4	5	5	4	4
4	4	4	4	4	4	4	4	5	5	4	5	5	4	4	4	4	4	5	4	4	5	5	5	5	4	5
4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	5	4	4	5	4	4	4	4
4	4	4	4	4	4	4	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	4	4	4	4	5

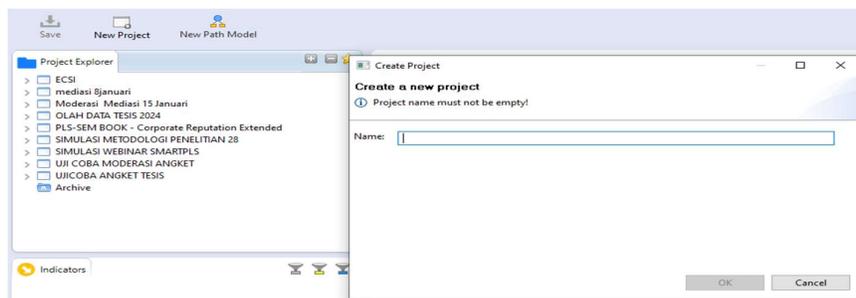
Open SmartPLS3 Software

Open the SmartPLS3 software (Sofyani, nd) that has been installed on the computer.

Then the image appears as follows:



If it opens as shown in the image above, select the new project menu (Hamid & Suhardi M Anwar, 2019) , then a window appears, type the name of the project.



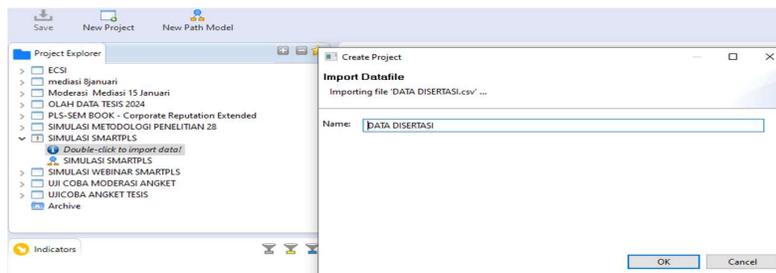
Once the project/file is in the SamrPLS3 software , in the file a double click to import data appears (Sofyani, nd) .

Import data

After clicking to import data (Hamid & Suhardi M Anwar, 2019, p. 33) , a window will appear indicating which file was selected. If the data we mean has not

appeared, then look for the data we have saved in *comma delimited CSV* format .

Once found, click OK so that the data is sent to *the SmartPLS3 software* .

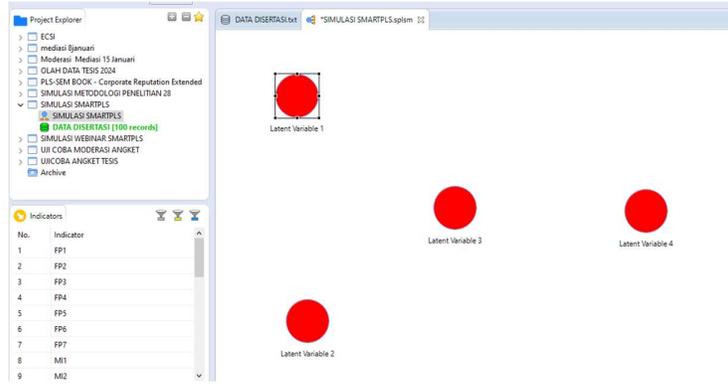


Once OK, the data looks like the image below (Hamid & Suhardi M Anwar, 2019) ,
move it to the bottom left by clicking on the file in the top left window.

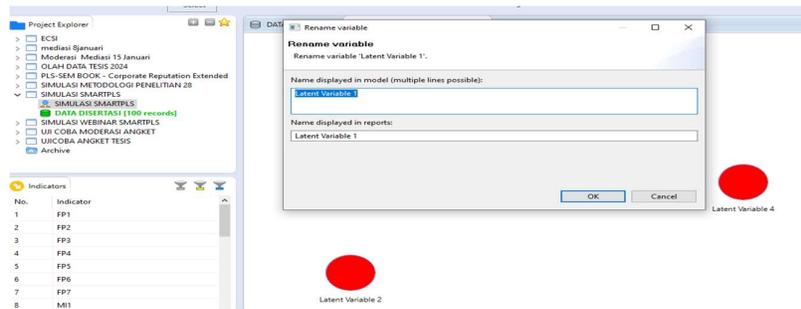
Indicators	N..	Missing	Mean	Median	Min	Max	Standard Devia...	Excess Kurtosis	Skewness
FP1	1	0	4.160	4.000	3.000	5.000	0.612	-0.414	-0.106
FP2	2	0	4.160	4.000	2.000	5.000	0.644	0.347	-0.392
FP3	3	0	4.110	4.000	1.000	5.000	0.799	2.609	-1.279
FP4	4	0	4.250	4.000	2.000	5.000	0.606	0.875	-0.461
FP5	5	0	4.270	4.000	1.000	5.000	0.705	4.040	-1.310
FP6	6	0	4.050	4.000	1.000	5.000	0.726	2.305	-0.873
FP7	7	0	3.920	4.000	2.000	5.000	0.717	0.967	-0.707
MI1	8	0	4.410	4.000	2.000	5.000	0.634	2.276	-1.089
MI2	9	0	4.560	5.000	3.000	5.000	0.535	-0.791	-0.641
MI3	10	0	4.490	5.000	2.000	5.000	0.624	1.348	-1.088
MI4	11	0	4.550	5.000	3.000	5.000	0.555	-0.505	-0.737
MI5	12	0	4.690	5.000	4.000	5.000	0.462	-1.331	-0.834
MI6	13	0	4.260	4.000	2.000	5.000	0.594	1.046	-0.449
KPK1	14	0	4.150	4.000	2.000	5.000	0.698	-0.246	-0.396
KPK2	15	0	4.400	4.000	2.000	5.000	0.583	1.267	-0.676
KPK3	16	0	4.220	4.000	2.000	5.000	0.642	1.492	-0.701

Research Models

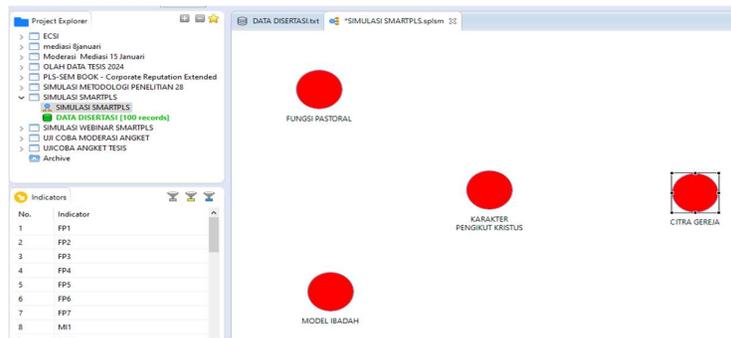
After the workspace is empty and the data has moved to the bottom left, the next step is to draw a model according to the research model. *SmartPLS3* has three types of modeling modes that function to design research models, namely *selection mode* , *drawing mode* , and *connection mode* (Hamid & Suhardi M Anwar, 2019) . Click the cursor on the *selection mode symbol* to draw latent variables then release them on the worksheet, do the same thing until all variables match the research model.



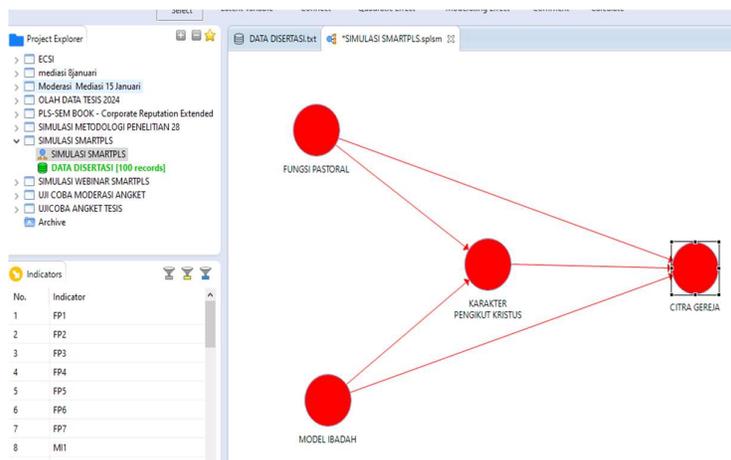
Name the variable according to the name of the research variable. Naming is done by clicking on the variable, then right clicking, the *rename menu appears* , click then a window for writing the variable name is available (Hamid & Suhardi M Anwar, 2019) .



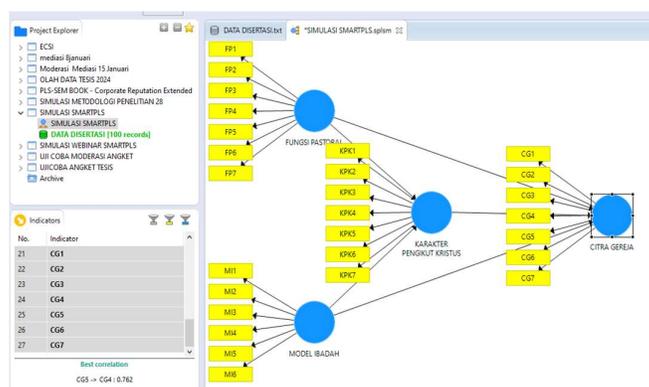
Do this for all variables so that all variables have names.



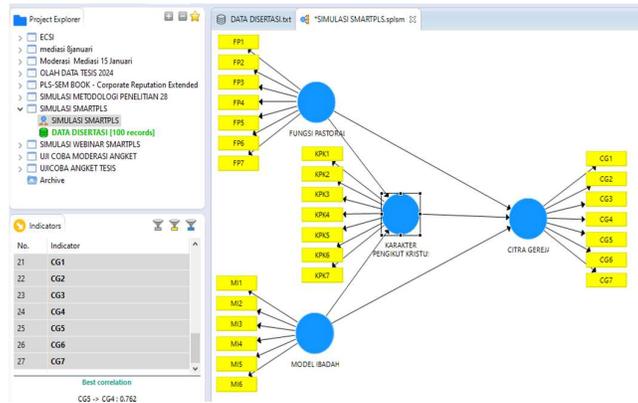
Then click the cursor in *connection mode* (arrow symbol) (Hamid & Suhardi M Anwar, 2019) , to connect exogenous variables to endogenous variables, in accordance with the research hypothesis. The arrow line depicts the influence of exogenous variables on endogenous variables.



After that, each variable is filled in with a variable indicator. To do this, *highlight the manifest variable (indicator) for each latent variable, then drag and drop with the mouse towards the latent variable that corresponds to the drawing board (Hamid & Suhardi M Anwar, 2019)* . Do the same for all variables so that each variable has an indicator.

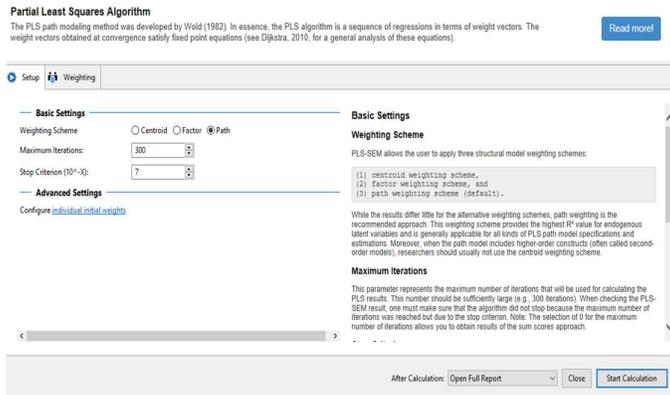


There are several options presented in the context menu to edit the model that has been created on the drawing board . Among them are *rename, delete, align, hide indicators of selected constructs* , and *switch between formative/reflective* (Hamid & Suhardi M Anwar, 2019) . The direction of the indicator can be adjusted so that the lines do not overlap with other lines so that it is easy to read. The direction of the indicator can be right, left, up and down. The way to move the direction of the indicator arrow is as follows. Move the cursor to the variable, then right click, choose the indicator direction you want (right, left, up, down). So the picture looks like the following.



Rhythm Algo Calculation Process

If the model image is as shown in step four, then continue with the analysis process. By clicking *calculate* , three options will appear, choose *PLS Algorithm* . After clicking *PLS Algorithm* , a window will appear, leave the template and don't change the numbers in the template. As follows

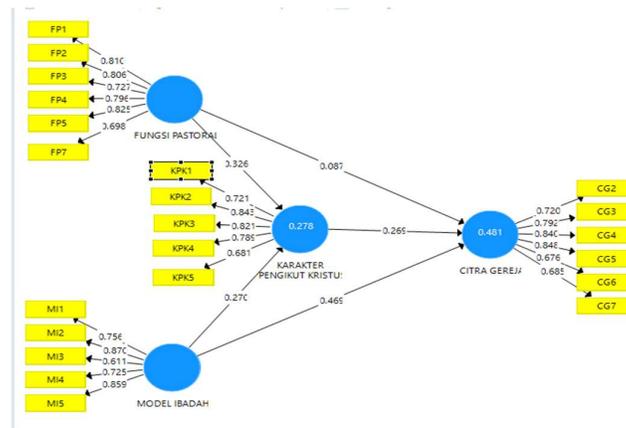


Then click *star calculation* . After completing the process, select *construct reliability and validity* , it appears on the monitor as follows:

Construct Reliability and Validity				
Matrix	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
CITRA GEREJA	0.850	0.851	0.887	0.532
FUNGSI PASTORAL	0.872	0.878	0.902	0.568
KARAKTER PENGIKUT KRISTUS	0.831	0.839	0.875	0.506
MODEL IBADAH	0.828	0.851	0.875	0.543

If all the numbers are green, then in general they have met validity and reliability. If there is still red in a particular variable, then pay attention to the variable whose value is red. Indicator

variables that do not meet the validity and reliability criteria and are colored red must be excluded/eliminated (Pering, 2020) . *The Rule of Thumb* for assessing convergent validity is that *the outer loading / loading factor value* must be more than 0.7 for confirmatory research and between 0.6–0.7 for exploratory research , and *the average variance inflation factor (AVE)* value must be greater than 0.5 (Hamid & Suhardi M Anwar, 2019) . Values that do not meet the validity and reliability criteria must be eliminated. The elimination process is carried out by opening the *outer loading menu* . Note all the *outer loading values* that are colored red (because the value is less than 0.7). Pay attention to values that are red and less than 0.5. Note that indicators whose values are red and less than 0.5 must be eliminated.



The elimination process is carried out by: returning to the research model image menu. Place the cursor in the eliminated indicator box; then press the delete button. Do this for all the indicators that will be eliminated. Once you have finished eliminating the red indicators then continue the process as from the beginning. Perform the *Calculate process again* , select *PLS algorithm* , wait for the results. Click *construct reliability and validity* . If all the numbers are green, it has met validity and reliability. Check again at *outer loading* . Are there still values in *the outer loading* that are red and less than 0.6. If there are, carry out the elimination process again. This can be done many times until all data meets validity and reliability.

Testing Validity and Reliability

Testing Validity .

If the Ave value is more than 0.5 and is green then it meets the convergent validity criteria. The following table shows the AVE value for church image 0.532, pastoral function 0.568, character of Christ followers 0.506 and worship model 0.543. These values meet the

criteria for convergent validity because the value is more than 0.5 and is green (Ghozali & Latan, 2020) ; then the construction is declared valid (Hamid & Suhardi M Anwar, 2019) .

Matrix	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	Copy to Clipboard:
	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	
CITRA GEREJA	0.850	0.851	0.887	0.532	
FUNGSI PASTORAL	0.872	0.878	0.902	0.568	
KARAKTER PENGIKUT KRISTUS	0.831	0.839	0.875	0.506	
MODEL IBADAH	0.828	0.851	0.875	0.543	

If the *outer loading value* is more than 0.7 (green), the absolute criterion, or more than 0.6, meets convergent validity as shown in the following table. The *outer loading* values of FP1, FP2, FP3, FP4, FP5 in green absolutely meet convergent validity. Meanwhile, FP7 is 0.698 even though it is red, but because it is more than 0.6 it can be accepted to meet the convergent validity criteria (Rachmawati, 2023) , as in the following table, all *outer loading values* are declared valid, because they have an *outer loading* of more than 0.6 (Hamid & Suhardi M Anwar, 2019) :

	CITRA GEREJA	FUNGSI PASTORAL
FP1		0.810
FP2		0.806
FP3		0.727
FP4		0.796
FP5		0.825
FP7		0.698

To test discriminant validity, click *discriminant validity* , then select *fornell-larcker criterion*. If the value of the *Fornell-Larcker criterion/ root AVE*, for the numbers in the diagonal line is greater than the numbers below it, then it meets the discriminant validity criteria (Ghozali & Latan, 2020) . Like the following picture

	CITRA GEREJA	FUNGSI PASTORAL	KARAKTER PENGIKUT KRISTUS	MODEL IBADAH
CITRA GEREJA	0.763			
FUNGSI PASTORAL	0.478	0.778		
KARAKTER PENGIKUT KRISTUS	0.522	0.477	0.773	
MODEL IBADAH	0.639	0.562	0.453	0.770

The second way to test discriminant validity, click *discriminant validity* , then select *crossloading*. It will look like the following table .

Discriminant Validity

	CITRA GEREJA	FUNGSI PASTORAL	KARAKTER PENGIKUT KRISTUS	MODEL IBADAH
CG2	0.720	0.338	0.390	0.404
CG3	0.792	0.343	0.393	0.584
CG4	0.840	0.385	0.317	0.511
CG5	0.848	0.358	0.377	0.561
CG6	0.676	0.398	0.449	0.405
CG7	0.685	0.371	0.470	0.430

The row containing the church image variable indicator in the church image variable column has a value greater than the value in the same row in the other indicator column. In the table above, the row containing the church image variable indicator value is in the first row the CG1 indicator with a value of 0.720, in the same row the pastoral function variable column is 0.338, in the character of followers of Christ column is 0.390 and in the worship model column is 0.404. Thus, the CG1 line value is 0.792 which is greater than 0.338, 0.390 and 0.404. Carry out tests like these in the following lines. If the variable indicator row in the relevant variable column is greater than the other variables; concluded that it meets the criteria for discriminant validity (Ghozali & Latan, 2020) .

Testing Reliability

If the *Cronbach alpha value* for each variable is more than 0.7 then it meets the reliability criteria. Look at the following table: The *Cronbach alpha value* of the church image variable is 0.850, the pastoral function variable is 0.872, the character variable of followers of Christ is 0.831 and the worship model variable is 0.828. Because the *Cronbach alpha value* for all variables is more than 0.7, it meets the reliability criteria (Ghozali & Latan, 2020) .

Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
CITRA GEREJA	0.850	0.851	0.887	0.532
FUNGSI PASTORAL	0.872	0.878	0.902	0.568
KARAKTER PENGIKUT KRISTUS	0.831	0.839	0.875	0.506
MODEL IBADAH	0.828	0.851	0.875	0.543

If the *composite reliability value* for each variable is more than 0.7 then it meets the reliability criteria. Look at the table above: The *composite reliability value* of the church image variable is 0.851, the pastoral function variable is 0.878, the character variable of followers of Christ is 0.875 and the worship model variable is 0.8875. Because the *composite reliability value* for all variables is more than 0.7, it meets the reliability criteria (Ghozali & Latan, 2020)

Testing R Square .

By clicking *R Square* , a table of *R square* values appears .

R Square

Matrix	R Square	R Square Adjusted
	R Square	R Square Adjusted
CITRA GEREJA	0.481	0.465
KARAKTER PENGIKUT KRISTUS	0.278	0.263

Select h column *R Square* , not *R Square Adjusted* . This value is the value of the combined influence of exogenous variables on endogenous variables. Values between 0.19-0.32 have a weak effect. A value of 0.33-0.66 has a moderate influence and a value of 0.67-0.99 has a strong influence (Ganga Anuraga, Edy Sulistiyawan, 2017) . To find out the percentage of influence, this is done by multiplying the *R value Square* with 100%. From the *R Square table* above, the character of followers of Christ is influenced by pastoral function and worship models by 27.8%. Meanwhile, 72.2% is influenced by other variables. Including low influence. The image of the church is influenced by its pastoral function, worship model and character of followers of Christ by 48.1%. Meanwhile, 51.9% was influenced by other variables. Included in the moderate to strong influence category.

TESTING MODEL FIT

By clicking on the fit model the following table appears;

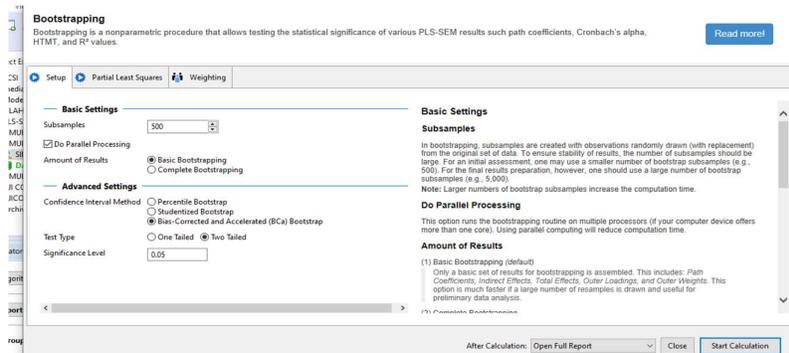
Model_Fit

Fit Summary	rms Theta	
	Saturated Model	Estimated Model
SRMR	0.087	0.087
d_ULS	1.928	1.928
d_G	0.863	0.863
Chi-Square	440.144	440.144
NFI	0.680	0.680

Pay attention to the NFI value in the table above. The NFI value is between 0 and 1, if the NFI value is closer to 1 (one), the better the research model (Ringle, nd) .

Bootstrapping Calculation Process

To carry out the bootstrapping process, the display on the screen returns to the model image. After the model image appears, click calculate, select *bootstrapping* . If the window appears, just leave the template and don't change the numbers.



Then click *star calculation* . Wait until the process is complete. Then the following appears on the screen.

	Original Sample (O)	Sample Mean (M)	Standard Devia...	T-Statistics (O/STDEV)	P Values
FUNGSI PASTORAL -> CITRA GEREJA	0.087	0.087	0.094	0.921	0.357
FUNGSI PASTORAL -> KARAKTER PENGIKUT KRISTUS	0.326	0.327	0.103	3.162	0.002
KARAKTER PENGIKUT KRISTUS -> CITRA GEREJA	0.269	0.268	0.087	3.081	0.002
MODEL IBADAH -> CITRA GEREJA	0.469	0.478	0.091	5.165	0.000
MODEL IBADAH -> KARAKTER PENGIKUT KRISTUS	0.270	0.272	0.120	2.241	0.025

Path coefficient table (path coefficient). This table is to test the hypothesis. For the numbers that appear in the table, pay attention to the original sample value, T-Statistics and P-Value. The numbers in the P-Value column will be colored red if the value is more than 0.05. And green if the value is less than 0.05.

TESTING HYPOTHESES

If testing the direct influence hypothesis, use a *path coefficient table* like the table above . *Meanwhile, if you test the mediation influence hypothesis* , you can also use the *path coefficient table* also uses a *specific indirect effects table*. The following is a table of *specific indirect effects*

Specific Indirect Effects							
Mean, STDEV, T-Values, P-Val...	Confidence Intervals	Confidence Intervals Bias Co...	Samples	Copy to Clipboard:	Excel Format	R Format	
			Original Sampl...	Sample Mean (...)	Standard Devia...	T Statistics (O ...	P Values
FUNGSI PASTORAL -> KARAKTER PENGIKUT KRISTUS -> CITRA GEREJA			0.126	0.135	0.062	2.048	0.041
MODEL IBADAH -> KARAKTER PENGIKUT KRISTUS -> CITRA GEREJA			0.119	0.121	0.048	2.471	0.014

To test the hypothesis, use the T-Statistics value and P-value (Hidayat, 2021) . If the T-Statistics value is more than 1.96 and the P-Value is less than 0.05, then the effect is significant, which is accepted by H_1 . If the T-statistic value is less than 1.96 and the P-value is more than 0.05, then it is not significant, which is accepted as H_0 . Also pay attention to the original value of the sample. The positive *original sample* value has the same effect and the negative value has the opposite effect. The size of the original sample value shows the increase in influence, if there is a change in the form of an increase or decrease of one point in the exogenous variable, then the value increases or decreases by the same amount as the *original sample value* depending on whether the influence is in the same direction or in the opposite direction.

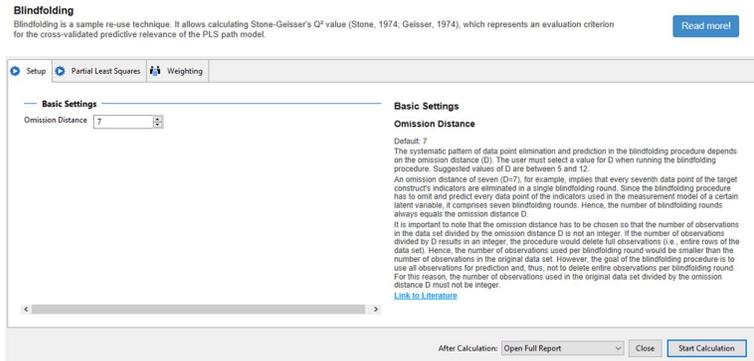
Testing the mediation model hypothesis is done by comparing direct influence data (table path *coefficient*) with indirect influence data (table *specific indirect effects*). (Duryadi, 2021) . By adapting the mediation model according to Solimun, the test is based on the following criteria (Solimun, 2011) :

- If a (XY) direct influence (*table path co efficient*) is not significant, and XY (indirect influence) through c (XM) and d (MY) is significant (*table specific indirect effects*), then variable M is said to be a perfect mediating variable (*complete mediation*).
- If a (XY) direct influence is significant (*table path coefficient*), and XY (indirect influence) through c (XM) and d (MY) is significant (*table specific indirects effects*), then M is a partial mediation variable .).
- If a (XY) direct influence is not significant (*table path co efficient*), and XY (indirect influence) through c (XM) or d (MY) is not significant (*table specific indirect effects*), then M is not a mediating variable

Blindfolding Calculation Process

To carry out the process, *Calculation blindfolding* the display on the screen returns to the model image. After the model image appears, click *calculate* , select *Calculation*

blindfolding . If the window appears, just leave the template and don't change the numbers. It looks like the following picture:



Then click *star calculation* . Wait until the process is complete. Then the following will appear on the screen.

Construct Crossvalidated Redundancy							
Total	Case1	Case2	Case3	Case4	Case5	Case6	Case7
	SSO	SSE	Q ² (=1-SSE/SSO)				
CITRA GEREJA	600.000	444.786	0.259				
FUNGSI PASTORAL	600.000	600.000					
KARAKTER PENGIKUT KRISTUS	500.000	424.484	0.151				
MODEL IBADAH	500.000	500.000					

Testing the level of observation

blindfolding table above, pay attention to the Q square value (Q^2). Q^2 has a value in the range $0 < Q^2 < 1$, where the closer to 1 means the better (Gangga Anuraga, Edy Sulistiyawan, 2017) . In the table above, the Q^2 values are 0.259 and 0.151, meaning that more than zero has a good observation level.

Implications

As a tool for analyzing quantitative research results, *SmartPLS3* is used to predict the influence of exogenous variables (X) on endogenous variables (Y) and explain the theoretical relationship between the two variables. *SmartPLS3* is also used to analyze linear regression models, multiple regression, path analysis (direct influence and indirect influence with moderating variables or through mediating variables). *SmartPLS3* is also able to identify factors which are a combination of variable X as an explanation and variable Y as a response (Ganga Anuraga, Edy Sulistiyawan, 2017) ; confirm theory; to explain whether there is a relationship between latent variables. *SmartPLS3* can analyze both constructs formed by reflexive indicators and *formative indicators* (Hidayat, 2018) . So *SmartPLS3* can answer researchers' quantitative research needs.

With the very complex function of *SmartPLS3* , when researchers try to use *SmartPLS3* , they don't just use *the software* that has been used, for example SPSS. *Smart PLS3* function according to Hidayat: (Hidayat, 2018)

1. Partial Least Square is an analysis whose main function is for model design, but can also be used to confirm theories.
2. PLS does not require as many conditions or assumptions as SEM.
3. The Partial Least Square function can be grouped into two, namely inner model and outer model. The outer model is more towards testing validity and reliability. Meanwhile, the inner model is more directed towards regression, namely to assess the influence of one variable on other variables.
4. Model suitability in Partial Least Square... there are 2 criteria for assessing model suitability, namely the suitability of the outer model which is called the outer model and the suitability of the inner part which is called the inner model....
5. Assessment of the suitability of the outer model includes: Reliability and validity of reflective latent variables and validity of formative latent variables.
6. Assessment of the suitability of the inner model includes: Explanation of the variance of endogenous latent variables, the size of the effect contributed and relevance in prediction.

With this function, the need for research data analysis has been answered by *SmartPLS3*.

Recommendations for Further Research

This research has not examined all statistical computer *software* , because the focus is on *SmartPLS 3* , which is a type of VB-SEM; appropriate for analyzing path analysis models. Meanwhile, for structural models, it is very appropriate to use the CB-SEM type, which is currently being developed with *SmartPLS4 software* . Therefore, an in-depth study is needed regarding techniques for analyzing research results using statistical computer *software* developed by experts in the future. For further research, more in-depth and comprehensive research is needed regarding the analysis of research results with new and up-to-date statistical computer *software* .

CONCLUSION

There are many models of Christian religious education research and practical theology that choose applied research, causality and quantitative methods. These models include: linear regression models, multiple regression and *path analysis models* . To analyze various research models, you can choose the available *software* . There are many choices of statistical computer *software* . **This software** includes: **Statistical Package for the Social Sciences (SPSS)** , **Structural Equation Modeling Analysis of Moment Structure (SEM AMOS)** , **Lisier Structural Relationships (LISREL)** , **Partial Least Square (SmartPLS3)** . Each *software* has weaknesses but also advantages depending on the research model chosen by the researcher. In this article, *the software* that I introduce is *SmartPLS3 software* for analyzing linear regression models, multiple regression and *path analysis models* .

SmartPLS3 software is very easy, efficient and effective for analyzing linear regression models, multiple regression and *path analysis* . With *SmartPLS3* , especially for analyzing *path analysis models* either with moderating effects or through mediating variables, there is no need to use the Sobel test. If *the path analysis model* is with a moderating variable, then in *the path coefficient table* the results of the direct influence and moderating effect analysis are presented. With this data available, to test the hypothesis with the moderating variable, all you have to do is compare the available data. Meanwhile, if the *path analysis model* uses mediation, then the data from the analysis results is available in the *path coefficient table* and in *the specific indirect effect table* . By comparing these two data, hypothesis testing through mediating variables can be carried out and concluded. We hope that this article can help researchers, whether for thesis, dissertation or journal assignments, to choose the right and simple statistical computer software for your research assignments.

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