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Management Multivariate Analysis Methods for Variables Measurement in Scientific Papers

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Abstract

The management of writing a scientific papers we already know has important chapters in the writing. And have a way of choosing in a variety of methods. There are problems in this study, namely the absence of the use of research methods in scientific-rich management. Then one of them is needed by multivariate data analysis management to become one of the methods in writing scientific papers. Multivariate data is data collected from two or more observations by measuring these observations with several characteristics. There are 2 (two) methods in multivariate data, namely dependency and interdependence methods. Dependency analysis functions to explain or predict dependent variables by using two or more independent variables. Focused on the dependency method there are 9 (nine) classifications. It is expected that the multivariate data analysis management can help writers to use scientific research methods well and be able to analyze the influence of several variables on other variables at the same time.

Keywords*: management, multivariate data, scientific paper*

1. Introduction

The current era is undeniable with rapid technological developments [1]. In the delivery of information, it should also be clear so as to increase the satisfaction conveyed [2]. What is clear now is that activities are integrated with information technology [3]. Writing a scientific papers needs the existence of accurate information and can meet reader satisfaction [4]. Good analytical management activities are able to provide efficient time [5].

In the management of writing scientific papers, certain methods are also used in accordance with the needs of the research in the hope of being able to present information that is easily understood [6]. Today, fast and precise information is needed to support life activities, for example in management writing scientific papers [7]. And in the management of scientific writing using citations from various published articles [8].

Management Multivariate statistical analysis is a statistical method that allows us to research more than two variables simultaneously. By using this analysis technique, we can analyze the influence of several variables on other variables at the same time [9]. For example, we can analyze the influence of product quality variables, prices and distribution channels on customer satisfaction. Management Multivariate analysis is used because in reality the problem that occurs cannot be solved by simply connecting two variables or seeing the effect of one variable on another. Like the example above, the variable customer satisfaction is influenced not only by product quality but also by the price and distribution channel of the product.

Multivariate data management is data collected from two or more observations by measuring these observations with several characteristics. Furthermore, the analysis is divided

into two categories of methods, namely methods of dependency and interdependence. The first model has two variables, namely independent and dependent variables, while the second model has only one type of variable, namely the independent variable. By using this management analysis technique researchers can analyze the influence of several variables on other variables at the same time. Multivariate analysis management is used because in reality the problem that occurs cannot be solved by simply connecting two variables or seeing the effect of one variable on another.

Dependency analysis functions to explain or predict dependent variables by using two or more independent variables. Included in this classification are multiple regression, analysis of variance and covariance, conjoint analysis, multiple discriminant analysis, canonical analysis, multivariate analysis of variance, path analysis, and structural equation modeling.

2. Research Method

In a management process of scientific writing, research methods are needed in order to achieve goals and obtain accurate and reliable information, then needed by the author to perform several stages in the research [10].

2.1 Analysis technique

By using 2 (two) techniques in multivariate data analysis in this study, namely:

1. The Interdependence Method has 2 (two) variables namely free and dependent. Which is used to find the causes of problems, or help provide the desired information. This case the researcher wants to know something unknown problem [11].
2. Dependency method functions to explain or predict dependent variables by using two or more independent variables.

2.2 Literature Review

In addition, there are 5 (five) literature studies in this study:

1. Research by Nila Rahmawati entitled "Perbandingan Model Fungsi Transfer dan Neural Network untuk Meramalkan Harga Penutupan Saham (Close Price) pada PT. Bank Central Asia, Tbk"discusses forecasting stock closing price data (close price) by considering the effect of the stock opening price data (open price) as the independent variable on the forecasting model using the multivariate method [12].
2. The research conducted by Haryati astuti and fitri with the title "ANALISIS FAKTOR PEMBERIAN IMUNISASI DASAR" explained the use of multivariate methods in this study to identify factors related to immunization. What is considered important is to enter the model to maintain the independent variable [13].
3. The study, entitled "KAJIAN INDEKS KUALITAS AIR SUNGAI MENGGUNAKAN METODE STATISTIK MULTIVARIAL PRINCIPAL COMPONENT ANALYSIS DAN ANALISIS FAKTOR (STUDI KASUS SUNGAI BELIK)" was carried out by Krisnanto Wibowo. Sungai Belik. In addition, it can also be known that the dominant parameter can represent water quality in Sungai Belik [14].
4. The research conducted by Sutrisno and Dewi Wulandari "Multivariate Analysis of Variance (MANOVA) untuk Memperkaya Hasil Penelitian Pendidikan" describes MANOVA as a solution for quantitative analysis techniques for researchers in the world of education and also enriches research results in the world of education [15].
5. The research entitled "PENGKLASIFIKASIAN OBJEK DENGAN ANALISIS DISKRIMINAN LINIER KLASIK DAN ANALISIS DISKRIMINAN LINIER ROBUST" by JUSTIN EDUARDO SIMARMATA discusses that discriminant analysis is one part of multivariate analysis with dependency method. Where this analysis requires normal multivariate distribution assumptions and homogeneous matrix variance-covariables [16].

2.3 Constructivist Approach

A constructivist approach is an approach that has not been widely studied in the information system literature. In general, research with this approach will produce a construct,

model, method or operationalization of all three in the birth of information system science contracts. The research can be carried out with a variety of models discussed above. Theoretical research that produces conceptual models and software development can be included in research with a constructivist approach. However, the constructivist approach is more than just producing a model or software. The process of testing the implementation of a software or information system in an organizational or user context is an integral part of the approach using multivariate statistics. With information systems also able to maximize the research conducted [17]. For example, when a decision support system application has been carried out, the effectiveness of this application must also be tested, including related to the level of user acceptance and tangible benefits felt by the user. Therefore, it is time for multivariate analysis management to be applied in information system research.

3. Results and Analysis

The discussion in this study is the kinds of dependency analysis included in the multivariate data analysis management function predicting a variable. There are 9 (nine) classifications of dependency methods including the part of multivariate analysis management.

3.1 Multiple Regression

Multiple Regression is a statistical method according to if the research problem includes one dependent variable (criterion variable) that measures metric scale (interval or ratio), which is expected to be predicted by independent variables that are metric scale (interval or ratio). In other words, what is meant by multiple regression analysis is an association analysis that is used simultaneously to examine the effect of two or more independent variables on one dependent variable on the interval scale (Anderson, 2001).

The purpose of this method is to manage and predict changes in the dependent variable associated with changes that occur in a number of independent variables (predictor variables). If viewed from the number of independent variables (predictors of X) used in the study, regression analysis can be divided into two parts, namely: single or simple regression analysis (with one predictor) and multiple regression analysis (with two or more predictors). So when paired with linearity assumptions, wherein the regression analysis there are two forms of relationships namely linear and non-linear, we get four kinds of regression analysis: namely (1) single linear regression analysis, (2) multiple linear regression analysis, (3) single non-linear regression analysis and (4) multiple non-linear analysis.

Single linear regression analysis is used to determine the basic forecast of a data distribution consisting of variable criteria (Y) and one predictor variable (X) which have a linear relationship. Multiple linear regression analysis is divided into two parts, namely regression analysis with two predictors and three predictors. Regression analysis with two predictors is a parametric statistical technique that is used to test the association of two predictors (^{X_1} X_1 and X_2X_2) with the criterion variable (Y). Regression analysis with three predictors is a parametric statistical technique that is used to make the basic predictions regarding the magnitude of variation that occurs in the Y criterion based on the values derived from three predictor variables.

3.2 Variant Analysis (Anava)

Analysis of variance or better known as Anava is a type of parametric statistical analysis used to test differences between 3 groups of data (observations) or more. Anava is not only able to test the differences between 3 groups or more than one independent variable, but it can also be used to resolve groups of data from two or more independent variables. Anava with 1 independent variable is called Anava 1 path while Anava with 2 independent variables or more is called a double Anava or factorial Anava.

A variant analysis is often used to test hypotheses about significant mean differences between two or more groups. The advantages compared to t testing based on the difference between the two averages are that t-tests can only test the difference between the two averages. So for more than two average values, we have to test each of the averages with other averages. To detect differences between groups, variance analysis can be continued with the Schema test, Duncan Multiple Range test, Tukey's test, Student-Newman-Keul's test [18].

3.3 Covariance Analysis (Anakova)

Covariance analysis or often referred to as Anakova is a statistical technique for multivariate different tests which is a combination of regression analysis (Anareg) with variance analysis (Anava). Anakova will be calculated by using statistical controls to clean or purify changes that occur in the dependent variable as a research design that is not strong. Variable control procedures in Anakova are 2 ways, namely: (1) control on the influence of external variables and (2) control in the initial conditions of different dependent variables.

The term kova in anakova derived from the word covariance (covariance) indicates the existence of a variable that is connected, that is, between the independent variables covariates with the criteria / bound variable. Remember, co in English means together, which indicates the existence of a relationship. In ANAKOVA there is a process of comparing the dependent variable/criteria (Y) in terms of the categorical scale treatment independent variable (A) while connecting the dependent variable with the independent variable numerical covariate variable (X). The variable X used predicts this is called the covariate variable.

Some definitions of variables that will be used in the covariant analysis include: (1) criteria, is the dependent variable (Y), which is the variable that is affected, where data must be in the form of intervals or ratios. (2) Covariables, also called control variables, control variables, concomitant variables given the X symbol, and data must be in the form of intervals or ratios. (3) Factors, namely designations for independent variables or experimental variables that want to be known for their effects and data must be in the form of nominal or ordinal.

3.4 Conjoint Analysis

Conjoint Analysis is a statistical method used to measure the combination of correlations between variables that are non-metric (nominal or ordinal). The results of evaluations by consumers can be used for product design policies [19]. In other words, conjoint analysis is a multivariate technique that is used specifically to understand how respondents develop preferences for products or services or ideas. The usefulness of conjoint analysis includes (1) grouping respondents who have the same part-worth, (2) knowing the relative contribution of each attribute to the overall assessment of an object, (3) identifying market opportunities from extracting combinations of attributes that are not currently present [20]

Examples of conjoint analysis applications for information systems are research on the attributes of work opportunities that are interested in information system graduates, professional system information attributes that are of interest to companies, and professional ethics attributes that are most preferred by professionals in information systems, and so on. Application or use of conjoint analysis is applied in consumer goods, industrial goods, finance, and other services. After all, this application has expanded throughout the marketing field. A new survey of conjoint analysis applications to identify new products or concepts, competitive analysis, pricing, market segmentation, advertising and distribution of computer products.

3.5 *Multiple Discriminant Analysis*

Discriminant analysis is a technique of analyzing data if non-free variables (called critters) are categories (non-metric, nominal or ordinal, qualitative) while independent variables as predictors are metrics (intervals or ratios, quantitative). The main purpose of using discriminant analysis is to see linear combinations.

So it can be concluded that the purpose of the discriminant analysis is to understand group differences and to predict the likelihood that an individual or object belongs to a particular group based on independent variables (independent or predictor) measuring metric scale (interval or ratio).

3.6 *Canonical analysis*

Understanding of canonical correlation analysis is a statistical technique used to determine the level of linear association between two sets of variables, where each device consists of several variables (Sekaran, 2004). The canonical method aims to correlate several dependent variables with a metric scale simultaneously with a number of independent variables that measure metric scale. Besides that, it is also used to simultaneously predict several dependent variables from several independent variables. In addition to being used for metrically sized variables, it can also be used for data that is not the original metric transformed into dummy variables.

The assumptions of canonical analysis are (1) the correlation between any two variables must be based on linear relationships, (2) canonical correlations are linearly related between variates (linear combination of dependent variables and linear combinations of independent variables), (3) fulfill multivariate normality, (4) there is no multicollinearity.

Examples of canonical analysis applications are testing the relationship between a combination of computer quality, computer speed, computer system flexibility, and the service of electronic data processing parts (independent variables) with the level of computer use and user satisfaction level (dependent variables). Canonical analysis can find out which independent variables are the main predictors of the dependent variable.

3.7 Multivariate Analysis of Variance (MANOVA)

Manova has the meaning of a statistical technique method used to calculate the testing of the significance of the mean differences simultaneously between groups for two or more dependent variables. Manova is used to find or form groups of sample elements based on independent variables and at the same time determine differences between groups in terms of the combined values (variant) of the dependent variables.

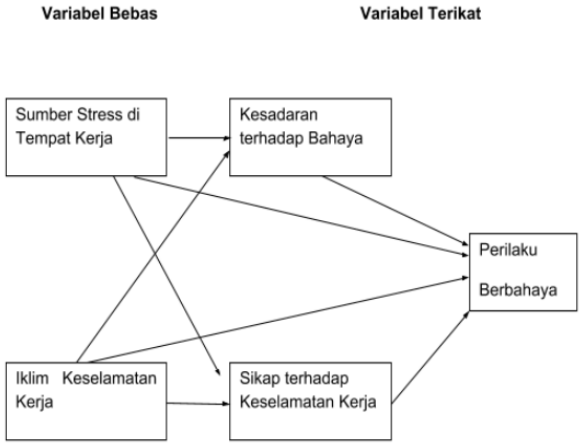
In SPSS manova procedures also called multivariate GLM are used to calculate regression analysis and variance for more than one dependent variable using one or more factor variables or covariates. Factor variables are used to divide the population into groups. Manova can be used if it fulfills assumptions: (1) observations must be independent, (2) the similarity of dependent variable variants between groups, (3) dependent variables must be normal at least univariate, (4) relationships between dependent variables are linear, (5) between dependent variables there is no high multicollinearity, and (6) free from outliers. The recommended number of samples for each cell is a minimum of 20 (Swandari, 2002).

An example of a manova application is determining the difference in the level of liquidity, solvency, and profitability between large, medium and small companies. In this example, more than one dependent variable (liquidity, solvency, and profitability) is measured by the ratio, and the independent variable (crisis state and firm size) is measured in nominal terms.

3.8 Path Analysis

Pedhazur (2001) argues that path analysis is a method used to see the effects (effects) directly and indirectly of a variable that is hypothesized as causes of variables that are treated as a result. It is important to know that path analysis is actually not a method used to find causes, but it is used to find an explanation of the patterns of direct and indirect relations of a causal model that are compiled based on theoretical considerations and knowledge of the

researcher. In a causal model, it must be distinguished between exogenous and endogenous variables. Exogenous variables are variables whose variability is assumed to be determined by causes that are outside the model. While endogenous variables are variables whose variations can be explained by exogenous and endogenous variables in the system [21].



Images 3.1 Conceptual Model of Relations between Variables

From Images 3.1 above, hypothesis testing in the study was conducted on the null form of the alternative hypothesis proposed based on the conceptual model of the relationship between variables. In the opinion of the author, the procedure adopted in the hypothesis test is by examining the limits of acceptance-rejection of the statistical significance level of the path coefficients produced. Path coefficient is the standard regression coefficient. There are two ways that can be taken to determine whether the standard regression coefficient is included in a statistically significant coefficient or not, namely by checking the ratio t and the ratio F.

3.8 *Structural Equation Modeling* (SEM)

Structural Equation modeling is a statistical technique that allows separate relationships for each dependent variable device. In simple structural equation modeling presents a most appropriate and efficient estimation technique for a series of multiple regression equations that are estimated simultaneously. Thus what is meant by SEM is a multivariate technique that combines aspects of multiple regression and factor analysis to estimate a series of interdependent relationships simultaneously. Data analysis with SEM can use AMOS or LISREL software [22].

SEM is a combination of two statistical methods, namely (1) factor analysis developed in psychology/psychometry or sociology and (2) simultaneous equation models developed in econometrics[23]. Today, processing data for SEM analysis is easy with the help of some statistical software, such as Lisrel, AMOS and Smart PLS. Lisrel is the statistical software for SEM analysis that is the most widely used[24]. The basis of processing with Lisrel can be done in four ways, namely the pre-project, simplis project, lisrel project, or path diagram. In addition, SEM analysis can also use Smart PLS software. Smart PLS is an alternative method of SEM analysis using PLS (Partial Least Square). In closing, information system research will be discussed with a constructivist approach[25].

4. Conclusion

Management Multivariate analysis is a statistical technique that focuses and makes clear the structure of simultaneous relationships between three or more phenomena. By using this management analysis technique, we can analyze the influence of several variables on other variables at the same time. With multivariate analysis management, researchers can move from observation to construct and return from construct to observation to refine the construct formula and predict certain observations. During the management process, we build limited descriptions or explain the relationship between facts and constructs. By carrying out interactive observations and explaining constructs, we build models that have reality, especially in developing information systems that develop in the community. Isn't that the noble goal of science.

Management Analysis of multivariate data is basically classified into two, namely dependency analysis and interdependence analysis. Dependency analysis functions to explain or predict dependent variables by using two or more independent variables. Included in the management classification of this analysis are multiple regression, analysis of variance and covariance, conjoint analysis, multiple discriminant analysis, canonical analysis, multivariate analysis of variance, path analysis, and structural equation modeling.

References

[1] Sunarya, A., Saptoro, A., & Apriyani, D. (2017). Utilization Setting Menu To Build Company Accounting System In Web Based Accounting Online System. Aptisi Transactions of Management (ATM), 1(1), 1-10.

[2] Rahardja, U., Aini, Q., & Sari, D. M. (2018). Pemanfaatan Automated Email System (AEMS) Sebagai Media Notifikasi Penilaian Hasil Belajar. SENSITEK, 1(1), 49-54.

[3] Rahardja, U., Aini, Q., & Santoso, N. P. L. (2018). Pengintegrasian YII Framework Berbasis API pada Sistem Penilaian Absensi. SISFOTENIKA, 8(2), 140-152.

[4] Febriyanto, E., & Yulianto, F. H. N. L. (2018). Penerapan Viewboard Rooster Berbasis Bootstrap Sebagai Penunjang Pelayanan iDuhelp! Pada Perguruan Tinggi. Jurnal Ilmiah Teknologi Informasi Asia, 12(2).

[5] Sudaryono, S., Aisyah, E. S. N., Apriyani, D. (2017). Utilization Of Online Accounting Software As A Supplier Data Collection System At The Company. Aptisi Transactions of Management (ATM), 1(2), 87-92.

[6] Rahardja, U., Aini, Q., & Khoirunisa, A. (2017). Implementasi Business Intelligence Menggunakan Highchart pada Sistem Penilaian Absensi berbasis YII Framework. CSRID (Computer Science Research and Its Development Journal), 9(2), 115-124.

[7] Rahardja, U., Aini, Q., & Faradilla, F. (2018). Implementasi Viewboard Berbasis Interaktif Javascript Charts Pada Sistem Penilaian Perkuliahan. Jurnal Ilmiah Teknologi Informasi Asia, 12(2), 91-102.

[8] Rahardja, U., Harahap, E. P., & Dewi, S. R. (2019). The Strategy of Enhancing Article Citation and H-Index on SINTA to Improve Tertiary Reputation. TELKOMNIKA (Telecommunication Computing Electronics and Control), 17(1).

[9] Wijaya, Toni. 2010. Analisis Multivariat: Teknik Olah Data Untuk Skripsi, Tesis, dan Disertasi Menggunakan SPSS. Penerbit UAJY: Yogyakarta.

[10] Agustina, I. I., Handayani, I., Aini, Q., & Cholisoh, N. (2018). Pemanfaatan Google Form Sebagai Pendaftaran TOEFL (Test Of English as a Foreign Language) Secara Online. Jurnal Teknoinfo, 12(2), 18-22.

[11] Simarmata, J. E. (2018). Pengklasifikasian Objek dengan Analisis Diskriminan Linier Klasik dan Analisis Diskriminan Linier Robust.

[12] Rahmawati, N. (2018). Perbandingan Model Fungsi Transfer dan Neural Network untuk Meramalkan Harga Penutupan Saham (Close Price) pada PT. Bank Central Asia, Tbk. SKRIPSI Jurusan Matematika-Fakultas MIPA UM.

[13] Astuti, H. (2018). Faktor–Faktor Yang Berhubungan Dengan Imunisasi Dasar Lengkap. Jurnal Kebidanan Midwiferia, 3(1), 1-13.

[14] WIBOWO, K., & Saraswati, I. S. P. (2018). KAJIAN INDEKS KUALITAS AIR SUNGAI MENGGUNAKAN METODE STATISTIK MULTIVARIAT PRINCIPAL COMPONENT ANALYSIS DAN ANALISIS FAKTOR (STUDI KASUS SUNGAI BELIK) (Doctoral dissertation, Universitas Gadjah Mada).
[15] Sutrisno, S., & Wulandari, D. (2018). Multivariate Analysis of Variance (MANOVA) untuk Memperkaya Hasil Penelitian Pendidikan. AKSIOMA: Jurnal Matematika dan Pendidikan Matematika, 9(1), 37-53.
[16] Simarmata, J. E. (2018). Pengklasifikasian Objek dengan Analisis Diskriminan Linier Klasik dan Analisis Diskriminan Linier Robust.
[17] Handayani, I., Aini, Q., & Alfiansah, R. (2016). Fitur Form Emailer Dalam Memaksimalkan Penggunaan Rinfo Form Pada Perguruan Tinggi. Technomedia Journal, 1(1), 1-10.
[18] Wibisono, W. 2003. Riset Bisnis: Panduan bagi Praktisi dan Akademisi, Gramedia Pustaka Utama: Jakarta.
[19] Hair, Joseph F, et al, 2001. Multivariate Data Analysis: With Reading, Englewood, Cliffs, N.J: Prentice-Hall.
[20] Ghozali, Imam. 2010. Structural Equating Modeling: Model Alternatif dengan Partial Least Square. Semarang: Badan Penerbit Universitas Diponegoro.
[21] Latan, Hengki. 2012. Structural Equation Modeling: Konsep dan Aplikasi Menggunakan Program Lisrel 8.80. Bandung: Alfabeta.
[22] Ghozali, Imam & Fuad. 2010. Structural Equating Modeling: Teori, Konsep, dan Aplikasi dengan Program Lisrel 8.80. Semarang: Badan Penerbit Universitas Diponegoro.
[23] Alwiyah, A., Louangdy, T. T., & Yolandari, A. (2018). Relation of Relationship Between Research Theory and Variable with Management Case Study. *Aptisi Transactions on Management (ATM)*, *2*(1), 70-78.
[24] Harjanto, R., Manurung, E. B. P., & Lestari, A. D. (2018). Optimization of Proposal Management Arrangements as Learning Tools in Scientific Research Activities. *Aptisi Transactions on Management (ATM)*, *2*(1), 55-62.
[25] Sudaryono, S., Sunarya, L., & Maulani, G. (2017). Facility for Customizing Transaction Forms on Master Data Using an Online Accounting System Web For Work Efficiency Company. *Aptisi Transactions on Management (ATM)*, *1*(1), 17-23.