CONTROL OF THE LEARNING PROCESS AT SDN 050753 GEBANG
(Using a Multivariate Analysis Approach)

Febrina Dafit[1], Rizki Nurjehan[2], Siti Quratul Ain[3], Natalia Kristiani Lase[4], Hasratuddin[5]

Basic Education Study Program, State University of Medan

Abstract. The content of this paper is about the control analysis of a process and learning outcomes that take place at SDN 050753 Gebang. The goal is to see whether the product produced from a process is in accordance with what was expected initially, or whether it is still running according to the expected standard or in accordance with the original plan of the product produced. The learning process is a process whose implementation and results must be controlled in order to produce results that are in accordance with the objectives and quality. In this regard, it is interesting to discuss an actual event of authentic data obtained, how to show parties related to the importance of data and how data processed using appropriate statistics, will be able to give us an idea of how a process occurs. For this reason, the authentic data used in this paper is the final exam scores of grade IV students of SDN 050753 Gebang with the subjects of mathematics, Indonesian, English Language, Science, Social Studies and PPKN for the 2019/2020 to 2022/2023 school year.

Keywords: control, process, learning, elementary

Introduction

Multivariate analysis is a statistical method used to understand data structures in high dimensions (Morrison, 1990; Hardle & Simar, 2007; Leps & Smilauer, 1999). Multivariate statistical methods are statistical analysis techniques that treat a group of correlated criteria variables as a system by taking into account the correlation between these variables (Takaredase et al., 2019). Using multivariate analysis, these variables can be examined simultaneously to understand the impact of the resulting process (Sutrisno &; Wulandari, 2018). Many fields such as social sciences, psychology, economics, agriculture, health, and education use multivariate statistics in their research (Wustqa et al., 2018). Multivariate analysis allows researchers to find solutions to more general, or more complex problems or problems that better reflect the real situation. One of the goals of multivariate analysis is to find and interpret the underlying structure or traits of the data.

The content of this paper is about the control analysis of a process and learning outcomes that take place at SDN 050753 Gebang, Langkat Regency, Sumatra Province.

The goal is to see whether the product produced from a process is in accordance with what was expected initially, or whether it is still running according to the expected standard or in accordance with the original plan of the product produced.

Learning is essentially a process, namely the process of organizing, organizing the environment around students so that it can grow and encourage students to carry out the learning process (Rohmah, 2017). Learning is also said to be the process of providing guidance or assistance to students in carrying out the learning process. The learning process is a process whose implementation and results must be controlled so that the results are in accordance with the objectives and quality (Nst et al., 2022). In this regard, it is interesting to discuss an actual occurrence of authentic data, how to show the 2 importance of a data and how data processed using appropriate statistics, will be able to provide an idea of how a process occurs. For this reason, authentic data will be used on the scores of grade IV students of SDN 050753 Gebang, Langkat Regency, North Sumatra Province with the subjects of mathematics, Indonesian, English, Science, Social Studies and PPKN for the 2019/2020 to 2022/2023 school year.

The problem raised in this paper is how is the relationship and relationship of a subject with other subjects using multivariate statistical methods? What are the results of the control of the learning process that runs? The purpose of this article is to investigate and describe the relationships and relationships between subjects covered in the Final Exam, as well as to provide information to interested parties on how to achieve learning process control results at SDN 050753 Gebang, Langkat Regency, North Sumatra Province using multivariate statistical methods.

Discussion

The sampleused for this analysis is the final grade data of grade IV students of SDN 050753 Gebang, Langkat Regency, North Sumatra Province, with the subjects of mathematics, Indonesian, English, Science, Social Studies and PPKN for the 2019/2020 to 2022/2023 school year. The focus of data analysis in this paper is; 1) about the relationship between mathematics, Indonesian, English, Science, Social Studies and PPKN subjects. This was chosen for the 2019/2020 to 2022/2023 school year, because the author wanted to see more interconnected lessons; 2) For the control of the five-year learning process, final exam score data is sent through the Uper Control Limit (UCL) control model.

Data Analysis 2019/2020

The data used for data analysis in 2019/2020 is teaching mop score data consisting of 6subjects, including: Mathematics (X1), Indonesian (X2), English Language (X3), PA (X4), Social Studies (X5) and PPKn (X6) as many as 38 students. Here is a descriptive analysis of the 6 subjects:

Table 1. Descriptive analysis of 2019/ 2020 data

Subject	Math	B.Indo	B. English	IPA	IPS	PPKN
Sum	2923	3160	2844	3209	3228	3145
Mean	76,921053	83,15789	74,842105	84,44737	84,94737	82,76316
Variance	19,534139	8,244666	6,0284495	5,929587	7,834993	5,753201

The table above assumes that the data in the six subjects are normally distributed, this means that teachers have the same ability to deliver 6 subjects. The highest average score is 84.9 4 which is inIPS subjects, whilethe lowest average score for subjects is English which is 74.84. To see the relationship between subjects can be seen in tabel correlation matrix under i ni:

Table 2. Data Correlation Matrix 2019/ 2020

	Math	B.indo	B.ing	IPA	IPS	PPKN
Math	1	0,66334	0,2279525	-0,14981	0,163504	-0,0935
B.Indo	0,6633397	1	0,1263077	-0,07222	-0,11663	-0,1396
B.Ing	0,2279525	0,126308	1	-0,16416	0,010556	-0,0524
IPA	-0,149815	-0,07222	-0,164164	1	0,086817	-0,2266
IPS	0,1635038	-0,11663	0,0105558	0,086817	1	-0,1146
PPKN	-0,093591	-0,13962	-0,052414	-0,22661	-0,11462	1

From thecorrelation above, it can be seen that the highest correlation is 0.66, which is the correlation between Indonesian subjects and mathematics subjects, whilethe lowest correlation is -0.226, which is the correlation between science subjects and PPKN subjects . This data shows that there is a negative correlation value, this shows that if the higher the score of one subject, someother subjects will decrease and vice versa.

Tosee the influence of subjects on other subjects can be seen inan inverse correlation matrix table. Here can be seen the inverse correlation matrix of 6 subjects:

Table 3. Inverse Correlation Matrix 2019/ 2020 data

	Math	B.indo	B.ing	IPA	IPS	PPKN
Math	2,12101015	-1,424039	-0,26473	0,2114372	-0,53156	-0,02721
B.Indo	-1,424039411	2,017380	0,065762	-0,055381	0,494709	0,195991

B.Ing	-0,264726831	0,065761	1,081846	0,157984	0,035095	0,080934
IPA	0,211437195	-0,055380	0,157984	1,1225707	-0,11011	0,26211
IPS	-0,531564631	0,494709	0,035095	-0,110113	1,168722	0,130169
PPKN	-0,027205647	0,195991	0,080934	0,2621102	0,130169	1,103379

Based on the results of the analysisof prediction of subject values usingregression analysis can be explained as follows:

a. The amount of prediction given by each mathematics score against other subjects is:

$$-46{,}125 + 1{,}03_{B.indo} + \ 0{,}22_{B.Ing} - 0{,}18_{IPA} + 0{,}39_{IPS} + 0{,}02_{PPKN}$$

b. The predicted value given by IPA to IPS and PPKN is $98{,}33 + 0{,}053_{IPS} - 0{,}22_{PPKN}$

c. The predicted value given by mathematics to science and English is $66{,}46 + 0{,}37_{B.ing} - \ 0{,}20_{IPA}$

d. The predicted value of Indonesian for social studies and PPKN subjects is $110{,}22 - 0{,}137_{IPS} - 0{,}1855_{PPKN}$

Data Analysis 2020/2021

The data used for this analysis is subject score data consisting of 6 subjects in 2020 /2021, namely: Mathematics (X1), Indonesian (X2), English (X3), Science (X4), Social Studies (X5) and PPKn (X6) as many as 29 students. Here is a descriptive analysis for the 2020/2021 data.

Table 4. Descriptive analysis of data 2020/ 2021

Subject	Math	B.Indo	B. English	IPA	IPS	PPKN
Sum	2298	2417	2202	2498	2455	2483
Mean	79,24138	83,34483	75,93103	86,1379	84,65517	85,62069
Variance	17,76108	6,519704	2,566502	3,69458	6,805418	4,458128

The table above shows that the highest average score is science subjects with a score of 86.14 and the lowest average score isEnglish subjects of 75.93.

To see the relationship between subjects can be seen in tabel correlation matrix under i ni:

Table 5. Data Correlation Matrix 2020/ 2021

	Math	B.indo	B.ing	IPA	IPS	PPKN
Math	1	0,6060	-0,1085	0,0883	-0,1351	-0,1338
B.Indo	0,6060	1	-0,0551	-0,0246	-0,0298	-0,0610

B.Ing	-0,1085	-0,0551	1	0,1772	-0,0401	-0,0186
IPA	0,0883	-0,0246	0,1772	1	-0,0970	0,0310
IPS	-0,1351	-0,0298	-0,0401	-0,0970	1	-0,0246
PPKN	-0,1338	-0,0610	-0,0186	0,0310	-0,0246	1

The table above shows that the highest correlation is mathematics and Indonesian subjects with a correlation value of 0.6060 and the highestis the correlation betweenMathematics and Social Studies subjects, which is -0.1351. Thismenushows that the score between mathematics and social studies subjects has a negative correlation, the higher the math score, the lower the social studies score with a value of 0.1351, and vice versa.

Tosee the influence of subjects on other subjects can be seen inan inverse correlation matrix table. Here can be seen the inverse correlation matrix of 6 subjects:

Table 6. Inverse Correlation Matrix 2020/ 2021 data

	Math	B.indo	B.ing	IPA	IPS	PPKN
Math	1,69524	-1,005795	0,1736401	-0,192182	0,1918014	0,17942246
B.Indo	-1,0058	1,60508	-0,047805	0,130521	-0,078422	-0,04356841
B.Ing	0,17364	-0,047805	1,0544247	-0,200325	0,046019	0,04723373
IPA	-0,19218	0,130521	-0,200325	1,064277	0,0718487	-0,05265331
IPS	0,191801	-0,078422	0,046019	0,071849	1,0334961	0,044934761
PPKN	0,179422	-0,043568	0,0472337	-0,052653	0,0449348	1,024967048

Based on the results of the analysisof prediction of subject values usingregression analysis can be explained as follows:

a. The amount of prediction given by each mathematics score against other subjects is:

$$30,23 + 0,97_{B.indo} - 0,269_{B.Ing} + 0,248_{IPA} - 0,182_{IPS} - 0,211_{PPKN}$$

b. The predicted value given by IPA to IPS and PPKN is $89,91 - 0,070_{IPS} + 0,026_{PPKN}$

c. The predicted value given by mathematics to science and English is $83,878 - 0,37_{B.ing} + 0,243_{IPA}$

d. The predicted value of Indonesian for social studies and PPKN subjects is $92,33 - 0,030_{IPS} - 0,0746_{PPKN}$

Data Analysis 2021/2022

The data used is subject score data consisting of 6 subjects in 2021/2022, including: Mathematics (X1), Indonesian (X2), English (X3), PA (X4), Social Studies (X5) and PPKn (X6) as many as 15 students. Here is a descriptive analysis of the 6 subjects:

Table 7. Descriptive analysis of data 2021/ 2022

Subject	Math	B.Indo	B. English	IPA	IPS	PPKN
Sum	1205	1255	1140	1317	1267	1292
Mean	80,33333	83,66667	76	87,8	84,46667	86,13333
Variance	16,80952	6,952381	3,142857	6,457143	7,409524	2,409524

Tabel above assumes that the data of 6 subjects in 2021/2022 are normally distributed, this means that teachers have the same ability to deliver lessons. The highest average score was 87.8 inscience subjects, while the lowest average score in English was 76. To see the relationship between subjects can be seen in tabel correlation matrix under i ni:

Table 8. Data Correlation Matrix 2021/ 2022

	Math	B.indo	B.ing	IPA	IPS	PPKN
Math	1	0,334773	-0,17689	0,754166	0,567492	0,35167
B.Indo	0,334773	1	-0,106965	0,639641	0,371541	-0,11053
B.Ing	-0,17689	-0,10696	1	-0,25369	-0,26643	-0,07787
IPA	0,754166	0,639641	-0,253694	1	0,55144	-0,01087
IPS	0,567492	0,371541	-0,266432	0,55144	1	0,643511
PPKN	0,35167	-0,11053	-0,077869	-0,01087	0,643511	1

The correlation table above shows that the highest correlation is 0.64, which is the correlation between IPS and PPKN, while the lowest correlation is -0.266, which is the correlation between English and IPS. This data shows that there is a positive and negative correlation value, this shows that if the higher the score of one lesson, several other subjects will decrease and vice versa for correlation such as social studies and PPKN scores, the higher the social studies score, the higher the PPKN score.

Tosee the influence of subjects on other subjects can be seen inan inverse correlation matrix table. Here can be seen the inverse correlation matrix of 6 subjects:

Table 9. Inverse Correlation Matrix 2021/ 2022 data

	Math	B.indo	B.ing	IPA	IPS	PPKN
Math	3,8018	0,5982	-0,1350	-3,8095	0,9152	-1,9117
B.Indo	0,5982	1,9201	-0,1624	-1,4595	-0,4680	0,2745

B.Ing	-0,1350	-0,1624	1,1157	0,3155	0,3125	-0,0813
IPA	-3,8095	-1,4595	0,3155	6,3726	-2,6363	2,9687
IPS	0,9152	-0,4680	0,3125	-2,6363	4,1555	-3,0520
PPKN	-1,9117	0,2745	-0,0813	2,9687	-3,0520	3,6925

The results of the analysis of prediction of subject values using regression analysis are:

a. The predicted value given by each math score against other subjects is: $-131,157 - 0,244_{B.indo} + 0.0821_{B.Ing} + 1,616_{IPA} - 0362_{IPS} + 1,328_{PPKN}$

  b. The predicted value given by IPA to IPS and PPKN is $100,659 + 0,8897_{IPS} - 1,021_{PPKN}$

  c. The predicted value given by mathematics to science and English is $-29,76 + 0,0356_{B.ing} + 1,223_{IPA}$

  d. The predicted value of Indonesian for social studies and PPKN subjects is $109,15 + 00,731_{IPS} - 1,013_{PPKN}$

Data Analysis 2022/2023

The data used for this analysis is subject score data consisting of 6 subjects in 2022/2023, including: Mathematics (X1), Indonesian (X2), English (X3), Science (X4), Social Studies (X5) and PPKn (X6) as many as 11 students. Here is the iptif deskr analysisfor 2022/ 2023 data.

Table 10. Descriptive analysis of data 2022/ 2023

Subject	Math	B.Indo	B. English	IPA	IPS	PPKN
Sum	891	957	924	943	906	923
Mean	81	87	84	85,72727	82,36364	83,90909
Variance	6,6	8,6	6,2	9,618182	12,65455	5,090909

The table above shows that the highest average score is Indonesian subject with a grade of 87 and the lowest average score a isa mathematics subject of 81. To see the relationship between subjects can be seen in tabel correlation matrix under i ni:

Table 11. Data Correlation Matrix 2022/ 2023

	Math	B.indo	B.ing	IPA	IPS	PPKN
Math	1	0,836218	0,281387	0,615004	-0,24073	0,189768
B.Indo	0,836218	1	0,082169	0,241895	-0,27799	0,136018
B.Ing	0,281387	0,082169	1	0,466187	-0,34998	-0,17799
IPA	0,615004	0,241895	0,466187	1	0,154916	0,410535
IPS	-0,24073	-0,27799	-0,349979	0,154916	1	0,689769

PPKN	0,189768	0,136018	-0,177994	0,410535	0,689769	1

The table above shows that the highest correlation is mathematics and Indonesian subjects with a correlation value of 0.8362 and the lowest is the correlation between English and social studies subjects which is -0.3499. This shows that the score between English and social studies subjects has a negative correlation, the higher the English score, the lower the social studies score with a value of 0.3499, and vice versa.

Tosee the influence of subjects on other subjects can be seen inan inverse correlation matrix table. Here can be seen the inverse correlation matrix of 6 subjects:

Table 9. Inverse Correlation Matrix 2022/ 2023 data

	Math	B.indo	B.ing	IPA	IPS	PPKN
Math	9,604771	-6,6119	0,637937	-4,95606	1,18327	0,408659
B.Indo	-6,6119	6,01218	-0,155237	3,066521	0,259951	-1,02889
B.Ing	0,637937	-0,15524	1,829308	-1,44317	0,781892	0,278809
IPA	-4,95606	3,066521	-1,44317	4,521664	-0,85763	-0,99821
IPS	1,18327	0,259951	0,781892	-0,85763	3,059858	-1,87924
PPKN	0,408659	-1,02889	0,278809	-0,99821	-1,87924	2,818066

The results of the analysis of prediction of subject values using regression analysis are:

a. The amount of prediction given by each mathematics score against other subjects is:
$$9,039 + 0,603_{B.indo} - 0,068_{B.Ing} + 0,427_{IPA} - 0,088_{IPS} - 0,048_{PPKN}$$

b. The predicted value given by IPA to IPS and PPKN is $36,482 - 0,213_{IPS} + 0,796_{PPKN}$

c. The predicted value given by mathematics to science and English is $37,69 - 0,007_{B.ing} + 0,512_{IPA}$

d. The predicted value of Indonesian for social studies and PPKN subjects is $66,969 - 0,584_{IPS} + 0,8126_{PPKN}$

Learning Process Control Analysis

To perform a control analysis of the learning process, thefirst control analysis that is carried out is to calculate the determinant of the covariance matrix. The determinants of the data covariance matrix of 6 subjects for the 2019/2020 school year to the 2022/2023 school year can be seen in the table below:

Table 13. Determinants of Covariance Matrix

School Year	Mdet	average	UPL	LCL
Year 2019/2020	51,92	81,179825	95,81193	69,555572
Year 2020/2021	40,36385256	82,488	95,81193	69,555572
Year 2021/2022	40,30	83,066	95,81193	69,555572
Year 2022/2003	44,33057851	84	95,81193	69,555572

Furthermore, for the variability control chart from data from 6 subjects for the 2019/2020 school year to the 2022/2023 school year, it can be seen in the following chart:
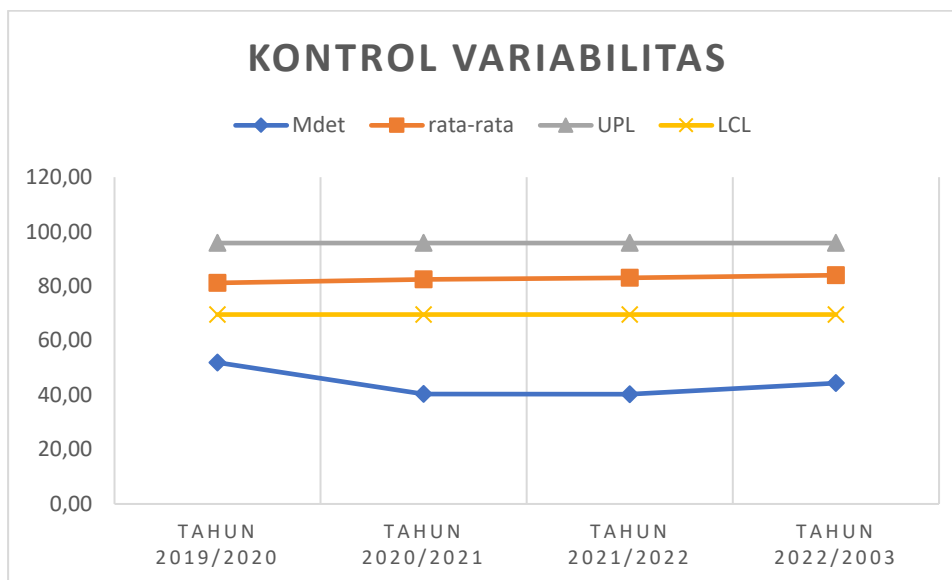

Chart 1. Variability Control

The graph above shows that the control variable line is belowthe UCL line. This means that the learning process of 6 subjects during the period of the 2019/2020 school year to the 2022/2023 school year runs according to the learning outcomes producedn.

Conclusion

a. Correlational between subjects

   1. Final value data 20 19/20 20

      a) In general, of the six subjects, namelym athematicia, b ahasa Indonesia, bahasa I nggris, IPA, IPS and PPKn which were examinedt ahun 20 19/20 20 at SDN 050753 Gebang, the highest average score of student achievement was in social studies subjects which was 84.94 and has a standard deviation of 7.834993. While the average score of student achievement is the lowest 74.84 in English lessons with a standard deviation of 6.0284495.

b) The correlation betweensubjects showed the highest correlation was 0.66, which is the correlation between Indonesian and mathematics, while the lowest correlation was -0.226, which is the correlation between science and PPKN. This data shows that there is a negative correlation value, this shows that if the higher the score of one lesson, some other subjects will decrease and vice versa.

c) The results of regression analysis are used topredict subject values , including:

1) The amount of prediction given by each mathematics score against other subjects is:

$$-46,125 + 1,03_{B.indo} + 0,22_{B.Ing} - 0,18_{IPA} + 0,39_{IPS} + 0,02_{PPKN}$$

2) The predicted value given by IPA to IPS and PPKN is $98,33 + 0,053_{IPS} - 0,22_{PPKN}$

3) The predicted value given by mathematics to science and English is $66,46 + 0,37_{B.ing} - 0,20_{IPA}$

4) The predicted value of Indonesian for social studies and PPKN subjects is $110,22 - 0,137_{IPS} - 0,1855_{PPKN}$

2. Final value data 20 20/20 21

a) In general, of the six subjects, namely mathematiciatics, b ahasa Indonesia, bahasa I nggris, IPA, IPS and PPKn which were examinedt ahun 20 19/20 20 at SDN 050753 Gebang, the highest average score of student achievement was in science subjects , which was 8 6.1 4 and has a standard deviation of 3.69458. While the average score of student achievement is the lowest 75.93 in English lessons with a standard deviation of 2.566502.

b) Thecorrelation between subjects showed the highest correlation was mathematics and Indonesian subjects with a correlation value of 0.6060 and the lowest was the correlation between Mathematics and Social Studies subjects which was -0.1351. Thisshows that the score between mathematics and social studies subjects has a negative correlation, the higher the math score, the lower the social studies score with a value of 0.1351, and vice versa.

c) The results of regression analysis are used topredict subject values , including:

1) The amount of prediction given by each mathematics score against other subjects is:

$$30,23 + 0,97_{B.indo} - 0,269_{B.Ing} + 0,248_{IPA} - 0,182_{IPS} - 0,211_{PPKN}$$

2) The predicted value given by IPA to IPS and PPKN is $89,91 - 0,070_{IPS} + 0,026_{PPKN}$

3) The predicted value given by mathematics to science and English is $83,878 - 0,37_{B.ing} + 0,243_{IPA}$

4) The predicted value of Indonesian for social studies and PPKN subjects is $92,33 - 0,030_{IPS} - 0,0746_{PPKN}$

3. Final value data 20 21/2022

   a) In general, of the six subjects, namely mathematiciatics, b ahasa Indonesia, bahasa I English, IPA, IPS and PPKn which were examinedt ahun 20 19/20 20 at SDN 050753 Gebang, the highest average score of student achievement was in science subjects which was 87.8 and has a standard deviation of 6.457143. While the average score of student achievement is the lowest 76 in English lessons with a standard deviation of 3.142857.

   b) Thecorrelation between subjects showed the highest correlation was 0.64, which is the correlation between social studies and PPKN, while the lowest correlation was -0.266, which is the correlation between English and social studies. This data shows that there is a positive and negative correlation value, this shows that if the higher the score of one lesson, several other subjects will decrease and vice versa for correlation such as social studies and PPKN scores, the higher the social studies score, the higher the PPKN score.

   c) The results of regression analysis are used topredict subject values , including:

      1) The predicted value given by each math score against other subjects is:
      $$-131,157 - 0,244_{B.indo} + 0.0821_{B.Ing} + 1,616_{IPA} - 0362_{IPS} + 1,328_{PPKN}$$

      2) The predicted value given by IPA to IPS and PPKN is $100,659 + 0,8897_{IPS} - 1,021_{PPKN}$

      3) The predicted value given by mathematics to science and English is $-29,76 + 0,0356_{B.ing} + 1,223_{IPA}$

      4) The predicted value of Indonesian for social studies and PPKN subjects is $109,15 + 00,731_{IPS} - 1,013_{PPKN}$

4. Final value data 20 22/2023

a) In general, of the six subjects, namely m athematicia, b ahasa Indonesia, bahasa I English, IPA, IPS and PPKn which were examinedt ahun 20 19/20 20 at SDN 050753 Gebang, the highest average score of student achievement was in the subject of Mathematics, namely 87 and has a standard deviation of 8.6. While the average score of student achievement is the lowest 81 in Mathematics with a standard deviation of 6.6.

b) Thecorrelation between subjects showed the highest correlation was mathematics and Indonesian subjects with a correlation value of 0.8362 and the lowest was the correlation between English and social studies subjects of -0.3499. This shows that the score between English and Social Studies subjects has a negative correlation, the higher the English score, the lower the social studies score with a value of 0.3499, And vice versa.

c) The results of regression analysis are used topredict subject values , including:

1) The amount of prediction given by each mathematics score against other subjects is:

$$9{,}039 + 0{,}603_{B.indo} - 0{,}068_{B.Ing} + 0{,}427_{IPA} - 0{,}088_{IPS} - 0{,}048_{PPKN}$$

2) The predicted value given by IPA to IPS and PPKN is $36{,}482 - 0{,}213_{IPS} + 0{,}796_{PPKN}$

3) The predicted value given by mathematics to science and English is $37{,}69 - 0{,}007_{B.ing} + 0{,}512_{IPA}$

4) The predicted value of Indonesian for social studies and PPKN subjects is $66{,}969 - 0{,}584_{IPS} + 0{,}8126_{PPKN}$

b. Control the learning process

From five years, the final value data from the 2019/2020-2022/2023 time frame analyzed shows that there is a match between the learning process and the results achieved. This is shown by the graph above showing that the control variable line is below the UCL line.

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