

# Web-based application of descriptive statistics for data dispersion analysis to support statistic learning

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## Abstract

Statistics is a branch of science that studies ways of collecting, processing, presenting, analyzing, interpreting and drawing conclusions from data. Descriptive Statistics is a part of statistics that carries out the tasks of collecting data, classifying, processing and presenting quantitative data.

Statistics has a very important and necessary role in various areas of life, so that statistics courses are taught in almost all departments, both exact and non-exact, at various educational institutions. A common problem found in studying statistics courses is that students in non-exact majors are less interested in courses involving numerical data processing, so that learning outcomes for this course are generally relatively low.

With advances in information technology, several statistical applications have been developed, but these applications directly present the final results of data processing without displaying the steps to obtain the final results. This is inadequate from a learning perspective, because students do not get a clear picture of the steps for solving problems based on statistics. This research uses the method waterfall [8] [9] or linear sequential, namely a sequential and systematic software development method consist of : Analysis, Design, Coding and Testing. The result of making this application is an analysis of data dispersion measures consisting of Range, Inter Quartile Range, Quartile Deviation, Average Deviation, Standard Deviation, Variance, Coefficient Variation and Coefficient Quartile. This application will show in detail the steps to solve the problem according to theory, formulas and calculation steps to get the final result. These results will make it easier for students to understand and it is hoped that this course will be presented more interestingly and ultimately increase learning outcomes.

**Keywords:** Web based; Application; Descriptive statistics; Dispersion analysis; Statistics learning

## 1. Introduction

Statistics is a branch of science that studies ways of collecting, processing, presenting, analyzing, interpreting and drawing conclusions from data. Then statistics can be interpreted as a collection of methods and rules regarding the collection, processing, interpretation and drawing conclusions from data in the form of numbers. [1]

Descriptive Statistics is a part of statistics that carries out the tasks of collecting data, classifying, processing and presenting quantitative data [2]. In other words, descriptive statistics only describe or describe the characteristics or traits possessed by a group of data, without generalizing, namely drawing general conclusions based on sample data applied to the population. Meanwhile, Analytical Statistics is a part of statistics that has the same task as descriptive statistics plus analysis, interpretation and drawing conclusions that apply generally. In the world of economics, statistics has a function as a tool in data analysis, forecasting and decision making, especially for economic actors, businesses and

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decision makers [1]. Looking at the function of statistics, it can be seen that statistics has a very important and necessary role in various areas of life. Based on this situation, statistics courses are taught in almost all departments, both exact and non-exact, at various educational institutions [3].

A common problem found in studying statistics courses is that students in non-exacts study programs are less interested in courses involving numerical data processing, so that learning outcomes for these courses are generally relatively low [4].

With advances in information technology, several applications have been developed [5], including statistical applications, but these applications directly present the results without displaying the steps to solve the problem (Figure 1). This is inadequate from a learning perspective, because students do not get an idea of the steps to solving problems based on their knowledge of statistics.

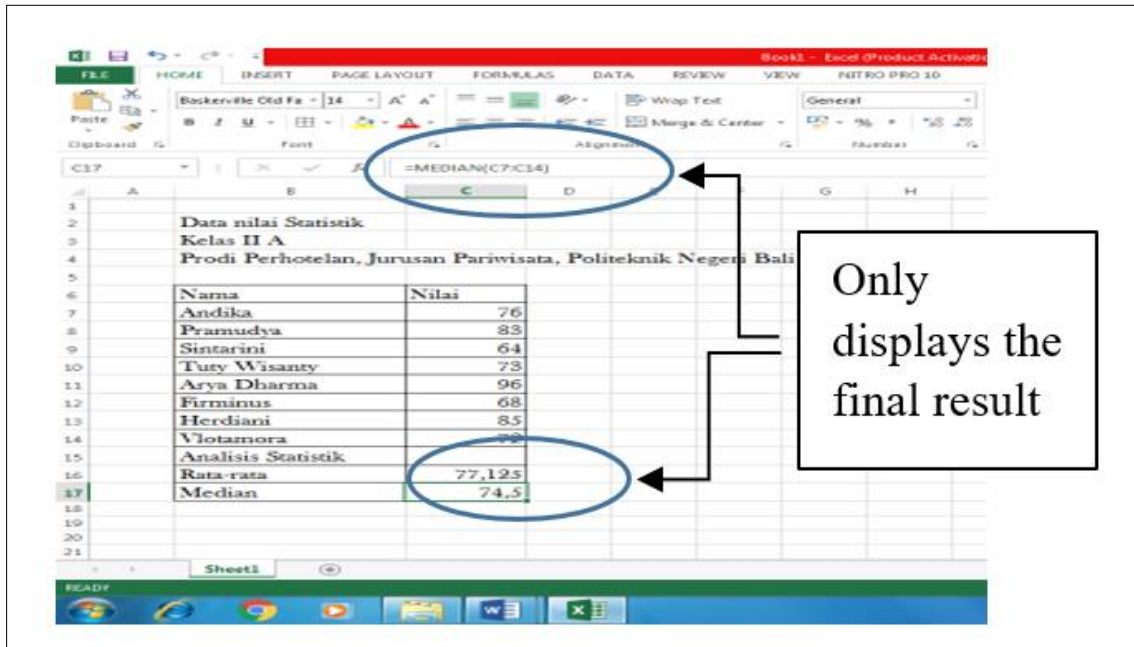


Figure 1 Statistical Applications in Excel

Based on this, we created a web-based application for descriptive statistics for data deviation analysis. In making this application, the steps for solving the problem will be shown in detail according to theory, formulas and calculation steps to get the final result (Figure 2). This will make it easier for students to understand and it is hoped that the presentation of this course will be more interesting and finally increase learning outcomes.



Figure 2 Examples of Research Results

## 2. Materials and methods

The research carried out is in the form of designing a system that produces certain software. This research uses the method Waterfall [8] [9] or linear sequential, namely a sequential and systematic software development method consist of :

- Analysis : The process of gathering software requirements, such as information domain, performance and *interface* required. This stage will produce software requirements specifications [10].
- Design : a multi-step process consisting of data design, architectural design, interface design and procedural details/algorithms that will be applied in the next step, namely creating program codes [11].
- Coding : The process of translating a design into program codes that can be read and executed by a computer machine. In this case, coding will be used using the PHP Triad program which consists of the PHP programming language, MySQL database and Apache server [12][13][14][15][16].
- Testing : When the code is created, testing begins, which consists of internal logic testing and external functional testing to eliminate errors and ensure the results are as required. Apart from that, this stage is also intended so that the resulting system can be used easily by future users [8].

## 3. Results and discussion

### 3.1. Initial Implementation

The beginning of implementation is a display of the identity of this system and the system can begin to be used by providing pathways for 3 (three) types of facilities provided, namely: Data Concentration Measures, Data Dispersion / Deviation Measures and Other Analysis as shown in Figure 3.

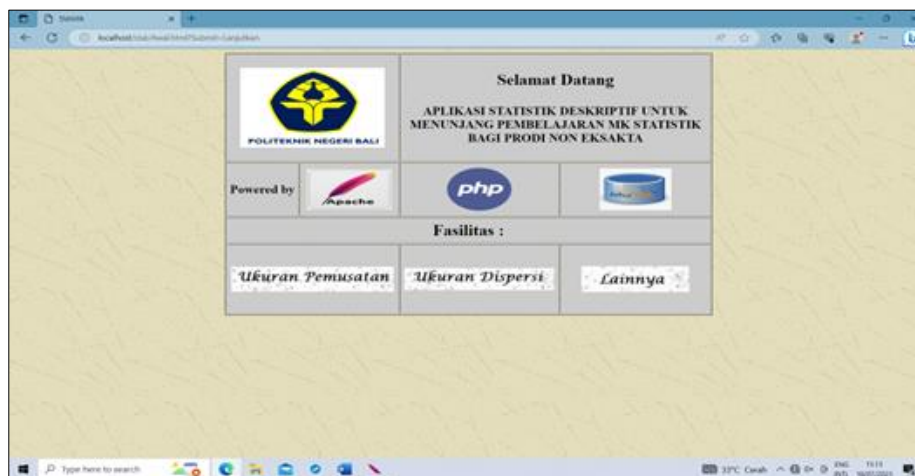


Figure 3 Application initial display

### 3.2. Application Usage Cycle for Data Dispersion Analysis

The Descriptive Statistics application can be used by general users by utilizing the facilities available in each main form according to the category at the start of the application (figure 3).

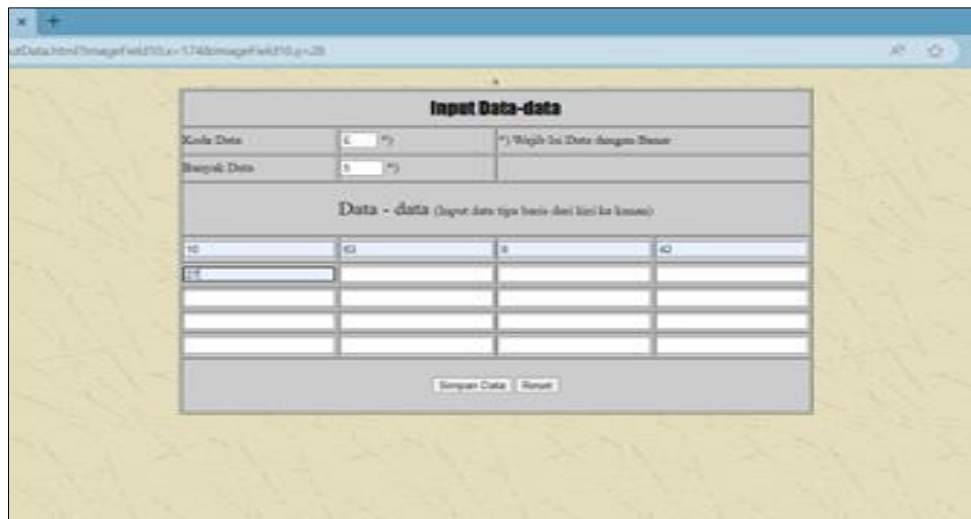
The Data Deviation Measure Analysis facility can be used via the main data deviation measure form as shown in Figure 4 which will be explained in the following stages.



**Figure 4** Main Form Data Dispersion Analysis

### 3.2.1. Input New Statistical Data

The new statistical data input facility is used to enter new data that will be analyzed for data centralization measures. This is done by clicking the "Input Data" facility on the main menu. The form and data entered can be seen in Figure 5.



**Figure 5** Input New Statistical Data

### 3.2.2. View Statistical Data

The statistical data viewing facility is a facility provided for users to see that previously inputted data has been included in the data list, it is also provided for users who wish to obtain information about existing/registered data. A display of the use of the "View Data" facility can be seen in Figure 6.

Daftar Data Tersimpan																					
Kode Data	Banyak Data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	4	10	5	15	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	5	26	11	8	16	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	6	16	63	27	42	10	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	8	36	27	4	15	27	8	10	45	0	0	0	0	0	0	0	0	0	0	0	0
E	5	10	63	8	42	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 6 View Statistical Data

3.2.3. Using the Data Deviation Analysis Facility

In data deviation analysis, several facilities are available that can be used according to user needs, namely: Range, Inter Quartile Range (IQR), Quartile Deviation (QD), Average Deviation, Standard Deviation, Variance, Coefficient of Variation and Coefficient of Quartile Variation. The following explains one by one the use of these facilities.

Start Using

- Select/click the analysis menu available from the main menu for data dispersion measures (figure 4).
- Next, a list of existing data will be displayed that will be analyzed. Select the data to be extracted by clicking "Select" on the available data (figure 7).

Daftar Data Tersimpan																						
Kode Data	Banyak Data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
A	4	10	5	15	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pilih
B	5	26	11	8	16	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pilih
C	6	16	63	27	42	10	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pilih
D	8	36	27	4	15	27	8	10	45	0	0	0	0	0	0	0	0	0	0	0	0	Pilih
E	5	10	63	8	42	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pilih

Figure 7 Selecting Data to Analyze

- The results obtained will be explained in the next stages.

In the results obtained, the following can be seen:

- Title: Name of the analysis carried out
- Theory: is a theory used as a basis for analysis.
- Formula: is the implementation of theory in the form of equations and mathematical operations based on the theory.



- Data and calculations: the data that is analyzed, the steps in the calculation operations that are carried out to obtain the final results of the required analysis.
- Returning to the main analysis form, there is a "Back" menu which can be used to return to the main menu.
- For other data deviation analysis needs, the sequence of steps above can be reused.

#### Data Deviation Analysis Results

- Range (R)

Range is a measure commonly called the spread, namely the difference between the largest value and the smallest value in a data series. The results obtained are as shown in Figure 8.

Range / Rentang / Sebaran (R)	
Teori	Range adalah suatu ukuran yang biasa disebut rentang / sebaran, yaitu selisih antara nilai yang terbesar dengan nilai yang terkecil dari suatu kelompok data.
Rumus	$R = X_{max} - X_{min}$
Data dan Hitungan	Data : 10 - 63 - 27 - 42 - 10 - 26 - Data terbesar = $X_{max} = 63$ Data Terkecil = $X_{min} = 10$ $R = X_{max} - X_{min} = 63 - 10 = 53$
Kembali	

**Figure 8** Range Analysis Results

- Inter Quartile Range (IQR) dan Quartile Deviation (QD)

Inter Quartile Range (IQR) / quartile distribution, which is a measure that is the difference between the value of the 3rd quartile (Q3) and the value of the 1st quartile (Q1).

Quartile Deviation is the value that is half the difference between Q<sub>3</sub> with Q<sub>1</sub>. The results obtained are as shown in Figure 9.

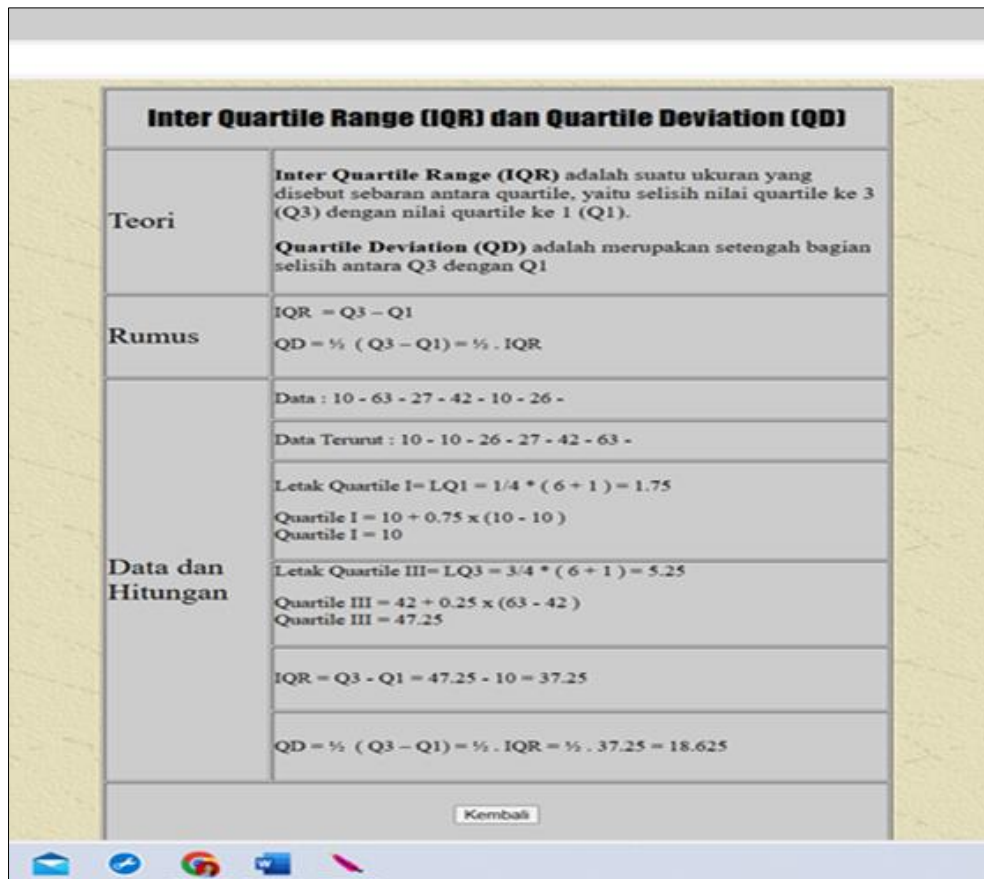


Figure 9 IQR and QD Analysis Results

- Average Deviation (AD)

Average Deviation is the average deviation value. The results obtained are as shown in Figure 10.

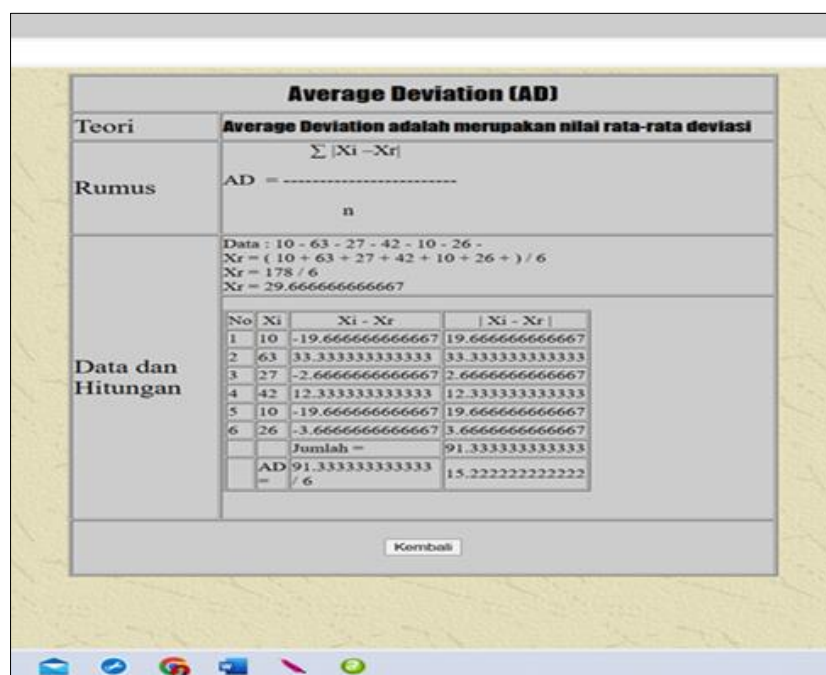
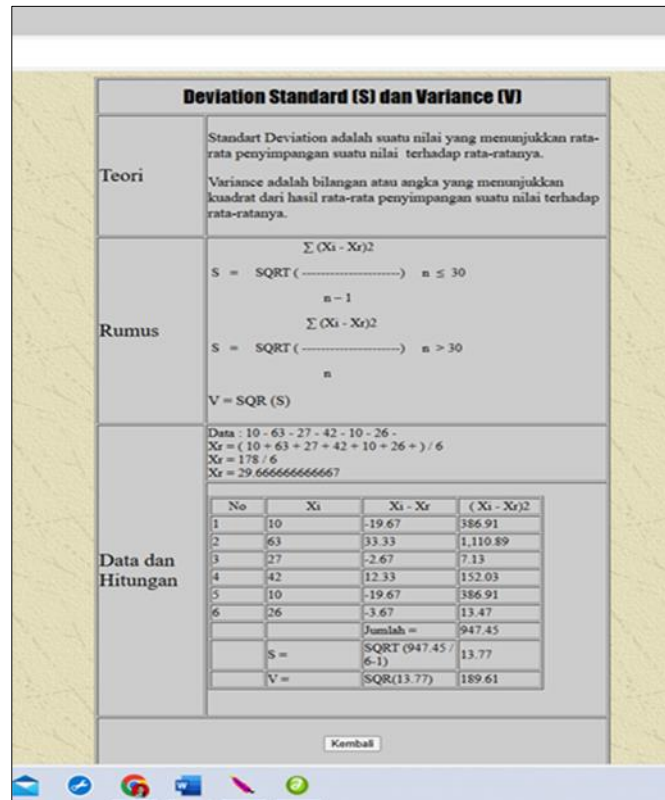


Figure 10 Average Deviation Analysis Results

- Standard Deviation (S) and Variance (V)

Standard Deviation is a value that shows the average deviation of a value from the average.

Variance is a number or figure that shows the square of the average deviation of a value from the average. The results obtained are as shown in Figure 11.



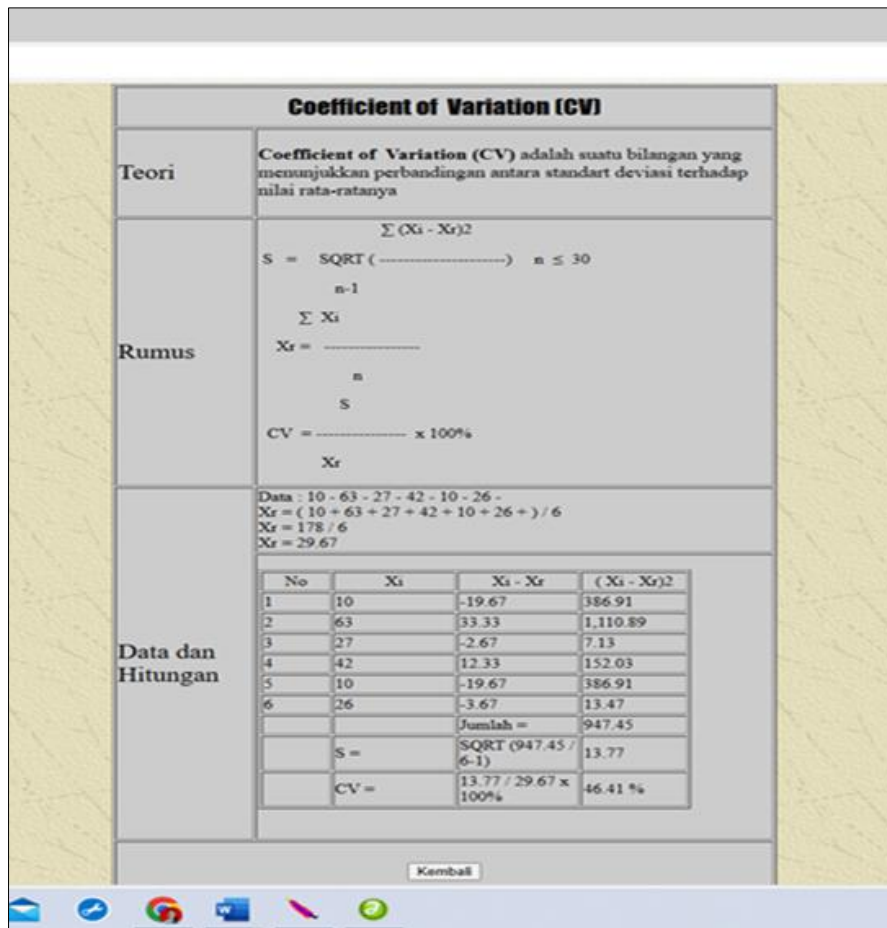
**Figure 11** Results of Standard Deviation and Variance Analysis

- Coefficient of Variation (CV)

Coefficient of Variation (CV), namely: is a number that shows the comparison between the standard deviation and the average value.

The results obtained are as shown in Figure 12.





**Figure 12** Coefficient of Variation (CV) Analysis Results

- Coefficient of Quartile Variation (CQV)

Coefficient of Quartile Variation (CQV) is a value obtained from a comparison between the differences in Q<sub>3</sub> with Q<sub>1</sub> to the total value Q<sub>3</sub> and Q<sub>1</sub>.

The results obtained are as shown in Figure 13.

<b>Coefficient of Quartile Variation (CQV)</b>	
<b>Teori</b>	<b>Coefficient of Quartile Variation (CQV)</b> adalah suatu bilangan yang diperoleh dari perbandingan antara selisih Q3 dengan Q1 terhadap jumlah nilai Q3 dan Q1.
<b>Rumus</b>	$\text{CQV} = \frac{(Q3 - Q1)}{(Q3 + Q1)} \times 100\%$
<b>Data dan Hitungan</b>	Data : 10 - 63 - 27 - 42 - 10 - 26 - Data Terurut : 10 - 10 - 26 - 27 - 42 - 63 - Letak Quartile I= $LQ1 = 1/4 * (6 + 1) = 1.75$ Quartile I = $10 + 0.75 * (10 - 10)$ Quartile I = 10 Letak Quartile III= $LQ3 = 3/4 * (6 + 1) = 5.25$ Quartile III = $42 + 0.25 * (63 - 42)$ Quartile III = 47.25 CQV = $(Q3 - Q1) / (Q3 + Q1) \times 100\%$ = $(47.25 - 10) / (47.25 + 10) \times 100\%$ = 78.84 %
<input type="button" value="Kembali"/>	

**Figure 13** Coefficient of Quartile Variation (CQV) Analysis Results

#### 4. Conclusions

In the data deviation analysis application, several facilities are available that can be used according to user needs, namely: Range, Inter Quartile Range, Quartile Deviation, Average Deviation, Standard Deviation, Variance, Coefficient Variation dan Coefficient Quartile.

Each analysis element is equipped with a title, theory, formula and data along with calculation steps to obtain final results, which are not available in other statistical applications. This is a specialty of this application because it will make it easier to understand and analyze the required statistics.

#### Compliance with ethical standards

##### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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