Combating Hoax and Misinformation in Indonesia Using Machine Learning: What is Missing and Future Directions

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Abstract – Data analysis is essential for gaining insights and making informed decisions. A crutial step in data analysis is data processing, which involves preparing and filtering raw data to ensure accuracy, consistency, and structure. While Microsoft Excel is commonly used for data processing, it is susceptible to human errors and has limitations in handling large datasets. Python provides an alternative by automating data processing through scripts executed by the interpreter. The superior software for data processing is obtained by comparing the computer resource utilization based on statistical theory approach, Wilcoxon signed-rank test. This test is appropriate because it does not require the assumption of a normal distribution, providing flexibility in comparing computer resource utilization between Microsoft Excel and Python. Microsoft Excel and Python proceed *.csv and *.xlsx files, then Task Manager recorded the data of computer resource utilization for each processing step. The Wilcoxon signed-rank test analyzes the data and evaluating two hypotheses. H0 (there is no any significant differences in computer resource utilization between Microsoft Excel and Python are calculated for each data processing) and H1 (there is significant differences in computer resource utilization between Microsoft Excel and Python are calculated for each data processing). The sum of ranks in Wilcoxon test are compared to the critical value from the Wilcoxon distribution table to determine the accepted hypothesis. Based on the Wilcoxon test results, hypothesis H1 is accepted, indicating a significant difference in computer resource utilization between Microsoft Excel and Python.

Keywords: Data Processing; Python; Microsoft Excel; Wilcoxon; Computer Resource Utilization

I. INTRODUCTION

Data has become indispensable in modern society, permeating every aspect of daily life and driving decisionmaking processes across industries. In today's interconnected world, organizations rely on data to understand customer behavior, enhance efficiency, and gain a competitive edge (Cuenca et al., 2021). Data provides invaluable insights that help businesses understand consumer preferences, market trends, and operational inefficiencies (Menghinello et al., 2020). This understanding allows companies to tailor their products and services to better meet customer needs and improve overall efficiency. Data also drives innovation by revealing patterns and connections that were previously unseen, leading to the development of new technologies, products, and services. Effective collection, analysis, and utilization of data are paramount for driving progress and shaping the future.

Data analysis is crucial for extracting valuable insights and making informed decisions across various domains (Fanelli et al., 2023). It enables organizations to understand patterns, trends, and correlations within their datasets, unlocking opportunities for optimization, innovation, and strategic planning. By employing statistical methods, machine learning algorithms, and visualization techniques, data analysis helps uncover hidden patterns, identify outliers, and predict future trends, thereby empowering businesses to improve efficiency, enhance customer experiences, and drive growth (Menghinello et al., 2020). Numerous tools are available for data analysis, ranging from traditional spreadsheet software like Microsoft Excel (Sousa et al., 2021) to advanced platforms such as Python and R programming languages with libraries like Pandas, NumPy, and scikit-learn, as well as specialized tools like Tableau and Power BI for data visualization (Rahmany et al., 2020). These tools offer diverse functionalities to handle various data types, perform complex analyses, and create compelling visualizations, catering to the diverse needs of analysts and decision-makers alike.

Before data analysis, data processing is a critical step that involves preparing and refining raw data to make it suitable for analysis (Fanelli et al., 2023). This process ensures that the data is accurate, consistent, and structured in a way that facilitates meaningful analysis. This process typically includes data collection from diverse sources, data cleaning to address errors and inconsistencies, data integration to merge disparate datasets, data transformation to standardize formats and apply necessary calculations, and finally, data storage in suitable repositories for easy access. Data processing is generally conducted using Microsoft Excel (Sousa et al., 2021).

However, using Microsoft Excel for data processing often encounters several issues. Microsoft Excel tends to slow down when processing very large datasets and sometimes causes the program to crash or stop functioning, requiring it to be reloaded. Additionally, Microsoft Excel is prone to human errors, such as inputting data incorrectly and improper data processing procedures. Another alternative for data processing is using the Python programming language (Mckinney, 2022). Python enables automated data processing using scripts executed by an interpreter. One of the commonly used Python libraries for data processing is Pandas.

The use of Python as an alternative to Microsoft Excel in data processing is discussed in Crowe et al., n.d article. Crowe et al., n.d. article explores the consistency of data obtained from financial data processing based on Microsoft Excel and Python. The article indicates data consistency between Microsoft Excel and Python after data processing. In addition, Mansour et al., 2024 article also discusses the use of Python as an alternative to Microsoft Excel in financial modeling. This article uses runtime as a parameter to assess the efficiency of using Microsoft Excel and Python in financial modeling. The final results show that Python improves efficiency by more than 90%. A new approach can be taken to measure the performance of Microsoft Excel and Python in data processing by monitoring computer resource utilization. Computer resource utilization is a crucial factor determining the efficiency of both Microsoft Excel and Python (Sun et al., 2021). Therefore, this research assesses the efficiency of Microsoft Excel and Python in data processing by testing their computer resource usage.

Analyzing computer resource usage to compare Microsoft Excel and Python for data processing is essential for making an informed choice between the two tools (Sun et al., 2021). By monitoring central processing unit (CPU) and graphical processing unit (GPU) utilization during data processing tasks, organizations can gain insights into the performance characteristics and resource requirements of each tool (Sousa et al., 2021). For Microsoft Excel, resource analysis may reveal limitations in handling large datasets or complex calculations, leading to sluggish performance or system crashes. In contrast, Python's resource usage analysis might highlight its efficient memory management, multi-threading capabilities, and scalability for processing large volumes of data. Additionally, examining resource usage patterns over time can help identify trends and optimize resource allocation strategies for both Excel-based and Python-based data processing workflows. Ultimately, leveraging insights from computer resource usage analysis enables organizations to select the tool that best aligns with their performance requirements, scalability needs, and resource constraints for effective data processing.

One of the tools used for analyzing computer resource usage is Task Manager (Essien & Constant Umo, 2024). Task Manager is a system monitoring utility provided by Microsoft Windows operating systems. It offers real-time information about the processes and programs running on a computer, as well as the overall performance of the system. Users can view details information about CPU and GPU utilization for each process. Task Manager also provides options to end tasks, start new tasks, and monitor system services.

Applying the Wilcoxon signed-rank test further enhances the comparison between Microsoft Excel and Python for data processing (Dao, 2022). This statistical analysis evaluates the differences in resource usage between the two tools systematically (Walpole & Myers, 2023). By conducting the Wilcoxon test on CPU and GPU utilization data collected during processing tasks, organizations can determine if there are statistically significant disparities in resource utilization. If the test reveals significant differences, it provides quantitative evidence to support the selection of one tool over the other based on resource efficiency. Moreover, the Wilcoxon test allows for a nuanced understanding of which aspects of resource usage contribute most to performance variations between Excel and Python.

The computer resources could be monitored to determine the performance of each resource, such as Python's scalability and efficient memory management compared to potential challenges in Microsoft Excel with handling a process. This comprehensive approach empowers organizations to make data-driven decisions when choosing the most suitable tool for their specific data processing needs, ensuring optimal performance and resource utilization in their workflows.

II. METHODS

This research was conducted by collecting testing data for computer resource utilization in data processing using both Microsoft Excel (Sousa et al., 2021) and Python (Molin, 2019). The tested data processing tasks included reading CSV files, reading XLSX files, using formulas and IF logic functions, pivot tables, and saving data in XLSX format. Each data processing task was tested with computer resource utilization parameters, including CPU and GPU, which were observed in the Task Manager software (Martyshkin, 2020). This data was recorded in tables and

analyzed using the Wilcoxon signed-rank test (Hogg et al., 2019). To perform the Wilcoxon test, hypotheses were formulated: the null hypothesis (H_0) stating that there is no significant difference, and the alternative hypothesis (H_1) stating that there is a significant difference. The results of the Wilcoxon test consist of a test value obtained by comparing the smallest sum of ranks with the Wilcoxon test table. This result is compared against the critical value obtained using the Wilcoxon distribution table, shown in Table I (Hogg et al., 2019), to determine which hypothesis is accepted. If H_1 is accepted, then the superior software for data processing can be determined by calculating the highest sum of ranks. Figure 1 illustrates the flowchart of the research methodology employed to analyze the computer resource usage of Microsoft Excel and Python in data processing.



Figure 1. Computer Resource Utilization of Microsoft Excel and Python in Data Processing Analyze Process

2.1 Data Processing Using Microsoft Excel

Microsoft Excel is spreadsheet software used to manage, analyze, and visualize data in table form (Jelen & Syrstad, 2022). With Microsoft Excel, users can create spreadsheets consisting of rows and columns to store data and apply various formulas and functions to perform mathematical calculations and data analysis. Microsoft Excel can read files in *.csv and *.xlsx formats. Commaseparated value (CSV) is a simple text format used for Microsoft Excel data in tabular form, with each row representing a record and each value separated by a comma or other delimiter. CSV files are widely used because of their simplicity and can be read by various applications such as Microsoft Excel and Python. Figure 1 (Peng & Li, 2017) illustrates Microsoft Excel file in *.csv format. On the other hand, *.xlsx is a specific file format from Microsoft Excel for data in a more complex spreadsheet format, including text, numbers, formulas, and cell formatting. *.xlsx format can also store worksheets with multiple sheets, charts, and other objects, and provide support for more complex layout and formatting settings. Figure 2 (Kaewrat et al., 2019) illustrates Microsoft Excel file in *.xlsx format.



Figure 3. Example of Microsoft Excel File in *.xlsx Format (Kaewrat et al., 2019)

The use of formulas and IF logical functions is applied to multiple columns in Microsoft Excel. The formulas and functions are written on the first row of each column. Some formulas applied include LEFT and RIGHT, used for extracting characters from a cell within a column, as well as combining two columns using the '&' operator. Computer resource usage is measured when the autofill feature is used to automatically copy formulas or data to related cells. Meanwhile, vertical lookup is performed separately using the VLOOKUP function. Microsoft Excel also features pivot tables, enabling users to quickly and easily summarize, analyze, and aggregate data in table format. With Pivot Table, users can swiftly organize and analyze data in various ways, including subtotal calculations, crosstab analysis, and generating informative data-based reports. Pivot Table allows users to quickly change data perspectives and explore hidden patterns and trends, making it a valuable tool for in-depth data analysis.

Microsoft Excel can be saved in *.XLSX file format, designed to store information in a complex spreadsheet format. The *.XLSX format provides various features including storing text, numbers, formulas, and complex cell layout and formatting settings. *.XLSX also supports storing worksheets with multiple sheets, charts, objects, and further layout settings. By using the *.XLSX format, users can save their data in well-structured files compatible with newer versions of Microsoft Excel, facilitating sharing and collaboration with other users.

2.2 Data Processing Using Python

Python is one of the alternatives that can be used for data processing (Molin, 2019). One of the Python libraries commonly used for data processing is Pandas. Pandas provide powerful data structures such as series and data frames. The series data structure is a one-dimensional array with labels that allow flexible indexing and is similar to columns in Microsoft Excel spreadsheets. Meanwhile, the data frame is a two-dimensional data structure in the form of a table, with each column called a series. This allows users to store and manipulate data in a format similar to Microsoft Excel spreadsheets. These data structures enable users to easily load, clean, and manipulate data.

Python scripts can be written using Jupyter Notebook running on Visual Studio Code (Molin, 2019). Jupyter Notebook is an application used in data development due to its ability to combine code, visualization, and narrative in one interactive document. Using Jupyter Notebook provides an interactive environment that allows users to run Python code step by step, view results instantly, and include narrative text, visualizations, and explanatory notes in one easily accessible and shareable document. Jupyter Notebook has a processing engine that can execute code interactively behind the scenes, known as a kernel. The kernel is responsible for executing code written in Jupyter Notebook, generating output, and storing all variables and environments in a specific session. Python can read Microsoft Excel files in CSV or XLSX formats. Python reads CSV files using the read csv function, while XLSX files are read using the read excel function. Python can also execute formulas and IF logical functions and can be applied automatically to all cells in a column. Some formulas in Microsoft Excel that are used to extract characters from a cell in a column can be executed using the str() function in Python. Vertical lookup can also be performed using the merge() function. Python also has the pivot table() function used to quickly and easily summarize, analyze, and aggregate data in table format. Additionally, Python can save its data frame to a Microsoft Excel file in XLSX format using the to excel () function.

2.3 Computer Resource Utilization Data Collection

The utilization of computer resources by Microsoft Excel and Python in data processing is monitored using Task Manager (Essien & Constant Umo, 2024). Task Manager provides information about hardware resource utilization and performance related to individual applications and

processes on the computer system. This information includes information about the utilization of the central processing unit (CPU) and graphic processing unit (GPU) (Sun et al., 2021). The computer resource utilization data was tested and recorded in a table.

CPU responsible for processing data, instructions, and controlling system operations (Ledin, 2020). It consists of the control unit, which regulates computer operations, and the arithmetic/logic unit, which performs calculations and logical operations. The efficiency of CPU usage can significantly impact the overall performance of the computer system.

GPU is a computer component initially designed for graphics processing and image rendering, but it is now frequently utilized in data processing due to its high capability in handling parallel processing (Ledin, 2020). GPUs have hundreds to thousands of cores that can work simultaneously, making them ideal for handling computationally intensive tasks such as machine learning, deep learning, and big data analysis. The ability of GPUs to process many operations concurrently allows for significant acceleration in data processing compared to CPU, which has fewer cores and works serially. Therefore, in data analysis and processing, GPUs are a crucial resource that enhances computational efficiency and speed.

The utilization of computer resources (CPU and GPU) are test for tasks such as reading *.csv format files, reading *xlsx files, using formulas and IF logic functions, pivoting tables, merging files, and saving *.xlsx files. The utilization of computer resources for *.csv files reading, data sorting, and column data replacement is obtained by averaging these data processing processes across 6 *.csv files. The utilization involves applying formulas and IF logical functions, which include character removal from a column cell, character extraction from a column cell, column merging, IF logic usage, and simultaneous vertical lookup. The utilization of computer resources for pivot table data processing is obtained by averaging 12 data summarization processes with different files and indices. The utilization for file merging data processing is obtained by averaging data processing processes across 4 worksheets in each *.csv file. Meanwhile, the utilization for *.xlsx file storage data processing is obtained by averaging the storage of 4 *.xlsx files.

2.4 Wilcoxon Signed-Rank Test

The Wilcoxon signed-rank test is a non-parametric comparative statistical method used to compare two related samples (Hogg et al., 2019). The Wilcoxon signed-rank test provides a more flexible approach to comparing the usage of computer resources by Microsoft Excel and Python. The Wilcoxon test does not rely on assumptions that the data is normally distributed or has the same variance between the two data groups. The usage data of computer resources by Microsoft Excel and Python may have unexpected distributions or different variabilities.

In its application, researchers formulate a null hypothesis (H0) stating that there is no significant difference between the two compared conditions or treatments and an alternative hypothesis (H1) stating that there is a significant difference between the two compared conditions or treatments (Walpole & Myers, 2023). The significance level is determined in the Wilcoxon signed-rank test as a measure indicating whether there is a significant difference. The significance level represents the percentage of rejecting the null hypothesis. The significance level is compared against the sample size using the Wilcoxon distribution table, as shown in Table I (Walpole & Myers, 2023), for critical values.

Table I.	Wilcoxon	Distribution	Table
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n	0.005	0.010	0.025	0.050	0.100
5	-	-	-	-	0
6	-	-	-	0	2
7	-	-	0	2	3
8	-	0	2	3	5
9	0	1	3	5	8
10	1	3	5	8	10
11	3	5	8	10	13
12	5	7	10	13	17
13	7	9	13	17	21
14	9	12	17	21	25
15	12	15	20	25	30
16	15	19	25	29	35
17	19	23	29	34	41
18	23	27	34	40	47
19	27	32	39	46	53
20	32	37	45	52	60

The Wilcoxon signed-rank test can be calculated from this data. The result is compared with critical values from the Wilcoxon distribution corresponding to the sample size and selected significance level to determine whether the null hypothesis is rejected or not. The significance value indicates the percentage of rejecting the null hypothesis. If the test value is smaller than the critical value, then the null hypothesis is rejected, and the conclusion is made that there is a significant difference between the two groups.

In the Wilcoxon signed-rank test, the differences between the measured values in each pair are recorded with either a positive or negative sign (Walpole & Myers, 2023). A positive difference occurs when the second value is greater than the first, while a negative difference occurs when the second value is smaller than the first. These differences are ranked based on the magnitude of absolute values (smaller differences receive lower ranks, and so on). In the Wilcoxon signed-rank test, if there are ties (i.e., identical differences) among several pairs of values, the differences receive the same rank. In such cases, tied ranks are assigned by averaging the ranks that would have been assigned if the differences were not tied.

The ranks of the absolute differences are summed separately for positive and negative differences. The sum of ranks with the smaller value between positive and negative differences is used as the Wilcoxon test statistic. This statistic is then compared against critical values to determine acceptance of the null hypothesis. If the Wilcoxon test statistic is smaller than the critical value, the null hypothesis is rejected, indicating a significant difference between the two groups.

III. RESULTS AND DISCUSSION

The data on computer resource usage by Microsoft Excel and Python is analyzed using the Wilcoxon signedrank test method. This method uses the null hypothesis and the alternative hypothesis to determine the significance of the difference. In this research, the null hypothesis (H0) states that there is a significant difference between Microsoft Excel and Python computer resource utilization during data processing. The alternative hypothesis (H1) states that there is a significant difference between Microsoft Excel and Python computer resource utilization during data processing. This hypothesis is rejected or accepted by comparing the test statistic result from the Wilcoxon signed-rank test with the critical value obtained based on the significance level and sample size. The significance level and sample size are matched using the Wilcoxon distribution table. A Significance level of 0.05 is used with a sample size of 10. Based on the Wilcoxon distribution table, the critical value used is 8. This critical value is compared against the smaller of the sums of positive and negative ranks. The results of the Wilcoxon test can be seen in Table II.

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Ex	Pv						
	- 5	KD	AD	ADR	PSR	NSR	
CPU (%)							
19.78	8.48	11.30	11.30	7	7		
15,70	15.10	0.60	0.60	1	1		
89.55	15.30	74.25	74.25	10	10		
87.78	14.41	73.37	73.37	9	9		
50.67	16.07	34.60	34.60	8	8		
GPU (%)							
9.30	5.65	3.65	3.65	3	3		
0.4	6.60	-6.20	6.20	5		5	
8.4	7.50	0.90	0.90	2	2		
10.75	5.1	5.65	5.65	4	4		
15.67	5.9	9.77	9.77	6	6		
30.80	10.01						
					50	5	
	19.78 15.70 89.55 87.78 50.67 9.30 0.4 8.4 10.75 15.67 30.80	CPU 19.78 8.48 15.70 15.10 89.55 15.30 87.78 14.41 50.67 16.07 9.30 5.65 0.4 6.60 8.4 7.50 10.75 5.1 15.67 5.9 30.80 10.01	CPU (%) 19.78 8.48 11.30 15.70 15.10 0.60 89.55 15.30 74.25 87.78 14.41 73.37 50.67 16.07 34.60 GPU (%) 9.30 5.65 3.65 0.4 6.60 -6.20 8.4 7.50 0.90 10.75 5.1 5.65 15.67 15.9 9.77 30.80 10.01	CPU (%) 19.78 8.48 11.30 11.30 15.70 15.10 0.60 0.60 89.55 15.30 74.25 74.25 87.78 14.41 73.37 73.37 50.67 16.07 34.60 34.60 9.30 5.65 3.65 3.65 0.4 6.60 -6.20 6.20 8.4 7.50 0.90 0.90 10.75 5.1 5.65 5.65 15.67 5.9 9.77 9.77 30.80 10.01	CPU (%) 19.78 8.48 11.30 11.30 7 15.70 15.10 0.60 0.60 1 89.55 15.30 74.25 74.25 10 87.78 14.41 73.37 73.37 9 50.67 16.07 34.60 34.60 8 CPU (%) 9.30 5.65 3.65 3.65 3 0.4 6.60 -6.20 6.20 5 8.4 7.50 0.90 0.90 2 10.75 5.1 5.65 5.65 4 15.67 5.9 9.77 9.77 6 30.80 10.01	CPU (%) 19.78 8.48 11.30 11.30 7 7 15.70 15.10 0.60 0.60 1 1 89.55 15.30 74.25 74.25 10 10 87.78 14.41 73.37 73.37 9 9 50.67 16.07 34.60 34.60 8 8 CPU (%) 9.30 5.65 3.65 3 3 0.4 6.60 -6.20 6.20 5 8.4 7.50 0.90 0.90 2 2 10.75 5.1 5.65 5.65 4 4 15.67 5.9 9.77 9.77 6 6 30.80 10.01 55 5.65 5 5	

Explanation of Columns:

Ex : Microsoft Excel's CPU and GPU utilization

Py : Python's CPU and GPU utilization

RD : Relative Difference

AD : Absolute Difference

ADR : Absolute Difference Rank

PSR : Positive Sign Rank

NSR : Negative Sign Rank

The difference in Table II is calculated by subtracting the value of Microsoft Excel from Python. Thus, positive ranks indicate Microsoft Excel, while negative ranks indicate Python. Based on the sum of positive and negative ranks, the smallest sum is 5, which comes from the sum of negative ranks. This smallest sum is smaller than the critical value determined, which is 8. Therefore, the null hypothesis (H0) stating no significant difference is rejected, and the alternative hypothesis (H1) stating a significant difference is accepted. With the acceptance of hypothesis H1, it is proven that there is a significant difference between Microsoft Excel and Python in terms of computer resource usage for data processing. Based on the average computer resource usage shown in Table 2, it is evident that Microsoft Excel has a much higher average computer resource usage compared to Python, at 30.80%. On the other hand, Python demonstrates significantly lower average computer resource usage compared to Microsoft Excel, at 10.01%. This indicates that Python is superior in terms of computer resource efficiency for data processing compared to Microsoft Excel.

IV. CONCLUSION

Microsoft Excel and Python are software that is often used for data processing. Microsoft Excel has limitations in terms of speed and smoothness in data processing. Therefore, the Python programming language can be used as an alternative. One of the factors that determine the performance of Microsoft Excel and Python in data processing is the utilization of computer resources. The utilization of computer resources is analyzed using Wilcoxon signed-rank test to determine the accepted hypothesis.

Based on the Wilcoxon test results in Table II, it can be concluded that there is a significant difference in the utilization of computer resources for data processing between Microsoft Excel and Python. This is indicated by the test value of 5 obtained from the smallest sum of ranks, which is the negative rank. This test value is significantly smaller than the critical value determined based on the sample size and significance level, which is 8. With the acceptance of hypothesis H1, it is proven that there is a significant difference between Microsoft Excel and Python in terms of computer resource usage for data processing. Based on the average computer resource utilization, it can also be concluded that Python is superior in computer resource efficiency compared to Microsoft Excel. This is evidenced by Microsoft Excel's average computer resource utilization in data processing at 30.80%, whereas Python's average computer resource usage in data processing is 10.01%.

Further research can explore the random-access memory and disk utilization needed by Microsoft Excel and Python during data processing. The goal is to gather information about the efficiency of memory and disk usage between the two platforms, complementing the analysis of CPU and GPU utilization efficiency already conducted.

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