ASSIGNMENT 2 : Multi Criteria Decision Making

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Task: The assignment is to build a small system (with a decision model) for ONE selected (out of 3) scenario. For each scenario, assume that there are 4 choices to select. For for example, for scenario 2, it means that there are 4 software tools to choose from.

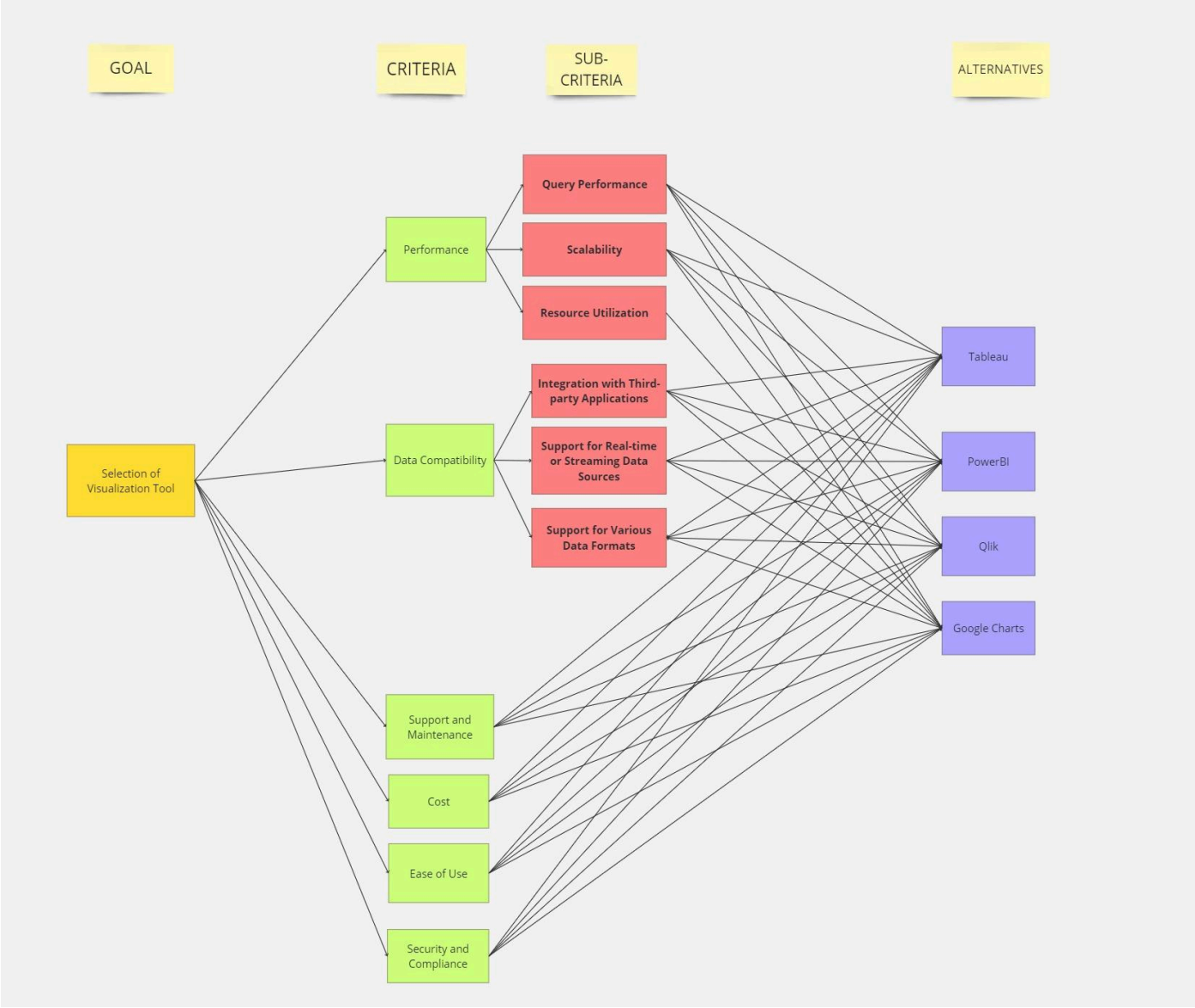
Evaluating different data visualization software tools.

Decision Hierarchy:

Here, I have created a decision hierarchy starting from left to right as seen in the figure.

- Goal: Selection of Visualization Tool
- Criteria:
    - Performance:
        - Sub-criteria:
            - Query Performance
            - Scalability
            - Resource Utilization
    - Data Compatibility:
        - Sub-criteria:
            - Integration with third-party Applications
            - Support for real-time/streaming data source
            - Support for various Data formats
    - Support and Maintenance
    - Cost
    - Ease of Use
    - Security and Compliance
- Alternatives:
    - Tableau
    - PowerBI
    - Qlik
    - Google Charts

  Based on this decision hierarchy, I will use the super decisions tool to select the best alternatives among the four tools mentioned above.



Based on my research, I have come up with the following characteristics and facts for the criterias and sub-criteria mentioned above. I will use these while creating a pairwise analysis and further decisions.

Tools	Performance	Data Compatibility	Support and Maintenance	Cost	Ease of Use	Security and compliance
Tableau	**Query performance :**Excellent **Scalability:** Excellent **Resource Utilization:**More	Excellent compatibility	extensive support resources, regular updates and patches to address bugs,various support plans, including Standard and Premium support options -2	Most expensive	User-friendly drag-and-drop interface; suitable for non-technical users.	comprehensive security features, compliance certifications, and support for on-premises deployment options
PowerBI	**Query performance :**excellent **Scalability**: Excellent **Resource Utilization:** similar to Qlik and tableau, only a bit difference in all three criteria	Excellent, only a minor difference with QLIK and Tableau	robust customer support,regular updates and enhancements,comprehensive maintenance support -1	Cheaper than tableau	Intuitive interface, suitable for both technical and non-technical users.	robust security capabilities but may have limitations in certain compliance standards
Qlik	**Query performance, Scalability, Resource Utilization,** Similar or only a little difference in all three sub-criteria	Excellent, only a little difference with tableau and powerBI	offering robust support options and regular updates -3	potentially higher cost compared to Power BI's free version.	Intuitive interface with familiar drag-and-drop interaction; suitable for non-technical users.	comprehensive security features, compliance certifications, and support for on-premises deployment options

Google Charts	**Query performance :**Google Chart, being primarily a client-side rendering tool, may not involve complex queries but relies on efficient data retrieval and processing from the server-side., **Scalability:** limitations in scalability compared to the other tools, particularly for handling large datasets or serving a large user base concurrently., **Resource Utilization: lower resource utilization compared to server-side BI tools**	limited compatibility with complex or large-scale datasets.,limited support for real-time or streaming data sources,limited integration capabilities compared to the other tools	limited support and maintenance compared to dedicated BI platforms -4	Free.	Simple and straightforward, but with limited customization options; suitable for basic charting needs.	fewer built-in security features compared to enterprise-grade BI platforms

Pairwise Comparison overview/Establish Priorities:

I have set the comparison of all the criteria based on the goal node ‘best Visualization tool’. The comparison is made based on the above table. The questionnaire mode has been used to set the values.

Comparisons wrt "Best Visualization Tool" node in "2Criteria" cluster
5Security and Compliance is very strongly to extremely more important than 6Suppor

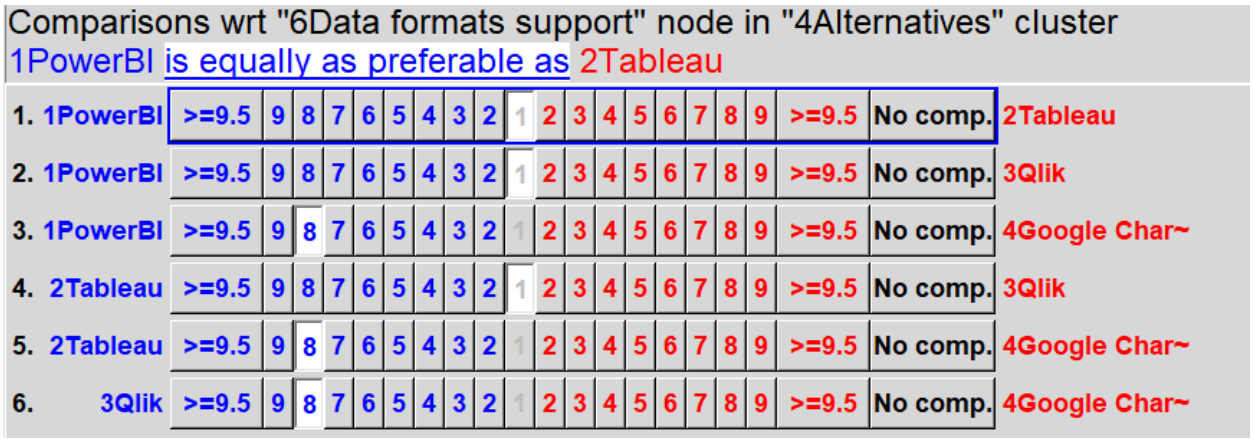
1.	1Ease of Use	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	2Cost
2.	1Ease of Use	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	3Performance
3.	1Ease of Use	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	4Data Compat~
4.	1Ease of Use	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	5Security an~
5.	1Ease of Use	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	6Support and~
6.	2Cost	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	3Performance
7.	2Cost	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	4Data Compat~
8.	2Cost	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	5Security an~
9.	2Cost	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	6Support and~
10.	3Performance	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	4Data Compat~
11.	3Performance	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	5Security an~
12.	3Performance	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	6Support and~
13.	4Data Compat~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	5Security an~
14.	4Data Compat~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	6Support and~
15.	5Security an~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>=9.5	No comp.	6Support and~

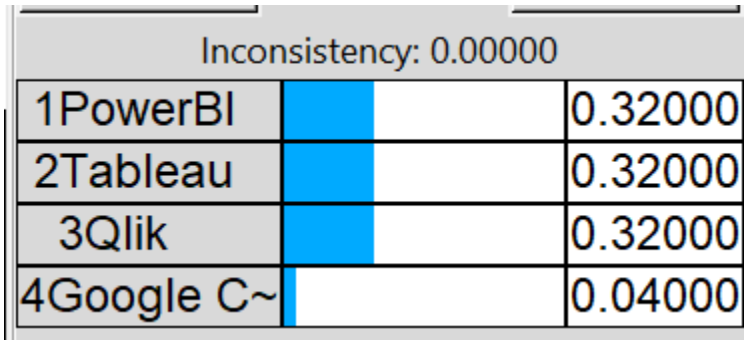
Inconsistency: 0.03926

1Ease of ~	0.10227
2Cost	0.03164
3Performa~	0.21710
4Data Com~	0.43650
5Security~	0.18096
6Support ~	0.03153

As you can see from the table, based on my research and some assumptions of the visualization tools, I have given more importance to Data Compatibility. Because if the data isn't compatible with the tool, all other functionalities and criteria doesn't matter. Similarly, it is followed by Performance which is obviously the better need compared to other factors. I felt that the cost would be the least important criteria because if any organization is using any tools, they would be ready to invest some amount of money. Also, the tools aren't that expensive.
Here, the inconsistency is around 3% and I have decided to take the inconsistency of less than 10%.

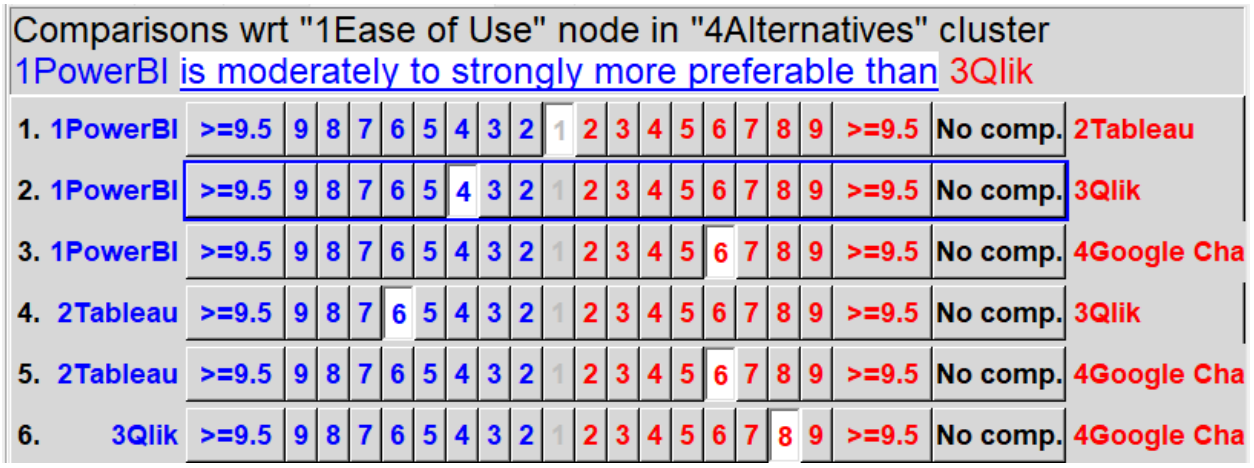
Data Formats Support:

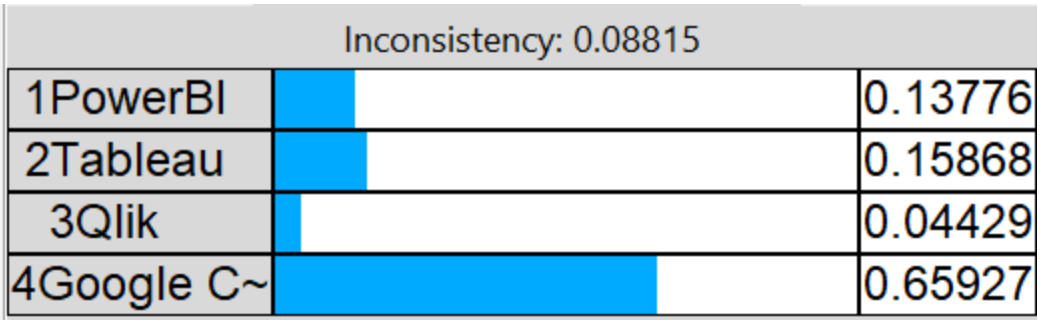




For data formats support, as you can see PowerBI,Tableau and Qlik are equally prioritized (based on my research/assumptions) and since Google Charts are very basic and use only JSON format, I gave it least importance. The inconsistency here is 0 which is ideal.

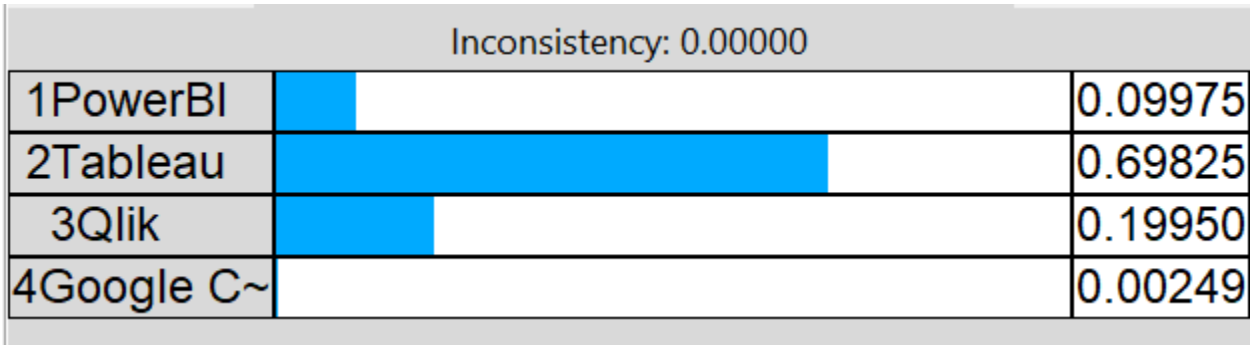
Comparison of tools based on ease of use Ease of Use:



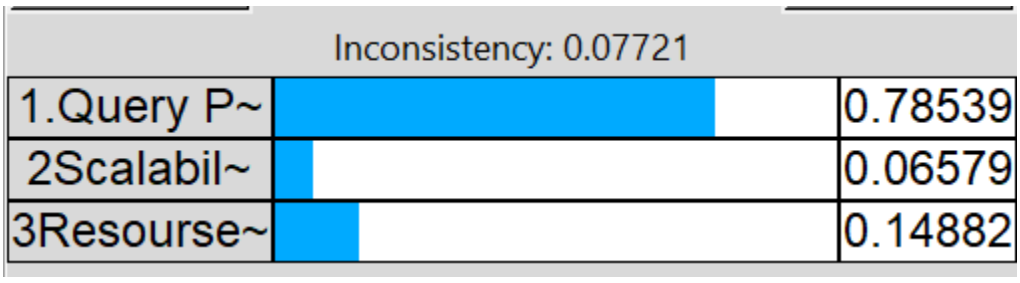


Based on the research, since Google Charts provides basic functionalities for visualizations, it is more preferable than other tools which are more elaborate. Qlik is the most difficult to learn and use and PowerBI and Tableau are almost similar as seen above. The inconsistency is around 8% which is less than 10% which is the threshold.

Comparison of the Tools based on Cost:
Based on the research done and the points mentioned in table 1, Tableau is the most expensive one, followed by Qlik and Google chart is a free version. Here, we can see that inconsistency is 0. Also, I provided a direct numerical value in this case since I got some rough figures from the internet.



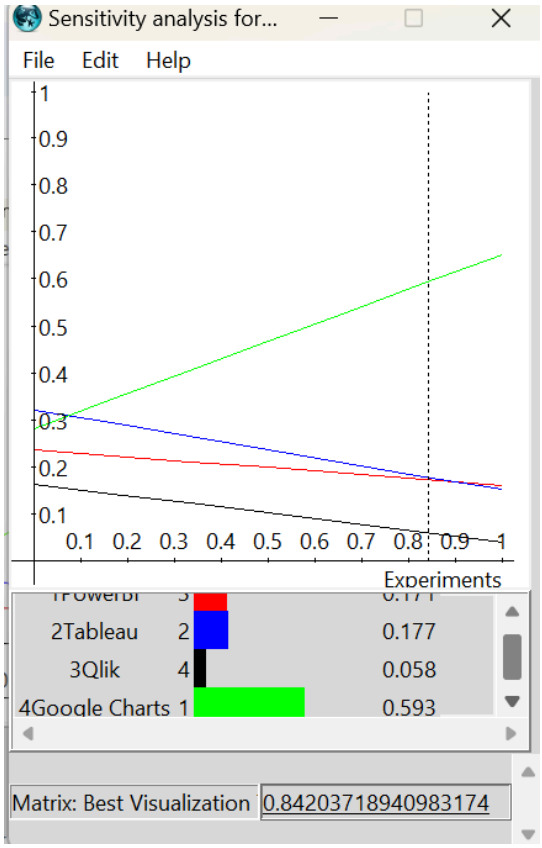
Comparison of sub-criteria of performance:

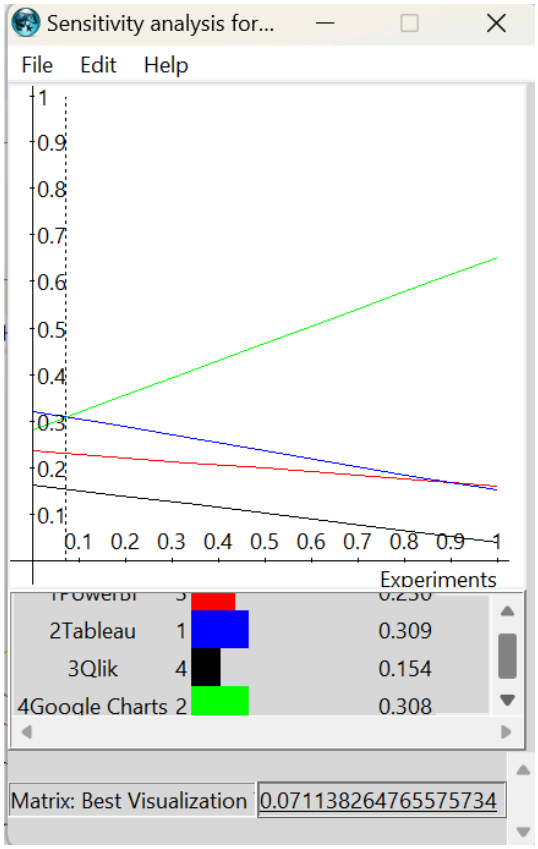


Here, query performance is given more priority than scalability and resource allocation. Query performance means how fast the query fetches the result in the tools which as per me is the more important criteria. AAfter that how much resources does the tool take in the machine and then scalability comes last. Here, the inconsistency is 7% which is below 10% threshold.

Sensitivity Analysis:

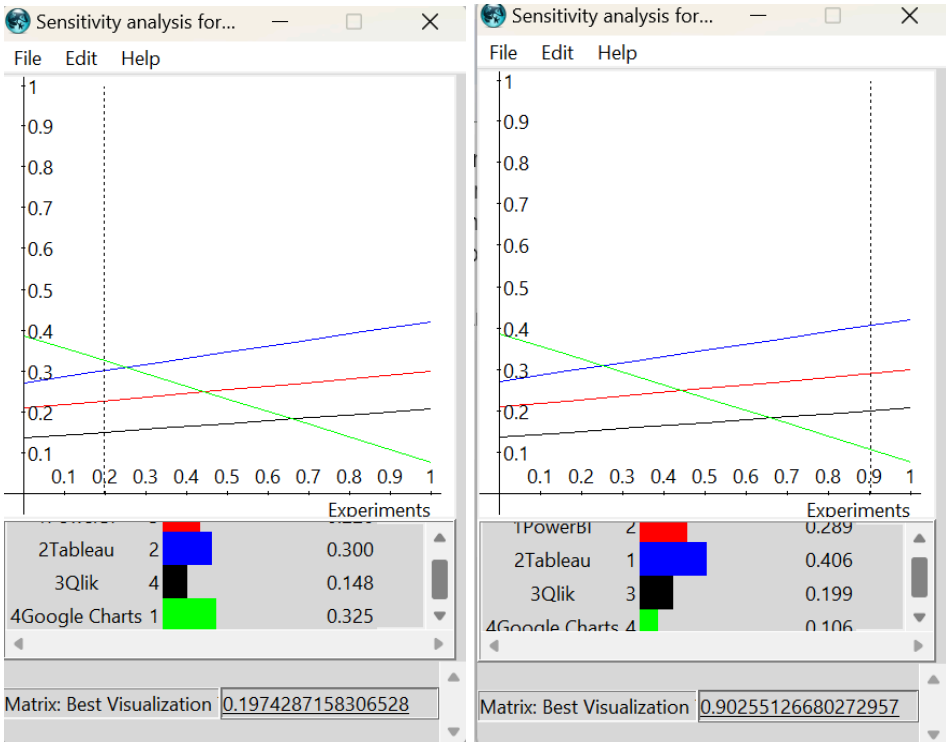
Sensitivity Analysis for Ease of Use:





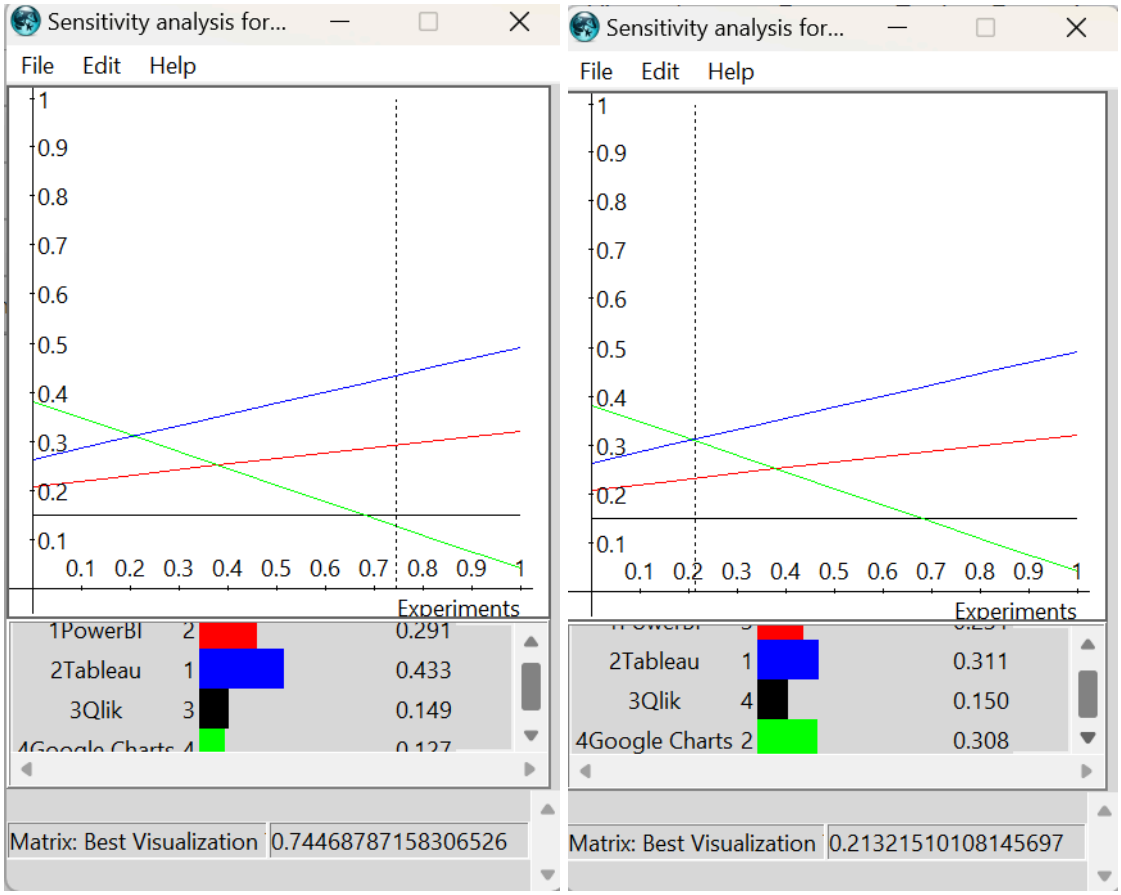
From the sensitivity analysis based on the Ease of Use, we can see that if the priority for ease of use is more than 80%, Google Charts is the best choice. Similarly, if the priority set for ease of use is minimal i.e. around 7% then Tableau is the best choice. From this, we can see that if we want a tool that is easy to use, we must choose Google Charts.

Sensitivity Analysis for Performance:



If the priority is given more to performance i.e. more than 90%, Tableau is the best choice (0.406) closely followed by PowerBI (0.289) whereas the worst choice is google charts as shown in the figure. However, if we don't want to prioritize performance and just give it the weightage of less than 20%, Google charts emerges as the better choice.

Sensitivity Analysis by Security and Compliance:



Based on the security and compliance criteria, Tableau should be preferred because if our priority is good security and compliance mechanism i.e. more than 70 percent, it performs the best (0.433) followed closely by PowerBI (0.291). However, if we don't give much priority to security and compliance, Google charts emerges as better choice if we give priority to security as less than 20%

Final Result:

Name	Graphic	Ideals	Normals	Raw
1PowerBI		0.741273	0.236568	0.097140
2Tableau		0.920884	0.293889	0.120677
3Qlik		0.471287	0.150405	0.061759
4Google Charts		1.000000	0.319138	0.131044

Based on the comparisons and priority settings, the final ranking has been done as shown above. Here, Google Charts has won and will be selected as the visualization tool. Closely followed by Tableau and PowerBI. However, Qlik is far behind in the decision.
Here, the **'Ideals'** value of 0.92 for Tableau means that it is 92% as good as Google charts. Similarly, Qlik is 47% as good as Google Charts.

Note: I wasn't able to screenshot the final report because I kept on facing the error below. However, I got the above result from the synthesize option.