

AT82.04: Business Intelligence and Analytics

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Under the guidance of: **Dr. Vatcharaporn Esichaikul**

TA: **Rakshya Lama Moktan**

Submitted by:

Name: **Arya Bhavesh Shah**

Student ID: **st125462**

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Assignment 2: Multi Criteria Decision Making

In the following assignment, out of the provided choices, I shall be building a decision making system for the following Scenario:

Scenario 1: Selecting the best laptop for a DSAI student

Introduction

In everyday decision-making, people often rely on intuition or gut feelings. However, when making critical decisions involving significant investments or long-term impacts, a structured and analytical approach is essential. Multi-Criteria Decision Making (MCDM) is a sub-discipline of operations research that provides systematic methods for evaluating and ranking alternatives based on multiple, often conflicting, criteria.

Selecting a suitable laptop for any student pursuing higher studies in the fields of Computer Science, AI, Machine Learning, Data Science, and similar quantitative fields is one of the most crucial tasks. In this project, I shall be building a decision Model Using SuperDecisions Software to help select the most suitable laptop for a student specializing in the field of Data Science and AI.



I shall be making use of the Analytical Hierarchy Process (AHP) in order to create this decision-making process. A well structured multi-criteria decision-making methodology shall be followed throughout the implementation of this project.

Objectives

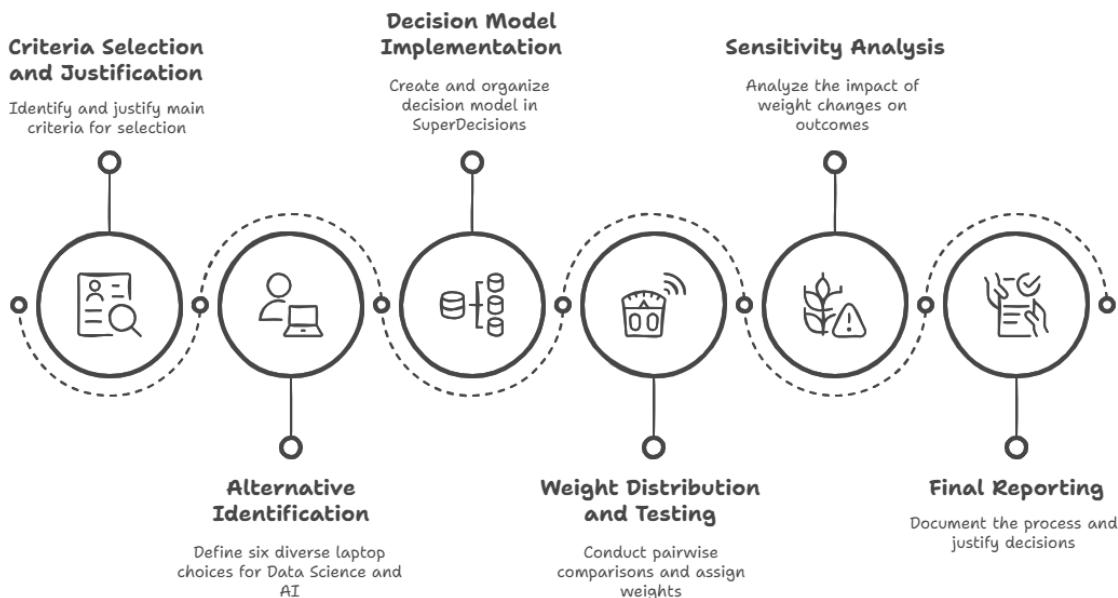
By completing this assignment, I aim to accomplish the following objectives:

1. Create a systematic approach to evaluate amongst various laptop alternatives based on a set of relevant criteria that make sense for a student pursuing Data Science and Artificial Intelligence.
2. Implement the AHP Decision Model using the SuperDecisions Software
3. Analyze and justify the final selection of the most suitable laptop with the help of appropriate weight distribution.
4. Test the robustness of the proposed AHP Model with the help of sensitivity analysis

Proposed Workflow

The following diagram depicts the overall project workflow I aim to follow throughout the project.

Decision-Making Process for Laptop Selection



Basically, we shall be starting with Criteria Selection and Justification where I identify the main criteria and sub-criteria and their justifications in terms of relevance to a Data Science and AI student. I'll move on to then define 6 laptop choices that are suitable for a DSAI student, ensuring that these 6 choices have different specifications and price points in order to infuse diversity while making a decision using the AHP Model.

Next, I shall create a hierarchy structure in the SuperDecisions Software which includes creation of nodes and clusters and defining the relationships between these elements. Once the Decision Model is successfully implemented, I shall proceed towards weight distribution and testing which includes performing pairwise comparisons, assigning weights based on relative importance amongst the nodes and finally, validating the consistency of judgements.

Once the weight distribution and testing is done, sensitivity analysis will follow which will be conducted in order to test how changing weights affects the outcome for our scenario of choosing the best laptop for a DSAI student.

The entire process shall be documented and the presented results will have a justification for all the decisions made by the AHP Model.

Deliverables

As part of the deliverables, I shall be providing the following as part of the final outcome once the project is successfully completed. The complete files shall be made on my GitHub repository, which shall include:

1. Complete SuperDecisions model (.sdmod file)
2. A detailed report consisting of- Decision making methodology, criteria selection and justification, alternative evaluation, weight distribution reasoning, sensitivity analysis results and the final recommendations with justifications.
3. The final HTML report hosted on the web, accessible through a web URL.

Links to follow:

1. GitHub Repository for this Assignment:

<https://github.com/aryashah2k/SuperDecisions-MCDM-AHP-Model>

2. SuperDecisions Report hosted as HTML on GitHub Pages:

<https://aryashah2k.github.io/SuperDecisions-MCDM-AHP-Model/>

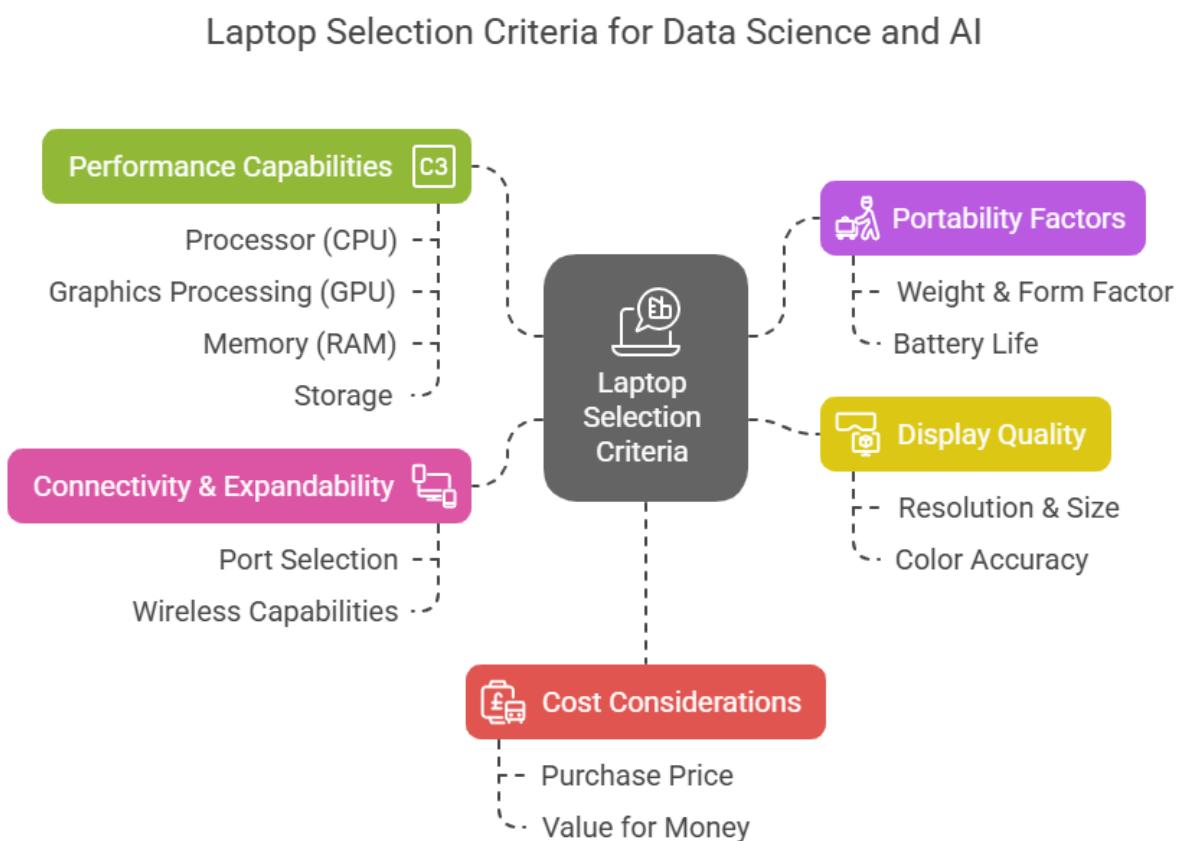
I shall now begin with the actual assignment implementation next section onwards.

Criteria Selection

For a DSAI Student, selection of the correct laptop involves evaluation of multiple factors that impact both performance and ability to perform demanding computational tasks along with the overall usability by a student.

I have created the following 5-part Main Criteria Structure under which lie many useful and crucial sub-criteria.

Here's an illustration of the overall criteria structure:



Performance Capabilities

Performance is one of the most crucial criteria for Artificial Intelligence, Data Science and Machine Learning workflows. This involves complex computations, model training, big data processing and storing large amounts of data and models. The hardware specifications of the laptop directly impact productivity and the scale of projects that can be undertaken and implemented without any hiccups.

Sub-criteria

A total of 4 sub-criteria have been selected for the main criteria of Performance Capabilities:

Processor (CPU)

The processor determines the speed at which the laptop executes instructions. The modern data science workflows need processors with multiple cores to speed up their parallel task execution. The essential needs for performing data analytics and creating algorithms and statistical models include a CPU that delivers high performance capabilities. The recommended standards in the industry currently require at least an Intel Core i7/i9 or AMD Ryzen 7/9 processor with minimum six cores up to a preferred eight cores for time-efficient data preprocessing will handle your feature engineering needs and execute complicated algorithms during the workflow. The speed in executing one sequence at a time comes from single core performance yet multiple cores enable efficient execution of parallel operations including cross-validation and hyperparameter tuning. For processor performance evaluation use the model name alongside core/thread count together with base and boost speeds and benchmark scores from Geekbench and Cinebench systems. The system must have at least 14 cores to handle serious work requirements.

Graphics Processing (GPU)

Essential for deep learning and neural network training. The training of machine learning models through deep learning and neural networks requires GPUs although the basic data analytical functions can operate without this hardware component. The matrix operations found in ML algorithms gain tremendous speed boosts from GPU technology which uses parallel processing design. Students who work with computer vision or natural language processing as well as those who fine-tune large language models must possess a dedicated NVIDIA GPU with CUDA support as an essential tool. The GPU's VRAM size sets the maximum model size that students can train on their personal devices. Students requiring GPU models for ML operations should select NVIDIA RTX series units which must have at least 8GB VRAM for substantial work while 16GB and above facilitates LLM fine-tuning.

Memory (RAM)

System performance using memory (RAM) decides the maximum level of big dataset operations that can occur in memory. Among all components RAM stands as the most important factor since it determines what size of datasets can run without disk-based solutions. The workload performance together with dataset capacity suffers from system instabilities when RAM memory is insufficient for use. Data science professionals should work with either 32GB of memory or more to reach optimal application performance but entry-level workers can operate with 16GB. Apple MacBooks feature a memory architecture that adds benefits for particular types of work execution. The system requires minimum 32GB RAM and 64GB is ideal in conjunction with DDR5 type over DDR4 and minimum 3200 MHz speed for successful operations.

Storage

Determines data access speed and capacity for datasets. The performance of storage directly affects the system's reaction speed as well as the duration needed for data import and model file saving. Manufacturers must purchase NVMe SSDs to get data access speeds that eclipse those of both SATA SSDs and traditional HDDs. Working data scientists require at least 1TB storage capacity but those who need extended storage volume for big datasets or numerous projects or model optimization should obtain 2TB storage. The speed of storage has a direct impact on virtual memory performance when the system RAM reaches its limitations.

The measure for SSD selection specifies NVMe PCIe Gen4 as the preferred option alongside 1TB minimum storage that recommends 2TB capacity and read/write speeds above 3000 MB/s as well as expandability options.

Portability Factors

As a student, irrespective of their field of study, mobility and convenience are equally crucial considerations that affect their daily usability and productivity considering they shall be learning and implementing most of their AI workloads in class, or lab or library.

Sub-criteria

As per portability factor considerations, I choose two most important sub criteria as follows:

Weight & Form Factor

This affects the ease of transportation and portability. Students demand balance between performance needs and portability. Most high-performance laptops tend to be

heavier due to the number of components, GPUs, body design, etc. There have been innovations in laptop designs where they have become more powerful and at the same time, reasonably portable options have also been made available. Many ultrabooks, like the Lenovo Yoga Slim 7i, weigh 1.53kg, which offers a good balance. Gaming laptops like MSI Raiser, which is approximately 2.5kg sacrifices portability for performance.

Form factor also impacts thermal performance, i.e thicker laptops offer better cooling for heavy workloads.

As a means of measure, weight under 2kg is preferred for daily computing, thickness under 2cm for being counted as ultraportable, and overall dimensions and build quality consisting of an aluminum chassis isd preferred for durability.

Battery Life

The device's battery life determines its working duration in situations without power outlet availability.

The life duration of a battery represents a crucial requirement that students need when working in different locations during their daily activities. Dedicated GPUs as well as high-performance components lead to a substantial reduction of battery duration. The M-series processors from Apple deliver outstanding performance efficiency for particular kinds of work. Six hours represents the necessary battery lifespan for data science students but they prefer 10 hours or more for uninterrupted all-day work activity. The overall convenience depends on fast charging abilities.

The battery testing procedure includes assessing total battery endurance for coding and data analysis tasks as well as determining both recharge time and the available charging methods.

Display Quality

Taking into consideration, the majority of students working with AI and data Science tasks will be spending a lot of time visualizing data and even would be subjected to long duration of coding sessions, hence it is important to have superior display quality which does not impact their productivity negatively and reduces eye strain as well.

Sub-criteria

The following subcriteria have been identified for the main criteria of display quality:

Resolution & Size

Resolution & Size affects workspace and visual clarity. Data scientists profit from displays that offer both increased resolution along with expanded screen dimensions which allows them to view multiple viewing windows without discomfort (code, visualizations, documentation). A 16:10 aspect ratio gives coding users and data analysts more vertical area than typical 16:9 displays. A screen of minimum 14 inches works best but users seeking optimal performance along with mobility should choose 15-16 inches since these sizes provide the best screen area without sacrificing portability while 4K displays deliver maximum workspace at the expense of battery capacity.

Screen dimensions of 15-16 inches strike a balance for practical use and the resolution should exceed 1920x1200 pixels with optimal density and 16:10 proportion is the preferred aspect ratio.

Color Accuracy

Color Accuracy stands as a crucial factor which ensures correct data visualization display. Correct color representation supports correct and consistent interpretation of

visualizations when people view work in different environments. Community projects and research sharing require precise presentation techniques which make accurate findings readily available to peers. High-quality professional displays that maintain precise color accuracy serve to combat eye fatigue during extensive working hours. Most data science work functions adequately with displays that present 100% sRGB while choosing DCI-P3 gamut displays enhances multimedia tasks.

One must check the following display qualities: 100% sRGB color gamut coverage alongside DCI-P3 is the preferred standard and the brightness level should be above 300 nits alongside IPS or OLED panel types.

Connectivity & Expandability

No Data Science practitioner can work and implement workloads locally on their machines, it is important to have the ability to connect to various peripherals and networks in order to have a productive workflow, collaboration and future-proofing of their work.

Sub-criteria

In terms of connectivity and expandability, the following subcriteria have been identified:

Port Selection

Determines compatibility with peripherals and external devices. The workflows of data science frequently require establishing data connections between computing systems and external displays and storage as well as specialized hardware devices. The Thunderbolt/USB-C ports let users link their system to fast storage and external GPUs and multiple display screens. The market value of traditional USB-A ports continues to

be relevant because they allow users to connect hardware they currently have. The computer enables users to expand their workspace through external monitors by providing HDMI or DisplayPort output options. Highly portable laptop designs that use fewer ports create problems for expandability unless users have appropriate dongles.

The evaluation includes port analysis through measuring the quantity and varieties of connection ports including USB-C/Thunderbolt, USB-A, HDMI and SD card reader and their maximum display capabilities and data exchange rates.

Wireless Capabilities

This criteria affects network connectivity options. Reputable and fast internet connectivity functions as an essential requirement for both processing cloud resources and downloading datasets and team collaboration. The Bluetooth version 5.0+ combined with Wi-Fi 6/6E standards delivers advanced performance features that operate effectively in dense university areas. Users can maximize their productivity by using wireless Bluetooth peripherals enabled through the system's connection capabilities. Cloud data scientists experience workflow output impact based on the quality of their network connections when working with cloud resources.

Nowadays, users require Wi-Fi standards that support Wi-Fi 6E/6 with at least version 5.0 Bluetooth connection plus cellular service.

Cost Considerations

Many students study on loans, and are usually under a tight budget. Budget constraints, thus, are a reality for most students. This requires a careful balancing of performance needs against financial limitations a student has. It is important to navigate this tradeoff carefully.

Sub-criteria

In order to accommodate the budget constraints of the students, the following sub criteria have been identified

Purchase Price

The initial investment forms the basis of purchasing cost. Data science laptops exist at different cost levels because they range from affordable models priced at \$800-1000 to high-end devices that exceed \$3000 in value. Students who operate under financial constraints need to choose from lower-end models even when upper-end models deliver better performance. Data science technologies in multiple price ranges give users distinctive performance capabilities: the bottom tiers between \$800 and \$1200 allow basic analytics operations whereas the intermediate sections from \$1200 to \$2000 serve well for standard data science applications and the highest-priced models above \$2000 perform best for advanced machine learning computations.

Students can assess costs through their local currency market prices along with available student discount benefits and financing possibilities.

Value for Money

The ratio of specifications quality against cost creates value for money. Value assessment reaches beyond price evaluation by taking into account the dollar-to-performance relationship and how well the laptop suits individual requirements. Better value emerges from these models because they deliver enhanced construction quality along with prolonged support cycles and improved heat management of components. Users can make a compelling case to invest in the high-cost MacBooks because these computers optimize software performance and maintain extended support periods. Gaming

laptops deliver outstanding system capabilities while making users trade off battery runtime and convenience features.

The assessment of price performance ratio together with warranty durations and equipment lifespan along with potential future upgrade capabilities operates as the measurement force.

Thus, we have identified all our main criteria and the sub criteria present in each of them. Next, we weigh these criteria based on their relative importance with respect to DSAI students. On a heuristic level, I believe that the performance aspects will receive higher weights simply because Data Science and AI is a computationally demanding field. This hypothesis will only be proved once we perform pairwise comparisons to determine the precise weights.

Also, specifically, for data science, RAM and CPU typically deserve highest weighting, followed by storage speed and capacity. GPU performance also varies significantly based on the specific focus area, i.e. deep learning will critically require more performance capability compared to statistical analysis. Finally, portability factors become more important for those students who frequently travel in order to attend classes or are needed to visit different locations for studies.

Our next step entails the selection of particular laptop options which show various combinations between our established criteria. We will add the criteria structure and alternative variants into SuperDecisions for organized assessment. A quantitative analytical model will serve as the base for purchasing a laptop while respecting technical needs alongside functional limitations.

Alternative Identification

As per the requirements for the assignment, we were asked to select 6 alternatives to choose from. This leads to the selection of 6 best laptop choices for a student pursuing

Data Science & AI. As per the outcome of the final result, we will receive the ranking of the six laptops for most suitable to least suitable, which can be helpful for the student to make a calculated decision in choosing the correct laptop for their studies in this field.

Here are the six laptops chosen along with their justification:

Alternative 1: Dell XPS 15 (Premium All-Rounder)



Processor	Intel Core i7-12700H (14 cores, up to 4.7GHz)
Graphics	NVIDIA GeForce RTX 3050Ti (4GB GDDR6)
Memory	32GB DDR5-4800MHz
Storage	1TB PCIe NVMe SSD
Display	15.6" 3.5K (3456 x 2160) OLED touch display, 100% DCI-P3

Portability	1.96 kg (4.31 lbs), 18mm thick
Battery Life	Up to 12 hours under normal use
Connectivity	2x Thunderbolt 4, 1x USB-C 3.2, SD card reader, Wi-Fi 6
Price Range	\$2,200-\$2,500
Justification: This premium device achieves a balance between excellent performance capabilities and top-quality construction alongside display excellence. Deep learning processing attainable through the RTX GPU and visualization benefits that utilize the OLED screen make this choice suitable for premium purposes.	

Alternative 2: Lenovo ThinkPad P16 (Workstation Performance)



Processor	Intel Core i9-12950HX (16 cores, up to 5.0GHz)
Graphics	NVIDIA RTX A5500 (16GB GDDR6)
Memory	64GB DDR5-4800MHz
Storage	2TB PCIe Gen4 SSD
Display	16" 3840 x 2400 IPS, 100% Adobe RGB
Portability	2.95 kg (6.5 lbs), 30.23mm thick

Battery Life	Up to 8 hours under normal use
Connectivity	2x Thunderbolt 4, 2x USB-A 3.2, HDMI, SD card reader, Wi-Fi 6E
Price Range	\$3,500-\$4,000
Justification: This knowledge-oriented mobile workstation offers top performance at the cost of restricted portability features. The professional-grade GPU successfully completes CUDA-accelerated workloads which enable the execution of sophisticated deep learning models.	

Alternative 3: ASUS ROG Zephyrus G14 (Compact Performance)



Processor	AMD Ryzen 9 7940HS (8 cores, up to 5.2GHz)
Graphics	NVIDIA GeForce RTX 4060 (8GB GDDR6)
Memory	16GB DDR5-4800MHz
Storage	1TB PCIe Gen4 SSD

Display	14" 2560 x 1600 IPS, 120Hz, 100% DCI-P3
Portability	1.65 kg (3.64 lbs), 19.5mm thick
Battery Life	Up to 10 hours under normal use
Connectivity	1x USB-C 4.0, 1x USB-C 3.2, 2x USB-A, HDMI 2.1, Wi-Fi 6E
Price Range	\$1,800-\$2,000
Justification: Offers an excellent balance of performance and portability. This device strikes an optimum combination of portability through its compact design together with efficient GPU processing abilities needed for AI applications.	

Alternative 4: MacBook Pro 16" (Apple Silicon)



Processor	Apple M2 Pro (12-core CPU)
Graphics	19-core integrated GPU
Memory	32GB unified memory
Storage	1TB SSD
Display	16.2" 3456 x 2234 Liquid Retina XDR, 1000 nits, P3 wide color
Portability	2.15 kg (4.7 lbs), 16.8mm thick

Battery Life	Up to 18 hours under normal use
Connectivity	3x Thunderbolt 4, HDMI, SD card reader, MagSafe, Wi-Fi 6E
Price Range	\$3,000-\$3,300
<p>Justification: Its exceptional battery performance matches well with strong performance capabilities when executing AI tasks. The unified memory architecture helps execute some machine learning operations but developers must find solutions to run CUDA-dependent frameworks.</p>	

Alternative 5: Acer Swift 3 (Budget Option)



Processor	Intel Core i5-1240P (12 cores, up to 4.4GHz)
Graphics	Intel Iris Xe Graphics
Memory	16GB LPDDR4X
Storage	512GB PCIe NVMe SSD
Display	14" 1920 x 1080 IPS, 100% sRGB
Portability	1.25 kg (2.76 lbs), 17.9mm thick

Battery Life	Up to 10 hours under normal use
Connectivity	2x USB-A, 1x Thunderbolt 4, HDMI, Wi-Fi 6
Price Range	\$800-\$950
Justification: A budget-friendly option for students with financial constraints. The laptop offers satisfactory functionality without GPU acceleration while meeting the requirements for academic data science tasks as well as coding work and model sizes below a certain threshold.	

Alternative 6: Microsoft Surface Laptop Studio (Convertible Powerhouse)



Processor	Intel Core i7-11370H (4 cores, up to 4.8GHz)
Graphics	NVIDIA GeForce RTX 3050 Ti (4GB GDDR6)
Memory	32GB LPDDR4x
Storage	1TB PCIe SSD
Display	14.4" 2400 x 1600 PixelSense Touch display, 120Hz, 3:2 aspect ratio

Portability	1.82 kg (4.0 lbs), 18.94mm thick
Battery Life	Up to 14 hours under normal use
Connectivity	2x Thunderbolt 4, Surface Connect port, 3.5mm headphone jack, Wi-Fi 6
Price Range	\$2,400-\$2,700
Justification: This device provides three different usage modes because its design incorporates a woven hinge mechanism that switches between laptop and stage and studio configurations. Users who need data visualization and note-taking support will find them in the touchscreen interface with pen support on this premium device that delivers strong performance. Its flexible design enables students to achieve two functions through a combination of presentation modes and tablet use for their data monitoring needs.	

Differentiation Analysis

The six options provide unique methods to fulfill requirements of Data Science and AI students

1. Students who seek premium performance together with build quality should consider the Dell XPS 15.
2. Lenovo ThinkPad P16: Maximum performance at the expense of portability and price

3. ASUS ROG Zephyrus G14: Gaming-oriented but excellent for AI with superior portability

4. MacBook Pro 16": Apple ecosystem with excellent battery life and display

5. The Acer Swift 3 stands out as an affordable choice that provides acceptable performance level despite its budget-friendly approach.

6. Microsoft Surface Laptop Studio: Versatile 2-in-1 device with unique form factor and touchscreen capabilities

The different models showcase various distinct characteristics on several aspects:

- Performance Range: From entry-level (Acer Swift) to workstation-class (ThinkPad P16)

The product prices span from an affordable \$800 up to a premium \$4,000.

- Weight Range: From ultra-portable (1.25 kg) to hefty (2.95 kg)

- Platform Diversity: Windows vs. macOS options

The GPU options in these devices extend from standard integrated graphics up to advanced professional RTX cards.

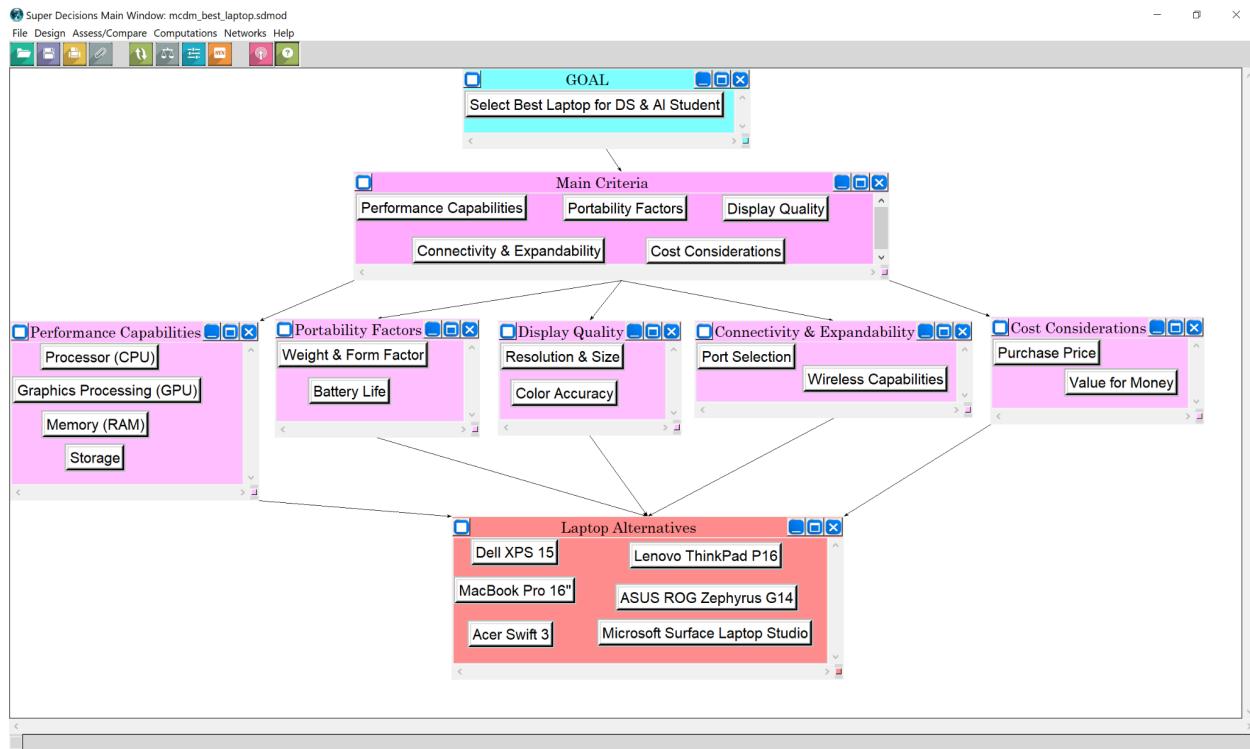
Users can pick from three main laptop designs: traditional laptops and gaming laptops in addition to convertible 2-in-1 formats.

Decision Model Implementation

On implementing the above criteria structure into the SuperDecisions Software, we get the following Network with nodes and clusters created for our AHP Model.

There are 4 levels to this hierarchical structure:

1. **Goal:** This is our goal we wish to accomplish
2. **Main Criteria:** This consist of the main criteria to be taken into consideration for making decisions based on the goal we wish to achieve
3. **Sub Criteria:** This consists of further breakdown of the main criteria components into subcategories
4. **Alternative Choice:** This consists of the alternatives under consideration, based on the AHP Decision Making Model, these alternatives shall be ranked from the best choice to the worst choice. In our case we have 6 distinct choices to choose from.



Weight Distribution and Analysis

Once the hierarchy network was created with the goal at level 1 followed by the main criteria, subcriteria and the alternatives, now was the time to actually understand how exactly does the AHP model function. It was known that the Analytical Hierarchy Model (AHP) makes use of pairwise comparisons in order to determine relative importance of the various nodes at a particular level. In the SuperDecisions Software, we make use of the fundamental scale in order to compare these elements:

This how the fundamental scale is formulated:

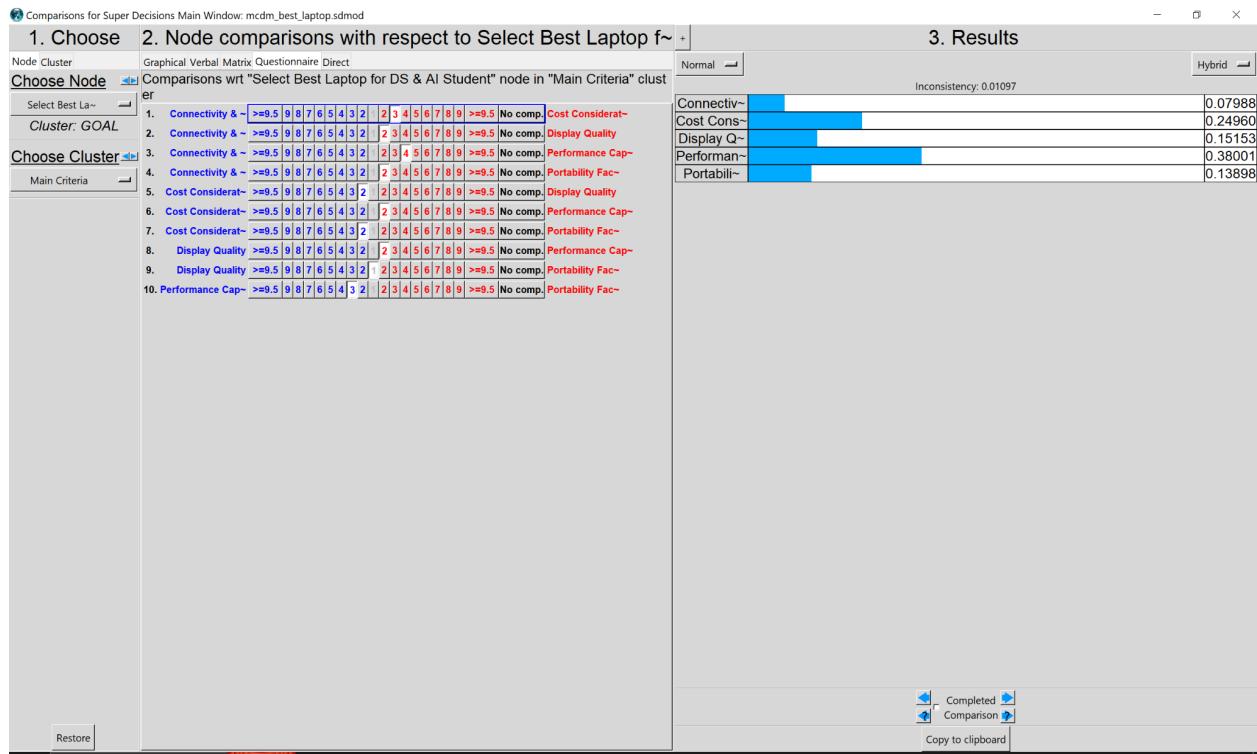
Value	Definition	Explanation
1	Equal importance	Two elements contribute equally
3	Moderate importance	Experience and judgment slightly favor one element
5	Strong importance	Experience and judgment strongly favor one element
7	Very strong importance	One element is favored very strongly over another
9	Extreme importance	The evidence favoring one element is of the highest possible order
2, 4, 6, 8	Intermediate values	When compromise is needed

Based on the above fundamental scale, I conducted the pairwise comparisons for each Criteria

Pairwise Comparison

Comparing Main Criteria

The very first comparison is: Main Criteria Node comparisons with respect to the GOAL.



One more thing to take note of and to take precautions while conducting these pairwise comparisons is checking for consistency. We need to ensure the Consistency Ratio lies in the acceptable range. The following are considered as thumb rules while checking for consistency once all the comparisons are completed:

- A Consistency Ratio < 0.1 is considered to be acceptable
- If Consistency Ratio > 0.1 , we need to review the comparisons and adjust judgements in order to abide by the consistency ratio range.

The consistency ratio is less than 0.1 in the above image which means that our comparison is considered acceptable.

Thus, in the above image of pairwise comparison of the various main criteria nodes, we come to the conclusion of placing the weights for each criteria as follows:

Pairwise Comparison Justifications:

1. Performance vs. Portability: Performance is moderately more important because data science and AI tasks require computational power more than mobility
2. Performance vs. Display: Performance is slightly more important as processing capability directly impacts ability to run models
3. Performance vs. Connectivity: Performance is strongly more important as connectivity features are supplementary to core computing needs
4. Performance vs. Cost: Performance is slightly more important as inadequate performance will limit educational outcomes
5. Portability vs. Display: Equal importance as both contribute similarly to usability for a student
6. Portability vs. Connectivity: Portability is slightly more important for a student needing to carry the laptop regularly
7. Portability vs. Cost: Cost is slightly more important than portability for most students with budget constraints
8. Display vs. Connectivity: Display quality is slightly more important for visualization work and long coding sessions
9. Display vs. Cost: Cost is slightly more important than display for most students
10. Connectivity vs. Cost: Cost is moderately more important than connectivity features

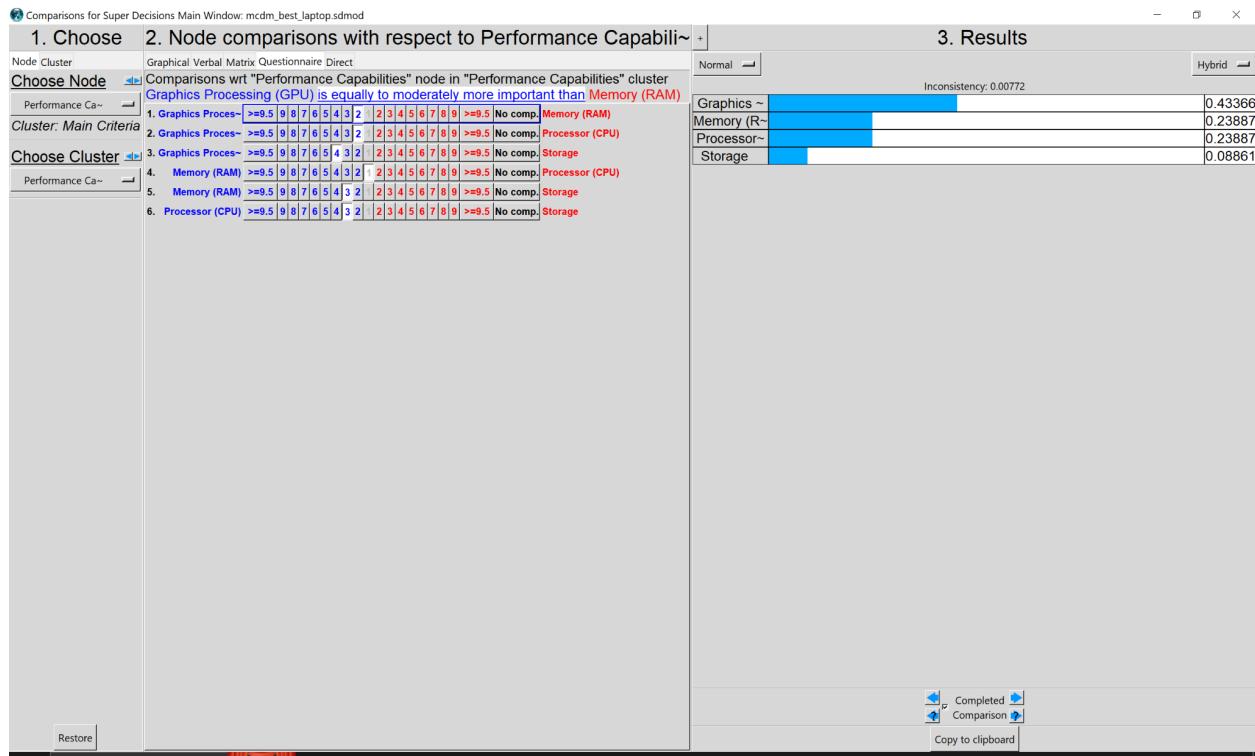
Criterion	Relative	Justification
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	Weight	
Performance Capabilities	~40%	Most important for running complex AI models and handling large datasets
Portability Factors	~13%	Important but secondary to performance for a student who needs mobility
Display Quality	~15%	Critical for data visualization and reducing eye strain during long coding sessions
Connectivity & Expandability	~7%	Necessary but less critical as most work can be done with standard configurations
Cost Considerations	~25%	Important due to student budget constraints but not at the expense of essential performance

Comparing Subcriteria

Once the main criteria were pairwise compared, it was time to move to comparison of subcriteria among each of the main criteria present.

Comparing Performance Capabilities Sub Criterion

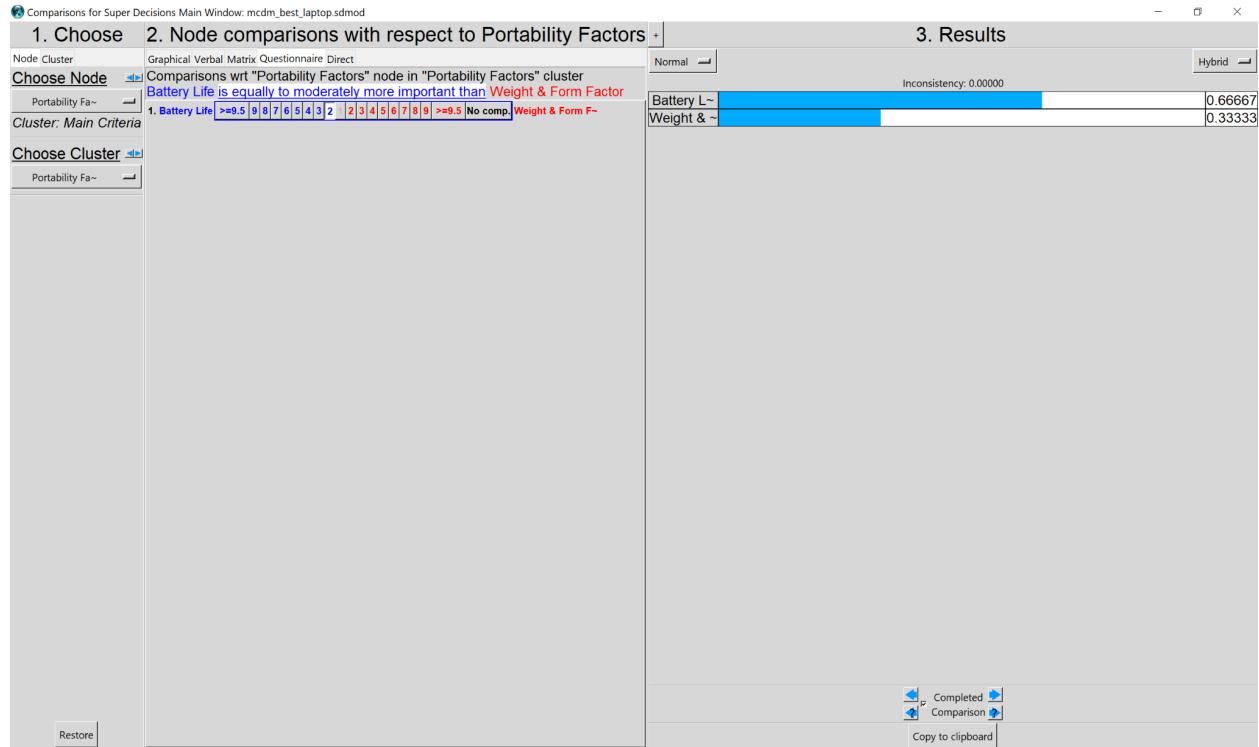


Pairwise Comparison Justifications:

1. Processor vs. Graphics: Graphics is slightly more important for deep learning tasks common in AI studies
2. Processor vs. Memory: Equal importance as both CPU and RAM are critical components for data analysis
3. Processor vs. Storage: Processor is moderately more important as computing power is more critical than storage space
4. Graphics vs. Memory: Graphics processing is slightly more important for AI model training
5. Graphics vs. Storage: Graphics is strongly more important as GPU acceleration is essential for deep learning based tasks
6. Memory vs. Storage: Memory is moderately more important as RAM directly impacts ability to work with large datasets in memory

Criterion	Relative Weight	Justification
Processor (CPU)	~23%	Essential for data processing pipelines and general computing tasks
Graphics Processing (GPU)	~43%	Critical for deep learning model training which is core to AI studies
Memory (RAM)	~23%	Necessary for handling large datasets in memory during analysis
Storage	~8%	Important but less critical as external storage can supplement if needed

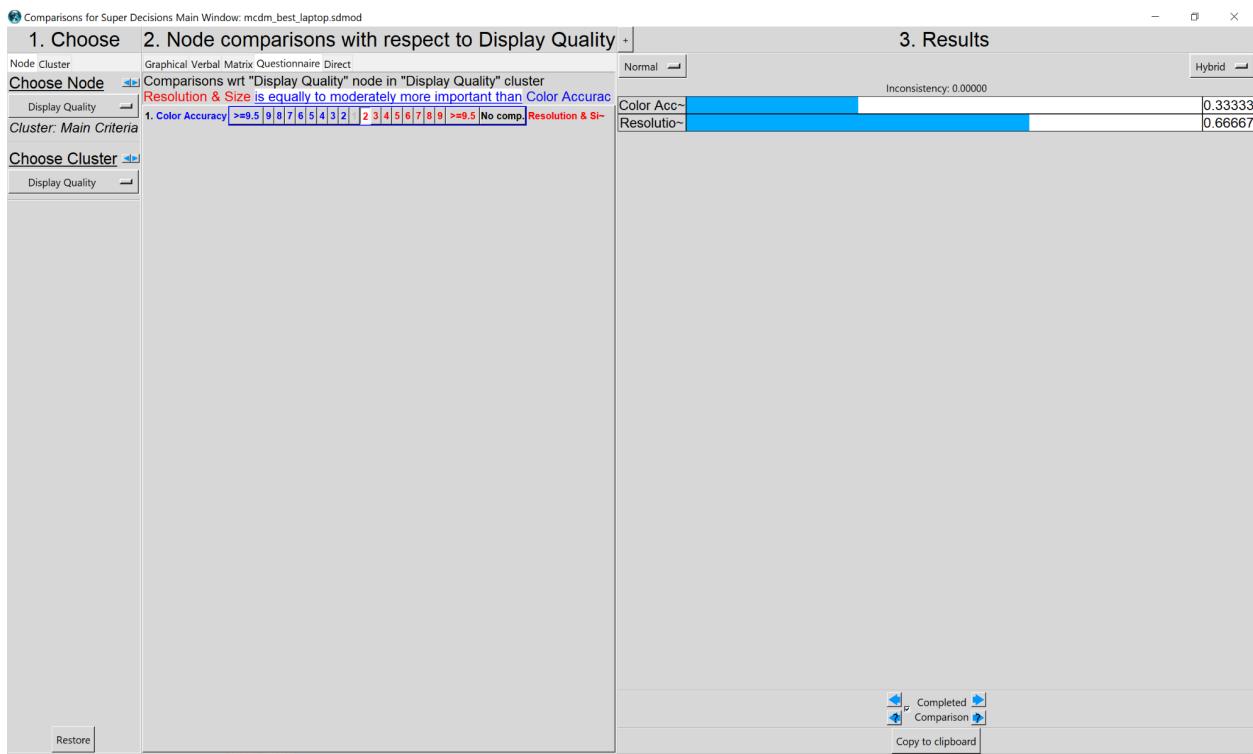
Comparing Portability Factors Sub Criterion



Pairwise Comparison Justifications:

Since there is only one pair, i.e Battery Life vs. Form Factor, Battery Life is slightly more important than weight or form factor for a student who is probably going to work in various locations, sometimes, without any access to power outlets.

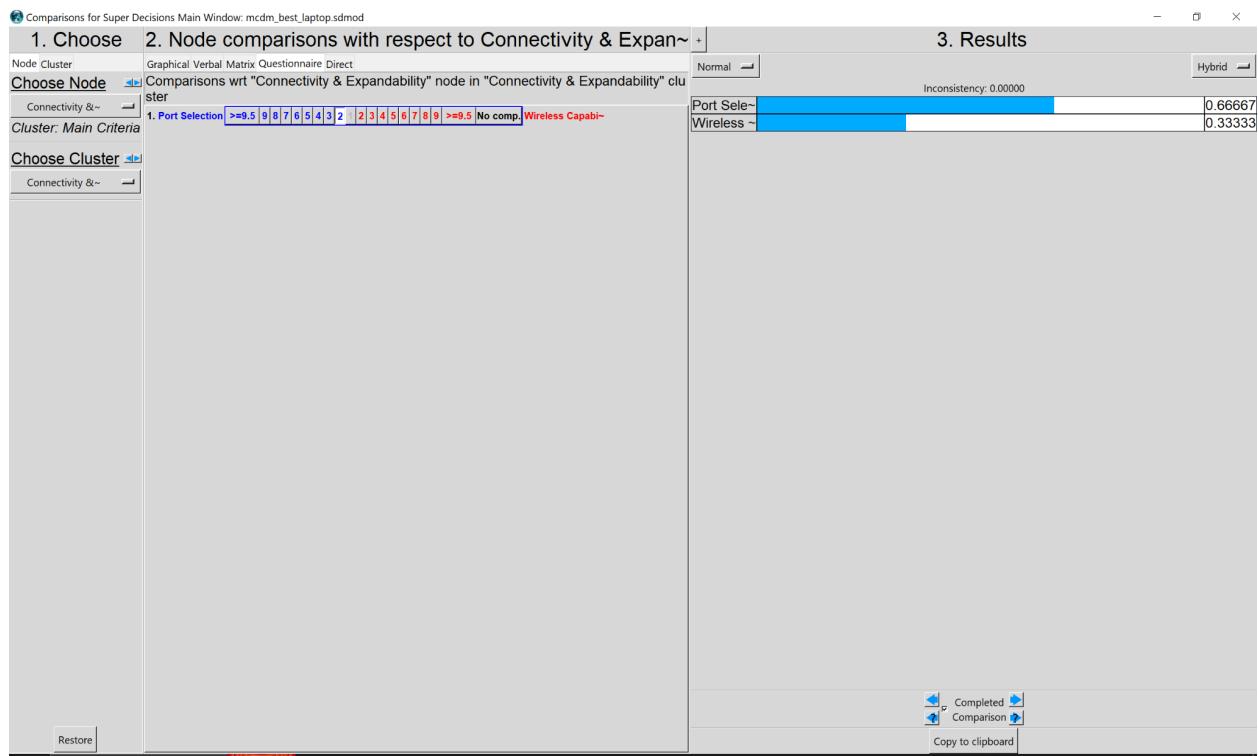
Comparing Display Quality Sub Criterion



Pairwise Comparison Justifications:

Here as well, we have one pair only, i.e Color Accuracy vs. Resolution & Size. Resolution & Size are slightly more important than color accuracy, specially when we are talking about general programming and data analytics work. The amount of screen available really affects the productivity of a student. More screen means less navigating from one tab to another.

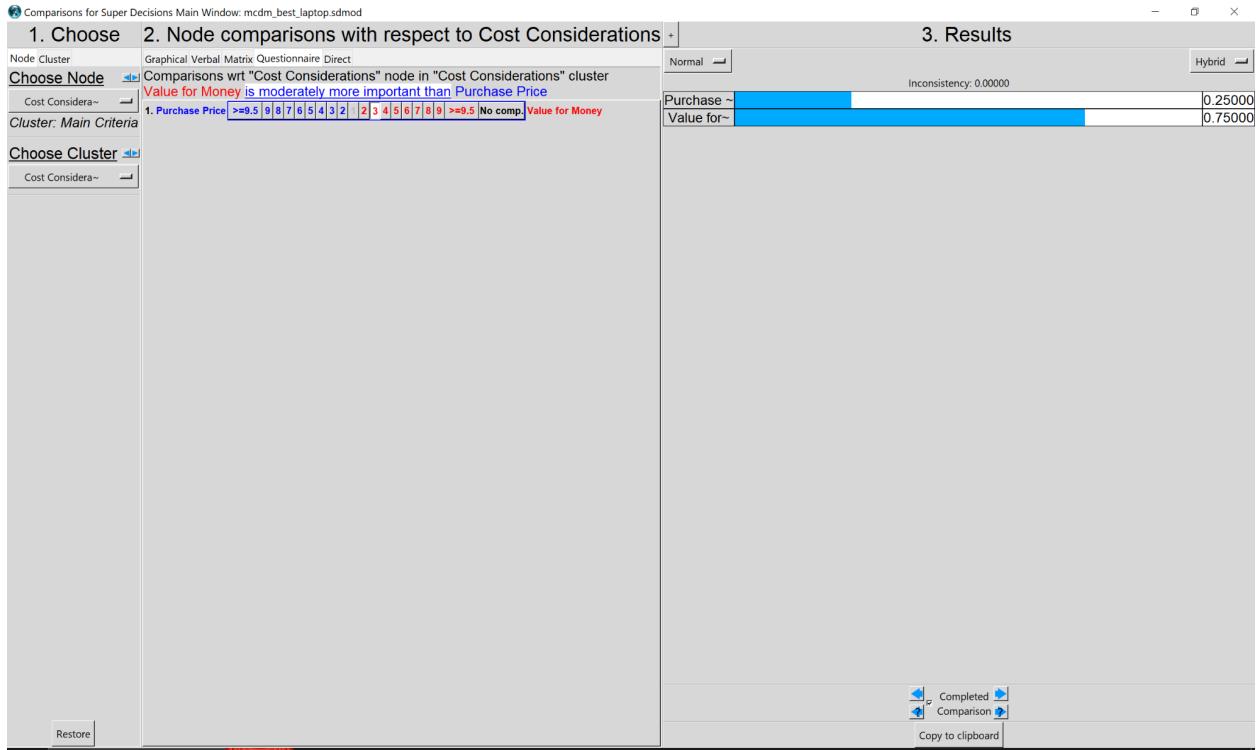
Comparing Connectivity & Expandability Sub Criterion



Pairwise Comparison Justifications:

Here as well, we have one pair of comparisons, i.e Port Selection vs. Wireless Capabilities. Port selection is slightly more important than wireless capabilities. This is due to the need for connectivity to several external devices, displays, storage devices, etc that are often needed in data science workloads and programming tasks in general.

Comparing Cost Considerations Sub Criterion



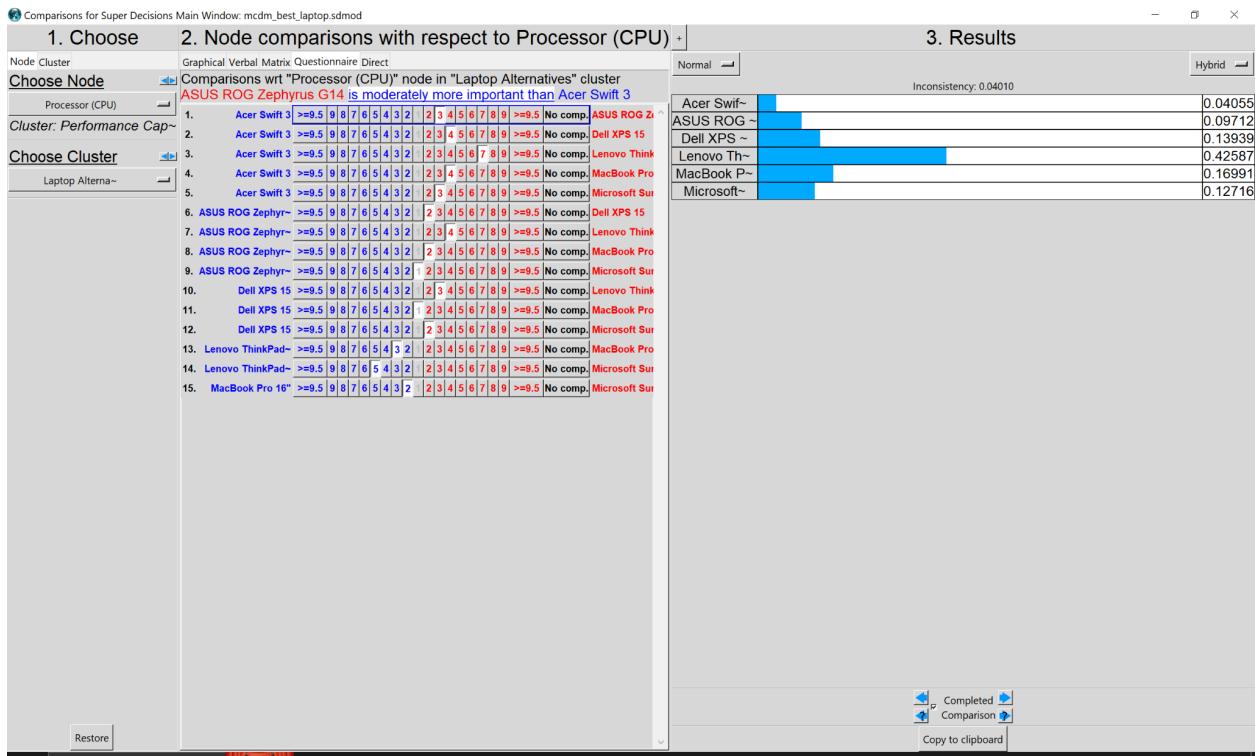
Pairwise Comparison Justifications:

Finally, pairwise comparison between factors for cost considerations i.e Purchase Price vs. Value for Money. It is quite clearly observed that students, when buying a laptop, are actually investing in that product for a long time. Value for money is moderately more important than the purchase price of the device at any given point of time since the investment in appropriate specifications will benefit the students throughout their studies.

Comparing Alternatives

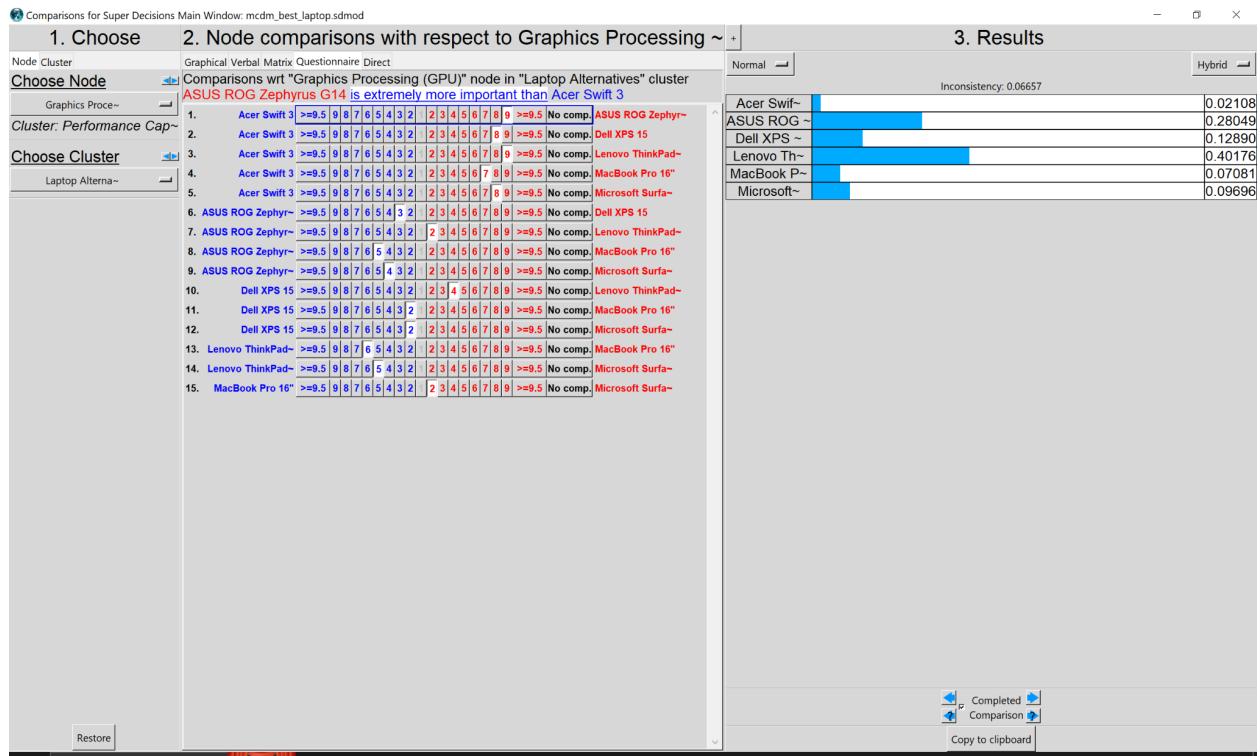
Now that we have performed pairwise comparisons of Main Criteria and Sub Criteria. In this section we shall perform pairwise comparisons in order to evaluate alternatives against each sub criterion. We will continue using the same 9-point scale where higher value indicates stronger performance and lower value the opposite.

Processor (CPU) Comparisons



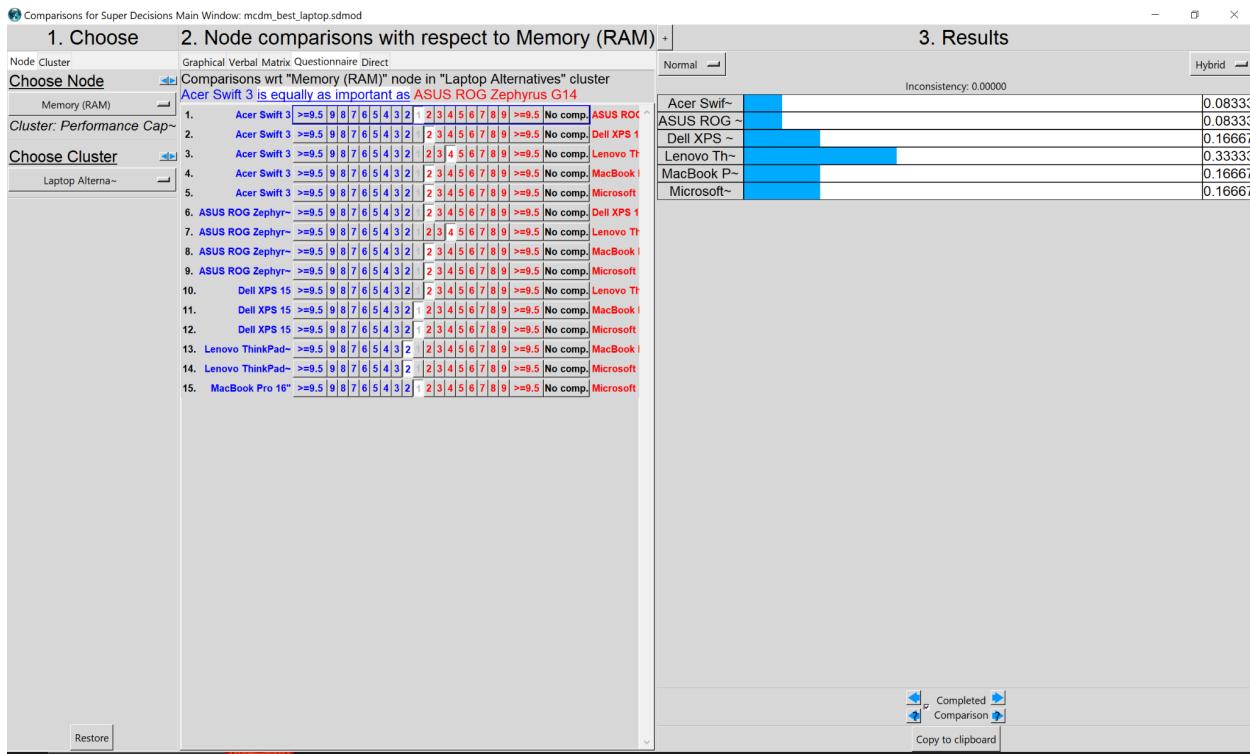
The ThinkPad P16 achieves the highest ranking because it contains an Intel Core i9 processor made for intensive AI and data analysis applications alongside professional work requirements. At the processor level both Dell XPS 15 and MacBook Pro compete alongside each other using Intel Core i7 and Apple M2 Pro processors respectively. The CPUs demonstrate superior functionality for managing various programs while handling demanding calculations. The Acer Swift 3 obtains the lowest placement among the group because its Intel Core i5 CPU is built to handle everyday activities instead of processing high-performance workloads thus unsuitable for intense computational activities.

Graphics Processing (GPU) Comparisons



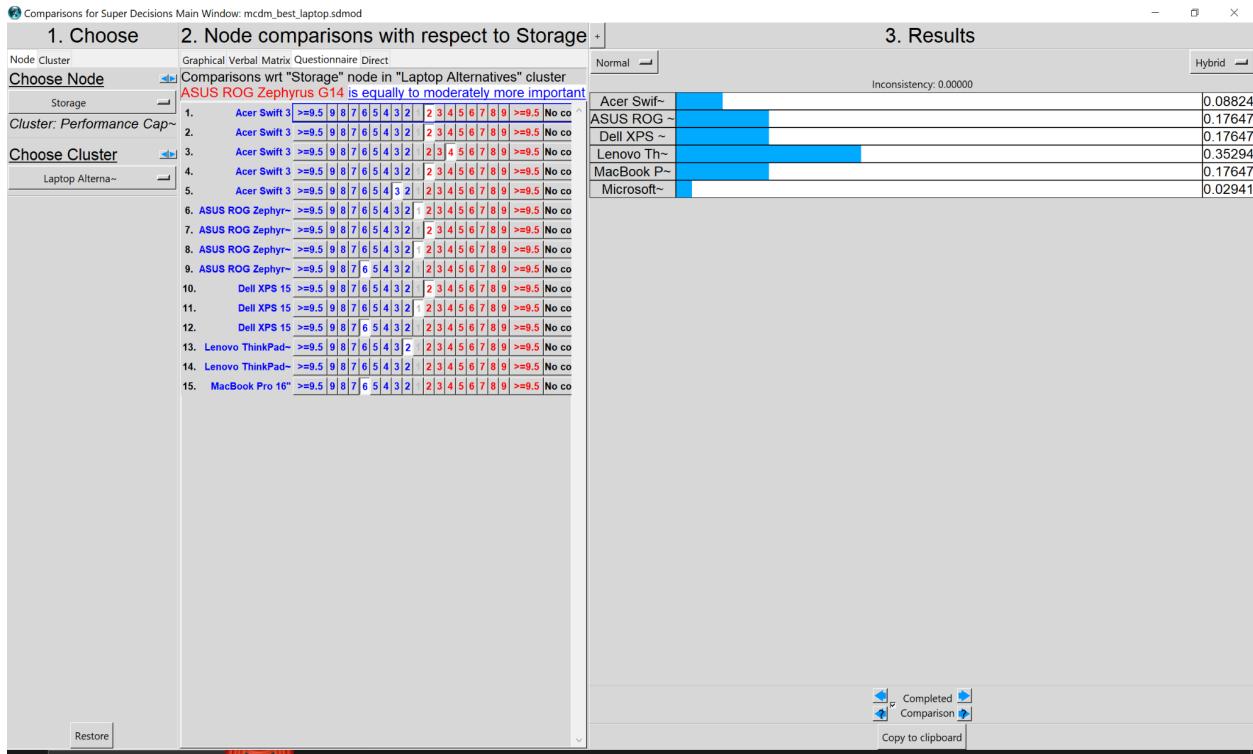
The ThinkPad P16 features an NVIDIA RTX A5500 GPU which serves professionals excellently for AI tasks and 3D operations and heavy graphical operations. Among the models ASUS ROG takes position two due to its RTX 4060 GPU that delivers outstanding gaming performance but does not match the professional capabilities of the A5500 GPU. Due to its built-in graphics the newest version of Acer Swift 3 holds the final position because these components do not meet the requirements for executing complex tasks regarding AI systems or graphics processing applications effectively.

Memory (RAM) Comparisons



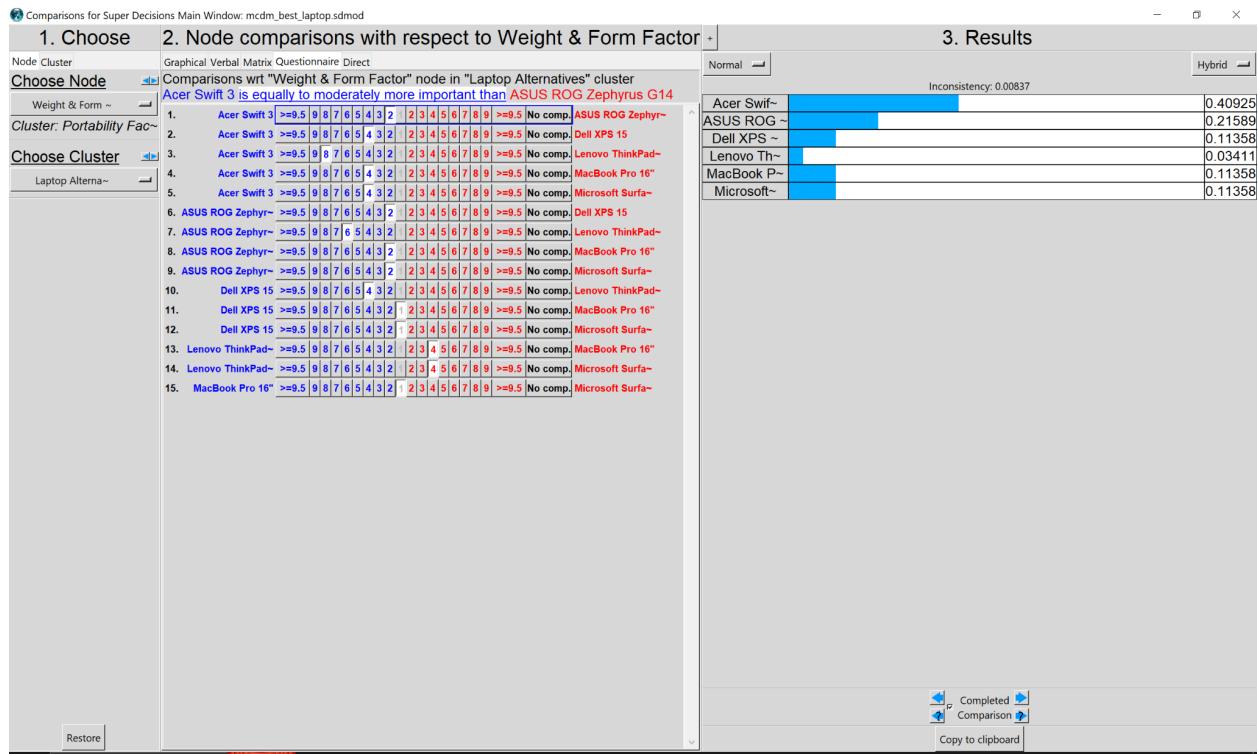
The ThinkPad P16 features 64GB of random-access memory that enables users to handle applications which demand mass memory such as virtual machines alongside large datasets. Professional activities perform smoothly with the combination of 32GB RAM found in the Dell XPS 15, MacBook Pro and Surface Studio. The ASUS ROG and Acer Swift 3 have 16GB of RAM which restricts their capacity to manage tedious multitasking together with complex memory-required programs.

Storage Comparisons



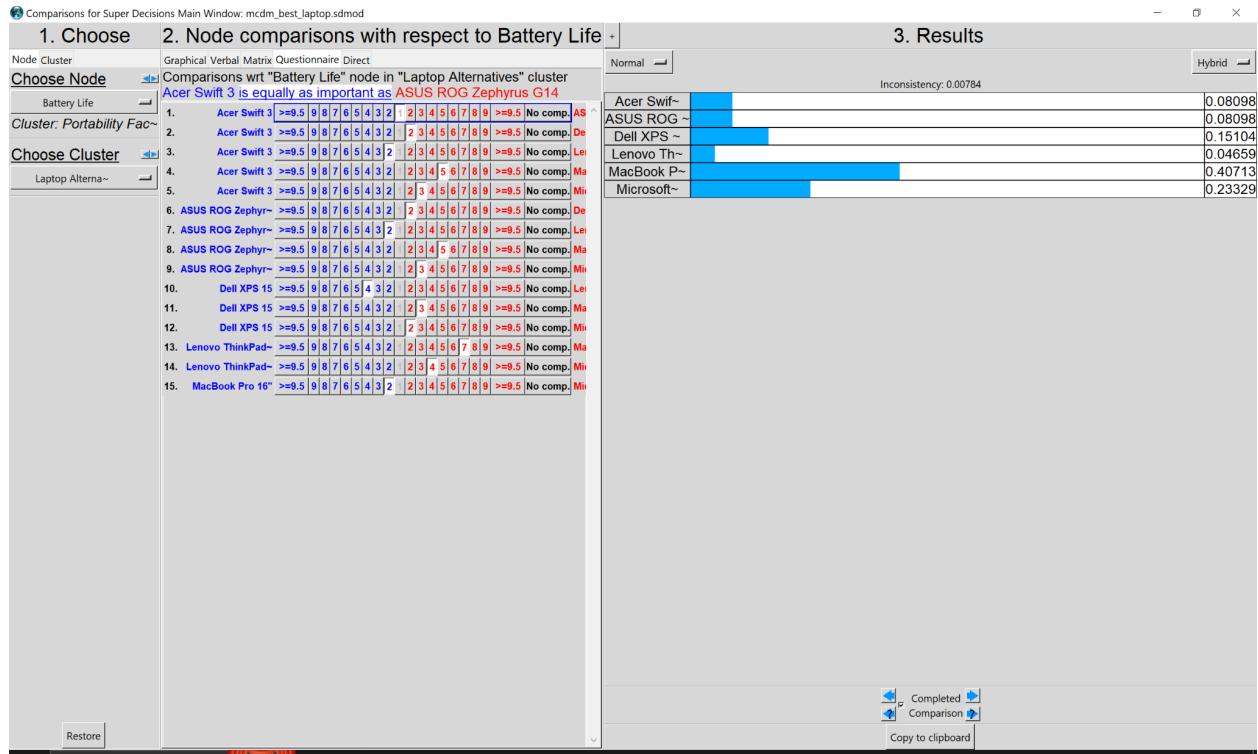
With 2TB SSD storage the ThinkPad P16 delivers enough room to accommodate large files together with multiple software programs. Besides the ThinkPad P16 most other choices including Dell XPS 15 and MacBook Pro and Surface Studio and ASUS ROG provide 1TB SSD storage that is sufficient for regular use yet insufficient for individuals who need large storage capacity. As the Acer Swift 3 features only a 512GB SSD internal memory it demonstrates the least capacity among competitors thus requiring regular use of external storage devices.

Weight & Form Factor Comparisons



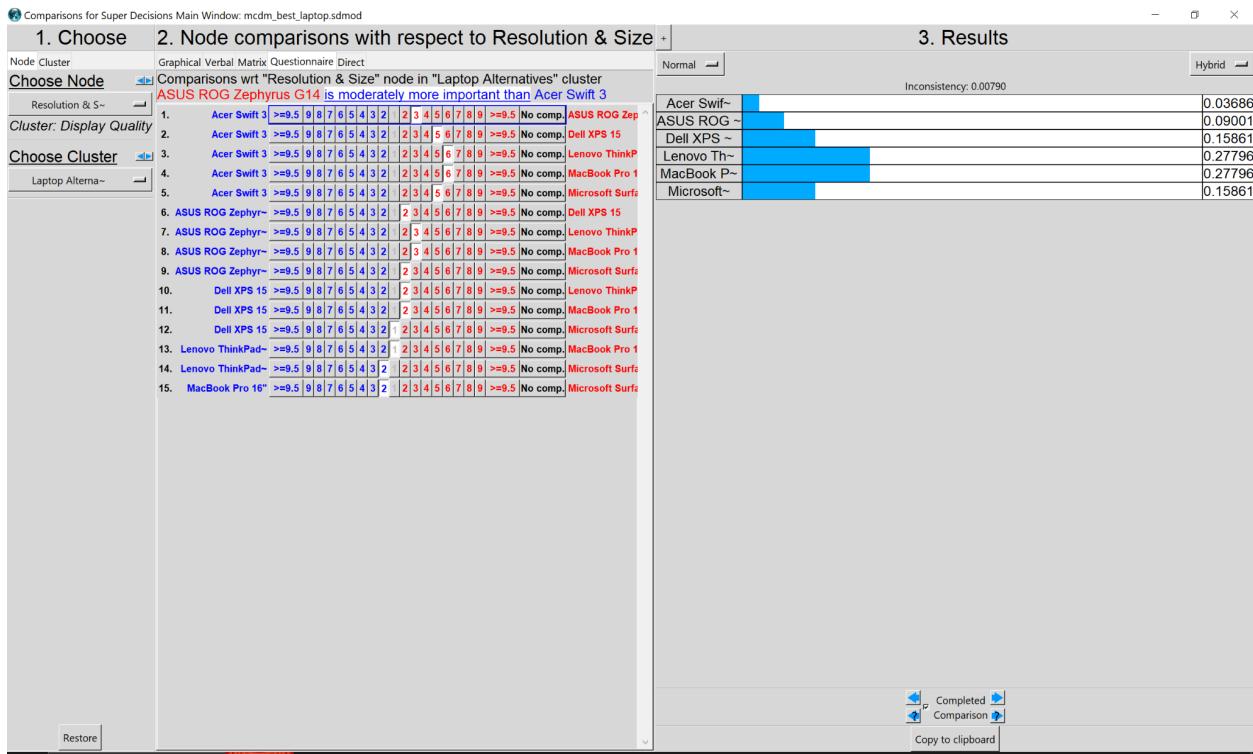
Portability functions as the central element in this assessment. Users requiring lightweight laptops should choose the Acer Swift 3 due to its exceptional weight of 1.25 kg which enhances its suitability for travel needs. The ASUS ROG weighs 1.65 kg while maintaining a good balance between transportation ease and system power. The ThinkPad P16 reaches a weight of 2.95 kg because it needs its sturdy build and advanced components yet this heavy construction reduces its portability.

Battery Life Comparisons



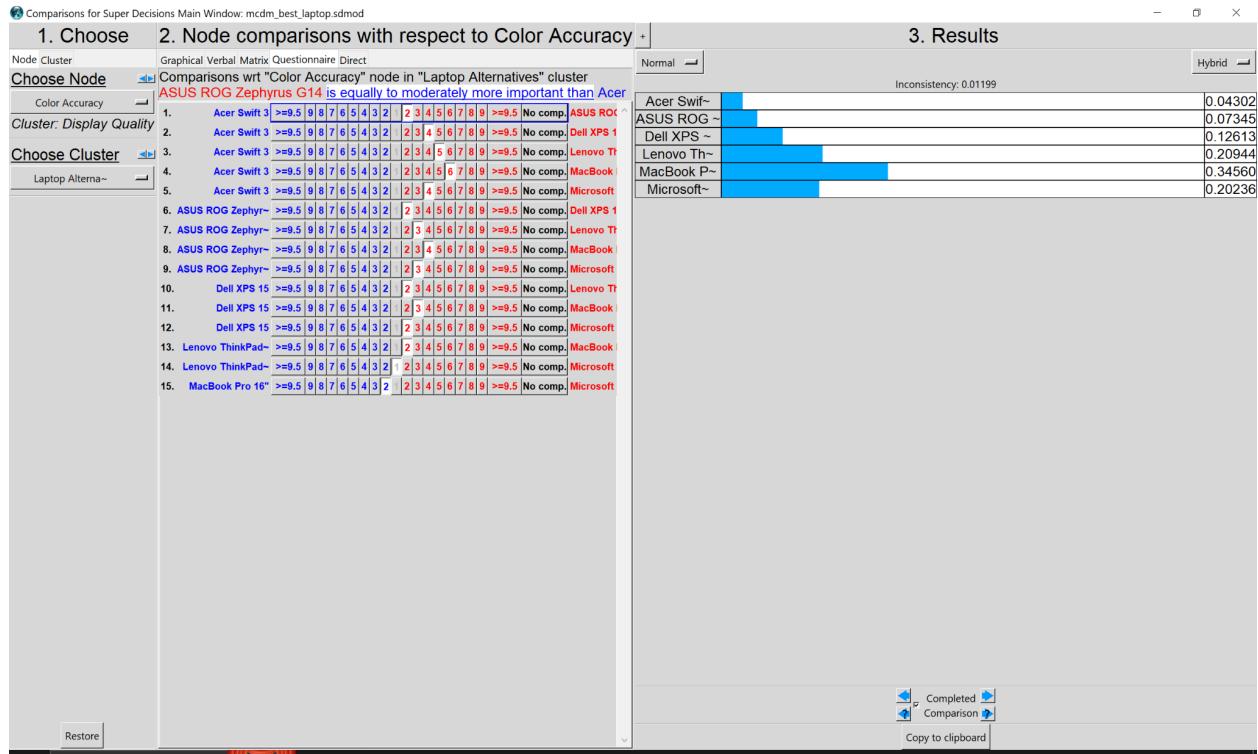
Apple achieved 18 hours of stand-by time in the MacBook Pro through efficient hardware-software optimization. The Surface Studio and Dell XPS 15 achieve battery times of 14 hours and 12 hours. The ThinkPad P16 achieves the shortest runtime of 8 hours because it contains the power-demanding combination of an RTX A5500 GPU alongside a Core i9 CPU

Resolution & Size Comparisons



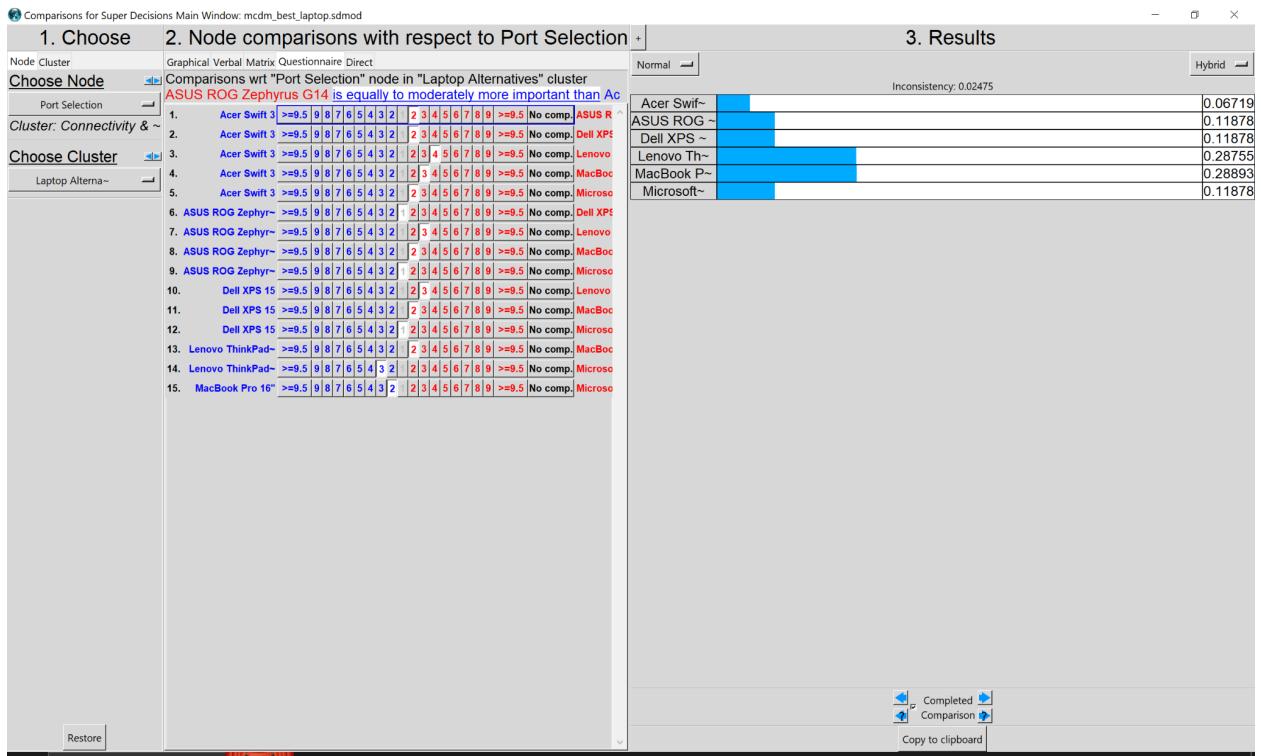
Users can find high-resolution screens across the MacBook Pro (3456 x 2234) and ThinkPad P16 (3840 x 2400) because their displays deliver exceptional visual details to creative professionals working with extensive visuals. The Acer Swift 3 achieves the lowest resolution at 1920 x 1080 making it inappropriate for demanding visual tasks.

Color Accuracy Comparisons



Due to its Liquid Retina XDR display the MacBook Pro delivers exceptional color accuracy and brightness adjustment which meets requirements for professional photo editing together with video production needs. The ThinkPad P16 and Surface Studio feature excellent displays which just surpass the capabilities of the MacBook Pro because their panel technologies vary.

Port Selection Comparisons



Having the most extensive port configuration stands out as the characteristic of ThinkPad P16 because it provides USB-A ports and Thunderbolt connectors and both HDMI output and SD card reader capabilities which make it ideal for multi-attachment needs. The Dell XPS 15 along with MacBook Pro provide modern connection features though they have restricted ports compared to ThinkPad P16

Wireless Capabilities Comparisons

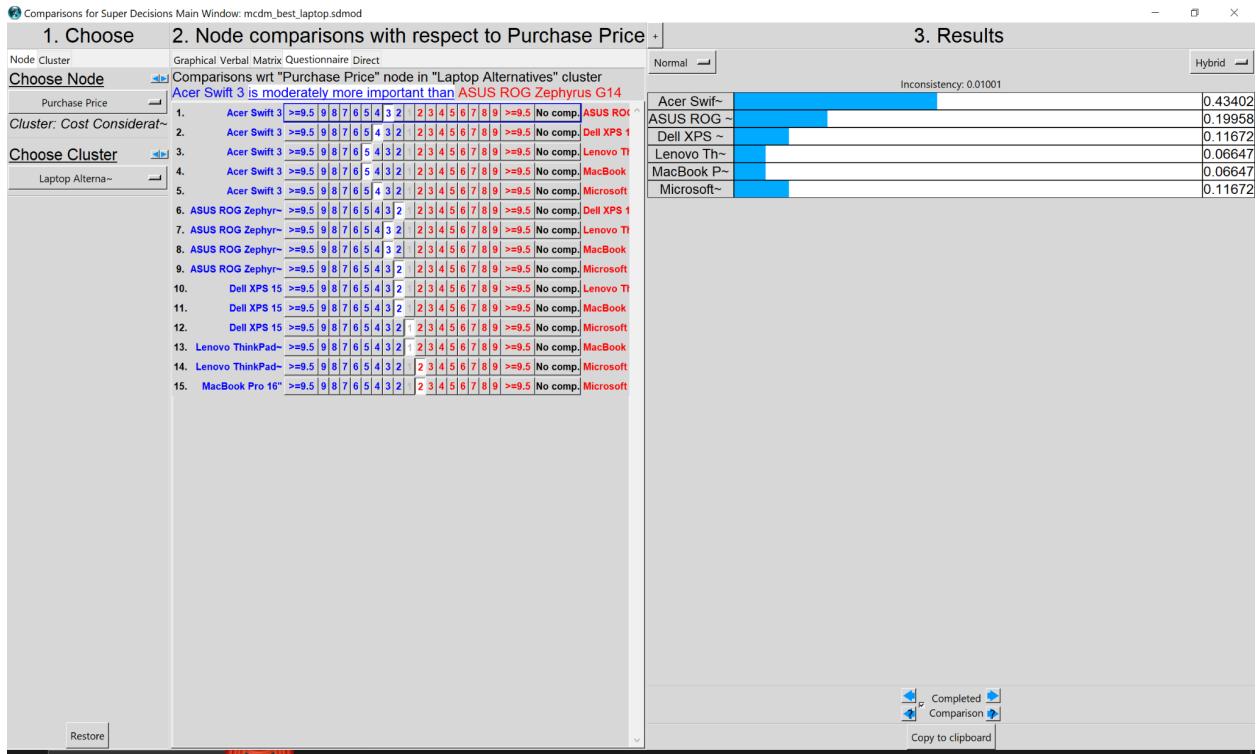
The screenshot shows the Super Decisions software interface with three main panels:

- 1. Choose**: A tree view under "Node Cluster" showing "Choose Node" and "Choose Cluster".
- 2. Node comparisons with respect to Wireless Capabilities**: A table comparing 15 laptop models based on their wireless capabilities. The columns represent different models: Acer Swift 3, ASUS ROG Zephyrus G14, Dell XPS 15, Lenovo ThinkPad P16, MacBook Pro 16", Microsoft Surface Studio, and others. The rows show the comparison results between these models.
- 3. Results**: A table showing the inconsistency values for each model. The inconsistency values are all 0.00000, indicating no significant inconsistency.

	Acer Swift~	ASUS ROG ~	Dell XPS ~	Lenovo Th~	MacBook P~	Microsoft~
Inconsistency:	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

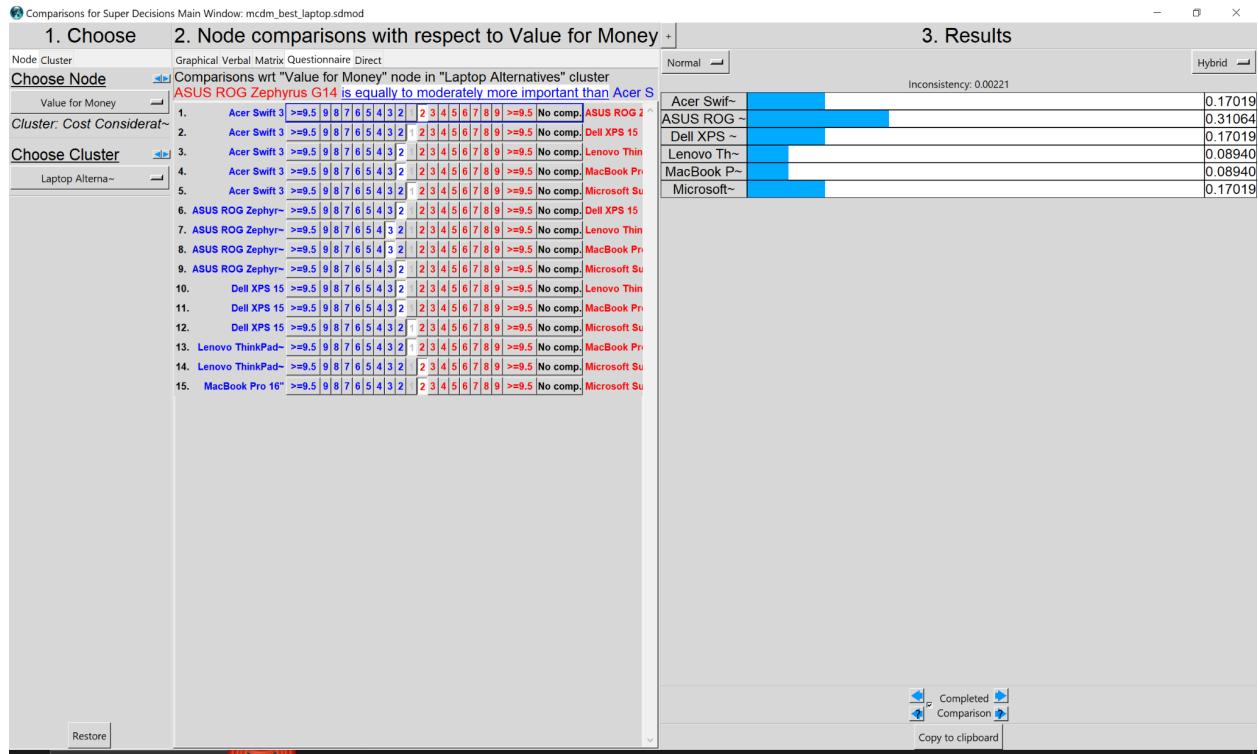
The ThinkPad P16 and ASUS ROG along with MacBook Pro and Surface Studio rank higher in the evaluation because Wi-Fi 6E capability enables them to use high-speed wireless connections on empty bands which Wi-Fi 6 devices Dell XPS 15 and Acer Swift 3 lack

Purchase Price Comparisons



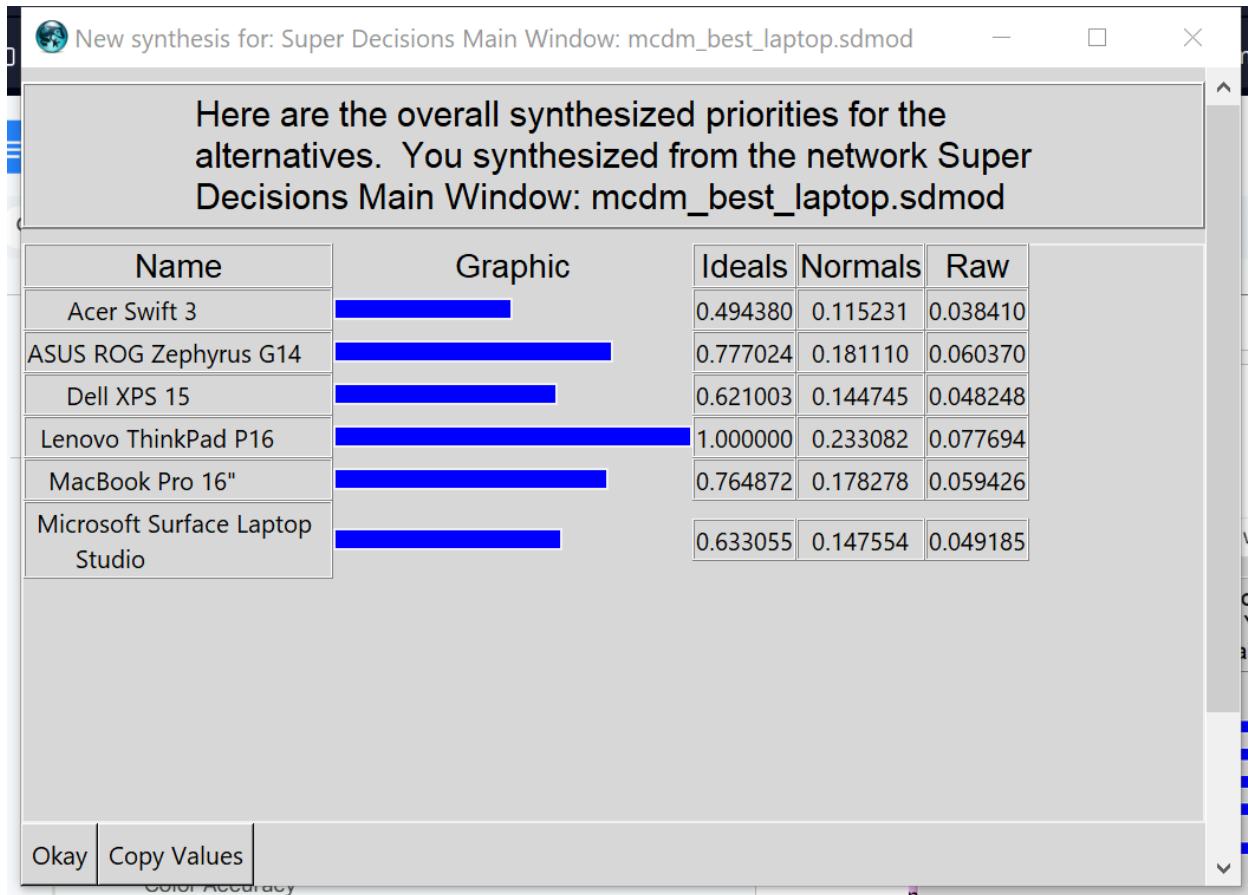
Users seeking affordability should choose the Acer Swift 3 since it costs between \$800 to \$950 and delivers basic functionality without fancy components. The ASUS ROG exists as a mid-range gaming laptop between inexpensive products and high-end offerings in its price segment. There is a reason why the ThinkPad P16 stands as the most expensive option since it includes premium components which elevate its price reach from \$3,500 up to \$4,000.

Value for Money Comparisons



Users seeking gaming abilities with pro features get the best value through ASUS ROG since it delivers powerful performance at a competitive price level. The premium pricing of ThinkPad P16 and MacBook Pro yields inferior value for money compared to their cost despite their superior technical specifications

Once the pairwise comparisons for all the Clusters and Nodes within were performed, the Synthesize selection from the drop down menu was selected in order to get the final ranking of the 6 alternatives proposed for the GOAL of this assignment. On synthesizing the following results were obtained:



The above synthesized priorities represent the overall ranking of alternatives based on the defined criteria and pairwise comparisons. The table includes three columns:

1. Ideals: This basically normalizes all the values relative to the highest priority alternative, i.e in our case Lenovo Thinkpad, which is assigned a value of 1. It shows how close the alternatives are to the best options
2. Normals: This column represents the normalized values where the sum of all priorities equals to 1 thereby providing a proportional comparison across the alternatives
3. Raw: These are the unnormalized values which have been directly derived from the calculations, i.e raw scores.

The following table provides a detailed explanation of the synthesized results:

Alternative	Priority	Justification
Lenovo ThinkPad P16	1	<p>The ThinkPad P16 emerges as the ideal choice because it demonstrates top performance in processor ability and graphics processing unit capability alongside abundant RAM memory and expandable internal storage and multiple connectivity ports. The machine excels specifically for data science and AI workloads because of its performance attributes.</p> <p>The leading position of the ThinkPad P16 in all normalized metrics is due to its superior performance across technical specifications.</p>
MacBook Pro 16"	2	<p>The MacBook Pro qualifies as an outstanding option with an ideal ranking at 0.764 because it delivers outstanding battery duration with its XDR display and adequate color precision features. The ThinkPad P16 outperforms the MacBook Pro 16" when it comes to GPU performance as well as port selection capabilities.</p>
ASUS ROG Zephyrus G14	3	<p>The ASUS ROG combines performance power with an inexpensive price for its RTX 4060 GPU setup thus achieving an ideal rating of 0.777. The device provides good monetary value despite its deficiency of professional-grade capabilities available in the ThinkPad P16</p>
Microsoft Surface Laptop Studio	4	<p>While the Surface Laptop Studio delivers outstanding battery times with impressive display features its below-average GPU</p>

		capability pushes up its price beyond its capabilities.
Dell XPS 15	5	Among its solid specification set the Dell XPS 15 does not lead in any specific feature when compared to superior alternatives that rank higher. This system maintains reasonable GPU and battery performance that stands average among its competitors
Acer Swift 3	6	Acer Swift 3 finds its position at the bottom because it has an average CPU combined with built-in graphics and only offers 16GB of RAM and 512GB of storage. Lightweight along with affordability do not outweigh how such adjustments render this system useless for demanding AI and data science operations.

Here are the priorities printed for each Cluster and their subsequent Nodes. It provides a breakdown of the priorities for the various criteria and alternatives and helps explain how the final synthesized rankings were actually derived. The table has the following 3 columns:

1. Names: This column lists the criteria, sub-criteria and the defined alternatives used by the Decision Making Model
2. Normalized by Cluster: This shows the relative importance of each item within its cluster. For example, The importance of Processor (CPU) within the Performance Capabilities Cluster.
3. Limiting: This column basically represents the global priority of each item across all the clusters and it is used for computing the overall ranking of all the alternatives.

1. Criteria Priorities

The ranking at the top of the table for "Port Selection" and "Wireless Capabilities" and additional criteria refers to their significance for attaining the objective of "Select Best Laptop for DS & AI Student". Each cluster weight rating can be found in the "Normalized by Cluster" column and gives an overview of how each criterion affects the final decision outcome. Performance capabilities (0.38001) function as the main priority factor because data science and AI students need solid hardware to perform model training and data processing tasks. The criteria of Portability Factors and Battery Life are important for students who need mobile work capabilities but hold less significance than other factors (0.13898 and 0.10669 respectively). The factor of cost receives substantial weight in the assessment reflecting a need for good price-quality relationship when selecting a computer.

2. Sub-Criteria Priorities

Every criterion possesses distinct sub-criteria which receive ranking according to their significance level. The dominant sub-components in Performance Capabilities are Graphics Processing (GPU) with 0.12066 points followed by Processor (CPU) with a score of 0.23887 because they determine AI workload execution. Weight & Form Factor at 0.33333 holds greater importance than the laptop run-time because portability needs to be prioritized.

3. Alternative Priorities

The evaluation process rates each laptop option by every criterion and its sub-criteria. Laptop performance rankings within distinct evaluation clusters become visible through their computed Normalized by Cluster scores. The analyzing process uses Limiting values to determine device ranking by assessing their general cluster significance throughout the final evaluation.

For example: Among its critical criteria such as CPU and GPU and RAM and storage the Lenovo ThinkPad P16 shows outstanding performance which gives it a high

limiting value of 0.077694. Despite its affordable price and light weight the Acer Swift 3 ranks lower than other models because of its reduced limiting value of 0.038410.

Thus, the table below actually breaks down how each criterion and alternative contributes to the final rankings. The global priorities i.e, the limiting values for alternatives are summed up across various criteria to calculate final scores provided in the synthesized results table. Finally, high priority criteria like “Performance Capabilities” have a greater influence on these scores. This is one such reason why Lenovo Thinkpad P16 was ranked the highest.

Super Decisions Main Window: mcdm_best_laptop....

Here are the priorities.

Icon	Name	Normalized by Cluster	Limiting
No Icon	Port Selection	0.66667	0.017752
No Icon	Wireless Capabilities	0.33333	0.008876
No Icon	Purchase Price	0.25000	0.020800
No Icon	Value for Money	0.75000	0.062400
No Icon	Color Accuracy	0.33333	0.016836
No Icon	Resolution & Size	0.66667	0.033672
No Icon	Select Best Laptop for DS & AI Student	0.00000	0.000000
No Icon	Acer Swift 3	0.11523	0.038410
No Icon	ASUS ROG Zephyrus G14	0.18111	0.060370
No Icon	Dell XPS 15	0.14474	0.048248
No Icon	Lenovo ThinkPad P16	0.23308	0.077694
No Icon	MacBook Pro 16"	0.17828	0.059426
No Icon	Microsoft Surface Laptop Studio	0.14756	0.049185
No Icon	Connectivity & Expandability	0.07988	0.026627
No Icon	Cost Considerations	0.24960	0.083200
No Icon	Display Quality	0.15153	0.050509
No Icon	Performance Capabilities	0.38001	0.126670
No Icon	Portability Factors	0.13898	0.046327
No Icon	Graphics Processing (GPU)	0.43366	0.054931
No Icon	Memory (RAM)	0.23887	0.030257
No Icon	Processor (CPU)	0.23887	0.030257
No Icon	Storage	0.08861	0.011224
No Icon	Battery Life	0.66667	0.030885
No Icon	Weight & Form Factor	0.33333	0.015442
Okay		Copy Values	

Sensitivity Analysis

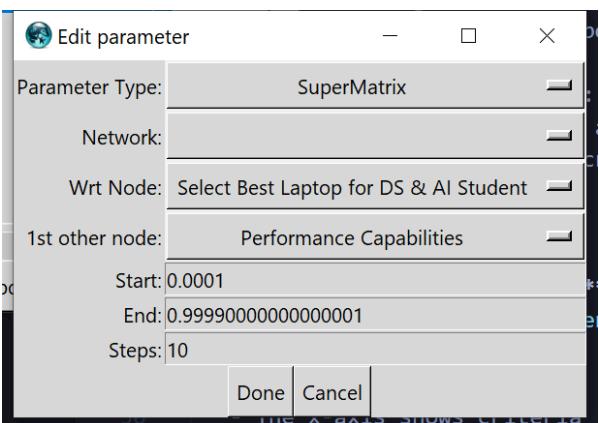
We perform sensitivity analysis in order to examine how changes in the criteria weights affect the overall ranking of the alternatives. This helps in a number of ways:

- Determine whether the decision is robust or susceptible to small fluctuations in judgement
- To identify the critical criteria which significantly impacts the final decisions
- It helps build confidence in the recommendations made by one based on the Model's decisions

In order to perform sensitivity analysis, we first configure the sensitivity parameters.

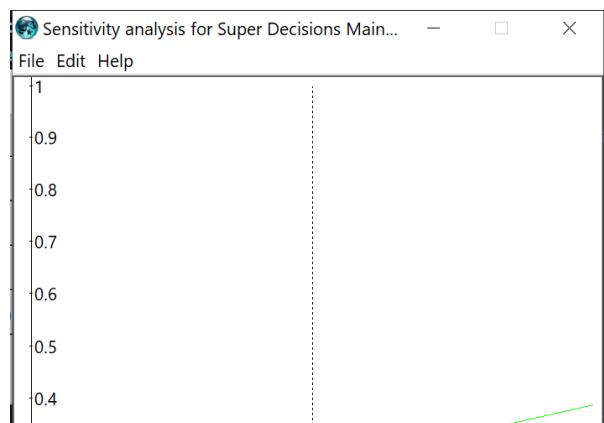
Here are the variations I have tried on for recording the sensitivity analysis:

Scenario 1: Choosing the best laptop with variations in Performance Capabilities



Sensitivity analysis for Super Decisions Main...

File Edit Help



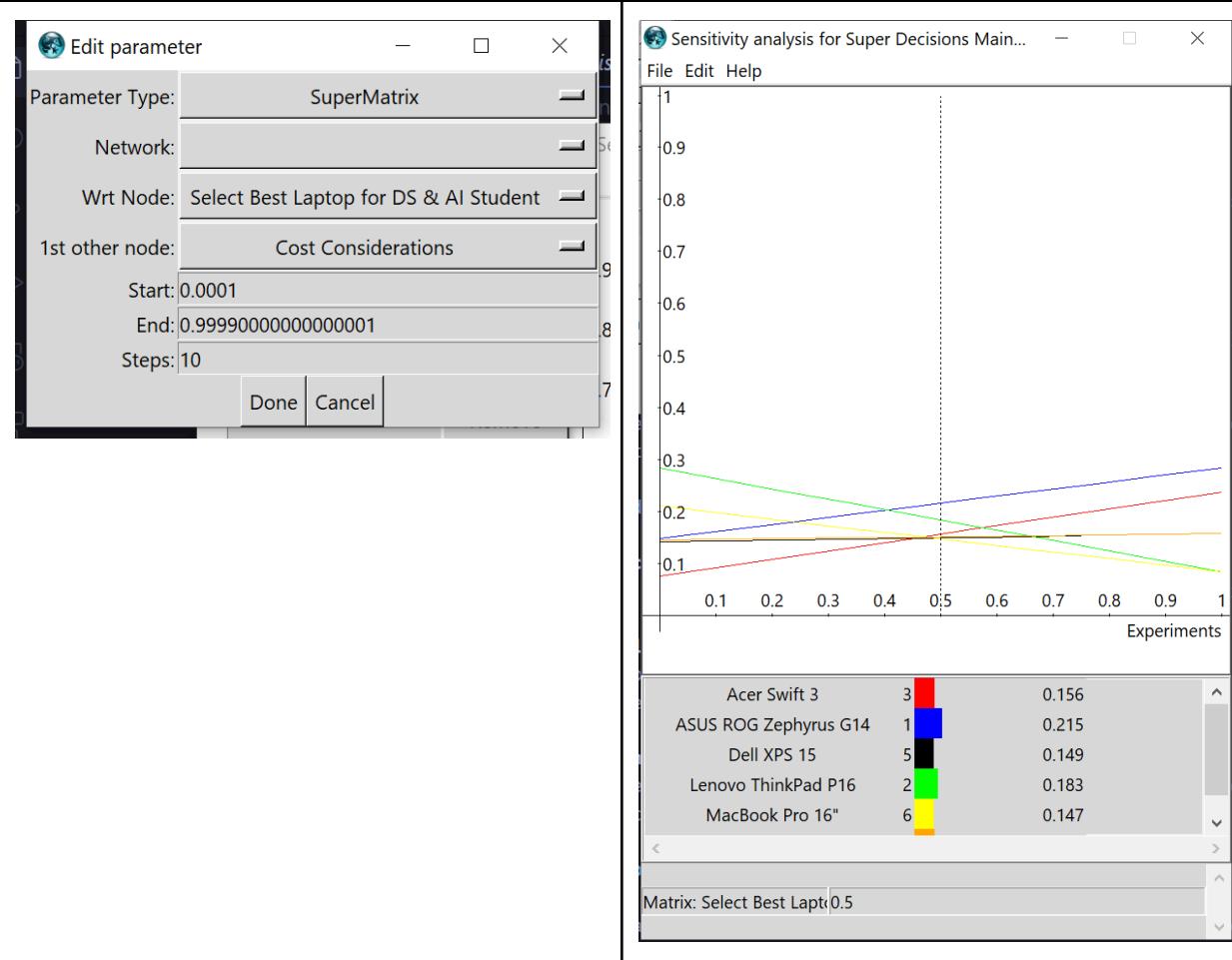
Laptop Model	Category	Score
Acer Swift 3	Red	0.102
ASUS ROG Zephyrus G14	Blue	0.181
Dell XPS 15	Black	0.145
Lenovo ThinkPad P16	Green	0.263
MacBook Pro 16"	Yellow	0.168

Matrix: Select Best Lapt[0.5]

Interpretation: If Performance Capability threshold is kept at around 21%, Macbook

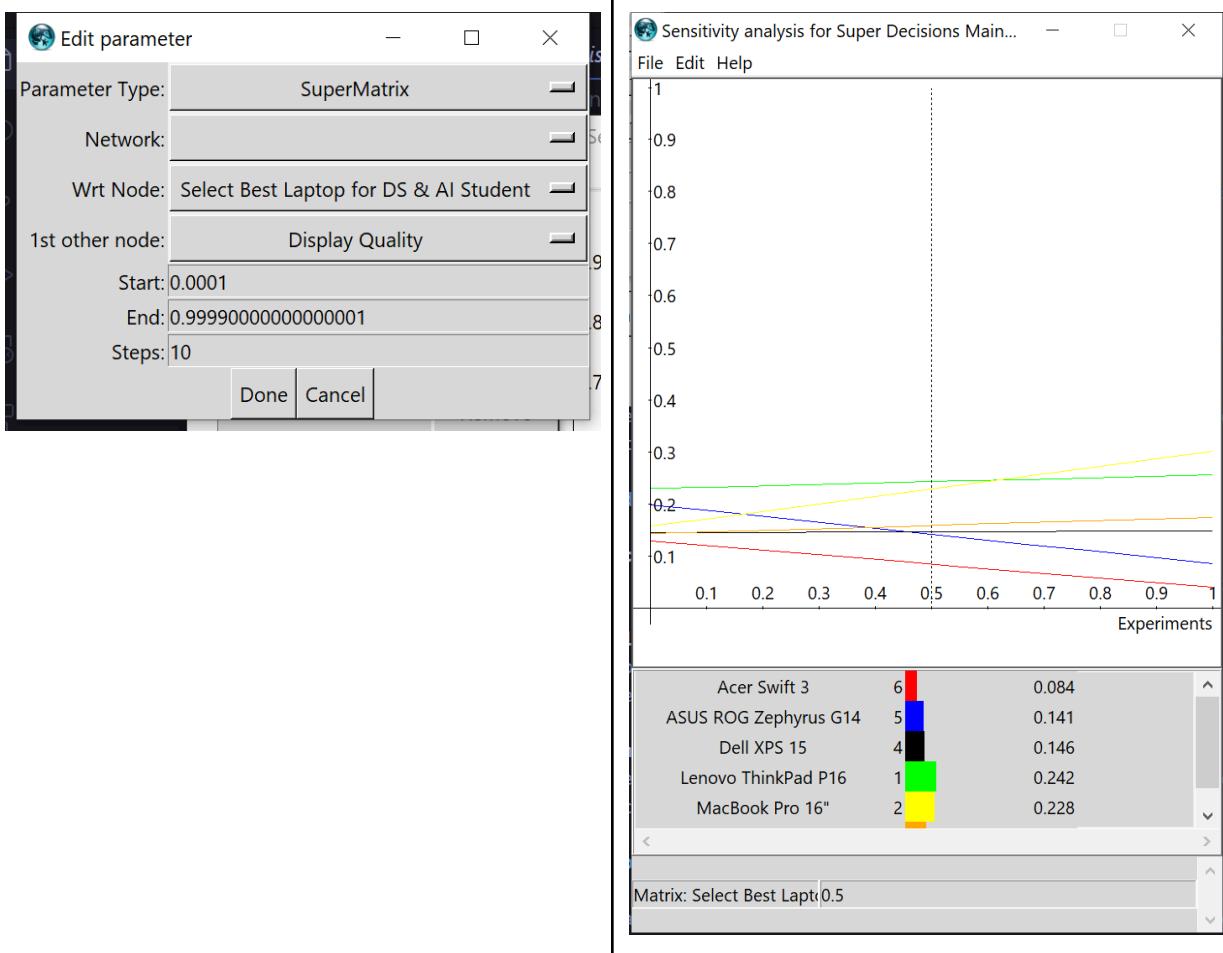
Pro 16" is preferred. As you increase the weight of Performance Capability, Lenovo takes a huge leap. ASUS ROG is a great alternative if you do not wish to reduce the weights of Performance Capabilities in the long run.

Scenario 2: Choosing the best laptop with variations in Cost Considerations



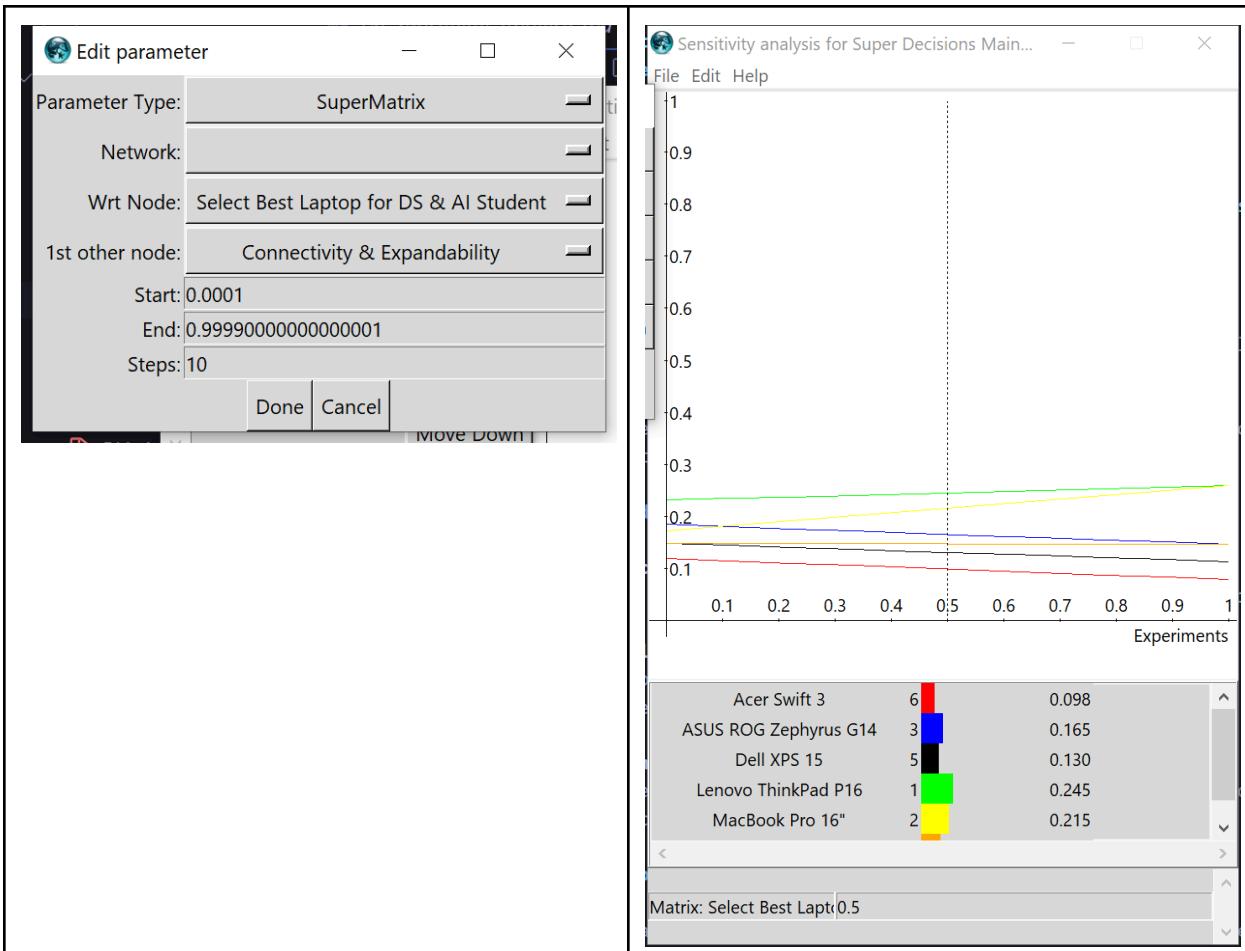
Interpretation: As you increase weights for Cost Considerations, Lenovo Thinkpad P16 becomes a costly choice, we see that ASUS ROG is the best choice if you want a good deal for your money. As you further decrease the weights, Acer being the cheapest is the preferred choice if you do not have money at all.

Scenario 3: Choosing the best laptop with variations in Display Quality



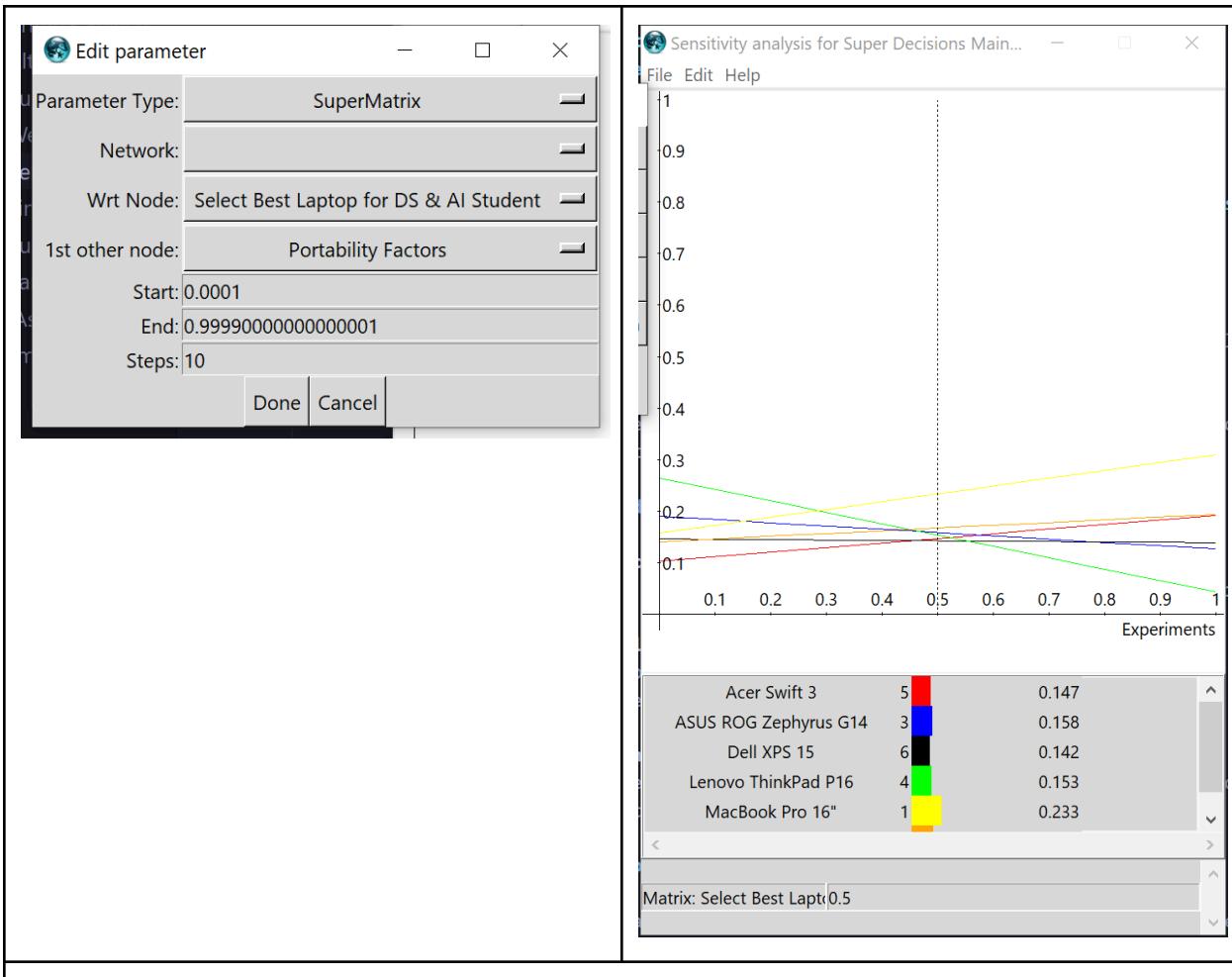
Interpretation: Increasing the weights for display beyond 50%, Macbook Pro 16" is preferred and Lenovo Thinkpad P16 takes the second spot. The third best choice is Microsoft's Surface laptop

Scenario 4: Choosing the best laptop with variations in Connectivity and Expandability



Interpretation: In terms of Connectivity and Expandability, Lenovo Thinkpad P16 consistently remains on the top with Macbook Pro 16" catching up eventually. The third best choice in terms of overall Connectivity and Expandability is the Asus ROG Laptop.

Scenario 5: Choosing the best laptop with variations in Portability Factors

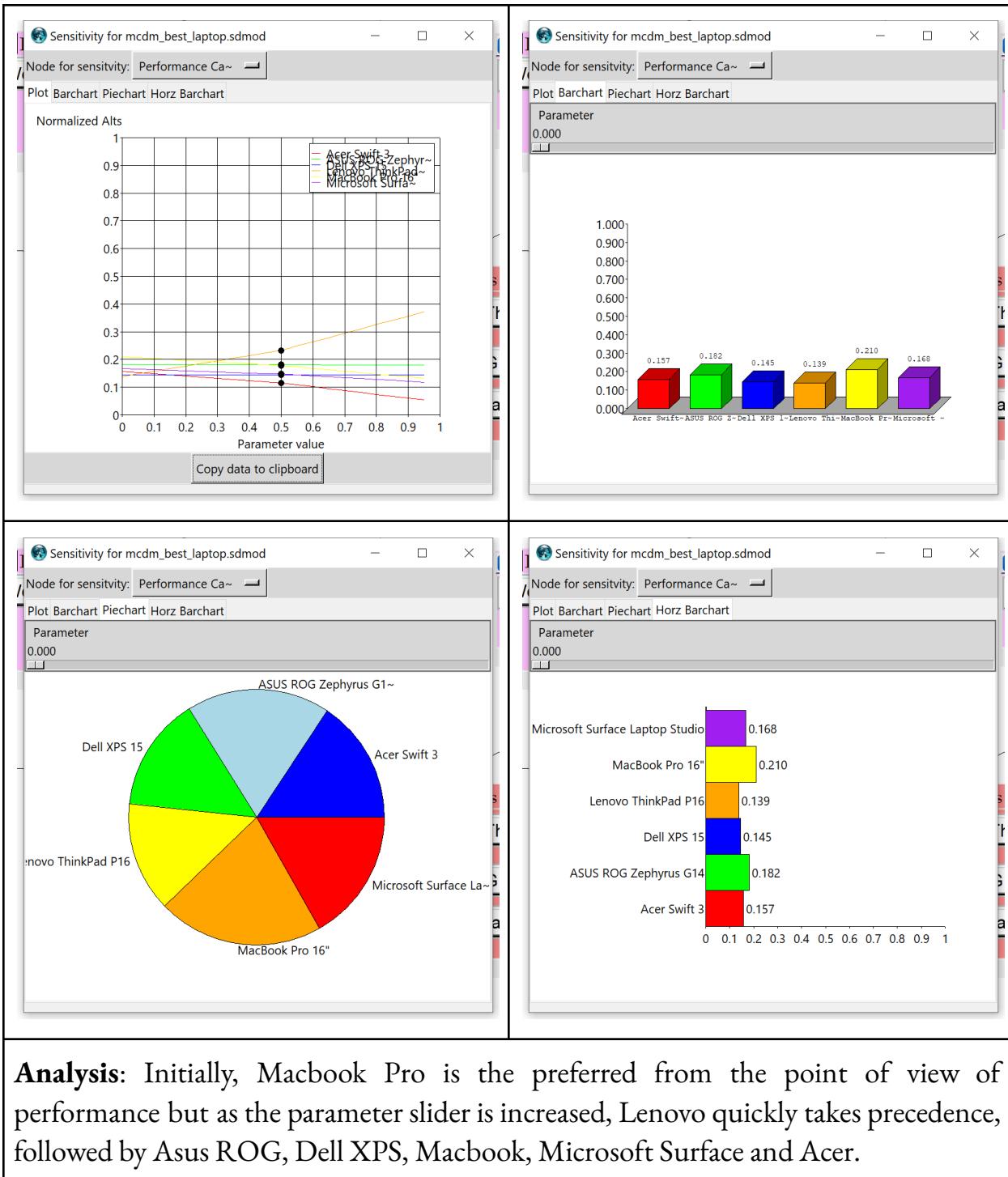


Interpretation: As you increase the weights and provide more importance to Portability, say beyond 50%, Macbook Pro 16" becomes the preferred choice, followed by Microsoft Surface. Since the Lenovo laptop is bulky due to performance components, it takes a hit when too much importance is laid on the Portability Factor

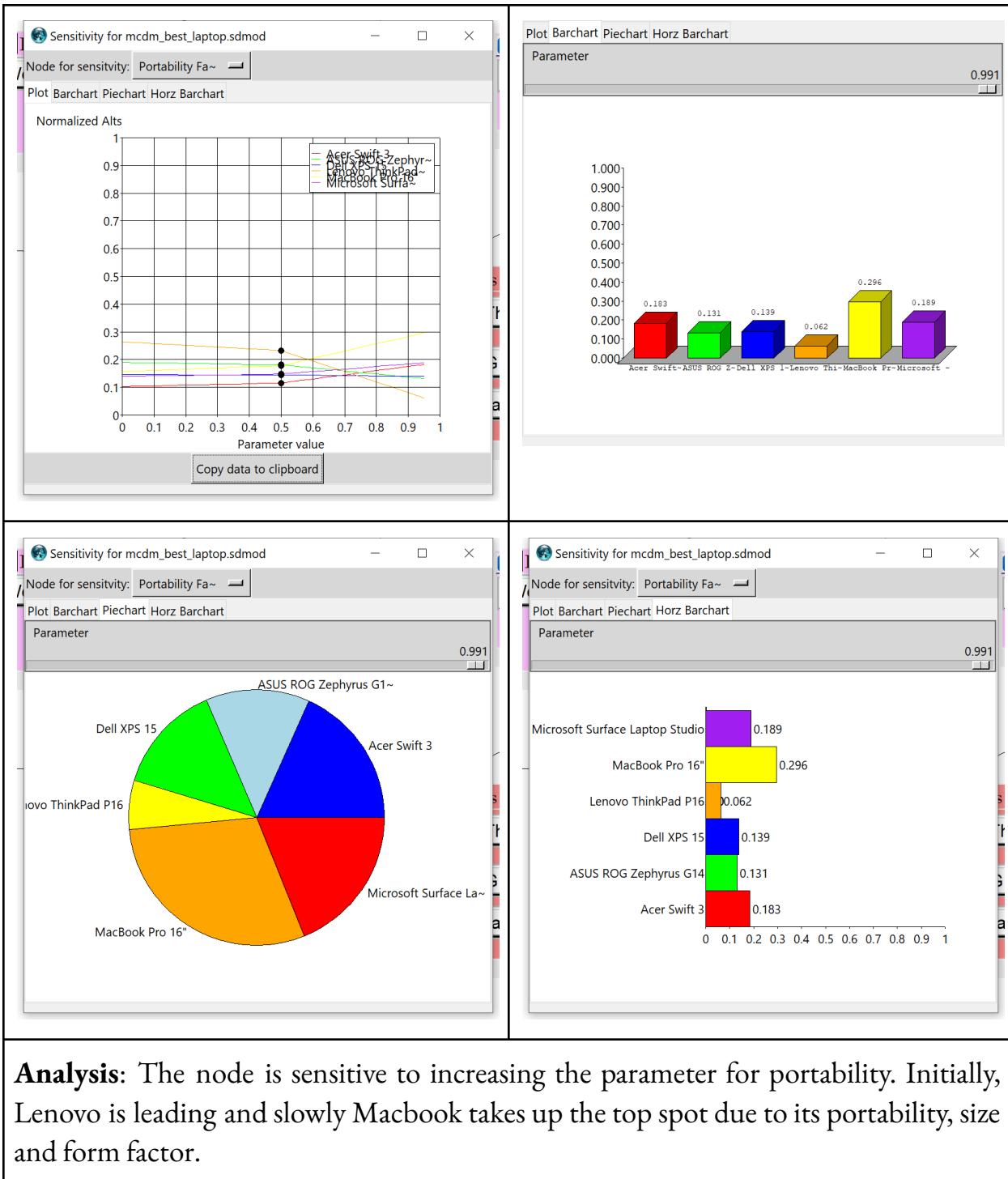
Node Sensitivity Analysis

This section provides detailed node analysis for each Node present in our AHP Model structure:

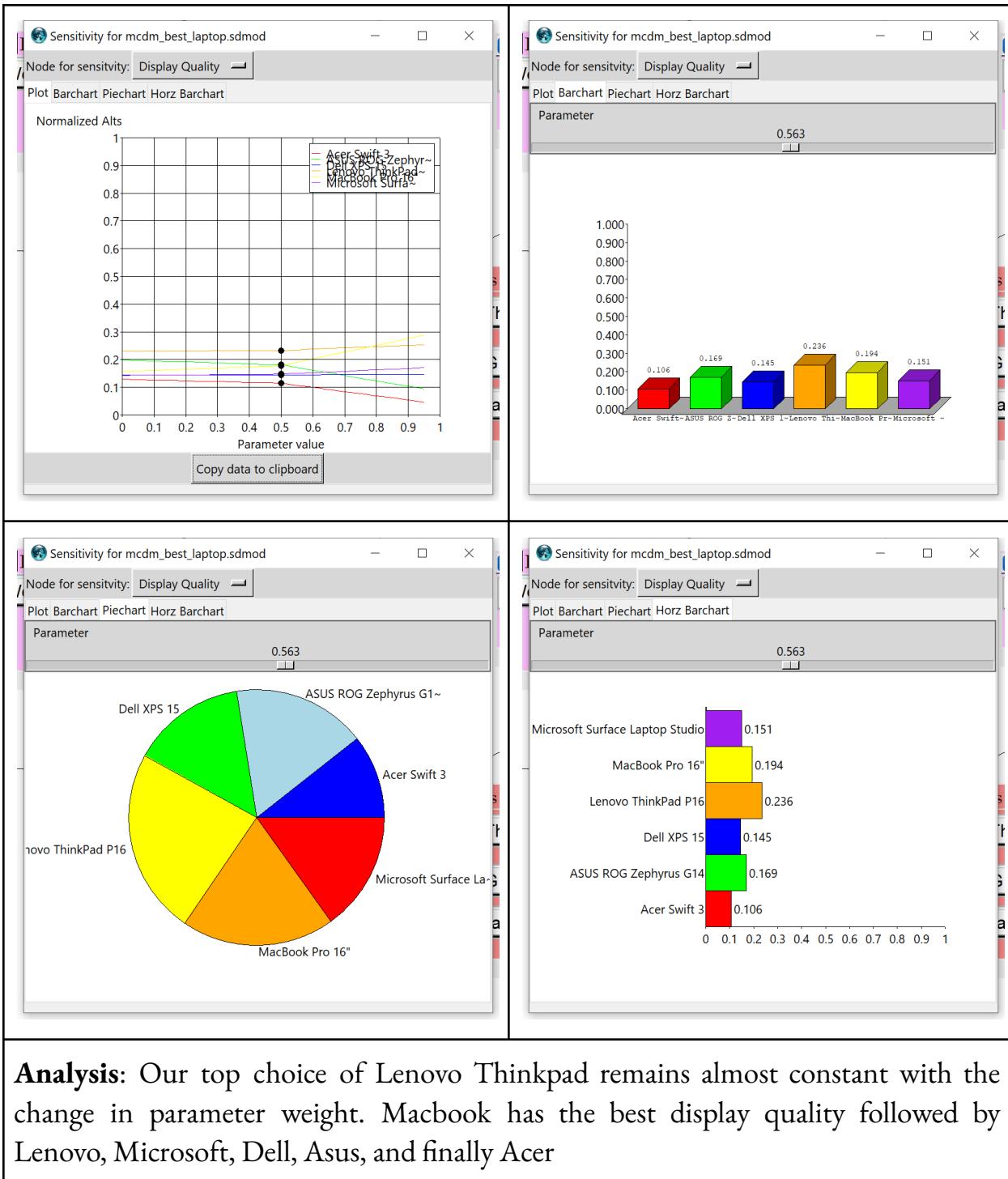
Main Criteria Cluster Node: Performance Capabilities



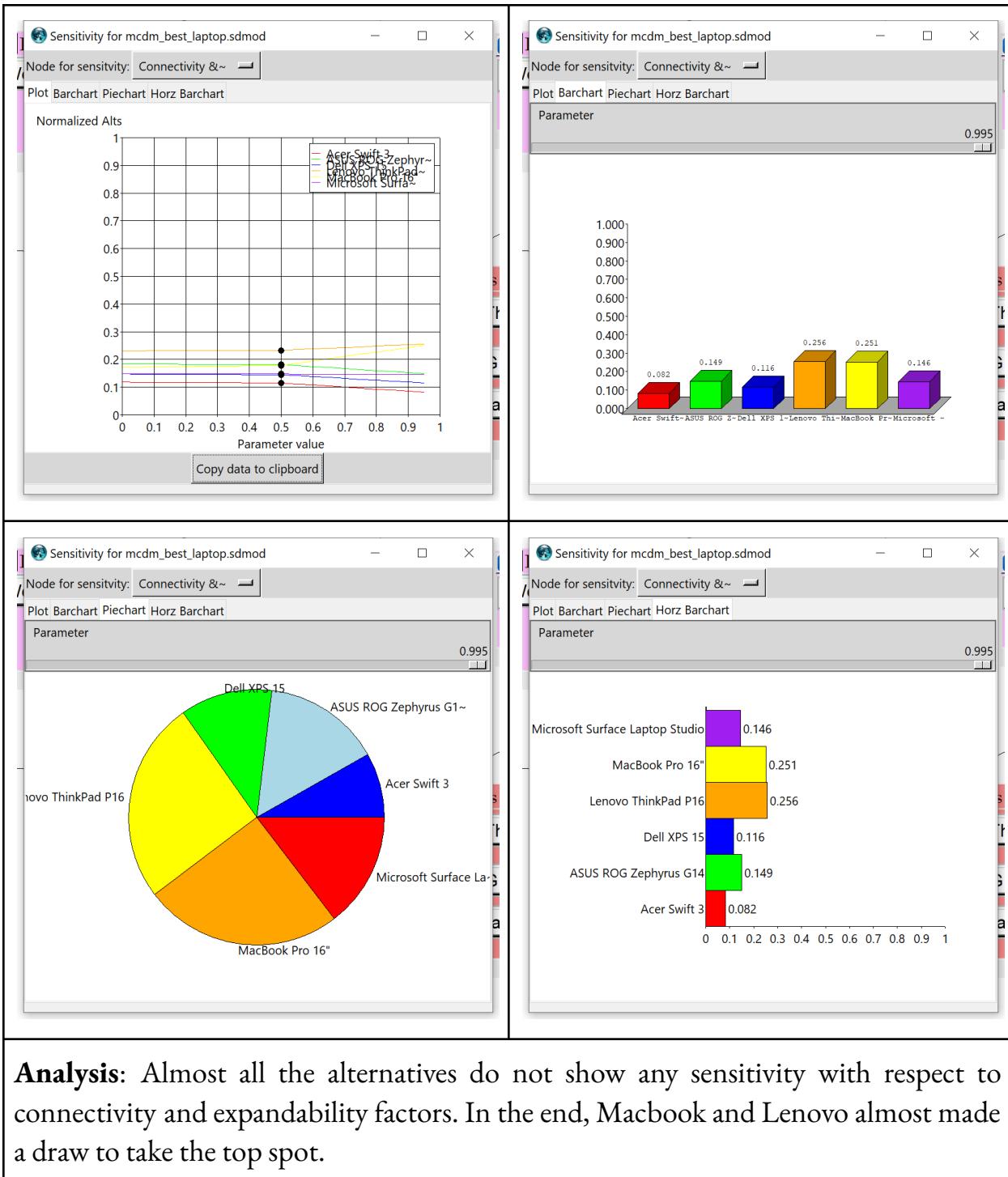
Main Criteria Cluster Node: Portability Factors



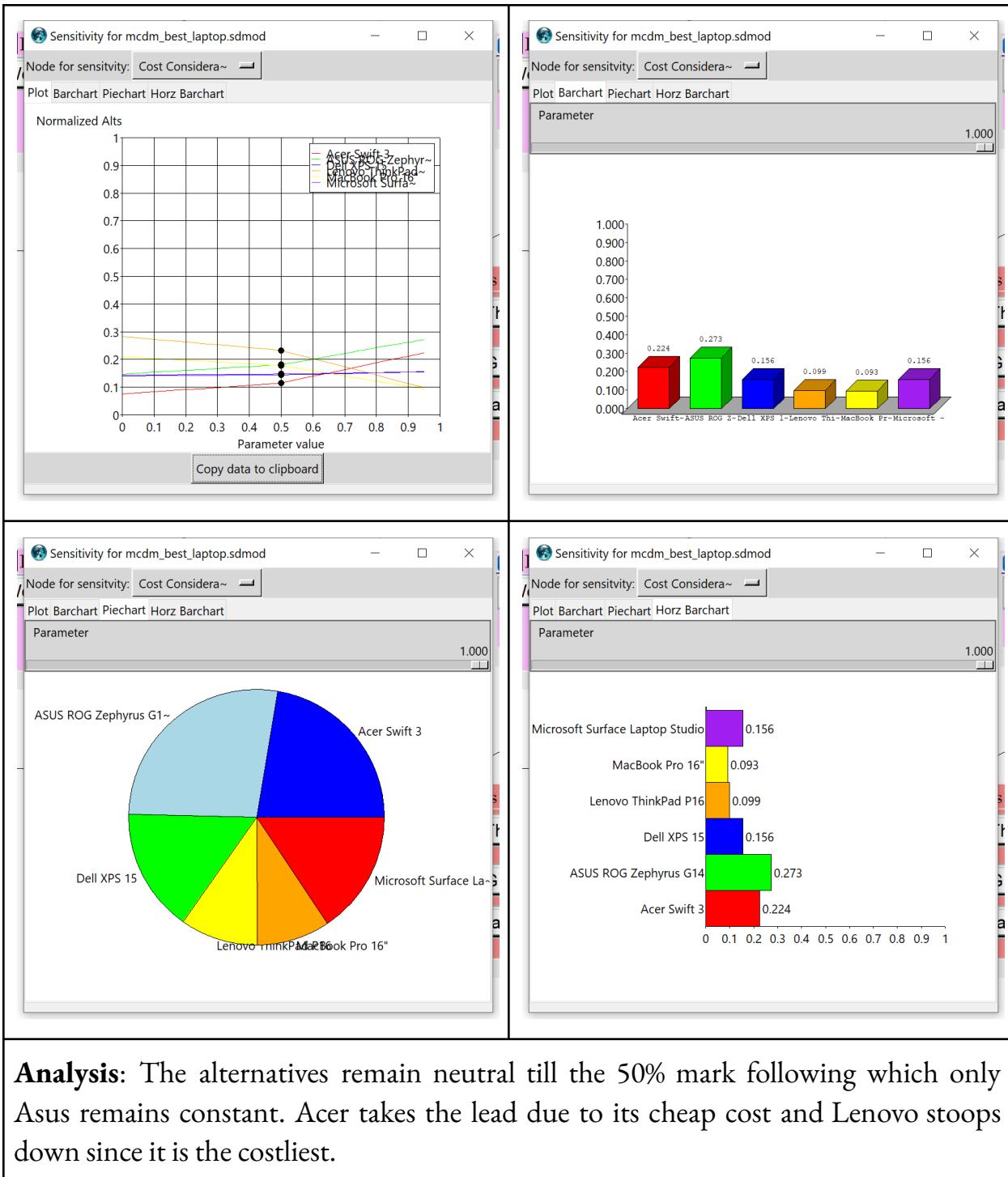
Main Criteria Cluster Node: Display Quality



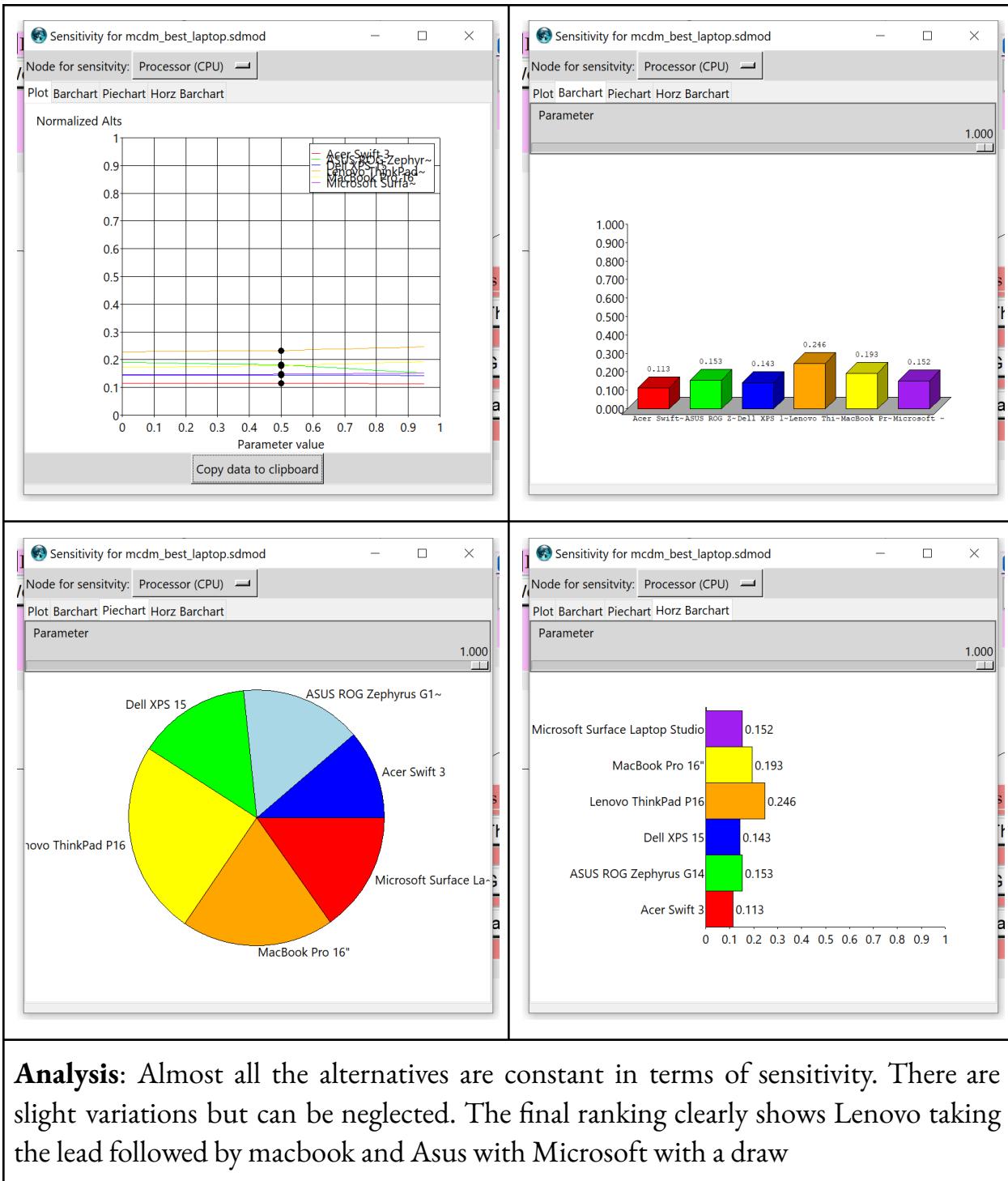
Main Criteria Cluster Node: Connectivity & Expandability



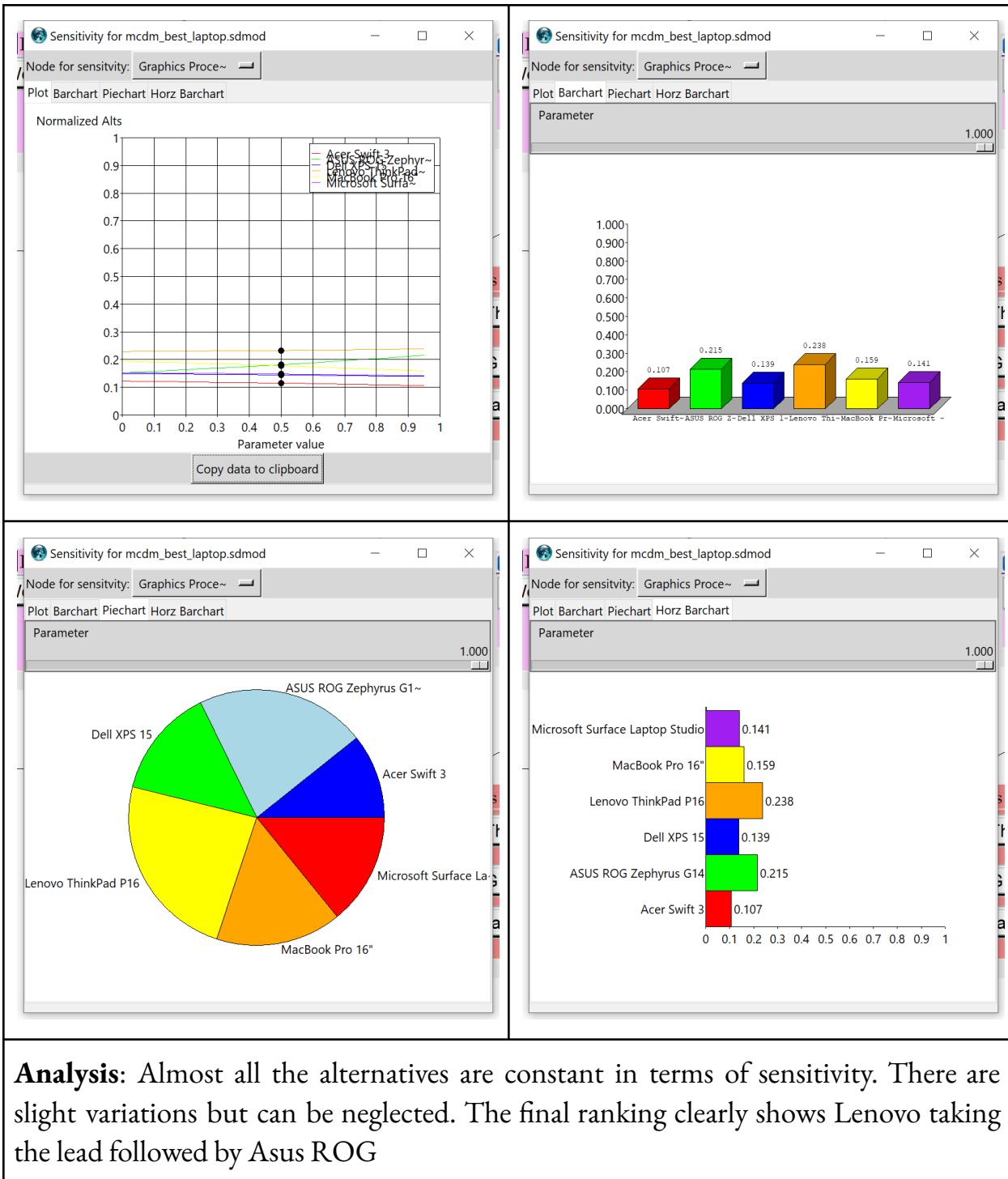
Main Criteria Cluster Node: Cost Considerations



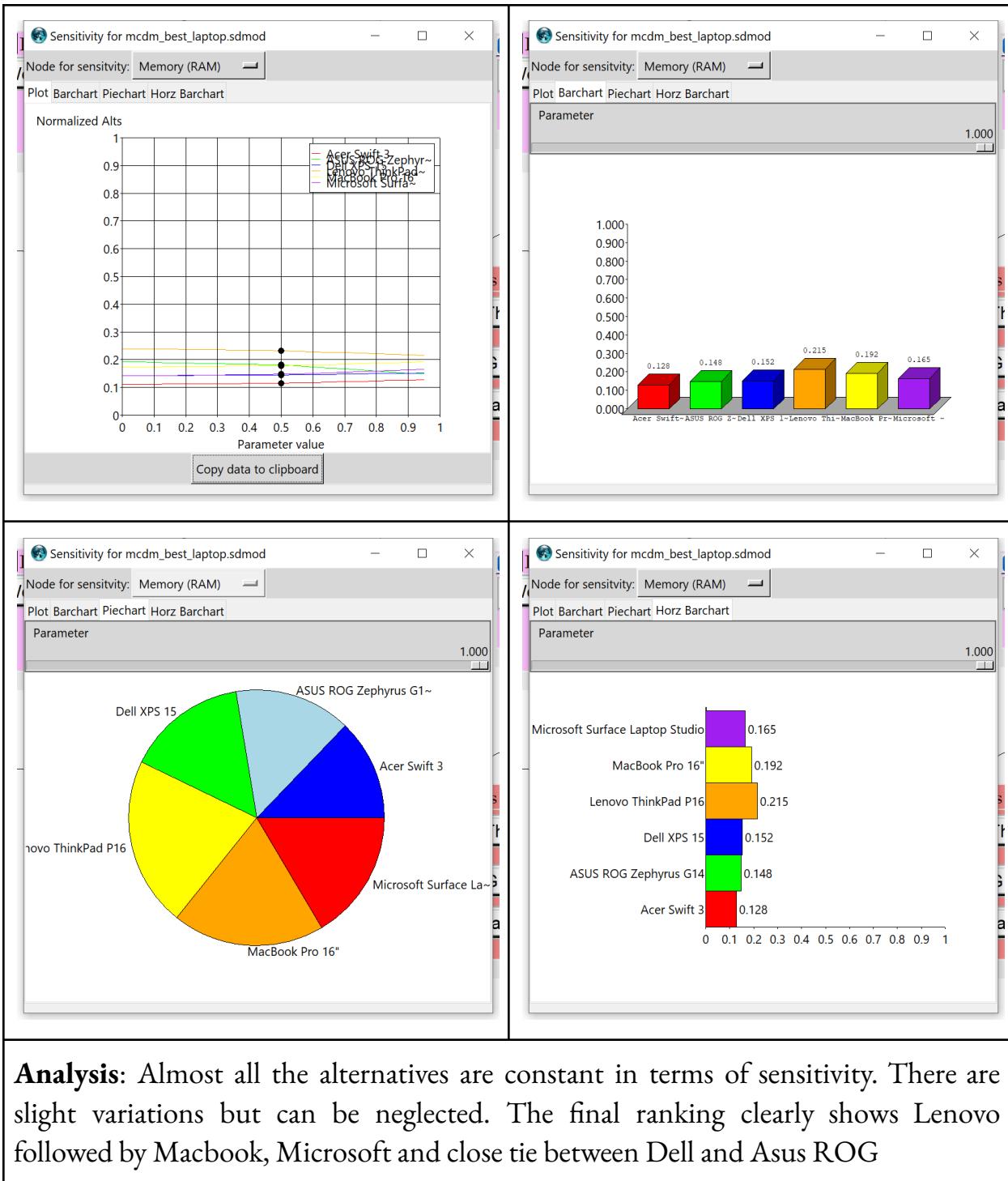
Sub Criteria Cluster Node: Processor (CPU)



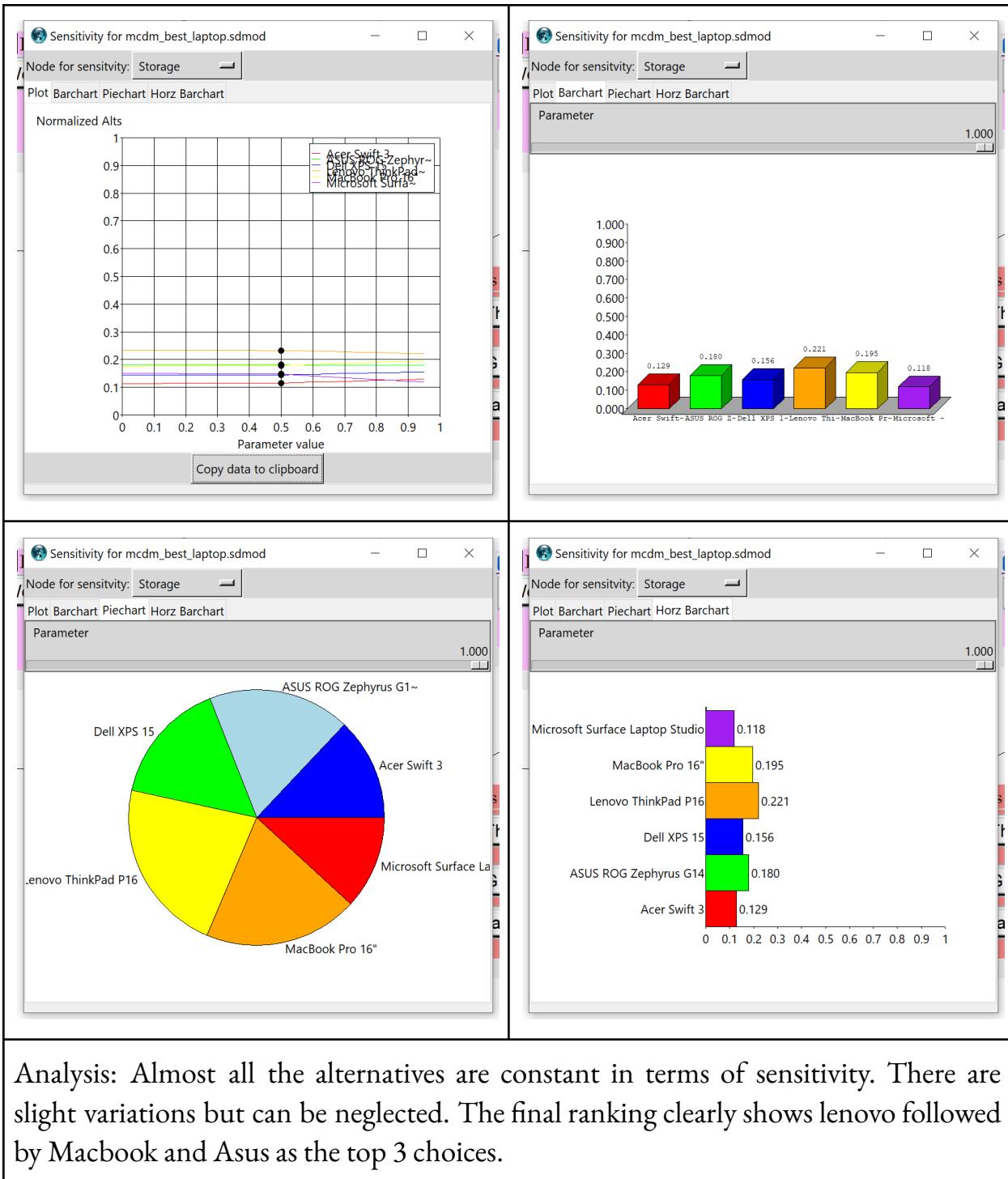
Sub Criteria Cluster Node: Graphics Processing (GPU)



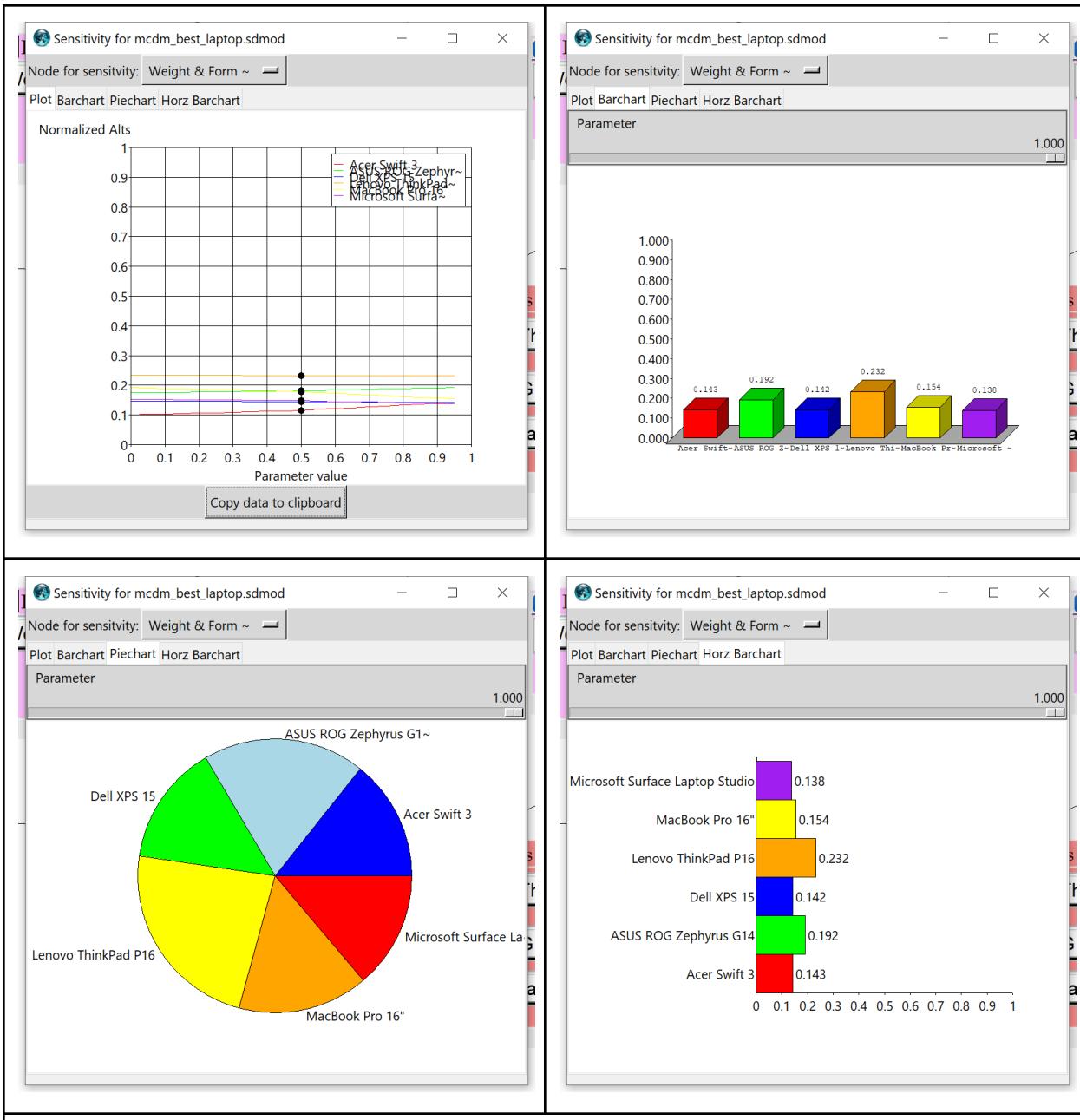
Sub Criteria Cluster Node: Memory (RAM)



Sub Criteria Cluster Node: Storage

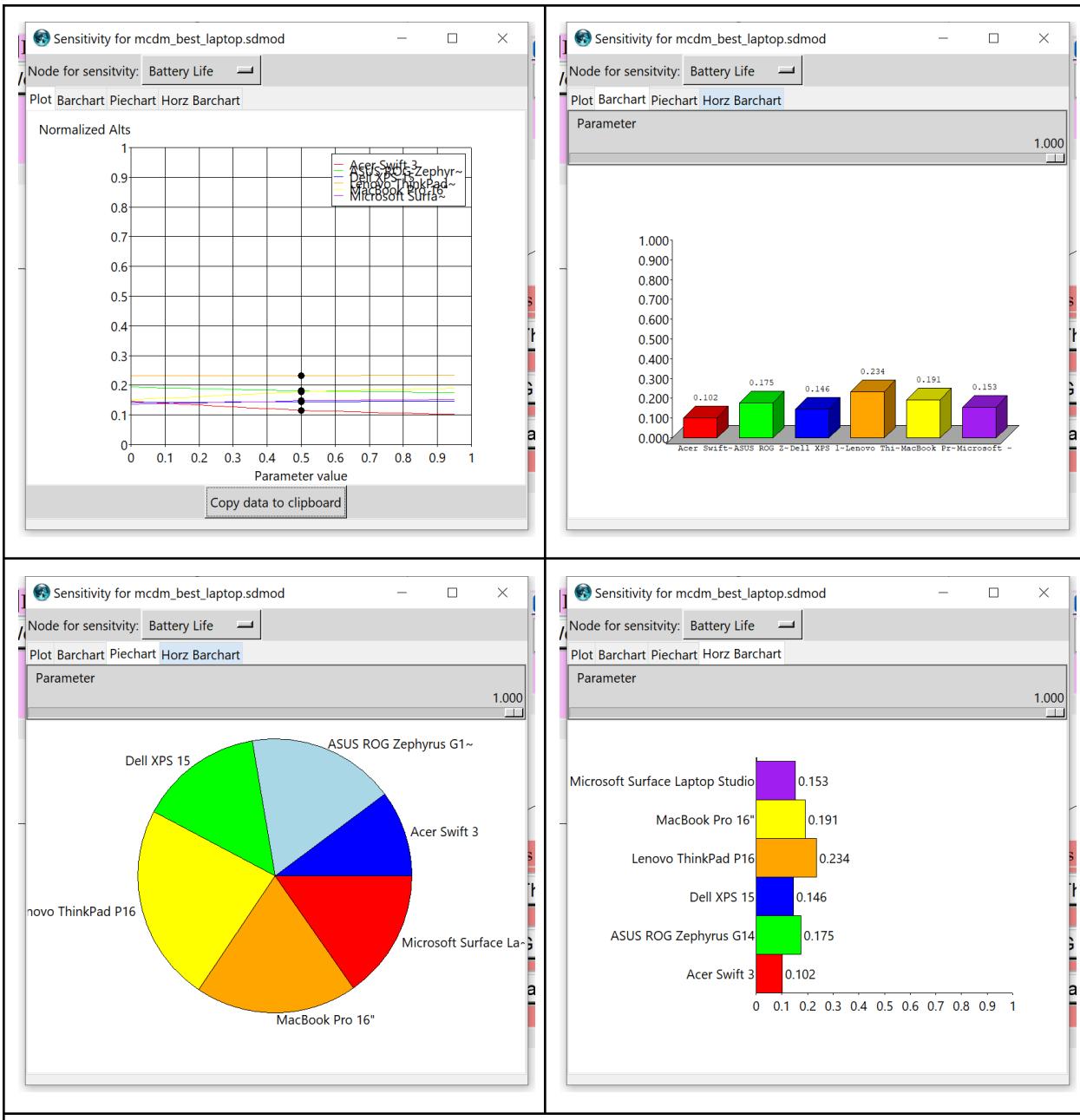


Sub Criteria Cluster Node: Weight & Form factor



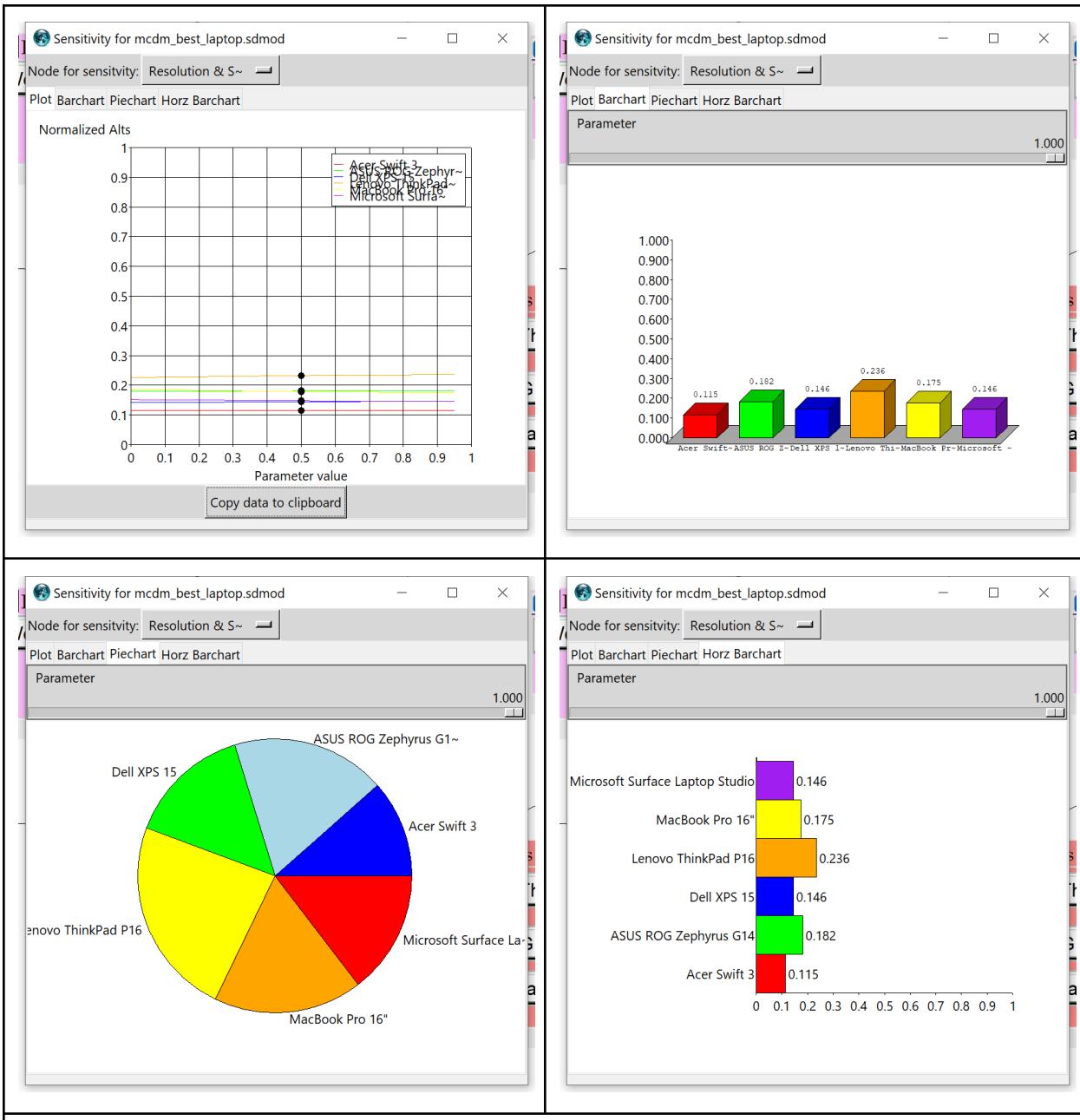
Analysis: As per the node sensitivity with respect to weight and form factor, we see that almost all alternatives remain constant except for Acer which increases as the parameter approaches to 1. Overall, we still have Lenovo leading, followed by Asus and Macbook as the second best and third best alternatives respectively.

Sub Criteria Cluster Node: Battery Life



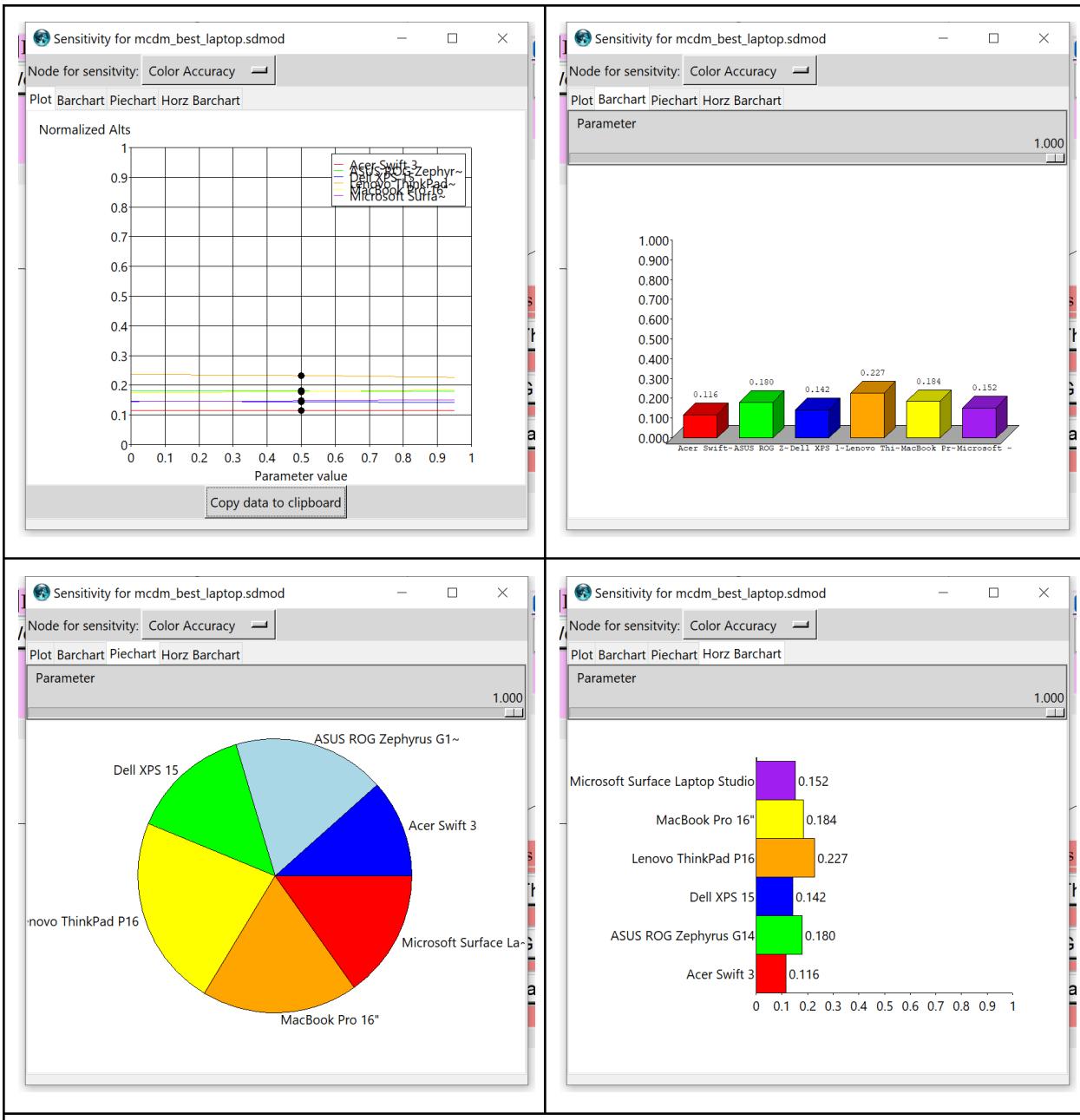
Analysis: In terms of node sensitivity related to battery life, we see that all the alternatives are constant and immune to any sensitivity, the Lenovo laptop continues to lead followed by Macbook and Asus and the trend remains constant throughout.

Sub Criteria Cluster Node: Resolution & Size



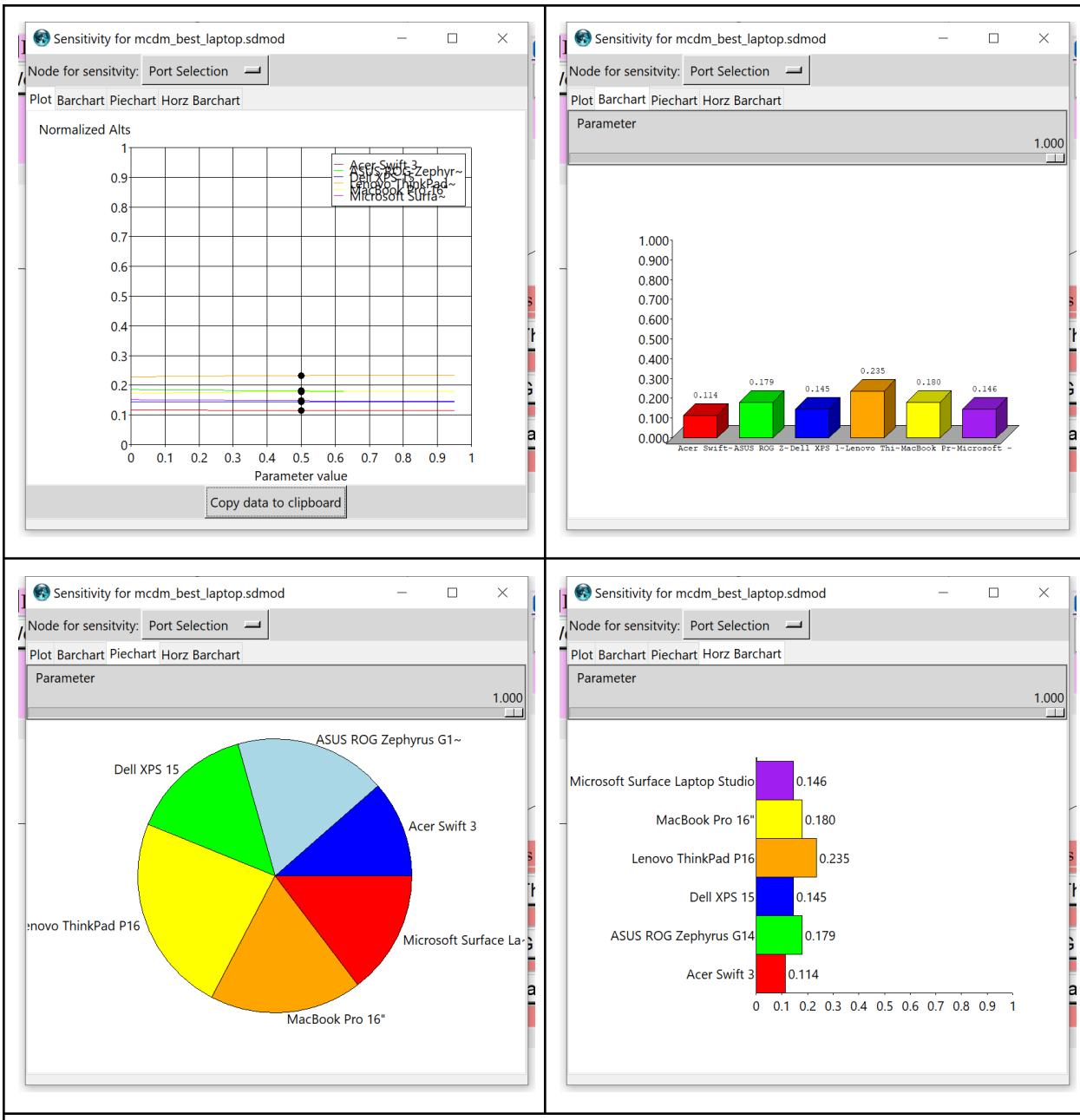
Analysis: With respect to resolution and size, we see that all the alternatives are constant and immune to any sensitivity, the Lenovo laptop continues to lead and the trend remains constant throughout the changing of parameter values to spot any fluctuations.

Sub Criteria Cluster Node: Color Accuracy



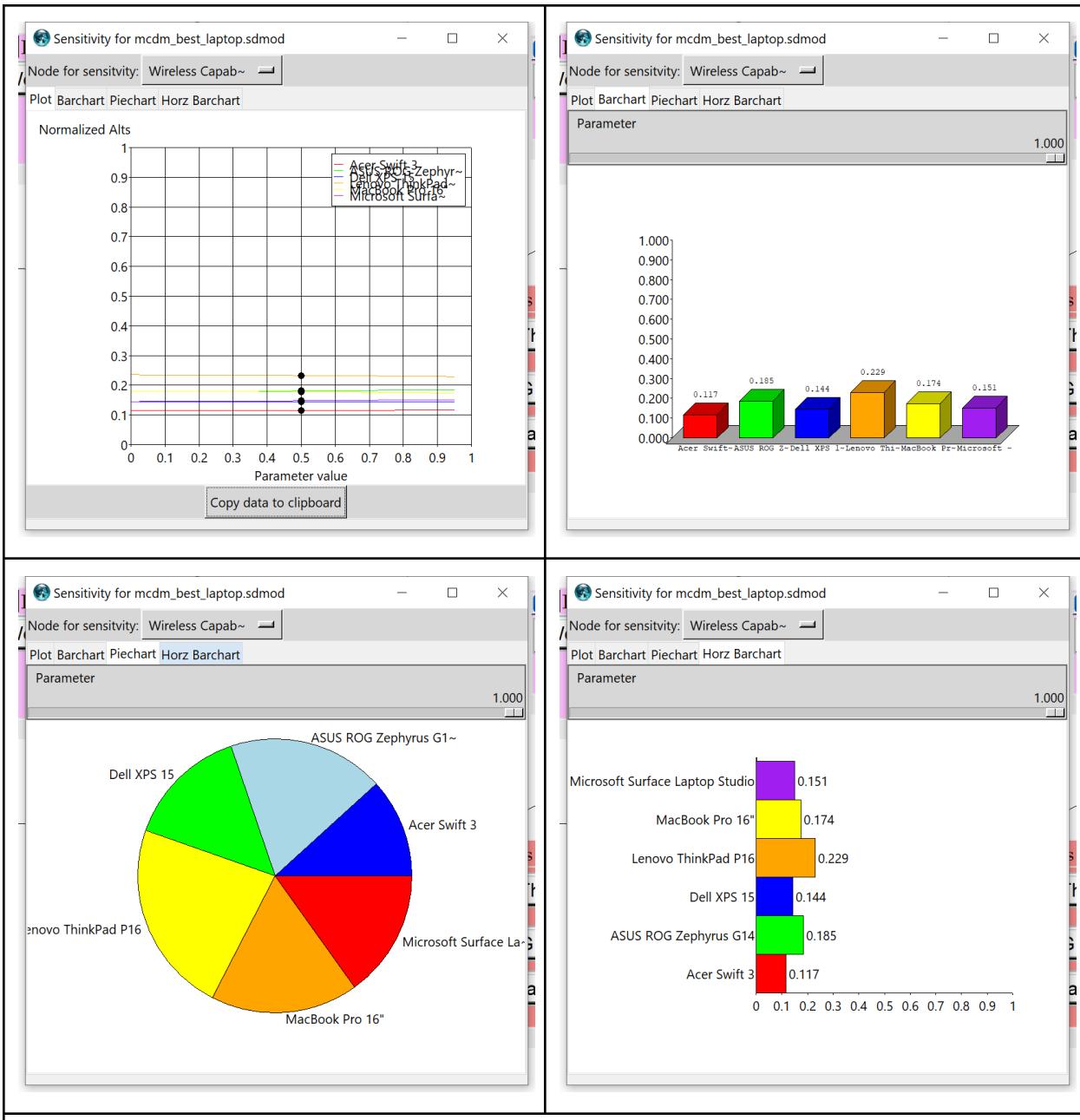
Analysis: With respect to color accuracy as well, we see that all the alternatives are constant and immune to any sensitivity, the Lenovo laptop continues to lead and the trend remains constant throughout the changing of parameter values to spot any fluctuations.

Sub Criteria Cluster Node: Port Selection



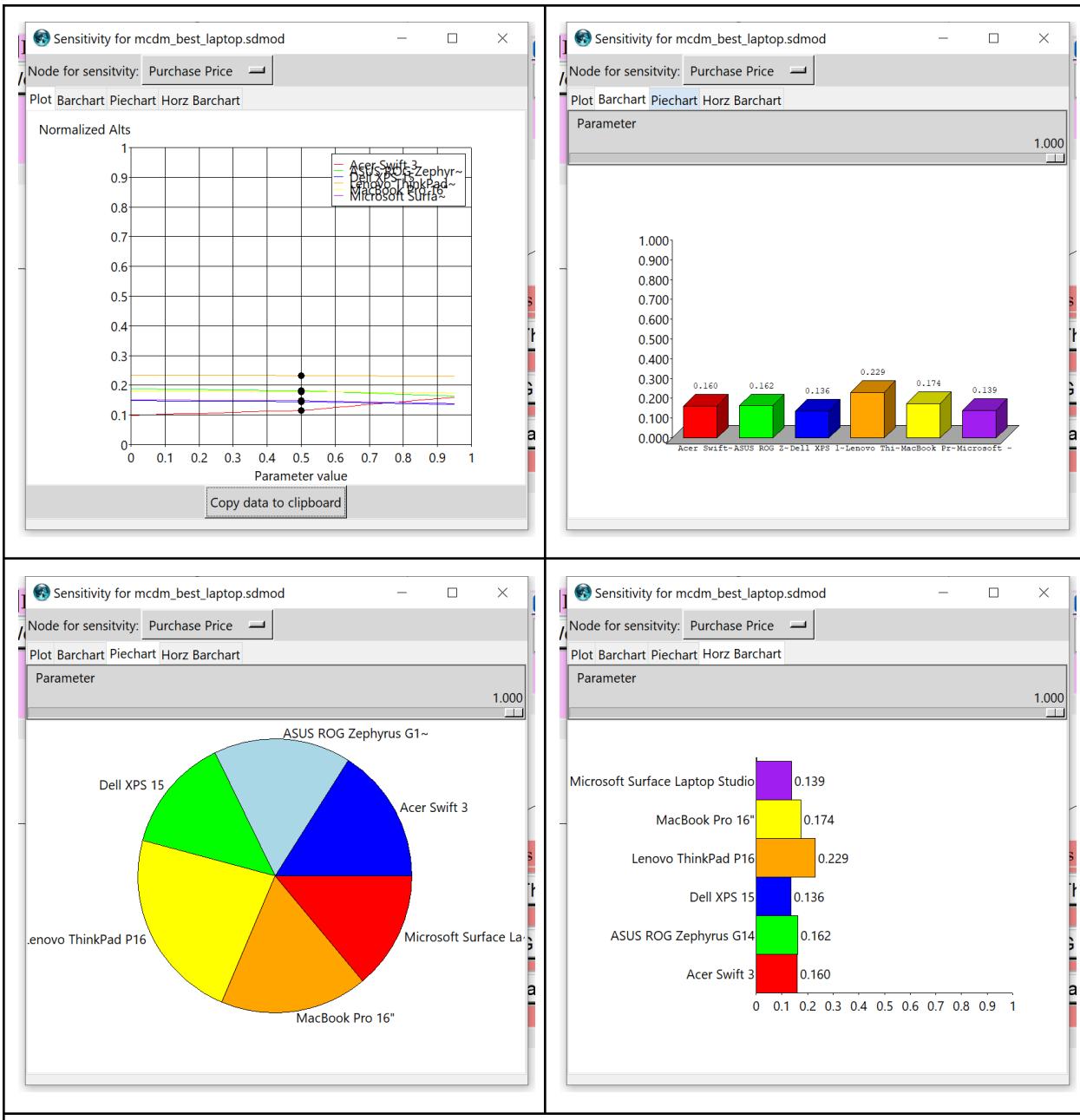
Analysis: With respect to port selection as well, we see that all the alternatives are constant and immune to any sensitivity, the Lenovo laptop continues to lead and the trend remains constant throughout the changing of parameter values to spot any fluctuations.

Sub Criteria Cluster Node: Wireless Capabilities



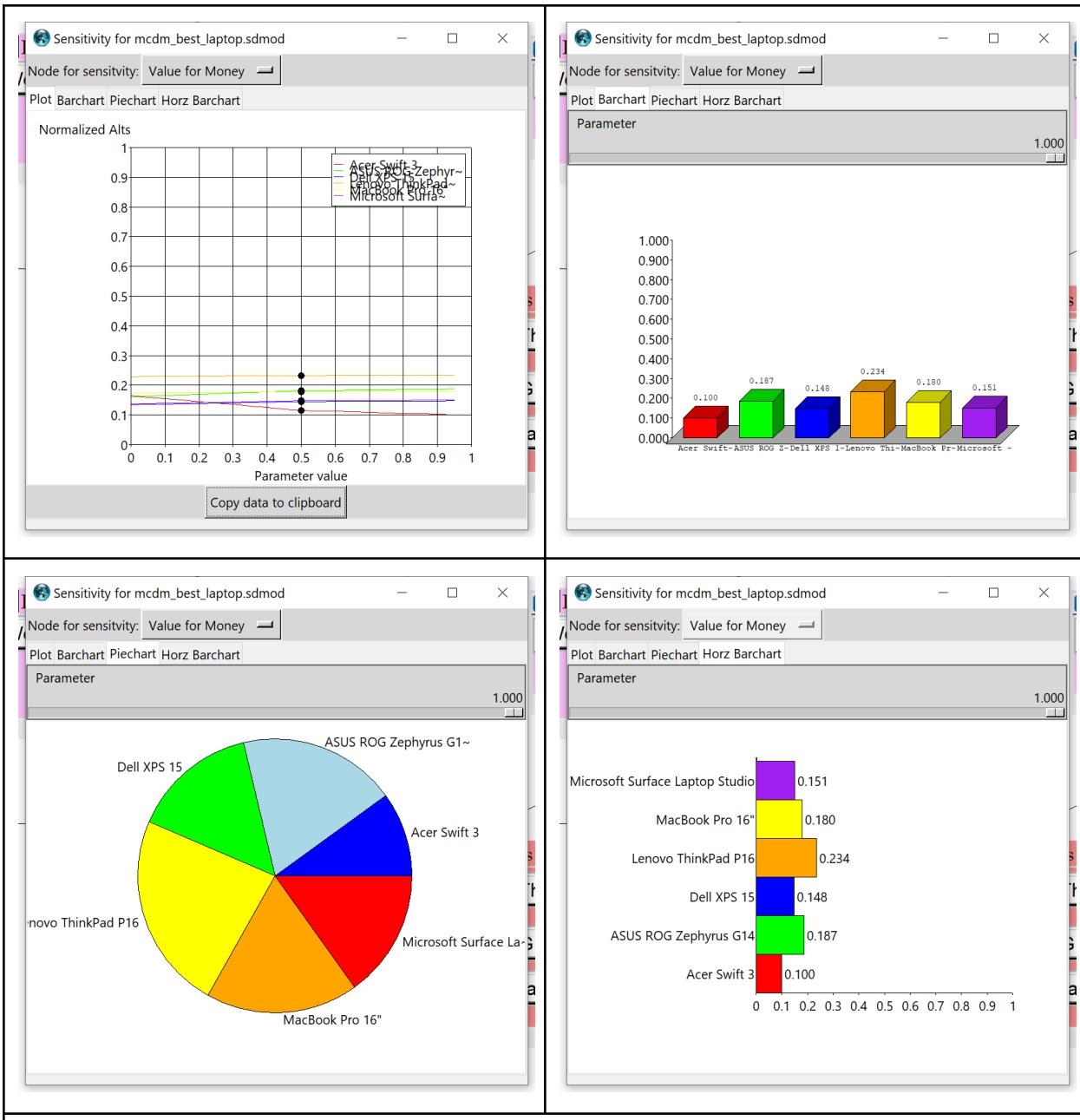
Analysis: With respect to wireless capabilities as well, we see that all the alternatives are constant and immune to any sensitivity, the Lenovo laptop continues to lead and the trend remains constant throughout the changing of parameter values to spot any fluctuations.

Sub Criteria Cluster Node: Purchase Price



Analysis: In terms of purchase price, we see there is slight node sensitivity noted for the Acer Swift model when parameter value > 0.5. This shows that on putting heavy weightage on purchase price, Acer quickly comes out to be the best alternative due to its budget friendly cost.

Sub Criteria Cluster Node: Value for Money



Analysis: With respect to value for money, we see a steady decline for the Acer Swift Laptop beyond the parameter value of 0.2. This signifies that although the laptop is cheap, it is not the value for money since the laptop has no features good enough for running most of the AI intensive workloads which might require lots of computational power.

Conclusion & Final Recommendations

The selection of an ideal laptop for students in Data Science and Artificial Intelligence (DSAI) used an analytical hierarchy process (AHP) which ran within SuperDecisions software. The methodology involved three levels of hierarchy containing goals alongside main criteria which had sub-criteria and six alternative laptops as components. Symfony's pairwise comparison system helped define weights for each factor while afterwards using those weights to rate the system alternatives. Decision-making process demonstrated both robustness and consistency because it validated judgments through consistency ratio checks.

In terms of criteria and weight selection, a comprehensive evaluation process addressed five main criteria sections which contained Performance Capabilities and sub-criteria with Portability Factors and Display Quality and Connectivity & Expandability and finally Cost Considerations. Assignment of weights occurred through assessment of criteria importance for DSAI students. For instance:

- Performance Capabilities gained the most weightage (approximately 40%) because AI and data science operations require powerful computational power.
- Budget limitations relevant to students accounted for ~25% of the total weight in the evaluation process.
- The researchers divided and assigned weights to Portability Factors at 13% and Display Quality at 15% and Connectivity & Expandability at 7% according to their importance for productivity and future-proofing and usability.

After synthesizing the results, the six laptops were ranked as follows:

Laptop	Rank	Description
Lenovo ThinkPad P16	1	The top choice due to its exceptional performance capabilities (CPU, GPU, RAM), abundant storage, and extensive connectivity

		options. It is ideal for handling computationally intensive AI workloads.
MacBook Pro 16"	2	Ranked second due to its outstanding battery life, display quality (Liquid Retina XDR), and unified memory architecture. However, it lacks CUDA support for GPU-intensive tasks.
ASUS ROG Zephyrus G14	3	A strong contender offering a balance between performance and portability at a competitive price point
Microsoft Surface Laptop Studio	4	A versatile 2-in-1 device with good display quality but limited GPU capabilities.
Dell XPS 15	5	A solid all-rounder but outperformed by higher-ranked alternatives in terms of GPU power and battery life.
Acer Swift 3	6	A solid all-rounder but outperformed by higher-ranked alternatives in terms of GPU power and battery life.

Based on the sensitivity analysis, the following insights were also gathered:

- The weight adjustment of Performance Capabilities strengthened Lenovo ThinkPad P16's position because it outperforms other competitors.
- The ranking changes to ASUS ROG Zephyrus G14 as the best value proposition along with Acer Swift 3 as a budget solution when cost considerations weight is increased.
- The Portability Factors and Display Quality aspects became key factors during evaluation which made MacBook Pro 16" stand out through its lightweight and efficient battery and first-rate screen quality.

The following table captures the final recommendations based on the analysis done in this assignment:

Primary Recommendation	Lenovo ThinkPad P16	<ul style="list-style-type: none">• This laptop belongs to the premium category because performance remains the main criterion for its selection.• This laptop provides exceptional performance that enables complex AI models together with deep learning operations and substantial dataset management.• The Lenovo ThinkPad P16 costs more but delivers professional performance benefits its users need.
Secondary Recommendation	MacBook Pro 16"	<ul style="list-style-type: none">• Suitable for students within the Apple ecosystem or those who value battery life and display quality.• This hardware provides excellent

		performance when CUDA-based GPU acceleration is not essential to the tasks.
Budget-Friendly Recommendation	ASUS ROG Zephyrus G14	<ul style="list-style-type: none"> • Offers excellent performance at a mid-range price point • This product aligns well with students who want to achieve optimal price and performance capabilities in their system choice.
Alternative Options	Acer Swift 3, Microsoft Surface Laptop Studio, Dell XPS 15	<ul style="list-style-type: none"> • Students looking for budget options should consider Acer Swift 3 since it offers affordable prices yet cannot perform complex AI task requirements • Users who want creativity plus adaptability should choose Microsoft Surface Laptop Studio because it offers a design that transforms between portrait and

		landscape orientations.
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The decision-making framework gives DSAI students a strong methodology to select the most suitable laptop. Individual preferences about budget requirements and portability requirements as well as specific use needs help shape the ultimate laptop choice beyond Lenovo ThinkPad P16 being named as overall best. Students should evaluate their priorities weighed against the established criteria in order to select an informed product purchase that meets academic and professional requirements.

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- Thank You -