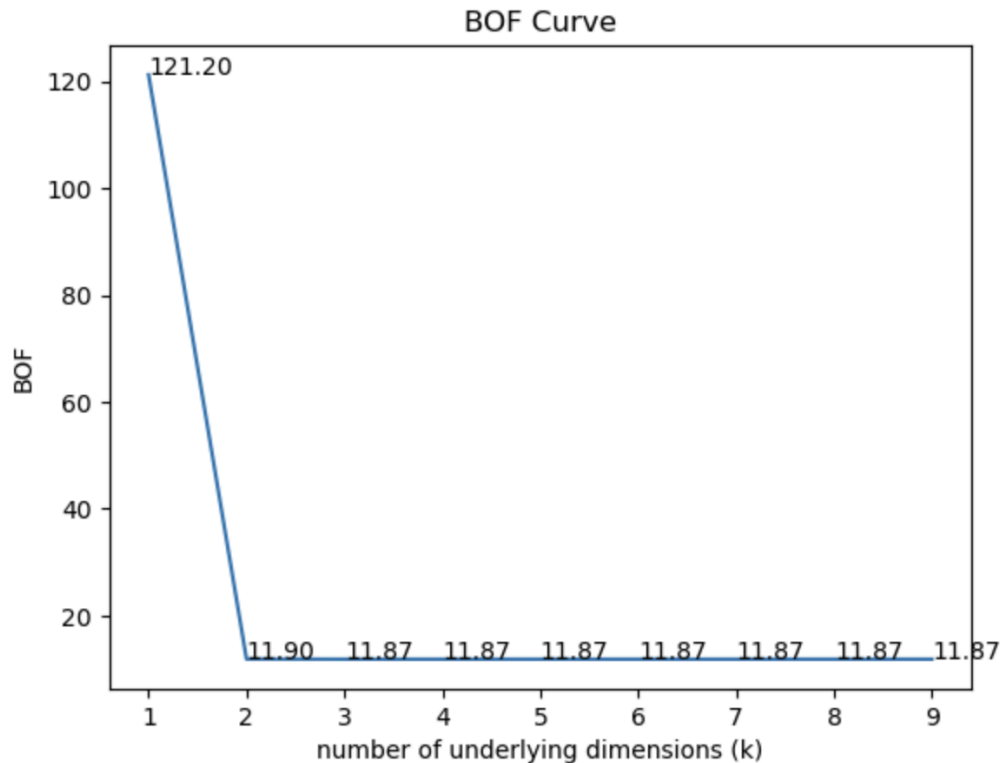


ASSIGNMENT -3 (Customer Analytics)

- Vishanth Hari Raj

PART A

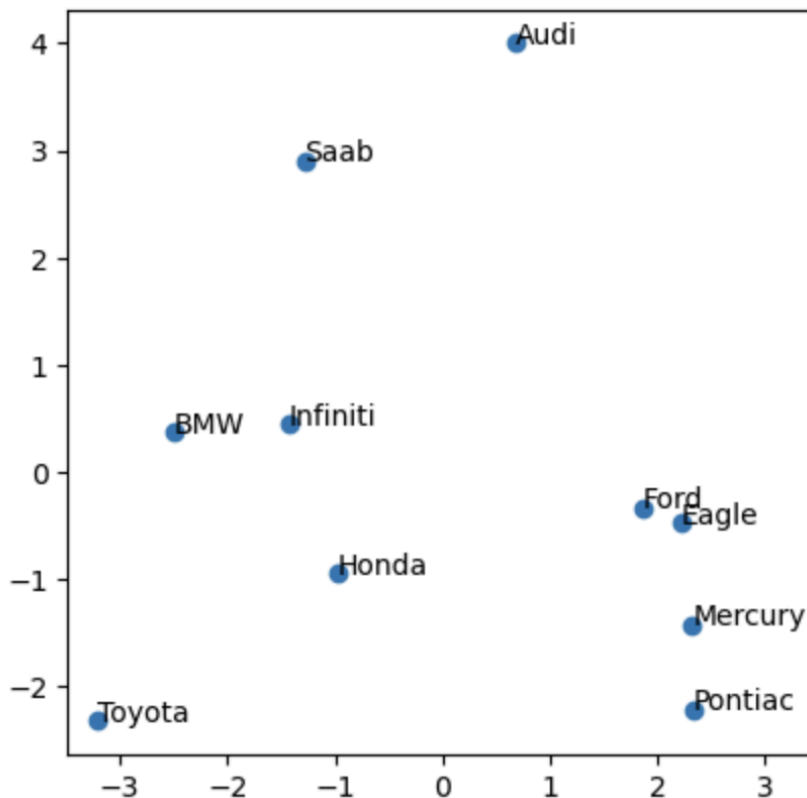
Q1



Sharp decline from $k = 1$ to $k = 2$: The BOF value drops significantly from 121.20 when $k = 1$ to approximately 11.90 when $k = 2$. This indicates a substantial improvement in fit by increasing the number of dimensions from 1 to 2.

Line after $k = 2$: Post $k = 2$, the curve flattens out as all subsequent values hover around 11.87. The marginal improvement in fit by adding more dimensions beyond $k = 2$ is minimal, suggesting that additional dimensions do not significantly enhance the model's ability to represent the data. The choice of $k = 2$ is justified as it provides a substantial improvement in the model fit with minimal complexity, which is beneficial for both interpretation and computational efficiency.

Q2:



In the analysis of this graph, where we conceptually rotated the plot by 0 degrees, the placement and interpretation of car brands can be significantly impacted. This adjustment changes how we perceive the dimensions of performance and built quality across these cars.

Horizontal Axis Interpretation (X-axis): This axis appears to represent built quality. Brands on the left side, such as Toyota and Honda, are generally recognized for their high built quality, known for reliability and durability. In contrast, brands positioned towards the right, like Mercury and Pontiac, may reflect a perception of lesser built quality.

Vertical Axis Interpretation (Y-axis): This axis likely measures performance. Brands positioned higher up, such as Audi and Saab, are typically associated with higher performance, offering advanced engineering and superior driving dynamics. Brands lower on the axis, such as Toyota and Honda, while reliable, are often seen as offering more practical and less performance-oriented vehicles.

Analysis:

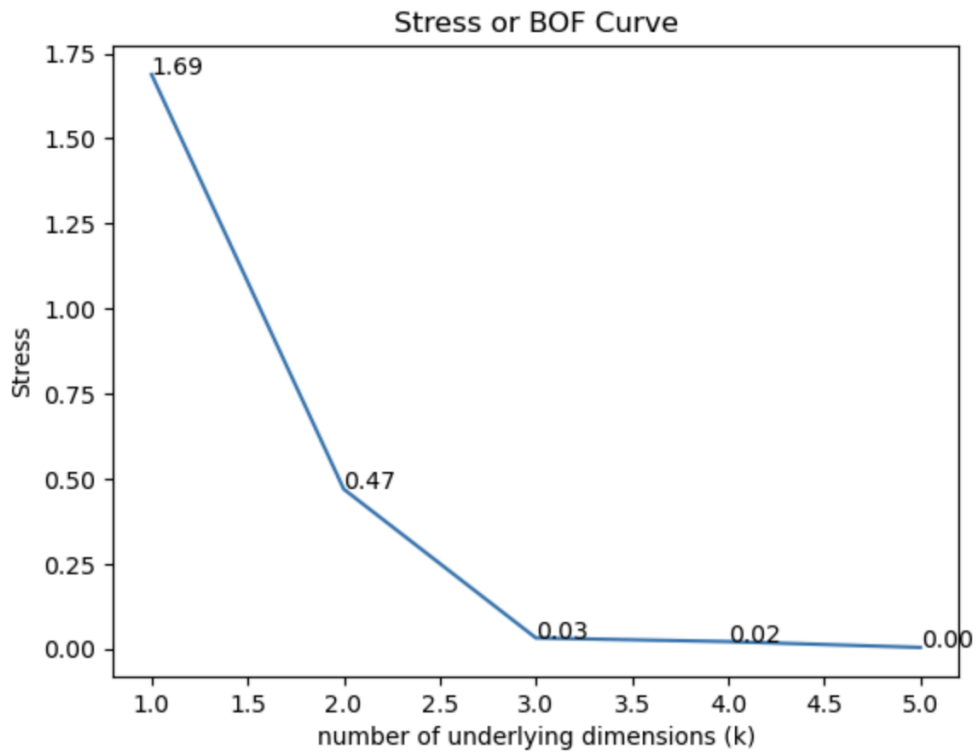
Brands like Toyota and Honda are known for their long-lasting vehicles that require minimal maintenance, aligning with their position towards high built quality (left side of the plot).

High-performance brands like Audi and Saab are positioned at the top, suggesting that they excel in performance metrics but do not necessarily lead in built quality.

Brands such as Ford and Eagle are clustered near the center, indicating a balance between built quality and performance, reflecting their market reputation as versatile but not necessarily excelling in any extreme.

PART B

Q1:



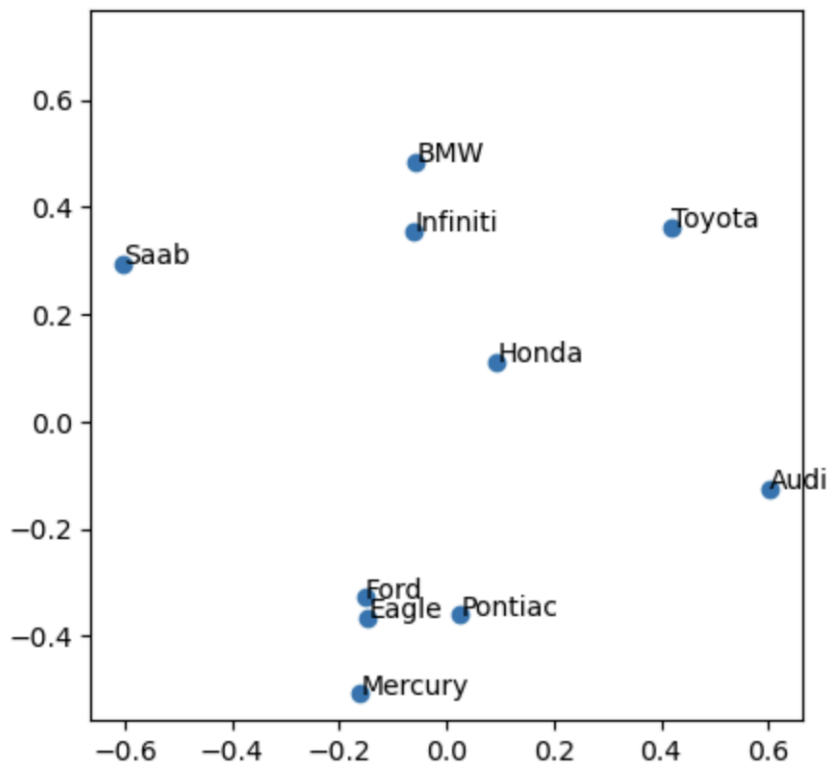
Sharp Drop from $k = 1$ to $k = 2$: Stress significantly decreases, suggesting a major improvement in model fit.

Further Reduction at $k = 3$: The stress value drops again, indicating another notable improvement.

Minimal Change Beyond $k = 3$: From $k = 3$ to $k = 5$, the stress values decrease very little.

Conclusion: Choosing $k = 3$ is effective, as it provides a good balance between model complexity and accuracy, with significant reductions in stress up to this point but minimal benefits from adding more dimensions.

Q2.



I treated the plot as if it were rotated by 0° clockwise. While the graph remains physically unchanged, this conceptual rotation allows us to examine the data from a new perspective and reassess the axes to better understand the car brands based on their origin and built quality.

Interpretation of Axes:

The Y-axis now measures whether brands are predominantly international or American. Brands situated higher on the axis, such as BMW and Saab, are associated with international markets, known for their high performance and reliability. In contrast, brands like Mercury and Pontiac, positioned lower on the axis, highlight their American roots and nationalistic marketing appeal. The X-axis assesses built quality. The left side of the axis, where Mercury and Ford are located, signifies lower built quality, while the right side, featuring Toyota and Audi, indicates higher built quality, known for durability and requiring less maintenance.

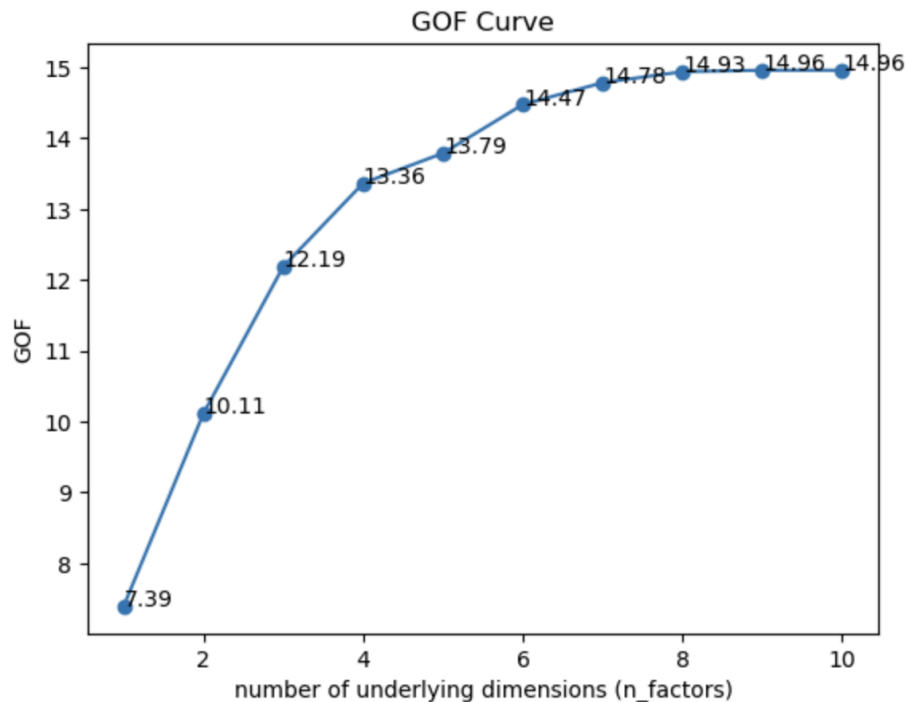
Conclusion:

This reinterpretation—or conceptual rotation—of the graph provides a clearer picture of how car brands are perceived in terms of their geographic origin and quality. It illustrates that while Toyota and Audi are celebrated for their superior built quality, brands like Mercury, Pontiac, and Ford are distinctively marketed for their American manufacturing, influencing consumer perception and choice.

Extra Analysis: if we rotate the plot by a anti clockwise angle of 60 degrees. The horizontal axis represents the luxury level of the car brands, while the vertical axis measures the average profit generated by these brands. Despite the rotation, the relative positions of most brands on the plot remained unchanged.

PART C:

Q1.

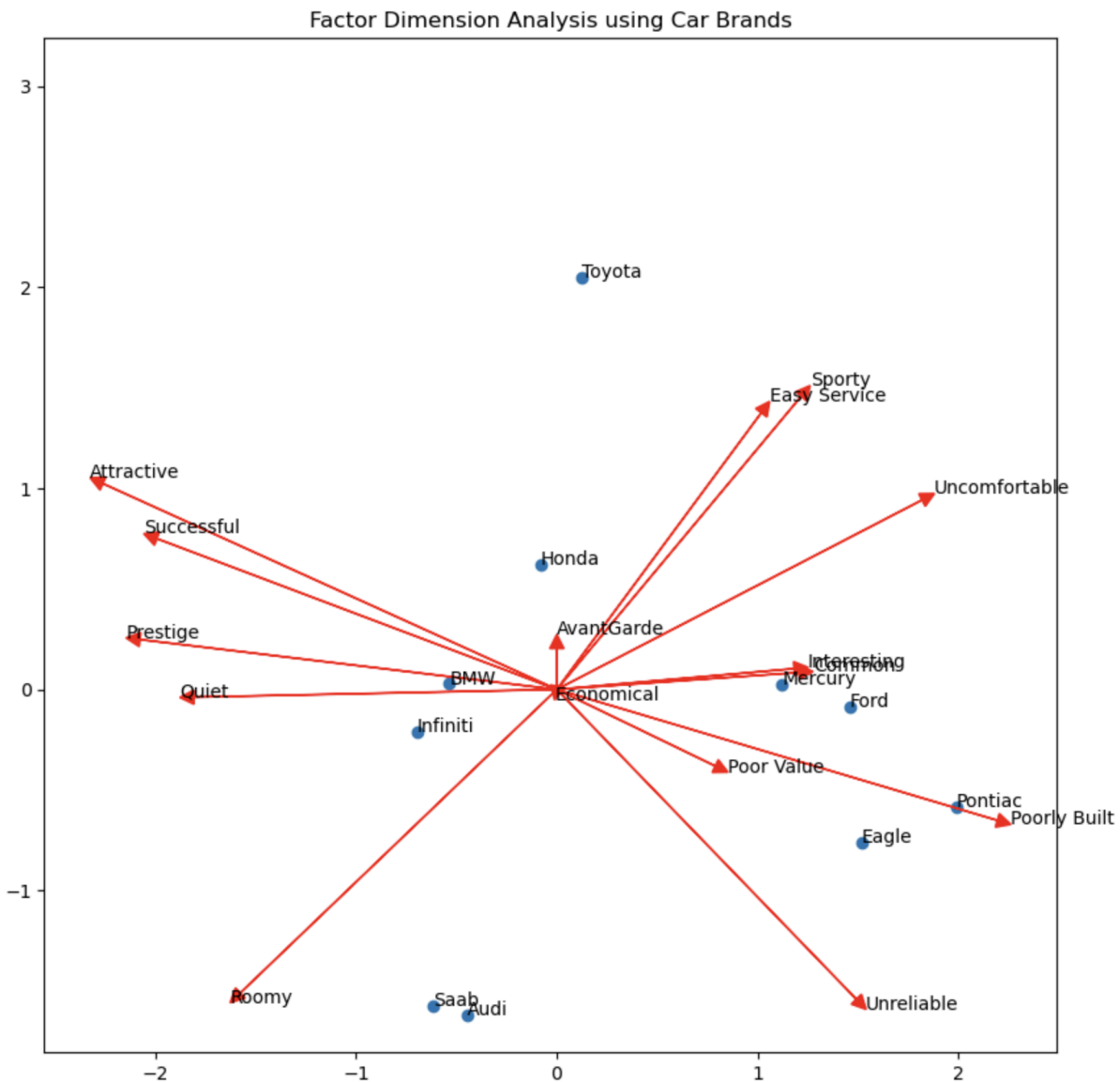


GOF Value Increase from $n = 2$ to $n = 6$: Starting at a GOF of 7.39 with two dimensions, there is a rapid and steady increase in the goodness of fit as more dimensions are added. This increase continues up to $n = 6$, where the GOF reaches 13.36.

Straight line of GOF Values Post $n = 6$: Beyond $n = 6$, from $n = 7$ to $n = 10$, the GOF values show a much more marginal increase, hovering around 14.47 to 14.96. This suggests that the addition of further dimensions beyond $n = 6$ contributes very little to improving the model's fit.

Conclusion: Based on this analysis, using $n = 6$ as the number of dimensions is justified because it provides a significantly improved fit without the diminishing returns observed in higher dimensions.

Q2:



In the provided Factor Analysis graph, the orientation has been conceptually rotated by 45 degrees clockwise to provide a new perspective on the placement of car brands according to two key attributes: attractiveness and practicality.

Graph Orientation and New Axis Explanation:

Y-Axis: This newly oriented Y-axis assesses the 'attractiveness' of the car brands, which encompasses factors like brand quality, success, and overall market appeal. Brands that appear higher up on this axis, such as BMW and Honda, are viewed as successful and attractive, indicating strong market presence and high consumer esteem. Brands towards the lower end of

this axis, like Eagle and Pontiac, might be seen as less attractive due to perceived issues in quality or desirability.

X-Axis: The X-axis in this rotated graph contrasts two aspects: sportiness and roominess. Positive values on this axis represent brands perceived as sportier but potentially less spacious, aligning with a design philosophy that might prioritize aesthetic appeal or performance features over interior space. Negative values, on the other hand, indicate brands that offer more room and comfort, possibly at the expense of a sporty appearance.

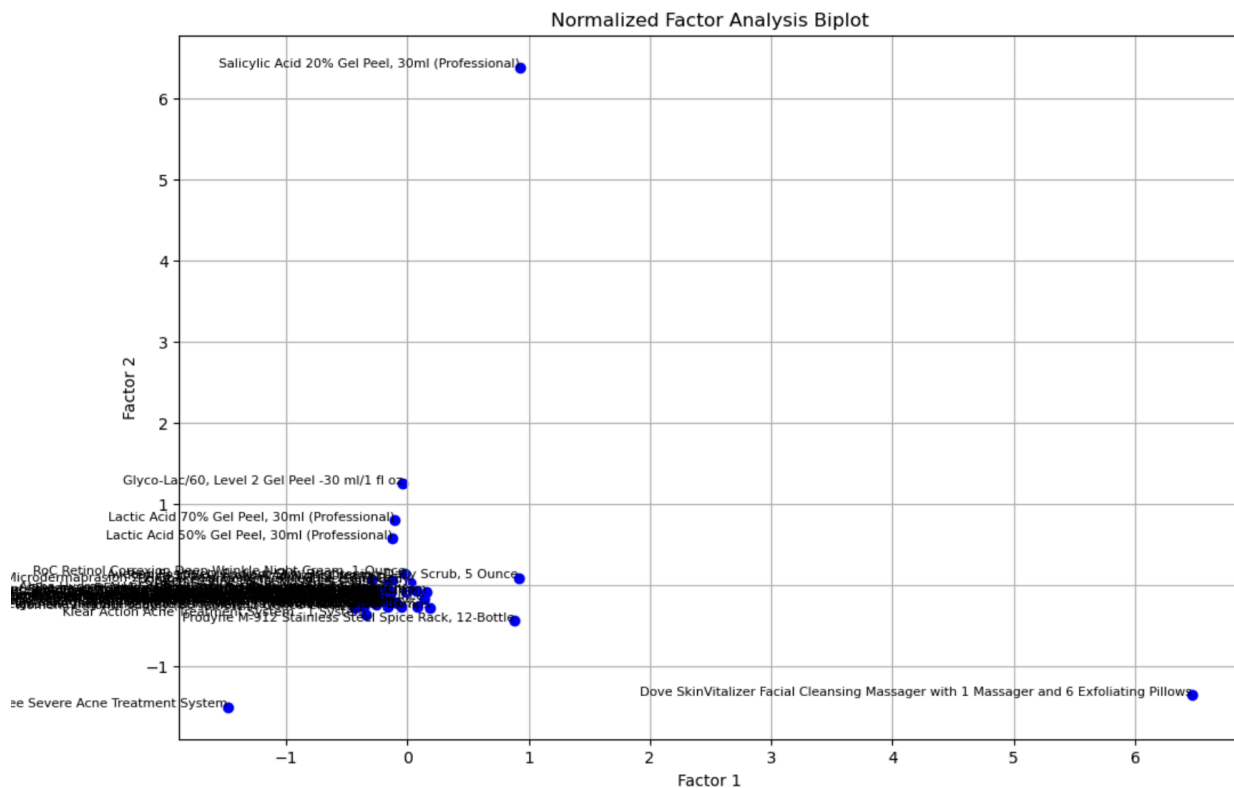
Detailed Brand Analysis:

- Toyota: Positioned towards the sporty but less roomy end, Toyota is recognized for designs that are stylish and dynamic, albeit with compact interiors. Despite this, the brand's reputation for reliability and ease of maintenance remains a strong selling point.
- Honda: Near the top of the attractiveness axis and leaning towards roomy, Honda is renowned for producing vehicles that effectively combine aesthetics, performance, and practicality, making them a popular choice among consumers looking for quality and reliability.
- BMW: At the top of the attractiveness axis and balanced between sporty and roomy, BMW exemplifies success in marrying sporty designs with robust construction, thereby maintaining its appeal among enthusiasts.
- Ford: Despite being recognized for powerful vehicles like the Mustang, Ford's position indicates a challenge in achieving consistent reliability, which somewhat hampers its attractiveness.
- Mercury: Positioned towards the lower end of both axes, Mercury is perceived as economical but struggles with a reputation for poor build quality and reliability, limiting its market success.
- Pontiac and Eagle: Both brands, depicted as less attractive, are noted for their focus on performance but criticized for lacking in comfort and reliability, affecting their overall brand perception.
- Infiniti: This brand successfully combines a quiet, attractive aesthetic with above-average build quality, making it a strong contender in the luxury segment.
- Saab: Known for its roominess and comfort, Saab maintains a good position on the roominess axis but is less sporty, which fits its market niche as a provider of luxurious, comfortable rides.
- Audi: Although Audi is positioned as roomy and attractive, it occasionally faces challenges with reliability, which slightly impacts its placement on the attractiveness axis.

This 45-degree clockwise rotation in the analysis framework sheds light on how brands balance the dual demands of attractiveness (encompassing quality and success) and practicality (balancing sportiness and roominess). This perspective helps to highlight each brand's strengths and areas for improvement, providing a nuanced understanding of market positioning relative to perceived consumer values.

PART D (OPTIONAL):

Q1:



Factor 1 (Horizontal Axis):

This axis appears to differentiate products based on a specific characteristic or set of characteristics likely highlighted in customer reviews. For example, if Factor 1 captures aspects related to "effectiveness" or "type of treatment," products positioned further along the positive side of this axis might be perceived as more effective or intense in their action (like peels or professional treatments), whereas those on the negative side might be milder or considered less aggressive.

Factor 2 (Vertical Axis):

The vertical axis could represent another set of attributes, possibly relating to the "sensory experience" or "use context." Products higher on this axis might be associated with attributes like "luxury" or "spa-like experience," suggested by products like "Dove SkinVitalizer Facial Cleansing Massager" which is likely to offer a gentle, spa-like treatment. In contrast, products lower on this axis could be more utilitarian or focused on medical or clinical benefits.

Specific Observations from the Biplot:

- Products such as "Salicylic Acid 20% Gel Peel, 30ml (Professional)" and other peels are grouped closely together along both axes, suggesting they are perceived similarly by

customers in terms of the factors captured here. This clustering might indicate a shared market segment focused on intense skin treatments.

- The "Dove SkinVitalizer Facial Cleansing Massager," located somewhat apart from other, more intense treatment products, suggests it is positioned differently in the market, likely emphasizing gentle cleansing and exfoliation.

Any product significantly distant from others in any direction can be considered to have unique properties that distinguish it from the rest in the dataset. For instance, if a product is far along the positive side of Factor 1 but near the origin of Factor 2, it could be highly effective but neutral in terms of luxury or sensory attributes.

Implications for Marketing and Product Development:

Target Audience:

Products grouped together are likely appealing to similar customer segments. Understanding these groupings can help in targeting marketing efforts or in developing new products that fit clearly within or between existing clusters.

Product Differentiation:

Observing how products are spaced relative to one another can inform strategies to differentiate new products. If the market appears saturated in one part of the biplot, introducing products that score differently on one or both factors might capture a new customer base.

Competitive Analysis:

This biplot helps identify which products compete directly with each other. Products that are close to each other are likely substitutes and compete more directly, which can be crucial for competitive positioning and pricing strategies.

PART F OPTIONAL

Part A: Error Debugging in Python Code

Prompt Entered: "I have a NameError in my Python script that uses the FactorAnalyzer. The error says 'FactorAnalyzer' is not defined. How can I fix it?"

Generative Tool Used: ChatGPT

Tool's Output: Explained the need to properly import the FactorAnalyzer from the factor_analyzer package and provided an example of how to correct the import statement in the Python script.

Part B: Data Visualization Interpretation

Prompt Entered: "Analyze a scatter plot of car brands based on perceived quality and performance, and explain what the graph reveals about the brands."

Generative Tool Used: ChatGPT

Tool's Output: Analyzed a provided scatter plot, identifying key trends such as the placement of luxury versus economy brands and the correlation between location on the graph and market perception regarding quality and performance.

Part C:

Rotating Graph Analysis

Prompt Entered: "Describe how rotating a factor analysis graph by 45 degrees clockwise changes the interpretation of the data for car brands."

Generative Tool Used: ChatGPT

Tool's Output: Discussed how a 45-degree clockwise rotation of the graph might alter the perception of axis definitions, shifting from traditional vertical and horizontal interpretations to more diagonal measures of car brand attributes like attractiveness and sportiness.