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Clustering technique to achieve sustainable goals in green marketing using machine learning

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Abstract: *With increasing demand for green products, most customers are adopting a sustainable approach. Consumers today are changing their consumption habits towards sustainable consumption as green products are in high demand. By analyzing demographic, psychographic, and behavioral characteristics of Indian green consumers, the study aims to operationalize the segmentation of green markets. Eco-friendly products are in demand, but consumers cannot be treated equally, nor can their attitudes toward eco-friendly products be treated as if they were all the same. Based on secondary data, we are trying to research green consumer psychology from convenience samples of Indian consumers. In this paper, a dataset of consumers has been analyzed using clustering techniques for customer segmentation. Clustering technique assists in segmenting the customers which means dividing similar customers in the same segment. This technique helps to understand the customers in both static demographics and dynamic behavior.*

Keywords: *Green Marketing, Machine Learning, Sustainable Goals, Clustering, Customer Segmentation.*

1. INTRODUCTION:

Sustainable goals are assumed to be achieved if human needs are satisfied while keeping the environment safe and healthy so that future generations should not be deprived of all this. Sustainability can be reached keeping following factors in mind: Environment, economy and society. The term sustainable development has become more popular nowadays. From sustainable goals to sustainable growth, sustainable society to sustainable economy; everything around is sustainable. (Gupta, 2013) According to the American Marketing Association, Green Marketing can be defined in three different ways: First, Green Marketing is the marketing of products that are presumed to be environmentally safe. Second, Green Marketing is the development and marketing of products designed to minimize negative effects on the environment or to improve its quality. Third, Green Marketing is the efforts by the organizations to produce, promote, package and reclaim products in a manner that is sensitive or responsive to ecological concerns. According to Pride and Ferrell (1993), Green Marketing, also called environmental marketing or sustainable marketing, refers to an organization's efforts at designing, promoting, pricing and distributing products that will not harm the environment. Polonsky (1994), explains "Green Marketing as all activities designed to generate and facilitate any exchanges intended to satisfy human needs or wants, such that satisfaction of these needs and wants occurs with minimal negative impact on the natural environment.

One size never fits all - a popular concept in marketing. All customers have different needs. Therefore, customer segmentation is very important. By using machine learning tools, we will be doing segmentation based on secondary data available and analyzing it to understand consumer behavior towards green marketing. Machine learning being a part of Artificial Intelligence is a science, not a new concept but it has gained a fresh boost because of automation. Machine learning tools will help in precise customer segmentation which can be very painful to perform manually or using conventional methods. It will help in analyzing big and complex data to get faster and more accurate results. Among various algorithms, k-means clustering algorithm is most commonly used for customer segmentation which is in unsupervised machine learning algorithm. The idea of green marketing and sustainability have common goals attached to them. So, green marketing activities directly or indirectly impact sustainable development. Marketers have realized that green marketing practices can be profitable to them for overall sustainable development. So to ensure long term sustainable development, marketers need to implement such solutions which can deal with increasing environmental challenges. And because green marketing includes people, profit and environment together, it leads to

ultimate sustainable development. Overall sustainable development through green marketing is not just about customer satisfaction today and taking future decisions. It is about sustaining the growth continuously for future generations.
With this study, the aim is to understand the purpose of green marketing in achieving sustainable goals and also consumer behavior and attitude towards these practices. We will be using machine learning tools and clustering techniques to segment the customers in different sub groups.

2. LITERATURE REVIEW:

In the early 1990s, the concept of "Green Marketing" emerged. In 1976, Henion and Kinnear described green consumers as those who have an environmentally conscious approach to their buying habits. Antil in 1984 further expanded on this concept by describing green consumerism as a form of socially conscious consumer behavior with a primary focus on protecting the environment. Green consumers are typically motivated by a desire to reduce their impact on the environment and prioritize sustainability when making their purchase decisions. This can manifest in a variety of ways, such as through the purchase of environmentally friendly products and services, reducing their consumption of natural resources, and recycling.

In 1991, Weiner and Doescher described green consumerism as "prosocial" behavior. Later on in 1994, Michael Polonsky explained “green marketing as the marketing that combines all activities designed to generate and facilitate any exchanges intended to fulfill human needs or wants, such that the satisfaction of these needs and wants occurs, with minimal damaging impact on the natural environment.”

Due to globalization, it has become difficult to maintain the natural beauty of our environment keeping customer and consumer perspective at peace. With growing technology and population, it has become more crucial to look upon environmental factors. Nowadays, customers are also aware of what impact environmental pollution will have in the long term due to issues such as global warming. In the current era of digitalization, Green Marketing has gained everybody’s attention especially in India. People are becoming aware about their rights towards a healthy environment. And thus companies who claim to follow an environmentally friendly approach are called “Green Company”, their marketing approach is called “Green Marketing” and products are often termed as “Green Product”. Green Marketing is all about marketing a product or service keeping the environment in mind and thus creating a win-win situation for both customer as well as organization. And obviously, industries following environmentally friendly policies have a competitive advantage in the market because customers are now positive towards a healthy environment.

The pressure of NGOs, government institutions, and environmentalists has led to many businesses integrating green issues into their marketing strategies. As a sign of their social responsibility, businesses with competitors who share sustainable attitudes will implement environmental policies. Environmental pressures lead to entities adopting environmentally friendly behaviors, such as green marketing. Green marketing is driven by market opportunities because organizations want to increase their market share by adopting environmentally friendly attitudes (Forsman, 2013).

Economic development results in a number of environmental problems, including coastal recovery, resource depletion, deforestation, desertification, climate change, pollution, and excessive energy consumption. There is a threat to economic sustainability, the health of the public, and the stability of society due to these issues. The rise of green markets and green consumers has also been a result of global economic growth, which has resulted in environmental concerns and social changes. In order to avoid environmental depletion and facilitate the transition to a green economy, issues associated with green marketing began to appear at government, organization, and consumer levels (Gouvea et al., 2013). The use of green marketing strategies by industries can have a significant influence on consumer choices. Now, consumers are also aware and insisting organizations to adopt green products and services resulting in innovation. If we go through previous literature, it has been found that firms are practicing Green Marketing or Green approach because of many reasons. Few common reasons are:

- CSR - The term refers to the concept of 'Corporate Social Responsibility,' which is a business model that helps a company act socially responsible toward its stakeholders and its consumers. Any company can achieve this only when they take environmental objectives parallely with their revenue related goals.
- Competition - Many companies are now practicing the Green approach, so to remain in the competition; other companies have to change their policies.
- Government Regulations - Government also now is very strict and has employed rules and regulations to control the firm's policies and approaches. Their ultimate goal is to have a low carbon footprint. Government also wants their citizens to be more socially responsible towards the environment.
- Opportunities - Role of green marketing is evitable in future as marketers now also understand the need of using resources carefully because of increasing demands of humans. So firms need to adopt this new environmental approach.

Therefore, in our further study, we will try to analyze customer behavior towards green practices and also scope of green marketing in achieving sustainable goals using machine learning techniques.

3. RESEARCH OBJECTIVES:

1) What are the different sustainable goals which are likely to impact green marketing actions?
2) What is the scope of green marketing to achieve desired goals?
3) Use of machine learning to analyze consumer behavior towards green marketing.

So the authorities need to know how consumers would react to a policy before they go ahead and develop it. If the reaction looks bad, they can try to change policies before they spend any money.

Figure 1: Architecture of sustainable goals in Green Marketing and flow of analysis

4. METHODOLOGY:

In 2015, the United Nations issued different development goals in terms of sustainability which calls for peace and prosperity for present and future generations not across nations but on the planet. Goals of green marketing are linked with sustainable goals. A dataset of certain customers has been collected from a secondary source to analyze the consumer behavior towards green marketing actions. Few sustainable goals are selected for the analysis part which has a relation with green marketing strategies. Like Food Quality, good health and good well-being, Responsible consumption and production and Climate action. Total data has been segmented into different sub groups based on clustering technique. Then machine learning tools were used to analyze data and to achieve sustainable performance based on selected sustainable goals. This study aims to identify how green actions contribute in achieving certain sustainable development goals.

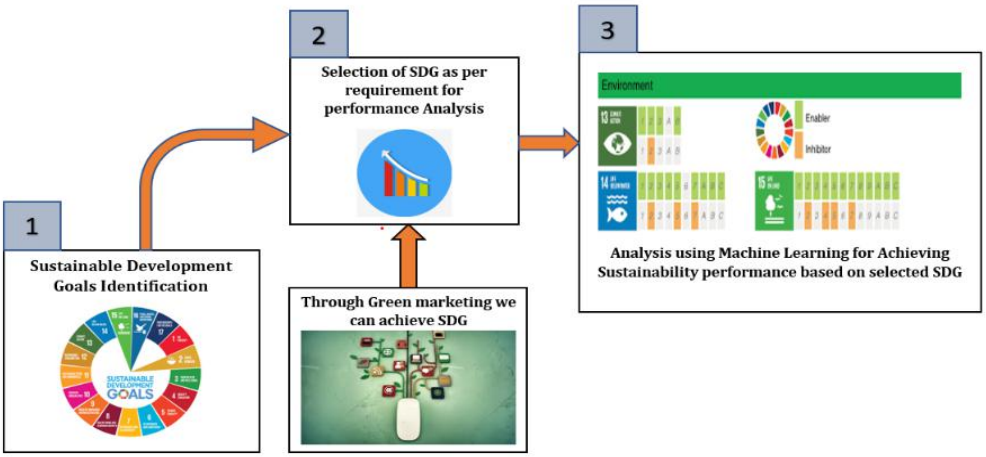


Figure 2: Flow of selection of Sustainable goals and Analysis of Performance

5. RESULT:

The tasks completed are as follows:

- Clean and manipulate the data with python and figure out the distribution of each feature.
- Use matplotlib & seaborn to visualize some features which might be significant in building the model.
- Use K-Means to cluster the dataset and analyze the result.

use profile report we can find the following characteristics in features:

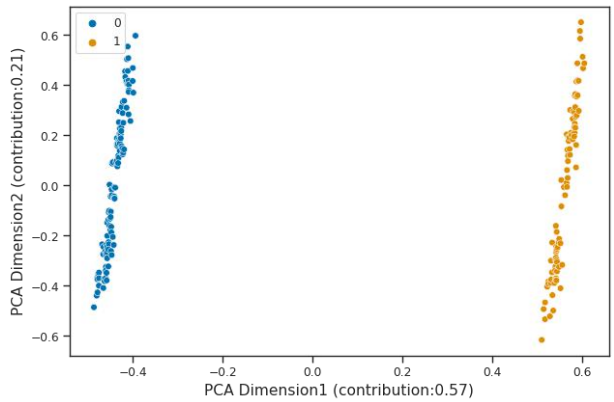
- Percentage of missing value in each feature
- Distinct values in each categorized feature and frequency in each distinct value
- Histogram in each categorized and continuous feature
- Statistical describe, such as maximum, minimum, mean, etc, in each continuous feature
- Correlations Matrix between each two features in the dataset

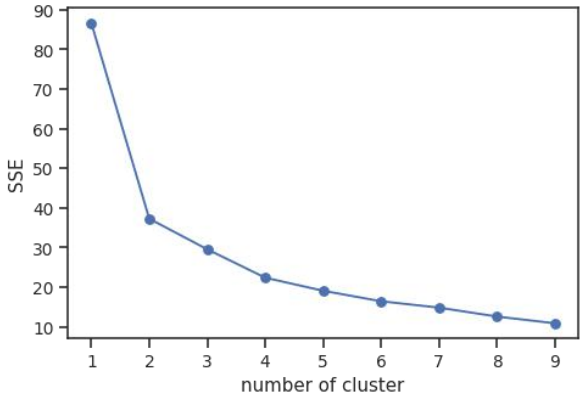
The purpose of the data cleaning is:

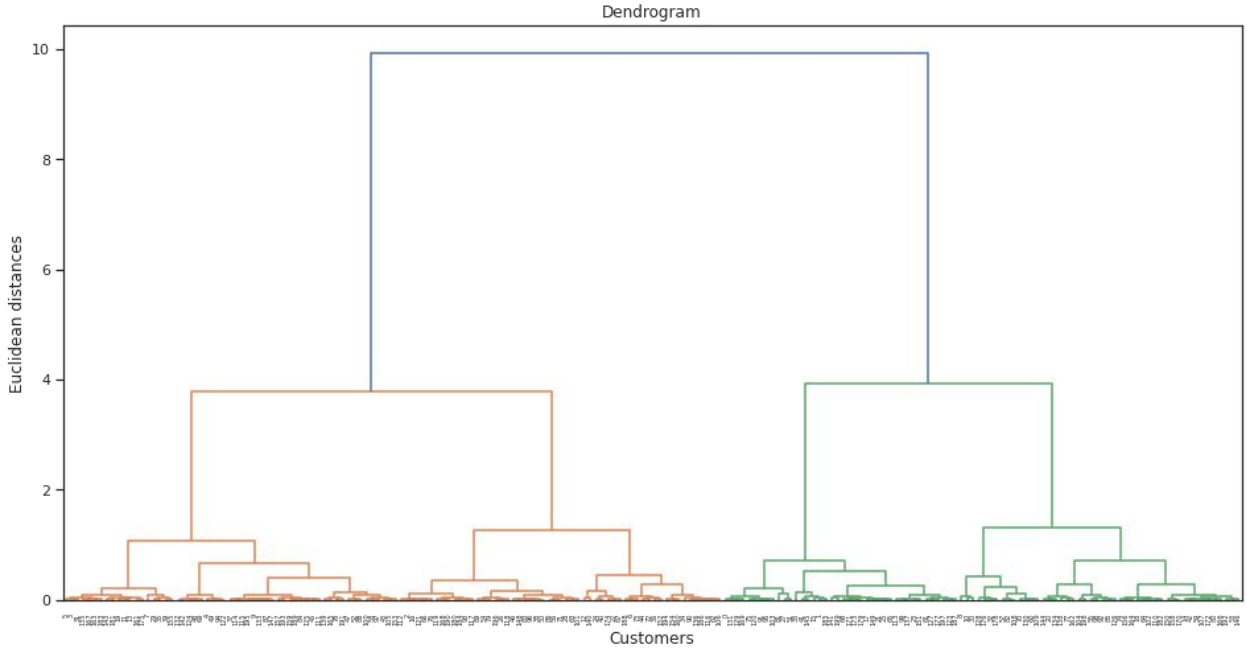
- Handle with missing values
- Remove some outliers in numerical features
- Standardized data format

Clustering:

PCA + KMeans: The sum of the explained variance ratio of first two PCA features are above 78%







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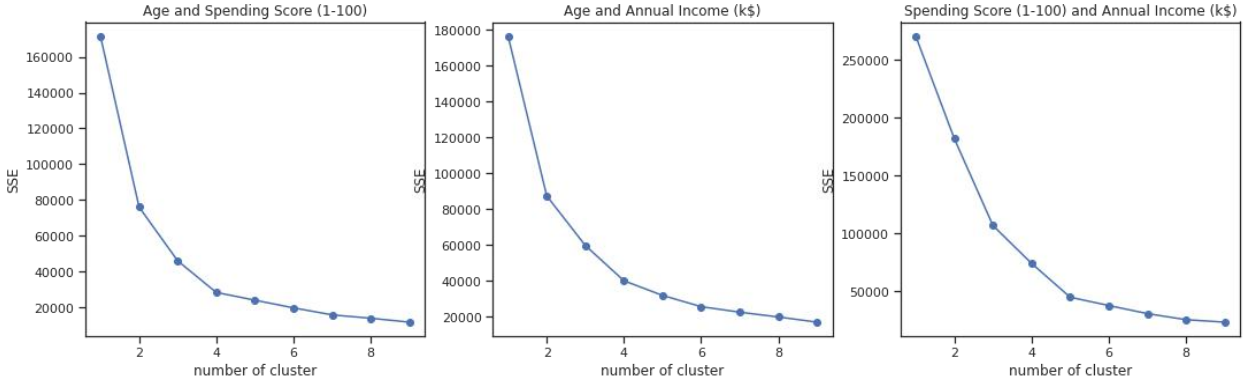
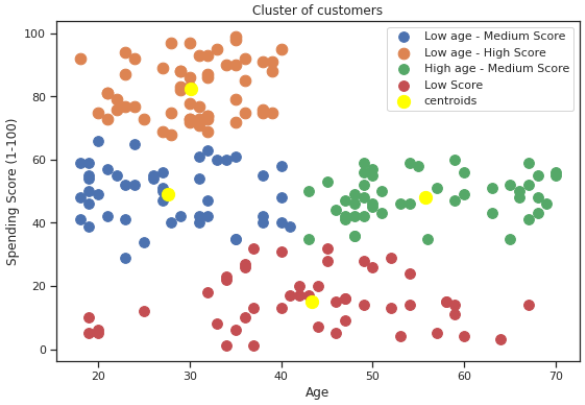
Clustering by each two features:





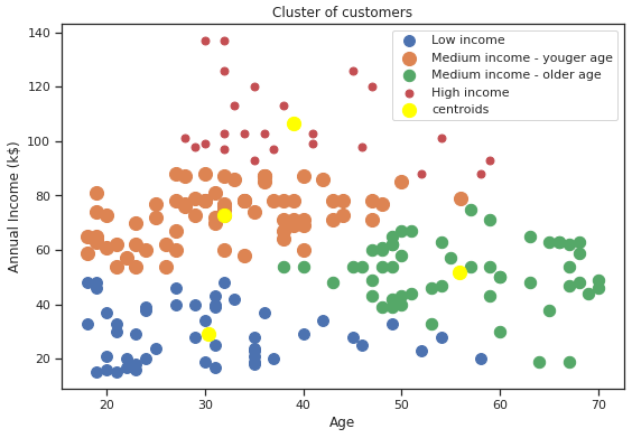
6. CONCLUSION:

ps: The scatter point size is related to the number of the clusters
According to the elbow plot which is measure by SSE, we choose n_clusters = 4
Categories cluster:

1. Low age - Medium Score
2. Low age - High Score
3. High age - Medium Score
4. Low Score

Thus:

1. About 50% of customers are classified as medium score, characterized by "spending score". In this category level, the distribution of each age group is uniform
2. Middle aged and elderly people do not appear at a high spending score, the majority of people in high spending scores are people between 30-40.



ps: The scatter point size is related to the number of the clusters

According to the elbow plot which is measure by SSE, we choose n_clusters = 4
Categories cluster:

1. Low income
2. Medium income - younger age
3. Medium income - older age
4. High income

Thus:

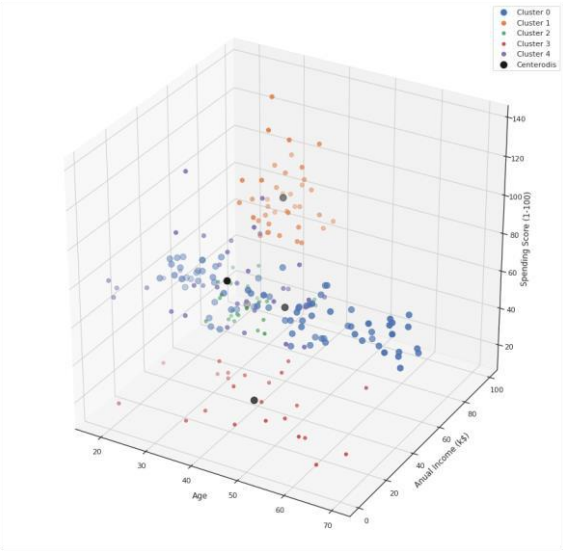
1. The number of people with high income is relatively small
2. The majority of people with low income are dense distribution between 15-35
3. The largest number of cluster groups are characterized by young people with middle income

ps: The scatter point size is related to the number of the clusters
According to the elbow plot which is measure by SSE, we choose n_clusters = 5
Categories cluster:

1. Low run through - Low income
2. Medium run through - Medium income
3. Low run through - High income
4. High run through - Low income
5. High run through - High income

Finally:

1. The majority of customers are Medium spending - Medium income
2. There are five clearly clusters in the combination of feature: spending score and annual income and each features can categorized into Low, Medium, High three level



1. Cluster 1 and Cluster 3 can be well distinguished from Cluster 0, 2 and 4
2. The number of people in cluster 0 are more over than any of the other four

7. FUTURE SCOPE:

The Machine Learning algorithms used to develop sustainable goals using clustering techniques in green marketing. Using PCA and K-means algorithms, the sum of the explained variance ratio of first two PCA features is 78%. Through this study the main point is the ML-PCA-K Means express extended up gradation and benefits in academics and research field to calculate the performance applications framework and to understand Green Marketing related literature of the current states. Based on a literature review, Clustering is a Machine Learning technique that has yet to be empirically tested. This framework can therefore be empirically validated by future researchers. Machine Learning can be used to identify differences in consumer patterns across different regions by applying a variety of clustering techniques.

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