A CASE STUDY ON COFFEE CONSUMPTION: BY ANALYTIC NETWORKING PROCESS (ANP)

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Abstract
Consumption of coffee has shown numerous beneficial effects from adequate drinking. The purpose of the paper is to study the coffee consumption among individuals according to the product attributes, personal preferences, socio-demographics, economic attributes, context of consumption and health concerns. The ANP approach is applied for selecting the best coffee with the various criteria and sub-criterions among the popular alternatives.
Key words: ANP, Coffee consumption, Optimization.

Introduction

Multi-Criteria Decision Making helps people to make decisions according to their preferences. It involves various alternatives and criteria to choose from. Many problems cannot be described in a hierarchal process as they involve dependencies and interactions of hierarchical levels, therefore Analytical network process (ANP) is represented by a network rather than a hierarchy. ANP is the generalization of the analytical hierarchy process (AHP). Coffee is one of the most popular hot beverages on the globe with an annual growth rate of 1.1% and it is the second most exported commodity after crude oil. It is assumed to be a healthy beverage alternative to alcohol, over the period of years varieties of coffee blends and brewed coffee increased rapidly among Individuals who are habituated to coffee drinking. According to recent surveys consumption of coffee varies among different countries [3]

Coffee beans are roasted and extolled for their aroma and flavor. According to the survey reports coffee consumption has increased up to 40% in 18-24 and 25% in the 25-39 age groups. Many studies concluded that consumption of coffee helps in preventing several chronic diseases and it is associated with significant dose-dependent reductions in type-2, 4 diabetes. Further coffee intake also reduces the risk of liver disease including cirrhosis, and hepatic injury [12].

Although there is a significant increase in coffee consumption nationally and globally, the gap in consumption is extremely high in the southern part of the country compared to the rest of India, Daily intake of coffee provides dietary antioxidants more than fresh fruits and vegetables, the biochemical composition of a cup of coffee depends upon a range of factors including the degree of roasting, the type of the bean and the methods go for the coffee brewing [8].

Data Collection & Survey

Data is gathered through both primary and secondary data collection methods to acquire the required information from the respondents, for this research purpose we have collected data from a total of 300+ people, where 150 women and 250 men from different regions of the

country, through various models of data collections, where we have passed a group of questions through online and offline sources [10]

Questionnaires

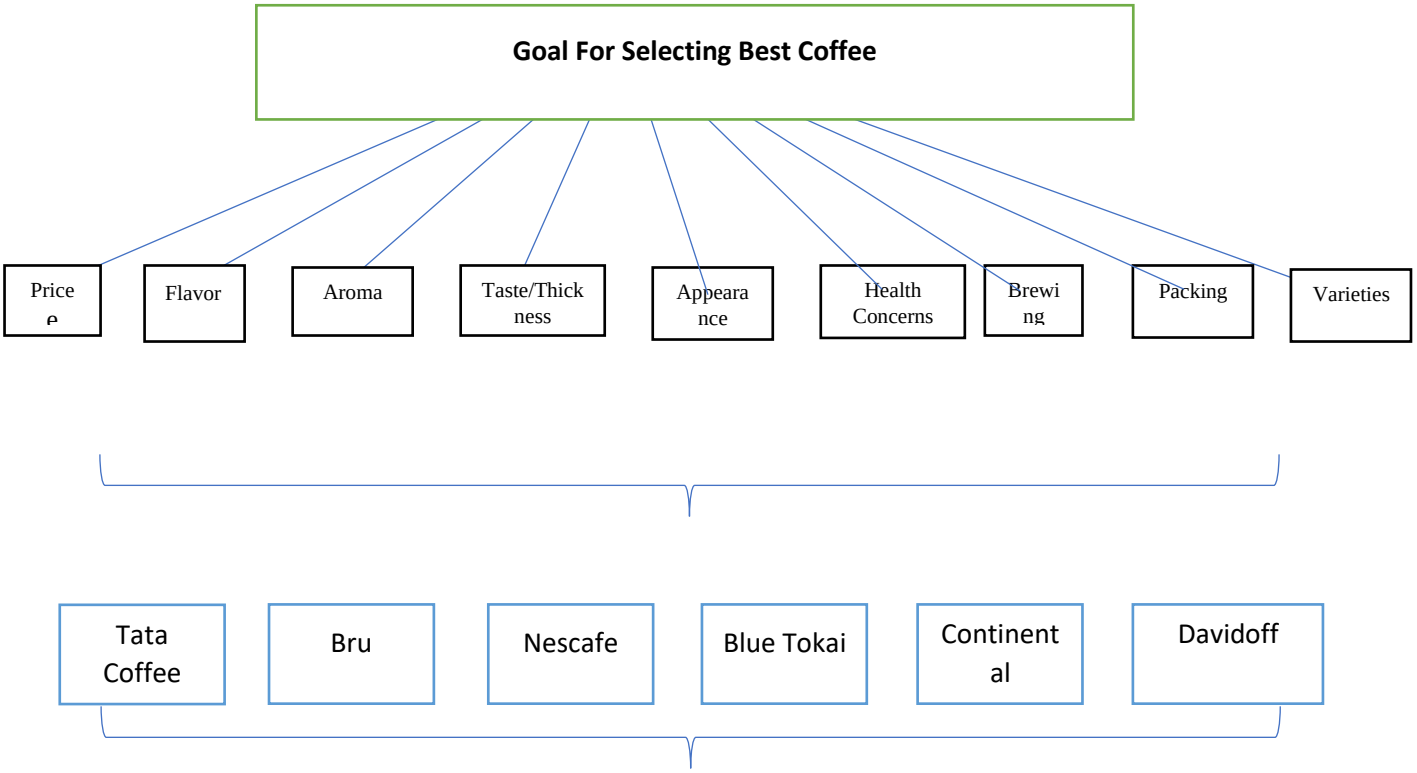
Where we have possessed a series of questions directly to the respondents, it contains structured questions with blanks to be filled through open-ended, multiple-choice questions. A respondent is requested to fill in the form themselves [9] exceptional care must be taken to get accurate information without any exceptions and errors.

Web-based Questionnaire

In this method of gathering information, we have sent a survey link to the selected respondents.

Interview Methods

As the name suggests, the information is collected through the verbal conversations of interviewing the people on a telephone, in person, or by using any computer-aided methods directly.



Criteria's Alternatives

Methodology

An Analytic Network Process (ANP) model was introduced to make decisions among the various alternatives when an extensive number of criteria are involved. This study aims to select the best coffee drink among the various alternatives which are available in the market with the help of the Multi-Criteria Decision-Making Methods (MCDM) [2]. ANP produces a framework to solve decisions, The first step in solving the decision-making problem with the ANP algorithm is to identify the decision criteria of the main problem.The study first analyzed the production of

coffee-grown areas and the quality output of beans after roasting them to a certain degree to get the best quality of roasted beans to make the amazing, flavored coffee with adequate nutrients to boost and provides the necessary supplements and oxidants to the body. The criteria used to serve the basic aspects of problem-solving which are Price (C1), Flavour (C2), Aroma (C3), Taste/Thickness (C4), Appearance (C5), Health Concerns (C6), Brewing Styles (C7), Packing (C8), and Varieties (C9). These nine criteria are taken based on the various economic conditions, preferences, and lifestyles, these criteria are selected for evaluating the best coffee upon the various reputed brand alternatives Tata Coffee (A1), Bru (A2), Nescafe (A3), Blue Tokai (A4), Continental (A5) and Davidoff (A6).

Defining the problem

Making of best coffee requires various factors to choose, selecting the mildly roasted beans of arabica or Robusta from a field that is enriched with a sufficient amount of caffeine and chemical compounds [11] that provide color and aroma to the hot beverage, In addition to the health factors and sensory appeals, many analyses concluded that lifestyle factors influence with certain beverage/food consumer behavior [6]. On the other hand, brewing styles and prices also make a difference in making the coffee. These criteria are categorized to create the decision network matrix.

Formation Of Paired Comparison Matrices and Checking Consistency Ratio

After creating the decision network matrix of the problem, paired comparisons are formulated by assigning the 1-9 values developed by Satty [1], these rankings are carried out between pairwise compared criteria, “1” is considered the equal importance, “3” for slightly important than other criteria, “5” it is used when one criterion has strongly more important than others, “7” is for the criteria when its dominance can be observed, “9” when one criterion has opted strongly with the highest validity and “2”,”4”,”6”,”8’ values are used to when a compromise is needed in selection between two consecutive judgments.

Creating paired Super matrix, Normalized super matrix

In table (1), a paired comparison matrix is generated by taking the criteria weights [13]. In order to provide priorities among the criteria which is available, based on the scale given by satty Thomas. In tables (2.1 & 2.2), created the paired criteria matrix with the alternatives, same for the alternatives with the criterions in table (3.1 & 3.2). (Only the data of first two alternatives is presented), Same as the normalized super matrix is created by taking the weights of the criteria and alternatives in table (4.1) & (4.2).

Results And Discussion's

As this study was conducted after the pandemic, most people became health conscious and they are choosing hygiene among the price and availability of beverages and other foods. Based on the profiles of respondents data from a total of 310 respondents, 67.7% (209) are men and 32.3% (101) are women, in addition to the majority of the sample being collected from men aged less than 50 years.

Nine Criteria's related attributes were listed in the questionnaire using the checkboxes, including the time of having coffee i.e., Morning, Afternoon, and Evening, most of the respondents were

interested to drink coffee in the evening times followed by morning and the afternoon, 74.2% of the sample reported that they consume coffee for refreshment, and 29.4% drink it as a habit and the remaining 6.4% would like to have it at gatherings and social occasions.

They also have been asked where they would like to have it. where we provided an option for selecting to make their own coffee or to take from a coffee shop, Among the total respondents 38% like to have their coffee by cozying on the sofa, rest 62% of people is wanting to socialize by walking into a coffee shop for formal and informal meetups.

In this study, the respondents from different regions, ages, and genders selected the hot beverage based on the various criteria by presenting the significant values. The analysis of these reports obtained from the gathered data is concluded by using the super decisions and GNU octave software for creating the matrices of super and normalized, when Flavor, aroma, and taste/thickness is considered, "Tata Coffee" ranked first, second is "Bru" and "Blue Tokai" grabbed the third positions. When brewing style, varieties, and health concerns are considered. "Continental" ranks first, followed by Blue Tokai and Davidoff. By adding all the priority values of the main criteria to the understanding and the respondent's data, "Tata Coffee" grabbed the first position, "Davidoff" is second, and the third rank is "Continental". Attractive brewing styles and aroma makes them stand first among others in emerging trends.

Table 1: Paired Comparison Matrix for main criterion's weights

Criteria's	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	1.0000	9.0000	8.0000	4.0000	2.0000	0.2000	2.0000	3.0000	0.1667
C2	0.1111	1.0000	6.0000	0.2000	3.0000	2.0000	5.0000	8.0000	2.0000
C3	0.1250	0.1667	1.0000	0.2500	0.2000	0.3333	7.0000	9.0000	6.0000
C4	0.2500	5.0000	4.0000	1.0000	7.0000	9.0000	5.0000	3.0000	2.0000
C5	0.5000	0.3333	5.0000	0.1429	1.0000	0.1111	0.1429	0.3333	0.1667
C6	5.0000	0.5000	3.0000	0.1111	9.0000	1.0000	0.1250	0.1429	0.2500
C7	0.5000	0.2000	0.1429	0.2000	7.0000	8.0000	1.0000	0.1667	5.0000
C8	0.3333	0.1250	0.1111	0.3333	3.0000	7.0000	6.0000	1.0000	4.0000
C9	6.0000	0.5000	0.1667	0.5000	6.0000	4.0000	0.2000	0.2500	1.0000

Consistency Ratio: 0.9856<1, Consistency

Table 2.1: Paired matrices of Criteria (C1) with Alternatives

C1	A1	A2	A3	A4	A5	A6
A1	1.0000	9.0000	6.0000	0.1429	0.2000	8.0000
A2	0.1111	1.0000	0.2000	7.0000	4.0000	0.3333
A3	0.1667	5.0000	1.0000	0.1111	0.1429	5.0000
A4	7.0000	0.1429	9.0000	1.0000	0.3333	0.1250
A5	5.0000	0.2500	7.0000	3.0000	1.0000	6.0000
A6	0.1250	3.0000	0.2000	8.0000	0.1667	1.0000

Consistency Ratio: 0.9899<1, Consistency

Table 2.2: Paired matrices of Criteria (C2) with Alternatives

C2	A1	A2	A3	A4	A5	A6
A1	1.0000	0.3333	5.0000	0.1250	6.0000	8.0000
A2	3.0000	1.0000	8.0000	7.0000	4.0000	0.1667
A3	0.2000	0.1250	1.0000	4.0000	0.1429	9.0000
A4	8.0000	0.1429	0.2500	1.0000	6.0000	0.1250
A5	0.1667	0.2500	7.0000	0.1667	1.0000	4.0000
A6	0.1250	6.0000	0.1111	8.0000	0.2500	1.0000

Consistency Ratio: 0.9991<1, Consistency

Table 3.1: Paired Matrices showing Effect of alternatives on Criterions (A1, Alternate)

A1	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	1.000	8.000	3.000	6.000	2.000	9.000	6.000	5.000	7.000
C2	0.125	1.000	0.500	0.143	5.000	9.000	6.000	4.000	3.000
C3	0.333	2.000	1.000	0.167	0.111	0.200	0.250	0.500	0.143
C4	0.167	7.000	6.000	1.000	0.200	0.111	2.000	0.125	0.250
C5	0.500	0.200	9.000	5.000	1.000	0.125	0.500	0.111	0.167
C6	0.111	0.111	5.000	9.000	8.000	1.000	6.000	5.000	2.000
C7	0.167	0.167	4.000	0.500	2.000	0.167	1.000	0.111	0.500
C8	0.200	0.250	2.000	8.000	9.000	0.200	9.000	1.000	6.000
C9	0.143	0.333	7.000	4.000	6.000	0.500	2.000	0.167	1.000

Consistency Ratio: 0.98003<1, Consistency

Table 3.2: (A2, Alternate)

A2	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	1.0000	0.1667	0.1111	0.2000	0.2500	0.5000	0.1429	7.0000	0.3333
C2	6.0000	1.0000	6.0000	9.0000	5.0000	4.0000	2.0000	7.0000	5.0000
C3	9.0000	0.1667	1.0000	0.2000	0.1429	9.0000	6.0000	4.0000	3.0000
C4	5.0000	0.1111	5.0000	1.0000	0.1667	0.1667	4.0000	0.5000	2.0000
C5	4.0000	0.2000	7.0000	6.0000	1.0000	8.0000	2.0000	9.0000	6.0000
C6	2.0000	0.2500	0.1111	6.0000	0.1250	1.0000	7.0000	0.2000	6.0000
C7	7.0000	0.5000	0.1667	0.2500	0.5000	0.1429	1.0000	0.1429	9.0000
C8	0.1429	0.1429	0.2500	2.0000	0.1111	5.0000	7.0000	1.0000	0.1667
C9	3.0000	0.2000	0.3333	0.5000	0.1667	0.1667	0.1111	6.0000	1.0000

Consistency Ratio: 0.9999<1, Consistency

Table 4.1: Normalized Matrix criterions with respect to Alternatives

	A1	A2	A3	A4	A5	A6
C1	0.04125	0.00577	0.051502891	0.01392488	0.02396566	0.0257449
C2	0.01382	0.06509	0.038308387	0.007742519	0.02344417	0.0277054
C3	0.00568	0.02215	0.018888489	0.015230272	0.0224506	0.0278307
C4	0.00568	0.01344	0.033482067	0	0	0
C5	0.0053	0	0.025257373	0.002695047	0	0.037615
C6	0.01769	0.01363	0	0	0.01332086	0
C7	0.00443	0.00948	0	0	0	0.0108611
C8	0.01542	0	0.005914321	0	0	0
C9	0.00982	0.00761	0.011323281	0.003531511	0.03779184	0.0084287

Table 4.2: Normalized matrix of Alternatives with respect of criteria's

	C1	C2	C3	C4	C5	C6	C7	C8	C9
A1	0.2240	0.2210	0.0737	0.4431	0.1001	0.0422	0.1980	0.1028	0.3682
A2	0.1130	0.3300	0.1112	0.0248	0.3375	0.0437	0.0691	0.3218	0.1012
A3	0.0940	0.1070	0.3539	0.0739	0.0606	0.2143	0.3269	0.1068	0.1866
A4	0.1250	0.1160	0.1298	0.0765	0.2108	0.0813	0.0992	0.0635	0.1071
A5	0.3430	0.1140	0.1490	0.1004	0.2006	0.2724	0.1787	0.0950	0.0779
A6	0.1000	0.1120	0.1824	0.2814	0.0903	0.3461	0.1282	0.3101	0.1590

Table 5: Ranking Matrix

Criteria's	percentage	Ranks
C1	21.81818	**II**
C2	23.69559	**I**
C3	15.10094	**III**
C4	7.077919	**VI**
C5	9.535453	**V**
C6	6.005917	**VII**
C7	3.332576	**VIII**
C8	2.870915	**IX**
C9	10.56251	**VI**

Alternatives	Percentage	Rank
A1	19.70308	**I**
A2	16.13828	**V**
A3	16.93503	**IV**
A4	11.21445	**VI**
A5	17.01281	**III**
A6	18.99634	**II**

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