

Application of the Two-Step Cluster Method in Menu Engineering Analysis at The Alts Hotel Restaurant Palembang, South Sumatra

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ABSTRACT

This research elucidate interm of Hospitality Industry Business especially in Hotel Business, hence restaurants and food businesses as the ones of profit center in hotel often face the challenge of developing menus that are attractive to customers, but also efficient in terms of costs and resources. Effective menu development using the menu engineering method (Menu-Engineering) can increase revenue while achieving customer satisfaction. Therefore, this research uses the menu engineering method as the main basis which aims to identify and analyze existing menus. Furthermore researchers see that selecting a method using Menu-Engineering alone is not enough, especially for determining restaurant management strategy steps to reach the optimal point. Therefore, researchers conducted an in-depth study using the Two-Step Cluster method which is expected to be able to design a menu engineering strategy that can help restaurants increase sales and operational efficiency optimally. The research object was 5 Stars Hotel in City of Palembang namely "The Alts Hotel".

ABSTRAK

Penelitian ini menjelaskan bahwa dalam Industri Perhotelan khususnya Bisnis Hotel, maka Restoran dan bisnis makanan sebagai salah satu "profit center" di hotel seringkali menghadapi tantangan dalam mengembangkan menu yang menarik bagi pelanggan, namun juga efisien dari segi biaya dan sumber daya. Pengembangan menu yang efektif dengan metode rekayasa menu (*Menu-Engineering*) dapat meningkatkan pendapatan sekaligus mencapai kepuasan pelanggan. Oleh karena itu, penelitian ini menggunakan metode rekayasa menu sebagai landasan utama yang bertujuan untuk mengidentifikasi dan menganalisis menu-menu yang ada. Lebih lanjut Peneliti melihat bahwa pemilihan metode dengan menggunakan Menu-Engineering saja tidak cukup, terutama untuk menentukan langkah-langkah strategi pengelolaan restoran hingga mencapai titik optimal. Oleh karena itu, peneliti melakukan kajian mendalam dengan menggunakan metode *Two-Step Cluster* yang diharapkan mampu merancang strategi rekayasa menu yang dapat membantu restoran meningkatkan penjualan dan efisiensi operasional secara optimal. Objek penelitiannya adalah Hotel Bintang 5 di Kota Palembang yaitu "The Alts Hotel".

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INTRODUCTION

Two years have passed after the Covid-19 pandemic, today we are starting to see more and more stretching of the hospitality industry, both nationally and regionally. In the Sumatra Island region, one of them is in the province of South Sumatra, whose capital is Palembang. As reported by the Secretary General of the Indonesian Hotel and Restaurant Association Maulana Yusran in the Cross-Generation discussion: The stretch of the entertainment and tourism industry after the pandemic, Sunday (9/7/2023). It was stated that each region has its own characteristics, there is a tourism sector that is highlighted, there is also an entertainment sector. Both of these certainly have an impact on the hotel and restaurant industry in the area. So with this statement will increase the level of competition in the hotel industry, especially hotels with "Local-Chain" at 4 and 5 stars.

Furthermore, star hotels in South Sumatra Province are one of the growing industries in Indonesia. Many people are interested in using services or products in star hotels influenced by several causes such as per capita income, procurement of national and international events or events, provincial work contracts with outside companies, and community needs such as work meetings, weddings, events etc. One of the factors for choosing a location for holding these events is the presence of very adequate and quality restaurant facilities. One of the factors for choosing a location for holding these events is the presence of very adequate and quality restaurant facilities.

In the end, the competition of products, services and prices offered by each restaurant becomes very competitive. For this reason, precise marketing policy and strategy are needed to deal with increasingly incisive competition, [Atmoko, \(2020\)](#). Currently in Palembang there are several 5-star hotels with "Local-Chain" as below:

Table 1. Local-Chain Hotel in Palembang

No	Nama Hotel	Alamat
1	The Alts Hotel	Jl. Rajawali No.8, Ilir Timur, Palembang, Indonesia, 30113
2	The Arista Hotel	Jl. Kapten A. Rivai, Sumatera Selatan, Ilir Barat, Palembang, Indonesia, 30129
3	The Excelton Hotel	Jl. Demang Lebar Daun No.58, Ilir Barat, Palembang, Indonesia, 30151
4	Wyndham Opi Hotel	Komplek Opi Mall, Jl. Gubernur H.A Bastari Sungai Kedukan Rambutan, Palembang, Indonesia, 30967

Source: Proccesed by Researcher, 2023

This research was conducted at The ALTS Hotel Palembang which has 3 (three) types of food and b

verage product kites namely in "Café Eight" and "Gastro Pub" and "Room Service". Restaurants and food businesses often face challenges in developing menu's that are attractive to customers, but also efficient in terms of costs and resources. Effective menu development with menu engineering methods can increase revenue while achieving customer satisfaction. Therefore, this study uses the menu engineering method as the main basis which aims to identify and analyze the existing menu. Also the restaurant can be communicating with tourism education providers, to learn how to promote regional food, make a menu for regional food so that it can develop even better, [Suwandi, \(2021\)](#).

Researchers see that the selection of methods with Menu-Engineering alone is not enough, especially to determine strategic steps by restaurant management to reach the optimal point. Therefore, the researcher conducted an in-depth study by applying the Two-Step Cluster method which is expected to design a menu engineering strategy that can help restaurants increase sales and operational efficiency (optimal).

LITERATURE REVIEW

Product

As is known in the hospitality industry where the product is something that is

offered to guests/customers so that sales transactions occur. The product offered is always the best choice and is one of the driving factors for guests/customers to make purchases. This must be in line with the definition of products as stated by Kotler and Keller in [Jibril \(2013\)](#) as follows:

"Everything that can be offered to a market to satisfy a want or need", they indicate that it includes physical goods, services, experiences, events, places, people, property, organizations, information, and ideas".

From the above opinion, it can be concluded that a product is everything that is offered to consumers which initially raises attention, desire and will ultimately use or consume. Furthermore, the term product in the field of hospitality includes physical objects, services, personalities, places, organizations and ideas. Products that have good quality are very helpful in carrying out the marketing function for management because consumers generally already know how the quality of the products offered so that they will be able to increase sales. [Cengiz E, et al \(2018\)](#) *"Food and beverage (F&B) sales are one of the core elements of hotel sales revenue. From a financial perspective, the F&B department has a high cost-low profit indicator"*.

[Mertayasa and Komalawati \(2019\)](#), *"a restaurant is a place or building organized commercially that provides good service to guests, both in the form of food and drinks "*. It is very important for a restaurant to design business development in order to survive in the competition of other restaurant businesses. One of them is by using marketing tools in restaurants, namely the menu.

Menu

In the daily operation of a restaurant requires a tool that can be used to offer food and drinks to consumers, namely the menu. The appearance of the menu in a restaurant plays a very important role, where a good menu will be able to give a good image/reputation to the restaurant in general.

As for some of the foundations or opinions regarding the menu as stated by [Kotschevar and Withrow \(2008: 62\)](#) explain that:

"For foodservice consumers, a menu is a list, often presented with some fanfare, showing the food and drink offered by a restaurant, cafeteria, club, or hotel. For the manager of a foodservice establishment, however, the menu represents something significantly more: It is a strategic document that defines the purpose of the foodservice establishment and every phase of its operation."

Meanwhile, according to [Miller in Tumpuan \(2021\)](#) states that the menu is "The Menu is a reflection of those people whom you hope to attract into your restaurant and the products you want to serve them-at a profit.". It can be interpreted that the menu is a reflection of the expectations of consumers who come to the restaurant and the products they want to serve to consumers to be profitable.

Another expert, namely according to [Kasavana in Haryati \(2018\)](#) the menu is defined as "Menu is a list of products offered for service at foodservice establishment." From this quote it can be translated: A menu is a list of products offered for service at a foodservice establishment.

According to [Diana \(2017\)](#) "A menu is a list of foods that is a guide for people who prepare food and a guide for those who enjoy it".

Thus, the menu is a reflection of the guests who are expected to be interested in coming to the restaurant and have the products served as a source of profit.

Menu Engineering (Rekayasa Menu)

One of the most popular definitions of menu engineering in the restaurant field is that put forward by [Kassavana \(1982\)](#) in [Lontaan, et al \(2022\)](#) "Menu engineering is the design of quantitative models to provide businesses to analyze the success of menus both in terms of attracting customers and in terms of profitability."

In a different book Kasavana states that menu engineering is "Menu engineering is a service of process through which management can evaluate current and future menu pricing, design and content decisions."

According to Dittmer (2009) in Wardani, et al. (2023), "Menu Engineering is a technique for analyzing menu sales and providing useful information to increase gross profit".

From the explanation above, it can be concluded that "Menu Engineering" functions as a tool that helps management to evaluate and make decisions in pricing, design and menu content both for the present and the future.

Menu engineering is basically a menu analysis that aims to determine the effectiveness of each menu item offered to guests. This effectiveness concerns the level of popularity and the level of profit achieved from each food (menu item). The results of this analysis are expected to help management in compiling a menu that is favored by guests and profitable so that sales targets can be achieved Ardiansyah (2018). The results of this analysis are expected to help management in compiling a menu that is favored by guests and profitable so that sales targets can be achieved. Menu analysis is guided by two things, namely:

1. **Menu Mix (MM)** is an analysis of guest preferences for food choices contained in the menu (analysis of the level of popularity of each type of food). According to Swandana (2011), menu mix is an analysis of the number of food portions sold in a certain period. To find out whether the menu item has a high or low level of popularity, it is necessary to calculate the menu mix percentage and popularity index. According to Hernowo (2014), namely: "Converts the number sold of each menu item into a percentage of all items sold. The quantity sold of each item is divided by the total of all items sold and then multiplied by 100".

2. **Contribution Margin (CM)** is an analysis of the gross financials of all types of food in the menu. According to Garrison, et al (2013: 209) contribution margin is the sum of sales revenue minus variable expenses. The contribution margin is the amount available to cover fixed expenses and then to provide profit for the period. To obtain these calculations, three sources of data were obtained from:

- a) Sales history to get menu mix data
- b) Standard recipe to get food cost data
- c) Menu list to get selling price data

Two-Step Cluster Methode

The cluster method is one of the multivariate techniques whose main objective is to group objects based on their criteria. The cluster method classifies objects (types of food and beverage menu's), so that between one object and other objects located in one cluster will have a high similarity in accordance with the specified selection criteria, in this case the list of foods in the menu. The results of clustering should show homogeneous diversity within clusters and heterogeneous diversity between clusters formed.

a. Distance Measure

The similarity and dissimilarity measures used in the cluster method are object distance and inter-cluster distance. Distance functions that are often used include: Euclidean distance is the most common and most frequently used distance in cluster methods. The Euclidean distance between two points can be clearly defined. This distance is used when all the variables used are continuous variables. The Euclidean distance between the i-th cluster and the j-th cluster of p variables is defined as:

$$d(i, j) = \sqrt{\sum_{k=1}^p [x_{ik} - x_{jk}]^2}$$

Description:

$d(i, j)$ = Distance between object i to object j

x_{ik} = Value of object i in the k-th variable

x_{jk} = Value of object j in the k-th variable

p = Number of variables observed

b. Log-likelihood Distance

The Log-Like lihood distance can be used for both continuous (numeric) and categorical variables. The assumptions in this distance are that continuous variables spread normally, categorical variables spread multinomially and between variables are mutually independent. The Two Step Cluster method is quite robust to violations of these assumptions so that this method can still be used when there is a violation of assumptions.

The distance between cluster j and s is defined as follows:

$$\begin{aligned} d(i, j) &= \varepsilon_i + \varepsilon_j - \varepsilon_{(i,j)} \\ \varepsilon_i &= -n_i \left(\sum_{k=1}^K \frac{1}{2} \log \left(\hat{\sigma}_{ik}^2 + \hat{\sigma}_k^2 \right) \right) \\ \varepsilon_j &= -n_j \left(\sum_{k=1}^K \frac{1}{2} \log \left(\hat{\sigma}_{jk}^2 + \hat{\sigma}_k^2 \right) \right) \\ \varepsilon_{(i,j)} &= -n_{(i,j)} \left(\sum_{k=1}^K \frac{1}{2} \log \left(\hat{\sigma}_{i,jk}^2 + \hat{\sigma}_k^2 \right) \right) \end{aligned}$$

Description:

N = Number of data

N_j = Number of data in cluster j

N_{jkl} = Sum of the data in cluster j for the k-th categorical variable by lth

σ^2_k = Expected variance for the k-th continuous variable for all data

σ^2_{jk} = Expected variance for the k-th continuous variable in cluster j

KA = Number of continuous variables

KB = Number of categorical variables

LK = Number of categories for the k-th categorical variable

$d(j, s)$ = Distance between cluster j and

s

(j, s) = Combination index of clusters j and s

The Two Step Cluster method is a cluster method designed to overcome the problem of unequal measurement scales, in this case continuous and categorical types, and has a relatively large number of observed objects. The distance used in the Two Step Cluster method is the Log Likelihood

distance for unequal data scales, namely numeric and categorical, while the Euclidean distance is only for numeric data scales.

The procedure for clustering objects in the Two Step Cluster method is carried out in two stages, namely the pre-clustering stage and the optima cluster formation stage.

a. Pre-clustering

In this initial stage, pre-clustering is performed using a sequential clustering approach, where each pair of objects is observed based on a distance measure and decides whether to join a pre-formed cluster or start a new cluster. This approach is described by forming a Cluster Feature Tree (CF Tree). The CF Tree consists of levels of branches (nodes) and each branch contains a number of data entries. If it is a tree, then the branch levels are tree trunk, branches and leaves. In CF Tree, the leaf level is known as the leaf entry (entry in the leaf branch) which represents the desired "sub-cluster" result.

b. Optimum-cluster

The final cluster formation is characterized by the formation of an optimal cluster. A cluster is said to be optimal if it has the longest distance between clusters and the closest distance between objects in the cluster. The closer the distance between objects, the greater the similarity between objects in one cluster. In this stage, the sub-clusters (leaf entries) resulting from the first stage are used as input which is then grouped into the desired number of clusters. Since the number of sub-clusters is less than the number/size of the initial data, a simple merging method is effective. The Two Step Cluster method uses a hierarchical cluster method with an agglomerative method because it has an automatic clustering procedure that can properly form clusters. Each sub-cluster formed in the first stage will be merged one by one according to a predetermined distance

measure. This procedure ends until all sub-clusters become one cluster.

RESEARCH METHOD

This research uses a non-hypothetical analysis approach with a quantitative description method by describing, showing or summarizing data in a constructive way that refers to a statistical picture that helps understand the details of the data by summarizing and finding patterns from a specific data sample. Through samples, researchers will obtain absolute numbers that do not necessarily explain the motives or reasons behind the numbers. That is why inferential methods are needed for further analysis, namely the "Two-step Cluster" method. By using quantitative descriptive statistics, researchers can understand the basic characteristics of the data and make more accurate inferences about the phenomenon being observed.

RESULTS AND DISCUSSIONS

1. The Alts Hotel Menu Preferences

As a 5-star hotel, The Alts Hotel has three food and beverage service products into the category of 2 (two) restaurants namely "Café Eight" and "Gastro Pub" and 1 (one) service "Room Service". In accordance with the methodology used, this approach is used as a Cluster in the processing as follows:

a. Pre Clustering

Based on field observations and interviews conducted at the locus, data were obtained with the following classification.



Picture 1. Pre-clustering classification

Source: Proccesed by Researcher

Table 2: Food and beverage service products at The Alts Hotel

The following data is obtained:

Row Labels	Count of Cluster
CAFÉ DELAPAN	43
Dessert	4
Frape	1
Fresh Juice	1
Hot Coffee	1
Refreshment	1
Rice & Noodles	7
Sandwich	2
Side Dishes	5
Signature	9
Soup	2
Starter	6
Tea Selection	1
Vegetables	3
GASTRO PUB	61
Beers	5
Coffee	3
Dessert	5
Gastro Special	3
Legend	8
Main Course	5
Pizaa & Burger	6
Refreshment	8
Signature	3
Snack & Salad	7
Tea	5
Virgin	3
Grand Total	104

Source: The Alts Hotel Management, 2023

Then enter the calculation in db_cm as follows:

1. Menu-Mixed

$$(\text{Menu Mixed})\% = \frac{\text{Number of Sold Items}}{\text{Total Number of Item Sold}} \times 100\%$$

2. Index-Popularity

$$(\text{Popularity Index})\% = \frac{100\%}{\text{Number of Item Menu}} \times 70\%$$

$$CM. = \text{Selling Price} - \text{Food Cost}$$

3. Contribution-Margin

From these calculations, CF "Nodes" are obtained with the following categories and classifications:

Table 3. Test Result CF “Nodes”

Id Item	Category	Popularity	Contribution Margin	Revenue
1	2	0.65362	-170.277	-0.40559
2	1	-0.40383	0.07721	-0.36945
3	1	0.4717	0.07721	0.66315
4	1	-0.46069	0.07721	-0.4365
5	1	0.07373	0.07721	0.19379
6	1	-0.27876	-0.55163	-0.30722
7	1	-0.46069	-113.904	-0.46254
.....				
25	3	0.0851	-106.471	-0.20852
26	2	-0.36972	0.38769	-0.30484

95	1	-0.27876	-147.254	-0.43212

Source: Proccesed by Researcher, 2023

Thus it can be concluded that in this Pre-Clustering, the valid data for the next process with Bayesian Information Criterion (BIC) is 95 nodes.

b. Optimum Cluster–Optimation Clustering

The data obtained from pre-clustering is used as input to find clusters. Two-Step Cluster uses a hierarchical method in the clustering process. To determine the number of clusters to be formed, this research uses Schwarz's Bayesian Information Criterion (BIC) indicator. BIC is used to find the estimated number of clusters with a distance ratio, where BIC is precise information Mooi (2011). The BIC formula is shown in (Li & Sun, 2012; Schiopu, 2010).

$$BIC(j) = -2 \sum_{j=1}^j \xi_j + m_j \log(N)$$

In the above formula, it is shown that j is the number of clusters, with K is the number of cluster continuous variables and N is the number of observations. Where $m_j = 2Kj$. The cluster process is carried out by combining the sub-cluster results from the Pre-Clustering step according to the existing distance criteria until all data is incorporated into a cluster.

Table 4. The result of determining the cluster

Jumlah Cluster	Schwarz's Bayesian Criterion (BIC)	Perubahan BIC	Rasio Perubahan BIC	Rasio Ukuran Jarak
1	353.056	0	0	0
2	238.177	-114.879	1.000	2.006
3	194.615	-43.561	0.379	1.910
4	184.832	-9.784	0.085	2.929
5	199.488	14.656	-0.128	1.056
6	214.812	15.324	-0.133	1.040
7	230.602	15.790	-0.137	1.657
8	250.965	20.363	-0.177	1.148
9	272.225	21.260	-0.185	1.154
10	294.293	22.068	-0.192	1.581
11	318.293	23.999	-0.209	1.470
12	343.355	25.063	-0.218	1.217
13	368.820	25.465	-0.222	1.169
14	394.554	25.734	-0.224	1.032
15	420.337	25.783	-0.224	1.362

Source: Proccesed by Researcher, 2023

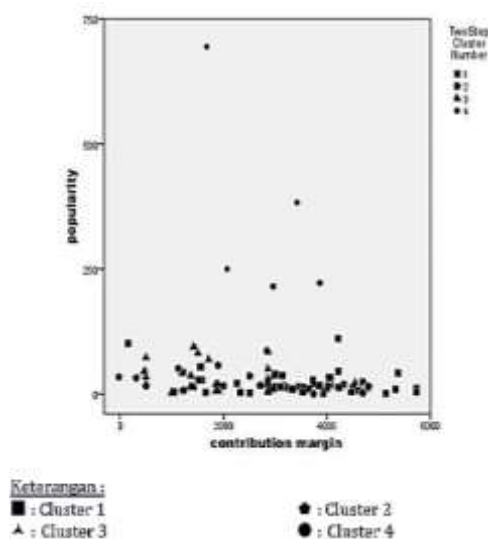
The table above is the result of determining the cluster (Clustering-Estimated) formed using the BIC indicator. Based on the results, there are 15 (fifteen) indicators along with details of distance changes and distance calculations. This process determines the number of clusters on BIC by taking into account the largest ratio distance. From the existing data, the number of clusters that have the largest distance ratio is 4 clusters which can be seen as "Optimum Cluster" with the calculation of popularity and contribution margin as in the scatter diagram below.

Table 5. Scatter diagram

Cluster	N	% Kombinasi
1	42	44,2%
2	16	16,8%
3	32	33,7%
4	5	5,3%
Total	95	100%

Source: Proccesed by Researcher, 2023

Furthermore, the existing menu is done clustering with the following results:



Picture 2. Clustering Menu

Source: Proccesed by Researcher

The table shows the number of frequencies and presentation of menu item combinations from each cluster. In cluster 1 there are 42 menu items or 44.2% of the total menu items, while cluster 2 contains 16 menu items or 16.8% of the total menu items. The cluster 3 contains 32 menu items or 33.7% of all menu items, and the last cluster 4 with a frequency of 5 menu items or 5.3% of all menu items. From these results we can see the CF in each cluster with details of the menu items as follows:

2. Menu Engineering (*Rekayasa Menu*)

From the results of the menu preference process with the "Two-Step" Analysis method, the following results were obtained:

a. Cluster 1 (Low Popularity & Above Average Contribution Margin) **Puzzles**

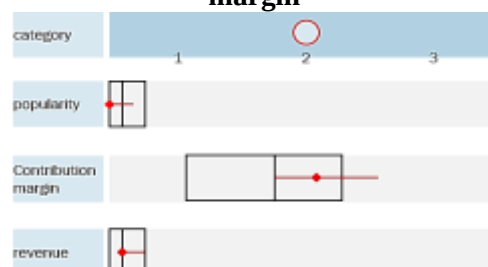
Cluster 1 is a cluster with 42 items in it. The comparison results show that the items in this cluster have low popularity but have an above-average contribution margin.

Table 6. Menu Engineering

Cluster	Number of Items	Total
Cluster 1	{1, 16, 18, 19, 20, 21, 22, 23, 24, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 71, 90, 91, 92, 93}	42
Cluster 2	{25, 28, 70, 74, 75, 76, 77, 78, 79, 80, 83, 84, 85, 86, 87, 88}	16
Cluster 3	{2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 55, 56, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 73, 81, 82, 94, 95}	32
Cluster 4	{57, 58, 67, 72, 89}	5

Source: Proccesed by Researcher, 2023

Picture 3. above-average contribution margin



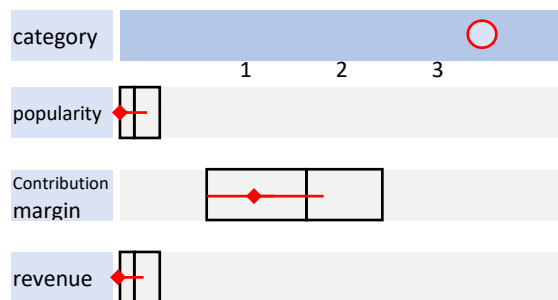
Source: Proccesed by Researcher

Items in cluster 1 on average come from item category 2, namely drinks. Items in this cluster have popularity that has not reached the average popularity of other items but items have a high contribution margin. Where there is a revenue variable that is used as an evaluation variable. Despite having a high contribution margin, due to low popularity, the revenue is in the average.

b. Cluster 2 (Low Popularity & Below Average Contribution Margin) **Dogs**

Cluster 2 has 16 items in it. The menu items in this cluster have low popularity and have below-average contribution margins.

Picture 4. Below-average contribution margins

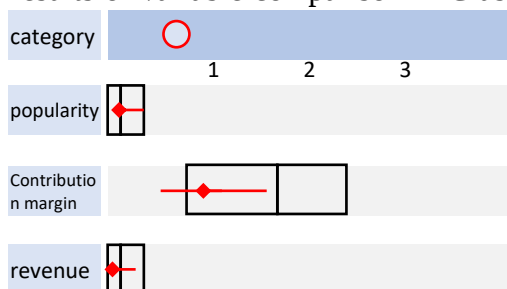


Source: Proccesed by Researcher

The data is a comparison of Cluster 2 which has an average item in item category 3, namely **snacks**. Revenue from menu items in this cluster is below average.

c. Cluster 3 (High Popularity & Below Average Contribution Margin) **Plow-Horses**.

Cluster 3 has 32 menu items in it. The results of variable comparison in Cluster



3 are as follows:

Picture 5. Variable comparison in Cluster 3

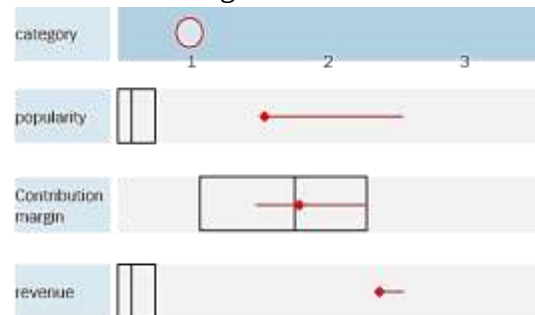
Source: Proccesed by Researcher

The data above shows that the average menu item in this cluster is in item category 1, namely food. This cluster shows a group of menu items with high popularity but has a contribution margin below the average, resulting in low revenue.

d. Cluster 4 (High Popularity & Above Average Contribution Margin) **Stars**

Cluster 4 has 5 members in it, namely item 57, item 58, item 67, item 72 and item 89. Cluster 4 has items that are mostly in the food category. This cluster generates high revenue.

Cluster 4 is a group of menu items that have high popularity and above-average contribution margins.



Picture 6. High Popularity & Above Average Contribution Margin

Source: Proccesed by Researcher

CONCLUSION

The clustering process using Two-Step Cluster provides convenience in data analysis because it accommodates categorical variables and continuous variables and produces the optimal number of clusters because it is adjusted to the conditions of the data set.

In this study, there are 4 clusters formed according to the similarity of criteria in each item set. The cluster results are categorized according to popularity and contribution margin by adding revenue variables that can provide a clearer analysis of the conditions of each cluster formed. In addition, category variables are also added to add specific cluster results and see the majority of menu categories that are members of each cluster. Two-Step Cluster can also find the most optimal cluster according to the variants of the data set.

There is an outstanding cluster in the high popularity and above average contribution margin cluster which has five item sets that provide high revenue for the Ala Carte Menu. From the resulting clusters, new policy recommendations can be given to Ala Carte Menu owners to increase business revenue.

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