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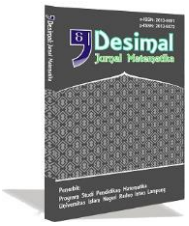

# Application of k-prototypes algorithm to smoking addiction at FST UINSU Medan

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## ABSTRACT

*One of the addictive chemicals that can cause addiction is cigarettes. By combining smoking data among students of the Faculty of Science and Technology (FST) at UINSU Medan, this study seeks to overcome the problem of smoking. The K-Prototypes approach is one of the ones that is applied. Microsoft Excel 2010 and IBM SPSS Statistics are programs used to analyze research data. A sample questionnaire of FST students from UINSU Medan provided data. The findings showed that the K prototype had an impact on smoking factors, study programs, types of cigarettes, the number of cigarettes smoked, and the early age of smoking. There are 19 objects in Cluster 1, 21 objects in Cluster 2, and 25 objects in Cluster 3 students in each cluster. According to the cluster data of the K-Prototypes method, the smoking factor was caused by friends in cluster 1, which included early-age smokers (12.789) with 1.895 packs of salt warehouse cigarettes. In the second group of early smoking age groups (15.810), 1.381 packs of salt warehouse cigarettes were smoked, and the smoking factor was associated with the family. In the third group of early-age smokers (20.44), there were 1.96 packs of Marlboro cigarettes, and friends were a factor in smoking. Thus, the three study programs at FST UINSU Medan require a lot of attention from schools, families, and students.*

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## INTRODUCTION

Cigarettes are tobacco products that are meant to be burned and smoked (Iriyanti & Mandagi, 2022). Smoking is one of the habits of smoking cigarettes that is carried out in daily life; smoking is also an unavoidable need for people who experience a tendency to smoke cigarettes (Rifiana, Evelianti, & Pratiwi, 2023). The difficulty for adolescent smokers to quit smoking is due to cigarettes being highly addictive (Jatmika, Maulana, & Apriliyanti, 2023). Smoking is the beginning of a

person's easy-to-try other addictive substances (B. Kurniawan & Ayu, 2023). In addition, association with people who smoke can also put social pressure on individuals to try smoking (Pasaribu, Carolina, Harahap, Mursyid, & Harahap, 2023).

FST students who want to be accepted by their peers or want to look mature or rebellious may try smoking. The harmful health impacts may not be realized by FST students. Most FST students start smoking when they are teenagers. Those who have friends and parents who smoke are more likely to start smoking than those who don't. Some students say they "just want to try it," or they think smoking is "cool." Some college students smoke when hanging out with friends or to feel comfortable in social situations. Social smokers smoke occasionally and almost always in groups.

Seeing the number of male students who smoke and start smoking when they are still underage and still studying is a difficult problem to solve because the problem of students smoking at this time is so concerning. The difficulty of this smoking habit started in adolescence, which makes these teenagers addicted and addicted and even difficult to quit so their health is disturbed during their growth period. Smoking can also have a negative impact on people around smokers. Their friends encouraged them to try cigarettes and continue smoking. They see smoking as a way of rebelling and showing independence. They think that everyone smokes, and they should too. One of the factors that affect smoking behavior in adolescents is environmental factors such as family factors, peers, and mass media.

Smoking habits in adolescents can be caused by several factors, including the influence of parents who smoke, the influence of friends, personality factors such as curiosity, and the influence of advertisements (Utami, 2020). A teenager is someone who is between the ages of 10 and 24 and is not married (Pratiwi, 2022).

Smoking behavior is a behavior that is harmful to health, but there are still many people who practice this habit (Patana & Elon, 2019). Smoking can have a negative impact on health not only for the smoker himself but also for the people around him who smoke (Sekeronej, Saija, & Kailola, 2020). Given the magnitude of the impact of smoking behavior, especially on adolescents, it is important to prevent and control smoking behavior (Oktania, Widjarnako, & Shaluhiyah, 2023). Nationally, the average age of smoking is 17.6 years, with the age group of 15 to 19 having the largest percentage of those who start smoking daily (Nurdin et al., 2023).

The existence of cigarette advertisements delivered from various media can also affect all groups, especially teenagers. One of the reasons for the large number of teenagers who smoke is that the parenting style of their parents is not good. Teenagers are probably influenced by their peers because the more smokers there are, the more probable it is that their friends also smoke (Susilaningsih, Brata, & Siswanto, 2022).

The research variables for the characteristics of smoking behavior used in Malikussaleh University students were age, number of cigarettes per day, duration of smoking after waking up, and factors that affected smoking behavior through questionnaires (Sawitri, Maulina, & Dwi Aqsa, 2020). The research variables in Dianita's research through questionnaires are gender, age, age for the first time smoking, smoking reasons, smoking frequency, number of cigarettes in a day, and number of smoking cessation efforts (Sugiyo, 2021). Similarity measures are used in cluster analysis using the distance between objects and the distance between clusters (Novidianto & Fithriasari, 2021). Numerous observational data sets are analyzed via data mining, which uncovers unexpected

relationships (Gustientiedina, Adiya, & Desnelita, 2019). To cluster mixed-type objects, the K-Prototypes algorithm combines the k-means and k-modes algorithms (Ganmanah & Kudus, 2021). K-Prototype is used for data objects that have mixed data types, namely numeric and categorical (Koni, Djakaria, Yahya, Matematika, & Mipa, 2023).

One non-hierarchical clustering technique called K-Means Cluster aims to organize data into a cluster that consists of data that share similar properties (Aprilia et al., 2022). The goal of the multivariate technique known as cluster analysis is to organize objects or cases (respondents) into comparatively homogeneous groups, or clusters (Fadilah & Husein, 2019). Cluster analysis must meet the assumption of non-multicollinearity, namely the existence of a perfect or definite linear relationship between some or all variables (Az-zahra, Marsaoly, Lestyani, Salsabila, & Madjida, 2021). The technique is part of the distance-based clustering algorithm, which only works with numerical attributes and separates data into many groups (R. Kurniawan, Suhada, & Rafiqa, 2021).

The K-means algorithm is modified to produce K-modes (Kartikasari, Pranoto, & Rudhistiar, 2021). The most popular technique for classifying sizable categorical data sets into distinct clusters denoted by the most prevalent modes or values is the K-Modes method (Dwiyamti, Nisa, Sutrisno, & Herawati, 2022).

According to the above description, the purpose of this study is to use the K-Prototypes method to group smoking data with a sample, specifically FST UINSU Medan students. The fact that only male students made up the sample limits the application of the problem.

## METHOD

The researcher obtained data from questionnaires that were given to FST UINSU Medan students. The type of research used is quantitative. Quantitative research uses a lot of numbers to collect data to then be measured by statistical methods. Quantitative research tends to look at facts based on the data collected. The type of data used in this study is a mixed questionnaire that is used to obtain a series of research data including in the form of numbers. The data was obtained by filling out a questionnaire for FST UINSU Medan students.

The data collection technique carried out is using a questionnaire, which is carried out by filling in the questions on the questionnaire and sharing the questionnaire link with a group of science students about smoking addiction at FST UINSU Medan in 2024. Researchers also use literature studies by studying several books and journal articles related to research. The basic theory used is the K-Prototypes algorithm to determine the grouping of smoking data in FST UINSU Medan students using the K-Prototypes method.

The variables that showed numerical data were the age of smoking (X1) and the number (pack) of cigarettes (X2). Meanwhile, the variables that showed categorical data were study program (X3), type of cigarette (X4), and smoking factor (X5). Before conducting the research flow, the VIF values of the five variables were searched using SPSS. To find out if there is an intercorrelation (strong relationship) between independent variables.

The procedures of the research can be seen in Figure 1.

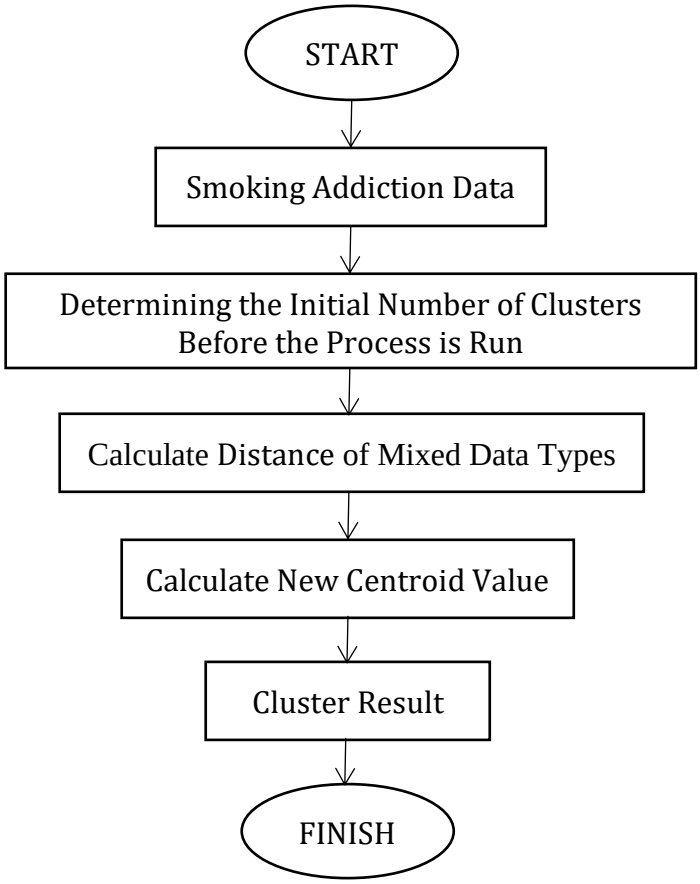


**Figure 1.** Research Phase

The method employed in this study is as follows: (1) establish how many clusters (k) will be formed; (2) identify the prototypes' initials as the cluster's centroid or center point; (3) calculate distance using mixed data types; (4) place all objects in the clusters with the closest distance values; (5) calculate the new centroid value using the mode value and the average value for the categorical and numerical variables; and (6) move the object into each cluster based on the calculation of the closest distance to the new centroid value. The algorithm procedure is terminated if the cluster's centroid, or center point, is stable or has converged (Reihanah, I Maruddani, & Widiharih, 2024).

## RESULTS AND DISCUSSION

### Non-Multicollinearity Assumptions

The assumption of multicollinearity is a state in which there is a strong relationship between explanatory variables (independent). Table 1 displays the multicollinearity test results using SPSS.

**Table 1.** Non-Multicollinearity Assumptions

| Variable | VIF |
|---|---|
| $X_1$ | 1.041 |
| $X_2$ | 1.070 |
| $X_3$ | 1.089 |
| $X_4$ | 1.033 |
| $X_5$ | 1.026 |

Based on Table 1, the VIF value is less than 10.00, multicollinearity does not occur, so the assumption of non-multicollinearity is met.

### Clustering Process

Data on students addicted to smoking at FST UINSU Medan were grouped using the k-prototypes algorithm. The steps used in the K-Prototypes method are to determine the number of clusters (k) to be formed; for example, the

value $k = 3$. Then randomly select 3 objects, namely the 46th object, the 51st object, and the 59th object as the centroid of the first iteration in Table 2.

**Table 2.** Initial Centroid On Clustering with $k = 3$

| i-th Object | Centroid | Variable Index to (p) | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 46 | $C_1$ | 13 | 2 | 1 | 3 | 3 |
| 51 | $C_2$ | 12 | 1 | 2 | 2 | 1 |
| 59 | $C_3$ | 15 | 3 | 3 | 1 | 2 |

Next, use SPSS to check the standard deviation values (as shown in Table 3). The standard deviation value is used to find the gamma value. The obtained gamma value will then be used to calculate the distance of all data objects to the initial centroid using a mixed distance measure.

**Tabel 3.** Standard Deviation

| Statistics | | | |
|---|---|---|---|
| | | $X_1$ | $X_2$ |
| *N* | *Valid* | 65 | 65 |
| | *Missing* | 0 | 0 |
| *Mean* | | 16.71 | 1.75 |
| *Median* | | 16.00 | 2.00 |
| *Std. Deviation* | | 3.445 | 0.751 |
| *Minimum* | | 11 | 1 |
| *Maximum* | | 23 | 3 |

It is known that $\sigma_1$ = 3.445 and $\sigma_2$ = 0.751, so the value of the gamma coefficient (γ).

$$\gamma = \frac{1}{m}(\sigma_1 + \sigma_2) = \frac{1}{2}(3.445 + 0.751) = \frac{1}{2}(4.196) = 2.098$$

Then, using the mixed distance measure, it determines how far each data object is from the original centroid. Suppose to calculate the distance of the 1 object to each of the 1 centroid cluster ($C_1$), the 2 centroid cluster ($C_2$), and the 3 centroid cluster ($C_3$) as follows:

$d(x_1, c_1) = ((x_{11} - c_{11})^2 + (x_{12} - c_{12})^2) + \gamma(\delta(x_{13}; c_{13}) + \delta(x_{14}; c_{14}) + \delta(x_{15}; c_{15})) = ((15 - 13)^2 + (2 - 2)^2) + \gamma(\delta(2; 1) + \delta(3; 3) + \delta(2; 3)) = 8.196$

$d(x_1, c_2) = ((x_{11} - c_{21})^2 + (x_{12} - c_{22})^2) + \gamma(\delta(x_{13}; c_{23}) + \delta(x_{14}; c_{24}) + \delta(x_{25}; c_{25})) = ((15 - 12)^2 + (2 - 1)^2) + \gamma(\delta(2; 2) + \delta(3; 2) + \delta(2; 1)) = 14.196$

$d(x_1, c_3) = ((x_{11} - c_{31})^2 + (x_{12} - c_{32})^2) + \gamma(\delta(x_{13}; c_{33}) + \delta(x_{14}; c_{34}) + \delta(x_{15}; c_{35})) = ((15 - 15)^2 + (2 - 3)^2) + \gamma((\delta(2; 3) + \delta(3; 1) + \delta(2; 2)) = 5.196$

and so on until the 65th object d($X_{65}$,$C_1$), d($X_{65}$,$C_2$), and d($X_{65}$,$C_3$).

**Table 4**. Results of Distance Calculation in Iteration 1 Clustering with $k = 3$

| i-th Object | d($X_i$,$C_1$) | d($X_i$,$C_1$) | d($X_i$,$C_1$) | Mean Value | Cluster |
|---|---|---|---|---|---|
| 1 | 8.196 | 14.196 | 5.196 | 5.196 | 3 |
| 2 | 21.196 | 27.098 | 14.294 | 14.294 | 3 |
| 3 | 4.196 | 6.196 | 9.196 | 4.196 | 1 |
| ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... |
| 64 | 6.196 | 4.196 | 17.196 | 4.196 | 2 |
| 65 | 70.294 | 86.196 | 39.098 | 39.098 | 3 |

Fifth, calculate the new centroid values for numerical variables and categorical variables. In Table 4. The members obtained in cluster 1 are 14 objects, cluster 2 is 5 objects, and cluster 3 is 46. Here is the calculation of the new centroid value

$$c_{11} = \frac{13 + 11 + 14 + 13 + 14 + 12 + 13}{14}$$

$$\frac{14 + 12 + 14 + 13 + 13 + 13 + 14}{14} = \frac{183}{14} = 13.071$$

$$c_{12} = \frac{2 + 2 + 1 + 2 + 2 + 1 + 3 + 2 + 3}{14}$$

$$\frac{+1+1+1+2+1}{14} = \frac{24}{14} = 1.714$$

$c_{13}$ = Modus ({1; 3; ...; 5}) = 1

$c_{14}$ = Modus ({1; 3; ...; 3}) = 3

$c_{15}$ = Modus ({1; 2; ...; 1}) = 2

**Table 5.** Centroid Iteration 2 On Clustering with $k = 3$

| Centroid | Variable Index to (p) | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| $C_1$ | 13.071 | 1.714 | 1 | 3 | 2 |
| $C_2$ | 12.2 | 1 | 2 | 2 | 1 |
| $C_3$ | 18.304 | 1.848 | 3 | 3 | 2 |

The sixth step is to relocate the object into each cluster based on the calculation of the closest distance to the new Centroid value. If the centroid or the center point of the cluster does not change anymore or has converged, then the algorithmic process is stalled. However, if there are still changes to the centroid, then the algorithm will be repeated from stage 3 until the maximum iteration is reached or there is no more object movement in the cluster. In this process, stop at centroid 9 and iteration 9 with the same centroid and cluster values.

**Table 6.** Centroid Iteration 9 On Clustering with $k = 3$

| Centroid | Variable Index to (p) | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| $C_1$ | 12.789 | 1.895 | 3 | 3 | 2 |
| $C_2$ | 15.810 | 1.381 | 2 | 3 | 1 |
| $C_3$ | 20.44 | 1.96 | 1 | 1 | 2 |

**Table 7.** Results of Distance Calculation in Iteration 9 Clustering with $k = 3$

| i-th Object | $d(X_i,C_1)$ | $d(X_i,C_1)$ | $d(X_i,C_1)$ | Mean Value | Cluster |
|---|---|---|---|---|---|
| 1 | 6.998 | 3.137 | 33.791 | 3.137 | 2 |
| 2 | 22.730 | 1.561 | 19.049 | 1.561 | 2 |
| 3 | 6.350 | 12.475 | 57.453 | 6.350 | 1 |
| ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... |
| 64 | 5.620 | 20.955 | 74.253 | 5.620 | 1 |
| 65 | 71.628 | 31.515 | 2.413 | 2.413 | 3 |

Based on Table 7. The characteristics of each cluster can be known, and the centroid values in iteration 9 can be seen in Table 6.

The results of this study provide information about the grouping of data on the most smoking students at FST UINSU Medan, which can be solved by the K-Prototypes method after going through the process of determining variable problems, data collection, and algorithms. The results obtained were three faculties that were most addicted to smoking, namely computer science, information systems, and mathematics. Smoking behavior is mostly due to factors such as friends and family. The results of the previous study showed that the influence of friendship was irrelevant to the reason for smoking behavior in UINSU IV Tuntungan students. But based on the results, smoking behavior is mostly done when hanging out or playing with friends (Pasaribu et al., 2023).

## CONCLUSIONS AND SUGGESTIONS

The number of students in each cluster is 19 objects in cluster 1, cluster 2

is 21 objects and cluster 3 is 25 objects. Cluster 1 for the Mathematics Study Program, Cluster 2 for the Information Systems Study Program, and Cluster 3 for the Computer Science Study Program. Three out of five study programs have the highest rates of smoking addiction. These three study programs require a lot of attention from the campus, family, and awareness of students at FST UINSU Medan not to smoke so that diseases such as Pulmonary TB and so on do not occur. In cluster 1 of the early age of smoking 12.789, the number of cigarettes was 1.895 packs with the type of salt warehouse cigarettes, and the smoking factor was caused by friends. In cluster 2 of the early age of smoking 15.810, the number of cigarettes was 1.381 packs with the type of salt warehouse cigarettes, and the smoking factor was caused by the family. In cluster 3 of the early age of smoking 20.44, the number of cigarettes was 1.96 packs with the type of Marlboro cigarettes, and the smoking factor was caused by friends.

This research can be used as a consideration for the campus to use the researcher's theory regarding the K-Prototypes method to group data and can help the problem of grouping study program students with the highest level of smoking addiction. Recommendations for future research can be more specific in researching using the K-Prototypes method to produce the best grouping.

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