

1. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) are business units or economic activities that stand alone, managed by individuals or business entities that are not legal entities. MSMEs can operate in various economic sectors, such as agriculture, manufacturing, trade, and services [1]. MSMEs have a very significant role in Indonesia's economic growth, considering that the number reaches 99% of the total existing business units. In 2023, the number of MSME businesses reached around 66 million. The contribution of MSMEs reached 61% of Indonesia's Gross Domestic Product (GDP), equivalent to IDR 9,580 trillion. MSMEs absorb around 117 million workers (97%) of the total workforce [2]. One of the fastest-growing industries in the MSME sector is fashion, including shoe production, which has high market demand [3].

MSMEs in Banyumas Regency encompass 84,350 business units across various sectors, including the shoe industry [4]. One of the MSMEs in Banyumas engaged in this sector is Bintang Sepatu Purwokerto. This MSME produces leather shoes in various styles for both men and women. In terms of marketing, it relies on a door-to-door sales strategy. Although the number of salespeople increased from one in May 2023 to three by the end of the year, the main challenge faced was that the products often did not match customer preferences, particularly in size and design. As a result, sales volumes fell short of targets, and the production capacity set at 500 pairs per month was not fully utilized, as illustrated in Figure 1. Consequently, an appropriate marketing approach is essential to address this issue. One of appropriate strategies to be implemented is to comprehend customer characteristics to inform marketing decisions. Prior research demonstrated that analyzing customer characteristics with the components of the marketing mix (product, price, place, promotion, process, and licensing) facilitated the formulation of effective marketing strategies, resulting in increased sales volume [5] - [6]. However, prior studies predominantly employed conventional segmentation methods and tended to analyze either numerical or categorical data in isolation, thereby constraining their capacity to comprehensively capture the complexity of customer profiles.

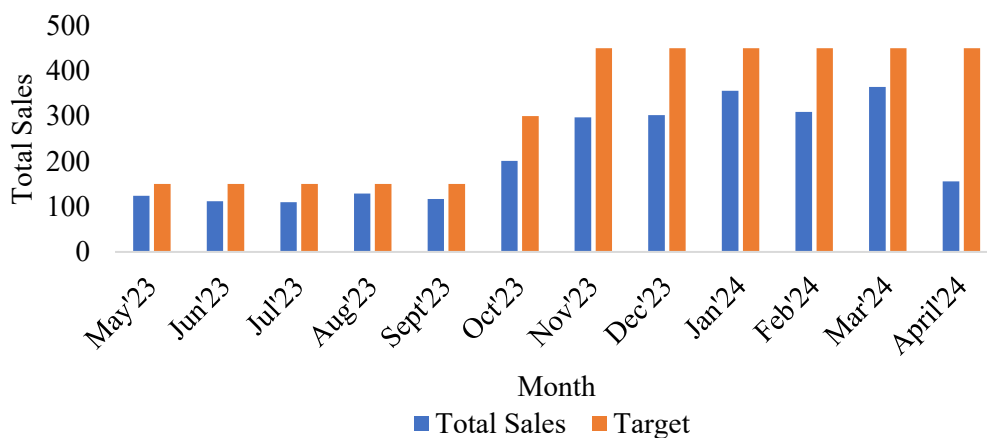


Figure 1. Product Sales Data

One of the methods that can be conducted to analyze customer characteristics is clustering analysis, where k-means is the popular algorithm. This algorithm can be leveraged to cluster objects into several clusters based on observed features, so that the higher similarity of objects in the same cluster is obtained compared to objects from different clusters. The k-

means algorithm has been utilized in several fields such as education [7] - [11], environment [12], shape analysis [13], biology [14], feature selection [15], and marketing [16] - [17].

In the clustering process, K-means clustering necessitates the adjustment of each cluster's centroid according to its constituent object. If all features in the dataset are numeric, the data can serve as an object configuration, with the centroid often adjusted using Euclidean distance. Nevertheless, if the dataset comprises both categorical and numeric data, a particular methodology is required to ascertain the configuration of each object inside the dataset. One method that can be employed is the Principal Coordinate Analysis (PCoA) algorithm [15]. This approach can generate the configuration of objects using their proximity matrix. In addition, PCoA facilitates the dimensionality reduction of customer data, enabling highly correlated variables to be depicted in fewer dimensions while preserving essential information [18] - [19].

Although this approach holds significant potential, to date, few studies have integrated the Principal Coordinate Analysis (PCoA) algorithm with k-means clustering for customer segmentation in the MSME sector, particularly within the footwear industry, while considering the full spectrum of mixed attributes in the marketing mix. This situation highlights a research gap where conventional clustering methods have not been able to effectively handle mixed-type marketing data. The novelty of this study lies in the integration of the Principal Coordinate Analysis (PCoA) algorithm and k-means clustering to analyze customer characteristics involving both categorical and numerical attributes based on the marketing mix, with a specific application in the footwear MSME context. This approach enables the development of a more accurate and comprehensive segmentation model, thereby more effectively reflecting customer preferences compared to conventional methods.

Based on the aforementioned statements, this study aims to analyze the customer characteristics of Bintang Sepatu Purwokerto MSME and categorize them into more specific segments based on their characteristics and the elements of the marketing mix (product, price, place, promotion, process, and licensing) by using clustering analysis. The PCoA algorithm will be utilized to handle the numerical and categorical data simultaneously when constructing the configuration of objects for the k-means algorithm. This research is expected to provide data-driven recommendations to enhance Bintang Sepatu Purwokerto MSME's comprehension of client needs. The results of this study will facilitate the formulation of a more focused marketing plan, enhance sales volume, and optimize manufacturing capacity, thus allowing the MSME to enhance its competitiveness in the intensifying shoe sector.