In the modern world, at the point where today's industries have come, the reverse logistics is as important as the traditional logistics. This is not only important for the companies, but also for the environmental protection. Like the production processes, companies do not want to endure more costs during the reverse logistics processes and while protecting the environment.

Companies can hit two birds with one stone by optimizing the reverse logistics process. Precisely at this point, this book will be a very convenient resource for students, engineers, researchers, industries, and anyone who needs both theoretically and practically.

Associate Professor
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To my family:
Behice ÖZDEMIR
Emir ÖZDEMIR
Uras ÖZDEMİR

PREFACE

In this book, waste recycling centre coordinates were proposed for local authorities according to seven regional areas in Turkey. 81 provinces in Turkey were divided into 7 regions and the cities that should be located in these territories were determined by using k-means clustering analysis according to cities' longitudes and latitudes coordinates. In addition to that, waste recycling centre coordinates were specified via using k-means clustering analysis and particle swarm optimization methods. The distance of the waste recycling centre coordinates to the cities in the region were compared for k-means clustering analysis and particle swarm optimization results. According to our findings, particle swarm optimization is more successful than k-means clustering analysis.

K-means clustering analysis(K-MCA) is one of a machine learning technique and particle swarm optimization (PSO) is one of a heuristic technique.

It is aimed to propose waste recycling centres for the seven regions that will represent 81 cities in Turkey via comparison of the performance of K-MCA, and PSO. Firstly, k-means clustering analysis was performed. K-MCA, outputs the clusters and the cluster centers both. Outputted cluster centers were used for K-MCA's waste recycling centres. Secondly, PSO analysis were conducted and determined waste recycling centres via the clusters defined by K-MCA. Although both methods depend on the euclidean distances, in order to produce a more realistic solution to the real-life problem, all distances between the waste recycling centres and the city centers were converted and reported as kilometer unit unlike euclidean distance via using Google Maps as distance unit in Turkey is kilometer.

K-MCA and PSO were used to specify the coordinates of waste recycling centres for the regions. The distances from the proposed coordinates by K-MCA and PSO to the cities in the region were compared for both methods. Compared results aforementioned methods were one-time shipment distances from waste recycling centres to the city centers and reported via tables and graphs.

K-MCA, was performed by using stats package in R Programming Language (R Core Team, 2018), and the PSO is coded and implemented in the R Programming Language by the author. The ggplot2 package(H. Wickham, 2016) was used to obtain the graphs.

In the next section, reverse logistics is explained. In the second section, Municipal indicators for Turkey is given. In section three a comprehensive literature review is discussed. In section four K-MCA and PSO techniques are examined. In the fifth section data is explained. Analysis results are included in the sixth part of the book. Finally, last section covers the assessments.

Muhlis ÖZDEMİR – 2021
Gazi University, Ankara