Customer Segmentation to Design the Supply Chain Network on GIS Map using Unsupervised Machine Learning

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Abstract

The optimum and correct location of warehouse in order to minimise the inbound and outbound logistic cost of the company/firm plays a crucial role in these challenging and costly environment. As of now very tedious and time consuming techniques are there to solve and locate it. This work covers the strategy to select the best geographical location within the targeted range, this work can also be successfully utilised in customer-warehouse model, warehouse-manufacturing unit model and manufacturing unit-supplier model by minimizing inbound, outbound logistics cost and the transporting raw material cost. The model is prepared with KMeans algorithm, unsupervised machine learning and shape file is used for the visual representation of results on GIS map of the selected region. KMeans is very powerful algorithm in deciding the initial clustering of customers based on geographical location. The model clusters the location by calculating the Euclidean distance and grouping them based on the minimum distance criteria. Latitude and longitude, being on the coordinate reference system, a spherical one, haversine formula is used for the distance calculation in the KMeans logic development. This work presents the clustering model that incorporate longitude, latitude and shape file of the geographical region as an input. Steps: Randomly initialize centroids, from each data point calculate haversine distance, group them based on minimum distance, update the centroid by using mean of all the points, check for the centroids again, if not changed otherwise go to step. For the experiment, India map is the system of consideration, with the top 20 major cities and the cleaned geographical data of cities and shape file of the Indian boundaries are given as input to the K Means algorithm, resulting in the three optimum location at (Lat1, Long1), (Lat2, Long2), (Lat3, Long3) and group the cities into respective clusters. The major and only input is the GIS Coordinate i.e. latitude and longitude for the machine learning model and with the minimal input, this work gives the ability/flexibility to get the basic structure of the supply chain element i.e. supplier, manufacturing, warehouse and customer location. Later on based on the other parameters the results can be refined in order to consider the type of the product, population of the cities etc. In case of new product introduction or the extension of the already existing region, the outcome from this model might be a boon for the investment decision in the construction of new facility. it will help for decision making by not only giving the location but also the optimum number of location.

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Keywords

Machine Learning, Supply Chain, Latitude, Cluster, KMeans, Haversine.

Biographies

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Dr. Ramachandra Gopal P is currently an Assistant Professor in the School of Management at National Institute of Technology, Warangal, India. He has also worked in Thiagarajar School of Management, Madurai. He was awarded PHD from Indian Institute of Technology Kharagpur in the area of sustainable supply chain management. He holds a MTech degree from NITW and bachelors in Mechanical Engineering from Acharya Nagarjuna University, Andhra Pradesh. He has published papers in various peer-reviewed international journals such as Annals of Operations Research (Springer), PPC (Taylor & Francis), IJSE (Taylor & Francis) and IJPPM, WCPS. His fields of expertise include Operations Management, Supply Chain Management, Project Management, Quality Engineering, Total Quality Management and Business Research Methodology.