**K-Means Clustering of People with COVID-19**

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**DoYeong, Jeon  
Software Engineering Laboratory  
Soongsil University**

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# Source Code

## Code for Creating Database

* CreatingDB Class

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| class CreatingDB:  *"""  Class for creating random database  """* num\_people = 0 *# number of people to create* base\_date = None *# the base date of data* def \_\_init\_\_(self, num\_people, base\_date):  self.num\_people = num\_people  self.base\_date = base\_date   def generate\_incurred\_date(self):  *"""  function to create random incurred date  :return:  incurred\_date: string, the day of infection or contact  elapsed\_days: int, the difference between base date and incurred date  """* elapsed\_days = random.randint(0, 14) *# the valid day period is 0~14  # extracting the incurred day using periods and base date* incurred\_date = (self.base\_date - timedelta(days=elapsed\_days)). \  strftime(**"%Y %m %d"**)  return incurred\_date, elapsed\_days   def generate\_address\_list(self):  *"""  function to get one address randomly from the adress list  :return: the randomly generated address list  """* with open(**'./Address\_Part.txt'**, **'r'**, encoding=**'utf-8'**) as add\_file:  *# add\_file = add\_file.encoding* address\_list = add\_file.readlines()   random\_address\_list = [] *# list to store addresses   # extract addresses as many as the number of recipients* for \_ in range(1, self.num\_people + 1):  random\_address\_list.append(random.choice(address\_list))   return random\_address\_list   def generate\_csv\_data(self):  *"""  function to create .csv file with randomly generated records  :return: None  """* num\_healthy = round(self.num\_people / 3) *# 1/3 is healthy* num\_contacted = round(self.num\_people / 3) *# 1/3 is contacted  # 1/3 is confirmed* num\_confirmed = self.num\_people - num\_healthy - num\_contacted   id\_list = list(range(1, self.num\_people + 1)) *# ID as many as people* random.shuffle(id\_list) *# shuffle list   # age records as many as people* age\_list = list(random.randint(1, 100)  for \_ in range(1, self.num\_people + 1))  *# address records as many as people* address\_list = self.generate\_address\_list()   severity\_list = [] *# severity records as many as people* incurred\_date\_list = [] *# incurred date list including 'None'(healthy)* status\_list = [] *# status(Healthy, Contacted, and Confirmed) list   # Entire people num = healthy + contacted + confirmed  # Repeat as many healthy people* for \_ in range(num\_healthy):  *# severity\_list.append(0)* status\_list.append(**'Healthy'**)  incurred\_date\_list.append(**'None'**)   *# Repeat as many contacted people* for count in range(num\_contacted):  date, days = self.generate\_incurred\_date()  status\_list.append(**'Contacted'**)  *# severity\_list.append(round(self.compute\_severity('contacted', days), 2))* incurred\_date\_list.append(date)   *# Repeat as many confirmed people* for \_ in range(num\_confirmed):  date, days = self.generate\_incurred\_date()  status\_list.append(**'Confirmed'**)  *# severity\_list.append(round(self.compute\_severity('confirmed', days), 2))* incurred\_date\_list.append(date)   *# converting as pandas DataFrame data type to save .csv* df = pd.DataFrame({  **"ID"**: id\_list,  **"Age"**: age\_list,  **"Address"**: address\_list,  **"Covid Status"**: status\_list,  *# "Severity": severity\_list,* **"Incurred Date"**: incurred\_date\_list,  })  df = df.sort\_values([**'ID'**], ascending=[True])  df.reset\_index(drop=True, inplace=True)   *# saving as .csv file* df.to\_csv(**"corona\_data.csv"**, mode=**'w'**, encoding=**'utf-8-sig'**) |

## Code for Clustering

* ClusteringPeople Class

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| class ClusteringPeople:  df\_corona = None  added\_column\_list = []  cluster\_result\_dic = {}   centroids\_coord\_list = []   num\_healthy = 0  healthy\_id\_list = []  num\_contacted = 0  contacted\_id\_list = []  num\_confirmed = 0  confirmed\_id\_list = []   def \_\_init\_\_(self, file\_path):  self.load\_data(file\_path)  self.compute\_severity()  self.compute\_people\_number\_of\_type()   def load\_data(self, file\_path):  *"""  method to load .csv file  :param file\_path: string, the path of file  :return:  """* self.df\_corona = pd.read\_csv(file\_path)   def compute\_people\_number\_of\_type(self):  status\_series = self.df\_corona[**"Covid Status"**]  for idx in range(len(status\_series)):  if status\_series[idx] == **'Contacted'**:  self.num\_contacted += 1  self.contacted\_id\_list.append(idx+1)  elif status\_series[idx] == **'Confirmed'**:  self.num\_confirmed += 1  self.confirmed\_id\_list.append(idx+1)  else:  self.num\_healthy += 1  self.healthy\_id\_list.append(idx+1)   def compute\_average\_severity(self, id\_list):  sum\_of\_severity = 0  for id in id\_list:  sum\_of\_severity += self.df\_corona[**"Severity"**][id-1]  return sum\_of\_severity / len(id\_list)    def display\_load\_data(self):  print(**f"Total number of People:** {len(self.df\_corona)}**"**)  print(**f"**{**'ID'**:**<4**}**"  f"**{**'Age'**:**<4**}**"  f"**{**'Covid Status'**:**<13**}**"  f"**{**'Severity'**:**<9**}**"  f"**{**'Address'**:**<10**}**"**)  for i in range(len(self.df\_corona)):  print(**f"**{self.df\_corona[**'ID'**][i]:**<4**}**"  f"**{self.df\_corona[**'Age'**][i]:**<4**}**"  f"**{self.df\_corona[**'Covid Status'**][i]:**<13**}**"  f"**{round(self.df\_corona[**'Severity'**][i], 3):**<9**}**"  f"**{self.df\_corona[**'Address'**][i].split()[0]:**<10**}**"** )  print() *# float 1 line* print(**f"Number of healthy people:** {self.num\_healthy}**"**)  print(**f"Number of contacted people:** {self.num\_contacted}**"**)  print(**f"Number of confirmed people:** {self.num\_confirmed}**"**)  print(**f"Average Severity of contacted people: "  f"**{round(self.compute\_average\_severity(self.contacted\_id\_list), 2)}**"**)  print(**f"Average Severity of confirmed people: "  f"**{round(self.compute\_average\_severity(self.confirmed\_id\_list), 2)}**"**)  print() *# float 1 line* def compute\_severity(self):  *"""  method to preprocess the data for distance function  :return: None  """* col\_num = len(self.df\_corona) *# the number of rows from loaded data* today = datetime.now().date() *# date of today, YEAR-MONTH-DAY   # selecting specific column to compute 'severity'* incur\_date\_col = self.df\_corona[**'Incurred Date'**]  status = self.df\_corona[**'Covid Status'**]   severity\_list = [] *# list for storing severity result* for i in range(col\_num):  severity = 0 *# default is healthy, 0.* if status[i] == **'Contacted'**: *# contacted person?  # formula for contacted person:  # x = 1 - ((today's date) - (infected date)) \* 0.05)* elapsed\_days = (today - parse(incur\_date\_col[i]).date()).days  severity = (1 - (elapsed\_days \* 0.05)) \* 0.5   elif status[i] == **'Confirmed'**: *# confirmed person?  # formula for confirmed person:  # x = (1 - ((today's date) - (infected date)) \* 0.05)) / 2* elapsed\_days = (today - parse(incur\_date\_col[i]).date()).days  severity = 1 - (elapsed\_days \* 0.05)   severity\_list.append(severity) *# add the value to the list* self.df\_corona[**"Severity"**] = severity\_list  self.added\_column\_list.append(**"Severity"**)   def cluster\_kmeans(self, col\_name\_list, num\_cluster):  *# load the k-means model* km = cluster.KMeans(  n\_clusters=num\_cluster, *# the number of cluster* init=**'k-means++'**, *# how to initial cluster centers* max\_iter=300, *# maximum number of iterations* algorithm=**'auto'** *# three choices: auto, full, and elkan.* )   *# cluster* if len(col\_name\_list) == 1:  target\_data = self.df\_corona[col\_name\_list].values.tolist()  target\_data = np.array(target\_data)  cluster\_predicted\_list = km.fit\_predict(  target\_data.reshape(-1, 1)) *# changing the shape of data* silhouette\_score\_list.append(  silhouette\_score(target\_data.reshape(-1, 1),  cluster\_predicted\_list))   else: *# at least 2 column* target\_data = self.df\_corona[col\_name\_list]   min\_max\_scaler = preprocessing.MinMaxScaler()  target\_data = min\_max\_scaler.fit\_transform(target\_data)   cluster\_predicted\_list = km.fit\_predict(target\_data)  silhouette\_score\_list.append(  silhouette\_score(target\_data,  cluster\_predicted\_list))   *# storing the coordinates of centroids* self.centroids\_coord\_list.append(km.cluster\_centers\_)   *# storing the prediction result* self.cluster\_result\_dic[num\_cluster] = cluster\_predicted\_list   return cluster\_predicted\_list   def draw\_elbow\_method(self, sse\_list):  *"""  method to draw elbow graph using SSE(Sum of Squares Error)  :param sse\_list: list of SSE  :return: None  """* plt.plot(range(2, 10), sse\_list, marker=**'o'**)  plt.xlabel(**"The Number of Cluster"**)  plt.ylabel(**"SSE"**)  plt.show()   def print\_result\_of\_cluster(self,  num\_cluster,  cluster\_idx\_list,  cluster\_predicted\_list):   severity\_list = self.df\_corona[**"Severity"**].values.tolist()  age\_list = self.df\_corona[**"Age"**].values.tolist()   cluster\_predicted\_list = cluster\_predicted\_list.tolist()  people\_num\_of\_a\_cluster\_list = []  avg\_age\_of\_a\_cluster\_list = []  avg\_severity\_of\_a\_cluster\_list = []   print(**f"Number of Clusters:** {len(cluster\_idx\_list)}**"**)   for cluster\_idx in cluster\_idx\_list: *# 1 cluster* num\_people = cluster\_predicted\_list.count(cluster\_idx)  id\_target\_data\_tuple\_list = []  sum\_of\_severities = 0  sum\_of\_ages = 0   for person\_idx in range(len(cluster\_predicted\_list)):  if cluster\_idx == cluster\_predicted\_list[person\_idx]:  sum\_of\_severities += severity\_list[person\_idx]  sum\_of\_ages += age\_list[person\_idx]  id\_target\_data\_tuple\_list.append((  person\_idx+1, *# [0] of tuple is id* age\_list[person\_idx], *# [1] of tuple is age* round(severity\_list[person\_idx], 2))) *# [2] of tuple is severity* people\_num\_of\_a\_cluster\_list.append(num\_people)   print(**f"**\t**Cluster** {cluster\_idx}**:"**)  print(**f"**\t\t**Number of People:** {num\_people}**"**)  print(**f"**\t\t\t{**'ID'**:**<4**}{**'Age'**:**<4**}{**'Severity Value'**}**"**)  for person\_in\_cluster in id\_target\_data\_tuple\_list:  print(**f"**\t\t\t{person\_in\_cluster[0]:**<4**}**"  f"**{person\_in\_cluster[1]:**<4**}**"  f"**{person\_in\_cluster[2]}**"**)   print(**f"**\t\t**Average of Age: "  f"**{round(sum\_of\_ages / len(id\_target\_data\_tuple\_list), 2)}**"**)  print(**f"**\t\t**Average of severities: "  f"**{round(sum\_of\_severities / len(id\_target\_data\_tuple\_list), 2)}**"**)  print(**f"**\t\t**The Coordinates of Centroid:"**)  coords = self.centroids\_coord\_list[num\_cluster-2][cluster\_idx]  print(**f"**\t\t\t**X1 (Severity):** {round(coords[0], 2)}**"**)  print(**f"**\t\t\t**X2 (Age):** {round(coords[1], 2)}**"**)   avg\_age\_of\_a\_cluster\_list.append(  round(sum\_of\_ages / len(id\_target\_data\_tuple\_list), 2))  avg\_severity\_of\_a\_cluster\_list.append(  round(sum\_of\_severities / len(id\_target\_data\_tuple\_list), 2))   print() *# float 1 line* self.display\_summary\_table(people\_num\_of\_a\_cluster\_list,  avg\_age\_of\_a\_cluster\_list,  avg\_severity\_of\_a\_cluster\_list)  print() *# float 1 line* def data\_to\_csv(self, num\_cluster, cluster\_label\_list):  temp\_df = self.df\_corona.\_\_deepcopy\_\_()  temp\_df[**f"Cluster ID:** {num\_cluster}**"**] = cluster\_label\_list   file\_name = **f"clustered\_corona\_data\_k=**{num\_cluster}**\_"** \  **f"**{**'\_'**.join(self.added\_column\_list)}**.csv"** temp\_df.to\_csv(file\_name, encoding=**'utf-8-sig'**)   def display\_summary\_table(self,  people\_of\_cluster\_list,  avg\_age\_of\_cluster\_list,  avg\_severity\_of\_cluster\_list):  len\_id = 11  len\_p\_num = 11  len\_age = 13  len\_sev = 15  len\_sum = len\_id+len\_p\_num+len\_age+len\_sev   *# top row* print(**f"**\t{**'-'**\*(len\_sum+11)}**"**)  print(**f"**\t{**'Cluster ID'**:**>**{len\_id}} **"  f"|** {**'# of People'**:**>**{len\_p\_num}} **"  f"|** {**'Avg. of Ages'**:**>**{len\_age}} **"  f"|** {**'Avg. of Severity'**:**>**{len\_sev}} **"**)   *# contents of table* cluster\_id = 0  for people\_num, avg\_age, avg\_sev in zip(people\_of\_cluster\_list,  avg\_age\_of\_cluster\_list,  avg\_severity\_of\_cluster\_list):  print(**f"**\t{cluster\_id:**>**{len\_id}} **"  f"|** {people\_num:**>**{len\_p\_num}} **"  f"|** {avg\_age:**>**{len\_age}} **"  f"|**{avg\_sev:**>**{len\_sev}}**"**)  cluster\_id += 1   print(**f"**\t{**'-'**\*(len\_id+1)}**"  f"|**{**'-'**\*(len\_p\_num+2)}**"  f"|**{**'-'**\*(len\_age+2)}**"  f"|**{**'-'**\*(len\_sev+2)}**-"**)   *# bottom row* print(**f"**\t{**'Total'**:**^**{len\_id}} **|** {sum(people\_of\_cluster\_list):**>**{len\_p\_num}} **|"**)  print(**f"**\t{**'-'**\*(len\_sum+11)}**"**)   def draw\_silhouette(self):  *"""  method to draw graph using silhouette scores  :return: None  """* pass   def draw\_graph(self):  *"""  method to draw clustering result  :return: None  """* pass |

* main

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| if \_\_name\_\_ == **'\_\_main\_\_'**:  *# CODE FOR CLUSTERING* file\_path = **'./corona\_data.csv'** cp = ClusteringPeople(file\_path)  cp.display\_load\_data()   sse\_list = [] *# list for storing SSE(Sum of squares errors)* silhouette\_score\_list = [] *# list for storing silhouette scores   # cluster with 'Severity' and 'Age' columns* col\_name\_list = [**'Severity'**, **'Age'**]  k\_list = [k for k in range(2, 10)] *# cluster list* for num\_cluster in k\_list:  cluster\_id\_list = [id for id in range(num\_cluster)]  predicted\_list = cp.cluster\_kmeans(col\_name\_list, num\_cluster)  cp.print\_result\_of\_cluster(num\_cluster,  cluster\_id\_list,  predicted\_list) |

# Result of Clustering with Single Feature

## Clustering using Scikit-Learn Library

### Clustering using K-means

* Used Column: Severity
* Distance Function: Euclidean Distance
* Console window results

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| Total number of People: 100  ID Age Covid Status Severity Address  1 72 Contacted 0.125 충청남도  2 50 Healthy 0.0 경기도  3 49 Contacted 0.2 경상북도  4 45 Contacted 0.225 전라남도  5 45 Contacted 0.325 전라남도  6 66 Confirmed 0.55 부산광역시  7 86 Healthy 0.0 전라남도  8 43 Healthy 0.0 서울특별시  9 63 Healthy 0.0 경기도  10 81 Confirmed 0.35 광주광역시  11 2 Contacted 0.175 경상북도  12 69 Healthy 0.0 전라북도  13 66 Healthy 0.0 전라북도  14 37 Contacted 0.425 울산광역시  15 97 Healthy 0.0 경상북도  16 98 Healthy 0.0 경상북도  17 56 Confirmed 0.65 전라북도  18 26 Contacted 0.3 경상남도  19 90 Confirmed 0.9 전라북도  20 21 Confirmed 0.5 전라북도  21 26 Healthy 0.0 경상북도  22 17 Confirmed 0.45 제주특별자치도  23 55 Healthy 0.0 부산광역시  24 74 Healthy 0.0 경상북도  25 91 Contacted 0.275 경상북도  26 33 Healthy 0.0 대전광역시  27 1 Healthy 0.0 강원도  28 91 Confirmed 0.9 전라남도  29 74 Confirmed 0.45 전라남도  30 52 Contacted 0.275 경기도  31 49 Confirmed 0.4 전라남도  32 49 Confirmed 0.3 전라남도  33 13 Contacted 0.375 경상남도  34 90 Contacted 0.175 충청북도  35 40 Healthy 0.0 경상남도  36 59 Confirmed 0.9 인천광역시  37 21 Contacted 0.3 경상남도  38 99 Confirmed 0.3 경상남도  39 20 Healthy 0.0 경기도  40 21 Confirmed 0.95 전라북도  41 76 Healthy 0.0 제주특별자치도  42 17 Contacted 0.125 서울특별시  43 10 Healthy 0.0 전라북도  44 50 Contacted 0.45 인천광역시  45 58 Contacted 0.175 서울특별시  46 44 Confirmed 0.6 경상남도  47 1 Confirmed 0.75 강원도  48 94 Healthy 0.0 강원도  49 96 Healthy 0.0 울산광역시  50 96 Healthy 0.0 대전광역시  51 25 Healthy 0.0 전라북도  52 68 Contacted 0.375 강원도  53 59 Confirmed 0.3 경상북도  54 50 Confirmed 0.9 전라북도  55 13 Contacted 0.225 경상북도  56 76 Contacted 0.45 광주광역시  57 48 Contacted 0.3 부산광역시  58 53 Healthy 0.0 전라북도  59 12 Confirmed 0.85 서울특별시  60 43 Contacted 0.125 경상북도  61 54 Contacted 0.275 울산광역시  62 52 Confirmed 0.45 제주특별자치도  63 31 Confirmed 0.7 제주특별자치도  64 28 Contacted 0.275 전라남도  65 40 Contacted 0.2 경상남도  66 88 Confirmed 0.5 경기도  67 27 Contacted 0.275 충청남도  68 40 Confirmed 0.45 전라북도  69 66 Contacted 0.225 서울특별시  70 49 Contacted 0.375 충청남도  71 82 Healthy 0.0 광주광역시  72 7 Healthy 0.0 전라남도  73 78 Healthy 0.0 서울특별시  74 30 Contacted 0.325 서울특별시  75 87 Contacted 0.325 전라남도  76 72 Contacted 0.375 경상북도  77 67 Confirmed 0.35 서울특별시  78 16 Healthy 0.0 경기도  79 62 Contacted 0.45 전라북도  80 24 Healthy 0.0 경상북도  81 10 Confirmed 0.55 대구광역시  82 72 Confirmed 0.85 인천광역시  83 70 Contacted 0.2 경기도  84 30 Confirmed 0.6 경기도  85 37 Healthy 0.0 경상북도  86 23 Contacted 0.15 전라북도  87 13 Confirmed 0.55 경상남도  88 34 Confirmed 0.25 대구광역시  89 19 Confirmed 0.25 충청북도  90 12 Healthy 0.0 전라남도  91 88 Healthy 0.0 대구광역시  92 80 Healthy 0.0 충청북도  93 13 Healthy 0.0 서울특별시  94 46 Confirmed 0.65 서울특별시  95 49 Contacted 0.325 서울특별시  96 15 Confirmed 0.25 경기도  97 37 Confirmed 0.65 경기도  98 40 Healthy 0.0 경상남도  99 65 Confirmed 0.55 충청북도  100 45 Confirmed 0.65 충청남도  Number of healthy people: 33  Number of contacted people: 33  Number of confirmed people: 34  Average Severity of contacted people: 0.28  Average Severity of confirmed people: 0.57  Number of Clusters: 2  Cluster 0:  Number of People: 64  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.12  Cluster 1:  Number of People: 36  Average of severities: 0.58  The Coordinates of Centroid:  X1 (Severity): 0.58  ------------------------------------------------  Cluster ID | # of People | Avg. of Severity  0 | 64 | 0.12  1 | 36 | 0.58  ------------|-------------|------------------  Total | 100 |  SSE | 2.29 |  ------------------------------------------------  Number of Clusters: 3  Cluster 0:  Number of People: 44  Average of severities: 0.32  The Coordinates of Centroid:  X1 (Severity): 0.32  Cluster 1:  Number of People: 19  Average of severities: 0.72  The Coordinates of Centroid:  X1 (Severity): 0.72  Cluster 2:  Number of People: 37  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  ------------------------------------------------  Cluster ID | # of People | Avg. of Severity  0 | 44 | 0.32  1 | 19 | 0.72  2 | 37 | 0.01  ------------|-------------|------------------  Total | 100 |  SSE | 0.82 |  ------------------------------------------------  Number of Clusters: 4  Cluster 0:  Number of People: 35  Average of severities: 0.28  The Coordinates of Centroid:  X1 (Severity): 0.28  Cluster 1:  Number of People: 21  Average of severities: 0.54  The Coordinates of Centroid:  X1 (Severity): 0.54  Cluster 2:  Number of People: 36  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  Cluster 3:  Number of People: 8  Average of severities: 0.88  The Coordinates of Centroid:  X1 (Severity): 0.87  ------------------------------------------------  Cluster ID | # of People | Avg. of Severity  0 | 35 | 0.28  1 | 21 | 0.54  2 | 36 | 0.01  3 | 8 | 0.88  ------------|-------------|------------------  Total | 100 |  SSE | 0.37 |  ------------------------------------------------  Number of Clusters: 5  Cluster 0:  Number of People: 36  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  Cluster 1:  Number of People: 28  Average of severities: 0.26  The Coordinates of Centroid:  X1 (Severity): 0.26  Cluster 2:  Number of People: 8  Average of severities: 0.88  The Coordinates of Centroid:  X1 (Severity): 0.87  Cluster 3:  Number of People: 17  Average of severities: 0.42  The Coordinates of Centroid:  X1 (Severity): 0.42  Cluster 4:  Number of People: 11  Average of severities: 0.61  The Coordinates of Centroid:  X1 (Severity): 0.61  ------------------------------------------------  Cluster ID | # of People | Avg. of Severity  0 | 36 | 0.01  1 | 28 | 0.26  2 | 8 | 0.88  3 | 17 | 0.42  4 | 11 | 0.61  ------------|-------------|------------------  Total | 100 |  SSE | 0.21 |  ------------------------------------------------  Number of Clusters: 6  Cluster 0:  Number of People: 33  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): -0.0  Cluster 1:  Number of People: 11  Average of severities: 0.61  The Coordinates of Centroid:  X1 (Severity): 0.61  Cluster 2:  Number of People: 15  Average of severities: 0.43  The Coordinates of Centroid:  X1 (Severity): 0.43  Cluster 3:  Number of People: 8  Average of severities: 0.88  The Coordinates of Centroid:  X1 (Severity): 0.87  Cluster 4:  Number of People: 13  Average of severities: 0.18  The Coordinates of Centroid:  X1 (Severity): 0.18  Cluster 5:  Number of People: 20  Average of severities: 0.3  The Coordinates of Centroid:  X1 (Severity): 0.3  ------------------------------------------------  Cluster ID | # of People | Avg. of Severity  0 | 33 | 0.0  1 | 11 | 0.61  2 | 15 | 0.43  3 | 8 | 0.88  4 | 13 | 0.18  5 | 20 | 0.3  ------------|-------------|------------------  Total | 100 |  SSE | 0.11 |  ------------------------------------------------  Number of Clusters: 7  Cluster 0:  Number of People: 13  Average of severities: 0.18  The Coordinates of Centroid:  X1 (Severity): 0.18  Cluster 1:  Number of People: 6  Average of severities: 0.67  The Coordinates of Centroid:  X1 (Severity): 0.68  Cluster 2:  Number of People: 13  Average of severities: 0.42  The Coordinates of Centroid:  X1 (Severity): 0.42  Cluster 3:  Number of People: 33  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): -0.0  Cluster 4:  Number of People: 7  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.89  Cluster 5:  Number of People: 20  Average of severities: 0.3  The Coordinates of Centroid:  X1 (Severity): 0.3  Cluster 6:  Number of People: 8  Average of severities: 0.55  The Coordinates of Centroid:  X1 (Severity): 0.55  ------------------------------------------------  Cluster ID | # of People | Avg. of Severity  0 | 13 | 0.18  1 | 6 | 0.67  2 | 13 | 0.42  3 | 33 | 0.0  4 | 7 | 0.89  5 | 20 | 0.3  6 | 8 | 0.55  ------------|-------------|------------------  Total | 100 |  SSE | 0.08 |  ------------------------------------------------  Number of Clusters: 8  Cluster 0:  Number of People: 14  Average of severities: 0.28  The Coordinates of Centroid:  X1 (Severity): 0.28  Cluster 1:  Number of People: 10  Average of severities: 0.46  The Coordinates of Centroid:  X1 (Severity): 0.46  Cluster 2:  Number of People: 33  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): -0.0  Cluster 3:  Number of People: 7  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.89  Cluster 4:  Number of People: 6  Average of severities: 0.67  The Coordinates of Centroid:  X1 (Severity): 0.68  Cluster 5:  Number of People: 13  Average of severities: 0.18  The Coordinates of Centroid:  X1 (Severity): 0.18  Cluster 6:  Number of People: 6  Average of severities: 0.57  The Coordinates of Centroid:  X1 (Severity): 0.57  Cluster 7:  Number of People: 11  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.35  ------------------------------------------------  Cluster ID | # of People | Avg. of Severity  0 | 14 | 0.28  1 | 10 | 0.46  2 | 33 | 0.0  3 | 7 | 0.89  4 | 6 | 0.67  5 | 13 | 0.18  6 | 6 | 0.57  7 | 11 | 0.35  ------------|-------------|------------------  Total | 100 |  SSE | 0.05 |  ------------------------------------------------  Number of Clusters: 9  Cluster 0:  Number of People: 15  Average of severities: 0.3  The Coordinates of Centroid:  X1 (Severity): 0.3  Cluster 1:  Number of People: 6  Average of severities: 0.67  The Coordinates of Centroid:  X1 (Severity): 0.68  Cluster 2:  Number of People: 33  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): -0.0  Cluster 3:  Number of People: 10  Average of severities: 0.46  The Coordinates of Centroid:  X1 (Severity): 0.46  Cluster 4:  Number of People: 7  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.89  Cluster 5:  Number of People: 7  Average of severities: 0.15  The Coordinates of Centroid:  X1 (Severity): 0.15  Cluster 6:  Number of People: 6  Average of severities: 0.57  The Coordinates of Centroid:  X1 (Severity): 0.57  Cluster 7:  Number of People: 7  Average of severities: 0.37  The Coordinates of Centroid:  X1 (Severity): 0.37  Cluster 8:  Number of People: 9  Average of severities: 0.22  The Coordinates of Centroid:  X1 (Severity): 0.22  ------------------------------------------------  Cluster ID | # of People | Avg. of Severity  0 | 15 | 0.3  1 | 6 | 0.67  2 | 33 | 0.0  3 | 10 | 0.46  4 | 7 | 0.89  5 | 7 | 0.15  6 | 6 | 0.57  7 | 7 | 0.37  8 | 9 | 0.22  ------------|-------------|------------------  Total | 100 |  SSE | 0.04 |  ------------------------------------------------ |

# Result of Clustering with Multiple Feature

## Clustering using Scikit-Learn Library

### Clustering using K-means

* Used Columns: Age, Severity
* Distance Function: Euclidean Distance
* Console window results

|  |
| --- |
| Total number of People: 100  ID Age Covid Status Severity Address  1 72 Contacted 0.125 충청남도  2 50 Healthy 0.0 경기도  3 49 Contacted 0.2 경상북도  4 45 Contacted 0.225 전라남도  5 45 Contacted 0.325 전라남도  6 66 Confirmed 0.55 부산광역시  7 86 Healthy 0.0 전라남도  8 43 Healthy 0.0 서울특별시  9 63 Healthy 0.0 경기도  10 81 Confirmed 0.35 광주광역시  11 2 Contacted 0.175 경상북도  12 69 Healthy 0.0 전라북도  13 66 Healthy 0.0 전라북도  14 37 Contacted 0.425 울산광역시  15 97 Healthy 0.0 경상북도  16 98 Healthy 0.0 경상북도  17 56 Confirmed 0.65 전라북도  18 26 Contacted 0.3 경상남도  19 90 Confirmed 0.9 전라북도  20 21 Confirmed 0.5 전라북도  21 26 Healthy 0.0 경상북도  22 17 Confirmed 0.45 제주특별자치도  23 55 Healthy 0.0 부산광역시  24 74 Healthy 0.0 경상북도  25 91 Contacted 0.275 경상북도  26 33 Healthy 0.0 대전광역시  27 1 Healthy 0.0 강원도  28 91 Confirmed 0.9 전라남도  29 74 Confirmed 0.45 전라남도  30 52 Contacted 0.275 경기도  31 49 Confirmed 0.4 전라남도  32 49 Confirmed 0.3 전라남도  33 13 Contacted 0.375 경상남도  34 90 Contacted 0.175 충청북도  35 40 Healthy 0.0 경상남도  36 59 Confirmed 0.9 인천광역시  37 21 Contacted 0.3 경상남도  38 99 Confirmed 0.3 경상남도  39 20 Healthy 0.0 경기도  40 21 Confirmed 0.95 전라북도  41 76 Healthy 0.0 제주특별자치도  42 17 Contacted 0.125 서울특별시  43 10 Healthy 0.0 전라북도  44 50 Contacted 0.45 인천광역시  45 58 Contacted 0.175 서울특별시  46 44 Confirmed 0.6 경상남도  47 1 Confirmed 0.75 강원도  48 94 Healthy 0.0 강원도  49 96 Healthy 0.0 울산광역시  50 96 Healthy 0.0 대전광역시  51 25 Healthy 0.0 전라북도  52 68 Contacted 0.375 강원도  53 59 Confirmed 0.3 경상북도  54 50 Confirmed 0.9 전라북도  55 13 Contacted 0.225 경상북도  56 76 Contacted 0.45 광주광역시  57 48 Contacted 0.3 부산광역시  58 53 Healthy 0.0 전라북도  59 12 Confirmed 0.85 서울특별시  60 43 Contacted 0.125 경상북도  61 54 Contacted 0.275 울산광역시  62 52 Confirmed 0.45 제주특별자치도  63 31 Confirmed 0.7 제주특별자치도  64 28 Contacted 0.275 전라남도  65 40 Contacted 0.2 경상남도  66 88 Confirmed 0.5 경기도  67 27 Contacted 0.275 충청남도  68 40 Confirmed 0.45 전라북도  69 66 Contacted 0.225 서울특별시  70 49 Contacted 0.375 충청남도  71 82 Healthy 0.0 광주광역시  72 7 Healthy 0.0 전라남도  73 78 Healthy 0.0 서울특별시  74 30 Contacted 0.325 서울특별시  75 87 Contacted 0.325 전라남도  76 72 Contacted 0.375 경상북도  77 67 Confirmed 0.35 서울특별시  78 16 Healthy 0.0 경기도  79 62 Contacted 0.45 전라북도  80 24 Healthy 0.0 경상북도  81 10 Confirmed 0.55 대구광역시  82 72 Confirmed 0.85 인천광역시  83 70 Contacted 0.2 경기도  84 30 Confirmed 0.6 경기도  85 37 Healthy 0.0 경상북도  86 23 Contacted 0.15 전라북도  87 13 Confirmed 0.55 경상남도  88 34 Confirmed 0.25 대구광역시  89 19 Confirmed 0.25 충청북도  90 12 Healthy 0.0 전라남도  91 88 Healthy 0.0 대구광역시  92 80 Healthy 0.0 충청북도  93 13 Healthy 0.0 서울특별시  94 46 Confirmed 0.65 서울특별시  95 49 Contacted 0.325 서울특별시  96 15 Confirmed 0.25 경기도  97 37 Confirmed 0.65 경기도  98 40 Healthy 0.0 경상남도  99 65 Confirmed 0.55 충청북도  100 45 Confirmed 0.65 충청남도  Number of healthy people: 33  Number of contacted people: 33  Number of confirmed people: 34  Average Severity of contacted people: 0.28  Average Severity of confirmed people: 0.57  Number of Clusters: 2  Cluster 0:  Number of People: 31  Average of Age: 45.74  Average of severities: 0.61  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.46  Cluster 1:  Number of People: 69  Average of Age: 50.81  Average of severities: 0.14  The Coordinates of Centroid:  X1 (Severity): 0.14  X2 (Age): 0.51  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 31 | 45.74 | 0.61  1 | 69 | 50.81 | 0.14  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 28.95 |  -------------------------------------------------------------  Number of Clusters: 3  Cluster 0:  Number of People: 45  Average of Age: 28.58  Average of severities: 0.19  The Coordinates of Centroid:  X1 (Severity): 0.2  X2 (Age): 0.28  Cluster 1:  Number of People: 25  Average of Age: 52.28  Average of severities: 0.65  The Coordinates of Centroid:  X1 (Severity): 0.68  X2 (Age): 0.52  Cluster 2:  Number of People: 30  Average of Age: 77.7  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.12  X2 (Age): 0.78  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 45 | 28.58 | 0.19  1 | 25 | 52.28 | 0.65  2 | 30 | 77.7 | 0.12  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 22.45 |  -------------------------------------------------------------  Number of Clusters: 4  Cluster 0:  Number of People: 22  Average of Age: 80.59  Average of severities: 0.05  The Coordinates of Centroid:  X1 (Severity): 0.05  X2 (Age): 0.81  Cluster 1:  Number of People: 17  Average of Age: 33.24  Average of severities: 0.69  The Coordinates of Centroid:  X1 (Severity): 0.73  X2 (Age): 0.33  Cluster 2:  Number of People: 32  Average of Age: 24.78  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.13  X2 (Age): 0.24  Cluster 3:  Number of People: 29  Average of Age: 61.83  Average of severities: 0.41  The Coordinates of Centroid:  X1 (Severity): 0.43  X2 (Age): 0.62  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 22 | 80.59 | 0.05  1 | 17 | 33.24 | 0.69  2 | 32 | 24.78 | 0.12  3 | 29 | 61.83 | 0.41  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 18.74 |  -------------------------------------------------------------  Number of Clusters: 5  Cluster 0:  Number of People: 26  Average of Age: 45.42  Average of severities: 0.21  The Coordinates of Centroid:  X1 (Severity): 0.22  X2 (Age): 0.45  Cluster 1:  Number of People: 20  Average of Age: 64.65  Average of severities: 0.6  The Coordinates of Centroid:  X1 (Severity): 0.63  X2 (Age): 0.65  Cluster 2:  Number of People: 22  Average of Age: 83.32  Average of severities: 0.08  The Coordinates of Centroid:  X1 (Severity): 0.08  X2 (Age): 0.84  Cluster 3:  Number of People: 13  Average of Age: 21.77  Average of severities: 0.6  The Coordinates of Centroid:  X1 (Severity): 0.63  X2 (Age): 0.21  Cluster 4:  Number of People: 19  Average of Age: 17.58  Average of severities: 0.08  The Coordinates of Centroid:  X1 (Severity): 0.08  X2 (Age): 0.17  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 26 | 45.42 | 0.21  1 | 20 | 64.65 | 0.6  2 | 22 | 83.32 | 0.08  3 | 13 | 21.77 | 0.6  4 | 19 | 17.58 | 0.08  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 17.34 |  -------------------------------------------------------------  Number of Clusters: 6  Cluster 0:  Number of People: 22  Average of Age: 82.64  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.08  X2 (Age): 0.83  Cluster 1:  Number of People: 10  Average of Age: 19.3  Average of severities: 0.65  The Coordinates of Centroid:  X1 (Severity): 0.69  X2 (Age): 0.19  Cluster 2:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  Cluster 3:  Number of People: 18  Average of Age: 15.39  Average of severities: 0.1  The Coordinates of Centroid:  X1 (Severity): 0.11  X2 (Age): 0.15  Cluster 4:  Number of People: 24  Average of Age: 42.83  Average of severities: 0.17  The Coordinates of Centroid:  X1 (Severity): 0.18  X2 (Age): 0.43  Cluster 5:  Number of People: 21  Average of Age: 59.33  Average of severities: 0.47  The Coordinates of Centroid:  X1 (Severity): 0.49  X2 (Age): 0.6  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 22 | 82.64 | 0.07  1 | 10 | 19.3 | 0.65  2 | 5 | 72.4 | 0.89  3 | 18 | 15.39 | 0.1  4 | 24 | 42.83 | 0.17  5 | 21 | 59.33 | 0.47  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 15.92 |  -------------------------------------------------------------  Number of Clusters: 7  Cluster 0:  Number of People: 11  Average of Age: 62.18  Average of severities: 0.74  The Coordinates of Centroid:  X1 (Severity): 0.78  X2 (Age): 0.62  Cluster 1:  Number of People: 18  Average of Age: 21.61  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.21  Cluster 2:  Number of People: 17  Average of Age: 82.65  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.83  Cluster 3:  Number of People: 12  Average of Age: 77.92  Average of severities: 0.37  The Coordinates of Centroid:  X1 (Severity): 0.39  X2 (Age): 0.78  Cluster 4:  Number of People: 15  Average of Age: 22.0  Average of severities: 0.37  The Coordinates of Centroid:  X1 (Severity): 0.39  X2 (Age): 0.21  Cluster 5:  Number of People: 6  Average of Age: 22.0  Average of severities: 0.75  The Coordinates of Centroid:  X1 (Severity): 0.79  X2 (Age): 0.21  Cluster 6:  Number of People: 21  Average of Age: 49.95  Average of severities: 0.25  The Coordinates of Centroid:  X1 (Severity): 0.26  X2 (Age): 0.5  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 11 | 62.18 | 0.74  1 | 18 | 21.61 | 0.02  2 | 17 | 82.65 | 0.02  3 | 12 | 77.92 | 0.37  4 | 15 | 22.0 | 0.37  5 | 6 | 22.0 | 0.75  6 | 21 | 49.95 | 0.25  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 13.99 |  -------------------------------------------------------------  Number of Clusters: 8  Cluster 0:  Number of People: 11  Average of Age: 52.27  Average of severities: 0.53  The Coordinates of Centroid:  X1 (Severity): 0.56  X2 (Age): 0.52  Cluster 1:  Number of People: 20  Average of Age: 19.65  Average of severities: 0.06  The Coordinates of Centroid:  X1 (Severity): 0.06  X2 (Age): 0.19  Cluster 2:  Number of People: 12  Average of Age: 61.58  Average of severities: 0.06  The Coordinates of Centroid:  X1 (Severity): 0.06  X2 (Age): 0.62  Cluster 3:  Number of People: 19  Average of Age: 41.32  Average of severities: 0.28  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.41  Cluster 4:  Number of People: 11  Average of Age: 18.73  Average of severities: 0.63  The Coordinates of Centroid:  X1 (Severity): 0.66  X2 (Age): 0.18  Cluster 5:  Number of People: 12  Average of Age: 88.42  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.89  Cluster 6:  Number of People: 10  Average of Age: 80.3  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.39  X2 (Age): 0.81  Cluster 7:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 11 | 52.27 | 0.53  1 | 20 | 19.65 | 0.06  2 | 12 | 61.58 | 0.06  3 | 19 | 41.32 | 0.28  4 | 11 | 18.73 | 0.63  5 | 12 | 88.42 | 0.01  6 | 10 | 80.3 | 0.38  7 | 5 | 72.4 | 0.89  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 13.05 |  -------------------------------------------------------------  Number of Clusters: 9  Cluster 0:  Number of People: 11  Average of Age: 92.45  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.07  X2 (Age): 0.93  Cluster 1:  Number of People: 13  Average of Age: 19.46  Average of severities: 0.36  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.19  Cluster 2:  Number of People: 11  Average of Age: 73.27  Average of severities: 0.43  The Coordinates of Centroid:  X1 (Severity): 0.45  X2 (Age): 0.74  Cluster 3:  Number of People: 4  Average of Age: 78.0  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.93  X2 (Age): 0.79  Cluster 4:  Number of People: 9  Average of Age: 43.78  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  X2 (Age): 0.44  Cluster 5:  Number of People: 11  Average of Age: 70.18  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.07  X2 (Age): 0.71  Cluster 6:  Number of People: 13  Average of Age: 15.08  Average of severities: 0.03  The Coordinates of Centroid:  X1 (Severity): 0.04  X2 (Age): 0.14  Cluster 7:  Number of People: 11  Average of Age: 33.91  Average of severities: 0.72  The Coordinates of Centroid:  X1 (Severity): 0.76  X2 (Age): 0.34  Cluster 8:  Number of People: 17  Average of Age: 47.12  Average of severities: 0.32  The Coordinates of Centroid:  X1 (Severity): 0.34  X2 (Age): 0.47  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 11 | 92.45 | 0.07  1 | 13 | 19.46 | 0.36  2 | 11 | 73.27 | 0.43  3 | 4 | 78.0 | 0.89  4 | 9 | 43.78 | 0.01  5 | 11 | 70.18 | 0.07  6 | 13 | 15.08 | 0.03  7 | 11 | 33.91 | 0.72  8 | 17 | 47.12 | 0.32  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 11.49 |  ------------------------------------------------------------- |

## Clustering using Pyclustering Library

### K-means Algorithm Using Custom Distance Function 1

* Used Columns: Age, Severity
* Distance Function: Weighted Euclidean Distance

When forming a cluster, the weight of a specific column is weighted, and the effect of the column value is greater.

* Code of weighted Euclidean distance function

Weight of first column (Severity): 0.9

Weight of second column (Age): 0.1

|  |
| --- |
| def weighted\_euclidean\_distance(point1, point2):  *# point 1 is data.  # point 2 is centroid   # 0.9 for first feature and 0.1 for second feature* weights\_list = [0.9, 0.1]  distance = 0.0   if len(point1) == 2: *# when calculating the distance of two coordinates* for i in range(len(point1)):  distance += weights\_list[i] \* (point1[i] - point2[i]) \*\* 2.0  else: *# when updating Centroid* for i in range(len(point1)):  distance += (point1[i] - point2[i]) \*\* 2.0   return distance \*\* 0.5 |

* Console window results

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| --- |
| Total number of People: 100  ID Age Covid Status Severity Address  1 72 Contacted 0.125 충청남도  2 50 Healthy 0.0 경기도  3 49 Contacted 0.2 경상북도  4 45 Contacted 0.225 전라남도  5 45 Contacted 0.325 전라남도  6 66 Confirmed 0.55 부산광역시  7 86 Healthy 0.0 전라남도  8 43 Healthy 0.0 서울특별시  9 63 Healthy 0.0 경기도  10 81 Confirmed 0.35 광주광역시  11 2 Contacted 0.175 경상북도  12 69 Healthy 0.0 전라북도  13 66 Healthy 0.0 전라북도  14 37 Contacted 0.425 울산광역시  15 97 Healthy 0.0 경상북도  16 98 Healthy 0.0 경상북도  17 56 Confirmed 0.65 전라북도  18 26 Contacted 0.3 경상남도  19 90 Confirmed 0.9 전라북도  20 21 Confirmed 0.5 전라북도  21 26 Healthy 0.0 경상북도  22 17 Confirmed 0.45 제주특별자치도  23 55 Healthy 0.0 부산광역시  24 74 Healthy 0.0 경상북도  25 91 Contacted 0.275 경상북도  26 33 Healthy 0.0 대전광역시  27 1 Healthy 0.0 강원도  28 91 Confirmed 0.9 전라남도  29 74 Confirmed 0.45 전라남도  30 52 Contacted 0.275 경기도  31 49 Confirmed 0.4 전라남도  32 49 Confirmed 0.3 전라남도  33 13 Contacted 0.375 경상남도  34 90 Contacted 0.175 충청북도  35 40 Healthy 0.0 경상남도  36 59 Confirmed 0.9 인천광역시  37 21 Contacted 0.3 경상남도  38 99 Confirmed 0.3 경상남도  39 20 Healthy 0.0 경기도  40 21 Confirmed 0.95 전라북도  41 76 Healthy 0.0 제주특별자치도  42 17 Contacted 0.125 서울특별시  43 10 Healthy 0.0 전라북도  44 50 Contacted 0.45 인천광역시  45 58 Contacted 0.175 서울특별시  46 44 Confirmed 0.6 경상남도  47 1 Confirmed 0.75 강원도  48 94 Healthy 0.0 강원도  49 96 Healthy 0.0 울산광역시  50 96 Healthy 0.0 대전광역시  51 25 Healthy 0.0 전라북도  52 68 Contacted 0.375 강원도  53 59 Confirmed 0.3 경상북도  54 50 Confirmed 0.9 전라북도  55 13 Contacted 0.225 경상북도  56 76 Contacted 0.45 광주광역시  57 48 Contacted 0.3 부산광역시  58 53 Healthy 0.0 전라북도  59 12 Confirmed 0.85 서울특별시  60 43 Contacted 0.125 경상북도  61 54 Contacted 0.275 울산광역시  62 52 Confirmed 0.45 제주특별자치도  63 31 Confirmed 0.7 제주특별자치도  64 28 Contacted 0.275 전라남도  65 40 Contacted 0.2 경상남도  66 88 Confirmed 0.5 경기도  67 27 Contacted 0.275 충청남도  68 40 Confirmed 0.45 전라북도  69 66 Contacted 0.225 서울특별시  70 49 Contacted 0.375 충청남도  71 82 Healthy 0.0 광주광역시  72 7 Healthy 0.0 전라남도  73 78 Healthy 0.0 서울특별시  74 30 Contacted 0.325 서울특별시  75 87 Contacted 0.325 전라남도  76 72 Contacted 0.375 경상북도  77 67 Confirmed 0.35 서울특별시  78 16 Healthy 0.0 경기도  79 62 Contacted 0.45 전라북도  80 24 Healthy 0.0 경상북도  81 10 Confirmed 0.55 대구광역시  82 72 Confirmed 0.85 인천광역시  83 70 Contacted 0.2 경기도  84 30 Confirmed 0.6 경기도  85 37 Healthy 0.0 경상북도  86 23 Contacted 0.15 전라북도  87 13 Confirmed 0.55 경상남도  88 34 Confirmed 0.25 대구광역시  89 19 Confirmed 0.25 충청북도  90 12 Healthy 0.0 전라남도  91 88 Healthy 0.0 대구광역시  92 80 Healthy 0.0 충청북도  93 13 Healthy 0.0 서울특별시  94 46 Confirmed 0.65 서울특별시  95 49 Contacted 0.325 서울특별시  96 15 Confirmed 0.25 경기도  97 37 Confirmed 0.65 경기도  98 40 Healthy 0.0 경상남도  99 65 Confirmed 0.55 충청북도  100 45 Confirmed 0.65 충청남도  Number of healthy people: 33  Number of contacted people: 33  Number of confirmed people: 34  Average Severity of contacted people: 0.28  Average Severity of confirmed people: 0.57  Number of Clusters: 2  Cluster 0:  Number of People: 64  Average of Age: 49.52  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.12  X2 (Age): 0.5  Cluster 1:  Number of People: 36  Average of Age: 48.75  Average of severities: 0.58  The Coordinates of Centroid:  X1 (Severity): 0.61  X2 (Age): 0.49  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 64 | 49.52 | 0.12  1 | 36 | 48.75 | 0.58  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 16.13 |  -------------------------------------------------------------  Number of Clusters: 3  Cluster 0:  Number of People: 44  Average of Age: 49.59  Average of severities: 0.32  The Coordinates of Centroid:  X1 (Severity): 0.34  X2 (Age): 0.5  Cluster 1:  Number of People: 37  Average of Age: 51.43  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  X2 (Age): 0.51  Cluster 2:  Number of People: 19  Average of Age: 44.16  Average of severities: 0.72  The Coordinates of Centroid:  X1 (Severity): 0.76  X2 (Age): 0.44  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 44 | 49.59 | 0.32  1 | 37 | 51.43 | 0.01  2 | 19 | 44.16 | 0.72  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 11.24 |  -------------------------------------------------------------  Number of Clusters: 4  Cluster 0:  Number of People: 20  Average of Age: 24.1  Average of severities: 0.03  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.24  Cluster 1:  Number of People: 19  Average of Age: 79.63  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.8  Cluster 2:  Number of People: 42  Average of Age: 49.76  Average of severities: 0.33  The Coordinates of Centroid:  X1 (Severity): 0.35  X2 (Age): 0.5  Cluster 3:  Number of People: 19  Average of Age: 44.16  Average of severities: 0.72  The Coordinates of Centroid:  X1 (Severity): 0.76  X2 (Age): 0.44  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 20 | 24.1 | 0.03  1 | 19 | 79.63 | 0.02  2 | 42 | 49.76 | 0.33  3 | 19 | 44.16 | 0.72  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 9.62 |  -------------------------------------------------------------  Number of Clusters: 5  Cluster 0:  Number of People: 20  Average of Age: 24.1  Average of severities: 0.03  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.24  Cluster 1:  Number of People: 19  Average of Age: 79.63  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.8  Cluster 2:  Number of People: 27  Average of Age: 48.96  Average of severities: 0.27  The Coordinates of Centroid:  X1 (Severity): 0.29  X2 (Age): 0.49  Cluster 3:  Number of People: 21  Average of Age: 47.43  Average of severities: 0.47  The Coordinates of Centroid:  X1 (Severity): 0.49  X2 (Age): 0.47  Cluster 4:  Number of People: 13  Average of Age: 47.0  Average of severities: 0.79  The Coordinates of Centroid:  X1 (Severity): 0.83  X2 (Age): 0.47  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 20 | 24.1 | 0.03  1 | 19 | 79.63 | 0.02  2 | 27 | 48.96 | 0.27  3 | 21 | 47.43 | 0.47  4 | 13 | 47.0 | 0.79  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 8.27 |  -------------------------------------------------------------  Number of Clusters: 6  Cluster 0:  Number of People: 18  Average of Age: 25.39  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  X2 (Age): 0.25  Cluster 1:  Number of People: 18  Average of Age: 79.06  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  X2 (Age): 0.8  Cluster 2:  Number of People: 13  Average of Age: 74.0  Average of severities: 0.28  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.74  Cluster 3:  Number of People: 20  Average of Age: 31.4  Average of severities: 0.27  The Coordinates of Centroid:  X1 (Severity): 0.28  X2 (Age): 0.31  Cluster 4:  Number of People: 18  Average of Age: 46.83  Average of severities: 0.49  The Coordinates of Centroid:  X1 (Severity): 0.51  X2 (Age): 0.47  Cluster 5:  Number of People: 13  Average of Age: 47.0  Average of severities: 0.79  The Coordinates of Centroid:  X1 (Severity): 0.83  X2 (Age): 0.47  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 18 | 25.39 | 0.01  1 | 18 | 79.06 | 0.01  2 | 13 | 74.0 | 0.28  3 | 20 | 31.4 | 0.27  4 | 18 | 46.83 | 0.49  5 | 13 | 47.0 | 0.79  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 7.51 |  -------------------------------------------------------------  Number of Clusters: 7  Cluster 0:  Number of People: 16  Average of Age: 24.81  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): 0.0  X2 (Age): 0.24  Cluster 1:  Number of People: 17  Average of Age: 79.47  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): 0.0  X2 (Age): 0.8  Cluster 2:  Number of People: 12  Average of Age: 47.92  Average of severities: 0.18  The Coordinates of Centroid:  X1 (Severity): 0.18  X2 (Age): 0.48  Cluster 3:  Number of People: 16  Average of Age: 32.69  Average of severities: 0.29  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.32  Cluster 4:  Number of People: 10  Average of Age: 72.2  Average of severities: 0.34  The Coordinates of Centroid:  X1 (Severity): 0.36  X2 (Age): 0.73  Cluster 5:  Number of People: 16  Average of Age: 46.56  Average of severities: 0.5  The Coordinates of Centroid:  X1 (Severity): 0.52  X2 (Age): 0.46  Cluster 6:  Number of People: 13  Average of Age: 47.0  Average of severities: 0.79  The Coordinates of Centroid:  X1 (Severity): 0.83  X2 (Age): 0.47  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 16 | 24.81 | 0.0  1 | 17 | 79.47 | 0.0  2 | 12 | 47.92 | 0.18  3 | 16 | 32.69 | 0.29  4 | 10 | 72.2 | 0.34  5 | 16 | 46.56 | 0.5  6 | 13 | 47.0 | 0.79  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 6.92 |  -------------------------------------------------------------  Number of Clusters: 8  Cluster 0:  Number of People: 16  Average of Age: 24.81  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): 0.0  X2 (Age): 0.24  Cluster 1:  Number of People: 17  Average of Age: 79.47  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): 0.0  X2 (Age): 0.8  Cluster 2:  Number of People: 12  Average of Age: 47.92  Average of severities: 0.18  The Coordinates of Centroid:  X1 (Severity): 0.18  X2 (Age): 0.48  Cluster 3:  Number of People: 16  Average of Age: 35.56  Average of severities: 0.28  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.35  Cluster 4:  Number of People: 12  Average of Age: 76.17  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.4  X2 (Age): 0.77  Cluster 5:  Number of People: 10  Average of Age: 30.2  Average of severities: 0.46  The Coordinates of Centroid:  X1 (Severity): 0.48  X2 (Age): 0.3  Cluster 6:  Number of People: 10  Average of Age: 42.1  Average of severities: 0.64  The Coordinates of Centroid:  X1 (Severity): 0.67  X2 (Age): 0.42  Cluster 7:  Number of People: 7  Average of Age: 56.43  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.57  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 16 | 24.81 | 0.0  1 | 17 | 79.47 | 0.0  2 | 12 | 47.92 | 0.18  3 | 16 | 35.56 | 0.28  4 | 12 | 76.17 | 0.38  5 | 10 | 30.2 | 0.46  6 | 10 | 42.1 | 0.64  7 | 7 | 56.43 | 0.89  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 5.85 |  -------------------------------------------------------------  Number of Clusters: 9  Cluster 0:  Number of People: 16  Average of Age: 24.81  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): 0.0  X2 (Age): 0.24  Cluster 1:  Number of People: 17  Average of Age: 79.47  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): 0.0  X2 (Age): 0.8  Cluster 2:  Number of People: 12  Average of Age: 47.92  Average of severities: 0.18  The Coordinates of Centroid:  X1 (Severity): 0.18  X2 (Age): 0.48  Cluster 3:  Number of People: 15  Average of Age: 34.0  Average of severities: 0.28  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.34  Cluster 4:  Number of People: 9  Average of Age: 74.78  Average of severities: 0.34  The Coordinates of Centroid:  X1 (Severity): 0.35  X2 (Age): 0.75  Cluster 5:  Number of People: 10  Average of Age: 30.2  Average of severities: 0.46  The Coordinates of Centroid:  X1 (Severity): 0.48  X2 (Age): 0.3  Cluster 6:  Number of People: 6  Average of Age: 71.83  Average of severities: 0.49  The Coordinates of Centroid:  X1 (Severity): 0.52  X2 (Age): 0.72  Cluster 7:  Number of People: 8  Average of Age: 36.25  Average of severities: 0.66  The Coordinates of Centroid:  X1 (Severity): 0.69  X2 (Age): 0.36  Cluster 8:  Number of People: 7  Average of Age: 56.43  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.57  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 16 | 24.81 | 0.0  1 | 17 | 79.47 | 0.0  2 | 12 | 47.92 | 0.18  3 | 15 | 34.0 | 0.28  4 | 9 | 74.78 | 0.34  5 | 10 | 30.2 | 0.46  6 | 6 | 71.83 | 0.49  7 | 8 | 36.25 | 0.66  8 | 7 | 56.43 | 0.89  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 5.52 |  ------------------------------------------------------------- |

### K-means Algorithm Using Custom Distance Function 2

* Used Columns: Age, Severity
* Distance Function: Weighted Euclidean Distance

When forming a cluster, the weight of a specific column is weighted, and the effect of the column value is greater.

* Code of weighted Euclidean distance function

Weight of first column (Severity): 0.1

Weight of second column (Age): 0.9

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| --- |
| def weighted\_euclidean\_distance(point1, point2):  *# point 1 is data.  # point 2 is centroid   # 0.1 for first feature and 0.9 for second feature* weights\_list = [0.1, 0.9]  distance = 0.0   if len(point1) == 2: *# when calculating the distance of two coordinates* for i in range(len(point1)):  distance += weights\_list[i] \* (point1[i] - point2[i]) \*\* 2.0  else: *# when updating Centroid* for i in range(len(point1)):  distance += (point1[i] - point2[i]) \*\* 2.0   return distance \*\* 0.5 |

* Console window results

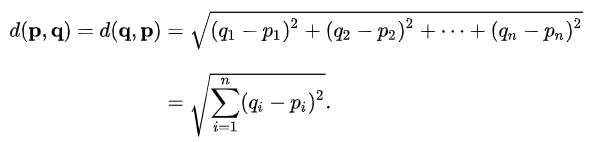
|  |
| --- |
| Total number of People: 100  ID Age Covid Status Severity Address  1 72 Contacted 0.125 충청남도  2 50 Healthy 0.0 경기도  3 49 Contacted 0.2 경상북도  4 45 Contacted 0.225 전라남도  5 45 Contacted 0.325 전라남도  6 66 Confirmed 0.55 부산광역시  7 86 Healthy 0.0 전라남도  8 43 Healthy 0.0 서울특별시  9 63 Healthy 0.0 경기도  10 81 Confirmed 0.35 광주광역시  11 2 Contacted 0.175 경상북도  12 69 Healthy 0.0 전라북도  13 66 Healthy 0.0 전라북도  14 37 Contacted 0.425 울산광역시  15 97 Healthy 0.0 경상북도  16 98 Healthy 0.0 경상북도  17 56 Confirmed 0.65 전라북도  18 26 Contacted 0.3 경상남도  19 90 Confirmed 0.9 전라북도  20 21 Confirmed 0.5 전라북도  21 26 Healthy 0.0 경상북도  22 17 Confirmed 0.45 제주특별자치도  23 55 Healthy 0.0 부산광역시  24 74 Healthy 0.0 경상북도  25 91 Contacted 0.275 경상북도  26 33 Healthy 0.0 대전광역시  27 1 Healthy 0.0 강원도  28 91 Confirmed 0.9 전라남도  29 74 Confirmed 0.45 전라남도  30 52 Contacted 0.275 경기도  31 49 Confirmed 0.4 전라남도  32 49 Confirmed 0.3 전라남도  33 13 Contacted 0.375 경상남도  34 90 Contacted 0.175 충청북도  35 40 Healthy 0.0 경상남도  36 59 Confirmed 0.9 인천광역시  37 21 Contacted 0.3 경상남도  38 99 Confirmed 0.3 경상남도  39 20 Healthy 0.0 경기도  40 21 Confirmed 0.95 전라북도  41 76 Healthy 0.0 제주특별자치도  42 17 Contacted 0.125 서울특별시  43 10 Healthy 0.0 전라북도  44 50 Contacted 0.45 인천광역시  45 58 Contacted 0.175 서울특별시  46 44 Confirmed 0.6 경상남도  47 1 Confirmed 0.75 강원도  48 94 Healthy 0.0 강원도  49 96 Healthy 0.0 울산광역시  50 96 Healthy 0.0 대전광역시  51 25 Healthy 0.0 전라북도  52 68 Contacted 0.375 강원도  53 59 Confirmed 0.3 경상북도  54 50 Confirmed 0.9 전라북도  55 13 Contacted 0.225 경상북도  56 76 Contacted 0.45 광주광역시  57 48 Contacted 0.3 부산광역시  58 53 Healthy 0.0 전라북도  59 12 Confirmed 0.85 서울특별시  60 43 Contacted 0.125 경상북도  61 54 Contacted 0.275 울산광역시  62 52 Confirmed 0.45 제주특별자치도  63 31 Confirmed 0.7 제주특별자치도  64 28 Contacted 0.275 전라남도  65 40 Contacted 0.2 경상남도  66 88 Confirmed 0.5 경기도  67 27 Contacted 0.275 충청남도  68 40 Confirmed 0.45 전라북도  69 66 Contacted 0.225 서울특별시  70 49 Contacted 0.375 충청남도  71 82 Healthy 0.0 광주광역시  72 7 Healthy 0.0 전라남도  73 78 Healthy 0.0 서울특별시  74 30 Contacted 0.325 서울특별시  75 87 Contacted 0.325 전라남도  76 72 Contacted 0.375 경상북도  77 67 Confirmed 0.35 서울특별시  78 16 Healthy 0.0 경기도  79 62 Contacted 0.45 전라북도  80 24 Healthy 0.0 경상북도  81 10 Confirmed 0.55 대구광역시  82 72 Confirmed 0.85 인천광역시  83 70 Contacted 0.2 경기도  84 30 Confirmed 0.6 경기도  85 37 Healthy 0.0 경상북도  86 23 Contacted 0.15 전라북도  87 13 Confirmed 0.55 경상남도  88 34 Confirmed 0.25 대구광역시  89 19 Confirmed 0.25 충청북도  90 12 Healthy 0.0 전라남도  91 88 Healthy 0.0 대구광역시  92 80 Healthy 0.0 충청북도  93 13 Healthy 0.0 서울특별시  94 46 Confirmed 0.65 서울특별시  95 49 Contacted 0.325 서울특별시  96 15 Confirmed 0.25 경기도  97 37 Confirmed 0.65 경기도  98 40 Healthy 0.0 경상남도  99 65 Confirmed 0.55 충청북도  100 45 Confirmed 0.65 충청남도  Number of healthy people: 33  Number of contacted people: 33  Number of confirmed people: 34  Average Severity of contacted people: 0.28  Average Severity of confirmed people: 0.57  Number of Clusters: 2  Cluster 0:  Number of People: 47  Average of Age: 25.38  Average of severities: 0.29  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.25  Cluster 1:  Number of People: 53  Average of Age: 70.4  Average of severities: 0.28  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.71  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 47 | 25.38 | 0.29  1 | 53 | 70.4 | 0.28  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 15.31 |  -------------------------------------------------------------  Number of Clusters: 3  Cluster 0:  Number of People: 31  Average of Age: 17.55  Average of severities: 0.29  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.17  Cluster 1:  Number of People: 35  Average of Age: 47.2  Average of severities: 0.32  The Coordinates of Centroid:  X1 (Severity): 0.34  X2 (Age): 0.47  Cluster 2:  Number of People: 34  Average of Age: 80.24  Average of severities: 0.24  The Coordinates of Centroid:  X1 (Severity): 0.25  X2 (Age): 0.81  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 31 | 17.55 | 0.29  1 | 35 | 47.2 | 0.32  2 | 34 | 80.24 | 0.24  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 11.28 |  -------------------------------------------------------------  Number of Clusters: 4  Cluster 0:  Number of People: 17  Average of Age: 16.24  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.07  X2 (Age): 0.16  Cluster 1:  Number of People: 15  Average of Age: 20.07  Average of severities: 0.52  The Coordinates of Centroid:  X1 (Severity): 0.54  X2 (Age): 0.19  Cluster 2:  Number of People: 34  Average of Age: 47.62  Average of severities: 0.33  The Coordinates of Centroid:  X1 (Severity): 0.35  X2 (Age): 0.48  Cluster 3:  Number of People: 34  Average of Age: 80.24  Average of severities: 0.24  The Coordinates of Centroid:  X1 (Severity): 0.25  X2 (Age): 0.81  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 17 | 16.24 | 0.07  1 | 15 | 20.07 | 0.52  2 | 34 | 47.62 | 0.33  3 | 34 | 80.24 | 0.24  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 10.49 |  -------------------------------------------------------------  Number of Clusters: 5  Cluster 0:  Number of People: 17  Average of Age: 15.53  Average of severities: 0.09  The Coordinates of Centroid:  X1 (Severity): 0.09  X2 (Age): 0.15  Cluster 1:  Number of People: 8  Average of Age: 13.5  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.13  Cluster 2:  Number of People: 20  Average of Age: 36.5  Average of severities: 0.29  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.36  Cluster 3:  Number of People: 29  Average of Age: 56.1  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.4  X2 (Age): 0.56  Cluster 4:  Number of People: 26  Average of Age: 84.42  Average of severities: 0.2  The Coordinates of Centroid:  X1 (Severity): 0.22  X2 (Age): 0.85  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 17 | 15.53 | 0.09  1 | 8 | 13.5 | 0.62  2 | 20 | 36.5 | 0.29  3 | 29 | 56.1 | 0.38  4 | 26 | 84.42 | 0.2  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 9.73 |  -------------------------------------------------------------  Number of Clusters: 6  Cluster 0:  Number of People: 13  Average of Age: 12.77  Average of severities: 0.1  The Coordinates of Centroid:  X1 (Severity): 0.11  X2 (Age): 0.12  Cluster 1:  Number of People: 8  Average of Age: 13.5  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.13  Cluster 2:  Number of People: 16  Average of Age: 32.44  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.12  X2 (Age): 0.32  Cluster 3:  Number of People: 9  Average of Age: 40.0  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.66  X2 (Age): 0.4  Cluster 4:  Number of People: 27  Average of Age: 55.7  Average of severities: 0.31  The Coordinates of Centroid:  X1 (Severity): 0.33  X2 (Age): 0.56  Cluster 5:  Number of People: 27  Average of Age: 83.96  Average of severities: 0.23  The Coordinates of Centroid:  X1 (Severity): 0.24  X2 (Age): 0.85  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 13 | 12.77 | 0.1  1 | 8 | 13.5 | 0.62  2 | 16 | 32.44 | 0.12  3 | 9 | 40.0 | 0.62  4 | 27 | 55.7 | 0.31  5 | 27 | 83.96 | 0.23  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 9.12 |  -------------------------------------------------------------  Number of Clusters: 7  Cluster 0:  Number of People: 10  Average of Age: 10.6  Average of severities: 0.08  The Coordinates of Centroid:  X1 (Severity): 0.08  X2 (Age): 0.1  Cluster 1:  Number of People: 8  Average of Age: 13.5  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.13  Cluster 2:  Number of People: 13  Average of Age: 25.85  Average of severities: 0.16  The Coordinates of Centroid:  X1 (Severity): 0.17  X2 (Age): 0.25  Cluster 3:  Number of People: 9  Average of Age: 40.0  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.66  X2 (Age): 0.4  Cluster 4:  Number of People: 21  Average of Age: 47.24  Average of severities: 0.2  The Coordinates of Centroid:  X1 (Severity): 0.21  X2 (Age): 0.47  Cluster 5:  Number of People: 20  Average of Age: 66.7  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.67  Cluster 6:  Number of People: 19  Average of Age: 88.84  Average of severities: 0.2  The Coordinates of Centroid:  X1 (Severity): 0.21  X2 (Age): 0.9  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 10 | 10.6 | 0.08  1 | 8 | 13.5 | 0.62  2 | 13 | 25.85 | 0.16  3 | 9 | 40.0 | 0.62  4 | 21 | 47.24 | 0.2  5 | 20 | 66.7 | 0.35  6 | 19 | 88.84 | 0.2  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 7.78 |  -------------------------------------------------------------  Number of Clusters: 8  Cluster 0:  Number of People: 7  Average of Age: 8.29  Average of severities: 0.06  The Coordinates of Centroid:  X1 (Severity): 0.06  X2 (Age): 0.07  Cluster 1:  Number of People: 8  Average of Age: 13.5  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.13  Cluster 2:  Number of People: 13  Average of Age: 22.08  Average of severities: 0.15  The Coordinates of Centroid:  X1 (Severity): 0.16  X2 (Age): 0.22  Cluster 3:  Number of People: 7  Average of Age: 34.14  Average of severities: 0.49  The Coordinates of Centroid:  X1 (Severity): 0.51  X2 (Age): 0.34  Cluster 4:  Number of People: 12  Average of Age: 44.0  Average of severities: 0.06  The Coordinates of Centroid:  X1 (Severity): 0.07  X2 (Age): 0.44  Cluster 5:  Number of People: 16  Average of Age: 49.81  Average of severities: 0.49  The Coordinates of Centroid:  X1 (Severity): 0.51  X2 (Age): 0.5  Cluster 6:  Number of People: 19  Average of Age: 68.16  Average of severities: 0.29  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.69  Cluster 7:  Number of People: 18  Average of Age: 89.56  Average of severities: 0.21  The Coordinates of Centroid:  X1 (Severity): 0.22  X2 (Age): 0.9  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 7 | 8.29 | 0.06  1 | 8 | 13.5 | 0.62  2 | 13 | 22.08 | 0.15  3 | 7 | 34.14 | 0.49  4 | 12 | 44.0 | 0.06  5 | 16 | 49.81 | 0.49  6 | 19 | 68.16 | 0.29  7 | 18 | 89.56 | 0.21  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 7.4 |  -------------------------------------------------------------  Number of Clusters: 9  Cluster 0:  Number of People: 7  Average of Age: 8.29  Average of severities: 0.06  The Coordinates of Centroid:  X1 (Severity): 0.06  X2 (Age): 0.07  Cluster 1:  Number of People: 8  Average of Age: 13.5  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.13  Cluster 2:  Number of People: 13  Average of Age: 22.08  Average of severities: 0.15  The Coordinates of Centroid:  X1 (Severity): 0.16  X2 (Age): 0.22  Cluster 3:  Number of People: 7  Average of Age: 34.14  Average of severities: 0.49  The Coordinates of Centroid:  X1 (Severity): 0.51  X2 (Age): 0.34  Cluster 4:  Number of People: 12  Average of Age: 44.0  Average of severities: 0.06  The Coordinates of Centroid:  X1 (Severity): 0.07  X2 (Age): 0.44  Cluster 5:  Number of People: 15  Average of Age: 49.2  Average of severities: 0.46  The Coordinates of Centroid:  X1 (Severity): 0.49  X2 (Age): 0.49  Cluster 6:  Number of People: 13  Average of Age: 66.46  Average of severities: 0.46  The Coordinates of Centroid:  X1 (Severity): 0.49  X2 (Age): 0.67  Cluster 7:  Number of People: 10  Average of Age: 73.0  Average of severities: 0.03  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.73  Cluster 8:  Number of People: 15  Average of Age: 91.47  Average of severities: 0.25  The Coordinates of Centroid:  X1 (Severity): 0.26  X2 (Age): 0.92  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 7 | 8.29 | 0.06  1 | 8 | 13.5 | 0.62  2 | 13 | 22.08 | 0.15  3 | 7 | 34.14 | 0.49  4 | 12 | 44.0 | 0.06  5 | 15 | 49.2 | 0.46  6 | 13 | 66.46 | 0.46  7 | 10 | 73.0 | 0.03  8 | 15 | 91.47 | 0.25  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 6.82 |  -------------------------------------------------------------  Process finished with exit code 0 |

### K-means Algorithm using Euclidean Distance Function

* Used Columns: Age, Severity
* Distance Function: Euclidean Distance

The Euclidean distance between points p and q is the length of the line segment connecting (pq)

* Euclidean Formula



* Console window results

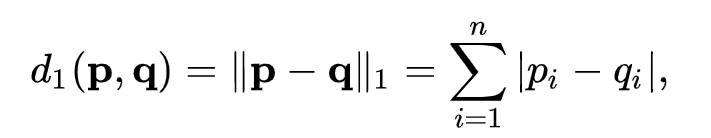
|  |
| --- |
| Total number of People: 100  ID Age Covid Status Severity Address  1 72 Contacted 0.125 충청남도  2 50 Healthy 0.0 경기도  3 49 Contacted 0.2 경상북도  4 45 Contacted 0.225 전라남도  5 45 Contacted 0.325 전라남도  6 66 Confirmed 0.55 부산광역시  7 86 Healthy 0.0 전라남도  8 43 Healthy 0.0 서울특별시  9 63 Healthy 0.0 경기도  10 81 Confirmed 0.35 광주광역시  11 2 Contacted 0.175 경상북도  12 69 Healthy 0.0 전라북도  13 66 Healthy 0.0 전라북도  14 37 Contacted 0.425 울산광역시  15 97 Healthy 0.0 경상북도  16 98 Healthy 0.0 경상북도  17 56 Confirmed 0.65 전라북도  18 26 Contacted 0.3 경상남도  19 90 Confirmed 0.9 전라북도  20 21 Confirmed 0.5 전라북도  21 26 Healthy 0.0 경상북도  22 17 Confirmed 0.45 제주특별자치도  23 55 Healthy 0.0 부산광역시  24 74 Healthy 0.0 경상북도  25 91 Contacted 0.275 경상북도  26 33 Healthy 0.0 대전광역시  27 1 Healthy 0.0 강원도  28 91 Confirmed 0.9 전라남도  29 74 Confirmed 0.45 전라남도  30 52 Contacted 0.275 경기도  31 49 Confirmed 0.4 전라남도  32 49 Confirmed 0.3 전라남도  33 13 Contacted 0.375 경상남도  34 90 Contacted 0.175 충청북도  35 40 Healthy 0.0 경상남도  36 59 Confirmed 0.9 인천광역시  37 21 Contacted 0.3 경상남도  38 99 Confirmed 0.3 경상남도  39 20 Healthy 0.0 경기도  40 21 Confirmed 0.95 전라북도  41 76 Healthy 0.0 제주특별자치도  42 17 Contacted 0.125 서울특별시  43 10 Healthy 0.0 전라북도  44 50 Contacted 0.45 인천광역시  45 58 Contacted 0.175 서울특별시  46 44 Confirmed 0.6 경상남도  47 1 Confirmed 0.75 강원도  48 94 Healthy 0.0 강원도  49 96 Healthy 0.0 울산광역시  50 96 Healthy 0.0 대전광역시  51 25 Healthy 0.0 전라북도  52 68 Contacted 0.375 강원도  53 59 Confirmed 0.3 경상북도  54 50 Confirmed 0.9 전라북도  55 13 Contacted 0.225 경상북도  56 76 Contacted 0.45 광주광역시  57 48 Contacted 0.3 부산광역시  58 53 Healthy 0.0 전라북도  59 12 Confirmed 0.85 서울특별시  60 43 Contacted 0.125 경상북도  61 54 Contacted 0.275 울산광역시  62 52 Confirmed 0.45 제주특별자치도  63 31 Confirmed 0.7 제주특별자치도  64 28 Contacted 0.275 전라남도  65 40 Contacted 0.2 경상남도  66 88 Confirmed 0.5 경기도  67 27 Contacted 0.275 충청남도  68 40 Confirmed 0.45 전라북도  69 66 Contacted 0.225 서울특별시  70 49 Contacted 0.375 충청남도  71 82 Healthy 0.0 광주광역시  72 7 Healthy 0.0 전라남도  73 78 Healthy 0.0 서울특별시  74 30 Contacted 0.325 서울특별시  75 87 Contacted 0.325 전라남도  76 72 Contacted 0.375 경상북도  77 67 Confirmed 0.35 서울특별시  78 16 Healthy 0.0 경기도  79 62 Contacted 0.45 전라북도  80 24 Healthy 0.0 경상북도  81 10 Confirmed 0.55 대구광역시  82 72 Confirmed 0.85 인천광역시  83 70 Contacted 0.2 경기도  84 30 Confirmed 0.6 경기도  85 37 Healthy 0.0 경상북도  86 23 Contacted 0.15 전라북도  87 13 Confirmed 0.55 경상남도  88 34 Confirmed 0.25 대구광역시  89 19 Confirmed 0.25 충청북도  90 12 Healthy 0.0 전라남도  91 88 Healthy 0.0 대구광역시  92 80 Healthy 0.0 충청북도  93 13 Healthy 0.0 서울특별시  94 46 Confirmed 0.65 서울특별시  95 49 Contacted 0.325 서울특별시  96 15 Confirmed 0.25 경기도  97 37 Confirmed 0.65 경기도  98 40 Healthy 0.0 경상남도  99 65 Confirmed 0.55 충청북도  100 45 Confirmed 0.65 충청남도  Number of healthy people: 33  Number of contacted people: 33  Number of confirmed people: 34  Average Severity of contacted people: 0.28  Average Severity of confirmed people: 0.57  Number of Clusters: 2  Cluster 0:  Number of People: 69  Average of Age: 50.81  Average of severities: 0.14  The Coordinates of Centroid:  X1 (Severity): 0.14  X2 (Age): 0.51  Cluster 1:  Number of People: 31  Average of Age: 45.74  Average of severities: 0.61  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.46  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 69 | 50.81 | 0.14  1 | 31 | 45.74 | 0.61  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 28.95 |  -------------------------------------------------------------  Number of Clusters: 3  Cluster 0:  Number of People: 38  Average of Age: 27.63  Average of severities: 0.15  The Coordinates of Centroid:  X1 (Severity): 0.16  X2 (Age): 0.27  Cluster 1:  Number of People: 35  Average of Age: 76.43  Average of severities: 0.16  The Coordinates of Centroid:  X1 (Severity): 0.17  X2 (Age): 0.77  Cluster 2:  Number of People: 27  Average of Age: 44.41  Average of severities: 0.64  The Coordinates of Centroid:  X1 (Severity): 0.67  X2 (Age): 0.44  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 38 | 27.63 | 0.15  1 | 35 | 76.43 | 0.16  2 | 27 | 44.41 | 0.64  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 22.2 |  -------------------------------------------------------------  Number of Clusters: 4  Cluster 0:  Number of People: 22  Average of Age: 23.18  Average of severities: 0.05  The Coordinates of Centroid:  X1 (Severity): 0.05  X2 (Age): 0.23  Cluster 1:  Number of People: 17  Average of Age: 48.0  Average of severities: 0.74  The Coordinates of Centroid:  X1 (Severity): 0.78  X2 (Age): 0.48  Cluster 2:  Number of People: 32  Average of Age: 78.44  Average of severities: 0.15  The Coordinates of Centroid:  X1 (Severity): 0.15  X2 (Age): 0.79  Cluster 3:  Number of People: 29  Average of Age: 37.52  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.37  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 22 | 23.18 | 0.05  1 | 17 | 48.0 | 0.74  2 | 32 | 78.44 | 0.15  3 | 29 | 37.52 | 0.35  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 19.48 |  -------------------------------------------------------------  Number of Clusters: 5  Cluster 0:  Number of People: 31  Average of Age: 24.13  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.12  X2 (Age): 0.24  Cluster 1:  Number of People: 21  Average of Age: 81.1  Average of severities: 0.04  The Coordinates of Centroid:  X1 (Severity): 0.04  X2 (Age): 0.82  Cluster 2:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  Cluster 3:  Number of People: 16  Average of Age: 28.81  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.66  X2 (Age): 0.28  Cluster 4:  Number of People: 27  Average of Age: 61.11  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.61  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 31 | 24.13 | 0.12  1 | 21 | 81.1 | 0.04  2 | 5 | 72.4 | 0.89  3 | 16 | 28.81 | 0.62  4 | 27 | 61.11 | 0.35  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 16.89 |  -------------------------------------------------------------  Number of Clusters: 6  Cluster 0:  Number of People: 26  Average of Age: 57.12  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.57  Cluster 1:  Number of People: 5  Average of Age: 80.0  Average of severities: 0.81  The Coordinates of Centroid:  X1 (Severity): 0.85  X2 (Age): 0.81  Cluster 2:  Number of People: 23  Average of Age: 80.87  Average of severities: 0.06  The Coordinates of Centroid:  X1 (Severity): 0.06  X2 (Age): 0.81  Cluster 3:  Number of People: 11  Average of Age: 33.91  Average of severities: 0.72  The Coordinates of Centroid:  X1 (Severity): 0.76  X2 (Age): 0.34  Cluster 4:  Number of People: 20  Average of Age: 24.1  Average of severities: 0.03  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.24  Cluster 5:  Number of People: 15  Average of Age: 21.6  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.21  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 26 | 57.12 | 0.35  1 | 5 | 80.0 | 0.81  2 | 23 | 80.87 | 0.06  3 | 11 | 33.91 | 0.72  4 | 20 | 24.1 | 0.03  5 | 15 | 21.6 | 0.35  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 15.39 |  -------------------------------------------------------------  Number of Clusters: 7  Cluster 0:  Number of People: 16  Average of Age: 15.19  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.08  X2 (Age): 0.14  Cluster 1:  Number of People: 11  Average of Age: 18.73  Average of severities: 0.63  The Coordinates of Centroid:  X1 (Severity): 0.66  X2 (Age): 0.18  Cluster 2:  Number of People: 13  Average of Age: 77.0  Average of severities: 0.36  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.78  Cluster 3:  Number of People: 11  Average of Age: 62.18  Average of severities: 0.74  The Coordinates of Centroid:  X1 (Severity): 0.78  X2 (Age): 0.62  Cluster 4:  Number of People: 12  Average of Age: 48.42  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.48  Cluster 5:  Number of People: 22  Average of Age: 42.41  Average of severities: 0.32  The Coordinates of Centroid:  X1 (Severity): 0.33  X2 (Age): 0.42  Cluster 6:  Number of People: 15  Average of Age: 85.07  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.86  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 16 | 15.19 | 0.07  1 | 11 | 18.73 | 0.63  2 | 13 | 77.0 | 0.36  3 | 11 | 62.18 | 0.74  4 | 12 | 48.42 | 0.02  5 | 22 | 42.41 | 0.32  6 | 15 | 85.07 | 0.02  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 13.7 |  -------------------------------------------------------------  Number of Clusters: 8  Cluster 0:  Number of People: 23  Average of Age: 19.22  Average of severities: 0.13  The Coordinates of Centroid:  X1 (Severity): 0.13  X2 (Age): 0.19  Cluster 1:  Number of People: 9  Average of Age: 15.33  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.15  Cluster 2:  Number of People: 3  Average of Age: 84.33  Average of severities: 0.88  The Coordinates of Centroid:  X1 (Severity): 0.93  X2 (Age): 0.85  Cluster 3:  Number of People: 19  Average of Age: 52.95  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.4  X2 (Age): 0.53  Cluster 4:  Number of People: 13  Average of Age: 87.31  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  X2 (Age): 0.88  Cluster 5:  Number of People: 8  Average of Age: 83.5  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.4  X2 (Age): 0.84  Cluster 6:  Number of People: 8  Average of Age: 46.0  Average of severities: 0.71  The Coordinates of Centroid:  X1 (Severity): 0.75  X2 (Age): 0.46  Cluster 7:  Number of People: 17  Average of Age: 53.76  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.08  X2 (Age): 0.54  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 23 | 19.22 | 0.13  1 | 9 | 15.33 | 0.62  2 | 3 | 84.33 | 0.88  3 | 19 | 52.95 | 0.38  4 | 13 | 87.31 | 0.01  5 | 8 | 83.5 | 0.38  6 | 8 | 46.0 | 0.71  7 | 17 | 53.76 | 0.07  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 13.46 |  -------------------------------------------------------------  Number of Clusters: 9  Cluster 0:  Number of People: 17  Average of Age: 82.65  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.83  Cluster 1:  Number of People: 8  Average of Age: 17.38  Average of severities: 0.68  The Coordinates of Centroid:  X1 (Severity): 0.72  X2 (Age): 0.17  Cluster 2:  Number of People: 2  Average of Age: 90.5  Average of severities: 0.9  The Coordinates of Centroid:  X1 (Severity): 0.95  X2 (Age): 0.91  Cluster 3:  Number of People: 14  Average of Age: 20.36  Average of severities: 0.27  The Coordinates of Centroid:  X1 (Severity): 0.28  X2 (Age): 0.2  Cluster 4:  Number of People: 11  Average of Age: 79.36  Average of severities: 0.36  The Coordinates of Centroid:  X1 (Severity): 0.38  X2 (Age): 0.8  Cluster 5:  Number of People: 15  Average of Age: 50.33  Average of severities: 0.27  The Coordinates of Centroid:  X1 (Severity): 0.28  X2 (Age): 0.5  Cluster 6:  Number of People: 3  Average of Age: 60.33  Average of severities: 0.88  The Coordinates of Centroid:  X1 (Severity): 0.93  X2 (Age): 0.61  Cluster 7:  Number of People: 18  Average of Age: 28.06  Average of severities: 0.0  The Coordinates of Centroid:  X1 (Severity): 0.0  X2 (Age): 0.28  Cluster 8:  Number of People: 12  Average of Age: 50.0  Average of severities: 0.54  The Coordinates of Centroid:  X1 (Severity): 0.57  X2 (Age): 0.5  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 17 | 82.65 | 0.02  1 | 8 | 17.38 | 0.68  2 | 2 | 90.5 | 0.9  3 | 14 | 20.36 | 0.27  4 | 11 | 79.36 | 0.36  5 | 15 | 50.33 | 0.27  6 | 3 | 60.33 | 0.88  7 | 18 | 28.06 | 0.0  8 | 12 | 50.0 | 0.54  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 12.04 |  ------------------------------------------------------------- |

### K-means Algorithm using Manhattan Distance Function

* Used Columns: Age, Severity
* Distance Function: Manhattan Distance

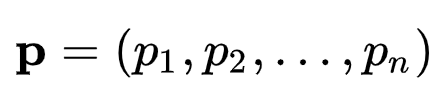
The taxicab distance, in an n-dimensional real vector space with fixed Cartesian coordinate system, is the sum of the lengths of the projections of the line segment between the points onto the coordinate axes.

* Function of Manhattan Distance Formula

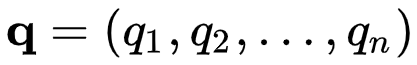


where (p, q) are vectors

d1 is Manhattan distance, and



and



* Console window results

|  |
| --- |
| Total number of People: 100  ID Age Covid Status Severity Address  1 72 Contacted 0.125 충청남도  2 50 Healthy 0.0 경기도  3 49 Contacted 0.2 경상북도  4 45 Contacted 0.225 전라남도  5 45 Contacted 0.325 전라남도  6 66 Confirmed 0.55 부산광역시  7 86 Healthy 0.0 전라남도  8 43 Healthy 0.0 서울특별시  9 63 Healthy 0.0 경기도  10 81 Confirmed 0.35 광주광역시  11 2 Contacted 0.175 경상북도  12 69 Healthy 0.0 전라북도  13 66 Healthy 0.0 전라북도  14 37 Contacted 0.425 울산광역시  15 97 Healthy 0.0 경상북도  16 98 Healthy 0.0 경상북도  17 56 Confirmed 0.65 전라북도  18 26 Contacted 0.3 경상남도  19 90 Confirmed 0.9 전라북도  20 21 Confirmed 0.5 전라북도  21 26 Healthy 0.0 경상북도  22 17 Confirmed 0.45 제주특별자치도  23 55 Healthy 0.0 부산광역시  24 74 Healthy 0.0 경상북도  25 91 Contacted 0.275 경상북도  26 33 Healthy 0.0 대전광역시  27 1 Healthy 0.0 강원도  28 91 Confirmed 0.9 전라남도  29 74 Confirmed 0.45 전라남도  30 52 Contacted 0.275 경기도  31 49 Confirmed 0.4 전라남도  32 49 Confirmed 0.3 전라남도  33 13 Contacted 0.375 경상남도  34 90 Contacted 0.175 충청북도  35 40 Healthy 0.0 경상남도  36 59 Confirmed 0.9 인천광역시  37 21 Contacted 0.3 경상남도  38 99 Confirmed 0.3 경상남도  39 20 Healthy 0.0 경기도  40 21 Confirmed 0.95 전라북도  41 76 Healthy 0.0 제주특별자치도  42 17 Contacted 0.125 서울특별시  43 10 Healthy 0.0 전라북도  44 50 Contacted 0.45 인천광역시  45 58 Contacted 0.175 서울특별시  46 44 Confirmed 0.6 경상남도  47 1 Confirmed 0.75 강원도  48 94 Healthy 0.0 강원도  49 96 Healthy 0.0 울산광역시  50 96 Healthy 0.0 대전광역시  51 25 Healthy 0.0 전라북도  52 68 Contacted 0.375 강원도  53 59 Confirmed 0.3 경상북도  54 50 Confirmed 0.9 전라북도  55 13 Contacted 0.225 경상북도  56 76 Contacted 0.45 광주광역시  57 48 Contacted 0.3 부산광역시  58 53 Healthy 0.0 전라북도  59 12 Confirmed 0.85 서울특별시  60 43 Contacted 0.125 경상북도  61 54 Contacted 0.275 울산광역시  62 52 Confirmed 0.45 제주특별자치도  63 31 Confirmed 0.7 제주특별자치도  64 28 Contacted 0.275 전라남도  65 40 Contacted 0.2 경상남도  66 88 Confirmed 0.5 경기도  67 27 Contacted 0.275 충청남도  68 40 Confirmed 0.45 전라북도  69 66 Contacted 0.225 서울특별시  70 49 Contacted 0.375 충청남도  71 82 Healthy 0.0 광주광역시  72 7 Healthy 0.0 전라남도  73 78 Healthy 0.0 서울특별시  74 30 Contacted 0.325 서울특별시  75 87 Contacted 0.325 전라남도  76 72 Contacted 0.375 경상북도  77 67 Confirmed 0.35 서울특별시  78 16 Healthy 0.0 경기도  79 62 Contacted 0.45 전라북도  80 24 Healthy 0.0 경상북도  81 10 Confirmed 0.55 대구광역시  82 72 Confirmed 0.85 인천광역시  83 70 Contacted 0.2 경기도  84 30 Confirmed 0.6 경기도  85 37 Healthy 0.0 경상북도  86 23 Contacted 0.15 전라북도  87 13 Confirmed 0.55 경상남도  88 34 Confirmed 0.25 대구광역시  89 19 Confirmed 0.25 충청북도  90 12 Healthy 0.0 전라남도  91 88 Healthy 0.0 대구광역시  92 80 Healthy 0.0 충청북도  93 13 Healthy 0.0 서울특별시  94 46 Confirmed 0.65 서울특별시  95 49 Contacted 0.325 서울특별시  96 15 Confirmed 0.25 경기도  97 37 Confirmed 0.65 경기도  98 40 Healthy 0.0 경상남도  99 65 Confirmed 0.55 충청북도  100 45 Confirmed 0.65 충청남도  Number of healthy people: 33  Number of contacted people: 33  Number of confirmed people: 34  Average Severity of contacted people: 0.28  Average Severity of confirmed people: 0.57  Number of Clusters: 2  Cluster 0:  Number of People: 69  Average of Age: 50.81  Average of severities: 0.14  The Coordinates of Centroid:  X1 (Severity): 0.14  X2 (Age): 0.51  Cluster 1:  Number of People: 31  Average of Age: 45.74  Average of severities: 0.61  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.46  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 69 | 50.81 | 0.14  1 | 31 | 45.74 | 0.61  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 37.34 |  -------------------------------------------------------------  Number of Clusters: 3  Cluster 0:  Number of People: 36  Average of Age: 75.67  Average of severities: 0.16  The Coordinates of Centroid:  X1 (Severity): 0.17  X2 (Age): 0.76  Cluster 1:  Number of People: 33  Average of Age: 24.55  Average of severities: 0.13  The Coordinates of Centroid:  X1 (Severity): 0.14  X2 (Age): 0.24  Cluster 2:  Number of People: 31  Average of Age: 44.84  Average of severities: 0.6  The Coordinates of Centroid:  X1 (Severity): 0.63  X2 (Age): 0.45  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 36 | 75.67 | 0.16  1 | 33 | 24.55 | 0.13  2 | 31 | 44.84 | 0.6  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 28.52 |  -------------------------------------------------------------  Number of Clusters: 4  Cluster 0:  Number of People: 18  Average of Age: 66.17  Average of severities: 0.61  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.66  Cluster 1:  Number of People: 24  Average of Age: 24.25  Average of severities: 0.05  The Coordinates of Centroid:  X1 (Severity): 0.06  X2 (Age): 0.24  Cluster 2:  Number of People: 25  Average of Age: 80.48  Average of severities: 0.09  The Coordinates of Centroid:  X1 (Severity): 0.09  X2 (Age): 0.81  Cluster 3:  Number of People: 33  Average of Age: 34.52  Average of severities: 0.42  The Coordinates of Centroid:  X1 (Severity): 0.44  X2 (Age): 0.34  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 18 | 66.17 | 0.61  1 | 24 | 24.25 | 0.05  2 | 25 | 80.48 | 0.09  3 | 33 | 34.52 | 0.42  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 25.43 |  -------------------------------------------------------------  Number of Clusters: 5  Cluster 0:  Number of People: 20  Average of Age: 78.15  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.79  Cluster 1:  Number of People: 16  Average of Age: 28.81  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.66  X2 (Age): 0.28  Cluster 2:  Number of People: 30  Average of Age: 23.27  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.13  X2 (Age): 0.23  Cluster 3:  Number of People: 29  Average of Age: 63.45  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.64  Cluster 4:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 20 | 78.15 | 0.01  1 | 16 | 28.81 | 0.62  2 | 30 | 23.27 | 0.12  3 | 29 | 63.45 | 0.35  4 | 5 | 72.4 | 0.89  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 20.97 |  -------------------------------------------------------------  Number of Clusters: 6  Cluster 0:  Number of People: 21  Average of Age: 83.43  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.07  X2 (Age): 0.84  Cluster 1:  Number of People: 15  Average of Age: 19.27  Average of severities: 0.34  The Coordinates of Centroid:  X1 (Severity): 0.35  X2 (Age): 0.19  Cluster 2:  Number of People: 9  Average of Age: 29.67  Average of severities: 0.71  The Coordinates of Centroid:  X1 (Severity): 0.75  X2 (Age): 0.29  Cluster 3:  Number of People: 22  Average of Age: 28.55  Average of severities: 0.03  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.28  Cluster 4:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  Cluster 5:  Number of People: 28  Average of Age: 58.07  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.4  X2 (Age): 0.58  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 21 | 83.43 | 0.07  1 | 15 | 19.27 | 0.34  2 | 9 | 29.67 | 0.71  3 | 22 | 28.55 | 0.03  4 | 5 | 72.4 | 0.89  5 | 28 | 58.07 | 0.38  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 19.41 |  -------------------------------------------------------------  Number of Clusters: 7  Cluster 0:  Number of People: 13  Average of Age: 37.62  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  X2 (Age): 0.37  Cluster 1:  Number of People: 14  Average of Age: 27.43  Average of severities: 0.65  The Coordinates of Centroid:  X1 (Severity): 0.68  X2 (Age): 0.27  Cluster 2:  Number of People: 15  Average of Age: 75.47  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.4  X2 (Age): 0.76  Cluster 3:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  Cluster 4:  Number of People: 23  Average of Age: 43.09  Average of severities: 0.31  The Coordinates of Centroid:  X1 (Severity): 0.33  X2 (Age): 0.43  Cluster 5:  Number of People: 17  Average of Age: 82.65  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.83  Cluster 6:  Number of People: 13  Average of Age: 12.38  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.13  X2 (Age): 0.12  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 13 | 37.62 | 0.01  1 | 14 | 27.43 | 0.65  2 | 15 | 75.47 | 0.38  3 | 5 | 72.4 | 0.89  4 | 23 | 43.09 | 0.31  5 | 17 | 82.65 | 0.02  6 | 13 | 12.38 | 0.12  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 16.49 |  -------------------------------------------------------------  Number of Clusters: 8  Cluster 0:  Number of People: 3  Average of Age: 11.33  Average of severities: 0.85  The Coordinates of Centroid:  X1 (Severity): 0.89  X2 (Age): 0.11  Cluster 1:  Number of People: 17  Average of Age: 82.65  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.83  Cluster 2:  Number of People: 12  Average of Age: 20.42  Average of severities: 0.29  The Coordinates of Centroid:  X1 (Severity): 0.3  X2 (Age): 0.2  Cluster 3:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  Cluster 4:  Number of People: 21  Average of Age: 51.67  Average of severities: 0.24  The Coordinates of Centroid:  X1 (Severity): 0.26  X2 (Age): 0.52  Cluster 5:  Number of People: 12  Average of Age: 34.17  Average of severities: 0.58  The Coordinates of Centroid:  X1 (Severity): 0.61  X2 (Age): 0.34  Cluster 6:  Number of People: 13  Average of Age: 76.62  Average of severities: 0.41  The Coordinates of Centroid:  X1 (Severity): 0.43  X2 (Age): 0.77  Cluster 7:  Number of People: 17  Average of Age: 22.76  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.22  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 3 | 11.33 | 0.85  1 | 17 | 82.65 | 0.02  2 | 12 | 20.42 | 0.29  3 | 5 | 72.4 | 0.89  4 | 21 | 51.67 | 0.24  5 | 12 | 34.17 | 0.58  6 | 13 | 76.62 | 0.41  7 | 17 | 22.76 | 0.02  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 15.32 |  -------------------------------------------------------------  Number of Clusters: 9  Cluster 0:  Number of People: 7  Average of Age: 70.43  Average of severities: 0.79  The Coordinates of Centroid:  X1 (Severity): 0.83  X2 (Age): 0.71  Cluster 1:  Number of People: 13  Average of Age: 87.31  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.01  X2 (Age): 0.88  Cluster 2:  Number of People: 17  Average of Age: 22.76  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.22  Cluster 3:  Number of People: 11  Average of Age: 78.64  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.4  X2 (Age): 0.79  Cluster 4:  Number of People: 3  Average of Age: 11.33  Average of severities: 0.85  The Coordinates of Centroid:  X1 (Severity): 0.89  X2 (Age): 0.11  Cluster 5:  Number of People: 10  Average of Age: 62.2  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.08  X2 (Age): 0.62  Cluster 6:  Number of People: 14  Average of Age: 18.21  Average of severities: 0.34  The Coordinates of Centroid:  X1 (Severity): 0.36  X2 (Age): 0.18  Cluster 7:  Number of People: 17  Average of Age: 47.29  Average of severities: 0.31  The Coordinates of Centroid:  X1 (Severity): 0.32  X2 (Age): 0.47  Cluster 8:  Number of People: 8  Average of Age: 41.12  Average of severities: 0.62  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.41  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 7 | 70.43 | 0.79  1 | 13 | 87.31 | 0.01  2 | 17 | 22.76 | 0.02  3 | 11 | 78.64 | 0.38  4 | 3 | 11.33 | 0.85  5 | 10 | 62.2 | 0.07  6 | 14 | 18.21 | 0.34  7 | 17 | 47.29 | 0.31  8 | 8 | 41.12 | 0.62  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 14.7 |  -------------------------------------------------------------  Process finished with exit code 0 |

### K-means Algorithm using Minkowski Distance Function

* Used Columns: Age, Severity
* Distance Function: Minkowski Distance

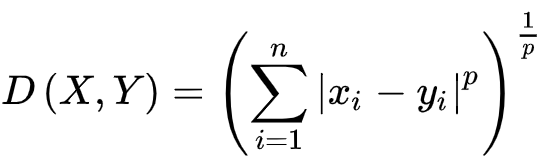
The Minkowski distance is a metric in a normed vector space which can be considered as a generalization of both the Euclidean distance and the Manhattan distance.

* Minkowski Distance Formula

The Minkowski distance of order *p* (where *p* is an integer) between two points

 and 

is defined as:



* Console window results

|  |
| --- |
| "C:\Users\SELab\Anaconda3\envs\Corona Clustering\python.exe" "C:/Users/SELab/Desktop/SELAB/04 Project Related/Corona Clustering/pyc\_clustering.py"  Total number of People: 100  ID Age Covid Status Severity Address  1 72 Contacted 0.125 충청남도  2 50 Healthy 0.0 경기도  3 49 Contacted 0.2 경상북도  4 45 Contacted 0.225 전라남도  5 45 Contacted 0.325 전라남도  6 66 Confirmed 0.55 부산광역시  7 86 Healthy 0.0 전라남도  8 43 Healthy 0.0 서울특별시  9 63 Healthy 0.0 경기도  10 81 Confirmed 0.35 광주광역시  11 2 Contacted 0.175 경상북도  12 69 Healthy 0.0 전라북도  13 66 Healthy 0.0 전라북도  14 37 Contacted 0.425 울산광역시  15 97 Healthy 0.0 경상북도  16 98 Healthy 0.0 경상북도  17 56 Confirmed 0.65 전라북도  18 26 Contacted 0.3 경상남도  19 90 Confirmed 0.9 전라북도  20 21 Confirmed 0.5 전라북도  21 26 Healthy 0.0 경상북도  22 17 Confirmed 0.45 제주특별자치도  23 55 Healthy 0.0 부산광역시  24 74 Healthy 0.0 경상북도  25 91 Contacted 0.275 경상북도  26 33 Healthy 0.0 대전광역시  27 1 Healthy 0.0 강원도  28 91 Confirmed 0.9 전라남도  29 74 Confirmed 0.45 전라남도  30 52 Contacted 0.275 경기도  31 49 Confirmed 0.4 전라남도  32 49 Confirmed 0.3 전라남도  33 13 Contacted 0.375 경상남도  34 90 Contacted 0.175 충청북도  35 40 Healthy 0.0 경상남도  36 59 Confirmed 0.9 인천광역시  37 21 Contacted 0.3 경상남도  38 99 Confirmed 0.3 경상남도  39 20 Healthy 0.0 경기도  40 21 Confirmed 0.95 전라북도  41 76 Healthy 0.0 제주특별자치도  42 17 Contacted 0.125 서울특별시  43 10 Healthy 0.0 전라북도  44 50 Contacted 0.45 인천광역시  45 58 Contacted 0.175 서울특별시  46 44 Confirmed 0.6 경상남도  47 1 Confirmed 0.75 강원도  48 94 Healthy 0.0 강원도  49 96 Healthy 0.0 울산광역시  50 96 Healthy 0.0 대전광역시  51 25 Healthy 0.0 전라북도  52 68 Contacted 0.375 강원도  53 59 Confirmed 0.3 경상북도  54 50 Confirmed 0.9 전라북도  55 13 Contacted 0.225 경상북도  56 76 Contacted 0.45 광주광역시  57 48 Contacted 0.3 부산광역시  58 53 Healthy 0.0 전라북도  59 12 Confirmed 0.85 서울특별시  60 43 Contacted 0.125 경상북도  61 54 Contacted 0.275 울산광역시  62 52 Confirmed 0.45 제주특별자치도  63 31 Confirmed 0.7 제주특별자치도  64 28 Contacted 0.275 전라남도  65 40 Contacted 0.2 경상남도  66 88 Confirmed 0.5 경기도  67 27 Contacted 0.275 충청남도  68 40 Confirmed 0.45 전라북도  69 66 Contacted 0.225 서울특별시  70 49 Contacted 0.375 충청남도  71 82 Healthy 0.0 광주광역시  72 7 Healthy 0.0 전라남도  73 78 Healthy 0.0 서울특별시  74 30 Contacted 0.325 서울특별시  75 87 Contacted 0.325 전라남도  76 72 Contacted 0.375 경상북도  77 67 Confirmed 0.35 서울특별시  78 16 Healthy 0.0 경기도  79 62 Contacted 0.45 전라북도  80 24 Healthy 0.0 경상북도  81 10 Confirmed 0.55 대구광역시  82 72 Confirmed 0.85 인천광역시  83 70 Contacted 0.2 경기도  84 30 Confirmed 0.6 경기도  85 37 Healthy 0.0 경상북도  86 23 Contacted 0.15 전라북도  87 13 Confirmed 0.55 경상남도  88 34 Confirmed 0.25 대구광역시  89 19 Confirmed 0.25 충청북도  90 12 Healthy 0.0 전라남도  91 88 Healthy 0.0 대구광역시  92 80 Healthy 0.0 충청북도  93 13 Healthy 0.0 서울특별시  94 46 Confirmed 0.65 서울특별시  95 49 Contacted 0.325 서울특별시  96 15 Confirmed 0.25 경기도  97 37 Confirmed 0.65 경기도  98 40 Healthy 0.0 경상남도  99 65 Confirmed 0.55 충청북도  100 45 Confirmed 0.65 충청남도  Number of healthy people: 33  Number of contacted people: 33  Number of confirmed people: 34  Average Severity of contacted people: 0.28  Average Severity of confirmed people: 0.57  Number of Clusters: 2  Cluster 0:  Number of People: 69  Average of Age: 50.81  Average of severities: 0.14  The Coordinates of Centroid:  X1 (Severity): 0.14  X2 (Age): 0.51  Cluster 1:  Number of People: 31  Average of Age: 45.74  Average of severities: 0.61  The Coordinates of Centroid:  X1 (Severity): 0.65  X2 (Age): 0.46  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 69 | 50.81 | 0.14  1 | 31 | 45.74 | 0.61  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 28.95 |  -------------------------------------------------------------  Number of Clusters: 3  Cluster 0:  Number of People: 41  Average of Age: 49.2  Average of severities: 0.54  The Coordinates of Centroid:  X1 (Severity): 0.57  X2 (Age): 0.49  Cluster 1:  Number of People: 26  Average of Age: 79.42  Average of severities: 0.08  The Coordinates of Centroid:  X1 (Severity): 0.09  X2 (Age): 0.8  Cluster 2:  Number of People: 33  Average of Age: 25.52  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.13  X2 (Age): 0.25  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 41 | 49.2 | 0.54  1 | 26 | 79.42 | 0.08  2 | 33 | 25.52 | 0.12  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 21.93 |  -------------------------------------------------------------  Number of Clusters: 4  Cluster 0:  Number of People: 35  Average of Age: 46.69  Average of severities: 0.48  The Coordinates of Centroid:  X1 (Severity): 0.51  X2 (Age): 0.47  Cluster 1:  Number of People: 33  Average of Age: 25.52  Average of severities: 0.12  The Coordinates of Centroid:  X1 (Severity): 0.13  X2 (Age): 0.25  Cluster 2:  Number of People: 6  Average of Age: 63.83  Average of severities: 0.9  The Coordinates of Centroid:  X1 (Severity): 0.95  X2 (Age): 0.64  Cluster 3:  Number of People: 26  Average of Age: 79.42  Average of severities: 0.08  The Coordinates of Centroid:  X1 (Severity): 0.09  X2 (Age): 0.8  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 35 | 46.69 | 0.48  1 | 33 | 25.52 | 0.12  2 | 6 | 63.83 | 0.9  3 | 26 | 79.42 | 0.08  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 19.94 |  -------------------------------------------------------------  Number of Clusters: 5  Cluster 0:  Number of People: 29  Average of Age: 63.45  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.64  Cluster 1:  Number of People: 29  Average of Age: 23.62  Average of severities: 0.11  The Coordinates of Centroid:  X1 (Severity): 0.12  X2 (Age): 0.23  Cluster 2:  Number of People: 16  Average of Age: 26.12  Average of severities: 0.61  The Coordinates of Centroid:  X1 (Severity): 0.64  X2 (Age): 0.26  Cluster 3:  Number of People: 20  Average of Age: 78.15  Average of severities: 0.01  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.79  Cluster 4:  Number of People: 6  Average of Age: 69.67  Average of severities: 0.85  The Coordinates of Centroid:  X1 (Severity): 0.89  X2 (Age): 0.7  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 29 | 63.45 | 0.35  1 | 29 | 23.62 | 0.11  2 | 16 | 26.12 | 0.61  3 | 20 | 78.15 | 0.01  4 | 6 | 69.67 | 0.85  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 16.89 |  -------------------------------------------------------------  Number of Clusters: 6  Cluster 0:  Number of People: 10  Average of Age: 32.3  Average of severities: 0.71  The Coordinates of Centroid:  X1 (Severity): 0.74  X2 (Age): 0.32  Cluster 1:  Number of People: 22  Average of Age: 28.55  Average of severities: 0.03  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.28  Cluster 2:  Number of People: 26  Average of Age: 58.96  Average of severities: 0.36  The Coordinates of Centroid:  X1 (Severity): 0.38  X2 (Age): 0.59  Cluster 3:  Number of People: 21  Average of Age: 83.43  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.07  X2 (Age): 0.84  Cluster 4:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  Cluster 5:  Number of People: 16  Average of Age: 20.38  Average of severities: 0.34  The Coordinates of Centroid:  X1 (Severity): 0.36  X2 (Age): 0.2  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 10 | 32.3 | 0.71  1 | 22 | 28.55 | 0.03  2 | 26 | 58.96 | 0.36  3 | 21 | 83.43 | 0.07  4 | 5 | 72.4 | 0.89  5 | 16 | 20.38 | 0.34  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 15.32 |  -------------------------------------------------------------  Number of Clusters: 7  Cluster 0:  Number of People: 22  Average of Age: 42.41  Average of severities: 0.32  The Coordinates of Centroid:  X1 (Severity): 0.33  X2 (Age): 0.42  Cluster 1:  Number of People: 15  Average of Age: 85.07  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.86  Cluster 2:  Number of People: 12  Average of Age: 20.83  Average of severities: 0.63  The Coordinates of Centroid:  X1 (Severity): 0.66  X2 (Age): 0.2  Cluster 3:  Number of People: 16  Average of Age: 15.19  Average of severities: 0.07  The Coordinates of Centroid:  X1 (Severity): 0.08  X2 (Age): 0.14  Cluster 4:  Number of People: 10  Average of Age: 64.0  Average of severities: 0.75  The Coordinates of Centroid:  X1 (Severity): 0.79  X2 (Age): 0.64  Cluster 5:  Number of People: 12  Average of Age: 48.42  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.03  X2 (Age): 0.48  Cluster 6:  Number of People: 13  Average of Age: 77.0  Average of severities: 0.36  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.78  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 22 | 42.41 | 0.32  1 | 15 | 85.07 | 0.02  2 | 12 | 20.83 | 0.63  3 | 16 | 15.19 | 0.07  4 | 10 | 64.0 | 0.75  5 | 12 | 48.42 | 0.02  6 | 13 | 77.0 | 0.36  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 13.71 |  -------------------------------------------------------------  Number of Clusters: 8  Cluster 0:  Number of People: 14  Average of Age: 75.71  Average of severities: 0.35  The Coordinates of Centroid:  X1 (Severity): 0.37  X2 (Age): 0.76  Cluster 1:  Number of People: 6  Average of Age: 14.67  Average of severities: 0.72  The Coordinates of Centroid:  X1 (Severity): 0.76  X2 (Age): 0.14  Cluster 2:  Number of People: 14  Average of Age: 14.93  Average of severities: 0.05  The Coordinates of Centroid:  X1 (Severity): 0.05  X2 (Age): 0.14  Cluster 3:  Number of People: 13  Average of Age: 48.46  Average of severities: 0.04  The Coordinates of Centroid:  X1 (Severity): 0.04  X2 (Age): 0.48  Cluster 4:  Number of People: 21  Average of Age: 34.24  Average of severities: 0.31  The Coordinates of Centroid:  X1 (Severity): 0.33  X2 (Age): 0.34  Cluster 5:  Number of People: 12  Average of Age: 48.33  Average of severities: 0.55  The Coordinates of Centroid:  X1 (Severity): 0.58  X2 (Age): 0.48  Cluster 6:  Number of People: 15  Average of Age: 85.07  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.86  Cluster 7:  Number of People: 5  Average of Age: 72.4  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.94  X2 (Age): 0.73  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 14 | 75.71 | 0.35  1 | 6 | 14.67 | 0.72  2 | 14 | 14.93 | 0.05  3 | 13 | 48.46 | 0.04  4 | 21 | 34.24 | 0.31  5 | 12 | 48.33 | 0.55  6 | 15 | 85.07 | 0.02  7 | 5 | 72.4 | 0.89  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 12.98 |  -------------------------------------------------------------  Number of Clusters: 9  Cluster 0:  Number of People: 15  Average of Age: 19.27  Average of severities: 0.34  The Coordinates of Centroid:  X1 (Severity): 0.35  X2 (Age): 0.19  Cluster 1:  Number of People: 17  Average of Age: 82.65  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.83  Cluster 2:  Number of People: 8  Average of Age: 42.38  Average of severities: 0.68  The Coordinates of Centroid:  X1 (Severity): 0.71  X2 (Age): 0.42  Cluster 3:  Number of People: 4  Average of Age: 78.0  Average of severities: 0.89  The Coordinates of Centroid:  X1 (Severity): 0.93  X2 (Age): 0.79  Cluster 4:  Number of People: 13  Average of Age: 53.38  Average of severities: 0.17  The Coordinates of Centroid:  X1 (Severity): 0.18  X2 (Age): 0.53  Cluster 5:  Number of People: 17  Average of Age: 22.76  Average of severities: 0.02  The Coordinates of Centroid:  X1 (Severity): 0.02  X2 (Age): 0.22  Cluster 6:  Number of People: 10  Average of Age: 46.8  Average of severities: 0.38  The Coordinates of Centroid:  X1 (Severity): 0.4  X2 (Age): 0.47  Cluster 7:  Number of People: 13  Average of Age: 76.62  Average of severities: 0.41  The Coordinates of Centroid:  X1 (Severity): 0.43  X2 (Age): 0.77  Cluster 8:  Number of People: 3  Average of Age: 11.33  Average of severities: 0.85  The Coordinates of Centroid:  X1 (Severity): 0.89  X2 (Age): 0.11  -------------------------------------------------------------  Cluster ID | # of People | Avg. of Ages | Avg. of Severity  0 | 15 | 19.27 | 0.34  1 | 17 | 82.65 | 0.02  2 | 8 | 42.38 | 0.68  3 | 4 | 78.0 | 0.89  4 | 13 | 53.38 | 0.17  5 | 17 | 22.76 | 0.02  6 | 10 | 46.8 | 0.38  7 | 13 | 76.62 | 0.41  8 | 3 | 11.33 | 0.85  ------------|-------------|---------------|------------------  Total | 100 |  SSE | 11.79 |  ------------------------------------------------------------- |