micaQuestionsFinal

August 21, 2022

0.1 First step: we import data and play with it a bit

[ ]:

```
# Import and exel file using pandas
import pandas as pd
# Read Excel file
df = pd.read_excel('testData_MICA.xlsx')
# print(df)

df1 = df
df1 = df1.rename({'Migrant Persons' : 'Migrant Persons X 1e6'}, axis=1)
df1 = df1.rename({'Migrant Males' : 'Migrant Males %'}, axis=1)
df1['Migrant Males %'] = df1['Migrant Males %']/df1['Migrant Persons X 1e6']*100
print(df1.head()) # to test that all is properly imported
```

```
             Home State Name  Home State ID    Current State  \
0                DAMAN & DIU             25  JAMMU & KASHMIR
1       DADRA & NAGAR HAVELI             26  JAMMU & KASHMIR
2                 PUDUCHERRY             34  JAMMU & KASHMIR
3  ANDAMAN & NICOBAR ISLANDS             35  JAMMU & KASHMIR
4                    MIZORAM             15  JAMMU & KASHMIR

   Current State ID  Migrant Persons X 1e6  Migrant Males %  Migrant Females
0                 1                      6        50.000000                3
1                 1                     17        23.529412               13
2                 1                     18        33.333333               12
3                 1                     51        49.019608               26
4                 1                     57        38.596491               35
```

[ ]:

```
print(df['Current State'].unique())
print(df['Current State ID'].unique())
```

```
['JAMMU & KASHMIR' 'HIMACHAL PRADESH' 'PUNJAB' 'CHANDIGARH' 'UTTARAKHAND'
 'HARYANA' 'NCT OF DELHI' 'RAJASTHAN' 'UTTAR PRADESH' 'BIHAR' 'SIKKIM'
 'ARUNACHAL PRADESH' 'NAGALAND' 'MANIPUR' 'MIZORAM' 'TRIPURA' 'MEGHALAYA'
 'ASSAM' 'WEST BENGAL' 'JHARKHAND' 'ODISHA' 'CHHATTISGARH'
 'MADHYA PRADESH' 'GUJARAT' 'DAMAN & DIU' 'DADRA & NAGAR HAVELI'
 'MAHARASHTRA' 'ANDHRA PRADESH' 'KARNATAKA' 'GOA' 'LAKSHADWEEP' 'KERALA'
 'TAMIL NADU' 'PUDUCHERRY' 'ANDAMAN & NICOBAR ISLANDS']
[ 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
```

```
 25 26 27 28 29 30 31 32 33 34 35]
```

Let us make an ID file. We will use this dataframe throughout the notebook.

[ ]:

```
# initialize list elements
data = {'ID': df['Current State ID'].unique(),
        'State': df['Current State'].unique()}

IDs = pd.DataFrame(data)

# print dataframe.
print(IDs)
```

```
    ID                      State
0    1            JAMMU & KASHMIR
1    2           HIMACHAL PRADESH
2    3                     PUNJAB
3    4                 CHANDIGARH
4    5                UTTARAKHAND
5    6                    HARYANA
6    7               NCT OF DELHI
7    8                  RAJASTHAN
8    9              UTTAR PRADESH
9   10                      BIHAR
10  11                     SIKKIM
11  12          ARUNACHAL PRADESH
12  13                   NAGALAND
13  14                    MANIPUR
14  15                    MIZORAM
15  16                    TRIPURA
16  17                  MEGHALAYA
17  18                      ASSAM
18  19                WEST BENGAL
19  20                  JHARKHAND
20  21                     ODISHA
21  22               CHHATTISGARH
22  23             MADHYA PRADESH
23  24                    GUJARAT
24  25                DAMAN & DIU
25  26       DADRA & NAGAR HAVELI
26  27                MAHARASHTRA
27  28             ANDHRA PRADESH
28  29                  KARNATAKA
29  30                        GOA
30  31                LAKSHADWEEP
31  32                     KERALA
32  33                 TAMIL NADU
33  34                 PUDUCHERRY
34  35  ANDAMAN & NICOBAR ISLANDS
```

0.1.1 Plotting the global data

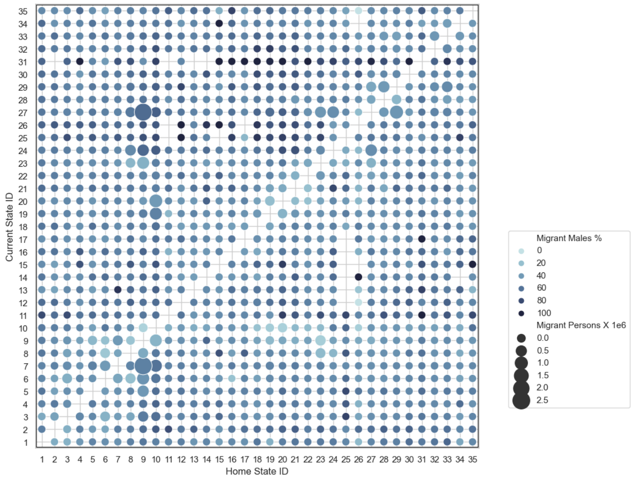
Here, we will plot how many workers migrated from a given state and to which state.

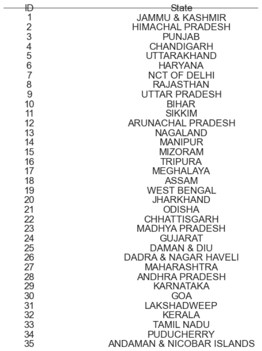
[ ]:

```
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
import matplotlib.ticker as ticker

sns.set_theme(style="whitegrid")

# Load the example planets dataset
# planets = sns.load_dataset("planets")
fig, (ax1, ax2) = plt.subplots(1, 2)
fig.set_size_inches(25, 10)

xmin, xmax = min(IDs['ID'])-0.5, max(IDs['ID'])+0.5
ax1.plot([xmin, xmax], [xmin, xmin],'k-', lw=3)
ax1.plot([xmax, xmax], [xmin, xmax],'k-', lw=3)
ax1.plot([xmin, xmax], [xmax, xmax],'k-', lw=3)
ax1.plot([xmin, xmin], [xmin, xmax],'k-', lw=3)

cmap = sns.cubehelix_palette(rot=-.2, as_cmap=True)

g = sns.scatterplot(
    data=df1,
    x="Home State ID", y="Current State ID",
    size="Migrant Persons X 1e6", hue="Migrant Males %",
    palette=cmap, sizes=(100, 500), ax=ax1
)

ax1.xaxis.grid(True, "minor", linewidth=.25)
ax1.yaxis.grid(True, "minor", linewidth=.25)
ax1.set_aspect('equal')
ax1.set_xlim(0.5, 35.5)
ax1.set_ylim(0.5, 35.5)
ax1.legend(bbox_to_anchor=(0.85, 0, 0.5, 0.5))

start, end = ax1.get_xlim()
ax1.xaxis.set_ticks(np.arange(start+0.5, end-0.5+1, 1))
ax1.xaxis.set_major_formatter(ticker.FormatStrFormatter('%d'))
ax1.yaxis.set_ticks(np.arange(start+0.5, end-0.5+1, 1))
ax1.yaxis.set_major_formatter(ticker.FormatStrFormatter('%d'))

ax2.axis('off')
ax2.table(cellText=IDs.values, colLabels=IDs.columns, loc='center',␣
 ↪colWidths=[0.1, 0.5],cellLoc='center',edges='open')
```

```python
import matplotlib.lines as lines
yL = 0.88
line = lines.Line2D([0.2, 0.7], [yL, yL],
                    lw=0.5, color='black', axes=ax2)
ax2.add_line(line)
```

```
[ ]: <matplotlib.lines.Line2D at 0x17f397fa0>
```





ID	State
1	JAMMU & KASHMIR
2	HIMACHAL PRADESH
3	PUNJAB
4	CHANDIGARH
5	UTTARAKHAND
6	HARYANA
7	NCT OF DELHI
8	RAJASTHAN
9	UTTAR PRADESH
10	BIHAR
11	SIKKIM
12	ARUNACHAL PRADESH
13	NAGALAND
14	MANIPUR
15	MIZORAM
16	TRIPURA
17	MEGHALAYA
18	ASSAM
19	WEST BENGAL
20	JHARKHAND
21	ODISHA
22	CHHATTISGARH
23	MADHYA PRADESH
24	GUJARAT
25	DAMAN & DIU
26	DADRA & NAGAR HAVELI
27	MAHARASHTRA
28	ANDHRA PRADESH
29	KARNATAKA
30	GOA
31	LAKSHADWEEP
32	KERALA
33	TAMIL NADU
34	PUDUCHERRY
35	ANDAMAN & NICOBAR ISLANDS

- As expected, the diagonal is empty. No one migrated to the state they were already in.
- The most common migration is from Uttar Pradesh to Delhi.
- In fact the number of people migrating from UP to all other states is higher in general.
- UP is followed very closely by Bihar.

0.1.2 Shortcoming of this plot:

We do not really see any details becuase of the large numbers included in this case. In the subsequent questions, we will make use of specific questions to understand the data better.

0.2 Question 1

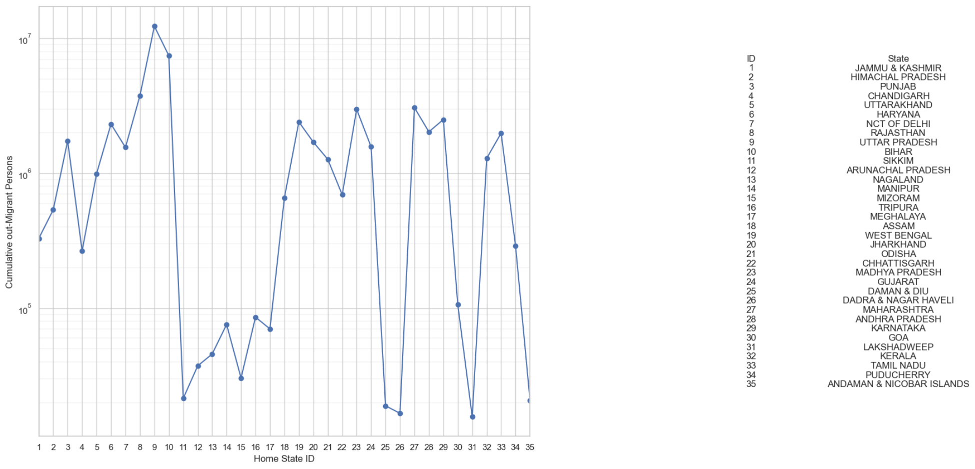
Now we do question 1. To keep things simple, we will use brute force.

To start, let us first calculate the total number of workers migrating out from a particular state

```python
[ ]: # Now, we get a sum of migrants from a particular Home State
     df2em = df.groupby(['Home State ID']).sum()

     # Plot Migrant Persons against Home State ID
     # print(df2em.index)
     fig, (ax, ax0) = plt.subplots(1,2)
     fig.set_size_inches(25, 10)
```

```
ax.plot(df2em.index, df2em['Migrant Persons'], 'o-')
ax.xaxis.grid(True, "minor", linewidth=.25)
ax.yaxis.grid(True, "minor", linewidth=.25)
ax.set_xlim(1, 35)
start, end = ax1.get_xlim()
ax.xaxis.set_ticks(np.arange(1, 36, 1))
ax.xaxis.set_major_formatter(ticker.FormatStrFormatter('%d'))
ax.set_xlabel('Home State ID')
ax.set_ylabel('Cumulative out-Migrant Persons')

# set yaxis to log scale
ax.set_yscale('log')

ax0.axis('off')
ax0.table(cellText=IDs.values, colLabels=IDs.columns, loc='center',␣
 ↪colWidths=[0.1, 0.5],cellLoc='center',edges='open')
```

```
[ ]: <matplotlib.table.Table at 0x17f6dc040>
```



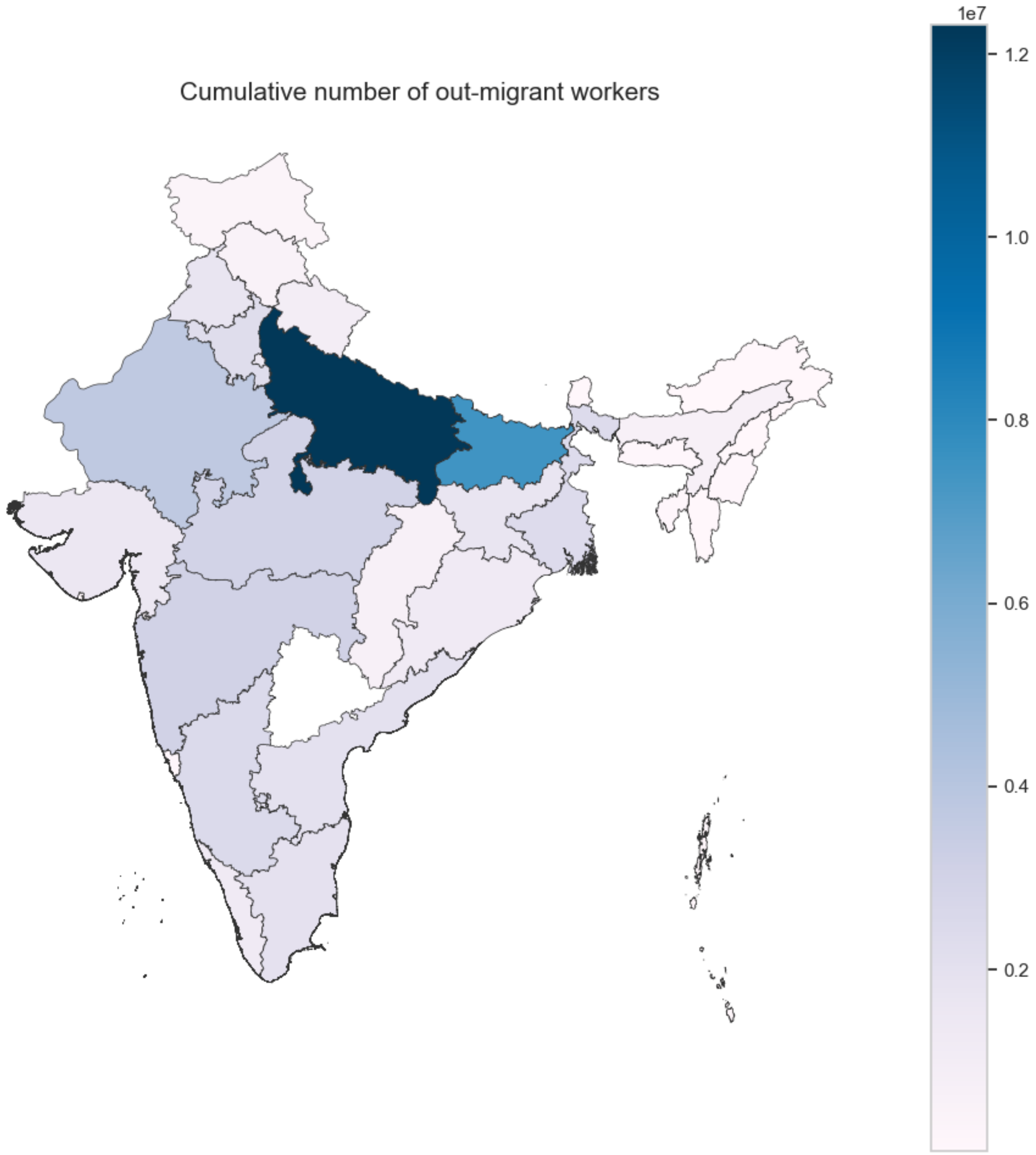
ID	State
1	JAMMU & KASHMIR
2	HIMACHAL PRADESH
3	PUNJAB
4	CHANDIGARH
5	UTTARAKHAND
6	HARYANA
7	NCT OF DELHI
8	RAJASTHAN
9	UTTAR PRADESH
10	BIHAR
11	SIKKIM
12	ARUNACHAL PRADESH
13	NAGALAND
14	MANIPUR
15	MIZORAM
16	TRIPURA
17	MEGHALAYA
18	ASSAM
19	WEST BENGAL
20	JHARKHAND
21	ODISHA
22	CHHATTISGARH
23	MADHYA PRADESH
24	GUJARAT
25	DAMAN & DIU
26	DADRA & NAGAR HAVELI
27	MAHARASHTRA
28	ANDHRA PRADESH
29	KARNATAKA
30	GOA
31	LAKSHADWEEP
32	KERALA
33	TAMIL NADU
34	PUDUCHERRY
35	ANDAMAN & NICOBAR ISLANDS

- Clearly, we see that by far the most workers are migrating out of Uttar Pradesh. This is followed by Bihar and Rajasthan. This is inline with our previous plot.

For better visualization, we will plot the above line graph onto the map of India. This way, we can keep track of the states and their migration patterns.

```
[ ]: import geopandas as gpd

df6id = df2em.index.to_numpy()
df6value = df2em['Migrant Persons'].to_numpy()

data = {'ID': df6id,
        'Migrant persons': df6value}
```

```
df6em = pd.DataFrame(data)

df7em = pd.merge(IDs, df6em, on="ID", how="left")
# print(df7)

map_dfem = gpd.read_file('IND_adm/IND_adm1.shp')
# Rename some states
map_dfem = map_dfem.replace({'Andaman and Nicobar':'ANDAMAN & NICOBAR ISLANDS',␣
 ↪'Andhra Pradesh':'ANDHRA PRADESH', 'Arunachal Pradesh':'ARUNACHAL PRADESH',␣
 ↪'Chhattisgarh':'CHHATTISGARH', 'Dadra and Nagar Haveli':'DADRA & NAGAR␣
 ↪HAVELI', 'Daman and Diu':'DAMAN & DIU', 'Delhi':'NCT OF DELHI', 'Jammu and␣
 ↪Kashmir':'JAMMU & KASHMIR', 'Lakshadweep':'LAKSHADWEEP', 'Madhya Pradesh':
 ↪'MADHYA PRADESH', 'Maharashtra':'MAHARASHTRA', 'Bihar':'BIHAR', 'Assam':
 ↪'ASSAM', 'Chandigarh':'CHANDIGARH','Goa':'GOA','Gujarat':'GUJARAT','Haryana':
 ↪'HARYANA','Himachal Pradesh':'HIMACHAL PRADESH','Jharkhand':
 ↪'JHARKHAND','Karnataka':'KARNATAKA','Kerala':'KERALA','Mizoram':
 ↪'MIZORAM','Nagaland':'NAGALAND','Orissa':'ODISHA','Puducherry':
 ↪'PUDUCHERRY','Punjab':'PUNJAB','Rajasthan':'RAJASTHAN','Sikkim':
 ↪'SIKKIM','Tamil Nadu':'TAMIL NADU','Telangana':'TELANGANA','Tripura':
 ↪'TRIPURA','Uttar Pradesh':'UTTAR PRADESH','Uttarakhand':'UTTARAKHAND','West␣
 ↪Bengal':'WEST BENGAL','Uttaranchal':'UTTARAKHAND','Manipur':
 ↪'MANIPUR','Meghalaya':'MEGHALAYA'})
# print(map_df)
dfMergeem = pd.merge(map_dfem, df7em, left_on='NAME_1', right_on='State',␣
 ↪how='left')
# print(dfMerge)
fig, ax = plt.subplots(1, figsize=(12, 12))
ax.axis('off')
ax.set_title('Cumulative number of out-migrant workers',
             fontdict={'fontsize': '15', 'fontweight' : '3'})
fig = dfMergeem.plot(column='Migrant persons', cmap='PuBu', linewidth=0.5,␣
 ↪ax=ax, edgecolor='0.2',legend=True)
```



Dark blue states are those with the highest number of workers migrating out. Light blue states are those with the lowest number of workers migrating out.

- Clearly, once again UP stands out.
- Unfortunately, there was no Telengana in the datafile. So, we have skipped it.

0.2.1 Finding the neighbours of a given state

Here, we will use geopanda to find the neighbours of a given state. We will use this to find the states that are most likely to be migrated to from a given state.

[ ]:

```
from sre_parse import State


map_dfem2 = gpd.read_file('IND_adm/IND_adm1.shp')
# Rename some states
map_dfem2 = map_dfem2.replace({'Andaman and Nicobar':'ANDAMAN & NICOBAR␣
 ↪ISLANDS', 'Andhra Pradesh':'ANDHRA PRADESH', 'Arunachal Pradesh':'ARUNACHAL␣
 ↪PRADESH', 'Chhattisgarh':'CHHATTISGARH', 'Dadra and Nagar Haveli':'DADRA &␣
 ↪NAGAR HAVELI', 'Daman and Diu':'DAMAN & DIU', 'Delhi':'NCT OF DELHI', 'Jammu␣
 ↪and Kashmir':'JAMMU & KASHMIR', 'Lakshadweep':'LAKSHADWEEP', 'Madhya␣
 ↪Pradesh':'MADHYA PRADESH', 'Maharashtra':'MAHARASHTRA', 'Bihar':'BIHAR',␣
 ↪'Assam':'ASSAM', 'Chandigarh':'CHANDIGARH','Goa':'GOA','Gujarat':
 ↪'GUJARAT','Haryana':'HARYANA','Himachal Pradesh':'HIMACHAL␣
 ↪PRADESH','Jharkhand':'JHARKHAND','Karnataka':'KARNATAKA','Kerala':
 ↪'KERALA','Mizoram':'MIZORAM','Nagaland':'NAGALAND','Orissa':
 ↪'ODISHA','Puducherry':'PUDUCHERRY','Punjab':'PUNJAB','Rajasthan':
 ↪'RAJASTHAN','Sikkim':'SIKKIM','Tamil Nadu':'TAMIL NADU','Telangana':
 ↪'TELANGANA','Tripura':'TRIPURA','Uttar Pradesh':'UTTAR␣
 ↪PRADESH','Uttarakhand':'UTTARAKHAND','West Bengal':'WEST␣
 ↪BENGAL','Uttaranchal':'UTTARAKHAND','Manipur':'MANIPUR','Meghalaya':
 ↪'MEGHALAYA'})

# map_dfem2.plot()
# add NEIGHBORS column
map_dfem2["NEIGHBORS"] = None

for index, State in map_dfem2.iterrows():

    # get 'not disjoint' countries
    neighbors = map_dfem2[~map_dfem2.geometry.disjoint(State.geometry)].NAME_1.
 ↪tolist()

    # remove own name of the country from the list
    neighbors = [ name for name in neighbors if State.NAME_1 != name ]

    # add names of neighbors as NEIGHBORS value
    map_dfem2.at[index, "NEIGHBORS"] = ", ".join(neighbors)

# print(map_dfem2)

map_dfem3StatesTemp = map_dfem2['NAME_1'].to_numpy()
map_dfem3NeighboursTemp = map_dfem2['NEIGHBORS'].to_numpy()

data = {'Home State Name': map_dfem3StatesTemp,
        'Neighbouring states': map_dfem3NeighboursTemp}

map_dfem3 = pd.DataFrame(data)
```

```
# print(map_dfem3)
```

df is our base dataframe. map_dfem3 is the dataframe that has all the states and their corresponding neighbours.

```
[ ]: print(map_dfem3.head())
```

```
              Home State Name  \
0  ANDAMAN & NICOBAR ISLANDS
1             ANDHRA PRADESH
2          ARUNACHAL PRADESH
3                      ASSAM
4                      BIHAR

                                  Neighbouring states
0
1  KARNATAKA, ODISHA, PUDUCHERRY, TAMIL NADU, TEL…
2                                     ASSAM, NAGALAND
3  ARUNACHAL PRADESH, MANIPUR, MEGHALAYA, MIZORAM…
4              JHARKHAND, UTTAR PRADESH, WEST BENGAL
```

```
[ ]: print(df.head())
```

```
              Home State Name  Home State ID    Current State  \
0                 DAMAN & DIU             25  JAMMU & KASHMIR
1        DADRA & NAGAR HAVELI             26  JAMMU & KASHMIR
2                  PUDUCHERRY             34  JAMMU & KASHMIR
3  ANDAMAN & NICOBAR ISLANDS             35  JAMMU & KASHMIR
4                     MIZORAM             15  JAMMU & KASHMIR

   Current State ID  Migrant Persons  Migrant Males  Migrant Females
0                 1                6              3                3
1                 1               17              4               13
2                 1               18              6               12
3                 1               51             25               26
4                 1               57             22               35
```

0.2.2 The most important part of the code to calculate the number of migrations to the neighbouring states

Here, we loop over all the states to find the percentage of workers migrating to the neighbouring states.

```
[ ]: # sort based on Home State Name
     df9em = df.sort_values(by=['Home State Name'])
     # print(df9em)

     neighborPercent = []
```

```
counter = 0
for state in map_dfem3['Home State Name']:
    # print("Doing %s" % state)
    df10em = df9em[df9em['Home State Name'] == state]
    TotalMigrants = df10em['Migrant Persons'].sum()
    # print(df10em)

    neighbors = map_dfem3['Neighbouring states'][counter]
    neighbors = neighbors.split(", ")
    # print(df10em)
    NeighborMigrant = 0
    for neighbor in neighbors:
      df11em = df10em[df10em['Current State'] == neighbor]
      NeighborMigrant += df11em['Migrant Persons'].sum()
        # df9em = df9em[df9em['Home State Name'] != neighbor]
    # % of migrants going to neighboring states
    if TotalMigrants != 0:
      NeighborMigrant = (NeighborMigrant/TotalMigrants)*100
    else:
      NeighborMigrant = 0
    print("Percentage Migrants from %s to neighbours is %d percent" % (state,␣
  ↪NeighborMigrant))
    neighborPercent.append(NeighborMigrant)

    # if counter == 1:
    #   break
    counter = counter + 1
```

```
Percentage Migrants from ANDAMAN & NICOBAR ISLANDS to neighbours is 0 percent
Percentage Migrants from ANDHRA PRADESH to neighbours is 65 percent
Percentage Migrants from ARUNACHAL PRADESH to neighbours is 54 percent
Percentage Migrants from ASSAM to neighbours is 63 percent
Percentage Migrants from BIHAR to neighbours is 47 percent
Percentage Migrants from CHANDIGARH to neighbours is 83 percent
Percentage Migrants from CHHATTISGARH to neighbours is 81 percent
Percentage Migrants from DADRA & NAGAR HAVELI to neighbours is 83 percent
Percentage Migrants from DAMAN & DIU to neighbours is 76 percent
Percentage Migrants from NCT OF DELHI to neighbours is 66 percent
Percentage Migrants from GOA to neighbours is 85 percent
Percentage Migrants from GUJARAT to neighbours is 84 percent
Percentage Migrants from HARYANA to neighbours is 90 percent
Percentage Migrants from HIMACHAL PRADESH to neighbours is 61 percent
Percentage Migrants from JAMMU & KASHMIR to neighbours is 26 percent
Percentage Migrants from JHARKHAND to neighbours is 75 percent
Percentage Migrants from KARNATAKA to neighbours is 95 percent
Percentage Migrants from KERALA to neighbours is 62 percent
Percentage Migrants from LAKSHADWEEP to neighbours is 0 percent
Percentage Migrants from MADHYA PRADESH to neighbours is 87 percent
Percentage Migrants from MAHARASHTRA to neighbours is 73 percent
Percentage Migrants from MANIPUR to neighbours is 50 percent
Percentage Migrants from MEGHALAYA to neighbours is 57 percent
Percentage Migrants from MIZORAM to neighbours is 74 percent
Percentage Migrants from NAGALAND to neighbours is 57 percent
Percentage Migrants from ODISHA to neighbours is 54 percent
Percentage Migrants from PUDUCHERRY to neighbours is 97 percent
Percentage Migrants from PUNJAB to neighbours is 61 percent
Percentage Migrants from RAJASTHAN to neighbours is 62 percent
Percentage Migrants from SIKKIM to neighbours is 53 percent
Percentage Migrants from TAMIL NADU to neighbours is 79 percent
Percentage Migrants from TELANGANA to neighbours is 0 percent
Percentage Migrants from TRIPURA to neighbours is 53 percent
Percentage Migrants from UTTAR PRADESH to neighbours is 58 percent
Percentage Migrants from UTTARAKHAND to neighbours is 41 percent
Percentage Migrants from WEST BENGAL to neighbours is 42 percent
```

neighborPercent variable stores the percentage of workers migrating to the neighbouring states.

[ ]:

```
print(neighborPercent)
```

```
[0.0, 65.61292490064059, 54.5546992078784, 63.66300133092009, 47.12418613692903,
83.37480472058574, 81.38551854585717, 83.22813345356177, 76.70051835396171,
66.4719322910375, 85.26498173189198, 84.38215314067011, 90.91028815824414,
61.32043603951305, 26.104907287204448, 75.20950806152179, 95.22908113446661,
62.201769500319436, 0.0, 87.2134914273977, 73.93318821170897,
50.873255798603324, 57.999373825923605, 74.4574345463527, 57.974373551405954,
54.81578858346295, 97.28286836037309, 61.745085953803745, 62.42973916580332,
53.76298988769281, 79.88224608935212, 0, 53.005986350189836, 58.42205650966363,
41.89740028382499, 42.19454239038346]
```

Let us make neighborPercent into a panda dataframe

[ ]:

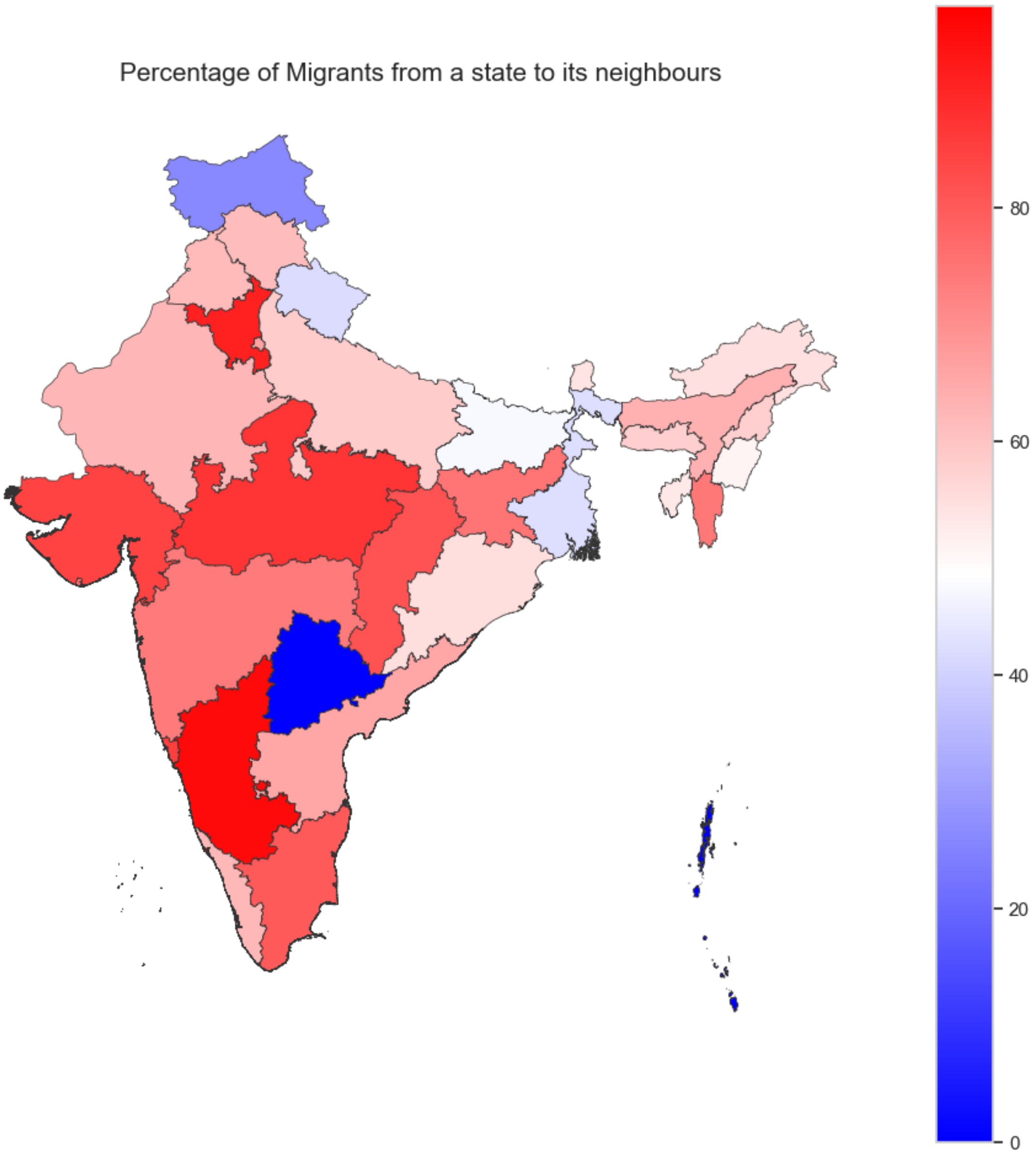
```
data = {'Home State Name': map_dfem3['Home State Name'],
        'Neighbor Percent migration': neighborPercent}

df12em = pd.DataFrame(data)
print(df12em.head())
```

```
             Home State Name  Neighbor Percent migration
0  ANDAMAN & NICOBAR ISLANDS                    0.000000
1             ANDHRA PRADESH                   65.612925
2          ARUNACHAL PRADESH                   54.554699
3                      ASSAM                   63.663001
4                      BIHAR                   47.124186
```

[ ]:

```
map_dfNeighbour = gpd.read_file('IND_adm/IND_adm1.shp')
# Rename some states
```

```
map_dfNeighbour = map_dfNeighbour.replace({'Andaman and Nicobar':'ANDAMAN &␣
 ↪NICOBAR ISLANDS', 'Andhra Pradesh':'ANDHRA PRADESH', 'Arunachal Pradesh':
 ↪'ARUNACHAL PRADESH', 'Chhattisgarh':'CHHATTISGARH', 'Dadra and Nagar Haveli':
 ↪'DADRA & NAGAR HAVELI', 'Daman and Diu':'DAMAN & DIU', 'Delhi':'NCT OF␣
 ↪DELHI', 'Jammu and Kashmir':'JAMMU & KASHMIR', 'Lakshadweep':'LAKSHADWEEP',␣
 ↪'Madhya Pradesh':'MADHYA PRADESH', 'Maharashtra':'MAHARASHTRA', 'Bihar':
 ↪'BIHAR', 'Assam':'ASSAM', 'Chandigarh':'CHANDIGARH','Goa':'GOA','Gujarat':
 ↪'GUJARAT','Haryana':'HARYANA','Himachal Pradesh':'HIMACHAL␣
 ↪PRADESH','Jharkhand':'JHARKHAND','Karnataka':'KARNATAKA','Kerala':
 ↪'KERALA','Mizoram':'MIZORAM','Nagaland':'NAGALAND','Orissa':
 ↪'ODISHA','Puducherry':'PUDUCHERRY','Punjab':'PUNJAB','Rajasthan':
 ↪'RAJASTHAN','Sikkim':'SIKKIM','Tamil Nadu':'TAMIL NADU','Telangana':
 ↪'TELANGANA','Tripura':'TRIPURA','Uttar Pradesh':'UTTAR␣
 ↪PRADESH','Uttarakhand':'UTTARAKHAND','West Bengal':'WEST␣
 ↪BENGAL','Uttaranchal':'UTTARAKHAND','Manipur':'MANIPUR','Meghalaya':
 ↪'MEGHALAYA'})
# print(map_df)
dfMergeem = pd.merge(map_dfNeighbour, df12em, left_on='NAME_1', right_on='Home␣
 ↪State Name', how='left')
# print(dfMerge)
fig, ax = plt.subplots(1, figsize=(12, 12))
ax.axis('off')
ax.set_title('Percentage of Migrants from a state to its neighbours',
             fontdict={'fontsize': '15', 'fontweight' : '3'})
fig = dfMergeem.plot(column='Neighbor Percent migration', cmap='bwr',␣
 ↪linewidth=0.5, ax=ax, edgecolor='0.2',legend=True)
```



Red denotes the states with highest number of workers migrating to the neighbouring states. Blue denotes the states with the lowest number of workers migrating to the neighbouring states.

In the above map of India, we have plotted the percentage of workers migrating to the neighbouring states. Clearly, the southern states have the highest percentage of workers migrating to the neighbouring states.

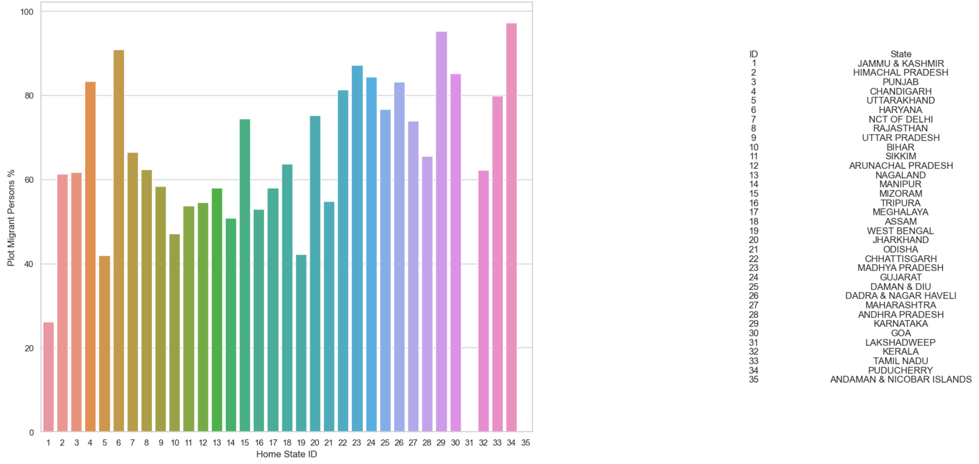
We also see that percentage of migrant workers from North-East to their neighbours is very high.

Not surprising, % of workers migrating from UP, Bihar, and other northern to their neighbours is very low. This is due to the fact that people from UP and Bihar go to Delhi, Maharashtra, and other southern states for jobs.

To further understnad the data, we can make bar plots of the states with the highest number of workers migrating to the neighbouring states.

```
[ ]: sns.set_theme(style="whitegrid")

     df13em = pd.merge(IDs, df12em, left_on='State', right_on='Home State Name',␣
      ↪how='left')
     # print(df13em)
     # Plot Migrant Persons % to neighbour against Home State ID
     fig, (ax10, ax12) = plt.subplots(1,2)
     fig.set_size_inches(25, 10)
     sns.barplot(x="ID", y="Neighbor Percent migration", data=df13em,ax=ax10)
     ax10.xaxis.grid(True, "minor", linewidth=.25)
     ax10.yaxis.grid(True, "minor", linewidth=.25)
     ax10.set_xlabel('Home State ID')
     ax10.set_ylabel('Plot Migrant Persons %')

     ax12.axis('off')
     ax12.table(cellText=IDs.values, colLabels=IDs.columns, loc='center',␣
      ↪colWidths=[0.1, 0.5],cellLoc='center',edges='open')
```

```
[ ]: <matplotlib.table.Table at 0x18b921930>
```



ID	State
1	JAMMU & KASHMIR
2	HIMACHAL PRADESH
3	PUNJAB
4	CHANDIGARH
5	UTTARAKHAND
6	HARYANA
7	NCT OF DELHI
8	RAJASTHAN
9	UTTAR PRADESH
10	BIHAR
11	SIKKIM
12	ARUNACHAL PRADESH
13	NAGALAND
14	MANIPUR
15	MIZORAM
16	TRIPURA
17	MEGHALAYA
18	ASSAM
19	WEST BENGAL
20	JHARKHAND
21	ODISHA
22	CHHATTISGARH
23	MADHYA PRADESH
24	GUJARAT
25	DAMAN & DIU
26	DADRA & NAGAR HAVELI
27	MAHARASHTRA
28	ANDHRA PRADESH
29	KARNATAKA
30	GOA
31	LAKSHADWEEP
32	KERALA
33	TAMIL NADU
34	PUDUCHERRY
35	ANDAMAN & NICOBAR ISLANDS

0.3 End of Question 1

0.4 Question (2)

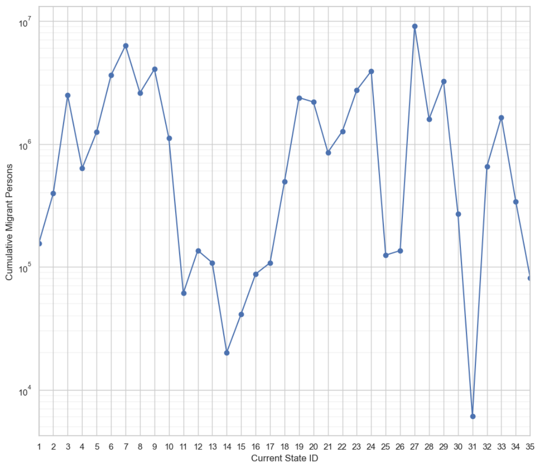
In this question, we need to find the top 10 employing states.

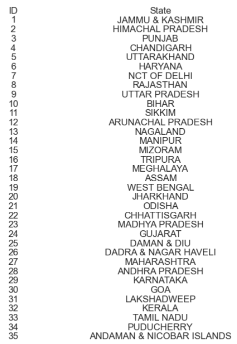
Idea is to first group and sum the data based on this group. Then plot it using a line plot to visualize the data.

After that, we can sort this group based on highest number of migrant persons.

```
[ ]: # Now, we get a sum of migrants to a particular Current State

     df2 = df.groupby(['Current State ID']).sum()

     # Plot Migrant Persons against Current State ID
     # print(df2.index)
     fig, (ax, ax0) = plt.subplots(1,2)
     fig.set_size_inches(25, 10)
     ax.plot(df2.index, df2['Migrant Persons'], 'o-')
     ax.xaxis.grid(True, "minor", linewidth=.25)
     ax.yaxis.grid(True, "minor", linewidth=.25)
     ax.set_xlim(1, 35)
     start, end = ax1.get_xlim()
     ax.xaxis.set_ticks(np.arange(1, 36, 1))
     ax.xaxis.set_major_formatter(ticker.FormatStrFormatter('%d'))
     ax.set_xlabel('Current State ID')
     ax.set_ylabel('Cumulative Migrant Persons')

     # set yaxis to log scale
     ax.set_yscale('log')

     ax0.axis('off')
     ax0.table(cellText=IDs.values, colLabels=IDs.columns, loc='center',␣
      ↪colWidths=[0.1, 0.5],cellLoc='center',edges='open')
```

```
[ ]: <matplotlib.table.Table at 0x18bd58310>
```





ID	State
1	JAMMU & KASHMIR
2	HIMACHAL PRADESH
3	PUNJAB
4	CHANDIGARH
5	UTTARAKHAND
6	HARYANA
7	NCT OF DELHI
8	RAJASTHAN
9	UTTAR PRADESH
10	BIHAR
11	SIKKIM
12	ARUNACHAL PRADESH
13	NAGALAND
14	MANIPUR
15	MIZORAM
16	TRIPURA
17	MEGHALAYA
18	ASSAM
19	WEST BENGAL
20	JHARKHAND
21	ODISHA
22	CHHATTISGARH
23	MADHYA PRADESH
24	GUJARAT
25	DAMAN & DIU
26	DADRA & NAGAR HAVELI
27	MAHARASHTRA
28	ANDHRA PRADESH
29	KARNATAKA
30	GOA
31	LAKSHADWEEP
32	KERALA
33	TAMIL NADU
34	PUDUCHERRY
35	ANDAMAN & NICOBAR ISLANDS

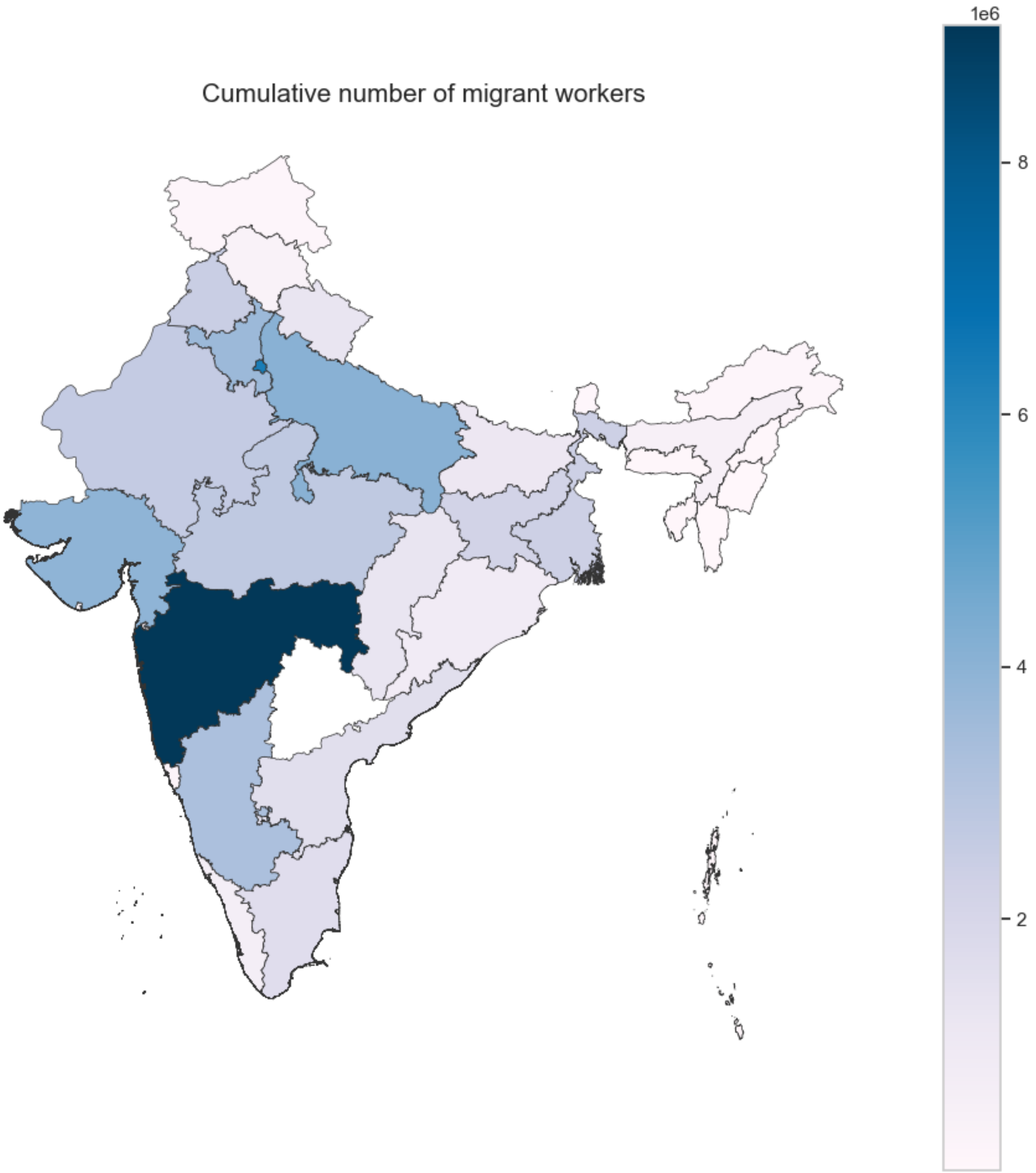
As we saw in the previous plots, Maharashtra and Delhi are the top 2 states with the highest number of migrant workers.

Surprisingly, UP is third in this list. This implies that UP does not only have the highest emigration but also has one of the highest immigration.

To further enhance the interpretation of this data, let us plot on the map of India

[ ]:

```
df6id = df2.index.to_numpy()
df6value = df2['Migrant Persons'].to_numpy()

data = {'ID': df6id,
        'Migrant persons': df6value}

df6 = pd.DataFrame(data)

df7 = pd.merge(IDs, df6, on="ID", how="left")
# print(df7)

import geopandas as gpd
# Read shapefile using Geopandas
map_df = gpd.read_file('IND_adm/IND_adm1.shp')
# Rename some states
map_df = map_df.replace({'Andaman and Nicobar':'ANDAMAN & NICOBAR ISLANDS',␣
  ↪'Andhra Pradesh':'ANDHRA PRADESH', 'Arunachal Pradesh':'ARUNACHAL PRADESH',␣
  ↪'Chhattisgarh':'CHHATTISGARH', 'Dadra and Nagar Haveli':'DADRA & NAGAR␣
  ↪HAVELI', 'Daman and Diu':'DAMAN & DIU', 'Delhi':'NCT OF DELHI', 'Jammu and␣
  ↪Kashmir':'JAMMU & KASHMIR', 'Lakshadweep':'LAKSHADWEEP', 'Madhya Pradesh':
  ↪'MADHYA PRADESH', 'Maharashtra':'MAHARASHTRA', 'Bihar':'BIHAR', 'Assam':
  ↪'ASSAM', 'Chandigarh':'CHANDIGARH','Goa':'GOA','Gujarat':'GUJARAT','Haryana':
  ↪'HARYANA','Himachal Pradesh':'HIMACHAL PRADESH','Jharkhand':
  ↪'JHARKHAND','Karnataka':'KARNATAKA','Kerala':'KERALA','Mizoram':
  ↪'MIZORAM','Nagaland':'NAGALAND','Orissa':'ODISHA','Puducherry':
  ↪'PUDUCHERRY','Punjab':'PUNJAB','Rajasthan':'RAJASTHAN','Sikkim':
  ↪'SIKKIM','Tamil Nadu':'TAMIL NADU','Telangana':'TELANGANA','Tripura':
  ↪'TRIPURA','Uttar Pradesh':'UTTAR PRADESH','Uttarakhand':'UTTARAKHAND','West␣
  ↪Bengal':'WEST BENGAL','Uttaranchal':'UTTARAKHAND','Manipur':
  ↪'MANIPUR','Meghalaya':'MEGHALAYA'})
# print(map_df)
dfMerge = pd.merge(map_df, df7, left_on='NAME_1', right_on='State', how='left')
# print(dfMerge)
fig, ax = plt.subplots(1, figsize=(12, 12))
ax.axis('off')
ax.set_title('Cumulative number of migrant workers',
             fontdict={'fontsize': '15', 'fontweight' : '3'})
fig = dfMerge.plot(column='Migrant persons', cmap='PuBu', linewidth=0.5, ax=ax,␣
  ↪edgecolor='0.2',legend=True)
```



There is no Telengana in the data. So, I have removed it from the plot.

[ ]:
```
# sort the data frame by Migrant Persons

df3 = df2.sort_values(by=['Migrant Persons'], ascending=False)
# top 10 states with highest number of migrants
df4 = df3.head(10)
# print(df4)

df5id = df4.index.to_numpy()
```

```
df5value = df4['Migrant Persons'].to_numpy()

data = {'ID': df5id,
        'Migrant persons': df5value}

df5 = pd.DataFrame(data)

print(df5)
```

```
   ID  Migrant persons
0  27          9087380
1   7          6330065
2   9          4061933
3  24          3916075
4   6          3626318
5  29          3247660
6  23          2744332
7   8          2604298
8   3          2488299
9  19          2381045
```

So, we have the id of the top ten employing states. Now, we need to find their names. For this, we will use the IDs dataframe that we created earlier.

[ ]:

```
# find index of top 10 states from IDs
IDs3 = IDs[IDs['ID'].isin(df4.index)]
# print(IDs3)

Tempid = IDs3['ID'].to_numpy()
Tempvalue = IDs3['State'].to_numpy()
Tempdata = {'ID': Tempid,
        'State': Tempvalue}

IDs4 = pd.DataFrame(Tempdata)
print(IDs4)
```

```
   ID           State
0   3          PUNJAB
1   6         HARYANA
2   7     NCT OF DELHI
3   8       RAJASTHAN
4   9   UTTAR PRADESH
5  19     WEST BENGAL
6  23  MADHYA PRADESH
7  24         GUJARAT
8  27     MAHARASHTRA
9  29       KARNATAKA
```

Of course, we need to arrange these states based on the migrant population as available in df5

[ ]:

```
IDs4 = IDs4.set_index('ID')
IDs4 = IDs4.reindex(index=df5['ID'])
IDs4 = IDs4.reset_index()
print(IDs4)
```

```
   ID           State
0  27     MAHARASHTRA
1   7    NCT OF DELHI
2   9   UTTAR PRADESH
3  24         GUJARAT
4   6         HARYANA
5  29       KARNATAKA
6  23  MADHYA PRADESH
7   8       RAJASTHAN
8   3          PUNJAB
9  19     WEST BENGAL
```

Finally we can merge the two datasets to get the top 10 employing states

[ ]:

```
pd.merge(df5, IDs4, on="ID", how="left")
```

[ ]:

```
   ID  Migrant persons           State
0  27          9087380     MAHARASHTRA
1   7          6330065    NCT OF DELHI
2   9          4061933   UTTAR PRADESH
3  24          3916075         GUJARAT
4   6          3626318         HARYANA
5  29          3247660       KARNATAKA
6  23          2744332  MADHYA PRADESH
7   8          2604298       RAJASTHAN
8   3          2488299          PUNJAB
9  19          2381045     WEST BENGAL
```

Above, we have plotted the top ten states with the highest number of migrant workers.

0.4.1 End of Question (2)

0.5 Question 3

Here, we want to look at the gender ratio of workers migrating to Maharashtra from all states over India.

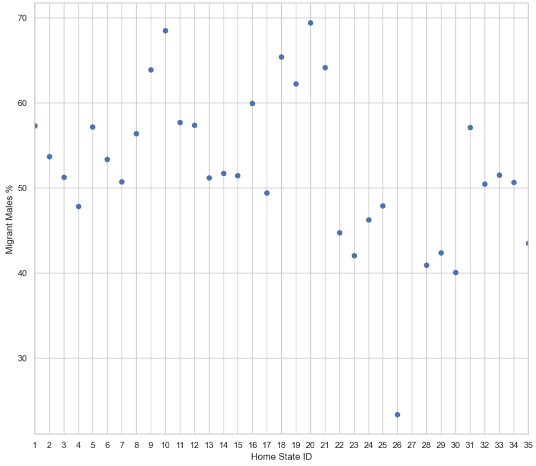
To do so, we will categorize data into dfMaharashtra

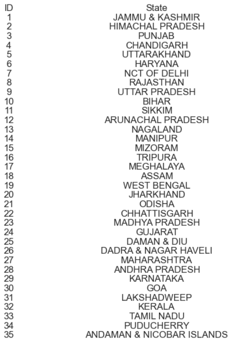
[ ]:

```
dfMaharashtra = df[df['Current State ID'] == 27]
dfMaharashtra = dfMaharashtra.rename({'Migrant Males' : 'Migrant Males %'},␣
 ↪axis=1)
```

```
dfMaharashtra['Migrant Males %'] = dfMaharashtra['Migrant Males %']/
 ↪dfMaharashtra['Migrant Persons']*100
# print(dfMaharashtra)

# plot Migrant Males % against Home State ID
fig, (ax3, ax4) = plt.subplots(1,2)
fig.set_size_inches(25, 10)
ax3.plot(dfMaharashtra['Home State ID'], dfMaharashtra['Migrant Males %'], 'o')
ax3.xaxis.grid(True, "minor", linewidth=.25)
ax3.yaxis.grid(True, "minor", linewidth=.25)
ax3.set_xlim(1, 35)
start, end = ax1.get_xlim()
ax3.xaxis.set_ticks(np.arange(1, 36, 1))
ax3.xaxis.set_major_formatter(ticker.FormatStrFormatter('%d'))
ax3.set_xlabel('Home State ID')
ax3.set_ylabel('Migrant Males %')


ax4.axis('off')
ax4.table(cellText=IDs.values, colLabels=IDs.columns, loc='center',␣
 ↪colWidths=[0.1, 0.5],cellLoc='center',edges='open')
```

```
[ ]: <matplotlib.table.Table at 0x18ba83250>
```





ID	State
1	JAMMU & KASHMIR
2	HIMACHAL PRADESH
3	PUNJAB
4	CHANDIGARH
5	UTTARAKHAND
6	HARYANA
7	NCT OF DELHI
8	RAJASTHAN
9	UTTAR PRADESH
10	BIHAR
11	SIKKIM
12	ARUNACHAL PRADESH
13	NAGALAND
14	MANIPUR
15	MIZORAM
16	TRIPURA
17	MEGHALAYA
18	ASSAM
19	WEST BENGAL
20	JHARKHAND
21	ODISHA
22	CHHATTISGARH
23	MADHYA PRADESH
24	GUJARAT
25	DAMAN & DIU
26	DADRA & NAGAR HAVELI
27	MAHARASHTRA
28	ANDHRA PRADESH
29	KARNATAKA
30	GOA
31	LAKSHADWEEP
32	KERALA
33	TAMIL NADU
34	PUDUCHERRY
35	ANDAMAN & NICOBAR ISLANDS

To further understand this data about percentage of males migrating to Maharashtra, we once again plot it on the map of india

```
[ ]: map_dfNeighbour = gpd.read_file('IND_adm/IND_adm1.shp')
     # Rename some states
```

```
map_dfNeighbour = map_dfNeighbour.replace({'Andaman and Nicobar':'ANDAMAN &␣
  ↪NICOBAR ISLANDS', 'Andhra Pradesh':'ANDHRA PRADESH', 'Arunachal Pradesh':
  ↪'ARUNACHAL PRADESH', 'Chhattisgarh':'CHHATTISGARH', 'Dadra and Nagar Haveli':
  ↪'DADRA & NAGAR HAVELI', 'Daman and Diu':'DAMAN & DIU', 'Delhi':'NCT OF␣
  ↪DELHI', 'Jammu and Kashmir':'JAMMU & KASHMIR', 'Lakshadweep':'LAKSHADWEEP',␣
  ↪'Madhya Pradesh':'MADHYA PRADESH', 'Maharashtra':'MAHARASHTRA', 'Bihar':
  ↪'BIHAR', 'Assam':'ASSAM', 'Chandigarh':'CHANDIGARH','Goa':'GOA','Gujarat':
  ↪'GUJARAT','Haryana':'HARYANA','Himachal Pradesh':'HIMACHAL␣
  ↪PRADESH','Jharkhand':'JHARKHAND','Karnataka':'KARNATAKA','Kerala':
  ↪'KERALA','Mizoram':'MIZORAM','Nagaland':'NAGALAND','Orissa':
  ↪'ODISHA','Puducherry':'PUDUCHERRY','Punjab':'PUNJAB','Rajasthan':
  ↪'RAJASTHAN','Sikkim':'SIKKIM','Tamil Nadu':'TAMIL NADU','Telangana':
  ↪'TELANGANA','Tripura':'TRIPURA','Uttar Pradesh':'UTTAR␣
  ↪PRADESH','Uttarakhand':'UTTARAKHAND','West Bengal':'WEST␣
  ↪BENGAL','Uttaranchal':'UTTARAKHAND','Manipur':'MANIPUR','Meghalaya':
  ↪'MEGHALAYA'})
# print(map_df)
dfMergeem = pd.merge(map_dfNeighbour, dfMaharashtra, left_on='NAME_1',␣
  ↪right_on='Home State Name', how='left')
print(dfMerge)
fig, ax = plt.subplots(1, figsize=(12, 12))
ax.axis('off')
ax.set_title('Percentage of Males Migrants from other states to Maharashtra',
             fontdict={'fontsize': '15', 'fontweight' : '3'})
fig = dfMergeem.plot(column='Migrant Males %', cmap='hot_r', linewidth=0.5,␣
  ↪ax=ax, edgecolor='0.2',legend=True)
```

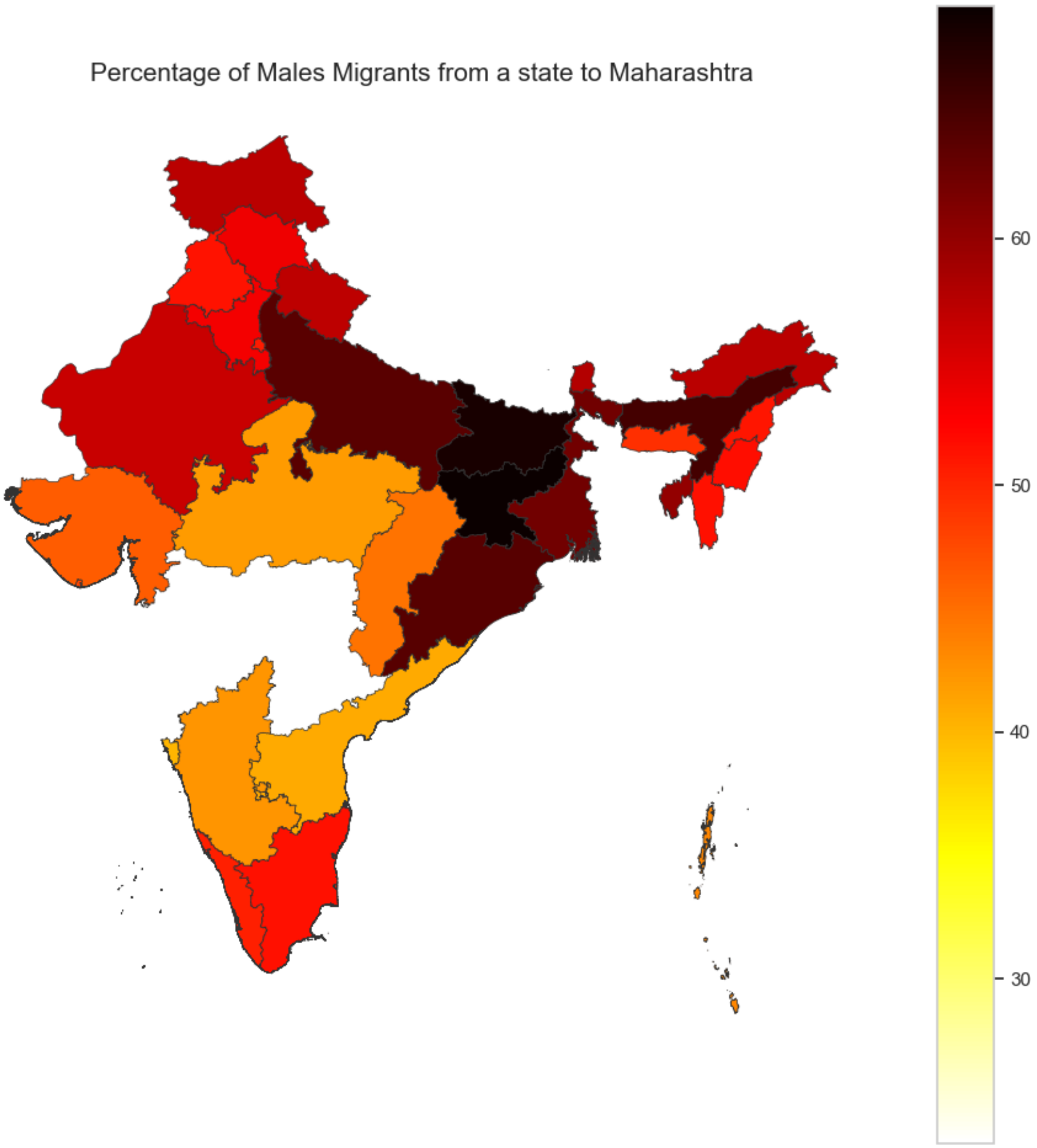
```
    ID_0  ISO NAME_0  ID_1                     NAME_1          TYPE_1  \
0    105  IND  India     1  ANDAMAN & NICOBAR ISLANDS  Union Territor
1    105  IND  India     2             ANDHRA PRADESH           State
2    105  IND  India     3          ARUNACHAL PRADESH           State
3    105  IND  India     4                      ASSAM           State
4    105  IND  India     5                      BIHAR           State
5    105  IND  India     6                 CHANDIGARH  Union Territor
6    105  IND  India     7               CHHATTISGARH           State
7    105  IND  India     8       DADRA & NAGAR HAVELI  Union Territor
8    105  IND  India     9                DAMAN & DIU  Union Territor
9    105  IND  India    10               NCT OF DELHI  Union Territor
10   105  IND  India    11                        GOA           State
11   105  IND  India    12                    GUJARAT           State
12   105  IND  India    13                    HARYANA           State
13   105  IND  India    14           HIMACHAL PRADESH  Union Territor
14   105  IND  India    15            JAMMU & KASHMIR           State
15   105  IND  India    16                  JHARKHAND           State
16   105  IND  India    17                  KARNATAKA           State
17   105  IND  India    18                     KERALA           State
18   105  IND  India    19                LAKSHADWEEP  Union Territor
```

```
19   105  IND  India    20             MADHYA PRADESH           State
20   105  IND  India    21                MAHARASHTRA           State
21   105  IND  India    22                    MANIPUR           State
22   105  IND  India    23                  MEGHALAYA           State
23   105  IND  India    24                    MIZORAM           State
24   105  IND  India    25                   NAGALAND           State
25   105  IND  India    26                     ODISHA           State
26   105  IND  India    27                 PUDUCHERRY  Union Territor
27   105  IND  India    28                     PUNJAB           State
28   105  IND  India    29                  RAJASTHAN           State
29   105  IND  India    30                     SIKKIM           State
30   105  IND  India    31                 TAMIL NADU           State
31   105  IND  India    32                  TELANGANA           State
32   105  IND  India    33                    TRIPURA           State
33   105  IND  India    34              UTTAR PRADESH           State
34   105  IND  India    35                UTTARAKHAND           State
35   105  IND  India    36                WEST BENGAL           State

          ENGTYPE_1 NL_NAME_1  \
0   Union Territory      None
1             State      None
2             State      None
3             State      None
4             State      None
5   Union Territory      None
6             State      None
7   Union Territory      None
8   Union Territory      None
9   Union Territory      None
10            State      None
11            State      None
12            State      None
13  Union Territory      None
14            State      None
15            State      None
16            State      None
17            State      None
18  Union Territory      None
19            State      None
20            State      None
21            State      None
22            State      None
23            State      None
24            State      None
25            State      None
26  Union Territory      None
27            State      None
28            State      None
```

```
29            State      None
30            State      None
31            State      None
32            State      None
33            State      None
34            State      None
35            State      None

                                        VARNAME_1  \
0   Andaman & Nicobar Islands|Andaman et Nicobar|I…
1                                                None
2   Agence de la Frontière du Nord-Est(French-obso…
3                                                None
4                                                None
5                                                None
6                                                None
7          DAdra et Nagar Haveli|Dadra e Nagar Haveli
8                                                None
9                                                None
10                                                Gôa
11                        Goudjerate|Gujerat|Gujerate
12                                               None
13                                               None
14                                               None
15                                          Vananchal
16                                      Maisur|Mysore
17                                               None
18  Íles Laquedives|Laccadive|Minicoy and Amindivi…
19                                               None
20                                               None
21                                               None
22                                               None
23                                               None
24                                               None
25                                               None
26                 Pondicherry|Puduchcheri|Pondichéry
27                                               None
28                        Greater Rajasthan|Rajputana
29                                               None
30                                    Madras|Tamilnad
31                                               None
32                                               None
33                                   United Provinces
34                                        UTTARAKHAND
35  Bangla|Bengala Occidentale|Bengala Ocidental|B…

                                         geometry    ID  \
0   MULTIPOLYGON (((93.78773 6.85264, 93.78849 6.8…  35.0
1   MULTIPOLYGON (((80.27458 13.45958, 80.27458 13…  28.0
2   POLYGON ((96.15778 29.38310, 96.16380 29.37668…  12.0
3   MULTIPOLYGON (((89.87145 25.53730, 89.87118 25…  18.0
4   MULTIPOLYGON (((88.10548 26.53904, 88.10505 26…  10.0
5   POLYGON ((76.80293 30.67548, 76.79437 30.66932…   4.0
6   POLYGON ((83.32760 24.09965, 83.34575 24.09707…  22.0
7   POLYGON ((73.02468 20.09630, 73.01955 20.10502…  26.0
8   MULTIPOLYGON (((72.86014 20.47096, 72.86340 20…  25.0
9   POLYGON ((77.32713 28.68516, 77.32539 28.68250…   7.0
10  MULTIPOLYGON (((73.78181 15.35569, 73.78181 15…  30.0
11  MULTIPOLYGON (((70.86097 20.75292, 70.86097 20…  24.0
12  POLYGON ((76.83715 30.87887, 76.85243 30.87069…   6.0
13  POLYGON ((76.80276 33.23666, 76.80630 33.23623…   2.0
14  POLYGON ((77.89957 35.42789, 77.90297 35.42759…   1.0
15  POLYGON ((87.59989 25.31466, 87.60688 25.31138…  20.0
16  MULTIPOLYGON (((74.67097 13.19986, 74.67097 13…  29.0
17  MULTIPOLYGON (((76.46736 9.54097, 76.46736 9.5…  32.0
18  MULTIPOLYGON (((73.01014 8.28042, 73.01014 8.2…  31.0
19  POLYGON ((78.36465 26.86884, 78.36688 26.86259…  23.0
20  MULTIPOLYGON (((73.45597 15.88986, 73.45597 15…  27.0
21  POLYGON ((94.57723 25.64833, 94.57609 25.64470…  14.0
22  POLYGON ((91.85384 26.10479, 91.86470 26.10035…  17.0
23  POLYGON ((92.80080 24.41905, 92.80370 24.41879…  15.0
24  POLYGON ((95.21445 26.93695, 95.21706 26.93420…  13.0
25  MULTIPOLYGON (((84.76986 19.10597, 84.76986 19…  21.0
26  MULTIPOLYGON (((79.84486 10.82653, 79.84486 10…  34.0
27  POLYGON ((75.86877 32.48868, 75.88712 32.47203…   3.0
28  POLYGON ((73.88944 29.97761, 73.89118 29.97007…   8.0
29  POLYGON ((88.64526 28.09912, 88.65411 28.08984…  11.0
30  MULTIPOLYGON (((77.55596 8.07903, 77.55596 8.0…  33.0
31  POLYGON ((78.33625 19.88319, 78.34669 19.88140…   NaN
32  POLYGON ((92.18520 24.52287, 92.18896 24.52019…  16.0
33  POLYGON ((77.58468 30.40878, 77.58639 30.40801…   9.0
34  POLYGON ((79.19478 31.35362, 79.19817 31.35196…   5.0
35  MULTIPOLYGON (((88.01861 21.57278, 88.01889 21…  19.0
```

```
                        State  Migrant persons
0   ANDAMAN & NICOBAR ISLANDS          81267.0
1              ANDHRA PRADESH        1591890.0
2           ARUNACHAL PRADESH         136010.0
3                       ASSAM         495699.0
4                       BIHAR        1111954.0
5                  CHANDIGARH         633966.0
6                CHHATTISGARH        1267668.0
7        DADRA & NAGAR HAVELI         135602.0
8                 DAMAN & DIU         124522.0
9                 NCT OF DELHI       6330065.0
10                        GOA         269689.0
```

```
11                    GUJARAT        3916075.0
12                    HARYANA        3626318.0
13           HIMACHAL PRADESH         395504.0
14            JAMMU & KASHMIR         155187.0
15                  JHARKHAND        2195521.0
16                  KARNATAKA        3247660.0
17                     KERALA         654423.0
18                LAKSHADWEEP           6077.0
19             MADHYA PRADESH        2744332.0
20                MAHARASHTRA        9087380.0
21                    MANIPUR          20100.0
22                  MEGHALAYA         107915.0
23                    MIZORAM          41380.0
24                   NAGALAND         108020.0
25                     ODISHA         855096.0
26                 PUDUCHERRY         339967.0
27                     PUNJAB        2488299.0
28                  RAJASTHAN        2604298.0
29                     SIKKIM          61163.0
30                 TAMIL NADU        1650771.0
31                        NaN              NaN
32                    TRIPURA          87378.0
33              UTTAR PRADESH        4061933.0
34                UTTARAKHAND        1250575.0
35                WEST BENGAL        2381045.0
```



We notice that Bihar and Jharkhand present one of the highest % of migrant males to Maharashtra. Clearly, the trend implies a mass gended biased migration of people from these states to Maharashtra.

0.6 End of Question 3