TestTrainCombinedData

March 26, 2023

[1]:
```
import pandas as pd, numpy as np

import warnings
warnings.filterwarnings('ignore')
pd.options.display.max_columns = None

# Load the 2016 data set into a pandas DataFrame
df2016 = pd.read_csv("/content/drive/MyDrive/CIND 820 Capstone Project/
 ↪2016_Mississauga_Business_Directory.csv")

#NAICSTitle and NAICSDescr are in the wrong columns from 2016 to 2018.  2019␣
 ↪and 2021 are correct.
#Rename NAICSTitle to NAICSDescr ; NAICSSecto to NAICSTitle
df2016.rename(columns = {'NAICSDescr':'NAICSCat', 'NAICSTitle':'NAICSDescr'},␣
 ↪inplace = True)


# Create a column to hold the year
df2016['Year'] = 2016

# Load the 2017 data set into a pandas DataFrame
df2017 = pd.read_csv("/content/drive/MyDrive/CIND 820 Capstone Project/
 ↪2017_Mississauga_Business_Directory.csv")

#NAICSTitle and NAICSDescr are in the wrong columns from 2016 to 2018.  2019␣
 ↪and 2021 are correct.
#Rename BID to BusinessID ; NAICSTitle to NAICSDescr ; NACISSecto to NAICSTitle␣
 ↪;
df2017.rename(columns = {'BID':'BusinessID','NAICSTitle':
 ↪'NAICSDescr','NAICSSecto':'NAICSCat'}, inplace = True)

# Create a column to hold the year
df2017['Year'] = 2017

#fix values on EmplRange that did not download properly in csv file from␣
 ↪publisher site. Confirmed on json file from publisher.
df2017['EmplRange'] = df2017['EmplRange'].replace('1000 puls','1000+')
```

```
# Load the 2018 data set into a pandas DataFrame
df2018 = pd.read_csv("/content/drive/MyDrive/CIND 820 Capstone Project/
 ↪2018_Mississauga_Business_Directory.csv")

#NAICSTitle and NAICSDescr are in the wrong columns from 2016 to 2018.  2019␣
 ↪and 2021 are correct.
#Rename ID1 to BusinessID ; NAICSTitle to NAICSDescr ; NAICSDescri to NAICSTitle
df2018.rename(columns = {'ID1':'BusinessID','NAICSTitle':
 ↪'NAICSDescr','NACSDescri':'NAICSCat','Street_Add':'Address','Bldg_No':
 ↪'BldgNo','Unit_No':'UnitNo','Modified_D':'EmplUpdate'}, inplace = True)

# Create a column to hold the year
df2018['Year'] = 2018
#correct the EmplRange category
df2018['EmplRange'] = df2018['EmplRange'].replace('1000 puls','1000+')

#eliminate the duplicate record for BusinessID 85606
df2018.drop(df2018[df2018['FID'] == 4602].index, inplace = True)

# Load the 2019 data set into a pandas DataFrame
df2019 = pd.read_csv("/content/drive/MyDrive/CIND 820 Capstone Project/
 ↪2019_Mississauga_Business_Directory.csv")

#Rename ID to BusinessID ; NAICSTitle to NAICS_Title
df2019.rename(columns = {'ID':'BusinessID','NAICSTitle':'NAICSCat','Modified':
 ↪'EmplUpdate'}, inplace = True)
#fix one bad NAICSCode based on what I know of the NAICS Code for this business␣
 ↪in other years
df2019['NAICSCode'] = df2019['NAICSCode'].replace(-812910, 812910)


# Create a column to hold the year
df2019['Year'] = 2019
#correct the EmplRange category
df2019['EmplRange'] = df2019['EmplRange'].replace('1000 plus','1000+')

# Load the 2021 data set into a pandas DataFrame
df2021 = pd.read_csv("/content/drive/MyDrive/CIND 820 Capstone Project/
 ↪2021_Mississauga_Business_Directory.csv")

#Rename ID to BusinessID ; NAICSTitle to NAICS_Title; X and Y to CENT_X and␣
 ↪CENT_Y
df2021.rename(columns = {'ID':'BusinessID','NAICSTitle':'NAICSCat','X':
 ↪'CENT_X','Y':'CENT_Y'}, inplace = True)
```

```
# Create a column to hold the year
df2021['Year'] = 2021
#correct the EmplRange category
df2021['EmplRange'] = df2021['EmplRange'].replace('1000 plus','1000+')
#correct records with no X Y value based on what I know about other records␣
 ↪with same CENT_X CENT_Y value
df2021.loc[df2021.CENT_X == 608544.3664, 'X'] = -79.65277411
df2021.loc[df2021.CENT_Y == 4840490.34, 'Y'] = 43.70946585

# Merge the 2016, 2017 and 2018 data sets on the common identifier BusinessID
#merged_df = pd.merge(df2016, df2017, on='BusinessID')
#merged_traindf = pd.merge(merged_df, df2018, on='BusinessID')

#Concatenate 2016, 2017, 2018, 2019 and 2021 data sets
merged_df1 = pd.concat([df2016, df2017], axis=0)
merged_df2 = pd.concat([merged_df1, df2018], axis=0)
merged_df3 = pd.concat([merged_df2, df2019], axis=0)
merged_complete_df = pd.concat([merged_df3, df2021], axis=0)

# Add a new unique identifier "RecordID" to the merged data set starting at 1
#merged_complete_df['RecordID'] = merged_complete_df.map(hash)
#merged_complete_df['RecordID'] = pd.factorize(all_data['_ID'])[0]
merged_complete_df = merged_complete_df.reset_index()
merged_complete_df = merged_complete_df.rename(columns={"index":"RecordID"})
merged_complete_df['RecordID'] = merged_complete_df.index + 1

#fix two bad NAICSCat based on what I know of THE NAICS Category and NAICS Code␣
 ↪for these two business in other years
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Accommodatio','Accommodation')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('ransportation','Transportation')
merged_complete_df['NAICSDescr'] = merged_complete_df['NAICSDescr'].
 ↪replace('813310 - Social Advocacy Organizations','Social Advocacy␣
 ↪Organizations')
#fix a record with an incorrect ward based on what I know about the same record␣
 ↪in other years
merged_complete_df['Ward'] = merged_complete_df['Ward'].replace(105,10)
#fix a record with an incorrect postal code based on the postal code the␣
 ↪business has in other years
merged_complete_df['PostalCode'] = merged_complete_df['PostalCode'].
 ↪replace("v","L5G 4P3")
merged_complete_df['PostalCode'] = merged_complete_df['PostalCode'].replace("L5␣
 ↪J1J4","L5J 1J4")
merged_complete_df['PostalCode'] = merged_complete_df['PostalCode'].replace("␣
 ↪L5T 1N8","L5T 1N8")
```

```
#How many years has the business been listed in the directory? Create a new␣
 ↪column to hold this information called 'Age' and count 1 for every year.
#merged_complete_df['Age'] = merged_complete_df.groupby('Year')['BusinessID'].
 ↪cumcount() + 1
#df.groupby((df['col'] != df['col'].shift(1)).cumsum()).cumcount()+1
merged_complete_df['Age']=merged_complete_df.groupby('BusinessID').Year.
 ↪apply(lambda x : (x!=x.shift()).cumsum())
merged_complete_df.groupby([merged_complete_df.BusinessID,merged_complete_df.
 ↪Age]).cumcount()+1


#Is the business new to the directory in a given year?  Create a column 'isnew'␣
 ↪and populate with true or false.
s1 = merged_complete_df.groupby('Year')['BusinessID'].value_counts()
s2 = s1.unstack().diff().replace({0: 'No', np.nan: 'Yes'}).stack()
merged_complete_df['isnew'] = merged_complete_df.set_index(['Year',␣
 ↪'BusinessID']).index.map(s2)

#Mark the last year a business existed in the directory by populating a column␣
 ↪to hold the Closed status
merged_complete_df['Closed'] = 'No'
not_last_rows = merged_complete_df['BusinessID'].duplicated(keep='last')
merged_complete_df.loc[~not_last_rows, 'Closed'] = 'Yes'

#Remove the closed status = yes from the 2021 records as we do not have 2022␣
 ↪data to tell us which closed
merged_complete_df.loc[merged_complete_df['Year'] == 2021, 'Closed'] = 'No'
#Remove the isnew status = yes from the 2016 records as we do not have 2015␣
 ↪data to tell us which were new in 2016
merged_complete_df.loc[merged_complete_df['Year'] == 2016, 'isnew'] = 'No'

#Missing values in the EmplRange field account for 2646 of 78032 records or 3.
 ↪39%
#Used backwards and then forwards fill na values in emplrange field as these␣
 ↪are actual values for companies
merged_complete_df['EmplRange'] = merged_complete_df.
 ↪groupby('BusinessID')['EmplRange'].ffill().bfill()

#Missing values in the NAICSCode NAICSCat field account for 145 of 78032␣
 ↪records or 0.185%
#change NAICSCode 1 to no value
merged_complete_df['NAICSCode'] = merged_complete_df['NAICSCode'].replace(1, np.
 ↪NAN)
merged_complete_df['NAICSCode'] = merged_complete_df['NAICSCode'].
 ↪replace(r'^\s*$', np.nan, regex=True)
```

```
#Used backwards and then forwards fill na values in NAICS fields as these are␣
 ↪actual values for companies
merged_complete_df['NAICSCode'] = merged_complete_df.
 ↪groupby('BusinessID')['NAICSCode'].ffill().bfill()

merged_complete_df['NAICSDescr'] = merged_complete_df['NAICSDescr'].
 ↪replace(r'^\s*$', np.nan, regex=True)
merged_complete_df['NAICSDescr'] = merged_complete_df.
 ↪groupby('BusinessID')['NAICSDescr'].ffill().bfill()

merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace(r'^\s*$', np.nan, regex=True)
merged_complete_df['NAICSCat'] = merged_complete_df.
 ↪groupby('BusinessID')['NAICSCat'].ffill().bfill()

#Used backwards and then forwards fill na values in␣
 ↪X,Y,CENT_X,CENT_Y,POSTALCODE, Location
merged_complete_df['X'] = merged_complete_df['X'].replace(r'^\s*$', np.nan,␣
 ↪regex=True)
merged_complete_df['X'] = merged_complete_df.groupby('BusinessID')['X'].ffill().
 ↪bfill()
merged_complete_df['X'] = merged_complete_df['X'].replace(np.nan, 0)

merged_complete_df['Y'] = merged_complete_df['Y'].replace(r'^\s*$', np.nan,␣
 ↪regex=True)
merged_complete_df['Y'] = merged_complete_df.groupby('BusinessID')['Y'].ffill().
 ↪bfill()
merged_complete_df['Y'] = merged_complete_df['Y'].replace(np.nan, 0)

merged_complete_df['CENT_X'] = merged_complete_df['CENT_X'].replace(r'^\s*$',␣
 ↪np.nan, regex=True)
merged_complete_df['CENT_X'] = merged_complete_df.
 ↪groupby('BusinessID')['CENT_X'].ffill().bfill()

merged_complete_df['CENT_Y'] = merged_complete_df['CENT_Y'].replace(r'^\s*$',␣
 ↪np.nan, regex=True)
merged_complete_df['CENT_Y'] = merged_complete_df.
 ↪groupby('BusinessID')['CENT_Y'].ffill().bfill()

merged_complete_df['PostalCode'] = merged_complete_df['PostalCode'].
 ↪replace(r'^\s*$', np.nan, regex=True)
merged_complete_df['PostalCode'] = merged_complete_df.
 ↪groupby('BusinessID')['PostalCode'].ffill().bfill()
```

```
#limit postal code to first 3 characters to allow for categorization that is␣
 ↪less granular
#merged_complete_df['PostalCode'] = merged_complete_df['PostalCode'].str.
 ↪slice(0,3)
merged_complete_df['PostalCode'] = merged_complete_df['PostalCode'].str[:3]

merged_complete_df['Location'] = merged_complete_df['Location'].
 ↪replace(r'^\s*$', np.nan, regex=True)
merged_complete_df['Location'] = merged_complete_df.
 ↪groupby('BusinessID')['Location'].ffill().bfill()
#replace remainging 5 records with the most tagged value
merged_complete_df['Location'] = merged_complete_df['Location'].replace(np.nan,␣
 ↪'Northeast EA (East)')

#fill the following fields TollFree, BldgNo, UnitNo, WebAddress, Email, Fax,␣
 ↪Phone with binary values
merged_complete_df['TollFree'] = merged_complete_df['TollFree'].
 ↪replace(r'^\s*$', np.nan, regex=True)
merged_complete_df['TollFree'] = merged_complete_df['TollFree'].replace(np.nan,␣
 ↪'No')
merged_complete_df['TollFree'] = np.where(merged_complete_df['TollFree'] !=␣
 ↪'No', 'Yes', merged_complete_df['TollFree'])

merged_complete_df['EMail'] = merged_complete_df['EMail'].replace(r'\S*@\S*\s?
 ↪', np.nan, regex=True)
merged_complete_df['EMail'] = merged_complete_df['EMail'].replace(np.nan, 'Yes')
merged_complete_df['EMail'] = np.where(merged_complete_df['EMail'] != 'Yes',␣
 ↪'No', merged_complete_df['EMail'])

merged_complete_df['Fax'] = merged_complete_df['Fax'].replace(r'^\s*$', np.nan,␣
 ↪regex=True)
merged_complete_df['Fax'] = merged_complete_df['Fax'].replace(np.nan, 'No')
merged_complete_df['Fax'] = np.where(merged_complete_df['Fax'] != 'No', 'Yes',␣
 ↪merged_complete_df['TollFree'])

merged_complete_df['Phone'] = merged_complete_df['Phone'].replace(r'^\s*$', np.
 ↪nan, regex=True)
merged_complete_df['Phone'] = merged_complete_df['Phone'].replace(np.nan, 'No')
merged_complete_df['Phone'] = np.where(merged_complete_df['Phone'] != 'No',␣
 ↪'Yes', merged_complete_df['TollFree'])

merged_complete_df['BldgNo'] = merged_complete_df['BldgNo'].replace(r'^\s*$',␣
 ↪np.nan, regex=True)
merged_complete_df['BldgNo'] = merged_complete_df['BldgNo'].replace(np.nan,␣
 ↪'No')
```

```
merged_complete_df['BldgNo'] = np.where(merged_complete_df['BldgNo'] != 'No',␣
 ↪'Yes', merged_complete_df['BldgNo'])

merged_complete_df['UnitNo'] = merged_complete_df['UnitNo'].replace(r'^\s*$',␣
 ↪np.nan, regex=True)
merged_complete_df['UnitNo'] = merged_complete_df['UnitNo'].replace(np.nan,␣
 ↪'No')
merged_complete_df['UnitNo'] = np.where(merged_complete_df['UnitNo'] != 'No',␣
 ↪'Yes', merged_complete_df['UnitNo'])


merged_complete_df['WebAddress'] = merged_complete_df['WebAddress'].
 ↪replace(r'^\s*$', np.nan, regex=True)
merged_complete_df['WebAddress'] = merged_complete_df['WebAddress'].replace(np.
 ↪nan, 'No')
merged_complete_df['WebAddress'] = np.where(merged_complete_df['WebAddress'] !=␣
 ↪'No', 'Yes', merged_complete_df['WebAddress'])

#limit NAICS to first 2 numbers to allow for categorization that is less␣
 ↪granular. Need to change to int so sort works
#then select the first 2 numbers and retirn to str
#merged_complete_df['NAICSCode'] = merged_complete_df['NAICSCode'].str.
 ↪slice(0,2)
merged_complete_df['NAICSCode'] = merged_complete_df['NAICSCode'].astype(int)
merged_complete_df.NAICSCode.astype(int)
merged_complete_df['NAICSCode'] = merged_complete_df.NAICSCode.astype(str).str[:
 ↪2].astype(int)
merged_complete_df['NAICSCode'] = merged_complete_df['NAICSCode'].astype(str)

#convert EmplRange to ordinal
empl_range_mapper = {'1 to 4': 1, '5 to 9': 2, '10 to 19': 3,'20 to 49': 4, '50␣
 ↪to 99': 5, '100 to 299': 6, '300 to 499': 7, '500 to 999': 8, '1000+': 9 }
merged_complete_df['EmplRange'].replace(empl_range_mapper, inplace=True)

#data['EmplRange'] = data['EmplRange'].fillna(data['EmplRange'].mean(),␣
 ↪inplace=True)
merged_complete_df['EmplRange'] = merged_complete_df['EmplRange'].
 ↪replace(r'^\s*$', np.nan, regex=True)
merged_complete_df['EmplRange'] = merged_complete_df['EmplRange'].replace(np.
 ↪NAN,1)
merged_complete_df['EmplRange'] = merged_complete_df['EmplRange'].astype(int)
merged_complete_df.EmplRange.astype(int)

#fix inconsistences in NAICSCat for 2017 records and standardize NAICSCat to␣
 ↪match Statistics Canada categories so we can compare easily to their study␣
 ↪results
```

```
#example - has both Accommodation and Accommodation and Food Services as the␣
 ↪NAICSCat for the same NAICSCode
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Accommodation','Accommodation and Food Services')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Administrative','Administrative and Support, Waste Management and␣
 ↪Remediation Services')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Administrative and Support, Waste Management and R','Administrative␣
 ↪and Support, Waste Management and Remediation Services')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Arts','Arts, Entertainment and Recreation')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Educational','Educational Services')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Finance','Finance and Insurance')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].replace('Health␣
 ↪Care','Health Care and Social Assistance')
#found one record where NAICSCode is incorrect for NAICSCat. This business␣
 ↪BusinessID89649 'IT Wizer Solutions' described itself in a different␣
 ↪category every year!
merged_complete_df['NAICSCode'] = np.where((merged_complete_df['NAICSCode'] ==␣
 ↪'54') & (merged_complete_df['NAICSCat'] == 'Information'), '51',␣
 ↪merged_complete_df['NAICSCode'])
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Information','Information and Cultural Industries')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Management','Management of Companies and Enterprises')
#found one record where NAICSCode is incorrect for NAICSCat. This business is␣
 ↪BusinessID13405 'World 17 / ProGroup'
merged_complete_df['NAICSCode'] = np.where((merged_complete_df['NAICSCode'] ==␣
 ↪'52') & (merged_complete_df['NAICSCat'] == 'Professional, Scientific and␣
 ↪Technical Services'), '54', merged_complete_df['NAICSCode'])
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Professional','Professional, Scientific and Technical Services')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].replace('Real␣
 ↪Estate','Real Estate and Rental and Leasing')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Retail','Retail Trade') # maps to 44 and 45 in NAICSCode. Only one␣
 ↪that does.
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Transportation','Transportation and Warehousing')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Transportation And Warehousing','Transportation and Warehousing')
merged_complete_df['NAICSCat'] = merged_complete_df['NAICSCat'].
 ↪replace('Wholesale','Wholesale Trade')
```

```
#found one record where StreetNo is incorrect and has part of the phone number␣
 ↪instead. This business is BusinessID17933 'Jade Xpress'
merged_complete_df['StreetNo'] = np.where((merged_complete_df['StreetNo'] ==␣
 ↪'905629') & (merged_complete_df['BusinessID'] == '17933'), '1575',␣
 ↪merged_complete_df['StreetNo'])

#drop these columns where the data is too sparse to fill reliably
merged_complete_df.
 ↪drop(['EmplUpdate','Character','CHArea','Modified','BIA_NAME','BIAFulName','Sector_Des','PI
 ↪axis=1, inplace=True)

# Save the merged data set to a new file
merged_complete_df.to_csv("/content/drive/MyDrive/CIND 820 Capstone Project/
 ↪merged_completedata.csv", index=False)

#Create closed company data frame
closed_df = merged_complete_df
#Add a year closed column and bump up one year past last year in directory
closed_df = closed_df[closed_df['Closed'] == 'Yes']
closed_df['YearClosed'] = closed_df.groupby('BusinessID').Year.transform(np.
 ↪roll, shift=-1)
#create an opened company data frame
opened_df = merged_complete_df
opened_df = opened_df[opened_df['isnew'] == 'Yes']

# Save the closed and opened data sets to new files
closed_df.to_csv("/content/drive/MyDrive/CIND 820 Capstone Project/closed_data.
 ↪csv", index=False)
opened_df.to_csv("/content/drive/MyDrive/CIND 820 Capstone Project/opened_data.
 ↪csv", index=False)

# Merge the 2019 and 2021 data sets on the common identifier BusinessID
merged_traintestdf = pd.merge(df2019, df2021, on='BusinessID')
```

[2]:
```
merged_complete_df.tail()
```

[2]:

	RecordID	X	Y	FID	BusinessID	\
78027	78028	-79.652774	0.0	14821	60142	
78028	78029	-79.652774	0.0	14822	60159	
78029	78030	-79.652774	0.0	14823	60160	
78030	78031	-79.652774	0.0	14824	60161	
78031	78032	-79.652774	0.0	14825	60162	

	Name	Address	StreetNo	StreetName	\
78027	JobsForU	2960 Drew Rd	2960	Drew Rd	

```
78028                Elite Source Solutions  2980 Drew Rd     2980    Drew Rd
78029                   Indian Sweet Master  2980 Drew Rd     2980    Drew Rd
78030  Mississauga Flooring & Supplies Inc.  2980 Drew Rd     2980    Drew Rd
78031                  Punjabi Textile Ltd.  2980 Drew Rd     2980    Drew Rd

      BldgNo UnitNo PostalCode             Location  Ward NAICSCode  \
78027     No    Yes        L4T  Northeast EA (East)     5        56
78028     No    Yes        L4T  Northeast EA (East)     5        56
78029     No    Yes        L4T  Northeast EA (East)     5        72
78030     No    Yes        L4T  Northeast EA (East)     5        41
78031     No    Yes        L4T  Northeast EA (East)     5        41

                                              NAICSCat  \
78027  Administrative and Support, Waste Management a…
78028  Administrative and Support, Waste Management a…
78029                    Accommodation and Food Services
78030                                    Wholesale Trade
78031                                    Wholesale Trade

                                          NAICSDescr Phone Fax TollFree  \
78027  Employment Placement Agencies and Executive Se…   Yes  No       No
78028  Employment Placement Agencies and Executive Se…   Yes  No       No
78029                            Full-service restaurants   Yes  No       No
78030             Floor Covering Wholesaler-Distributors   Yes  No       No
78031  Clothing and Clothing Accessories Wholesaler-D…   Yes  No       No

      EMail WebAddress  EmplRange       CENT_X        CENT_Y  Year  Age isnew  \
78027   Yes        Yes          3  608544.3664  4.840490e+06  2021    1   Yes
78028    No         No          1  608544.3664  4.840490e+06  2021    1   Yes
78029    No         No          1  608544.3664  4.840490e+06  2021    1   Yes
78030    No         No          1  608544.3664  4.840490e+06  2021    1   Yes
78031    No         No          1  608544.3664  4.840490e+06  2021    1   Yes

      Closed
78027     No
78028     No
78029     No
78030     No
78031     No
```

[ ]:
```
# Save the merged data set to a new file
#merged_traintestdf.to_csv("/content/drive/MyDrive/CIND 820 Capstone Project/
 ↪merged_traintestdata.csv", index=False)
```

[3]:
```
#use to check for null values and make decisions about columns to drop
#merged_complete_df['Location'].isnull().values.any()
#merged_complete_df['Location'].isnull().sum()
```

```
#merged_complete_df['Location'].head()

merged_complete_df.isnull().sum()
```

[3]:
```
RecordID      0
X             0
Y             0
FID           0
BusinessID    0
Name          0
Address       0
StreetNo      0
StreetName    0
BldgNo        0
UnitNo        0
PostalCode    0
Location      0
Ward          0
NAICSCode     0
NAICSCat      0
NAICSDescr    0
Phone         0
Fax           0
TollFree      0
EMail         0
WebAddress    0
EmplRange     0
CENT_X        0
CENT_Y        0
Year          0
Age           0
isnew         0
Closed        0
dtype: int64
```

[4]:
```
merged_complete_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 78032 entries, 0 to 78031
Data columns (total 29 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   RecordID    78032 non-null  int64
 1   X           78032 non-null  float64
 2   Y           78032 non-null  float64
 3   FID         78032 non-null  int64
 4   BusinessID  78032 non-null  int64
```

```
 5   Name         78032 non-null  object
 6   Address      78032 non-null  object
 7   StreetNo     78032 non-null  object
 8   StreetName   78032 non-null  object
 9   BldgNo       78032 non-null  object
 10  UnitNo       78032 non-null  object
 11  PostalCode   78032 non-null  object
 12  Location     78032 non-null  object
 13  Ward         78032 non-null  int64
 14  NAICSCode    78032 non-null  object
 15  NAICSCat     78032 non-null  object
 16  NAICSDescr   78032 non-null  object
 17  Phone        78032 non-null  object
 18  Fax          78032 non-null  object
 19  TollFree     78032 non-null  object
 20  EMail        78032 non-null  object
 21  WebAddress   78032 non-null  object
 22  EmplRange    78032 non-null  int64
 23  CENT_X       78032 non-null  float64
 24  CENT_Y       78032 non-null  float64
 25  Year         78032 non-null  int64
 26  Age          78032 non-null  int64
 27  isnew        78032 non-null  object
 28  Closed       78032 non-null  object
dtypes: float64(4), int64(7), object(18)
memory usage: 17.3+ MB
```

[5]:
```
merged_complete_df.head()
```

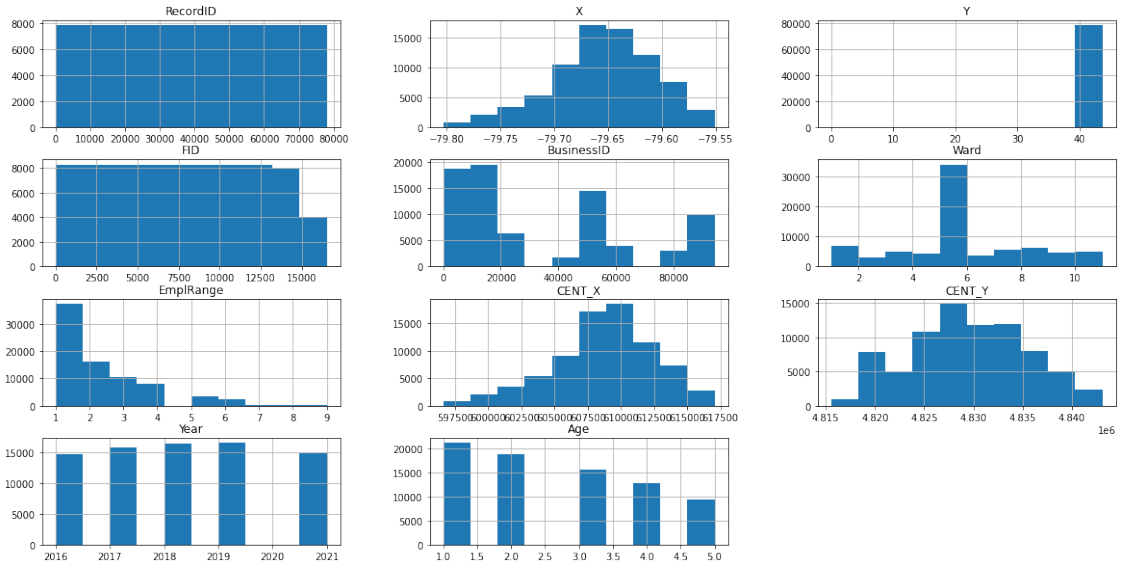
[5]:

	RecordID	X	Y	FID	BusinessID	Name	Address	StreetNo	StreetName	BldgNo	UnitNo	PostalCode	Location	Ward	NAICSCode
0	1	-79.689829	43.644181	1	1055	Golf Trends Inc.	300 Ambassador Dr	300	Ambassador Dr	No	No	L5T	Gateway EA (East)	5	41
1	2	-79.689419	43.644988	2	1057	Apex Graphics Inc.	320 Ambassador Dr	320	Ambassador Dr	No	No	L5T	Gateway EA (East)	5	32
2	3	-79.689419	43.644988	3	1058	Sands, John & Associates Limited	320 Ambassador Dr	320	Ambassador Dr	No	No	L5T	Gateway EA (East)	5	32
3	4	-79.689419	43.644988	4	1060	Printmedia-Tackaberry Times	320 Ambassador Dr	320	Ambassador Dr	No	No	L5T	Gateway EA (East)	5	32
4	5	-79.690664	43.645493	5	1061	S W R Industries Ltd.	321 Ambassador Dr	321	Ambassador Dr	No	No	L5T	Gateway EA (East)	5	32

```
3  Ambassador Dr     No     No        L5T  Gateway EA (East)     5        32
4  Ambassador Dr     No     No        L5T  Gateway EA (East)     5        41

          NAICSCat                                          NAICSDescr Phone  \
0  Wholesale Trade  Amusement and Sporting Goods Wholesaler-Distri…   Yes
1    Manufacturing                    Support Activities for Printing   Yes
2    Manufacturing                    Support Activities for Printing   Yes
3    Manufacturing                                      Other Printing   Yes
4  Wholesale Trade  Industrial Machinery, Equipment and Supplies W…   Yes

   Fax TollFree EMail WebAddress  EmplRange       CENT_X        CENT_Y  Year  \
0  Yes      Yes   Yes        Yes          3  605668.2538  4.833187e+06  2016
1  Yes       No   Yes        Yes          4  605699.9370  4.833277e+06  2016
2  Yes       No    No         No          5  605699.9370  4.833277e+06  2016
3  Yes       No   Yes        Yes          1  605699.9370  4.833277e+06  2016
4  Yes       No   Yes        Yes          2  605598.6442  4.833332e+06  2016

   Age isnew Closed
0    1    No     No
1    1    No     No
2    1    No     No
3    1    No     No
4    1    No     No
```

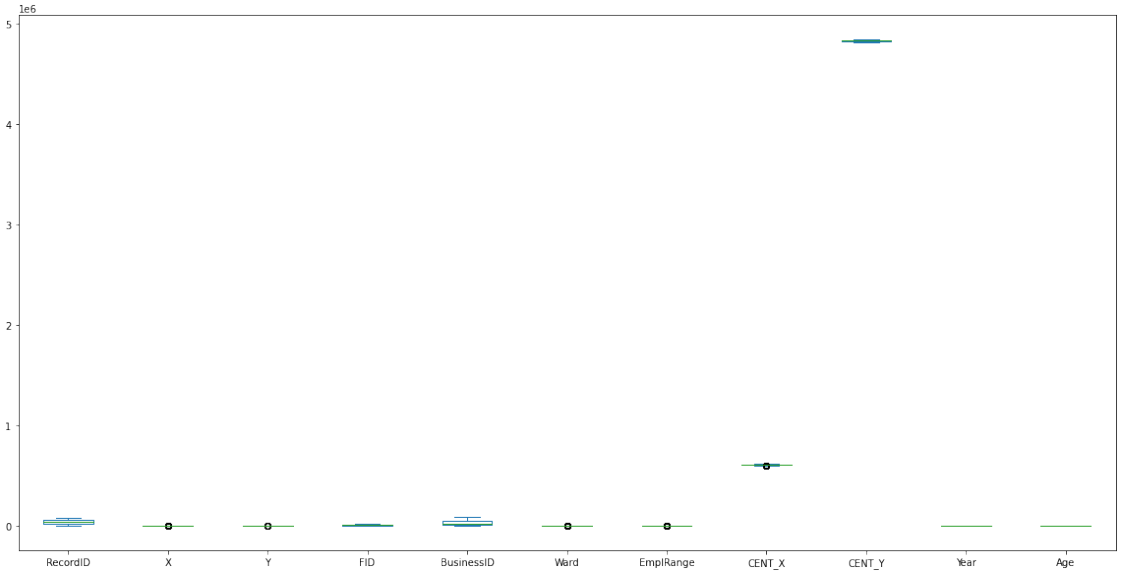
[6]:
```
#histograms of numeric attributes
merged_complete_df.hist(figsize=(20, 10))
```

[6]:
```
array([[<Axes: title={'center': 'RecordID'}>,
        <Axes: title={'center': 'X'}>, <Axes: title={'center': 'Y'}>],
       [<Axes: title={'center': 'FID'}>,
        <Axes: title={'center': 'BusinessID'}>,
        <Axes: title={'center': 'Ward'}>],
       [<Axes: title={'center': 'EmplRange'}>,
        <Axes: title={'center': 'CENT_X'}>,
        <Axes: title={'center': 'CENT_Y'}>],
       [<Axes: title={'center': 'Year'}>,
        <Axes: title={'center': 'Age'}>, <Axes: >]], dtype=object)
```



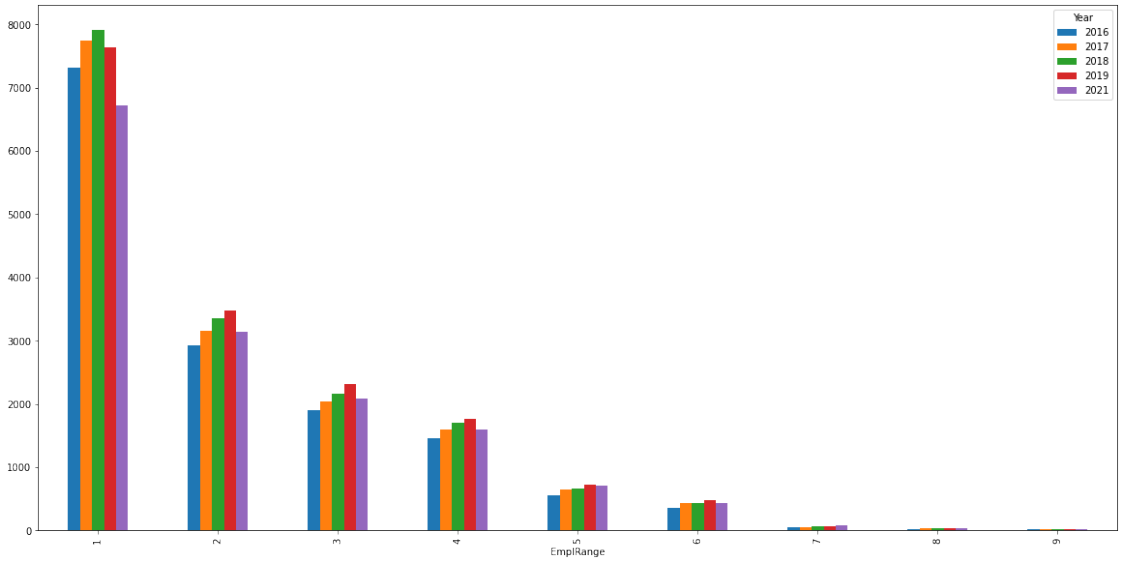
[7]:
```
#boxplots of numeric attributes
merged_complete_df.plot.box(figsize=(20, 10))
```

[7]: <Axes: >



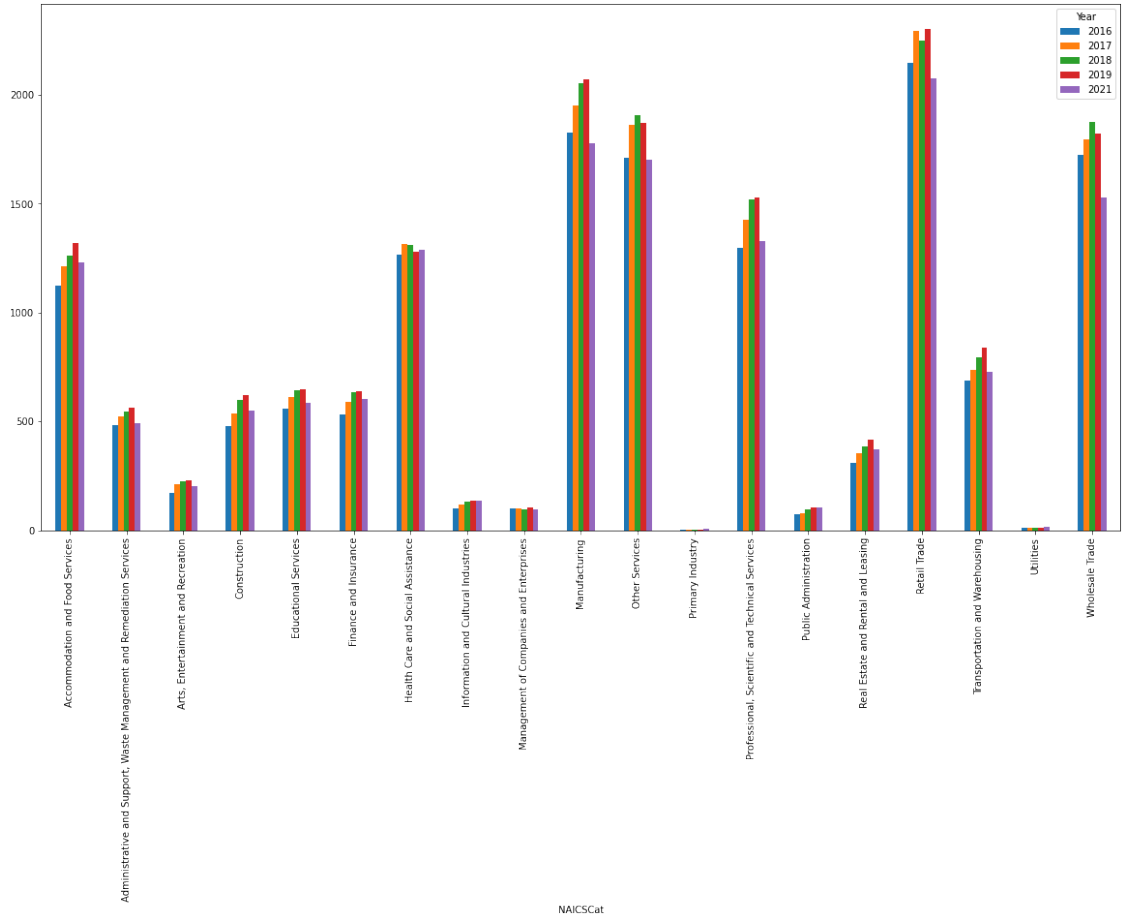
[8]:
```
#bar plots of categorical attributes by year - EmplRange
(merged_complete_df.groupby(['Year','EmplRange'])['Year']
    .count().unstack('Year').plot.bar(figsize=(20, 10)))
```

[8]: <Axes: xlabel='EmplRange'>



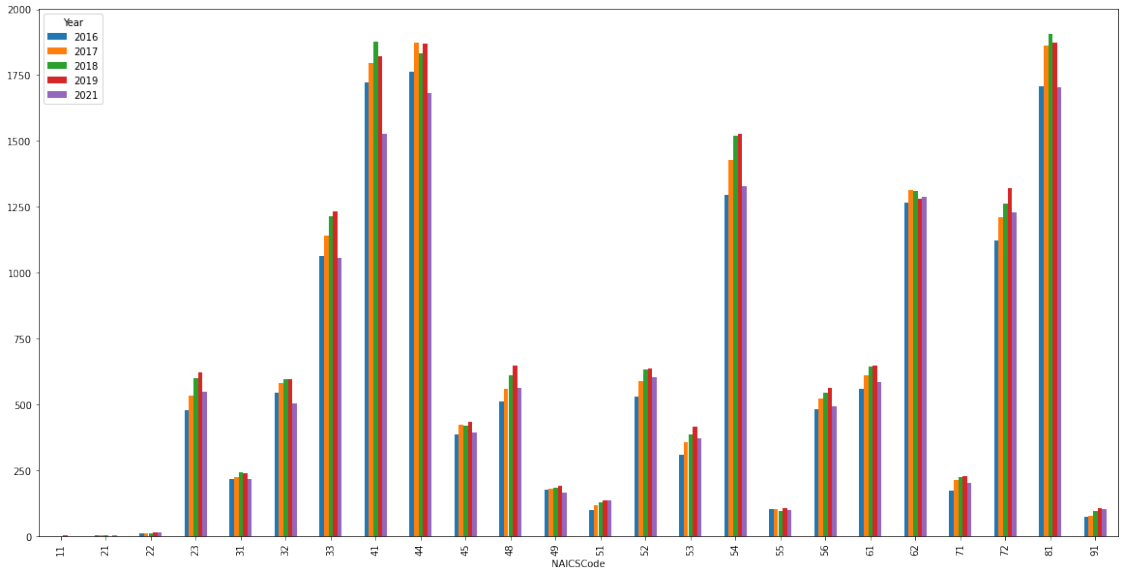
[9]:
```
#bar plots of categorical attributes by year - NAICSCat
(merged_complete_df.groupby(['Year','NAICSCat'])['Year']
    .count().unstack('Year').plot.bar(figsize=(20, 10)))
```

[9]: <Axes: xlabel='NAICSCat'>



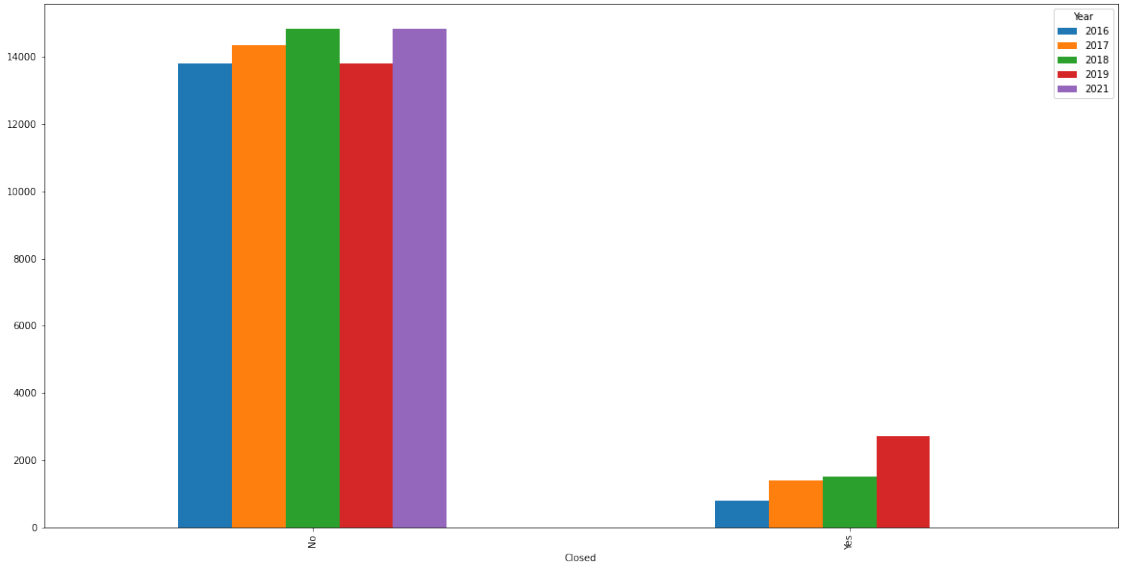
[10]:
```
#bar plots of categorical attributes by year - NAICSCode
(merged_complete_df.groupby(['Year','NAICSCode'])['Year']
    .count().unstack('Year').plot.bar(figsize=(20, 10)))
```

[10]: <Axes: xlabel='NAICSCode'>



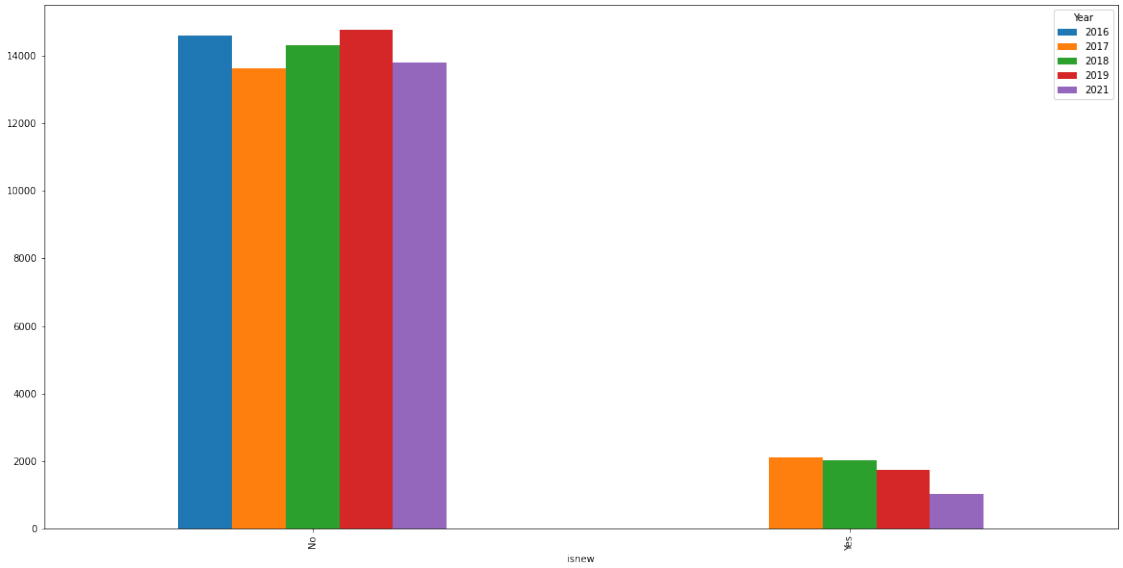
[11]:
```
#bar plots of categorical attributes by Year - Closed
(merged_complete_df.groupby(['Year','Closed'])['Year']
    .count().unstack('Year').plot.bar(figsize=(20, 10)))
```

[11]: <Axes: xlabel='Closed'>



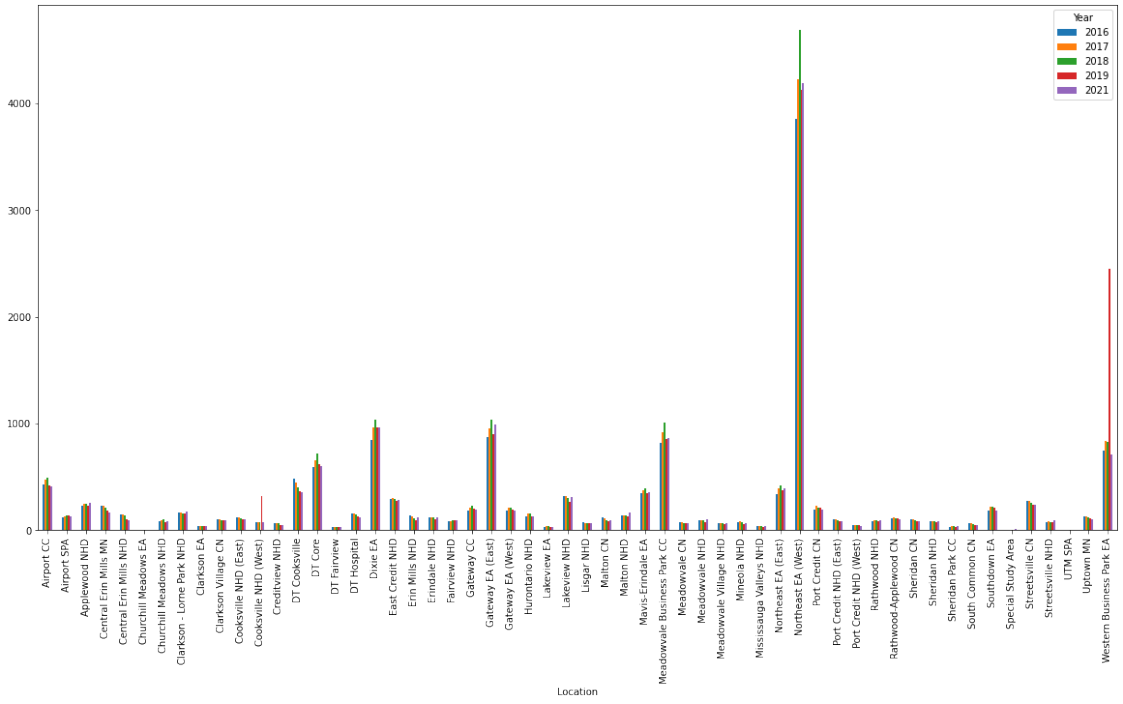
[12]:
```
#bar plots of categorical attributes by Year - isnew
(merged_complete_df.groupby(['Year','isnew'])['Year']
    .count().unstack('Year').plot.bar(figsize=(20, 10)))
```

[12]: <Axes: xlabel='isnew'>



[13]:
```
#bar plots of categorical attributes by Year - Location
(merged_complete_df.groupby(['Year','Location'])['Year']
    .count().unstack('Year').plot.bar(figsize=(20, 10)))
```

[13]: <Axes: xlabel='Location'>



[14]:
```
#bar plots of categorical attributes by Year - Age of business
(merged_complete_df.groupby(['Year','Age'])['Year']
    .count().unstack('Year').plot.bar(figsize=(20, 10)))
```

[14]: <Axes: xlabel='Age'>