```
import pandas as pd
import matplotlib.pyplot as plt
from plotnine import *
```

Data Reading / Initial Cleaning

```
start_date = '2015-01-01'
end_date = '2024-12-31'

date_range = pd.date_range(start=start_date, end=end_date, freq='M')

windows = []

for start in date_range:
    end = start + pd.DateOffset(months=5)
    if end <= pd.to_datetime(end_date):
        windows.append([start, end])

windows_df = pd.DataFrame(windows, columns=['Start', 'End'])

windows_df['Window'] = windows_df.apply(lambda row: f"[{row['Start']}, {row['End']}]", axis=1)

windows_df
```

```
<ipython-input-2-c772dbbd3d6d>:4: FutureWarning: 'M' is deprecated and will be removed in a future version, please use
          Start         End                                        Window
  0  2015-01-31  2015-06-30  [2015-01-31 00:00:00, 2015-06-30 00:00:00]
  1  2015-02-28  2015-07-28  [2015-02-28 00:00:00, 2015-07-28 00:00:00]
  2  2015-03-31  2015-08-31  [2015-03-31 00:00:00, 2015-08-31 00:00:00]
  3  2015-04-30  2015-09-30  [2015-04-30 00:00:00, 2015-09-30 00:00:00]
  4  2015-05-31  2015-10-31  [2015-05-31 00:00:00, 2015-10-31 00:00:00]
 ...        ...         ...                                           ...
110  2024-03-31  2024-08-31  [2024-03-31 00:00:00, 2024-08-31 00:00:00]
111  2024-04-30  2024-09-30  [2024-04-30 00:00:00, 2024-09-30 00:00:00]
112  2024-05-31  2024-10-31  [2024-05-31 00:00:00, 2024-10-31 00:00:00]
113  2024-06-30  2024-11-30  [2024-06-30 00:00:00, 2024-11-30 00:00:00]
114  2024-07-31  2024-12-31  [2024-07-31 00:00:00, 2024-12-31 00:00:00]
115 rows × 3 columns
```

```
BuildingPermits = pd.read_csv("/content/drive/MyDrive/Data Capstone/BuildingPermits.csv")
DemolitionPermits = pd.read_csv("/content/drive/MyDrive/Data Capstone/DemolitionPermits.csv")
CrimeIncidents = pd.read_csv("/content/drive/MyDrive/Data Capstone/CrimeIncidents.csv")
```

```
<ipython-input-3-a80e0f069692>:1: DtypeWarning: Columns (19) have mixed types. Specify dtype option on import or set lov
<ipython-input-3-a80e0f069692>:3: DtypeWarning: Columns (17) have mixed types. Specify dtype option on import or set lov
```

```
print(BuildingPermits.columns.tolist())
print(DemolitionPermits.columns.tolist())
print(CrimeIncidents.columns.tolist())
```

```
['ObjectId', 'PERMIT_ID', 'PRIMARY_ADDRESS', 'PERMIT_TYPE', 'PERMIT_SUBTYPE', 'PERMIT_CATEGORY', 'JOB_DESCRIPTION', 'USE
['ObjectId', 'PERMIT_ID', 'PERMIT_TYPE', 'PERMIT_SUBTYPE', 'PRIMARY_ADDRESS', 'PRIMARY_PARCEL', 'FILE_DATE', 'ISSUED_DAT
['OBJECTID', 'PrimaryKey', 'CaseNumber', 'District', 'UCRdesc', 'OffenseYear', 'TimeGroup', 'ReportedDate', 'OffenseMont
```

```
BuildingPermits = BuildingPermits.drop(columns=["ObjectId", "PERMIT_ID", "CONTRACTOR", "PLAN_TYPE", "PARCEL_NUMBER", "W
```

```
DemolitionPermits = DemolitionPermits.drop(columns=["ObjectId", "PERMIT_ID", "PRIMARY_PARCEL", "Contrator_Business_Name
```

```
CrimeIncidents = CrimeIncidents.drop(columns=["OBJECTID", "PrimaryKey", "CaseNumber", "District", "CENSUS_BLOCK_GROUP",
```

Crime Incidents Cleaning

```
violent_keywords = ["Assault", "Robbery", "Fel Assault", "Arson", "Weapons", "Sex Offenses", "Rape", "Offense Against F
vice_keywords = ["Drug Abuse Violations", "Liquor Laws", "Driving Under The Influence", "Prostitution", "Drunkenness",

def classify_crime(description):
    for word in violent_keywords:
        if word in description:
            return "Violent"
    for word in vice_keywords:
        if word in description:
            return "Vice"
    return "Nonviolent"

CrimeIncidents["CrimeType"] = CrimeIncidents["UCRdesc"].apply(classify_crime)
```

```
CrimeIncidents.rename(columns={'CENSUS_TRACT_GEOID': 'DW_Tract2020'}, inplace=True)
```

```
CrimeIncidents = CrimeIncidents[CrimeIncidents['OffenseYear'] >= 2015]
```

```
CrimeIncidents.head()
```

	UCRdesc	OffenseYear	OffenseMonth	OffenseDate	CENSUS_TRACT	DW_Tract2020	CrimeType	YearMonth
0	Assault	2016	1	2016-01-17 23:00:00	Census Tract 1275.01	39035127501	Violent	2016-01
1	Theft	2015	12	2015-12-31 05:01:00	Census Tract 1235.01	39035123501	Nonviolent	2015-12
2	Forgery & Counterfeiting	2015	12	2015-12-31 05:01:00	Census Tract 1235.01	39035123501	Nonviolent	2015-12
3	All Other Off	2016	1	2016-01-18	Census Tract		Nonviolent	2016-01

```
CrimeIncidents['YearMonth'] = CrimeIncidents['OffenseDate'].dt.to_period('M')
crime_summary = CrimeIncidents.groupby(['DW_Tract2020', 'YearMonth', 'CrimeType']).size().unstack(fill_value=0)
crime_summary['Total'] = crime_summary.sum(axis=1)
crime_summary = crime_summary.reset_index()

crime_summary.head(50)
```

CrimeType	DW_Tract2020	YearMonth	Nonviolent	Vice	Violent	Total
0	39035101101	2015-07	0	0	1	1
1	39035101101	2016-01	13	1	12	26
2	39035101101	2016-02	18	2	14	34
3	39035101101	2016-03	16	0	7	23
4	39035101101	2016-04	12	2	11	25
5	39035101101	2016-05	21	1	12	34
6	39035101101	2016-06	17	1	10	28
7	39035101101	2016-07	16	1	11	28
8	39035101101	2016-08	19	3	9	31
9	39035101101	2016-09	13	0	10	23
10	39035101101	2016-10	27	1	19	47
11	39035101101	2016-11	29	0	11	40
12	39035101101	2016-12	26	3	10	39
13	39035101101	2017-01	20	0	9	29
14	39035101101	2017-02	11	1	8	20
15	39035101101	2017-03	12	3	13	28
16	39035101101	2017-04	20	1	14	35
17	39035101101	2017-05	17	1	18	36
18	39035101101	2017-06	13	2	20	35
19	39035101101	2017-07	12	2	16	30
20	39035101101	2017-08	14	0	8	22
21	39035101101	2017-09	14	0	10	24
22	39035101101	2017-10	9	1	14	24
23	39035101101	2017-11	4	1	12	17
24	39035101101	2017-12	5	1	8	14
25	39035101101	2018-01	9	2	3	14
26	39035101101	2018-02	12	0	9	21
27	39035101101	2018-03	20	1	9	30
28	39035101101	2018-04	12	5	12	29
29	39035101101	2018-05	25	1	18	44
30	39035101101	2018-06	29	0	16	45
32	39035101101	2018-08	10	0	20	30
34	39035101101	2018-10	16	2	16	34
36	39035101101	2018-12	22	3	11	36
38	39035101101	2019-02	17	0	8	25
40	39035101101	2019-04	25	0	14	40

```
CrimeIncidents.head()
```

	UCRdesc	OffenseYear	OffenseMonth	OffenseDate	CENSUS_TRACT	DW_Tract2020	CrimeType
0	Assault	2016	1	2016-01-17 23:00:00	Census Tract 1275.01	39035127501	Violent
1	Theft	2015	12	2015-12-31 05:01:00	Census Tract 1235.01	39035123501	Nonviolent
2	Forgery & Counterfeiting	2015	12	2015-12-31 05:01:00	Census Tract 1235.01	39035123501	Nonviolent
3	All Other Offenses	2016	1	2016-01-18 14:55:00	Census Tract 1242.01	39035124201	Nonviolent
4	GTMV	2016	1	2016-01-18 05:30:00	Census Tract 1166	39035116600	Nonviolent

```
CrimeIncidents["6 Month Blocks"] = CrimeIncidents['OffenseYear'].astype(str) + ' Half ' + ((CrimeIncidents['OffenseMont
```

```
CrimesGrouped = CrimeIncidents.groupby(['DW_Tract2020', '6 Month Blocks']).agg(
    Total_Crimes=('CrimeType', 'size'),
    Total_Violent_Crimes=('CrimeType', lambda x: (x == 'Violent').sum()),
    Total_Vice_Crimes=('CrimeType', lambda x: (x == 'Vice').sum()),
    Total_Nonviolent_Crimes=('CrimeType', lambda x: (x == 'Nonviolent').sum())
).reset_index()
```

```
CrimesGrouped.sort_values(by='6 Month Blocks', inplace=True)
CrimesGrouped['Year'] = CrimesGrouped['6 Month Blocks'].str.split(' ').str[0].astype(int)
CrimesGrouped = CrimesGrouped[CrimesGrouped['Year'] >= 2015]
CrimesGrouped.drop(columns=['Year'], inplace=True)
CrimesGrouped.head(10)
```

```
  49      39035101101    2020-01        13        0          4         17
      DW_Tract2020  6 Month Blocks  Total_Crimes  Total_Violent_Crimes  Total_Vice_Crimes  Total_Nonviolent_Crimes
1647   39035115900      2015 Half 1             2                     1                  0                        1
 511   39035103300      2015 Half 1             1                     0                  0                        1
2829   39035121403      2015 Half 1             3                     1                  0                        2
3224   39035123800      2015 Half 1             2                     0                  0                        2
4979   39035980500      2015 Half 1             1                     0                  0                        1
  53   39035101201      2015 Half 1             1                     0                  0                        1
4905   39035199200      2015 Half 1             1                     1                  0                        0
1965   39035117300      2015 Half 1             2                     1                  0                        1
2019   39035117500      2015 Half 1             3                     1                  0                        2
 190   39035101700      2015 Half 1             1                     0                  0                        1
```

Population Data Cleaning

```
CensusPop = pd.read_csv("/content/drive/MyDrive/Data Capstone/CensusData.csv")
CensusPop = CensusPop[['Geographic Identifier - FIPS Code', 'Total Population']]
CensusPopChange = pd.read_csv("/content/drive/MyDrive/Data Capstone/Census2020.csv")
CensusPopChange = CensusPopChange[['GEOID10', 'Total Population Change']]
```

```
CensusPop.rename(columns={'Geographic Identifier - FIPS Code': 'DW_Tract2020'}, inplace=True)
CensusPopChange.rename(columns={'GEOID10': 'DW_Tract2020'}, inplace=True)
```

```
Pop = pd.merge(CensusPop, CensusPopChange, on='DW_Tract2020', how='inner')
Pop["ChangePerYear"] = Pop["Total Population Change"]/10
Pop.head()
```

```
   DW_Tract2020  Total Population  Total Population Change  ChangePerYear
0   39035101101              2072                      -97           -9.7
1   39035101102              4298                      117           11.7
2   39035101300              1652                        9            0.9
3   39035101400              1711                       16            1.6
4   39035101501              2021                      159           15.9
```

```
Pop_sorted = Pop
Pop_sorted = Pop_sorted.sort_values(by='Total Population', ascending = False)

Pop_sorted.head()
```

```
     DW_Tract2020  Total Population  Total Population Change  ChangePerYear
124   39035124100              5789                      368           36.8
 75   39035117700              5370                     -163          -16.3
 44   39035108701              4987                      156           15.6
107   39035121700              4899                     -154          -15.4
 39   39035107701              4679                     3580          358.0
```

```
time_periods = [f"{year} Half {half}" for year in range(2015, 2025) for half in [1, 2]]

new_rows = []

for tract in Pop['DW_Tract2020'].unique():
    for period in time_periods:
        new_row = {
            'DW_Tract2020': tract,
            'Total Population': 2072,
            'Total Population Change': -97,
            'ChangePerYear': -9.70,
            'Year Half': period
        }
        new_rows.append(new_row)

Pop1 = pd.DataFrame(new_rows)
Pop1.rename(columns={'Year Half': '6 Month Blocks'}, inplace=True)
```

```
Pop1.head()
```

	DW_Tract2020	Total Population	Total Population Change	ChangePerYear	6 Month Blocks
0	39035101101	2072	-97	-9.7	2015 Half 1
1	39035101101	2072	-97	-9.7	2015 Half 2
2	39035101101	2072	-97	-9.7	2016 Half 1
3	39035101101	2072	-97	-9.7	2016 Half 2
4	39035101101	2072	-97	-9.7	2017 Half 1

```
years = Pop1["6 Month Blocks"].astype(str).str[:4].astype(float)
Pop1['Year'] = years

Pop1["Population"] = Pop1.apply(
    lambda row: row["Total Population"] +
                 (row["ChangePerYear"] * abs(row["Year"] - 2020))
                 if row["Year"] != 2020 else row["Total Population"],
    axis=1
)
```

```
Population = Pop1[["DW_Tract2020", "6 Month Blocks", "Population"]]
Population.head()
```

	DW_Tract2020	6 Month Blocks	Population
0	39035101101	2015 Half 1	2023.5
1	39035101101	2015 Half 2	2023.5
2	39035101101	2016 Half 1	2033.2
3	39035101101	2016 Half 2	2033.2
4	39035101101	2017 Half 1	2042.9

```
CrimesGrouped.head()
```

	DW_Tract2020	6 Month Blocks	Total_Crimes	Total_Violent_Crimes	Total_Vice_Crimes	Total_Nonviolent_Crimes
1647	39035115900	2015 Half 1	2	1	0	1
511	39035103300	2015 Half 1	1	0	0	1
2829	39035121403	2015 Half 1	3	1	0	2
3224	39035123800	2015 Half 1	2	0	0	2
4979	39035980500	2015 Half 1	1	0	0	1

Getting Crime Statistics

```
Population['DW_Tract2020'] = Population['DW_Tract2020'].astype(str)
CrimesGrouped = pd.merge(CrimesGrouped, Population, on=['DW_Tract2020', '6 Month Blocks'], how='inner')
```

```
<ipython-input-21-afcdf5773357>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-
```

```
CrimesGrouped["Total_Crimes_Per_1000"] = (CrimesGrouped["Total_Crimes"] / CrimesGrouped["Population"]) * 1000
CrimesGrouped["Total_Violent_Crimes_Per_1000"] = (CrimesGrouped["Total_Violent_Crimes"] / CrimesGrouped["Population"])
CrimesGrouped["Total_Vice_Crimes_Per_1000"] = (CrimesGrouped["Total_Vice_Crimes"] / CrimesGrouped["Population"]) * 100(
CrimesGrouped["Total_Nonviolent_Crimes_Per_1000"] = (CrimesGrouped["Total_Nonviolent_Crimes"] / CrimesGrouped["Populat:

CrimesGrouped = CrimesGrouped.drop(columns=["Total_Crimes", "Total_Violent_Crimes", "Total_Vice_Crimes", "Total_Nonviol

CrimesGrouped.head()
```

	DW_Tract2020	6 Month Blocks	Total_Crimes_Per_1000	Total_Violent_Crimes_Per_1000	Total_Vice_Crimes_Per_1000	Total_Nonviole
0	39035115900	2015 Half 1	0.988386	0.494193	0.0	
1	39035103300	2015 Half 1	0.494193	0.000000	0.0	
2	39035121403	2015	1.482580	0.494193	0.0	

Cleaning Building Permits

```
BuildingPermits = BuildingPermits[~BuildingPermits['PERMIT_CATEGORY'].isin(['Demolitions', 'Board-ups', 'Zoning - Signs
       'Zoning - Fences', 'Zoning - Review', 'Zoning - Parking Lot License', 'Storm Water Run-off', 'Antenna'])]
```

```
def categorize_permit_use(value):
    if pd.isna(value):
        return 'Unknown'
    elif value in ["One Family", "Two Family", "R-2 Residential - Permanent Housing - Shared Egress", "R-3 Townhouse Pe
        return 'Housing'
    elif value.startswith(('A-3', 'A-4', 'A-1', 'A-5')):
        return 'Recreation'
    elif value.startswith('I-'):
        return 'Institutional Care'
    elif value.startswith('A-2'):
        return 'Food'
    elif value in ["B Business", "M Mercantile - Stores / Markets / Retail"]:
        return 'Businesses'
    elif value in ["E Educational"]:
        return 'Educational'
    elif value.startswith('S-'):
        return 'Storage'
    elif value.startswith('H-'):
        return 'Hazard'
    else:
        return 'Other'  # Catch-all for any other categories
```

```
BuildingPermits["Use"] = BuildingPermits["USE_GROUP_1"].apply(categorize_permit_use)
```

```
BuildingPermits['PERMIT_DATE'] = pd.to_datetime(BuildingPermits['ISSUE_DATE'])

BuildingPermits['6 Month Blocks'] = BuildingPermits['PERMIT_DATE'].dt.year.astype(str) + ' Half ' + ((BuildingPermits[
```

```
<ipython-input-26-4204d2d49f33>:1: UserWarning: Could not infer format, so each element will be parsed individually, fa
```

```
def categorize_permit_category(value):
      if value in ['Electrical', 'Plumbing', 'Installation','HVAC and Refrigeration']:
        return "Maintenance"
      elif value in ["New"]:
        return "New"
      elif value in ["Repair or Alteration", 'Exterior Alterations', 'Additions', 'Interior Alterations']:
        return "Alteration"
      else:
        return "Other"

BuildingPermits["Permit Category"] = BuildingPermits["PERMIT_CATEGORY"].apply(categorize_permit_category)
```

```
summary = BuildingPermits.groupby(['DW_Tract2020', '6 Month Blocks']).agg(
    Total_Permits=('Permit Category', 'size'),
    Total_Job_Value=('JOB_VALUE', 'sum'),
    New_Permits=('Permit Category', lambda x: (x == 'New').sum()),
    Maintenance_Permits=('Permit Category', lambda x: (x == 'Maintenance').sum()),
    Alteration_Permits=('Permit Category', lambda x: (x == 'Alteration').sum())
).reset_index()
```

```
use_types = ['Housing', 'Unknown', 'Businesses', 'Other', 'Institutional Care', 'Food', 'Recreation', 'Storage', 'Educa

for use_type in use_types:
    counts = BuildingPermits[(BuildingPermits['Use'] == use_type)]
    counts_summary = counts.groupby(['DW_Tract2020', '6 Month Blocks']).size().reset_index(name=f'{use_type}_Permits')
    summary = summary.merge(counts_summary, on=['DW_Tract2020', '6 Month Blocks'], how='left')

summary.fillna(0, inplace=True)
```

```
#use_types = ['Housing', 'Unknown', 'Businesses', 'Other', 'Institutional Care', 'Food', 'Recreation', 'Storage', 'Educ

#for use_type in use_types:
    #for permit_type in ['New', 'Maintenance', 'Alteration']:
        #counts = BuildingPermits[(BuildingPermits['Permit Category'] == permit_type) & (BuildingPermits['Use'] == use_
        #counts_summary = counts.groupby(['DW_Tract2020', '6 Month Blocks']).size().reset_index(name=f'{use_type}_{perm

        # Merge counts back into summary
        #summary = summary.merge(counts_summary, on=['DW_Tract2020', '6 Month Blocks'], how='left')

#summary.fillna(0, inplace=True)
```

```
#summary = summary.drop(columns=["Housing_Maintenance_Permits", "Businesses_Maintenance_Permits", "Other_Maintenance_Pe
```

```
BuildingPermitsGrouped = summary
BuildingPermitsGrouped.rename(columns={'Total_Permits': 'Total_Building_Permits'}, inplace=True)
BuildingPermitsGrouped.rename(columns={'Total_Job_Value': 'Total_Building_Job_Value'}, inplace=True)
BuildingPermitsGrouped.sort_values(by='6 Month Blocks', inplace=True)
BuildingPermitsGrouped.head()
```

	DW_Tract2020	6 Month Blocks	Total_Building_Permits	Total_Building_Job_Value	New_Permits	Maintenance_Permits	Alteratio
0	3.903510e+10	2015 Half 1	13	51402.00	5	8	
2455	3.903512e+10	2015 Half 1	96	6363880.63	52	44	
2435	3.903512e+10	2015 Half 1	40	285303.00	20	20	
400	3.903510e+10	2015 Half 1	62	558519.13	29	33	
2415	3.903512e+10	2015 Half 1	42	269320.00	25	17	

Cleaning Demolition Permits

```
DemolitionPermits.head()
```

	PERMIT_TYPE	PERMIT_SUBTYPE	PRIMARY_ADDRESS	FILE_DATE	ISSUED_DATE	CLOSED_DATE	Job_Value	DW_Tract2020
0	Building Permit	Residential	7732 Dercum Rd, Cleveland, OH, 44105	9/21/2020 12:00:00 AM	10/23/2020 3:17:29 PM	12/30/2020 12:00:00 AM	8450.0	3.903512e+10
1	Building Permit	Residential	12825 Longmead AVE, CLEVELAND, OH, 44135	10/9/2020 12:00:00 AM	10/22/2020 7:47:10 PM	11/18/2020 12:00:00 AM	8250.0	3.903512e+10
2	Building Permit	Residential	4232 E 71 ST, CLEVELAND, OH, 44105	10/9/2020 12:00:00 AM	10/22/2020 7:45:17 PM	11/6/2020 12:00:00 AM	9500.0	3.903512e+10
3	Building Permit	Residential	7804 New York Ave, Cleveland, OH, 44105	6/17/2021 12:00:00 AM	6/21/2021 6:48:52 PM	6/30/2021 12:00:00 AM	13889.0	3.903512e+10
4	Building Permit	Residential	7306 Colgate AVE, CLEVELAND, OH, 44102	10/9/2020 12:00:00 AM	10/22/2020 7:43:14 PM	11/30/2020 12:00:00 AM	12500.0	3.903510e+10

```
DemolitionPermits['PERMIT_DATE'] = pd.to_datetime(DemolitionPermits['ISSUED_DATE'])

DemolitionPermits['6 Month Blocks'] = DemolitionPermits['PERMIT_DATE'].dt.year.astype(str) + ' Half ' + ((DemolitionPe
```

```
<ipython-input-34-d8ade8901b23>:1: UserWarning: Could not infer format, so each element will be parsed individually, fa
```

```
summary = DemolitionPermits.groupby(['DW_Tract2020', '6 Month Blocks']).agg(
    Total_Permits=('PERMIT_SUBTYPE', 'size'),
    Total_Job_Value=('Job_Value', 'sum'),
    Residential_Permits=('PERMIT_SUBTYPE', lambda x: (x == 'Residential').sum()),
    Commercial_Permits=('PERMIT_SUBTYPE', lambda x: (x == 'Commercial').sum())
).reset_index()
```

```
DemolitionPermitsGrouped = summary
DemolitionPermitsGrouped.rename(columns={'Total_Permits': 'Total_Demolition_Permits'}, inplace=True)
DemolitionPermitsGrouped.rename(columns={'Total_Job_Value': 'Total_Demolition_Job_Value'}, inplace=True)
DemolitionPermitsGrouped.sort_values(by='6 Month Blocks', inplace=True)
DemolitionPermitsGrouped.head()
```

	DW_Tract2020	6 Month Blocks	Total_Demolition_Permits	Total_Demolition_Job_Value	Residential_Permits	Commercial_Permits
0	3.903510e+10	2015 Half 1	2	17916.0	2	0
232	3.903510e+10	2015 Half 1	1	16000.0	0	1
1514	3.903512e+10	2015	2	1700.0	2	0

Merging Data Frames

```
permits_merged = pd.merge(BuildingPermitsGrouped, DemolitionPermitsGrouped, on=['DW_Tract2020', '6 Month Blocks'], how=
permits_merged["DW_Tract2020"] = permits_merged["DW_Tract2020"].astype(int)
permits_merged["DW_Tract2020"] = permits_merged["DW_Tract2020"].astype(str)
```

```
permits_merged.head()
```

	DW_Tract2020	6 Month Blocks	Total_Building_Permits	Total_Building_Job_Value	New_Permits	Maintenance_Permits	Alteration_P
0	39035101101	2015 Half 1	13	51402.00	5	8	
1	39035123602	2015 Half 1	40	285303.00	20	20	
2	39035103500	2015 Half 1	62	558519.13	29	33	
3	39035123601	2015 Half 1	42	269320.00	25	17	
4	39035103602	2015 Half 1	158	5617360.50	50	108	

5 rows × 21 columns

```
df = pd.merge(permits_merged, CrimesGrouped, on=['DW_Tract2020', '6 Month Blocks'], how='inner')

df.sort_values(by=['DW_Tract2020', '6 Month Blocks'], inplace=True)
```

```
print(df.columns.to_list())
```

```
['DW_Tract2020', '6 Month Blocks', 'Total_Building_Permits', 'Total_Building_Job_Value', 'New_Permits', 'Maintenance_Pe
```

```
len(df["DW_Tract2020"].unique())

#133 Census Tracts
```

```
133
```

```
len(df)
```

```
1699
```

```
df.head()
```

	DW_Tract2020	6 Month Blocks	Total_Building_Permits	Total_Building_Job_Value	New_Permits	Maintenance_Permits	Alteration_
128	39035101101	2015 Half 2	10	69895.0	6	4	
247	39035101101	2016 Half 1	20	143098.0	9	11	
370	39035101101	2017 Half 1	38	370108.0	14	24	
844	39035101101	2019 Half 1	20	169922.0	12	8	
916	39035101101	2019 Half 2	34	236338.0	24	10	

5 rows × 25 columns

Explatory Analysis

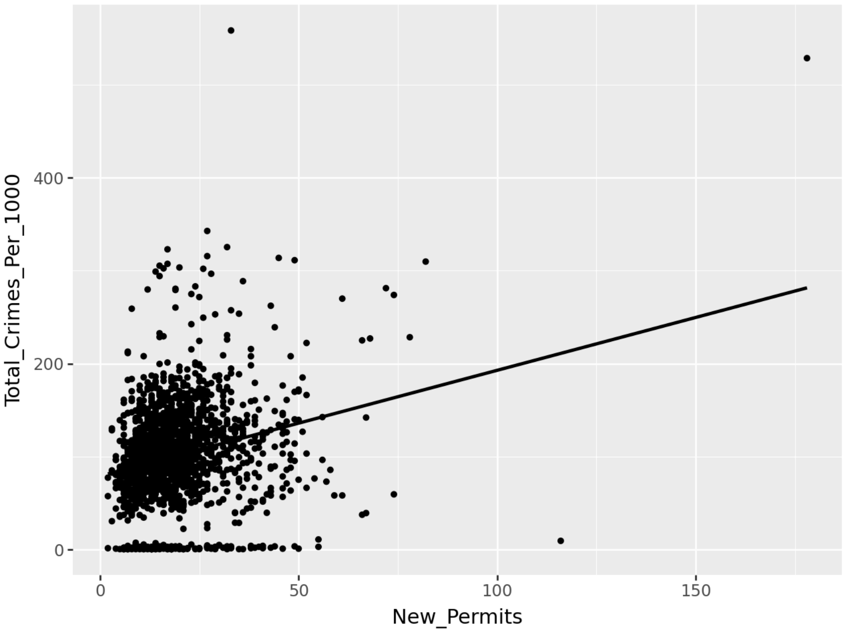
```
df.head()
```

	DW_Tract2020	6 Month Blocks	Total_Building_Permits	Total_Building_Job_Value	New_Permits	Maintenance_Permits	Alteration_
128	39035101101	2015 Half 2	10	69895.0	6	4	
247	39035101101	2016 Half 1	20	143098.0	9	11	
370	39035101101	2017 Half 1	38	370108.0	14	24	
844	39035101101	2019 Half 1	20	169922.0	12	8	
916	39035101101	2019 Half 2	34	236338.0	24	10	

5 rows × 25 columns

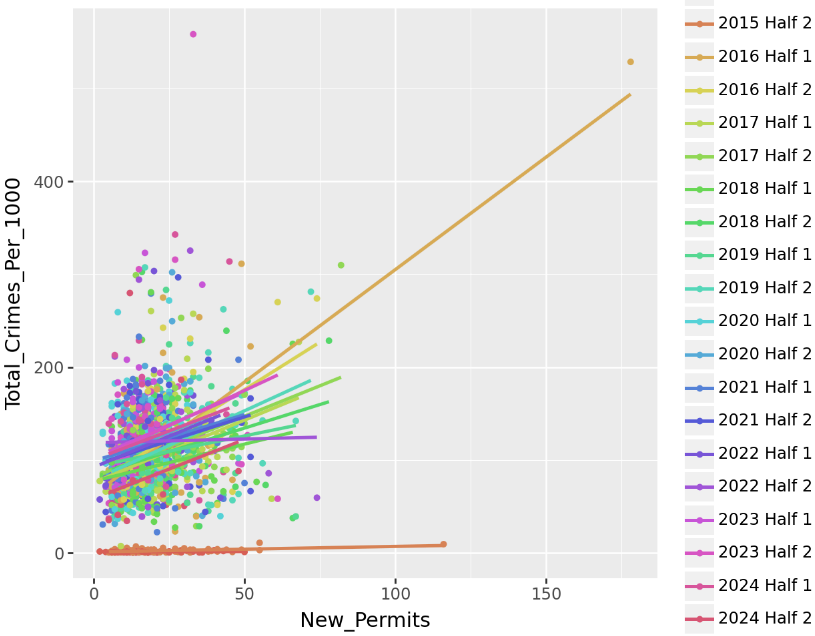
```
plot1 = (
    ggplot(df, aes(x='New_Permits', y='Total_Crimes_Per_1000')) +
    geom_point(size=1) +
    geom_smooth(method='lm', se=False)
)
print(plot1)
```

```
<ipython-input-45-4e905bc5d152>:6: FutureWarning: Using print(plot) to draw and show the plot figure is deprecated and
```



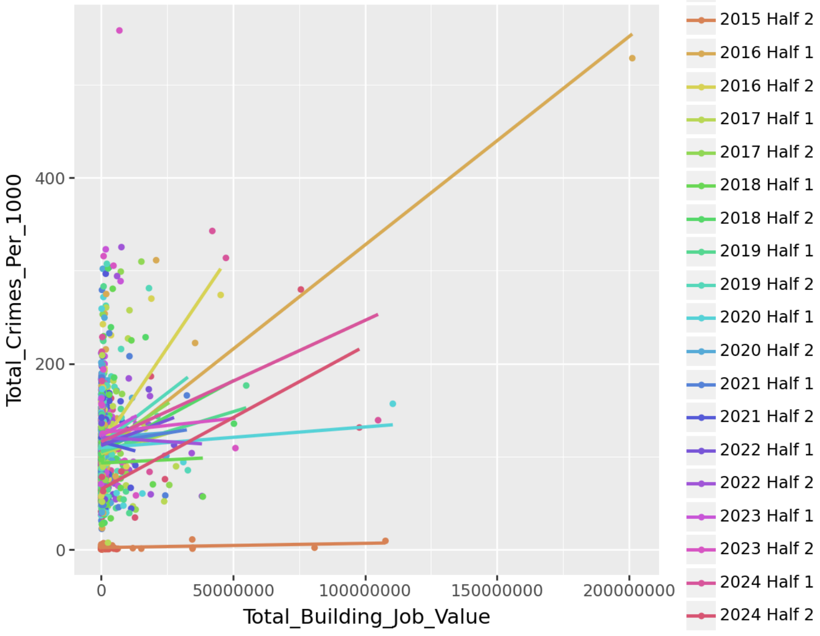
```
plot12 = (
    ggplot(df, aes(x='New_Permits', y='Total_Crimes_Per_1000', color = "6 Month Blocks")) +
    geom_point(size=1) +
    geom_smooth(aes(group='6 Month Blocks'), method='lm', se=False)
)
print(plot12)
```

```
<ipython-input-46-60673d92c3aa>:6: FutureWarning: Using print(plot) to draw and show the plot figure is deprecated and
```



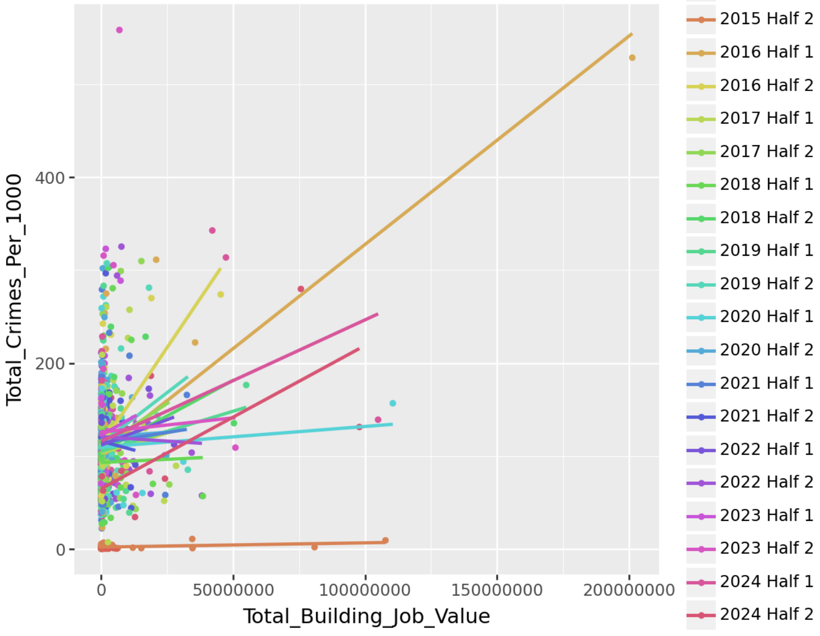
```
plot2 = (
    ggplot(df, aes(x='Total_Building_Job_Value', y='Total_Crimes_Per_1000', color = '6 Month Blocks')) +
    geom_point(size=1) +
    geom_smooth(aes(group='6 Month Blocks'), method='lm', se=False)
)
print(plot2)
```

```
<ipython-input-47-10fab14baca7>:6: FutureWarning: Using print(plot) to draw and show the plot figure is deprecated and w
```



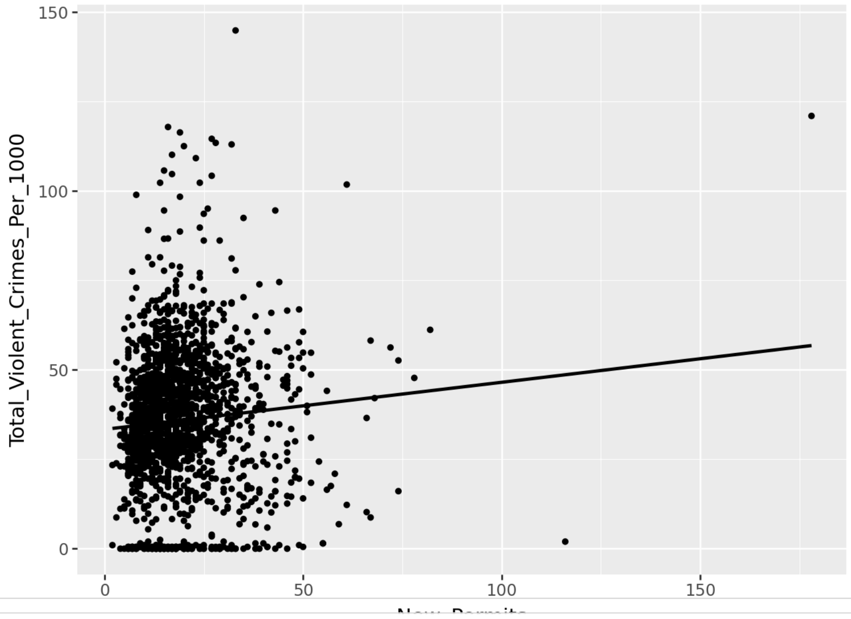
```
plot22 = (
    ggplot(df, aes(x='Total_Building_Job_Value', y='Total_Crimes_Per_1000', color = '6 Month Blocks')) +
    geom_point(size=1) +
    geom_smooth(aes(group='6 Month Blocks'), method='lm', se=False)
)
print(plot22)
```

```
<ipython-input-48-5a0ae160c0b9>:6: FutureWarning: Using print(plot) to draw and show the plot figure is deprecated and w
```



```
plot3 = (
    ggplot(df, aes(x='New_Permits', y='Total_Violent_Crimes_Per_1000')) +
    geom_point(size=1) +
    geom_smooth(method='lm', se=False)
)
print(plot3)
```

```
<ipython-input-49-30c48fd5ec96>:6: FutureWarning: Using print(plot) to draw and show the plot figure is deprecated and w
```



```
df[df["DW_Tract2020"] == "39035108701"]
```

	DW_Tract2020	6 Month Blocks	Total_Building_Permits	Total_Building_Job_Value	New_Permits	Maintenance_Permits	Alteratio
220	39035108701	2016 Half 1	67	1972146.98	23	44	
354	39035108701	2016 Half 2	140	19070239.00	61	79	
388	39035108701	2017 Half 1	249	1953109.00	19	230	
487	39035108701	2017 Half 2	341	7494517.00	14	327	
665	39035108701	2018 Half 1	290	4434721.00	19	271	
705	39035108701	2018 Half 2	107	2706098.16	16	91	
780	39035108701	2019 Half 1	49	987833.00	24	25	
948	39035108701	2019 Half 2	49	2218755.00	17	32	
987	39035108701	2020 Half 1	24	242999.00	8	16	
1209	39035108701	2021 Half 1	31	3133273.00	15	16	
1390	39035108701	2022 Half 2	40	6092854.12	15	25	
1571	39035108701	2023 Half 2	29	4736490.34	15	13	

12 rows × 25 columns

```
df.groupby('6 Month Blocks')[['Total_Building_Permits', 'Total_Crimes_Per_1000']].mean()
```

	Total_Building_Permits	Total_Crimes_Per_1000
6 Month Blocks		
2015 Half 1	39.169014	1.099754