m-crime-da-notebook

September 8, 2023

1 Montreal Crime Data Analysis

1.0.1 Step 1: Install + Import Necessary Libraries

```
[ ]: # !pip install pandas
     # !pip install numpy
     # !pip install matplotlib
     # !pip install seaborn
```

```
[1]: import os
     import pandas as pd
     import numpy as np
     import seaborn as sns
     import matplotlib.pyplot as plt
     %matplotlib inline
```

1.0.2 Step 2: Reading + Exploring Data

```
[2]: data = pd.read_csv('mtl-crime-data.csv')
```

```
[3]: data.head()
```

```
[3]:    Unnamed: 0             category        date postal_code      city  \
     0           0  Motor vehicle theft  2018-09-13     H1Z 1S9  MONTREAL
     1           1  Motor vehicle theft  2018-04-30     H1Z 1S9  MONTREAL
     2           2        Home Invasion  2018-01-10     H1Z 2V6  MONTREAL
     3           3             Mischief  2018-11-12     H1Z 2V6  MONTREAL
     4           4             Mischief  2018-08-15     H1Z 2V6  MONTREAL

       neighbourhood  year  count  longitude  latitude
     0  Saint-Michel  2018      1    -73.626    45.567
     1  Saint-Michel  2018      1    -73.626    45.567
     2  Saint-Michel  2018      1    -73.629    45.569
     3  Saint-Michel  2018      1    -73.629    45.569
     4  Saint-Michel  2018      1    -73.629    45.569
```

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 136642 entries, 0 to 136641
Data columns (total 10 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   Unnamed: 0     136642 non-null  int64
 1   category       136642 non-null  object
 2   date           136642 non-null  object
 3   postal_code    136642 non-null  object
 4   city           136642 non-null  object
 5   neighbourhood  136642 non-null  object
 6   year           136642 non-null  int64
 7   count          136642 non-null  int64
 8   longitude      136642 non-null  float64
 9   latitude       136642 non-null  float64
dtypes: float64(2), int64(3), object(5)
memory usage: 10.4+ MB
```

1.0.3 Step 3: Cleaning + Preprocessing

```
[5]: data.columns
```

```
[5]: Index(['Unnamed: 0', 'category', 'date', 'postal_code', 'city',
        'neighbourhood', 'year', 'count', 'longitude', 'latitude'],
       dtype='object')
```

Step 3.1: Removing unwanted columns We will drop the "Unnamed" column as it is just used for indexing purposes, and doesn't include any values.

```
[6]: data = data.drop('Unnamed: 0', axis=1)
```

```
[7]: data.columns
```

```
[7]: Index(['category', 'date', 'postal_code', 'city', 'neighbourhood', 'year',
        'count', 'longitude', 'latitude'],
       dtype='object')
```

```
[8]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 136642 entries, 0 to 136641
Data columns (total 9 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   category       136642 non-null  object
 1   date           136642 non-null  object
 2   postal_code    136642 non-null  object
 3   city           136642 non-null  object
 4   neighbourhood  136642 non-null  object
 5   year           136642 non-null  int64
 6   count          136642 non-null  int64
 7   longitude      136642 non-null  float64
 8   latitude       136642 non-null  float64
dtypes: float64(2), int64(2), object(5)
memory usage: 9.4+ MB
```

Step 3.2: Converting datatypes to required format "Date" column is currently in string format, and we need it to be in datetime format in order to perform analysis.

```
[9]: data['date'] = pd.to_datetime(data['date'])
```

```
[10]: pd.DataFrame(data.dtypes, columns=['Datatype']).rename_axis('Columns')
```

```
[10]:                      Datatype
      Columns
      category               object
      date           datetime64[ns]
      postal_code            object
      city                   object
      neighbourhood          object
      year                    int64
      count                   int64
      longitude             float64
      latitude              float64
```

Step 3.3: Checking for null values

```
[11]: pd.DataFrame(data.isnull().sum(), columns=['Missing Values']).
        ↪rename_axis('Feature')
```

```
[11]:                Missing Values
      Feature
      category                    0
      date                        0
      postal_code                 0
      city                        0
      neighbourhood               0
      year                        0
      count                       0
      longitude                   0
      latitude                    0
```

Dataset doesn't include null values.

1.0.4 Step 4: Data Analysis + Visualization

Question 1: Which neighbourhoods have the highest number of reported crimes?

[12]:

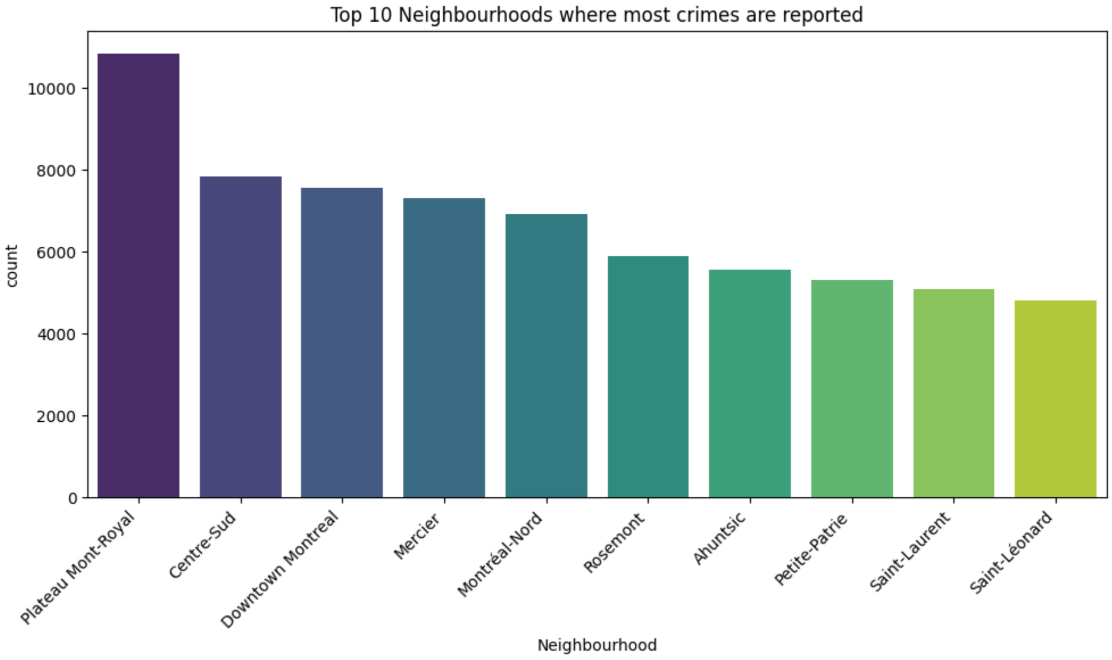
```
top_neighbourhood = pd.DataFrame(data['neighbourhood'].value_counts()).
 ↪rename({"neighbourhood":"Case Reported"}, axis = 1).
 ↪rename_axis("Neighbourhood").head(10)

top_neighbourhood.style.bar()
```

[12]:

```
<pandas.io.formats.style.Styler at 0x2029baf6150>
```

[15]:

```
top_neighbourhood = top_neighbourhood.sort_values(by='count', ascending=False).
 ↪head(10)

plt.figure(figsize=(10, 6))
sns.barplot(data=top_neighbourhood, x=top_neighbourhood.index, y='count',␣
 ↪palette='viridis')

plt.xlabel('Neighbourhood')
plt.ylabel('count')
plt.title('Top 10 Neighbourhoods where most crimes are reported')

# Rotating x-axis labels for better visibility
plt.xticks(rotation=45, ha='right')

# Display the plot
plt.tight_layout()
plt.show()
```



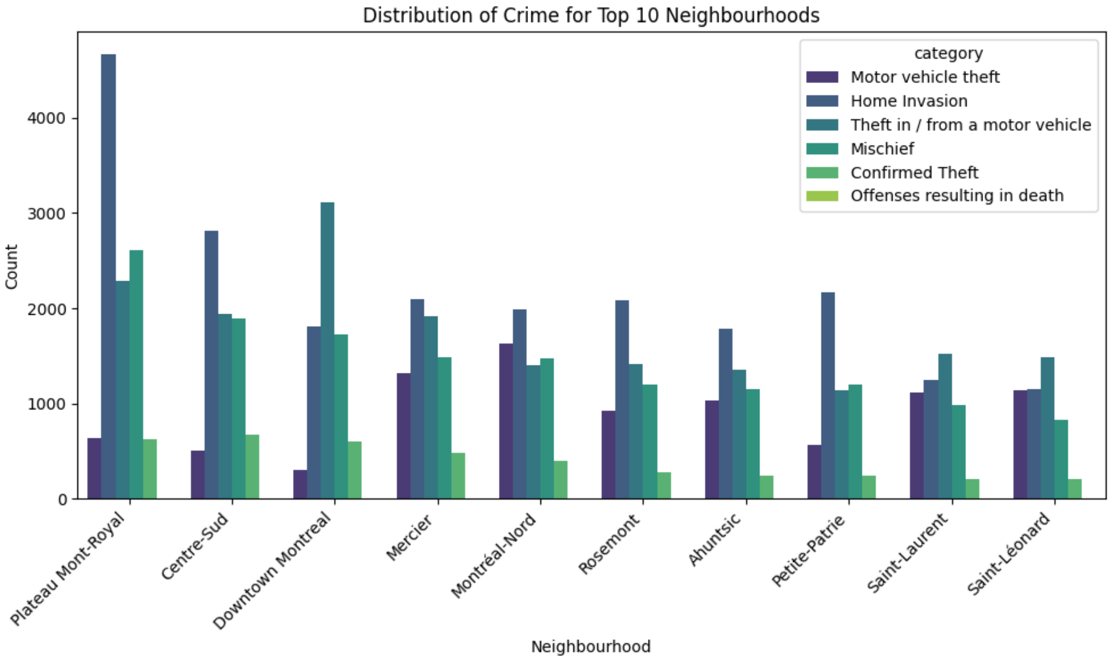
Analysis shows that the neighbourhoods with the highest number of reported crimes in Montreal between 2015 - 2021 are:

1. Plateau Mont-Royal (total of 10844 reported crimes)
2. Centre-Sud (total of 7849 reported crimes)
3. Downtown Montreal (total of 7565 reported crimes)
4. Mercier (total of 7302 reported crimes)
5. Montréal-Nord (total of 6913 reported crimes)
6. Rosemont (total of 5907 reported crimes)
7. Ahuntsic (total of 5575 reported crimes)
8. Petite-Patrie (total of 5327 reported crimes)
9. Saint-Laurent (total of 5094 reported crimes)
10. Saint-Léonard (total of 4822 reported crimes)

Question 2: What are the most frequent crimes by neighbourhood?

[16]:

```
# Calculate the top 10 neighbourhoods with highest crime rate
top_neighbourhoods = data['neighbourhood'].value_counts().head(10).index

# Filter the data to include only the top 10 neighbourhoods
data_top_neighbourhoods = data[data['neighbourhood'].isin(top_neighbourhoods)]

# Get the order of neighborhoods by crime count in descending order
neighbourhood_order = data_top_neighbourhoods.
 ↪groupby('neighbourhood')['category'].count().sort_values(ascending=False).
 ↪index

# Create a count plot using Seaborn
plt.figure(figsize=(10, 6))
sns.countplot(data=data_top_neighbourhoods, x='neighbourhood', hue='category',␣
 ↪palette='viridis', order=neighbourhood_order)

# Adding labels and title
plt.xlabel('Neighbourhood')
plt.ylabel('Count')
plt.title('Distribution of Crime for Top 10 Neighbourhoods')

# Slightly rotate the x-axis labels for readability
plt.xticks(rotation=45, ha='right')

# Display the plot
plt.tight_layout()
plt.show()
```



Home Invasions are the most reported type of crime in all neighbourhoods, except in **Downtown, Saint-Laurent, and Saint Léonard;** where **Theft In/From a Vehicle** has a higher rate.

Question 3: Number of reported crimes committed annualy in Montreal

[17]:
```
pd.DataFrame(data['year'].value_counts()).rename({"year":"Case Reported"}, axis␣
 ↪= 1).rename_axis("Year")
```

[17]:
```
      count
Year
2015  24222
2016  23407
2017  22611
2018  19419
2019  18650
2020  17786
2021  10547
```

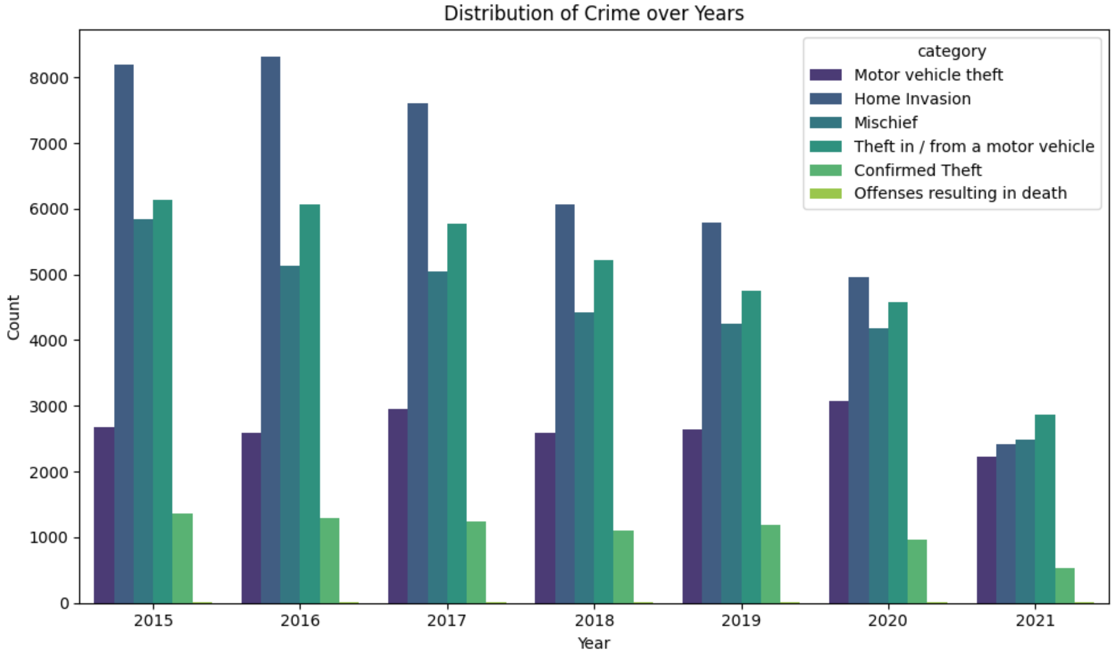
By default, the value_counts() method sorts values in descending order, so we can see that **2015 had the highest number of reported crimes (24,222 counts), while 2021 had the lowest number of reported crimes (10547).**

Question 4: What are the general trends in the reported crimes between 2015-2021

- What are the trends in the categories of reported crimes?
- Did crime rates increase or decrease?

1. What are the trends in the categories of reported crimes?

```
[18]: plt.figure(figsize=(10, 6))
      sns.countplot(data=data, x='year', hue='category', palette='viridis')

      # Adding labels and title
      plt.xlabel('Year')
      plt.ylabel('Count')
      plt.title('Distribution of Crime over Years')

      # Display the plot
      plt.tight_layout()
      plt.show()
```



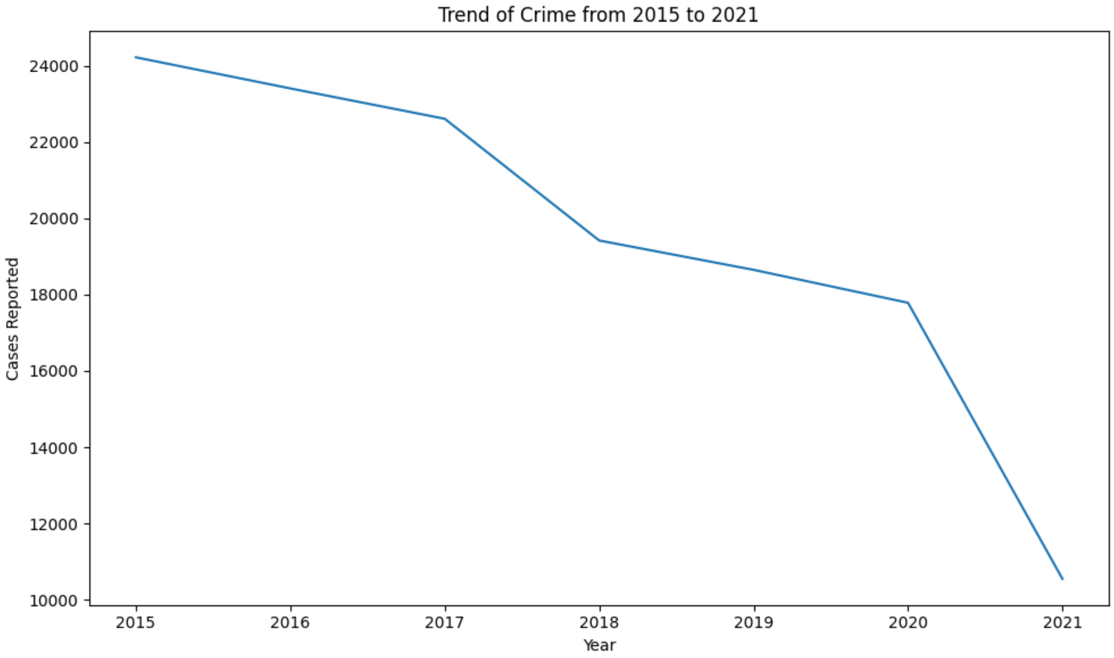
Home Invasions are the most reported crime from 2015-2020. In 2021 **Confirmed Theft** was the most reported crime.

Theft In/From a Motor Vehicle is the second most reported crime in Montreal from 20215-2021, followed by **Mischief**.

2. Did crime rates increase or decrease?

```
[19]: # Calculate the year-wise trend of crime rates
      year_wise_trend = data.groupby('year').sum(numeric_only=True).
        ↪drop(['longitude', 'latitude'], axis=1).rename({'count': 'Case Reported'},␣
        ↪axis=1)

      # Create a line plot using Seaborn
      plt.figure(figsize=(10, 6))
```

```
sns.lineplot(data=year_wise_trend, x=year_wise_trend.index, y='Case Reported')

# Adding labels and title
plt.xlabel('Year')
plt.ylabel('Cases Reported')
plt.title('Trend of Crime from 2015 to 2021')

# Display the plot
plt.tight_layout()
plt.show()
```



We can see that crime reports **decreased** from 2015-2021.

Question 5: On what days and months are a higher number of crimes reported?

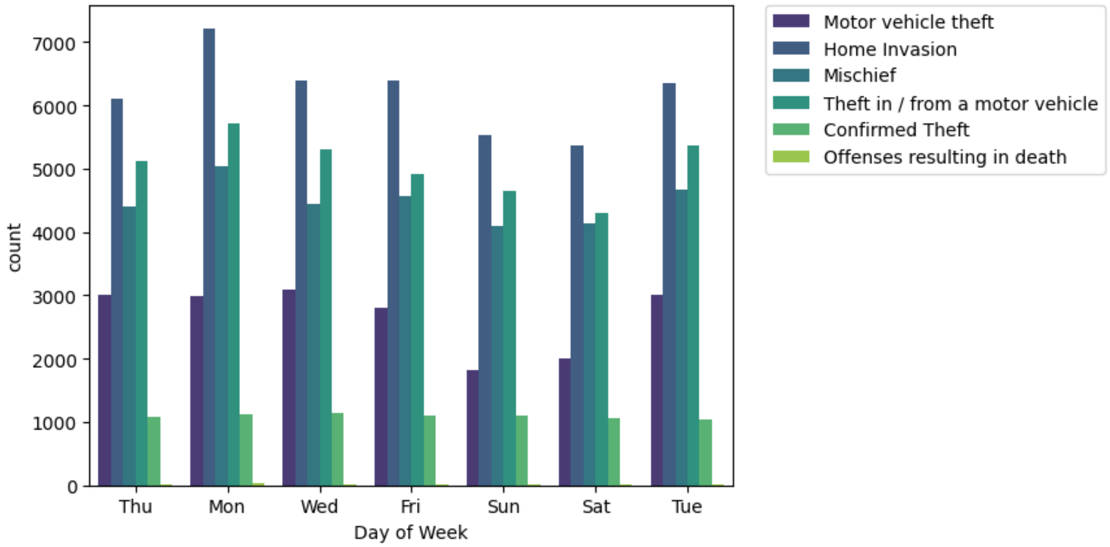
Let's explore the types of crime committed depending on the day of the week.

[20]:
```
data['Month'] = data['date'].apply(lambda time: time.month)
data['Day of Week'] = data['date'].apply(lambda time: time.dayofweek)
```

[21]:
```
dmap = {0:'Mon',1:'Tue',2:'Wed',3:'Thu',4:'Fri',5:'Sat',6:'Sun'}
data['Day of Week'] = data['Day of Week'].map(dmap)
```

[22]:
```
sns.countplot(x='Day of Week',data=data,hue='category',palette='viridis')
plt.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
```

[22]:
```
<matplotlib.legend.Legend at 0x20291df9250>
```



We can see that **Monday** has the highest rate of *Home Invasions*.

Saturday and **Sunday** have the lowest number of *Motor Vehicle Thefts*.

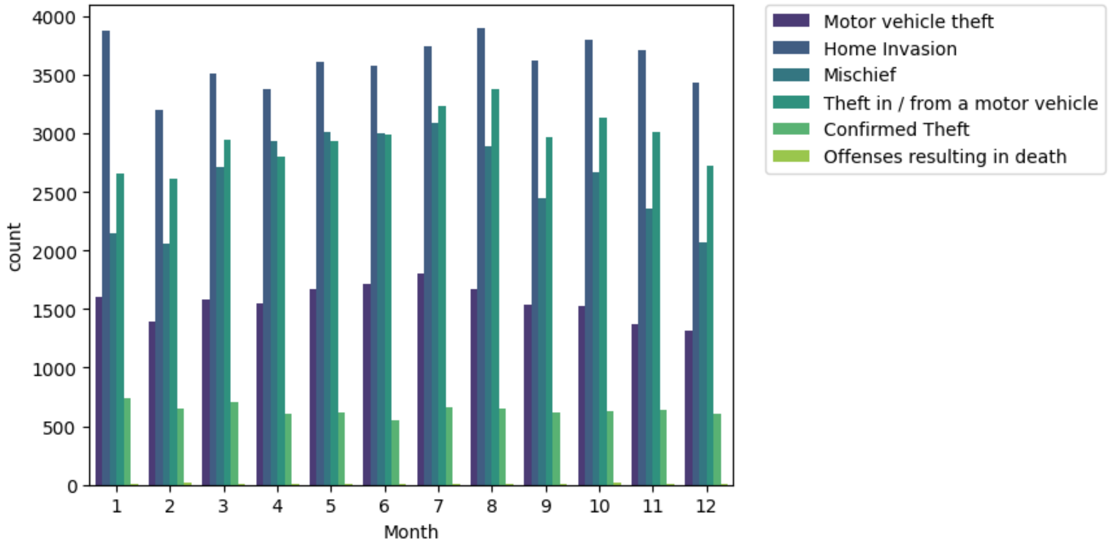
Let's explore the types of crime committed depending on the month of the year.

[23]:

```python
sns.countplot(x='Month', data=data, hue='category', palette='viridis')
plt.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
```

[23]:

```
<matplotlib.legend.Legend at 0x202a3931d90>
```



January and **August** have the highest numbers of *Home Invasions*.

July and **August** have the highest numbers of *Confirmed Thefts*.

Let's explore the overall correlation between the time of year and the reported number of crimes between 2015-2021.

Which days/months have the highest number of total reported crimes?

```
[24]: data.head()
```

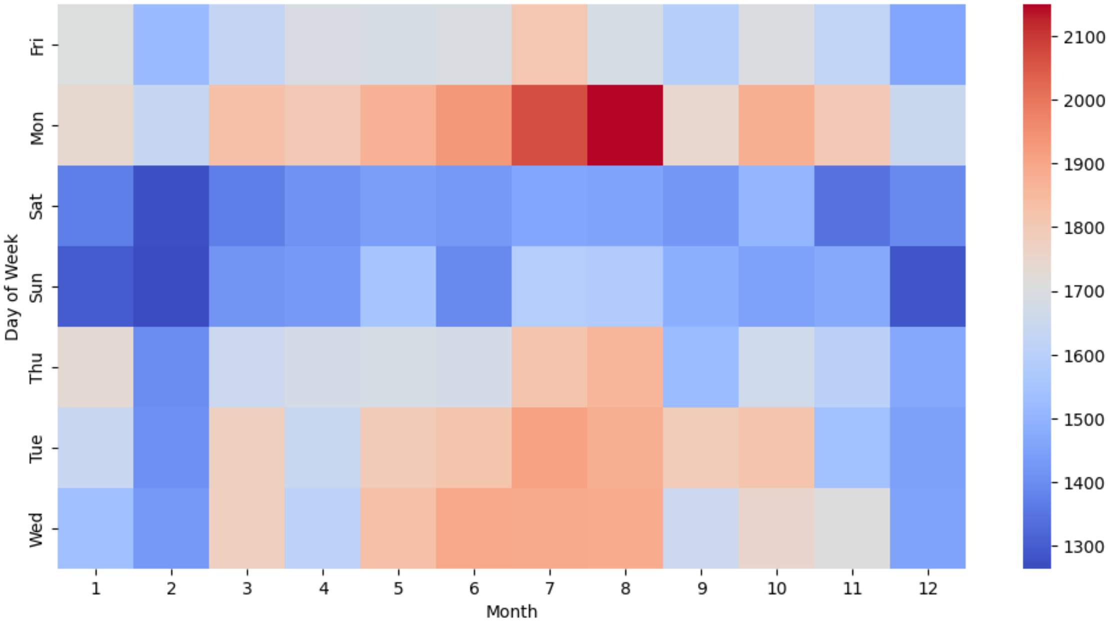
```
[24]:              category        date postal_code      city neighbourhood  year  \
0  Motor vehicle theft 2018-09-13     H1Z 1S9  MONTREAL  Saint-Michel  2018
1  Motor vehicle theft 2018-04-30     H1Z 1S9  MONTREAL  Saint-Michel  2018
2        Home Invasion 2018-01-10     H1Z 2V6  MONTREAL  Saint-Michel  2018
3             Mischief 2018-11-12     H1Z 2V6  MONTREAL  Saint-Michel  2018
4             Mischief 2018-08-15     H1Z 2V6  MONTREAL  Saint-Michel  2018

   count  longitude  latitude  Month Day of Week
0      1    -73.626    45.567      9         Thu
1      1    -73.626    45.567      4         Mon
2      1    -73.629    45.569      1         Wed
3      1    -73.629    45.569     11         Mon
4      1    -73.629    45.569      8         Wed
```

```
[25]: #correlation between days/months

dayMonth = data.groupby(by=['Day of Week', 'Month']).count()['category'].
  ↪unstack()
dayMonth.head()
```

```
[25]: Month          1     2     3     4     5     6     7     8     9     10    11  \
Day of Week
Fri          1706  1519  1630  1692  1685  1694  1809  1685  1590  1698  1624
Mon          1742  1636  1830  1803  1872  1931  2068  2150  1743  1879  1802
Sat          1372  1275  1371  1417  1443  1428  1459  1456  1425  1506  1345
Sun          1299  1265  1420  1428  1550  1394  1587  1578  1487  1450  1470
Thu          1734  1403  1652  1679  1685  1674  1818  1861  1521  1666  1607

Month          12
Day of Week
Fri          1460
Mon          1647
Sat          1394
Sun          1285
Thu          1466
```

```
[26]: plt.figure(figsize=(12,6))
sns.heatmap(dayMonth,cmap='coolwarm')
```

```
[26]: <Axes: xlabel='Month', ylabel='Day of Week'>
```



Overall, **Monday** has the *highest* number of reported crimes in the period between 2015-2021, followed by **Tuesday** and **Wednesday**.

We can also see that **June, July** and **August** have *higher* numbers of reported crimes.

2015 - 2021 Crime Data Analysis Final Results

- Neighborhood Insights:
  - Plateau
  - Centre-Sud
  - Downtown

- Crime Trends:
  - Mondays have the highest number of reported crimes, followed by Tuesday and Wednesday.
  - August is the month with the most number of reported crimes, followed by July and June.
  - Home invasions are the most reported crime, followed by theft in/from a motor vehicle and mischief.

- Yearly Statistics:
  - 2015 had the highest crime rate (24,222 cases), and 2021 the lowest (10,547 cases).
  - Overall, crime reports decreased every year from 2015 to 2021.