# Montreal Crime Data Analysis

## Step 1: Install + Import Necessary Libraries

In [ ]:

```
# !pip install pandas
# !pip install numpy
# !pip install matplotlib
# !pip install seaborn
```

In [1]:

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

## Step 2: Reading + Exploring Data

In [2]:

```
data = pd.read_csv('mtl-crime-data.csv')
```

In [3]:

```
data.head()
```

Out[3]:

| | Unnamed: 0 | category | date | postal_code | city | neighbourhood | year | count | longitude | latitude |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | Motor vehicle theft | 2018-09-13 | H1Z 1S9 | MONTREAL | Saint-Michel | 2018 | 1 | -73.626 | 45.567 |
| 1 | 1 | Motor vehicle theft | 2018-04-30 | H1Z 1S9 | MONTREAL | Saint-Michel | 2018 | 1 | -73.626 | 45.567 |
| 2 | 2 | Home Invasion | 2018-01-10 | H1Z 2V6 | MONTREAL | Saint-Michel | 2018 | 1 | -73.629 | 45.569 |
| 3 | 3 | Mischief | 2018-11-12 | H1Z 2V6 | MONTREAL | Saint-Michel | 2018 | 1 | -73.629 | 45.569 |
| 4 | 4 | Mischief | 2018-08-15 | H1Z 2V6 | MONTREAL | Saint-Michel | 2018 | 1 | -73.629 | 45.569 |

In [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
```

## Step 3: Cleaning + Preprocessing

In [5]:

```
data.columns
```

Out[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.**

In [6]:

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

In [7]:

```
data.columns
```

Out[7]:

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

In [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.**

In [9]:

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

In [10]:

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

Out[10]:

| Columns | Datatype |
|---|---|

| Columns | 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

In [11]:

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

Out[11]:

| Feature | Missing Values |
|---|---|
| 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.**

## Step 4: Data Analysis + Visualization

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

In [12]:

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

top_neighbourhood.style.bar()
```

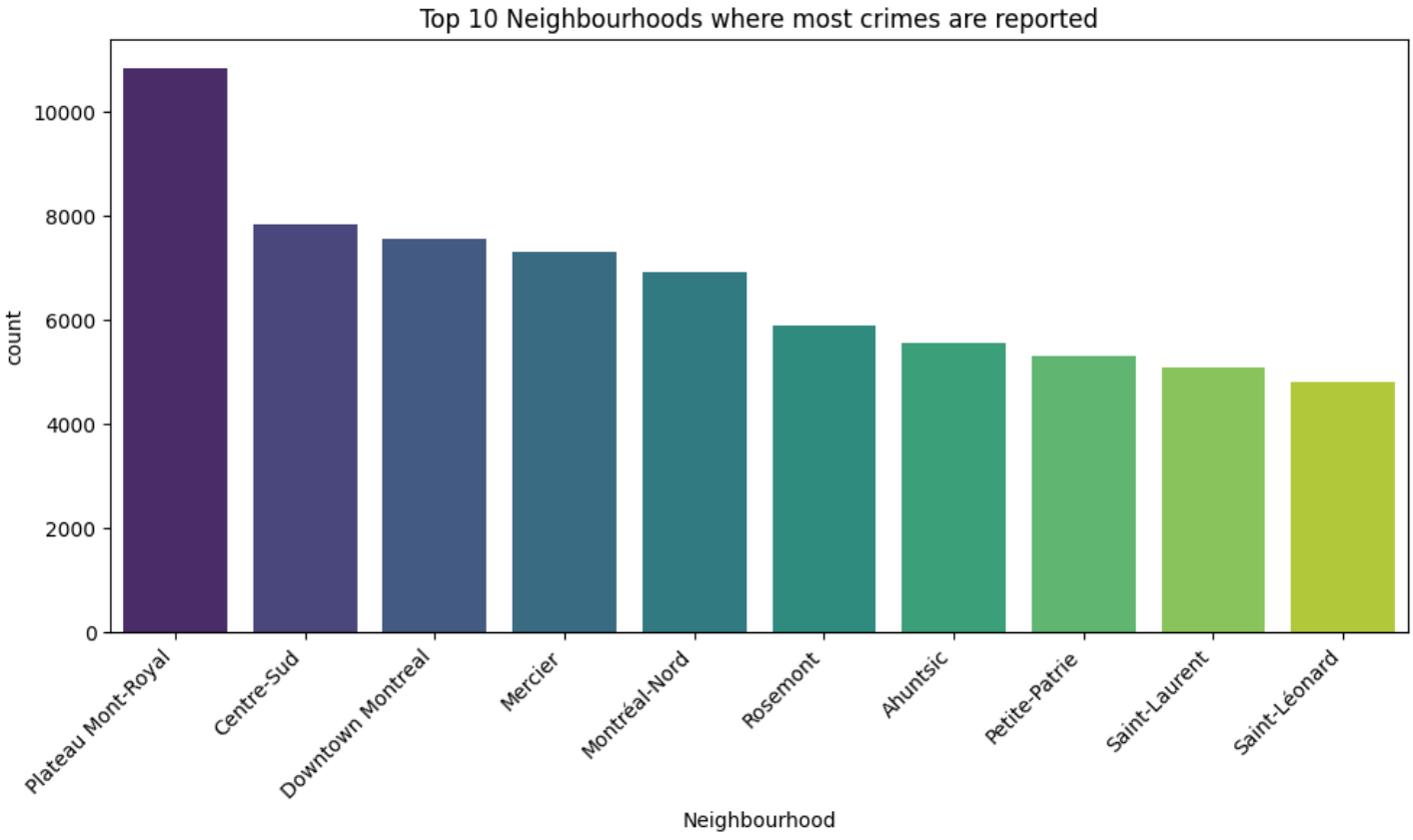
Out[12]:

| Neighbourhood | count |
|---|---|
| Plateau Mont-Royal | 10844 |
| Centre-Sud | 7849 |
| Downtown Montreal | 7565 |
| Mercier | 7200 |

| Neighbourhood | count |
|---|---|
| Mercier | 7302 |
| Montréal-Nord | 6913 |
| Rosemont | 5907 |
| Ahuntsic | 5575 |
| Petite-Patrie | 5327 |
| Saint-Laurent | 5094 |
| Saint-Léonard | 4822 |

In [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:**

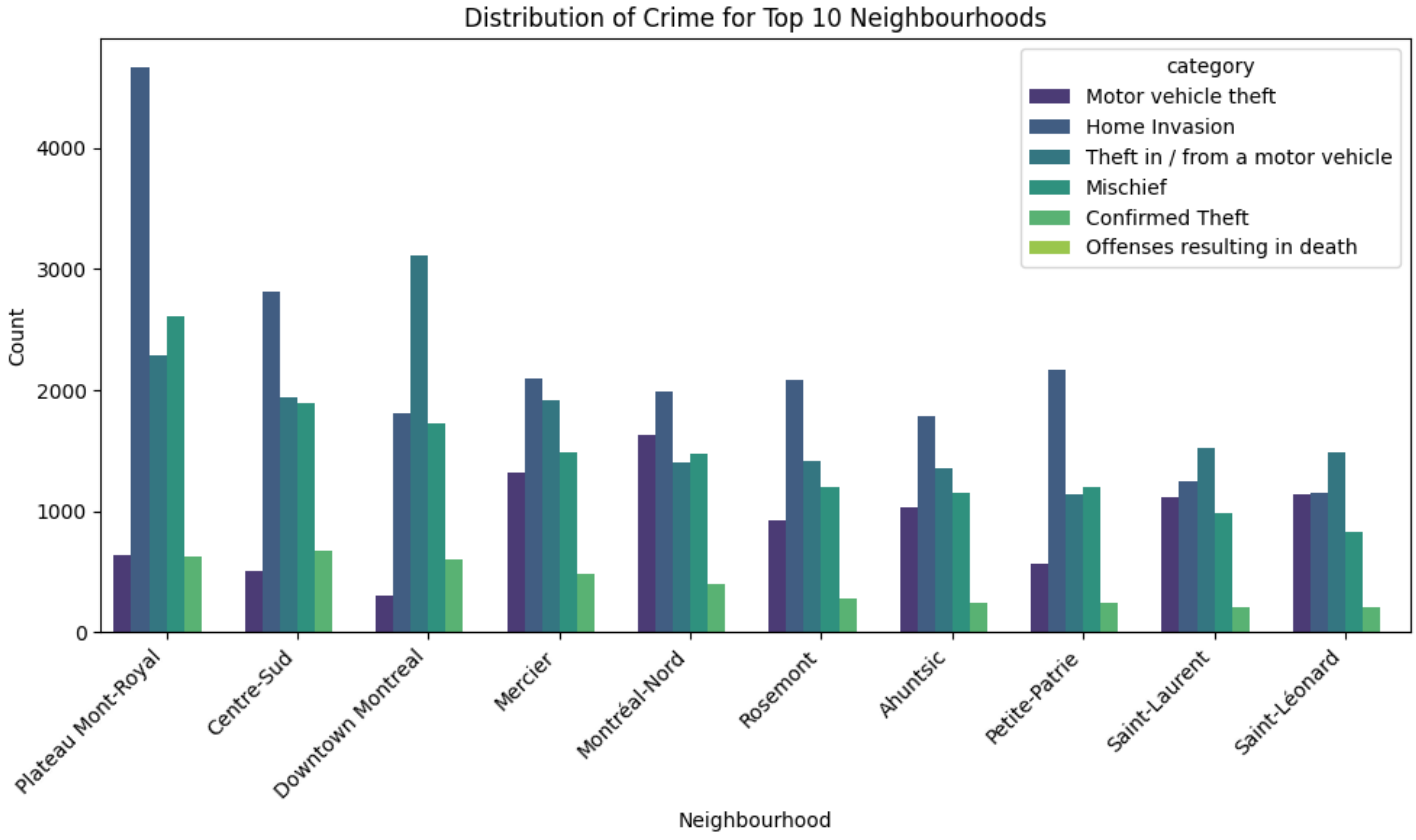
1. **Plateau Mont-Royal (total of 10844 reported crimes)**
2. **Centre-Sud (total of 7849 reported crimes)**
3. **Downtown Montreal (total of 7565 reported crimes)**
4. **Mercier (total of 7302 reported crimes)**
5. **Montréal-Nord (total of 6913 reported crimes)**
6. **Rosemont (total of 5907 reported 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?**

In [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='v
iridis', 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**

In [17]:

In [17]:

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

Out[17]:

| Year | count |
|---|---|
| 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).**

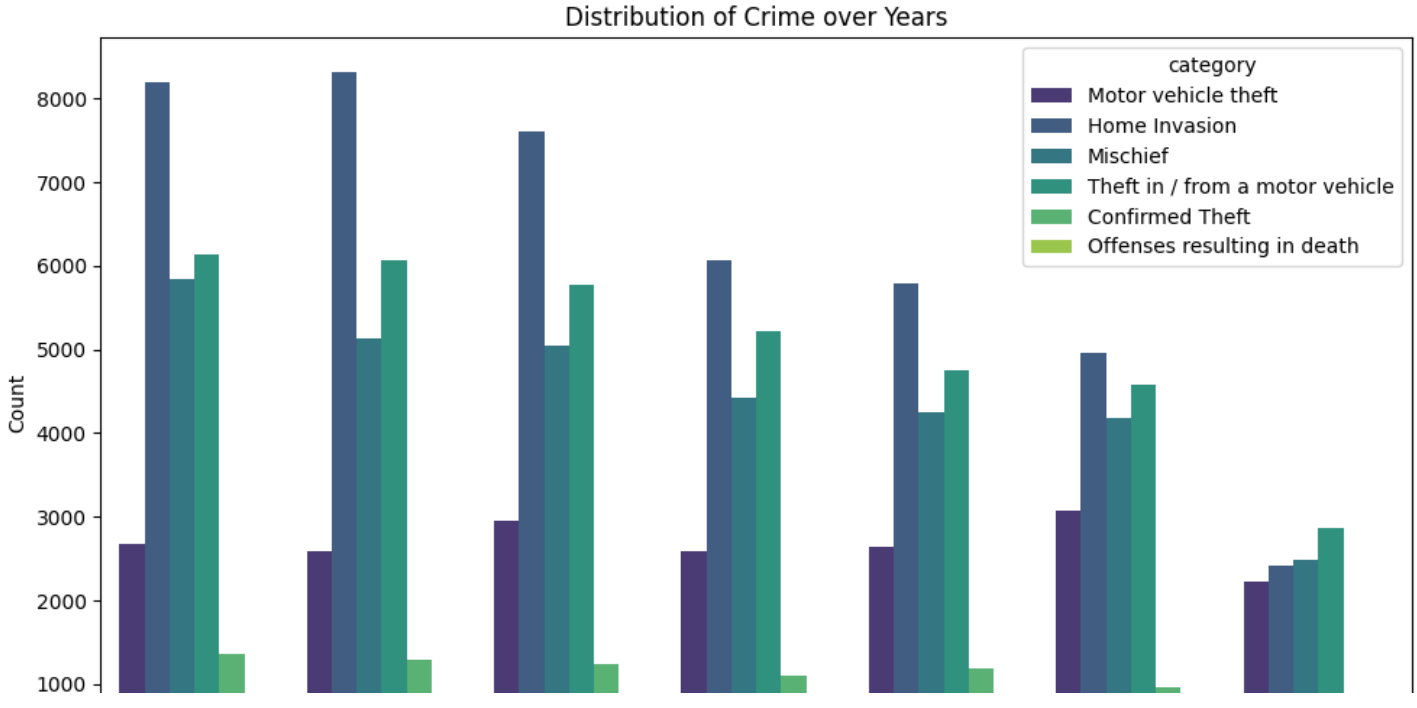
**Question 4: What are the general trends in the reported crimes between 2015-2021**

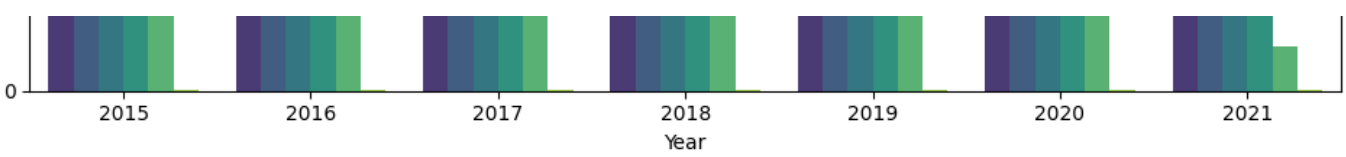
- **What are the trends in the categories of reported crimes?**
- **Did crime rates increase or decrease?**

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

In [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()
```





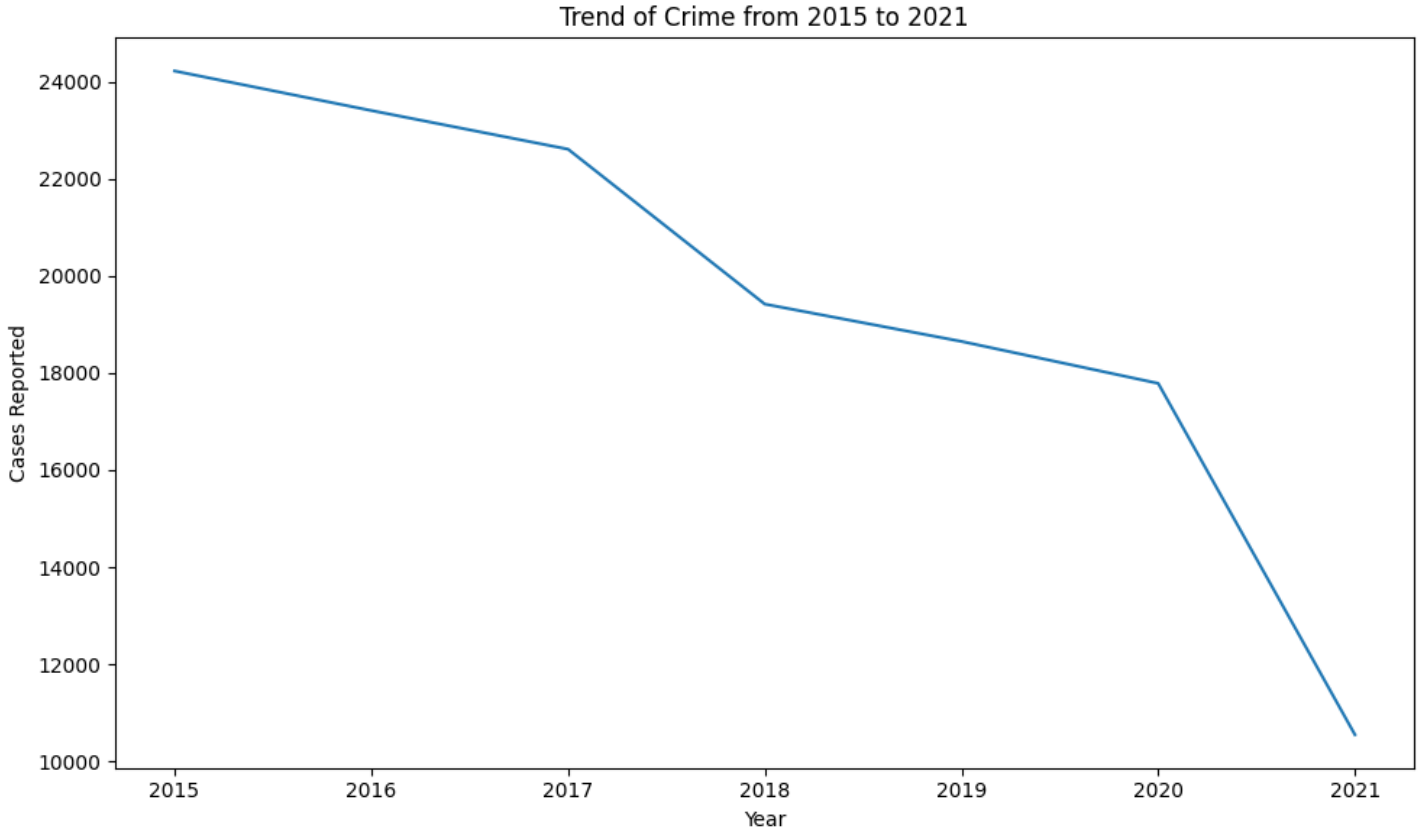

**Home Invasions** are the most reported crime from 2015-2020. In 2021 **Confirmed Theft** was the most reported crime.

**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?**

In [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.**

In [20]:

In [20]:

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

In [21]:

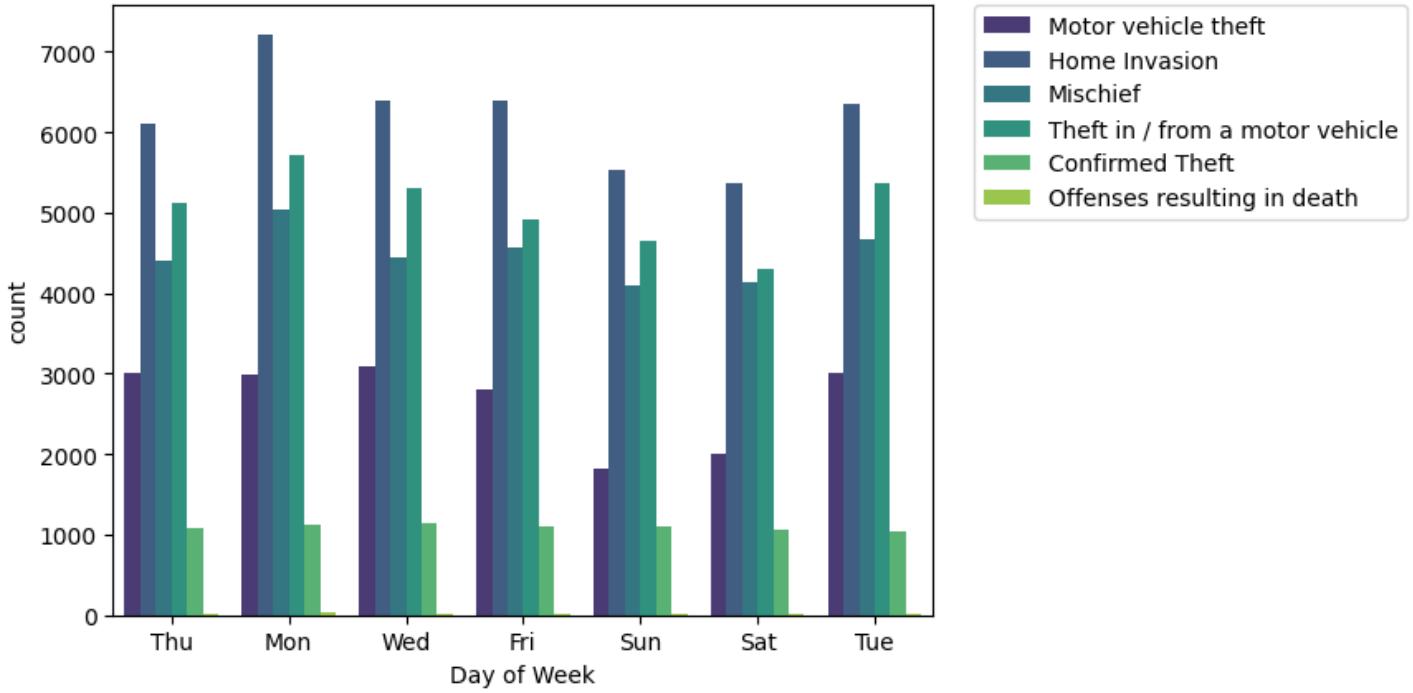
```
dmap = {0:'Mon',1:'Tue',2:'Wed',3:'Thu',4:'Fri',5:'Sat',6:'Sun'}
data['Day of Week'] = data['Day of Week'].map(dmap)
```

In [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.)
```

Out[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*.**

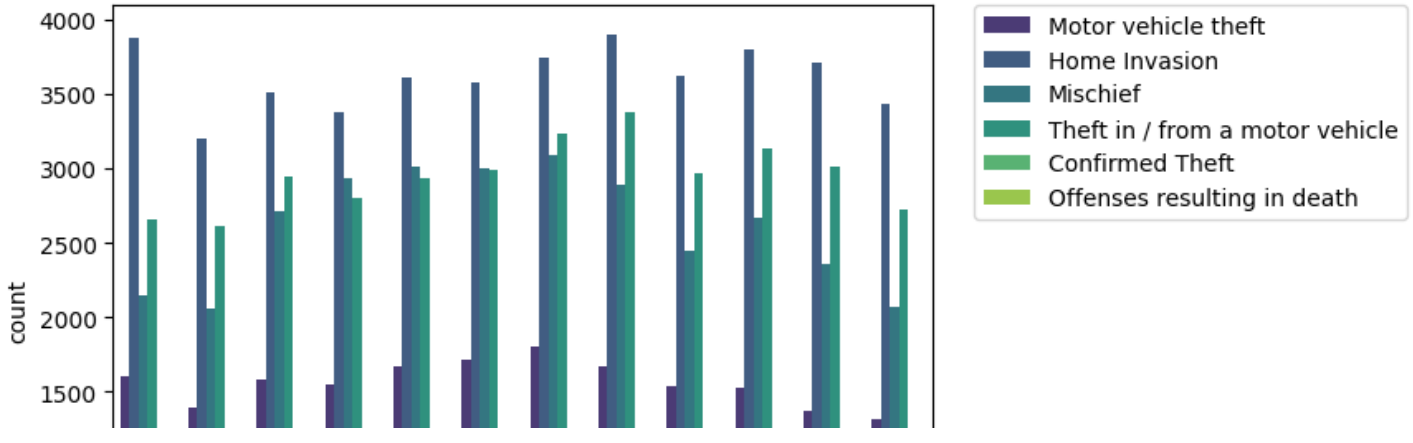
**Let's explore the types of crime committed depending on the month of the year.**

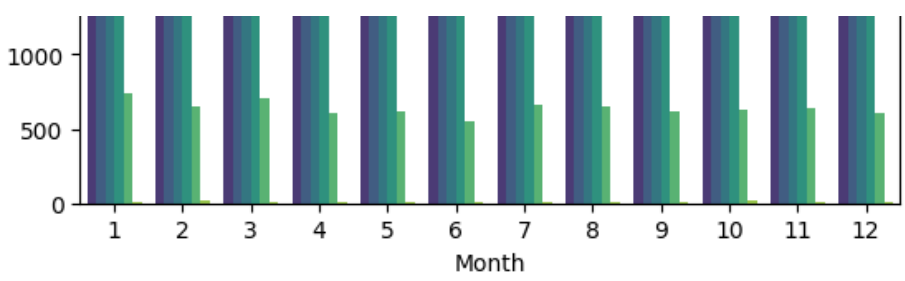
In [23]:

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

Out[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?**

In [24]:

```
data.head()
```

Out[24]:

| | category | date | postal_code | city | neighbourhood | year | count | longitude | latitude | Month | Day of Week |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Motor vehicle theft | 2018-09-13 | H1Z 1S9 | MONTREAL | Saint-Michel | 2018 | 1 | -73.626 | 45.567 | 9 | Thu |
| 1 | Motor vehicle theft | 2018-04-30 | H1Z 1S9 | MONTREAL | Saint-Michel | 2018 | 1 | -73.626 | 45.567 | 4 | Mon |
| 2 | Home Invasion | 2018-01-10 | H1Z 2V6 | MONTREAL | Saint-Michel | 2018 | 1 | -73.629 | 45.569 | 1 | Wed |
| 3 | Mischief | 2018-11-12 | H1Z 2V6 | MONTREAL | Saint-Michel | 2018 | 1 | -73.629 | 45.569 | 11 | Mon |
| 4 | Mischief | 2018-08-15 | H1Z 2V6 | MONTREAL | Saint-Michel | 2018 | 1 | -73.629 | 45.569 | 8 | Wed |

In [25]:

```
#correlation between days/months

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

Out[25]:

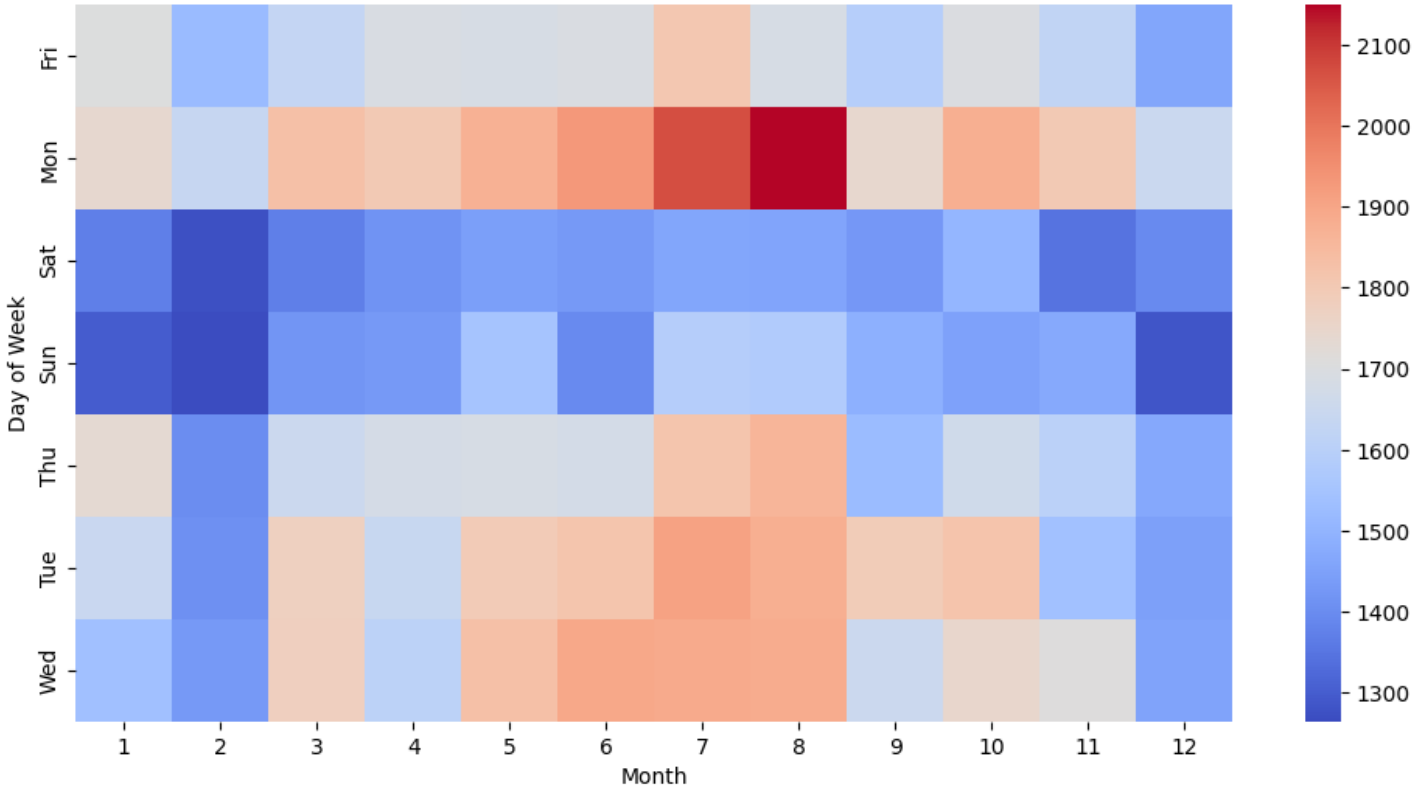
| Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day of Week** | | | | | | | | | | | | |
| **Fri** | 1706 | 1519 | 1630 | 1692 | 1685 | 1694 | 1809 | 1685 | 1590 | 1698 | 1624 | 1460 |
| **Mon** | 1742 | 1636 | 1830 | 1803 | 1872 | 1931 | 2068 | 2150 | 1743 | 1879 | 1802 | 1647 |
| **Sat** | 1372 | 1275 | 1371 | 1417 | 1443 | 1428 | 1459 | 1456 | 1425 | 1506 | 1345 | 1394 |
| **Sun** | 1299 | 1265 | 1420 | 1428 | 1550 | 1394 | 1587 | 1578 | 1487 | 1450 | 1470 | 1285 |
| **Thu** | 1734 | 1403 | 1652 | 1679 | 1685 | 1674 | 1818 | 1861 | 1521 | 1666 | 1607 | 1466 |

In [26]:

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

Out[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**

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- **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.**