Police Reported Crime Trends Analysis: West Yorkshire (April-September 2020)

1. Introduction and Objectives

Background

This analysis examines crime data from West Yorkshire Police covering six months during 2020. This period is particularly interesting as it coincides with the early months of the COVID-19 pandemic and associated lockdown measures, which may have influenced crime patterns.

In [ ]:
```
import os, pandas as pd, numpy as np, matplotlib.pyplot as plt, seaborn as sns
from datetime import datetime
print("\n1. DATA LOADING")
def load_crime_data(data_folder="../data"):
    months = ['2020-04', '2020-05', '2020-06', '2020-07', '2020-08', '2020-09']
    dataframes = []
    loading_summary = []
    print("Loading crime data files...")
    # Iterate through each month and load the corresponding file
    for month in months:
        # Construct the filename based on the month
        filename = f"{month}-west-yorkshire-street.csv"
        file_path = os.path.join(data_folder, filename)
        # Check if file exists
        if not os.path.exists(file_path):
            loading_summary.append({
                'Month': month,
                'Filename': filename,
                'Rows': 0,
                'Columns': 0,
                'Status': 'File not found'
            })
            print(f"✗ {month}: File not found - {filename}")
            continue
        # Load the CSV file
        df = pd.read_csv(file_path)
        dataframes.append(df)
        print(f"✓ {month}: {len(df):,} records loaded from {filename}")
    # Combine all dataframes
    if dataframes:
        combined_df = pd.concat(dataframes, ignore_index=True)
        print(f"\n Successfully combined data from {len(dataframes)} files")
        print(f" Total records loaded: {len(combined_df):,}")
        return combined_df, pd.DataFrame(loading_summary)
        return None, pd.DataFrame(loading_summary)
# Load the data
crime_data, loading_summary = load_crime_data()
```

```
1. DATA LOADING
Loading crime data files...
✓ 2020-04: 21,785 records loaded from 2020-04-west-yorkshire-street.csv
✓ 2020-05: 24,657 records loaded from 2020-05-west-yorkshire-street.csv
✓ 2020-06: 26,730 records loaded from 2020-06-west-yorkshire-street.csv
✓ 2020-07: 29,278 records loaded from 2020-07-west-yorkshire-street.csv
✓ 2020-08: 29,433 records loaded from 2020-08-west-yorkshire-street.csv
✓ 2020-09: 27,015 records loaded from 2020-09-west-yorkshire-street.csv

 Successfully combined data from 6 files
 Total records loaded: 158,898
```

In [15]:
```python
def summarize_dataframe(df):
    print("\nCOLUMN DETAILS")
    print(f"{'No.':<3} {'Column':<15} {'Type':<8} {'Non-null':>8} {'Non-%':>6} {'Mi
    total_rows = len(df)
    for i, col in enumerate(df.columns, 1):
        non_null = df[col].notna().sum()
        missing = total_rows - non_null
        non_null_pct = (non_null / total_rows) * 100
        missing_pct = (missing / total_rows) * 100
        print(f"{i:<3} {col[:15]:<15} {str(df[col].dtype)[:8]:<8} {non_null:>8} {no
data_summary = summarize_dataframe(crime_data)
```

```
COLUMN DETAILS
No. Column          Type     Non-null  Non-%     Miss Miss-%
1   Unnamed: 0      int64      158898   100%        0     0%
2   Crime ID        object     129209    81%    29689    19%
3   Month           object     156898    99%     2000     1%
4   Falls within    object     127620    80%    31278    20%
5   Longitude       float64    153411    97%     5487     3%
6   Latitude        float64    153411    97%     5487     3%
7   Location        object     156898    99%     2000     1%
8   LSOA code       object     153410    97%     5488     3%
9   LSOA name       object     153410    97%     5488     3%
10  Crime type      object     156898    99%     2000     1%
11  Last outcome ca object     127564    80%    31334    20%
12  Context         float64         0     0%   158898   100%
13  Reported by     object     135113    85%    23785    15%
```

In [33]:
```python
def analyse_data_anomalies(df):
    print("\n3. DATA ANOMALIES AND PATTERNS")
    # Duplicate rows
    print("DUPLICATE ANALYSIS:")
    print(f"   • Complete duplicate rows: {df.duplicated().sum():,}")
    if 'Crime ID' in df.columns:
        print(f"   • Duplicate Crime IDs: {df['Crime ID'].duplicated().sum():,}")
    # Geographic data validation
    print("\nGEOGRAPHIC DATA VALIDATION:")
    if {'Longitude', 'Latitude'}.issubset(df.columns):
        coords = df[['Longitude', 'Latitude']].dropna()
        uk_lon, uk_lat = (-8, 2), (49, 61)
        invalid = coords[
            (coords['Longitude'] < uk_lon[0]) | (coords['Longitude'] > uk_lon[1]) |
            (coords['Latitude'] < uk_lat[0]) | (coords['Latitude'] > uk_lat[1])
        ]
```

```
        print(f"   • Valid coordinate records: {len(coords):,}")
        print(f"   • Coordinates outside UK bounds: {len(invalid):,}")
        print(f"   • Longitude range: {coords['Longitude'].min():.6f} to {coords['L
        print(f"   • Latitude range: {coords['Latitude'].min():.6f} to {coords['Lat
analyse_data_anomalies(crime_data)
```

```
3. DATA ANOMALIES AND PATTERNS
DUPLICATE ANALYSIS:
   • Complete duplicate rows: 1
   • Duplicate Crime IDs: 29,690

GEOGRAPHIC DATA VALIDATION:
   • Valid coordinate records: 153,411
   • Coordinates outside UK bounds: 118
   • Longitude range: -99.342253 to 98.150160
   • Latitude range: -96.415042 to 99.528496
```

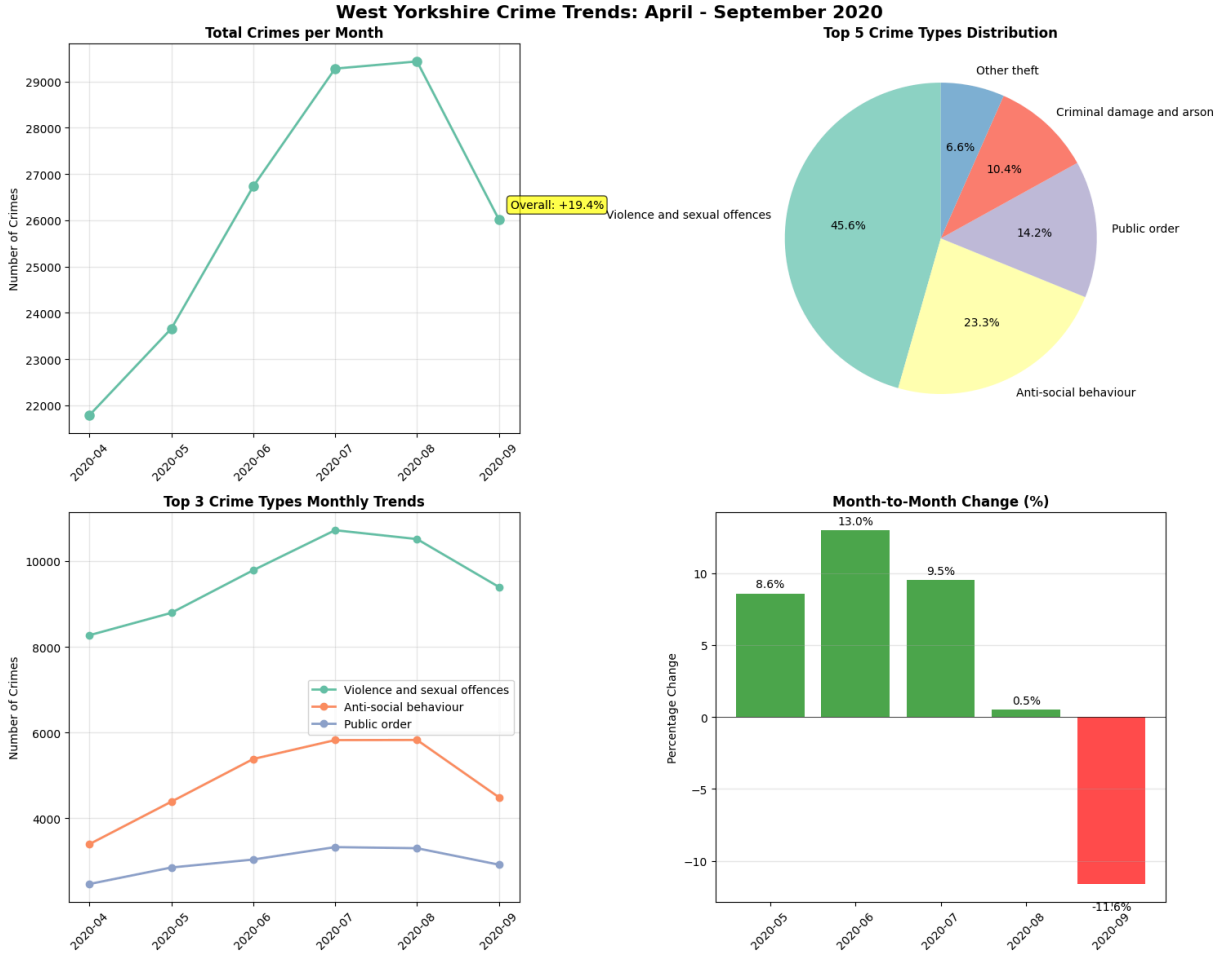
In [25]:
```
# Clean data for analysis
# Create clean dataset for trend analysis
clean_data = crime_data.dropna(subset=['Month', 'Crime type']).copy()
print(f"• Original dataset: {len(crime_data):,} records")
print(f"• Clean dataset: {len(clean_data):,} records")
print(f"• Records removed: {len(crime_data) - len(clean_data):,} ({((len(crime_data
```

```
• Original dataset: 158,898 records
• Clean dataset: 156,898 records
• Records removed: 2,000 (1.3%)
```

In [35]:
```
# 5. DATA VISUALIZATION
print("5. DATA VISUALIZATION")
# Set up plotting parameters
plt.rcParams['figure.figsize'] = (12, 8)
plt.rcParams['font.size'] = 10

# Create subplot layout
fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(2, 2, figsize=(15, 12))
fig.suptitle('West Yorkshire Crime Trends: April - September 2020', fontsize=16, fo

# Chart 1: Overall monthly trends
monthly_totals = clean_data.groupby('Month').size()
ax1.plot(monthly_totals.index, monthly_totals.values, marker='o', linewidth=2, mark
ax1.set_title('Total Crimes per Month', fontweight='bold')
ax1.set_ylabel('Number of Crimes')
ax1.grid(True, alpha=0.3)
ax1.tick_params(axis='x', rotation=45)

# Add trend annotation
trend_pct = ((monthly_totals.iloc[-1] - monthly_totals.iloc[0]) / monthly_totals.il
ax1.annotate(f'Overall: {trend_pct:+.1f}%',
             xy=(monthly_totals.index[-1], monthly_totals.iloc[-1]),
             xytext=(10, 10), textcoords='offset points',
             bbox=dict(boxstyle='round,pad=0.3', facecolor='yellow', alpha=0.7))

print("✓ Chart 1: Monthly totals created")

# Chart 2: Top 5 crime types distribution
top_5_crimes = clean_data['Crime type'].value_counts().head(5)
```

```
colors = plt.cm.Set3(range(len(top_5_crimes)))

ax2.pie(top_5_crimes.values, labels=top_5_crimes.index, autopct='%1.1f%%',
        colors=colors, startangle=90)
ax2.set_title('Top 5 Crime Types Distribution', fontweight='bold')

print("✓ Chart 2: Crime type distribution created")

# Chart 3: Trend comparison for top 3 crime types
top_3_crimes = clean_data['Crime type'].value_counts().head(3).index

for crime_type in top_3_crimes:
    crime_monthly = clean_data[clean_data['Crime type'] == crime_type].groupby('Mon
    ax3.plot(crime_monthly.index, crime_monthly.values, marker='o', label=crime_typ

ax3.set_title('Top 3 Crime Types Monthly Trends', fontweight='bold')
ax3.set_ylabel('Number of Crimes')
ax3.legend()
ax3.grid(True, alpha=0.3)
ax3.tick_params(axis='x', rotation=45)

print("✓ Chart 3: Top crime types trends created")

# Chart 4: Month-to-month percentage changes
monthly_changes = monthly_totals.pct_change() * 100
monthly_changes = monthly_changes.dropna()

colors = ['green' if x > 0 else 'red' for x in monthly_changes.values]
bars = ax4.bar(range(len(monthly_changes)), monthly_changes.values, color=colors, a
ax4.set_title('Month-to-Month Change (%)', fontweight='bold')
ax4.set_ylabel('Percentage Change')
ax4.set_xticks(range(len(monthly_changes)))
ax4.set_xticklabels(monthly_changes.index, rotation=45)
ax4.grid(True, alpha=0.3, axis='y')
ax4.axhline(y=0, color='black', linestyle='-', linewidth=0.5)

# Add value labels on bars
for i, bar in enumerate(bars):
    height = bar.get_height()
    ax4.annotate(f'{height:.1f}%',
                 xy=(bar.get_x() + bar.get_width()/2, height),
                 xytext=(0, 3 if height > 0 else -15),
                 textcoords="offset points",
                 ha='center', va='bottom' if height > 0 else 'top')

print("✓ Chart 4: Monthly changes created")

plt.tight_layout()
plt.show()
```

```
5. DATA VISUALIZATION
✓ Chart 1: Monthly totals created
✓ Chart 2: Crime type distribution created
✓ Chart 3: Top crime types trends created
✓ Chart 4: Monthly changes created
```


West Yorkshire Crime Trends: April - September 2020
Total Crimes per Month
Number of Crimes
Overall: +19.4%
Top 5 Crime Types Distribution
Other theft
Criminal damage and arson
Violence and sexual offences
Public order
Anti-social behaviour
6.6%
10.4%
45.6%
14.2%
23.3%
Top 3 Crime Types Monthly Trends
Violence and sexual offences
Anti-social behaviour
Public order
Month-to-Month Change (%)
Percentage Change
8.6%
13.0%
9.5%
0.5%
-11.6%
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

In [ ]: