BEE2041 Empirical Project Blog

Government allocations toward law enforcement are substantial, aiming to ensure community safety. However, a critical question arises: at what point does the cost of securing safety outweigh the benefits? It's straightforward to argue against spending more than £1 to recoup £1 worth of criminal damage. Yet, the value of law enforcement extends beyond direct financial returns. Ensuring justice, although hard to quantify, offers significant societal value. Moreover, effective law enforcement enhances the risks associated with criminal activities, potentially deterring crime. Indeed, a well-funded police force tends to be more effective, but what exactly is the value of this "deterrent effect"? Does increasing investment in law enforcement yield proportionate reductions in crime rates?

The goal here is simple: use data to see if wealthier police areas do indeed lead to safer communities. To do this, I've developed a bot to gather data directly from the police.uk website, focusing on financial reserves and reported crime rates across different regions.

This blog will walk you through how I collected and cleaned up the data, the challenges I encountered along the way, and the results of the analysis. Expect to see some graphs and insights that might make us rethink how we approach police funding.

Data Collection

By perusing the police.uk website, it is clear that financial data exists at the "force area" level. As such, we need to collect a list of all the force areas for which such data exists, as well as the crime rates for each force area. Further browsing identified that crime rates are available at a much more granular level, where each force area has crime rates recorded for subsections of that force area, that I will refer to as the "jurisdiction" level going forward.

Our data shopping list is therefore as follows:

- The names of all force areas (the macro-level)
- The jurisdictions associated with each force area
- Crime rates across all jurisdictions (the micro-level)

Web-scraping

Initial attempts at scraping the required data from police.uk involved using BeautifulSoup, cloudscraper and cfsoup, but each time the website's Cloudflare protection detected my "bot" and prevented access. It occurs to me that I am able to manually access the website consistently without having to prove that I am not a bot. If my bot could access the website and treat it just as I do when I interact with it, how would Cloudflare be able to distinguish my bot from me?

Emulating Human Interaction with Selenium

This is where Selenium, a python package, comes in. Alongside what is called a "webdriver", selenium allows the bot to access the front-end of the website in a browser (my choice of browser will be chrome), just like a human would interact with the site! Many coffees and interactions with ChatGPT later, as well

as a healthy amount of trial and error, and I've set up a script that can open the police.uk homepage on a chrome browser window- success!

Building an Ethical Bot

Having established that Selenium is capable of accessing the police.uk website, let's start building an ethical bot!

- **Adhering to Robots.txt**: Firstly, we access the [https://police.uk/robots.txt (https://police.uk/robots.txt)](https://police.uk/robots.txt) page and find certain URLs need to be disallowed. I decided to start by caching the robots.txt file so that my bot could refer to these disallowed URLs without sending repeated requests to the site. Before scraping a new URL, my bot would check that URL against those contained in the robot.txt file and would return a "robot.txt error" rather than crawl the forbidden URL.

- **Using a Custom User-Agent**: Furthermore, it is customary to include a specific "user-agent", which is like a tag to identify your bot to the website. I decided to name my bot "FriendlyUniStudentResearcher/1.0 (+mailto:[soc204@exeter.ac.uk (mailto:soc204@exeter.ac.uk)](mailto:soc204@exeter.ac.uk))". This user-agent serves a dual purpose: it helps identify the bot as part of a university research project, making its intentions transparent, and it provides a direct contact method for website administrators should any issues arise. Anyone wishing to recreate my findings can provide the bot with a different user-agent if they wish.

I have defined the functions that my bot script will call upon in separate jupyter notebook cells so that the script is modular, which was handy for debugging, but also leaves room for future development of the script:

In [3]:
```python
from selenium.webdriver.chrome.options import Options
def establish_user_agent(user_agent, chromedriver_path):
    chrome_options = Options()
    chrome_options.add_argument(f"user-agent={user_agent}")
    return chrome_options
```

In [4]:
```python
from selenium import webdriver
from selenium.webdriver.chrome.service import Service
def init_chrome_webdriver(chromedriver_path, chrome_options):
    chrome_options.add_argument("--no-sandbox")  # This parameter helps in avoidi
    chrome_options.add_argument("--disable-gpu")  # Disables GPU hardware acceler
    chrome_options.add_argument("--log-level=3")  # This will only show fatal err
    service = Service(executable_path=chromedriver_path)
    driver = webdriver.Chrome(service=service, options=chrome_options)
    return driver
```

```python
In [5]:   import time
          import json
          from selenium.webdriver.common.by import By
          def test_user_agent(driver, user_agent):
              driver.get("https://httpbin.org/user-agent")
              time.sleep(5)
              response_data = json.loads(driver.find_element(By.TAG_NAME, "body").text)
              echoed_user_agent = response_data["user-agent"]

              if echoed_user_agent != user_agent:
                  print("User-Agent does not match the expected value. Quitting...")
                  raise Exception("User-Agent does not match the expected value.")
```

```python
In [6]:   def is_target_disallowed(target, disallowed_dict):
              """
              Check if the target path matches any of the disallowed paths.

              :param target_path: The target path to check
              :param disallowed_paths: A dictionary of disallowed paths from robots.txtf fi
              :return: True if the target path is disallowed, False otherwise
              """
              # Extract base URL from the target
              parsed_url = urlparse(target)
              base_url = f"{parsed_url.scheme}://{parsed_url.netloc}"

              # Retrieve the list of disallowed patterns for the base URL
              disallowed_patterns = disallowed_dict.get(base_url, [])

              # Normalize target path
              target_pattern = f'{parsed_url.path}?{parsed_url.query}'.rstrip("?")
              target_path = target_pattern.rstrip("/")

              for pattern in disallowed_patterns:
                  # Normalize disallowed path
                  pattern = pattern.rstrip("/")

                  # Check if the target pattern starts with the disallowed pattern
                  if target_path.startswith(pattern):
                      return True
                  # Checking for file extension disallowance, e.g., '*.aspx$'
                  if pattern.endswith('$'):
                      base_pattern = pattern[1:-1]
                      if target_path.endswith(base_pattern):
                          return True

              return False
```

```
In [7]: ▶ from urllib.parse import urlparse
          import re
          def establish_bot_permissions(driver, target, existing_disallowed=None):
              parsed_url = urlparse(target)
              base_url = f"{parsed_url.scheme}://{parsed_url.netloc}"

              # Initialize the dictionary if not provided
              if existing_disallowed is None:
                  existing_disallowed = {}

              # If the base URL is already in the dictionary, return it
              if base_url in existing_disallowed:
                  if is_target_disallowed(target, existing_disallowed):
                      print('This URL is not allowed to be crawled in line with robots.txt'
                      raise Exception(f"Target path {target} is disallowed.")
                  else:
                      print(f"{target} is not disallowed")
                  return existing_disallowed

              # Navigate to relevant robots.txt file
              robots_url = f"{base_url}/robots.txt"
              driver.get(robots_url)
              time.sleep(1)

              # Scrape disallowed patterns
              robots_txt_content = driver.find_element(By.TAG_NAME, "body").text
              disallow_pattern = r"Disallow: ([^\n]+)"
              disallowed_paths = re.findall(disallow_pattern, robots_txt_content)
              existing_disallowed[base_url] = disallowed_paths

              if is_target_disallowed(target, existing_disallowed):
                  print('This URL is not allowed to be crawled in line with robots.txt')
                  raise Exception(f"Target path {target} is disallowed.")
              else:
                      print(f"{target} is not disallowed")
              return existing_disallowed
```

```python
from selenium.webdriver.support.ui import WebDriverWait
from selenium.webdriver.support import expected_conditions as EC

def get_force_areas(driver, target):
    try:
        driver.get(target)
        all_buttons = WebDriverWait(driver, 10).until(
            EC.presence_of_all_elements_located((By.CSS_SELECTOR, ".js-crime-stat
        )

        if len(all_buttons) > 1:
            toggle_button = all_buttons[1]  # Select the second button
            driver.execute_script("arguments[0].scrollIntoView(true);", toggle_bu
            toggle_button.click()
            time.sleep(2)
        else:
            print("Not enough buttons found.")

        tables = driver.find_elements(By.TAG_NAME, 'table')
        table = tables[-1]
        driver.execute_script("arguments[0].scrollIntoView(true);", table)
        rows = table.find_elements(By.TAG_NAME, 'tr')
        force_areas = []

        for row in rows:
            cells = row.find_elements(By.TAG_NAME, 'td')
            if cells:
                text = cells[0].text.strip()
                force_areas.append(text)
    except Exception as e:
        print(f"An error occurred while processing: {e}")
    return force_areas
```

```python
from selenium.webdriver.common.keys import Keys
def navigate_to_force_area_performance(driver, area, disallowed_patterns, force_a
    try:
        all_search_inputs = WebDriverWait(driver, 10).until(
            EC.visibility_of_all_elements_located((By.CSS_SELECTOR, "input[type='
        )

        # Make sure there are at least two search bars
        if len(all_search_inputs) >= 2:
            search_input = all_search_inputs[1]  # Select the second search input
        else:
            raise Exception("Less than two search inputs found on the page.")

        search_input.click()
        # Clear the search field first in case there's any pre-filled text
        search_input.clear()
        # Enter the area name into the search field
        search_input.send_keys(area)
        # Search!
        search_input.send_keys(Keys.ENTER)  # Press Enter directly via Selenium

        time.sleep(1)
        #Check if this new page is disallowed
        target = driver.current_url
        disallowed_patterns = establish_bot_permissions(driver,target,disallowed_

        driver.get(target)
        time.sleep(1)
        print(f"Navigation to the {area} performance page is successful.")

    except Exception as e:
        print(f"An error occurred while navigating to the {area} performance page
    return force_area_urls
```

```python
In [10]:  def get_jurisdictions(driver, area, disallowed_patterns, force_area_jurisdictions
              link = driver.find_elements(By.XPATH, "//a[.//h3[contains(@class, 'c-link-pan
              if len(link)<1:
                  print("No data available")
                  jurisdictions[area]={}
                  return jurisdictions
              link = WebDriverWait(driver, 10).until(
                      EC.visibility_of_element_located((By.XPATH, "//a[.//h3[contains(@clas
                  )
              target = link.get_attribute('href')
              disallowed_patterns = establish_bot_permissions(driver,target,disallowed_patt
              driver.get(target)
              time.sleep(1)
              all_buttons = driver.find_elements(By.CSS_SELECTOR, ".js-crime-stats-table-to
              if len(all_buttons) > 1:
                  toggle_button = all_buttons[1]
                  driver.execute_script("arguments[0].scrollIntoView(true);", toggle_button
                  toggle_button.click()
                  time.sleep(1)
              else:
                  print("Not enough buttons found.")
                  jurisdictions[area]={}
                  return jurisdictions

              tables = driver.find_elements(By.TAG_NAME, 'table')
              table = tables[2]
              driver.execute_script("arguments[0].scrollIntoView(true);", table)
              rows = table.find_elements(By.TAG_NAME, 'tr')
              force_area_jurisdictions = {}

              for row in rows:
                  cells = row.find_elements(By.TAG_NAME, 'td')
                  if cells:
                      text = cells[0].text.strip()
                      force_area_jurisdictions[text]=cells[1].text.strip()
              jurisdictions[area] = force_area_jurisdictions
              return jurisdictions
```

```
In [11]:  ▶ def get_force_area_finances(driver, area, disallowed_patterns,financial_reserves=
             navigate_to_force_area_performance(driver, area, disallowed_patterns)
             link = driver.find_elements(By.XPATH, "//a[.//h3[contains(@class, 'c-link-pan
             if len(link)<1:
                 print("No data available")
                 financial_reserves[area]={}
                 return financial_reserves
             link = WebDriverWait(driver, 10).until(
                     EC.visibility_of_element_located((By.XPATH, "//a[.//h3[contains(@clas
                 )
             target = link.get_attribute('href')
             disallowed_patterns = establish_bot_permissions(driver,target,disallowed_patt
             driver.get(target)
             time.sleep(1)
             all_buttons = driver.find_elements(By.CSS_SELECTOR, ".js-crime-stats-table-to
             if len(all_buttons) > 1:
                 toggle_button = all_buttons[0]
                 driver.execute_script("arguments[0].scrollIntoView(true);", toggle_button
                 toggle_button.click()
                 time.sleep(1)
             else:
                 print("Not enough buttons found.")
                 return financial_reserves

             tables = driver.find_elements(By.TAG_NAME, 'table')
             table = tables[-2]
             driver.execute_script("arguments[0].scrollIntoView(true);", table)
             rows = table.find_elements(By.TAG_NAME, 'tr')

             for row in rows:
                 cells = row.find_elements(By.TAG_NAME, 'td')
                 if cells:
                     year = cells[0].text.strip()
                     financial_reserves[area][year]['General fund']=cells[1].text.strip()
                     financial_reserves[area][year]['Earmarked reserves']=cells[2].text.st
                     financial_reserves[area][year]['Total resource reserves']=cells[3].te
                     financial_reserves[area][year]['Capital reserves']=cells[4].text.stri
             return financial_reserves
             # {force_area:{Mar 2018: {General Fund: 10000, Earmarked Reserves: 10000, Total R
             # {force_area_keys:{Year_keys:{Fund_type_keys:Values}}}
```

What follows is the webscraping script- remember to recreate this script's output, you must have first downloaded the relevant chromedriver for your machine from https://googlechromelabs.github.io/chrome-for-testing/#stable (https://googlechromelabs.github.io/chrome-for-testing/#stable), and provide the path to your own version of the chromedriver where prompted in the script. You may also wish to use your own user-agent. It is recommended that your user-agent contains a (+mailto:emailaddress) string so that any crawling of the bot that raises concerns with the service provider can be mediated by them reaching out to you.

```python
In [12]:    # Setup User-Agent
            user_agent = "FriendlyUniStudentResearcher/1.0 (+mailto:soc204@exeter.ac.uk)"

            #Provide the path to your own version of the chromedriver
            chromedriver_path = r"C:\Users\socor\Downloads\chromedriver-win64\chromedriver-wi

            chrome_options = establish_user_agent(user_agent, chromedriver_path)

            # Initialize the WebDriver (assuming Chrome)
            driver = init_chrome_webdriver(chromedriver_path,chrome_options)

            # Set target URL
            target = 'https://www.police.uk/pu/your-area/avon-somerset-constabulary/performan

            try:
                # Navigate to a website that echoes back the user-agent
                test_user_agent(driver, user_agent)

                # Navigate to target website robots.txt and save the disallowed patterns
                disallowed_patterns = establish_bot_permissions(driver, target)

                # Collect the names of Force areas for which data is available
                Force_Areas = get_force_areas(driver, target)

                target = 'https://www.police.uk/pu/performance/'
                disallowed_patterns = establish_bot_permissions(driver, target, disallowed_pa
                driver.get(target)
                force_area_urls = {}
                jurisdictions = {}
                financial_reserves = {}
                Periods = ('Mar 2011', 'Mar 2012', 'Mar 2013', 'Mar 2014', 'Mar 2015', 'Mar 2
                Reserves = ('General fund','Earmarked reserves', 'Total resource reserves', '
                for area in Force_Areas:
                    period_dict={}
                    for period in Periods:
                        reserves_dict={}
                        for reserve_type in Reserves:
                            reserves_dict[reserve_type] = None
                            period_dict[period] = reserves_dict
                            financial_reserves[area] = period_dict
                # Target each force area's performance data
                for area in Force_Areas[:-1]:
                    force_area_urls = navigate_to_force_area_performance(driver, area, disall
                    jurisdictions = get_jurisdictions(driver, area, disallowed_patterns)
                    #get force area's historical financial reserves
                    financial_reserves = get_force_area_finances(driver, area, disallowed_pat

                    driver.get('https://www.police.uk/pu/performance/')
                    time.sleep(2)

                time.sleep(10)

            except Exception as e:
                print(f"An error occurred: {e}")
            finally:
                # Close the browser
                driver.quit()
```

https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/financial-reserves/ (https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/financial-reserves/) is not disallowed

https://www.police.uk/pu/performance/ (https://www.police.uk/pu/performance/) is not disallowed

https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/performance-avon-somerset/?tc=AN004 (https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/performance-avon-somerset/?tc=AN004) is not disallowed

Navigation to the Avon and Somerset Constabulary performance page is successful.

https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/compare-your-area/?tc=AN004 (https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/compare-your-area/?tc=AN004) is not disallowed

https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/performance-avon-somerset/?tc=AN004 (https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/performance-avon-somerset/?tc=AN004) is not disallowed

Navigation to the Avon and Somerset Constabulary performance page is successful.

https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/financial-reserves/?tc=AN004 (https://www.police.uk/pu/your-area/avon-somerset-constabulary/performance/financial-reserves/?tc=AN004) is not disallowed

https://www.police.uk/pu/your-area/bedfordshire-police/performance/performance-bedfordshire-police/?tc=NU1 (https://www.police.uk/pu/your-area/bedfordshire-police/performance/performance-bedfordshire-police/?tc=NU1) is not disallowed

Navigation to the Bedfordshire Police performance page is successful.

https://www.police.uk/pu/your-area/bedfordshire-police/performance/compare-your-area/?tc=NU1 (https://www.police.uk/pu/your-area/bedfordshire-police/performance/compare-your-area/?tc=NU1) is not disallowed

https://www.police.uk/pu/your-area/bedfordshire-police/performance/performance-bedfordshire-police/?tc=NU1 (https://www.police.uk/pu/your-area/bedfordshire-police/performance/performance-bedfordshire-police/?tc=NU1) is not disallowed

Navigation to the Bedfordshire Police performance page is successful.

https://www.police.uk/pu/your-area/bedfordshire-police/performance/financial-reserves/?tc=NU1 (https://www.police.uk/pu/your-area/bedfordshire-police/performance/financial-reserves/?tc=NU1) is not disallowed

https://www.police.uk/pu/your-area/cambridgeshire-constabulary/performance/performance-cambridgeshire-constabulary/?tc=Huntingdon_and_Yaxley (https://www.police.uk/pu/your-area/cambridgeshire-constabulary/performance/performance-cambridgeshire-constabulary/?tc=Huntingdon_and_Yaxley) is not disallowed

Navigation to the Cambridgeshire Constabulary performance page is successful.

https://www.police.uk/pu/your-area/cambridgeshire-constabulary/performance/compare-your-area/?tc=Huntingdon_and_Yaxley (https://www.police.uk/pu/your-area/cambridgeshire-constabulary/performance/compare-your-area/?tc=Huntingdon_and_Yaxley) is not disallowed

https://www.police.uk/pu/your-area/cambridgeshire-constabulary/performance/performance-cambridgeshire-constabulary/?tc=Huntingdon_and_Yaxley (https://www.police.uk/pu/your-area/cambridgeshire-constabulary/performance/performance-cambridgeshire-constabulary/?tc=Huntingdon_and_Yaxley) is not disallowed

Navigation to the Cambridgeshire Constabulary performance page is successful.

https://www.police.uk/pu/your-area/cambridgeshire-constabulary/performance/financial-reserves/?tc=Huntingdon_and_Yaxley (https://www.police.uk/pu/your-area/cambridgeshire-constabulary/performance/financial-reserves/?tc=Huntingdon_and_Yaxley) is not disallowed

https://www.police.uk/pu/your-area/cheshire-constabulary/performance/performance-cheshire-constabulary/?tc=VB01 (https://www.police.uk/pu/your-area/cheshire-constabulary/performance/performance-cheshire-constabulary/?tc=VB01) is not disallowed

Navigation to the Cheshire Constabulary performance page is successful.

https://www.police.uk/pu/your-area/cheshire-constabulary/performance/compare-your-area/?tc=VB01 (https://www.police.uk/pu/your-area/cheshire-constabulary/performance/compare-your-area/?tc=VB01) is not disallowed

https://www.police.uk/pu/your-area/cheshire-constabulary/performance/performance-cheshire-constabulary/?tc=VB01 (https://www.police.uk/pu/your-area/cheshire-constabulary/performance/performance-cheshire-constabulary/?tc=VB01) is not disallowed

Navigation to the Cheshire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/cheshire-constabulary/performance/financial-reserves/?tc=VB01 (https://www.police.uk/pu/your-area/cheshire-constabulary/performance/financial-reserves/?tc=VB01) is not disallowed
https://www.police.uk/pu/your-area/cleveland-police/performance/performance-cleveland-police/?tc=Middlesbrough%20North (https://www.police.uk/pu/your-area/cleveland-police/performance/performance-cleveland-police/?tc=Middlesbrough%20North) is not disallowed
Navigation to the Cleveland Police performance page is successful.
https://www.police.uk/pu/your-area/cleveland-police/performance/compare-your-area/?tc=Middlesbrough+North (https://www.police.uk/pu/your-area/cleveland-police/performance/compare-your-area/?tc=Middlesbrough+North) is not disallowed
https://www.police.uk/pu/your-area/cleveland-police/performance/performance-cleveland-police/?tc=Middlesbrough%20North (https://www.police.uk/pu/your-area/cleveland-police/performance/performance-cleveland-police/?tc=Middlesbrough%20North) is not disallowed
Navigation to the Cleveland Police performance page is successful.
https://www.police.uk/pu/your-area/cleveland-police/performance/financial-reserves/?tc=Middlesbrough+North (https://www.police.uk/pu/your-area/cleveland-police/performance/financial-reserves/?tc=Middlesbrough+North) is not disallowed
https://www.police.uk/pu/your-area/cumbria-constabulary/performance/performance-cumbria-constabulary/?tc=LOCC1CAE (https://www.police.uk/pu/your-area/cumbria-constabulary/performance/performance-cumbria-constabulary/?tc=LOCC1CAE) is not disallowed
Navigation to the Cumbria Constabulary performance page is successful.
https://www.police.uk/pu/your-area/cumbria-constabulary/performance/compare-your-area/?tc=LOCC1CAE (https://www.police.uk/pu/your-area/cumbria-constabulary/performance/compare-your-area/?tc=LOCC1CAE) is not disallowed
https://www.police.uk/pu/your-area/cumbria-constabulary/performance/performance-cumbria-constabulary/?tc=LOCC1CAE (https://www.police.uk/pu/your-area/cumbria-constabulary/performance/performance-cumbria-constabulary/?tc=LOCC1CAE) is not disallowed
Navigation to the Cumbria Constabulary performance page is successful.
https://www.police.uk/pu/your-area/cumbria-constabulary/performance/financial-reserves/?tc=LOCC1CAE (https://www.police.uk/pu/your-area/cumbria-constabulary/performance/financial-reserves/?tc=LOCC1CAE) is not disallowed
https://www.police.uk/pu/your-area/derbyshire-constabulary/performance/performance-derbyshire-constabulary/?tc=SK03 (https://www.police.uk/pu/your-area/derbyshire-constabulary/performance/performance-derbyshire-constabulary/?tc=SK03) is not disallowed
Navigation to the Derbyshire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/derbyshire-constabulary/performance/compare-your-area/?tc=SK03 (https://www.police.uk/pu/your-area/derbyshire-constabulary/performance/compare-your-area/?tc=SK03) is not disallowed
https://www.police.uk/pu/your-area/derbyshire-constabulary/performance/performance-derbyshire-constabulary/?tc=SK03 (https://www.police.uk/pu/your-area/derbyshire-constabulary/performance/performance-derbyshire-constabulary/?tc=SK03) is not disallowed
Navigation to the Derbyshire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/derbyshire-constabulary/performance/financial-reserves/?tc=SK03 (https://www.police.uk/pu/your-area/derbyshire-constabulary/performance/financial-reserves/?tc=SK03) is not disallowed
https://www.police.uk/pu/your-area/devon-and-cornwall-police/performance/performance-devon-and-cornwall-police/?tc=DEV.4063 (https://www.police.uk/pu/your-area/devon-and-cornwall-police/performance/performance-devon-and-cornwall-police/?tc=DEV.4063) is not disallowed
Navigation to the Devon & Cornwall Police performance page is successful.
https://www.police.uk/pu/your-area/devon-and-cornwall-police/performance/compare-your-area/?tc=DEV.4063 (https://www.police.uk/pu/your-area/devon-and-cornwall-police/performance/compare-your-area/?tc=DEV.4063) is not disallowed
https://www.police.uk/pu/your-area/devon-and-cornwall-police/performance/performance-devon-and-cornwall-police/?tc=DEV.4063 (https://www.police.uk/pu/your-area/devon-and-cornwall-police/performance/performance-devon-and-cornwall-police/?tc=

DEV.4063) is not disallowed
Navigation to the Devon & Cornwall Police performance page is successful.
https://www.police.uk/pu/your-area/devon-and-cornwall-police/performance/financial-reserves/?tc=DEV.4063 (https://www.police.uk/pu/your-area/devon-and-cornwall-police/performance/financial-reserves/?tc=DEV.4063) is not disallowed
https://www.police.uk/pu/your-area/dorset-police/performance/performance-dorset-police/?tc=55.CP3001 (https://www.police.uk/pu/your-area/dorset-police/performance/performance-dorset-police/?tc=55.CP3001) is not disallowed
Navigation to the Dorset Police performance page is successful.
https://www.police.uk/pu/your-area/dorset-police/performance/compare-your-area/?tc=55.CP3001 (https://www.police.uk/pu/your-area/dorset-police/performance/compare-your-area/?tc=55.CP3001) is not disallowed
https://www.police.uk/pu/your-area/dorset-police/performance/performance-dorset-police/?tc=55.CP3001 (https://www.police.uk/pu/your-area/dorset-police/performance/performance-dorset-police/?tc=55.CP3001) is not disallowed
Navigation to the Dorset Police performance page is successful.
https://www.police.uk/pu/your-area/dorset-police/performance/financial-reserves/?tc=55.CP3001 (https://www.police.uk/pu/your-area/dorset-police/performance/financial-reserves/?tc=55.CP3001) is not disallowed
https://www.police.uk/pu/your-area/durham-constabulary/performance/performance-durham-police/?tc=DHAM11 (https://www.police.uk/pu/your-area/durham-constabulary/performance/performance-durham-police/?tc=DHAM11) is not disallowed
Navigation to the Durham Constabulary performance page is successful.
https://www.police.uk/pu/your-area/durham-constabulary/performance/compare-your-area/?tc=DHAM11 (https://www.police.uk/pu/your-area/durham-constabulary/performance/compare-your-area/?tc=DHAM11) is not disallowed
https://www.police.uk/pu/your-area/durham-constabulary/performance/performance-durham-police/?tc=DHAM11 (https://www.police.uk/pu/your-area/durham-constabulary/performance/performance-durham-police/?tc=DHAM11) is not disallowed
Navigation to the Durham Constabulary performance page is successful.
https://www.police.uk/pu/your-area/durham-constabulary/performance/financial-reserves/?tc=DHAM11 (https://www.police.uk/pu/your-area/durham-constabulary/performance/financial-reserves/?tc=DHAM11) is not disallowed
https://www.police.uk/pu/your-area/dyfed-powys-police/performance/performance-dyfed-powys-police/?tc=A005 (https://www.police.uk/pu/your-area/dyfed-powys-police/performance/performance-dyfed-powys-police/?tc=A005) is not disallowed
Navigation to the Dyfed-Powys Police performance page is successful.
https://www.police.uk/pu/your-area/dyfed-powys-police/performance/compare-your-area/?tc=A005 (https://www.police.uk/pu/your-area/dyfed-powys-police/performance/compare-your-area/?tc=A005) is not disallowed
https://www.police.uk/pu/your-area/dyfed-powys-police/performance/performance-dyfed-powys-police/?tc=A005 (https://www.police.uk/pu/your-area/dyfed-powys-police/performance/performance-dyfed-powys-police/?tc=A005) is not disallowed
Navigation to the Dyfed-Powys Police performance page is successful.
https://www.police.uk/pu/your-area/dyfed-powys-police/performance/financial-reserves/?tc=A005 (https://www.police.uk/pu/your-area/dyfed-powys-police/performance/financial-reserves/?tc=A005) is not disallowed
https://www.police.uk/pu/your-area/essex-police/performance/performance-essex-police/?tc=NB102 (https://www.police.uk/pu/your-area/essex-police/performance/performance-essex-police/?tc=NB102) is not disallowed
Navigation to the Essex Police performance page is successful.
https://www.police.uk/pu/your-area/essex-police/performance/compare-your-area/?tc=NB102 (https://www.police.uk/pu/your-area/essex-police/performance/compare-your-area/?tc=NB102) is not disallowed
https://www.police.uk/pu/your-area/essex-police/performance/performance-essex-police/?tc=NB102 (https://www.police.uk/pu/your-area/essex-police/performance/performance-essex-police/?tc=NB102) is not disallowed
Navigation to the Essex Police performance page is successful.
https://www.police.uk/pu/your-area/essex-police/performance/financial-reserves/?tc=NB102 (https://www.police.uk/pu/your-area/essex-police/performance/financial-reserves/?tc=NB102) is not disallowed
https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/performance-gloucestershire-constabulary/?tc=BB3 (https://www.police.uk/pu/your-are

a/gloucestershire-constabulary/performance/performance-gloucestershire-constabulary/?tc=BB3) is not disallowed
Navigation to the Gloucestershire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/compare-your-area/?tc=BB3 (https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/compare-your-area/?tc=BB3) is not disallowed
https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/performance-gloucestershire-constabulary/?tc=BB3 (https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/performance-gloucestershire-constabulary/?tc=BB3) is not disallowed

a/gloucestershire-constabulary/performance/performance-gloucestershire-constabulary/?tc=BB3) is not disallowed
Navigation to the Gloucestershire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/compare-your-area/?tc=BB3 (https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/compare-your-area/?tc=BB3) is not disallowed
https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/performance-gloucestershire-constabulary/?tc=BB3 (https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/performance-gloucestershire-constabulary/?tc=BB3) is not disallowed

Navigation to the Gloucestershire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/financial-reserves/?tc=BB3 (https://www.police.uk/pu/your-area/gloucestershire-constabulary/performance/financial-reserves/?tc=BB3) is not disallowed
https://www.police.uk/pu/your-area/greater-manchester-police/performance/performance-greater-manchester-police/?tc=AC20 (https://www.police.uk/pu/your-area/greater-manchester-police/performance/performance-greater-manchester-police/?tc=AC20) is not disallowed
Navigation to the Greater Manchester Police performance page is successful.
https://www.police.uk/pu/your-area/greater-manchester-police/performance/compare-your-area/?tc=AC20 (https://www.police.uk/pu/your-area/greater-manchester-police/performance/compare-your-area/?tc=AC20) is not disallowed
https://www.police.uk/pu/your-area/greater-manchester-police/performance/performance-greater-manchester-police/?tc=AC20 (https://www.police.uk/pu/your-area/greater-manchester-police/performance/performance-greater-manchester-police/?tc=AC20) is not disallowed
Navigation to the Greater Manchester Police performance page is successful.
https://www.police.uk/pu/your-area/greater-manchester-police/performance/financial-reserves/?tc=AC20 (https://www.police.uk/pu/your-area/greater-manchester-police/performance/financial-reserves/?tc=AC20) is not disallowed
https://www.police.uk/pu/your-area/gwent-police/performance/performance-gwent-police/?tc=TC83 (https://www.police.uk/pu/your-area/gwent-police/performance/performance-gwent-police/?tc=TC83) is not disallowed
Navigation to the Gwent Police performance page is successful.
https://www.police.uk/pu/your-area/gwent-police/performance/compare-your-area/?tc=TC83 (https://www.police.uk/pu/your-area/gwent-police/performance/compare-your-area/?tc=TC83) is not disallowed
https://www.police.uk/pu/your-area/gwent-police/performance/performance-gwent-police/?tc=TC83 (https://www.police.uk/pu/your-area/gwent-police/performance/performance-gwent-police/?tc=TC83) is not disallowed
Navigation to the Gwent Police performance page is successful.
https://www.police.uk/pu/your-area/gwent-police/performance/financial-reserves/?tc=TC83 (https://www.police.uk/pu/your-area/gwent-police/performance/financial-reserves/?tc=TC83) is not disallowed
https://www.police.uk/pu/your-area/hampshire-constabulary/performance/performance-hampshire-constabulary/?tc=9WC02 (https://www.police.uk/pu/your-area/hampshire-constabulary/performance/performance-hampshire-constabulary/?tc=9WC02) is not disallowed
Navigation to the Hampshire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/hampshire-constabulary/performance/compare-your-area/?tc=9WC02 (https://www.police.uk/pu/your-area/hampshire-constabulary/performance/compare-your-area/?tc=9WC02) is not disallowed
https://www.police.uk/pu/your-area/hampshire-constabulary/performance/performance-hampshire-constabulary/?tc=9WC02 (https://www.police.uk/pu/your-area/hampshire-constabulary/performance/performance-hampshire-constabulary/?tc=9WC02) is not disallowed
Navigation to the Hampshire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/hampshire-constabulary/performance/financial-reserves/?tc=9WC02 (https://www.police.uk/pu/your-area/hampshire-constabulary/performance/financial-reserves/?tc=9WC02) is not disallowed
https://www.police.uk/pu/your-area/hertfordshire-constabulary/performance/performance-hertfordshire-constabulary/?tc=B01 (https://www.police.uk/pu/your-area/hertfordshire-constabulary/performance/performance-hertfordshire-constabulary/?tc=B01) is not disallowed
Navigation to the Hertfordshire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/hertfordshire-constabulary/performance/compare-your-area/?tc=B01 (https://www.police.uk/pu/your-area/hertfordshire-constabulary/performance/compare-your-area/?tc=B01) is not disallowed
https://www.police.uk/pu/your-area/hertfordshire-constabulary/performance/performance-hertfordshire-constabulary/?tc=B01 (https://www.police.uk/pu/your-area/hertfordshire-constabulary/performance/performance-hertfordshire-constabulary/?tc=B01) is not disallowed
Navigation to the Hertfordshire Constabulary performance page is successful.

https://www.police.uk/pu/your-area/hertfordshire-constabulary/performance/financial-reserves/?tc=B01 (https://www.police.uk/pu/your-area/hertfordshire-constabulary/performance/financial-reserves/?tc=B01) is not disallowed
https://www.police.uk/pu/your-area/humberside-police/performance/performance-humberside-police/?tc=33 (https://www.police.uk/pu/your-area/humberside-police/performance/performance-humberside-police/?tc=33) is not disallowed
Navigation to the Humberside Police performance page is successful.
https://www.police.uk/pu/your-area/humberside-police/performance/compare-your-area/?tc=33 (https://www.police.uk/pu/your-area/humberside-police/performance/compare-your-area/?tc=33) is not disallowed
https://www.police.uk/pu/your-area/humberside-police/performance/performance-humberside-police/?tc=33 (https://www.police.uk/pu/your-area/humberside-police/performance/performance-humberside-police/?tc=33) is not disallowed
Navigation to the Humberside Police performance page is successful.
https://www.police.uk/pu/your-area/humberside-police/performance/financial-reserves/?tc=33 (https://www.police.uk/pu/your-area/humberside-police/performance/financial-reserves/?tc=33) is not disallowed
https://www.police.uk/pu/your-area/kent-police/performance/performance-kent-police/?tc=YA36 (https://www.police.uk/pu/your-area/kent-police/performance/performance-kent-police/?tc=YA36) is not disallowed
Navigation to the Kent Police performance page is successful.
https://www.police.uk/pu/your-area/kent-police/performance/compare-your-area/?tc=YA36 (https://www.police.uk/pu/your-area/kent-police/performance/compare-your-area/?tc=YA36) is not disallowed
https://www.police.uk/pu/your-area/kent-police/performance/performance-kent-police/?tc=YA36 (https://www.police.uk/pu/your-area/kent-police/performance/performance-kent-police/?tc=YA36) is not disallowed
Navigation to the Kent Police performance page is successful.
https://www.police.uk/pu/your-area/kent-police/performance/financial-reserves/?tc=YA36 (https://www.police.uk/pu/your-area/kent-police/performance/financial-reserves/?tc=YA36) is not disallowed
https://www.police.uk/pu/your-area/lancashire-constabulary/performance/performance-lancashire-constabulary/?tc=C21 (https://www.police.uk/pu/your-area/lancashire-constabulary/performance/performance-lancashire-constabulary/?tc=C21) is not disallowed
Navigation to the Lancashire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/lancashire-constabulary/performance/compare-your-area/?tc=C21 (https://www.police.uk/pu/your-area/lancashire-constabulary/performance/compare-your-area/?tc=C21) is not disallowed
Not enough buttons found.
https://www.police.uk/pu/your-area/lancashire-constabulary/performance/performance-lancashire-constabulary/?tc=C21 (https://www.police.uk/pu/your-area/lancashire-constabulary/performance/performance-lancashire-constabulary/?tc=C21) is not disallowed
Navigation to the Lancashire Constabulary performance page is successful.
https://www.police.uk/pu/your-area/lancashire-constabulary/performance/financial-reserves/?tc=C21 (https://www.police.uk/pu/your-area/lancashire-constabulary/performance/financial-reserves/?tc=C21) is not disallowed
https://www.police.uk/pu/your-area/leicestershire-police/performance/performance-leicestershire-police/?tc=NH20 (https://www.police.uk/pu/your-area/leicestershire-police/performance/performance-leicestershire-police/?tc=NH20) is not disallowed
Navigation to the Leicestershire Police performance page is successful.
https://www.police.uk/pu/your-area/leicestershire-police/performance/compare-your-area/?tc=NH20 (https://www.police.uk/pu/your-area/leicestershire-police/performance/compare-your-area/?tc=NH20) is not disallowed
https://www.police.uk/pu/your-area/leicestershire-police/performance/performance-leicestershire-police/?tc=NH20 (https://www.police.uk/pu/your-area/leicestershire-police/performance/performance-leicestershire-police/?tc=NH20) is not disallowed
Navigation to the Leicestershire Police performance page is successful.
https://www.police.uk/pu/your-area/leicestershire-police/performance/financial-reserves/?tc=NH20 (https://www.police.uk/pu/your-area/leicestershire-police/perfo

rmance/financial-reserves/?tc=NH20) is not disallowed

https://www.police.uk/pu/your-area/lincolnshire-police/performance/performance-lincolnshire-police/?tc=NC07 (https://www.police.uk/pu/your-area/lincolnshire-police/performance/performance-lincolnshire-police/?tc=NC07) is not disallowed
Navigation to the Lincolnshire Police performance page is successful.

https://www.police.uk/pu/your-area/lincolnshire-police/performance/compare-your-area/?tc=NC07 (https://www.police.uk/pu/your-area/lincolnshire-police/performance/compare-your-area/?tc=NC07) is not disallowed

https://www.police.uk/pu/your-area/lincolnshire-police/performance/performance-lincolnshire-police/?tc=NC07 (https://www.police.uk/pu/your-area/lincolnshire-police/performance/performance-lincolnshire-police/?tc=NC07) is not disallowed
Navigation to the Lincolnshire Police performance page is successful.

https://www.police.uk/pu/your-area/lincolnshire-police/performance/financial-reserves/?tc=NC07 (https://www.police.uk/pu/your-area/lincolnshire-police/performance/financial-reserves/?tc=NC07) is not disallowed

https://www.police.uk/pu/your-area/merseyside-police/performance/performance-merseyside-police/?tc=LPL2B (https://www.police.uk/pu/your-area/merseyside-police/performance/performance-merseyside-police/?tc=LPL2B) is not disallowed
Navigation to the Merseyside Police performance page is successful.

https://www.police.uk/pu/your-area/merseyside-police/performance/compare-your-area/?tc=LPL2B (https://www.police.uk/pu/your-area/merseyside-police/performance/compare-your-area/?tc=LPL2B) is not disallowed

https://www.police.uk/pu/your-area/merseyside-police/performance/performance-merseyside-police/?tc=LPL2B (https://www.police.uk/pu/your-area/merseyside-police/performance/performance-merseyside-police/?tc=LPL2B) is not disallowed
Navigation to the Merseyside Police performance page is successful.

https://www.police.uk/pu/your-area/merseyside-police/performance/financial-reserves/?tc=LPL2B (https://www.police.uk/pu/your-area/merseyside-police/performance/financial-reserves/?tc=LPL2B) is not disallowed

https://www.police.uk/pu/your-area/police-service-of-northern-ireland/performance/performance-psni/?tc=Strabane (https://www.police.uk/pu/your-area/police-service-of-northern-ireland/performance/performance-psni/?tc=Strabane) is not disallowed
Navigation to the MOPAC performance page is successful.
No data available

https://www.police.uk/pu/your-area/police-service-of-northern-ireland/performance/performance-psni/?tc=Strabane (https://www.police.uk/pu/your-area/police-service-of-northern-ireland/performance/performance-psni/?tc=Strabane) is not disallowed
Navigation to the MOPAC performance page is successful.
No data available

https://www.police.uk/pu/your-area/norfolk-constabulary/performance/performance-norfolk-constabulary/?tc=D12 (https://www.police.uk/pu/your-area/norfolk-constabulary/performance/performance-norfolk-constabulary/?tc=D12) is not disallowed
Navigation to the Norfolk Constabulary performance page is successful.

https://www.police.uk/pu/your-area/norfolk-constabulary/performance/compare-your-area/?tc=D12 (https://www.police.uk/pu/your-area/norfolk-constabulary/performance/compare-your-area/?tc=D12) is not disallowed

https://www.police.uk/pu/your-area/norfolk-constabulary/performance/performance-norfolk-constabulary/?tc=D12 (https://www.police.uk/pu/your-area/norfolk-constabulary/performance/performance-norfolk-constabulary/?tc=D12) is not disallowed
Navigation to the Norfolk Constabulary performance page is successful.

https://www.police.uk/pu/your-area/norfolk-constabulary/performance/financial-reserves/?tc=D12 (https://www.police.uk/pu/your-area/norfolk-constabulary/performance/financial-reserves/?tc=D12) is not disallowed

https://www.police.uk/pu/your-area/north-wales-police/performance/performance-north-wales-police/?tc=WCW18 (https://www.police.uk/pu/your-area/north-wales-police/performance/performance-north-wales-police/?tc=WCW18) is not disallowed
Navigation to the North Wales Police performance page is successful.

https://www.police.uk/pu/your-area/north-wales-police/performance/compare-your-area/?tc=WCW18 (https://www.police.uk/pu/your-area/north-wales-police/performance/compare-your-area/?tc=WCW18) is not disallowed

https://www.police.uk/pu/your-area/north-wales-police/performance/performance-no

rth-wales-police/?tc=WCW18 (https://www.police.uk/pu/your-area/north-wales-police/performance/performance-north-wales-police/?tc=WCW18) is not disallowed
Navigation to the North Wales Police performance page is successful.
https://www.police.uk/pu/your-area/north-wales-police/performance/financial-reserves/?tc=WCW18 (https://www.police.uk/pu/your-area/north-wales-police/performance/financial-reserves/?tc=WCW18) is not disallowed
https://www.police.uk/pu/your-area/north-yorkshire-police/performance/performance-north-yorkshire-police/?tc=york-outer (https://www.police.uk/pu/your-area/north-yorkshire-police/performance/performance-north-yorkshire-police/?tc=york-outer) is not disallowed
Navigation to the North Yorkshire Police performance page is successful.
https://www.police.uk/pu/your-area/north-yorkshire-police/performance/compare-your-area/?tc=york-outer (https://www.police.uk/pu/your-area/north-yorkshire-police/performance/compare-your-area/?tc=york-outer) is not disallowed

https://www.police.uk/pu/your-area/north-yorkshire-police/performance/performance-north-yorkshire-police/?tc=york-outer (https://www.police.uk/pu/your-area/north-yorkshire-police/performance/performance-north-yorkshire-police/?tc=york-outer) is not disallowed
Navigation to the North Yorkshire Police performance page is successful.
https://www.police.uk/pu/your-area/north-yorkshire-police/performance/financial-reserves/?tc=york-outer (https://www.police.uk/pu/your-area/north-yorkshire-police/performance/financial-reserves/?tc=york-outer) is not disallowed
https://www.police.uk/pu/your-area/northamptonshire-police/performance/performance-northamptonshire-police/?tc=NN6 (https://www.police.uk/pu/your-area/northamptonshire-police/performance/performance-northamptonshire-police/?tc=NN6) is not disallowed
Navigation to the Northamptonshire Police performance page is successful.
https://www.police.uk/pu/your-area/northamptonshire-police/performance/compare-your-area/?tc=NN6 (https://www.police.uk/pu/your-area/northamptonshire-police/performance/compare-your-area/?tc=NN6) is not disallowed
https://www.police.uk/pu/your-area/northamptonshire-police/performance/performance-northamptonshire-police/?tc=NN6 (https://www.police.uk/pu/your-area/northamptonshire-police/performance/performance-northamptonshire-police/?tc=NN6) is not disallowed
Navigation to the Northamptonshire Police performance page is successful.
https://www.police.uk/pu/your-area/northamptonshire-police/performance/financial-reserves/?tc=NN6 (https://www.police.uk/pu/your-area/northamptonshire-police/performance/financial-reserves/?tc=NN6) is not disallowed
https://www.police.uk/pu/your-area/northumbria-police/performance/performance-northumbria-police/?tc=A5 (https://www.police.uk/pu/your-area/northumbria-police/performance/performance-northumbria-police/?tc=A5) is not disallowed
Navigation to the Northumbria Police performance page is successful.
https://www.police.uk/pu/your-area/northumbria-police/performance/compare-your-area/?tc=A5 (https://www.police.uk/pu/your-area/northumbria-police/performance/compare-your-area/?tc=A5) is not disallowed
https://www.police.uk/pu/your-area/northumbria-police/performance/performance-northumbria-police/?tc=A5 (https://www.police.uk/pu/your-area/northumbria-police/performance/performance-northumbria-police/?tc=A5) is not disallowed
Navigation to the Northumbria Police performance page is successful.
https://www.police.uk/pu/your-area/northumbria-police/performance/financial-reserves/?tc=A5 (https://www.police.uk/pu/your-area/northumbria-police/performance/financial-reserves/?tc=A5) is not disallowed
https://www.police.uk/pu/your-area/nottinghamshire-police/performance/performance-nottinghamshire-police/?tc=31-28 (https://www.police.uk/pu/your-area/nottinghamshire-police/performance/performance-nottinghamshire-police/?tc=31-28) is not disallowed
Navigation to the Nottinghamshire Police performance page is successful.
https://www.police.uk/pu/your-area/nottinghamshire-police/performance/compare-your-area/?tc=31-28 (https://www.police.uk/pu/your-area/nottinghamshire-police/performance/compare-your-area/?tc=31-28) is not disallowed
https://www.police.uk/pu/your-area/nottinghamshire-police/performance/performance-nottinghamshire-police/?tc=31-28 (https://www.police.uk/pu/your-area/nottinghamshire-police/performance/performance-nottinghamshire-police/?tc=31-28) is not disallowed
Navigation to the Nottinghamshire Police performance page is successful.
https://www.police.uk/pu/your-area/nottinghamshire-police/performance/financial-reserves/?tc=31-28 (https://www.police.uk/pu/your-area/nottinghamshire-police/performance/financial-reserves/?tc=31-28) is not disallowed
https://www.police.uk/pu/your-area/south-wales-police/performance/performance-south-wales-police/?tc=W05000898 (https://www.police.uk/pu/your-area/south-wales-police/performance/performance-south-wales-police/?tc=W05000898) is not disallowed
Navigation to the South Wales Police performance page is successful.
https://www.police.uk/pu/your-area/south-wales-police/performance/compare-your-area/?tc=W05000898 (https://www.police.uk/pu/your-area/south-wales-police/performance/compare-your-area/?tc=W05000898) is not disallowed
https://www.police.uk/pu/your-area/south-wales-police/performance/performance-so

uth-wales-police/?tc=W05000898 (https://www.police.uk/pu/your-area/south-wales-police/performance/performance-south-wales-police/?tc=W05000898) is not disallowed

Navigation to the South Wales Police performance page is successful.
https://www.police.uk/pu/your-area/south-wales-police/performance/financial-reserves/?tc=W05000898 (https://www.police.uk/pu/your-area/south-wales-police/performance/financial-reserves/?tc=W05000898) is not disallowed
https://www.police.uk/pu/your-area/south-yorkshire-police/performance/performance-south-yorkshire-police/?tc=KC (https://www.police.uk/pu/your-area/south-yorkshire-police/performance/performance-south-yorkshire-police/?tc=KC) is not disallowed

Navigation to the South Yorkshire Police performance page is successful.
https://www.police.uk/pu/your-area/south-yorkshire-police/performance/compare-your-area/?tc=KC (https://www.police.uk/pu/your-area/south-yorkshire-police/performance/compare-your-area/?tc=KC) is not disallowed
https://www.police.uk/pu/your-area/south-yorkshire-police/performance/performance-south-yorkshire-police/?tc=KC (https://www.police.uk/pu/your-area/south-yorkshire-police/performance/performance-south-yorkshire-police/?tc=KC) is not disallowed

Navigation to the South Yorkshire Police performance page is successful.
https://www.police.uk/pu/your-area/south-yorkshire-police/performance/financial-reserves/?tc=KC (https://www.police.uk/pu/your-area/south-yorkshire-police/performance/financial-reserves/?tc=KC) is not disallowed
https://www.police.uk/pu/your-area/staffordshire-police/performance/performance-staffordshire-police/?tc=WM0 (https://www.police.uk/pu/your-area/staffordshire-police/performance/performance-staffordshire-police/?tc=WM0) is not disallowed
Navigation to the Staffordshire Police performance page is successful.
https://www.police.uk/pu/your-area/staffordshire-police/performance/compare-your-area/?tc=WM0 (https://www.police.uk/pu/your-area/staffordshire-police/performance/compare-your-area/?tc=WM0) is not disallowed
https://www.police.uk/pu/your-area/staffordshire-police/performance/performance-staffordshire-police/?tc=WM0 (https://www.police.uk/pu/your-area/staffordshire-police/performance/performance-staffordshire-police/?tc=WM0) is not disallowed
Navigation to the Staffordshire Police performance page is successful.
https://www.police.uk/pu/your-area/staffordshire-police/performance/financial-reserves/?tc=WM0 (https://www.police.uk/pu/your-area/staffordshire-police/performance/financial-reserves/?tc=WM0) is not disallowed
https://www.police.uk/pu/your-area/suffolk-constabulary/performance/performance-suffolk-constabulary/?tc=S16 (https://www.police.uk/pu/your-area/suffolk-constabulary/performance/performance-suffolk-constabulary/?tc=S16) is not disallowed
Navigation to the Suffolk Constabulary performance page is successful.
https://www.police.uk/pu/your-area/suffolk-constabulary/performance/compare-your-area/?tc=S16 (https://www.police.uk/pu/your-area/suffolk-constabulary/performance/compare-your-area/?tc=S16) is not disallowed
https://www.police.uk/pu/your-area/suffolk-constabulary/performance/performance-suffolk-constabulary/?tc=S16 (https://www.police.uk/pu/your-area/suffolk-constabulary/performance/performance-suffolk-constabulary/?tc=S16) is not disallowed
Navigation to the Suffolk Constabulary performance page is successful.
https://www.police.uk/pu/your-area/suffolk-constabulary/performance/financial-reserves/?tc=S16 (https://www.police.uk/pu/your-area/suffolk-constabulary/performance/financial-reserves/?tc=S16) is not disallowed
https://www.police.uk/pu/your-area/surrey-police/performance/performance-surrey-police/?tc=GDAS (https://www.police.uk/pu/your-area/surrey-police/performance/performance-surrey-police/?tc=GDAS) is not disallowed
Navigation to the Surrey Police performance page is successful.
https://www.police.uk/pu/your-area/surrey-police/performance/compare-your-area/?tc=GDAS (https://www.police.uk/pu/your-area/surrey-police/performance/compare-your-area/?tc=GDAS) is not disallowed
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s/?tc=GDAS (https://www.police.uk/pu/your-area/surrey-police/performance/financial-reserves/?tc=GDAS) is not disallowed

https://www.police.uk/pu/your-area/sussex-police/performance/performance-sussex-police/?tc=ES1NH1 (https://www.police.uk/pu/your-area/sussex-police/performance/performance-sussex-police/?tc=ES1NH1) is not disallowed

Navigation to the Sussex Police performance page is successful.

https://www.police.uk/pu/your-area/sussex-police/performance/compare-your-area/?tc=ES1NH1 (https://www.police.uk/pu/your-area/sussex-police/performance/compare-your-area/?tc=ES1NH1) is not disallowed

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Navigation to the Sussex Police performance page is successful.

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https://www.police.uk/pu/your-area/thames-valley-police/performance/performance-thames-valley-police/?tc=N473 (https://www.police.uk/pu/your-area/thames-valley-police/performance/performance-thames-valley-police/?tc=N473) is not disallowed

Navigation to the Thames Valley Police performance page is successful.

https://www.police.uk/pu/your-area/thames-valley-police/performance/compare-your-area/?tc=N473 (https://www.police.uk/pu/your-area/thames-valley-police/performance/compare-your-area/?tc=N473) is not disallowed

https://www.police.uk/pu/your-area/thames-valley-police/performance/performance-thames-valley-police/?tc=N473 (https://www.police.uk/pu/your-area/thames-valley-police/performance/performance-thames-valley-police/?tc=N473) is not disallowed

Navigation to the Thames Valley Police performance page is successful.

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https://www.police.uk/pu/your-area/warwickshire-police/performance/performance-warwickshire-police/?tc=wrw (https://www.police.uk/pu/your-area/warwickshire-police/performance/performance-warwickshire-police/?tc=wrw) is not disallowed

Navigation to the Warwickshire Police performance page is successful.

https://www.police.uk/pu/your-area/warwickshire-police/performance/compare-your-area/?tc=wrw (https://www.police.uk/pu/your-area/warwickshire-police/performance/compare-your-area/?tc=wrw) is not disallowed

https://www.police.uk/pu/your-area/warwickshire-police/performance/performance-warwickshire-police/?tc=wrw (https://www.police.uk/pu/your-area/warwickshire-police/performance/performance-warwickshire-police/?tc=wrw) is not disallowed

Navigation to the Warwickshire Police performance page is successful.

https://www.police.uk/pu/your-area/warwickshire-police/performance/financial-reserves/?tc=wrw (https://www.police.uk/pu/your-area/warwickshire-police/performance/financial-reserves/?tc=wrw) is not disallowed

https://www.police.uk/pu/your-area/west-mercia-police/performance/performance-west-mercia-police/?tc=PAC13 (https://www.police.uk/pu/your-area/west-mercia-police/performance/performance-west-mercia-police/?tc=PAC13) is not disallowed

Navigation to the West Mercia Police performance page is successful.

https://www.police.uk/pu/your-area/west-mercia-police/performance/compare-your-area/?tc=PAC13 (https://www.police.uk/pu/your-area/west-mercia-police/performance/compare-your-area/?tc=PAC13) is not disallowed

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Navigation to the West Mercia Police performance page is successful.

https://www.police.uk/pu/your-area/west-mercia-police/performance/financial-reserves/?tc=PAC13 (https://www.police.uk/pu/your-area/west-mercia-police/performance/financial-reserves/?tc=PAC13) is not disallowed

https://www.police.uk/pu/your-area/west-midlands-police/performance/performance-west-midlands-police/?tc=WS002 (https://www.police.uk/pu/your-area/west-midlands-police/performance/performance-west-midlands-police/?tc=WS002) is not disallowed

Navigation to the West Midlands Police performance page is successful.

https://www.police.uk/pu/your-area/west-midlands-police/performance/compare-your
-area/?tc=WS002 (https://www.police.uk/pu/your-area/west-midlands-police/perform
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west-midlands-police/?tc=WS002 (https://www.police.uk/pu/your-area/west-midlands
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mance/financial-reserves/?tc=WS002) is not disallowed

https://www.police.uk/pu/your-area/west-yorkshire-police/performance/performance
-west-yorkshire-police/?tc=WDT_WEST (https://www.police.uk/pu/your-area/west-yor
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Navigation to the West Yorkshire Police performance page is successful.
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https://www.police.uk/pu/your-area/wiltshire-police/performance/performance-wilt
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rmance/performance-wiltshire-police/?tc=EZ11) is not disallowed
Navigation to the Wiltshire Police performance page is successful.
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are-your-area/?tc=EZ11) is not disallowed
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shire-police/?tc=EZ11 (https://www.police.uk/pu/your-area/wiltshire-police/perfo
rmance/performance-wiltshire-police/?tc=EZ11) is not disallowed
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https://www.police.uk/pu/your-area/wiltshire-police/performance/financial-reserv
es/?tc=EZ11 (https://www.police.uk/pu/your-area/wiltshire-police/performance/fin
ancial-reserves/?tc=EZ11) is not disallowed

Notice how the bot determines whether the page is disallowed by robots.txt before scraping it!

Saving Raw Data

The dictionaries that were created by my bot are saved in my specified project folder with the following
cells:

```
In [13]:   file_path = r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\raw\jurisdi
           with open(file_path, 'w', encoding='utf-8') as file:
               json.dump(jurisdictions, file, ensure_ascii=False, indent=4)
```

```
In [14]:   file_path = r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\raw\finance
           with open(file_path, 'w', encoding='utf-8') as file:
               json.dump(financial_reserves, file, ensure_ascii=False, indent=4)
```

Data Cleaning

The webpage states that data is not available for "City of London Police" force area, so we'll add that force area manually. Similarly, most of the desired data was unavailable for the aggregate "Total England & Wales", so we need to add empty dictionaries to represent missing values in our data for those two "force areas".

```
In [60]:   Force_Areas.append("City of London Police")
```

Dictionaries to Dataframes

We need to store that data in a pandas series to unlock better functionality. The idea is to get force area level data on financial reserves over the period since records begin and average crime rate for each force area last year.

```python
import pandas as pd
import numpy as np

force_avg_crime_rate = {}
force_jurisdictions = {}
financial_data = {}

# Process average crime rates and jurisdictions
for area in Force_Areas:
    force_avg_crime_rate[area] = jurisdictions.get(area, {}).get('Force average',
    force_jurisdictions[area] = [j for j in jurisdictions.get(area, {}) if j != '

# Create Pandas Series
Force_Crime_Rates = pd.Series(force_avg_crime_rate, name='Average Crime Rate')
Force_Jurisdictions = pd.Series(force_jurisdictions, name='Jurisdictions')

# Create DataFrame from Series
ForceAreas = pd.DataFrame({'Average Crime Rate': Force_Crime_Rates, 'Jurisdiction

# Process financial reserves
for area in Force_Areas:
    area_data = financial_reserves.get(area, {})
    for period in Periods:
        for fund in Reserves:
            key = f"{period} {fund}"
            value = area_data.get(period, {}).get(fund, np.nan)
            financial_data.setdefault(key, {})[area] = value

# Add financial data to DataFrame
for key, values in financial_data.items():
    ForceAreas[key] = pd.Series(values)

ForceAreas.index.name = 'Force Area'
ForceAreas
```

Out[16]:

Force Area	Average Crime Rate	Jurisdictions	Mar 2011 General fund	Mar 2011 Earmarked reserves	Mar 2011 Total resource reserves	Mar 2011 Capital reserves	Mar 2012 General fund
Avon and Somerset Constabulary	83.24	[Bath & North East Somerset, South Gloucesters...	£6.7m	£25.6m	£32.2m	£2.1m	£7.5m
Bedfordshire Police	73.8	[Central Bedfordshire, Bedford, Luton]	£2.9m	£6.5m	£9.4m	£0.4m	£2.9m
Cambridgeshire Constabulary	84.51	[East Cambridgeshire, South Cambridgeshire,...	£4.8m	£13.3m	£18.1m	£18.2m	£7.0m

Strings to Floats

Everything that has been scraped is stored as a string. This means we cannot treat the numeric data as numbers without first converting the string into the appropriate number. The next two functions are designed to achieve this:

```
In [17]:  def convert_currency(value):
              # Check if the value is a string
              if isinstance(value, str):
                  # Remove the pound sign and any other non-numeric characters except for '
                  value = value.replace('£', '').replace('m', '').strip()
                  # Convert to float and then scale if 'm' was in the original string
                  try:
                      value = float(value)
                      value *= 1000000  # Convert millions to a plain numeric value
                  except ValueError:
                      return None
              return value
```

```
In [18]:  def string_to_float(string):
              value = 1
              # Check if the value is a string
              if isinstance(string, str):
                  try:
                      value = float(string)
                  except ValueError:
                      return np.nan
                  return value
```

```
In [19]:  for finances in ForceAreas.iloc[:,2:].columns:
              ForceAreas[finances]=ForceAreas[finances].apply(convert_currency)
          ForceAreas
```

Out[19]:

Force Area	Average Crime Rate	Jurisdictions	Mar 2011 General fund	Mar 2011 Earmarked reserves	Mar 2011 Total resource reserves	Mar 2011 Capital reserves	
Avon and Somerset Constabulary	83.24	[Bath & North East Somerset, South Gloucesters...	6700000.0	25600000.0	32200000.0	2100000.0	
Bedfordshire Police	73.8	[Central Bedfordshire, Bedford, Luton]	2900000.0	6500000.0	9400000.0	400000.0	
Cambridgeshire Constabulary	84.51	[East Cambridgeshire, South Cambridgeshire, Hu...	4800000.0	13300000.0	18100000.0	18200000.0	

```
In [20]:  ▶| ForceAreas['Average Crime Rate']=ForceAreas['Average Crime Rate'].str.strip().app
          ForceAreas
```

Out[20]:

Force Area	Average Crime Rate	Jurisdictions	Mar 2011 General fund	Mar 2011 Earmarked reserves	Mar 2011 Total resource reserves	Mar 2011 Capital reserves	
Avon and Somerset Constabulary	83.24	[Bath & North East Somerset, South Gloucesters...	6700000.0	25600000.0	32200000.0	2100000.0	
Bedfordshire Police	73.80	[Central Bedfordshire, Bedford, Luton]	2900000.0	6500000.0	9400000.0	400000.0	
Cambridgeshire Constabulary	84.51	[East Cambridgeshire, South Cambridgeshire, Hu...	4800000.0	13300000.0	18100000.0	18200000.0	

Generating Aggregates

Now that the data is numeric, we can calculate some aggregates, such as the average and maximum wealth for the force area over the 8 years on record, as well as a stand in "average" force area:

```
In [21]:  ▶| for period in Periods:
              newColumn = str(period+' Wealth')
              ForceAreas[newColumn] = ForceAreas[str(period+ ' Total resource reserves')] +
          ForceAreas['Average Wealth']=ForceAreas.iloc[:,-8:].mean(axis=1)
          ForceAreas['Max Wealth']=ForceAreas.iloc[:,-9:-1].max(axis=1)
          mean_row=ForceAreas.mean(skipna=True)
          ForceAreas.loc['Mean Force Area'] = mean_row
          ForceAreas
```

Force Area	Average Crime Rate	Jurisdictions	Mar 2011 General fund	Mar 2011 Earmarked reserves	Mar 2011 Total resource reserves	Mar 2 Ca reser
Avon and Somerset Constabulary	83.24000	[Bath & North East Somerset, South Gloucesters...	6.700000e+06	2.560000e+07	3.220000e+07	2.100000e
Bedfordshire Police	73.80000	[Central Bedfordshire, Bedford, Luton]	2.900000e+06	6.500000e+06	9.400000e+06	4.000000e
Cambridgeshire Constabulary	84.51000	[East Cambridgeshire, South Cambridgeshire, Hu...	4.800000e+06	1.330000e+07	1.810000e+07	1.820000e
Cheshire Constabulary	78.23000	[Cheshire East, Cheshire West, Warrington, Hal...	7.800000e+06	1.030000e+07	1.820000e+07	2.400000e
Cleveland Police	144.57000	[Stockton-on-Tees, Redcar & Cleveland, Hartlep...	7.100000e+06	6.000000e+06	1.310000e+07	3.000000e
Cumbria Constabulary	74.10000	[South Lakeland, Eden, Copeland, Allerdale, Ba...	5.100000e+06	1.680000e+07	2.200000e+07	3.300000e
Derbyshire Constabulary	85.62000	[Derbyshire Dales, North East Derbyshire, Sout...	3.300000e+06	3.170000e+07	3.500000e+07	6.200000e
Devon & Cornwall Police	58.60000	[Isles of Scilly, South Devon & Dartmoor, East...	6.200000e+06	2.230000e+07	2.850000e+07	6.200000e
Dorset Police	66.92000	[Dorset County, Poole, Bournemouth]	3.300000e+06	1.440000e+07	1.770000e+07	0.000000e
Durham Constabulary	106.92000	[County Durham, Darlington]	6.100000e+06	9.500000e+06	1.560000e+07	0.000000e
Dyfed-Powys Police	78.90000	[Powys, Carmarthenshire, Ceredigion, Pembrokes...	2.800000e+06	2.390000e+07	2.670000e+07	1.400000e
Essex Police	86.32000	[Rochford, Maldon, Uttlesford, Castle Point, B...	2.740000e+07	4.700000e+06	3.210000e+07	1.540000e
Gloucestershire Constabulary	85.25000	[Cotswold, Forest of Dean, Tewkesbury, Stroud,...	3.200000e+06	1.870000e+07	2.190000e+07	1.800000e
Greater Manchester Police	128.42000	[Trafford, Stockport, Bury, Wigan, Tameside, B...	3.260000e+07	1.770000e+07	5.030000e+07	2.100000e
Gwent Police	99.22000	[Monmouthshire, Caerphilly, Torfaen, Blaenau G...	5.500000e+06	3.470000e+07	4.010000e+07	0.000000e

Force Area	Average Crime Rate	Jurisdictions	Mar 2011 General fund	Mar 2011 Earmarked reserves	Mar 2011 Total resource reserves	Mar 2 Cap reser
Hampshire Constabulary	85.80000	[Fareham, East Hampshire, New Forest, Test Val...	2.950000e+07	7.800000e+06	3.730000e+07	0.000000e
Hertfordshire Constabulary	64.13000	[North Hertfordshire, Three Rivers, East Hertf...	6.100000e+06	1.330000e+07	1.940000e+07	0.000000e
Humberside Police	110.84000	[East Riding of Yorkshire, North Lincolnshire,...	5.400000e+06	2.840000e+07	3.390000e+07	0.000000e
Kent Police	92.93000	[Sevenoaks, Tunbridge Wells, Tonbridge & Malli...	6.000000e+06	1.460000e+07	2.060000e+07	1.350000e
Lancashire Constabulary	NaN	[]	6.900000e+06	1.320000e+07	2.010000e+07	1.100000e
Leicestershire Police	94.96000	[Rutland, Harborough, Oadby & Wigston, Hinckle...	5.300000e+06	1.850000e+07	2.380000e+07	0.000000e
Lincolnshire Police	75.72000	[North Kesteven, South Kesteven, South Holland...	5.100000e+06	5.500000e+06	1.060000e+07	0.000000e
Merseyside Police	111.70000	[Wirral, Sefton, Knowsley, St Helens, Liverpool]	9.300000e+06	2.090000e+07	3.020000e+07	2.100000e
MOPAC	NaN	[]	NaN	NaN	NaN	
Norfolk Constabulary	69.21000	[Broadland, North Norfolk, South Norfolk, Brec...	4.500000e+06	1.750000e+07	2.190000e+07	4.800000e
North Wales Police	84.07000	[Isle of Anglesey, Gwynedd, Flintshire, Conwy,...	7.200000e+06	2.100000e+07	2.820000e+07	5.100000e
North Yorkshire Police	59.65000	[North Yorkshire, York]	8.700000e+06	1.940000e+07	2.810000e+07	0.000000e
Northamptonshire Police	83.08000	[Daventry & South Northamptonshire, East North...	8.700000e+06	5.200000e+06	1.390000e+07	8.900000e
Northumbria Police	100.73000	[Northumberland, North Tyneside, Gateshead, So...	3.000000e+07	2.590000e+07	5.580000e+07	4.000000e
Nottinghamshire Police	91.75000	[South Nottinghamshire, Newark & Sherwood, Bas...	7.100000e+06	9.200000e+06	1.630000e+07	2.000000e
South Wales Police	83.63000	[Vale of Glamorgan, Neath & Port Talbot, Bridg...	5.700000e+06	3.090000e+07	3.670000e+07	0.000000e
South Yorkshire Police	113.65000	[Rotherham, Sheffield, Barnsley, Doncaster]	2.460000e+07	1.340000e+07	3.800000e+07	2.600000e

Force Area	Average Crime Rate	Jurisdictions	Mar 2011 General fund	Mar 2011 Earmarked reserves	Mar 2011 Total resource reserves	Mar 2011 Capital reserves
Staffordshire Police	80.51000	[Staffordshire Moorlands, South Staffordshire,...	5.400000e+06	8.000000e+06	1.340000e+07	0.000000e
Suffolk Constabulary	63.21000	[Suffolk Coastal, Western Suffolk, Waveney, Ip...	4.000000e+06	1.050000e+07	1.450000e+07	0.000000e
Surrey Police	62.25000	[Waverley, Tandridge, Surrey Heath, Mole Valle...	7.500000e+06	5.300000e+06	1.280000e+07	3.000000e
Sussex Police	79.09000	[Wealden, Mid Sussex, Horsham, Lewes, Rother, ...	1.020000e+07	4.150000e+07	5.170000e+07	4.800000e
Thames Valley Police	76.12000	[Chiltern, South Oxfordshire, Vale of White Ho...	1.840000e+07	2.290000e+07	4.130000e+07	2.040000e
Warwickshire Police	71.41000	[Rugby, South Warwickshire, North Warwickshire...	2.000000e+06	1.840000e+07	2.040000e+07	0.000000e
West Mercia Police	71.74000	[Shropshire, Herefordshire, South Worcestershi...	6.200000e+06	2.590000e+07	3.210000e+07	2.700000e
West Midlands Police	119.70000	[Dudley, Solihull, Walsall, Coventry, Sandwell...	8.000000e+06	7.110000e+07	7.910000e+07	3.990000e
West Yorkshire Police	132.34000	[Kirklees, Calderdale, Wakefield, Bradford, Le...	2.390000e+07	6.500000e+06	3.040000e+07	1.300000e
Wiltshire Police	59.43000	[Wiltshire County, Swindon]	7.700000e+06	9.000000e+06	1.670000e+07	0.000000e
Total England & Wales	NaN	NaN	NaN	NaN	NaN	
City of London Police	NaN	NaN	NaN	NaN	NaN	
Mean Force Area	86.80675	NaN	9.468293e+06	1.804634e+07	2.751463e+07	4.095122e

45 rows × 44 columns

Ranking Jurisdictions

We also want a dataframe that combines jurisdictions with their crime rates (excluding force area averages) so that we can see the worst 5 jurisdictions for crime rate and top 5 jurisdictions for crime rate. From that we need a dataframe linking each jurisdiction a force area so that we can identify which force areas have the most success and whether reserve resources are an effective predictor of reduced crime rate.

```
In [22]:    data = []
            for area, jurisdiction1 in jurisdictions.items():
                for jurisdiction2, crime_rate in jurisdiction1.items():
                    data.append({'Force Area': area, 'Jurisdiction': jurisdiction2, 'Crime Ra
            jurisdiction_df = pd.DataFrame(data)
            JurisdictionCrimes = jurisdiction_df[jurisdiction_df['Jurisdiction'] != 'Force av
            JurisdictionCrimes.set_index('Jurisdiction',inplace=True)
            JurisdictionCrimes
```

Out[22]:

Jurisdiction	Force Area	Crime Rate
Bath & North East Somerset	Avon and Somerset Constabulary	64.78
South Gloucestershire	Avon and Somerset Constabulary	65.18
Somerset	Avon and Somerset Constabulary	70.55
North Somerset	Avon and Somerset Constabulary	71.27
Bristol	Avon and Somerset Constabulary	118.47
...	...	...
Wakefield	West Yorkshire Police	138.20
Bradford	West Yorkshire Police	139.58
Leeds	West Yorkshire Police	140.83
Wiltshire County	Wiltshire Police	51.05
Swindon	Wiltshire Police	77.57

268 rows × 2 columns

```
In [23]:    JurisdictionCrimes['Crime Rate']=JurisdictionCrimes['Crime Rate'].apply(string_to
            JurisdictionCrimes
```

Out[23]:

Jurisdiction	Force Area	Crime Rate
Bath & North East Somerset	Avon and Somerset Constabulary	64.78
South Gloucestershire	Avon and Somerset Constabulary	65.18
Somerset	Avon and Somerset Constabulary	70.55
North Somerset	Avon and Somerset Constabulary	71.27
Bristol	Avon and Somerset Constabulary	118.47
...	...	...
Wakefield	West Yorkshire Police	138.20
Bradford	West Yorkshire Police	139.58
Leeds	West Yorkshire Police	140.83
Wiltshire County	Wiltshire Police	51.05
Swindon	Wiltshire Police	77.57

268 rows × 2 columns

```
In [40]: ▶ RankedJurisdictions=JurisdictionCrimes.sort_values('Crime Rate', ascending=True)
           RankedJurisdictions.loc['Mean Jurisdiction','Crime Rate']=RankedJurisdictions['Cr
           RankedJurisdictions
```

Out[40]:

Jurisdiction	Force Area	Crime Rate
Isles of Scilly	Devon & Cornwall Police	24.110000
South Devon & Dartmoor	Devon & Cornwall Police	41.470000
Broadland	Norfolk Constabulary	41.660000
Suffolk Coastal	Suffolk Constabulary	41.900000
Wealden	Sussex Police	43.220000
...	...	...
Liverpool	Merseyside Police	141.620000
Hartlepool	Cleveland Police	153.470000
Manchester	Greater Manchester Police	181.500000
Middlesbrough	Cleveland Police	183.780000
Mean Jurisdiction	NaN	82.644888

269 rows × 2 columns

```
In [25]: ▶ Top5Jurisdictions = RankedJurisdictions.iloc[:5,:]
           RelativeComparison_Top = Top5Jurisdictions.copy()
           RelativeComparison_Top.loc['Mean Jurisdiction'] = RankedJurisdictions.loc['Mean J
           RelativeComparison_Top.loc['Mean Jurisdiction','Force Area'] = np.nan
           RelativeComparison_Top
```

Out[25]:

Jurisdiction	Force Area	Crime Rate
Isles of Scilly	Devon & Cornwall Police	24.110000
South Devon & Dartmoor	Devon & Cornwall Police	41.470000
Broadland	Norfolk Constabulary	41.660000
Suffolk Coastal	Suffolk Constabulary	41.900000
Wealden	Sussex Police	43.220000
Mean Jurisdiction	NaN	82.644888

```
Bottom5Jurisdictions = RankedJurisdictions.iloc[-6:,:]
RelativeComparison_Bottom = Bottom5Jurisdictions.copy()
RelativeComparison_Bottom.loc['Mean Jurisdiction'] = RankedJurisdictions.loc['Mea
RelativeComparison_Bottom.loc['Mean Jurisdiction','Force Area'] = np.nan
RelativeComparison_Bottom
```

Out[26]:

Jurisdiction	Force Area	Crime Rate
Leeds	West Yorkshire Police	140.830000
Liverpool	Merseyside Police	141.620000
Hartlepool	Cleveland Police	153.470000
Manchester	Greater Manchester Police	181.500000
Middlesbrough	Cleveland Police	183.780000
Mean Jurisdiction	NaN	82.644888

Dropping Missing Data

Finally, we cannot use missing data. Unfortunately, the data was not available for every force area, so we will have to restrict our analysis to a subset of the force areas:

In [27]:

```
ForceAreasClean = ForceAreas.dropna()
ForceAreasClean
```

Out[27]:

Force Area	Average Crime Rate	Jurisdictions	Mar 2011 General fund	Mar 2011 Earmarked reserves	Mar 2011 Total resource reserves	Mar 2011 Capital reserves
Avon and Somerset Constabulary	83.24	[Bath & North East Somerset, South Gloucesters...	6700000.0	25600000.0	32200000.0	2100000.0
Bedfordshire Police	73.80	[Central Bedfordshire, Bedford, Luton]	2900000.0	6500000.0	9400000.0	400000.0
Cambridgeshire Constabulary	84.51	[East Cambridgeshire, South Cambridgeshire, Hu...	4800000.0	13300000.0	18100000.0	18200000.0

Saving Processed Data

The cleaned data is stored in my specified folder with the following cells:

In [39]:

```
file_path = r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\processed\f
ForceAreasClean.to_csv(file_path, index=True)
```

```
In [29]:  ▶| file_path = r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\processed\j
          RankedJurisdictions.to_csv(file_path, index=True)
```

```
In [30]:  ▶| file_path = r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\processed\b
          RelativeComparison_Top.to_csv(file_path, index=True)
```

```
In [31]:  ▶| file_path = r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\processed\w
          RelativeComparison_Bottom.to_csv(file_path, index=True)
```

Data Analysis

Best Jurisdictions

```
In [56]:  ▶| import matplotlib.pyplot as plt
          plt.figure(figsize=(8,6))
          plt.bar(RelativeComparison_Top.index, RelativeComparison_Top['Crime Rate'], color
          plt.title('Top 5 jurisdiction crime rates relative to mean jurisdiction')
          plt.xlabel('Jurisdiction')
          plt.ylabel('Crime Rate')
          plt.xticks(rotation=45)
          plt.grid(True)
          plt.tight_layout()
          plt.savefig(r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\outputs\bes
          plt.show()
```


Top 5 jurisdiction crime rates relative to mean jurisdiction
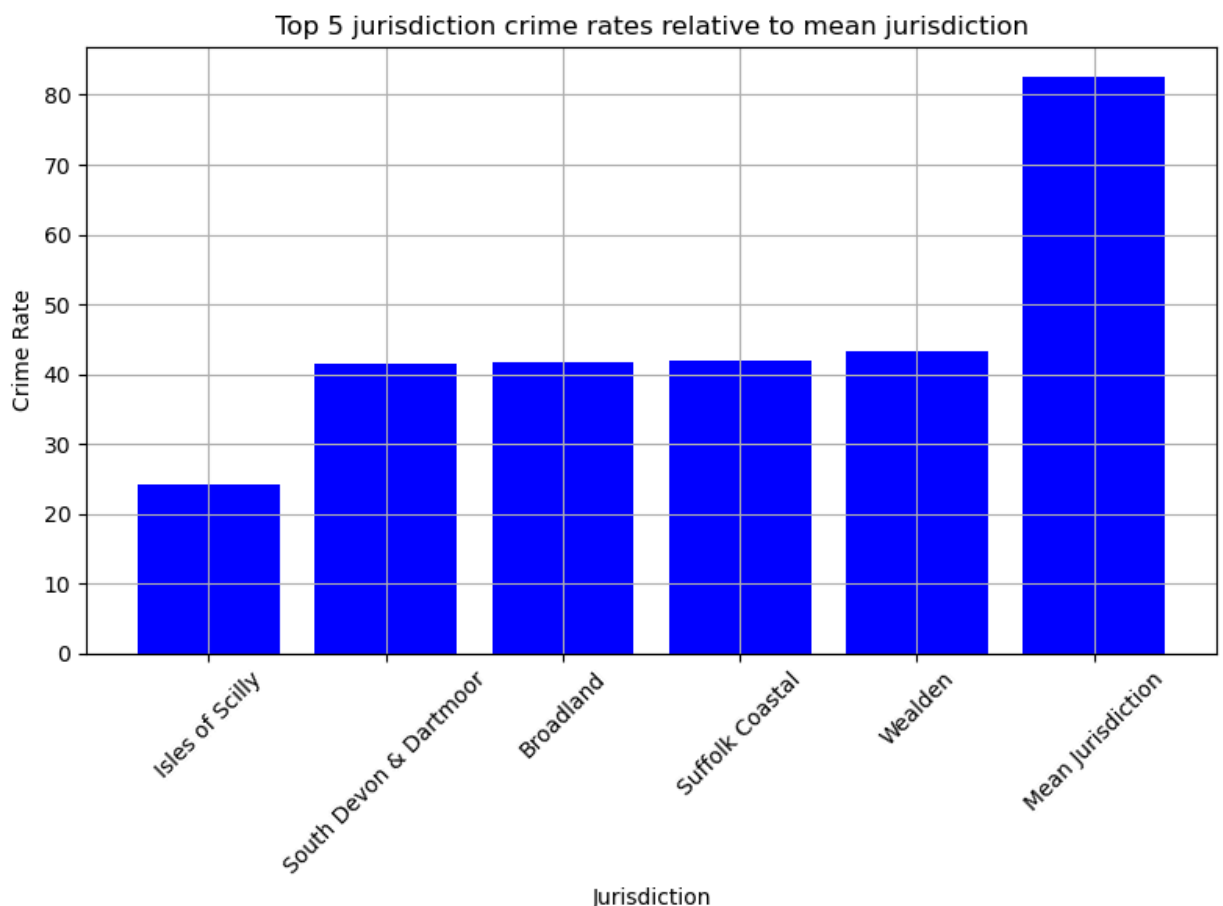
The above graphic tells us a few things:

- Which jurisdictions had the 5 lowest crime rates last year

- Crime rates for the safest jurisdictions were all below 50 per 1,000 residents
- The safest jurisdiction had a crime rate of more than 20 per 1,000 residents
- The average jurisdiction had a crime rate of over 80 per 1,000 residents

Worst Jurisdictions

In [57]:
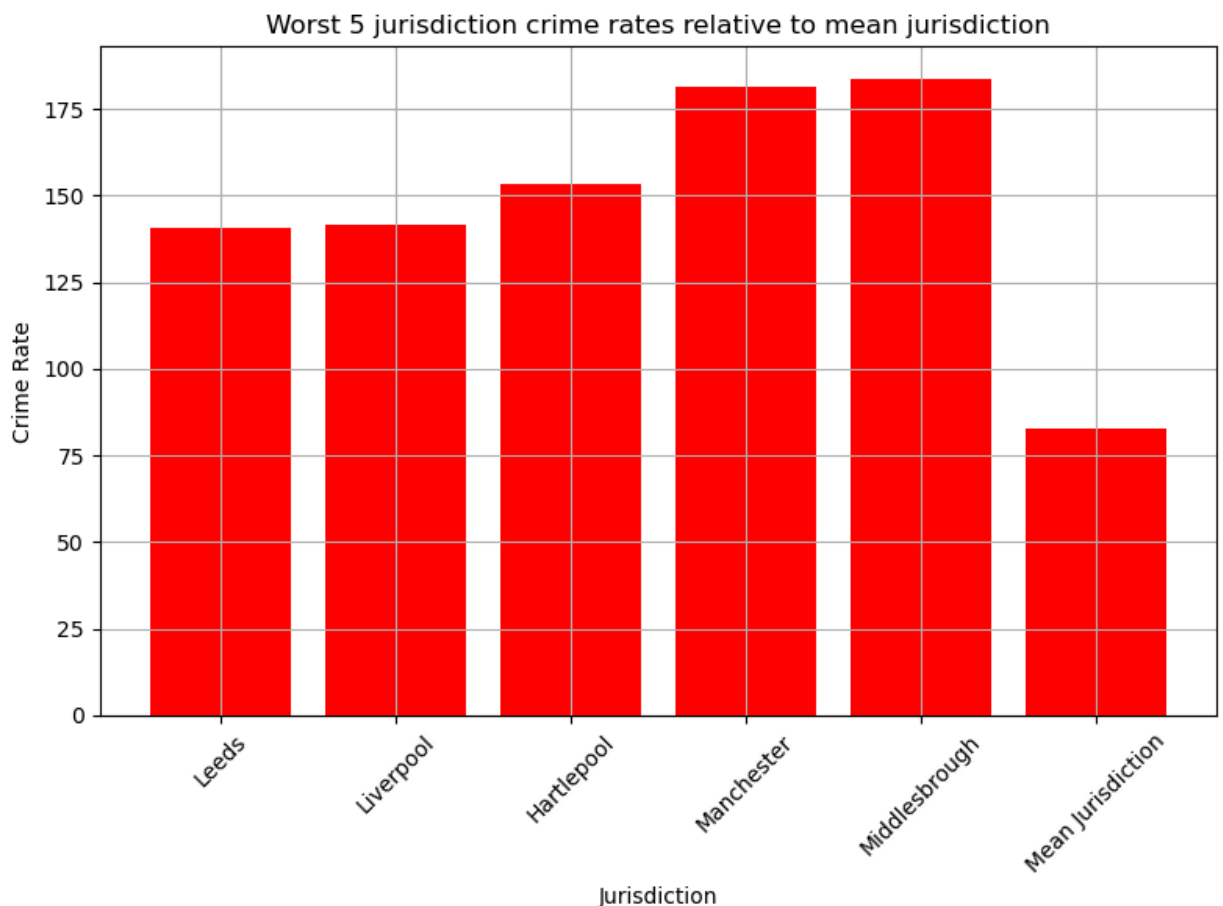```python
plt.figure(figsize=(8,6))
plt.bar(RelativeComparison_Bottom.index, RelativeComparison_Bottom['Crime Rate'],
plt.title('Worst 5 jurisdiction crime rates relative to mean jurisdiction')
plt.xlabel('Jurisdiction')
plt.ylabel('Crime Rate')
plt.xticks(rotation=45)
plt.grid(True)
plt.tight_layout()
plt.savefig(r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\outputs\wor
plt.show()
```



The above bar chart tells us about jurisdictions on the other end of the spectrum:

- Which 5 jurisdictions had the highest crime rate last year
- Crime rates for the worst jurisdictions were all above 125 per 1,000 residents
- The worst jurisdiction had a crime rate of over 175 per 1,000 residents
- Crime rates for the worst jurisdictions were between 50% and 100% more than the average jurisdiction

We can take away from the above bar charts that there is substantial variation in crime rates across jurisdictions, meaning that the best jurisdictions benefit substantially compared to the worst jurisdictions in terms of reduced crime rate- in the comparison between the best and the worst jurisdiction, there is a difference of approximately 155 crimes per 1,000 residents, or alternatively a difference of 15.5 percentage points. It would be beneficial to know whether our proposed deterrent effect can be seen to

cause this difference in crime rates. I am making the reasonable assumption that jurisdictions are designed such that they are comparable to each other, having taken into account covariates such as population and urbanisation when they were recorded as a separate jurisdiction.

We will now consider the best and worst force areas' wealth over time (measured by amount held in financial reserves by the force area), to verify whether wealthier force areas correlate to reduced crime rates.

## Case Study: Best Force Area

In [58]:
```python
import matplotlib.ticker as ticker
TopForceArea = Top5Jurisdictions['Force Area'].iloc[1]
print('Best Force Area: ' + TopForceArea)
WealthTime = ForceAreas.iloc[:,-10:-2]
TopForceWealthTime=WealthTime.loc[TopForceArea]
x_axis = [i[:8] for i in TopForceWealthTime.index[:]]
plt.figure(figsize=(8,6))
plt.plot(x_axis,TopForceWealthTime, color='green',label = TopForceArea)
plt.plot(x_axis,ForceAreas.loc['Mean Force Area'].iloc[-10:-2],color = 'blue', la
plt.xticks(rotation=45)
scale_factor = 1e6
ticks_loc = plt.gca().get_yticks().tolist()
plt.gca().yaxis.set_major_locator(ticker.FixedLocator(ticks_loc))
plt.gca().yaxis.set_major_formatter(ticker.FuncFormatter(lambda x, _: '{:0.1f}M'.
plt.title(str(TopForceArea + ' wealth over time relative to mean force area wealt
plt.xlabel('Period')
plt.ylabel('Reserves Value (Millions)')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.savefig(r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\outputs\bes
plt.show()
```

Best Force Area: Devon & Cornwall Police
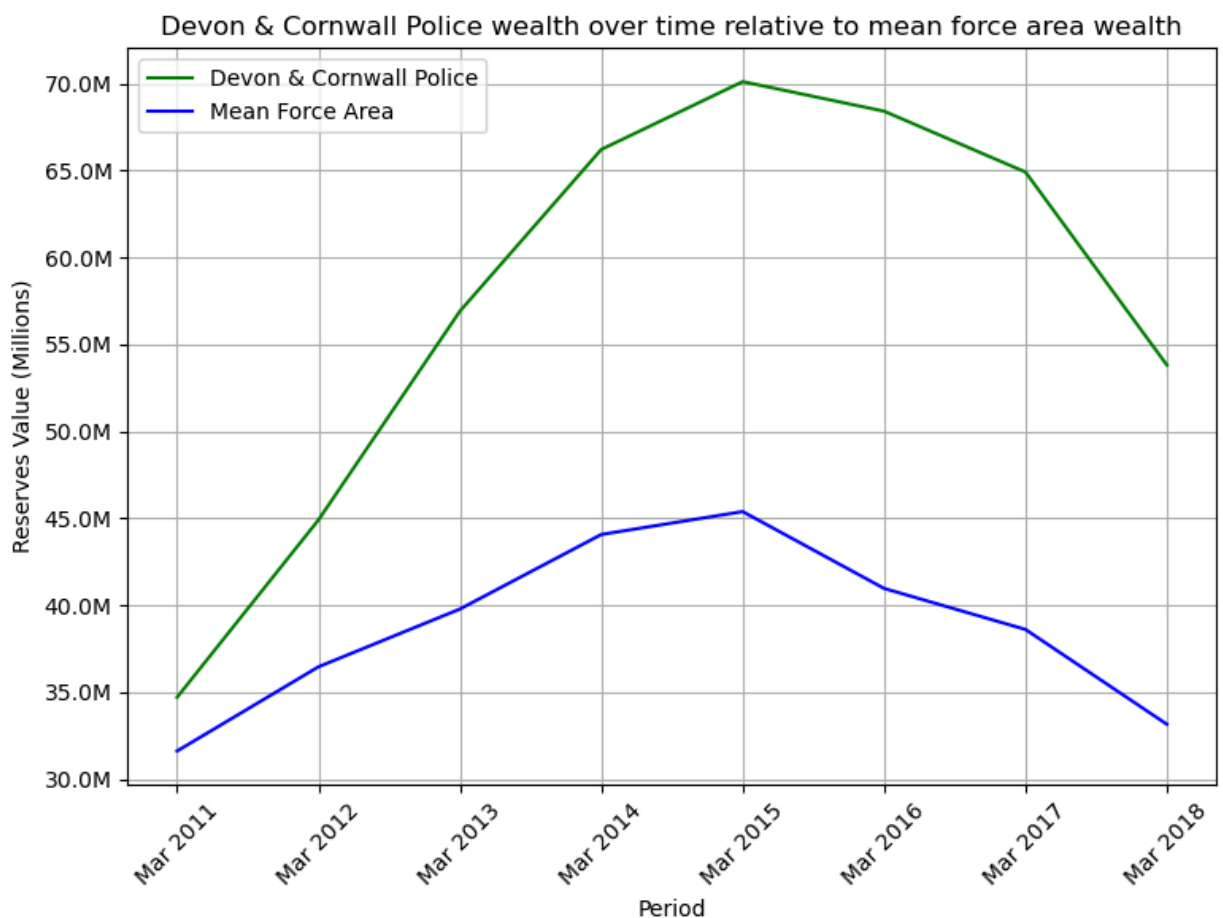
What we can see from the above line graph is that the best performing force area held substantially more in financial reserves than the average force area in every single year recorded. These are historical levels of wealth, but each subsequent year is reasonably assumed to be influenced by the

levels of wealth in the previous year(s). As such, we cannot rule out that historical wealth contributes to

Case Study: Worst Force Area

In [59]:

```python
WorstForceArea = Bottom5Jurisdictions['Force Area'].iloc[-2]
print('Worst Force Area: ' + WorstForceArea)
WealthTime = ForceAreas.iloc[:,-10:-2]
WorstForceWealthTime=WealthTime.loc[WorstForceArea]
x_axis = [i[:8] for i in WorstForceWealthTime.index[:]]
plt.figure(figsize=(8,6))
plt.plot(x_axis,WorstForceWealthTime, color='green', label = WorstForceArea)
plt.plot(x_axis,ForceAreas.loc['Mean Force Area'].iloc[-10:-2], color= 'blue', la
plt.xticks(rotation=45)
scale_factor = 1e6
ticks_loc = plt.gca().get_yticks().tolist()
plt.gca().yaxis.set_major_locator(ticker.FixedLocator(ticks_loc))
plt.gca().yaxis.set_major_formatter(ticker.FuncFormatter(lambda x, _: '{:0.1f}M'.
plt.title(str(WorstForceArea + ' wealth over time relative to mean force area wea
plt.xlabel('Period')
plt.ylabel('Reserves Value (Millions)')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.savefig(r'C:\Users\socor\Downloads\BEE2041 Empirical Project\data\outputs\wor
plt.show()
```

Worst Force Area: Cleveland Police
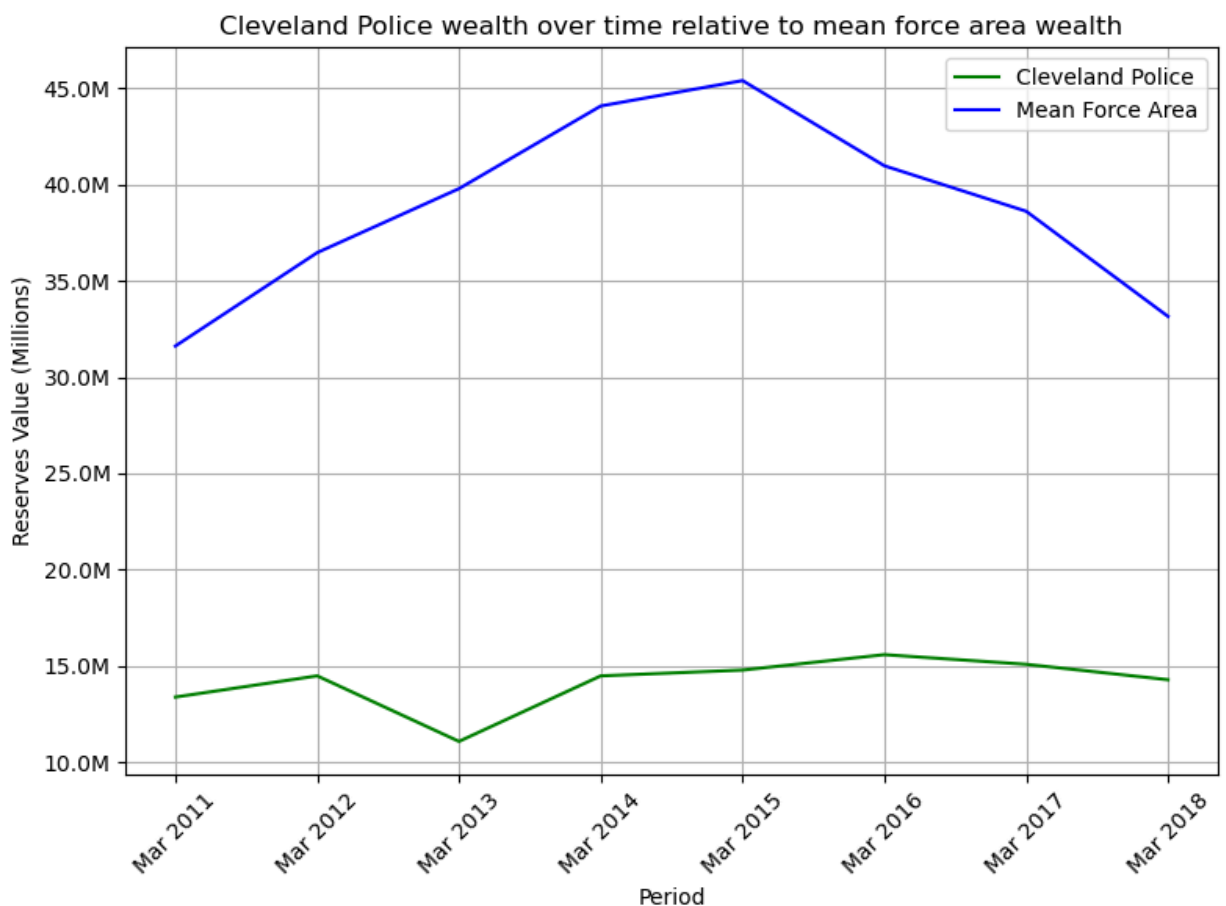
The converse to the previous graph, we can see that the worst performing force area held substantially less financial reserves than the average force area. That this correlates to the high crime rate associated with this force area chimes with the hypothesis that wealthier force areas benefit from a

How well does wealth held in reserves predict a force area's crime rate?

In [41]:
```python
from econml.dml import CausalForestDML
from sklearn.ensemble import GradientBoostingRegressor

# Scale the 'Average Wealth' by dividing by 10 million
ForceAreasClean['Scaled Wealth'] = ForceAreasClean['Average Wealth'] / 1000000

ForceAreasClean = ForceAreasClean.dropna(subset=['Average Wealth', 'Average Crime

# Define the causal forest model
causal_forest = CausalForestDML(
    model_y=GradientBoostingRegressor(),
    model_t=GradientBoostingRegressor(),
    discrete_treatment=False,
    random_state=123
)

# Fit the model
T = ForceAreasClean['Scaled Wealth']  # Treatment
X = pd.DataFrame([0]*len(T), index=T.index)  # No covariates
Y = ForceAreasClean['Average Crime Rate']  # Outcome
causal_forest.fit(Y=Y, T=T, X=X)

# Estimate the causal effect
effects = causal_forest.effect(X)
print("Estimated Causal Effect:\n", effects[0])
```

Not all column names are strings. Coercing to strings for now.

Estimated Causal Effect:
 0.24054136457471878

```python
import numpy as np
from sklearn.utils import resample

def bootstrap_causal_forest(Y, T, X, n_bootstrap=10):
    effects = []
    for _ in range(n_bootstrap):
        # Create a bootstrap sample of the data with replacement
        bs_indices = resample(np.arange(len(Y)), replace=True)
        bs_Y = Y.iloc[bs_indices]
        bs_T = T.iloc[bs_indices]
        bs_X = X.iloc[bs_indices]

        # Define and fit the causal forest model
        bs_causal_forest = CausalForestDML(
            model_y=GradientBoostingRegressor(),
            model_t=GradientBoostingRegressor(),
            discrete_treatment=False,
            random_state=123
        )
        bs_causal_forest.fit(Y=bs_Y, T=bs_T, X=bs_X)

        # Estimate the causal effect
        bs_effects = bs_causal_forest.effect(X)
        effects.append(np.mean(bs_effects))  # Aggregate effect or effect at spec

    return np.array(effects)

# Running the bootstrap
bootstrap_effects = bootstrap_causal_forest(Y, T, X, n_bootstrap=100)

# Calculate mean effect and 95% confidence interval
mean_effect = np.mean(bootstrap_effects)
conf_interval = np.percentile(bootstrap_effects, [2.5, 97.5])

print(f"Mean Estimated Causal Effect: {mean_effect}")
print(f"95% Confidence Interval: {conf_interval}")
```

```
Mean Estimated Causal Effect: 1.0621092178790064
95% Confidence Interval: [-3.09412147  6.38497846]
```

While the lack of covariates in my causal forest risks a biased causal estimate, my data appears to predict that if we treat a force area with an additional £1m in reserves then we can expect crime rate to INCREASE by 0.24 crimes per 1,000 population. Without scrutiny, a policy maker could conclude that the way to decrease the crime rate is to cut the amount held in reserves. Perhaps this is because the resources held in reserves are considered more effective in cutting crime rate when the reserves are actually spent/invested, and it is therefore inefficient to hold any reserves. However, in practice it is likely that every force needs some minimum amount in reserves to even exist as a functioning force area. As such, maybe the treatment effect is nonlinear, meaning that the increase in crime rate associated with a reduction in reserves becomes smaller and even negative as the value of amount held in reserves decreases. The next causal forest will check explicitly for non-linearity of the treatment:

```python
T = ForceAreasClean['Scaled Wealth']  # Treatment
Y = ForceAreasClean['Average Crime Rate']  # Outcome

# Creating a squared term of the treatment
T_squared = T ** 2

# Creating the covariate DataFrame
X = pd.DataFrame({
    'T_squared': T_squared
}, index=T.index)

# Define the causal forest model
causal_forest = CausalForestDML(
    model_y=GradientBoostingRegressor(),
    model_t=GradientBoostingRegressor(),
    discrete_treatment=False,
    random_state=123
)

# Fit the model with the original treatment and the squared term as a covariate
causal_forest.fit(Y=Y, T=T, X=X)

# Estimate the causal effect
effects = causal_forest.effect(X)
print("Estimated Causal Effects with Squared Term:\n", effects)

# Running the bootstrap
bootstrap_effects = bootstrap_causal_forest(Y, T, X, n_bootstrap=100)

# Calculate mean effect and 95% confidence interval
mean_effect = np.mean(bootstrap_effects)
conf_interval = np.percentile(bootstrap_effects, [2.5, 97.5])

print(f"Mean Estimated Causal Effect: {mean_effect}")
print(f"95% Confidence Interval: {conf_interval}")
```

```
Estimated Causal Effects with Squared Term:
 [0.63613335 0.63613335 0.63613335 0.63613335 0.63613335 0.63613335
 0.63613335 0.63613335 0.63613335 0.63613335 0.63613335 0.63613335
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 0.63613335 0.63613335 0.63613335 0.63613335 0.63613335 0.63613335
 0.63613335 0.63613335 0.63613335 0.63613335]
Mean Estimated Causal Effect: 0.9145722302238266
95% Confidence Interval: [-2.04241307  5.60848002]
```

For both of the previous causal forests, I have deployed bootstrapping methods to infer a 95% confidence interval, and in both cases the effect is not statistically distinct from zero at conventional levels. What this means is that my model doesn't detect a significant causal effect on crime rate from additional wealth. This does not support my hypothesis of a deterrent effect. So what is more likely to be wrong, my model or my hypothesis? Perhaps I have not accounted for reverse causality, which is the phenomenon where the causal effect is in the reverse direction to that hypothesised. In this case, maybe more resources are allocated to force areas which suffer from higher crime rates instead, and what is actually happening is the crime rate predicts wealth due to such a mechanism? I will run a final causal forest where the crime rate is the treatment and the wealth is the outcome to test this reverse causality:

In [49]: ▶

```python
# Define the causal forest model
causal_forest = CausalForestDML(
    model_y=GradientBoostingRegressor(),
    model_t=GradientBoostingRegressor(),
    discrete_treatment=False,
    random_state=123
)

# Fit the model
X = pd.DataFrame([0]*len(T), index=T.index)  # No covariates
T = ForceAreasClean['Average Crime Rate']  # Treatment
Y = ForceAreasClean['Average Wealth']  # Outcome
causal_forest.fit(Y=Y, T=T, X=X)

# Estimate the causal effect
effects = causal_forest.effect(X)
print("Estimated Causal Effect:\n", effects[0])
# Running the bootstrap
bootstrap_effects = bootstrap_causal_forest(Y, T, X, n_bootstrap=100)

# Calculate mean effect and 95% confidence interval
mean_effect = np.mean(bootstrap_effects)
conf_interval = np.percentile(bootstrap_effects, [2.5, 97.5])

print(f"Mean Estimated Causal Effect: {mean_effect}")
print(f"95% Confidence Interval: {conf_interval}")
```

```
Not all column names are strings. Coercing to strings for now.
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Not all column names are strings. Coercing to strings for now.
Not all column names are strings. Coercing to strings for now.
Not all column names are strings. Coercing to strings for now.

Mean Estimated Causal Effect: 410281.9598458002
95% Confidence Interval: [ -32022.52310674 1040002.29527911]
```

Again, the causal forest fails to detect a significant causal effect. This could be because of simultaneous causality making it difficult to isolate the causal effects of both mechanisms: the deterrent effect and the "chaser effect". The latter effect being the phenomenon where more funding is allocated to areas with higher crime rates.

Conclusion

My project has tested the hypothesis that a deterrent effect exists, which would be represented by the case in which greater wealth attributed to a force area is consistently associated with reduced crime rate. While the more advanced modelling indicates no such relationship exists, the result is still inconclusive because the assumptions underlying my analysis can be probed further.

Key Limitations and Recommendations for Future Research:

- **Lack of covariates:** Most significantly, my advanced models did not have any covariates accounted for. My data collection process did not pick up important covariates at either the force area or the jurisdiction level, and as a result I had to rely on the assumption that force areas are directly comparable. My project has highlighted the importance of such data, and recommends making use of it where it exists, or collecting it where that data does not exist.

- **Mechanisms of causality:** My project has also highlighted two possible mechanisms of causality, hypothesising a simultaneously causal relationship between force area wealth and crime rates. To disentangle these two mechanisms would require data collection of instrumental variables and using them to identify the true causal effect of each mechanism.

Engaging with experts

Finally, my project has highlighted the importance of collaboration with specialists in the field of policing, such as civil servants, police and crime commissioners and criminal law experts. Insights from such individuals would inform more streamlined data collection of relevant variables, both where the data already exists and where the data is not currently collected or stored anywhere. Furthermore, with a better understanding of the system behind how each force area is funded, we could identify the confounding "chaser" effect earlier on, as well as any other mechanisms that could confound my analysis and therefore better target my analysis to get more conclusive results.

Future Direction & Contributions to Policy Discussion

Overall, my project contributes to the discussion on how much we should allocate to police forces by identifying a correlation between force area wealth and crime rate, and opens up further, more targeted, research into the causal nature of the deterrent effect. Such research could ultimately enable policymakers to quantify the economic benefits of additional funding, attributing a tangible 'price-tag' to the deterrent effect of well-funded police forces. By initiating this conversation and identifying potential correlations between force area wealth and crime rates, this project contributes to broader discussions on optimal resource allocation for law enforcement. Continued research in this direction is vital to inform policy decisions that balance economic efficiency with effective crime prevention, and exploit the win-win nature of the real deterrent effect.

https://github.com/SOCStudentUoE/BEE2041-Empirical-Assignment