P4DS Summative Assignment 2

Data Analysis Project

Developing Education Equity: Analysing Positive Outlier Schools' Performance at Keystage 4 for Disadvantaged Pupils in the UK - 2022/23

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Project Plan

### 1.1 Sources of the dataset

#### a) Department for Education (DfE)

The multiple datasets are sourced from the Department for Education's (DfE) website [1][2]. The academic year 2022-23 is the most recent data and published on 1st February 2024. Five datasets from the DfE website were used in this analysis. For each of the data sets a separate file containing the metadata is also provided. The data sets were merged based on the Unique Reference Number (URN) column for each school. Progress 8 scores are used to evaluate school performance; this is a measure of the value-added by each school based on the progress made across 8 qualifications of each pupil, using their key stage 2 results from year 6 as a baseline. The attainment 8 score (total points across 8 subjects) of each pupil is similar key stage 2 results, is compared to the national average attainment 8; the difference indicates a level of progress. A progress 8 score of 1, would indicate the student has done better by 1 grade than the national average etc. Subjects included in progress 8 include:

- English and Mathematics - both double weighted due to importance

- EBacc Subjects - three slots from subjects such as sciences, computer science, history, geography and languages
- Open Group - remaining three from other academic, arts of vocational subjects

  The DfE has data of the progress 8 score and funding for disadvantaged and non-disadvantaged students, which makes its very convenient to analyse.

[1] Department for Education. (n.d.). Explore education statistics: Data tables. Retrieved November 1, 2024, from https://explore-education-statistics.service.gov.uk/data-tables

[2] Department for Education. (n.d.). Compare the performance of schools and colleges in England. Retrieved November 10, 2024, from https://www.gov.uk/school-performance-tables

b) Index of Multiple Deprivation (IMD)

In addition to the four data sets from the DfE, rather than use funding for schools or number of disadvantaged pupils, the deprivation index for each area in the UK was downloaded from the Ministry of Housing, Communities and Local Government (MHCLG) website [3] and merged with the school information data set using the school postcode. This allows for a more detailed analysis of the relationship between school performance and socioeconomic factors which may affect the performance of disadvantaged students.

[3] Ministry of Housing, Communities & Local Government. (2019). English Indices of Deprivation 2019: Postcode Lookup. Retrieved from https://imd-by-postcode.opendatacommunities.org/imd/2019

1.2 Accuracy and Reliability of Data

The data is sourced from the Department for Education's (DfE) website and the Ministry of Housing, Communities and Local Government website. The data is accurate and reliable as it is sourced from official government sources. For the DfE, provisional and final KS4 results are provided. The key differences are the final results are quality assured for:

a) Completeness of data: results are verified
b) Accuracy of data: results are corrected for any errors or omissions
c) Usage: results are approved for use in official publications and are publicly available.

The categorise each school's socioeconomic status, the Index of Multiple Deprivation Decile (IMD) is used, which ranks each postcode in England between 1 and 10. The IMD is a composite measure of deprivation based on several other domains of deprivation including income, employment, education and health. The data is from an official government source and is therefore accurate and reliable.

1.3 Data quality, usability, and presentation

Considerations: 1. The IMD data is from 2019 and is the nearest year to the academic year 2022-23 of school performance data. When evaluating the relationship between school performance and socioeconomic factors, the socioeconomic factors may have changed in some cases since 2019. However, I will treat these are negligible changes as it the three-year period between 2019 and 2022 is relatively short. 2. As the analysis in based on school performance on a national level, including thousands of schools, I will use 'inner' joins to merge the datasets to ensure the analysis is not affected by schools which are not recognised. I will also drop any rows with missing values in key columns used for analysis.

Project Aim and Objectives

2.1 Context and motivation

Context

I have been working in education for two decades now. More recently, I have worked in MATs that are high performing and data-driven. The efficiency of a school/MAT in using its funds, together with the impact of its pedagogoical framework can be seen unsing progress 8 scores. It has been shown that by five years of age, only 57% of disadvantaged pupils achieve a good level of development compared to 74% from better off households[4]. The gap continues throughout education; in 2022 -2023, 29% of free-school mean (FSM) pupils went to university which 49.8% of non FSM pupils progressed to university. [5].

Motivation

Several motivations underpin this analysis:

1. In a recent letter from the secretary of state for education, five priuorities were set out for higher education proviers, to top of which is : "Play a stronger role in expanding access and improving outcomes for disadvantaged students. The gap in outcomes from higher education between disadvantaged students and others is unacceptably large and is widening, with participation from disadvantaged students in decline for the first time in two decades." [6]
2. Enhancing Education Practice: Some secondary schools are able to close the gap and give students from disadvantaged backgrounds better opportunities to progress to university. This data science investigations aim to identify outlier schools who outperform what is expected from them.

3. Justifying School Funding: Given the various avenues of funding data available, e.g. pupil premium for disadvantaged pupils, school-led tutoring funding, and the results for FSM and non FSM students, progress 8 and Eng - Maths, the efficiency of schools in using their funds can be evaluated. I can also examine if their is a correlation between progress 8 of disadvantaged and the level of funding schools receive to support them.

4. Understand demographic factos: Analysis of school demographics, e.g. gender, school type, local authority, can help to undertand their influence on school performance.

5. Socioeconomic factors: The relationship between school performance and socioeconomic factors such as deprivation can be explored by merging the school performance data with the deprivation index for each area in the UK. Other factors such percentage of disadvantaged students, percentage of non-disadvantaged students, pupil premium funding, percentage of disadvantaged students achieving grades 9-5 in English and Maths, can also be explored.

6. Impact of MAT: Group level management, collaboration and performance, particularly on outlier schools, can be explored to determine if their is a correlation between school performance and the type of MAT they belong to.

[4] Institute for Fiscal Studies. (2024, May). *The past and future of UK health spending.* Retrieved from https://www.ifs.org.uk/publications/health-spending-report

[5] Busby, E. (2024, October 24). Gap between private and state school pupils going to top universities widens. *The Independent.* Retrieved from https://www.independent.co.uk/news/uk/gap-england-department-for-education-government-data-b2634966.html

[6] Phillipson, B. (2024, November 4). *Letter from the Secretary of State for Education.* Department for Education.

2.2 Specific Objective(s)

1. Evaluate National Disparities in Educational Performance Between Advantaged and Disadvantaged Pupils

Using comprehensive datasets from the Department for Education (DfE) and the Ministry of Housing, Communities, and Local Government (MHCLG), conduct a detailed national-level analysis of the performance gap in key metrics, including Progress 8, Attainment 8, and English and Mathematics scores. This objective will involve merging, cleaning and validating data, before statistical analysis is conducted to determine the level of gap between disadvantaged and advantaged pupils

2. Identify and analyse outlier schools nationally for progress 8 scores for disadvantaged pupils and investigate contributing factors.

This objective will conduct more in depth statistical analysis to identify positive outlier schools with progress-8 scores for disadvantaged pupils. Further analysis on quantitative and categorical factors will be conducted to determine the influence of socio-economic indicators, such as the Index of Multiple Deprivation and demographics of the school.

3. Identify and evaluate the top performing multi-academy trusts in supporting disadvantaged pupils.

This objective will conduct statistical analysis to identify top performing multi-academy trusts and their success in closing the disadvantage gap. Hypothesis testing and regression analysis will be conducted to determine the level of impact of potential factors.

System Design

Architecture

Key Components: Descriptions, Purpose and Challenges

The following data sets will be downloaded and used from the DfE website.

1. DfE data set 1: KS4 school performance 2022-23 - Purpose: This provides information on the academic performance of each school and provides categories relating to advantage and disadvantage pupils in progress 8, attainment-8 and in EBACC subjects English and Mathematics. The description of each field is given below.

- Key fields used for analysis:
  - `URN (Unique Reference Number)`
  - `Average Attainment 8 score`
  - `Average Progress 8 score`
  - `Percentage of disadvantaged students`
  - `Percentage of non-disadvantaged students`
  - `Percentage of disadvantaged students achieving grades 9-5 in English and Maths`
  - `Percentage of non-disadvantaged students achieving grades 9-5 in English and Maths`
  - `Attainment 8 score for non-disadvantaged students`
  - `Progress 8 score for non-disadvantaged students`
  - `Attainment 8 score for disadvantaged students`
  - `Progress 8 score for disadvantaged students`
  - `Progress 8 score in Maths for disadvantaged students`
  - `Progress 8 score in English for disadvantaged students`
  - `Progress 8 score in Maths for non-disadvantaged students`
  - `Progress 8 score in English for non-disadvantaged students`

2. Data set 2: School information - provides information on the demographics of each school.

Purpose: The purpose of this data set it to determine school demographics such as gender, Ofsted rating etc, and other such categorical columns which can be used to determine potential impact on students' progress.

Key fields used in analysis:

```
- URN - Unique Reference Number for the school
- Local Authority Name (LANAME) - Name of the local authority the school belongs to
- Local Authority Code (LA) - Numeric code identifying the local authority
- School Type - Type of school (e.g. Academy, Community School, etc.)
- Minor Group - More detailed classification of school type
- Gender - Whether the school is mixed, boys only or girls only
- Ofsted Rating - Latest Ofsted inspection rating for the school
```

3. Data set 3: School funding

Purpose: Provides information on the various types of funding for each school.

Key fields used in analysis:

```
- School UKPRN: Unique ID number for each school provider
- School URN: Another unique ID number for each school
- Time Period: The academic year the funding is for
- FSM Funding: Money given to schools for students eligible for free school meals
- FSM6 Funding: Money given for students who were eligible for free school meals in the
- Pupil Premium: Extra funding given to help disadvantaged students
- Pupil Premium Pupils: Number of students who qualify for pupil premium funding
- School-led Tutoring Funding: Money given to schools to provide extra tutoring
- Total Funding: The total amount of funding received by the school
```

4. DfE data set 4: Multi Academy Trust (MAT) performance

Purpose: provides information of performance for each Multi-Academy Trust (MAT)

Key fields used from MAT performance data:

```
- Trust Name: Name of the Multi-Academy Trust
- Trust UID: Unique identification number for the trust
- Trust ID: Alternative ID code for the trust
- Number of Institutions: Number of schools in the trust
- Total Pupils: Total number of pupils across all schools in the trust
- Average Attainment 8 Score: Average attainment score across 8 subjects for the trust
- Average Progress 8 Score: Average progress score showing value added by trust
- Time Period: Academic year the data is from
```

5. Data set 5: Academies membership

Purpose: provides information on which MAT each school belongs to allowing external data such as to be linked to schools through their postcode and then to URN.

Key fields used in analysis:

```
- URN - Unique Reference Number for the school
- Group UID - Unique identifier for school group/trust
- Group ID - Alternative identifier for school group/trust
- Establishment Name - Official name of the school
- Group Name - Name of the school group/trust
- Postcode - Postcode of the school
```

6. MHCLG Data - Index of Multiple Deprivation (IMD)

Purpose: In addition to the five data sets from the DfE, the deprivation index for each area in the UK will be downloaded from the Ministry of Housing, Communities and Local Government (MHCLG) website and merged with the school information data set using the school postcode. This allows for a more detailed analysis of the relationship between school performance and socioeconomic factors which may affect the performance of disadvantaged students, as compared to say relying solely on funding data or percentage of disadvantaged pupils.

Key columns used for analysis:

```
- Postcode
- Index of Multiple Deprivation Decile
```

7. Metadata

Purpose: To identify the appropriate columns for analysis from the DfE data sets, the metadata will be used. Each of the DfE data sets lists above will have a corresponding meta-data file.

8. Classes

Purpose: To optimise the processes above, functions will be organised in classes

Challenges: Key challenges will be selecting and identify the appropriate columns from the DfE data sets as the data set a very large number of fields. The meta data file will be needed to be used to identify the code and description for each field. The code used would then need to be re-written in most cases so it is clear to the non-technical reader what the field stands for, while retaining a format suitable for a data column in python. Another challenge will be ensuring data types are in the correct format for quantitative analysis. Where needed, feature engineering would need to be employed for new fields which may be required such as pupil premium funding per pupil. Another challenge will be in connecting the index of multiple deprivation IMD with each school, as the MHCLG is independent to the DfE, and will not include the school URN which is what will be used to combined the DfE data.

Pipeline and Workflow

The pipline starts by setting up necessary functions and classes for data loading, wrangling and cleaning.

- Determine necessary functions and classes needed for the project
- Data Collection: Collect 2022-23 school and MAT performance data from the Department for Education (DfE); this includes the five data sets listed above and their meta files.
- Data Collection: Collect data from the inistry of Housing, Communities and Local Government (MHCLG) website; Index of Multiple Deprivation Decile (IMD)
- Meta Data: Read the metadata for each data set to understand the data and variables. Create a dictionary of code and description.
- Using the meta-data fields extract the key columns for analysis from the data files.
- Data Integration: Merge the data sets based on the Unique Reference Number (URN) column for each school.
- Data Cleaning: Clean the data to remove any missing values and inconsistencies. Convert data to appropriate data types.
- Nomenclature: Determine new naming convention using meta-data dictionary and assign this to the data files.
- Feature Engineering: Create algorithms to define new features e.g pupil premium funding per pupil, key stage4_maths_gaps, keystage4 English gap and progress 8 gap between advantaged and disadvantaged pupils.
- Data Integration: Socioeconomic Indexing - incorporate the Index of Multiple Deprivation Decile (IMD) for each postcode to the school information data set.
- Statistical Analysis and Modelling: Conduct statistical analysis to determine advantage - disadvantage gap, identify outlier schools and top 10 performing MATs. Evaluate the impact of socioeconomic and other factors on school performance
- Visualisation: Create visualisations to present the findings.
- Conclusion: Summarise the findings and relate them to the original objectives.

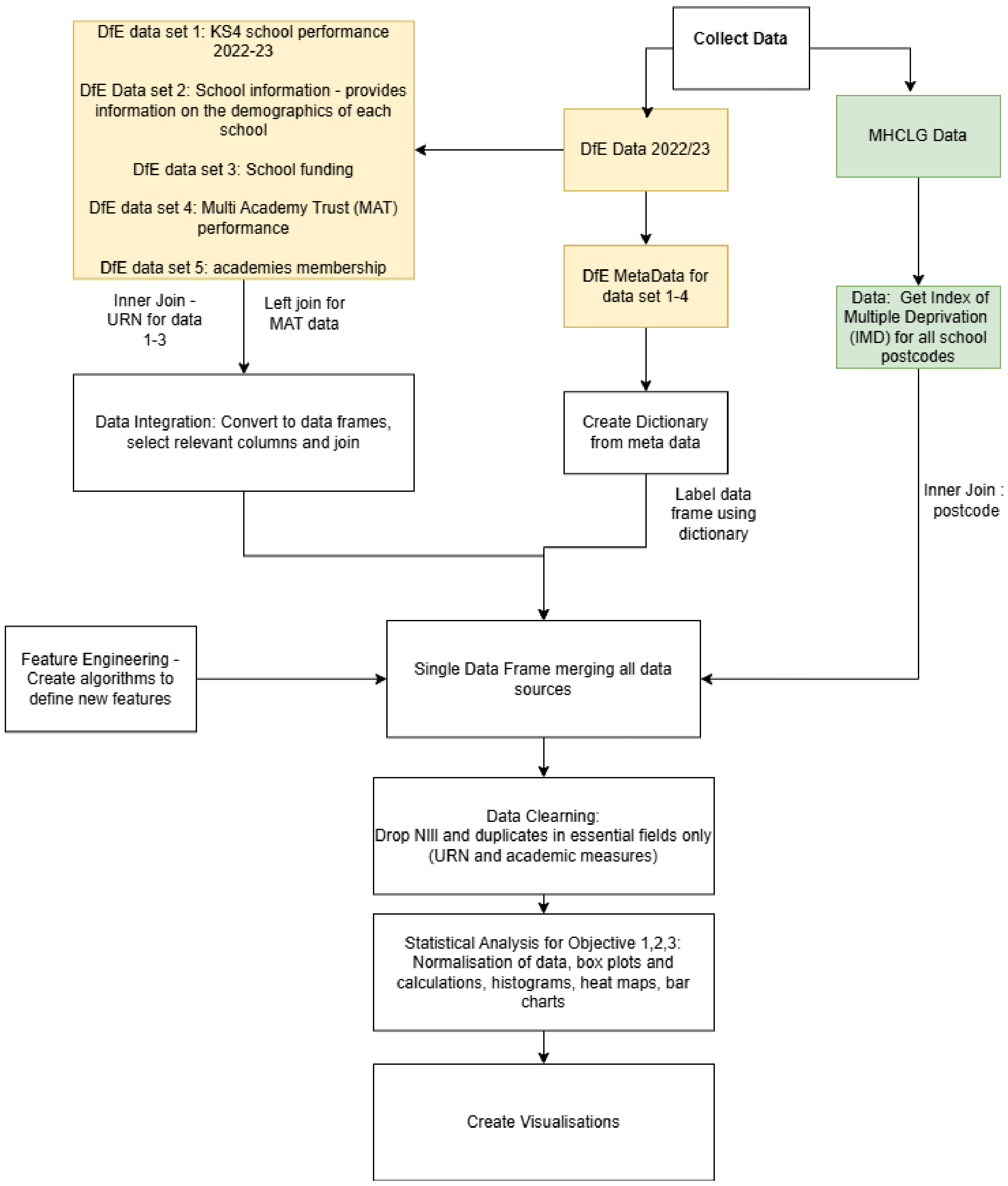
Collect Data
DfE Data 2022/23
MHCLG Data
DfE data set 1: KS4 school performance 2022-23
DfE Data set 2: School information - provides information on the demographics of each school
DfE data set 3: School funding
DfE data set 4: Multi Academy Trust (MAT) performance
DfE data set 5: academies membership
DfE MetaData for data set 1-4
Data: Get Index of Multiple Deprivation (IMD) for all school postcodes
Inner Join - URN for data 1-3
Left join for MAT data
Data Integration: Convert to data frames, select relevant columns and join
Create Dictionary from meta data
Label data frame using dictionary
Inner Join : postcode
Feature Engineering - Create algorithms to define new features
Single Data Frame merging all data sources
Data Clearning: Drop Nlll and duplicates in essential fields only (URN and academic measures)
Statistical Analysis for Objective 1,2,3: Normalisation of data, box plots and calculations, histograms, heat maps, bar charts
Create Visualisations

Figure 1: Pipeline.drawio.png

For a more dynamics view, workflow diagram can also be viewed here

Processing Modules and Algorithms

The following modules and algrorithms will be required in a number of instances and therefore defined and written within a class:

- **Class: DataWrangler** - load data from CSV, Excel file or existing pands data frame

Methods: - Load a csv file into a pandas dataframe using load_csv method - Load an excel file into a pandas dataframe using load_excel method - Create a dictionary from a dataframe using make_dictionary method - Rename columns in a dataframe using a dictionary using column_rename method - substitute original column names with descriptive names in a dictionary or list - Convert percentage strings in specified columns to float values using convert_percentage_columns method - Retrieve specific columns from a given dataframe using a set of URNs using get_school_details method

- Plot boxplots, histograms, heatmaps and scatter plots to visualise the data
- Write code to generate summary statistics of the boxplots

Program Code

Libraries

I will begin by by importing the needed libraries for converting data to dataframes, conducting calculations and visualisations

```python
import pandas as pd
import numpy as np
import statsmodels.api as sm
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats
import os
from sklearn.preprocessing import StandardScaler
```

Classes

A class called Dataloader will be created to manage all core functions related to data loading and wrangling. This includes:

- load_csv
- load_excel

- make_dictionary
- column_rename
- convert_percentages_column

Details of the functions purpose, paramters and return value can be read in the doctrings below the function defintion

```
class DataWrangler:
    def __init__(self, file_path=None, dataframe=None):
        """
        Initialise the DataWrangler with a file path or an existing DataFrame.

        Parameters:
        - file_path (str): The path to the data file (CSV or Excel).
        - dataframe (pd.DataFrame): An existing DataFrame to work with.
        """
        if dataframe is not None:
            self.df = dataframe.copy()
            print("DataWrangler initialised with the provided DataFrame.")
        elif file_path is not None:
            self.file_path = file_path
            self.df = None

            if self.file_path.endswith("csv"):
                self.load_csv()
            elif self.file_path.endswith(".xlsx"):
                self.load_excel()
            else:
                raise ValueError("Unsupported file format. Please provide a CSV or Excel fil
        else:
            raise ValueError("Either file_path or dataframe must be provided.")


    def load_csv(self):
        """
        Load a CSV file into a pandas DataFrame.
        """
        try:
            self.df = pd.read_csv(self.file_path, encoding='latin1')
            print(f"CSV file loaded successfully from {self.file_path}")
        except FileNotFoundError as e:
            print(f"Error loading CSV file: {e}")
```

```python
    def load_excel(self):
        """
        Load an Excel file into a pandas DataFrame.
        """
        try:
            self.df = pd.read_excel(self.file_path)
            print(f"Excel file loaded successfully from {self.file_path}")
        except FileNotFoundError as e:
            print(f"Error loading Excel file: {e}")
            self.df = None


    def make_dictionary(self, key_column: str, value_column: str):
        """
        Create a dictionary from two columns of the DataFrame.

        Parameters:
        - key_column (str): The column to use as the dictionary key.
        - value_column (str): The column to use as the dictionary value.

        Returns:
        - dict: A dictionary mapping keys to values.
        """
        try:
            return dict(zip(self.df[key_column], self.df[value_column]))
        except KeyError as e:
            print(f"Error: Key column not found in DataFrame: {e}")
            return None

    def column_rename(self, column_dict: dict):
        """
        Rename columns in the DataFrame using a provided dictionary.

        Parameters:
        - column_dict (dict): A dictionary mapping original column names to new names.

        Returns:
        - pd.DataFrame: The DataFrame with renamed columns.
        """
        self.df = self.df.rename(columns=column_dict)
        print("Columns renamed successfully.")
        return self.df
    def convert_percentage_columns(self, columns):
        """
        Remove % sign form colums .

        Parameters:
        - columns (list): List of column names to convert.

        Returns:
        - pd.DataFrame: The DataFrame with converted columns.
        """
        for col in columns:
            # Remove '%' and convert to float
            self.df[col] = self.df[col].astype(str).str.replace('%', '')
            print(f"Column '{col}' converted")
        return self.df


    def get_school_details(self, urn_set, columns):
        """
        Retrieve essential school details for specified URNs and columns.

        Parameters:
        - urn_set (set): A set of URNs (Unique Reference Numbers) for schools.
        - columns (list): List of columns to include in the output.

        Returns:
        - pd.DataFrame: A DataFrame containing the specified details.
        """
        return self.df[self.df['URN'].isin(urn_set)][columns]
```

Load Data

I will now load and examine the five data files from the DfE as pandas data frames and do a quick inspection using .head(),info(), describe(). To avoid repetition, I will do a more thorough analyse of data types and missing values later, once all the data is combined.

```
# Beginning with MAT data:
ks4_mat_performance = DataWrangler('data/2022-2023_england_ks4-mats-performance.csv')
ks4_mat_performance.df.head()
```

```
CSV file loaded successfully from data/2022-2023_england_ks4-mats-performance.csv
```

	TIME_PERIOD	TIME_IDENTIFIER	TRUST_GROUP_TYPE	TRUST_NAME	TRUST_UID
0	202223	AcademicYear	Multi-academy trusts	ACTIVATE LEARNING EDUCAT	
1	202223	AcademicYear	Multi-academy trusts	ACER TRUST	
2	202223	AcademicYear	Multi-academy trusts	RED KITE LEARNING TRUST	
3	202223	AcademicYear	Multi-academy trusts	CONSILIUM ACADEMIES	
4	202223	AcademicYear	Multi-academy trusts	BATLEY MULTI ACADEMY TR	

```python
# Keystage 4 school performance data:
ks4_school_performance = DataWrangler('data/2022-2023_england_ks4final.csv')
ks4_school_performance.df.head()
```

```
CSV file loaded successfully from data/2022-2023_england_ks4final.csv
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\3754428246.py:32: DtypeWarning: Columns (5
  self.df = pd.read_csv(self.file_path, encoding='latin1')
```

	ï»¿RECTYPE	LEA	ESTAB	URN	SCHNAME	SCHNAME_AC	ADDRESS1	ADDRESS2
0	1	201.0	6007.0	100003.0	City of London School	NaN	107 Que	
1	1	201.0	6005.0	100001.0	City of London School for Girls	NaN	St Giles	
2	1	201.0	6000.0	100544.0	David Game College	NaN	31 Jewr	
3	4	201.0	NaN	NaN	NaN	NaN	NaN	
4	1	202.0	4285.0	100053.0	Acland Burghley School	NaN	Burghle	

```python
#School demographics data:
school_demographics = DataWrangler('data/2022-2023_england_school_information.csv')
school_demographics.df.rename(columns={'ï»¿URN': 'URN'}, inplace=True) #correction to URN co
school_demographics.df.head()
```

```
CSV file loaded successfully from data/2022-2023_england_school_information.csv
```

	URN	LANAME	LA	ESTAB	LAESTAB	SCHNAME	STREET	LOCALITY	ADDRESS3
0	100000	City of London	201	3614	2013614	The Aldgate School	St James's Passa		
1	100001	City of London	201	6005	2016005	City of London School for Girls	St Giles' Terrace		

	URN	LANAME	LA	ESTAB	LAESTAB	SCHNAME	STREET	LOCALITY	ADDRESS3	TO
2	100002	City of London	201	6006	2016006	St Paul's Cathedral School	2 New Change			
3	100003	City of London	201	6007	2016007	City of London School	107 Queen Victo			
4	100008	Camden	202	2019	2022019	Argyle Primary School	Tonbridge Street			

```python
# School funding data:
school_funding = DataWrangler('data/20230126_school_level_data_csv.csv')
school_funding.df.rename(columns={'ï»¿time_period': 'time_period'}, inplace=True) #correctio
school_funding.df.head()
```

```
CSV file loaded successfully from data/20230126_school_level_data_csv.csv
```

	time_period	time_identifier	geographic_level	country_code	country_name	old_la_code	new_la
0	202223	Financial year	School	E92000001	England	301	E09000
1	202223	Financial year	School	E92000001	England	301	E09000
2	202223	Financial year	School	E92000001	England	301	E09000
3	202223	Financial year	School	E92000001	England	301	E09000
4	202223	Financial year	School	E92000001	England	301	E09000

```python
#Academies data which connect URN code to postcode
academies_membership = DataWrangler('data/academiesmatmembership20220901.csv')
academies_membership.df.head()
```

```
CSV file loaded successfully from data/academiesmatmembership20220901.csv
```

	URN	DfE Number	EstablishmentNumber	Establishment UKPRN	LA (code)	LA (name)	Group U
0	136683.0	840/4054	4054.0	10033436.0	840.0	County Durham	
1	140594.0	936/2341	2341.0	10044809.0	936.0	Surrey	
2	136354.0	925/3510	3510.0	10032221.0	925.0	Lincolnshire	
3	137036.0	381/5404	5404.0	10034739.0	381.0	Calderdale	
4	140214.0	925/2016	2016.0	10043499.0	925.0	Lincolnshire	

Load Metadata and Make Dictionaries

I will now load the meta-data for each data file. To determine what each column in the data files means, I will create a dictionary using the make_dictionary function defined as part of the DataWrangler class. The meta data is labeled after each associated data file with the addition of 'meta' at the end.

```
ks4_mat_performance_meta = DataWrangler('data/ks4-mats-performance_meta.csv')
ks4_mat_performance_dict = DataWrangler.make_dictionary(ks4_mat_performance_meta, 'Metafile 

ks4_mat_performance_dict
```

```
CSV file loaded successfully from data/ks4-mats-performance_meta.csv
```

```
{'TIME_PERIOD': nan,
 'TIME_IDENTIFIER': nan,
 'TRUST_GROUP_TYPE': 'Trust type',
 'TRUST_NAME': 'Trust name',
 'TRUST_UID': 'Trust Unique identifier',
 'TRUST_ID': 'Trust Identifier',
 'TRUST_COMPANIES_HOUSE_NUMBER': 'Trust companies house number',
 'TRUST_UKPRN': 'Trust UK provider reference number',
 'TRUST_LEADREGION': 'Trust lead region',
 'INSTITUTIONS_MATPTINC': 'URNs, included in performance measures',
 'NUMINST_MATPTINC': 'Number of academies in the trust, included in performance measures',
 'NUMINST_CONVERTER_MATPTINC': 'Number of converter academies, included in performance measu
 'NUMINST_SPONSOR_MATPTINC': 'Number of sponsor-led academies, included in performance measu
 'NUMINST_FREE_MATPTINC': 'Number of free school - mainstream academies, included in performa
 'NUMINST_STUDIO_MATPTINC': 'Number of free school - studio schools, included in performance 
 'NUMINST_UTC_MATPTINC': 'Number of free school - UTCs, included in performance measures',
 'NUMINST_FSM6CLA1A_MATPTINC': 'Number of academies with disadvantaged pupils, included in pe
 'NUMINST_3_MATPTINC': 'Number of academies that have been in the trust for 3 years, include
 'NUMINST_4_MATPTINC': 'Number of academies that have been in the trust for 4 years, include
 'NUMINST_5PLUS_MATPTINC': 'Number of academies that have been in the trust for 5 years or mo
 'TPUP_MATPTINC': 'Number of pupils at the end of ks4, included in performance measures',
 'KS2ASS_MATPTINC': 'KS4 cohort average KS2 Scaled Score (average of English reading and mat
 'PFSM6CLA1A_MATPTINC': '% of pupils at the end of ks4 who are disadvantaged, included in pe
 'PNOTFSM6CLA1A_MATPTINC': '% of pupils at the end of ks4 who are not disadvantaged, include
 'PEALGRP2_MATPTINC': '% of pupils at the end of ks4 with English as additional language (EA
 'PSEN_ALL4_MATPTINC': '% of pupils at the end of ks4 with special educational needs (SEN) i
 'ATT8SCR_WGTAVG': 'Average Attainment 8 score per pupil at the end of KS4, weighted average
 'P8MEACOV': '% of pupils at the end of ks4 included in Progress 8 measure',
 'P8MEA_WGTAVG': 'Progress 8 measure after adjustment for extreme scores, weighted average',
 'P8CILOW': 'Progress 8 lower 95% confidence interval for adjusted average',
 'P8CIUPP': 'Progress 8 upper 95% confidence interval for adjusted average',
 'PTL2BASICS_95_WGTAVG': '% of pupils at the end of KS4 achieving strong 9-5 passes in both E
 'EBACCAPS_WGTAVG': 'Average EBacc APS score per pupil at the end of KS4, weighted average',
 'PTEBACC_95_WGTAVG': '% of pupils at the end of KS4 achieving the English Baccalaureate wit
 'PTEBACC_94_WGTAVG': '% of pupils at the end of KS4 achieving the English Baccalaureate wit
 'PTEBACC_E_PTQ_EE_WGTAVG': '% of pupils at the end of KS4 with entries in all English Bacca
 'ATT8SCR_WGTAVG_FSM6CLA1A': 'Average Attainment 8 score per disadvantaged pupil at the end o
 'P8MEACOV_FSM6CLA1A': '% of disadvantaged pupils at the end of ks4 included in Progress 8 me
 'P8MEA_WGTAVG_FSM6CLA1A': 'Progress 8 measure after adjustment for extreme scores for disadv
 'P8CILOW_FSM6CLA1A': 'Progress 8 lower 95% confidence interval for adjusted average for dis
 'P8CIUPP_FSM6CLA1A': 'Progress 8 upper 95% confidence interval for adjusted average for dis
 'PTL2BASICS_95_WGTAVG_FSM6CLA1A': '% of disadvantaged pupils at the end of KS4 achieving st
 'EBACCAPS_WGTAVG_FSM6CLA1A': 'Average EBacc APS score per disadvantaged pupil at the end of
 'PTEBACC_95_WGTAVG_FSM6CLA1A': '% of disadvantaged pupils at the end of KS4 achieving the En
 'PTEBACC_94_WGTAVG_FSM6CLA1A': '% of disadvantaged pupils at the end of KS4 achieving the En
 'PTEBACC_E_PTQ_EE_WGTAVG_FSM6CLA1A': '% of disadvantaged pupils at the end of KS4 with entri
 'ATT8SCR_WGTAVG_NFSM6CLA1A': 'Average Attainment 8 score per non-disadvantaged pupil at the
 'P8MEACOV_NFSM6CLA1A': '% of non-disadvantaged pupils at the end of ks4 included in Progress
 'P8MEA_WGTAVG_NFSM6CLA1A': 'Progress 8 measure after adjustment for extreme scores for non-d
 'P8CILOW_NFSM6CLA1A': 'Progress 8 lower 95% confidence interval for adjusted average for non
 'P8CIUPP_NFSM6CLA1A': 'Progress 8 upper 95% confidence interval for adjusted average for non
 'PTL2BASICS_95_WGTAVG_NFSM6CLA1A': '% of non-disadvantaged pupils at the end of KS4 achievin
 'EBACCAPS_WGTAVG_NFSM6CLA1A': 'Average EBacc APS score per non-disadvantaged pupil at the en
 'PTEBACC_95_WGTAVG_NFSM6CLA1A': '% of non-disadvantaged pupils at the end of KS4 achieving t
 'PTEBACC_94_WGTAVG_NFSM6CLA1A': '% of non-disadvantaged pupils at the end of KS4 achieving t
 'PTEBACC_E_PTQ_EE_WGTAVG_NFSM6CLA1A': '% of non-disadvantaged pupils at the end of KS4 with
 'P8_BANDING': 'Progress 8 banding shown on performance tables website',
 'INSTITUTIONS_INMAT': 'URNs, including mainstream academies not in performance measures',
 'NUMINST_INMAT': 'Number of academies in the trust, including those not in performance meas
 'NUMINST_CONVERTER_INMAT': 'Number of converter academies, including those not in performanc
 'NUMINST_SPONSOR_INMAT': 'Number of sponsor-led academies, including those not in performanc
 'NUMINST_FREE_INMAT': 'Number of free school - mainstream academies, including those not in
 'NUMINST_STUDIO_INMAT': 'Number of free school - studio schools, including those not in per
 'NUMINST_UTC_INMAT': 'Number of free school - UTCs, including those not in performance meas
 'TPUP_INMAT': 'Number of pupils at the end of KS4, including those not in performance measu
 'PFSM6CLA1A_INMAT': '% of pupils at the end of KS4 who are disadvantaged, including those no
 'PNOTFSM6CLA1A_INMAT': '% of pupils at the end of KS4 who are not disadvantaged, including t
```

```python
school_demographics_meta = DataWrangler('data\school_information_meta.csv')
school_demographics_dict =  DataWrangler.make_dictionary(school_demographics_meta,'Field Name
school_demographics_dict
```

```
CSV file loaded successfully from data\school_information_meta.csv
```

```
{'URN': 'School unique reference number',
 'LANAME': 'Local authority name',
 'LA': 'Local authority number',
 'ESTAB': 'Establishment number',
 'LAESTAB': 'DfE number',
 'SCHNAME': 'School name',
 'STREET': 'School address (1)',
 'LOCALITY': 'School address (2)',
 'ADDRESS3': 'School address (3)',
 'TOWN': 'School town',
 'POSTCODE': 'School postcode',
 'SCHSTATUS': 'School open / closed status',
 'OPENDATE': 'Open date of school (if opened on or after 1st September 2022)',
 'CLOSEDATE': 'Date the school closed',
 'MINORGROUP': 'Type of school / college eg maintained school',
 'SCHOOLTYPE': 'School Type eg Voluntary Aided school',
 'ISPRIMARY': 'Does the school provide primary education? ( 0 = No, 1 = Yes)',
 'ISSECONDARY': 'Does the school provide secondary education? ( 0 = No, 1 = Yes)',
 'ISPOST16': 'Does the school provide post 16 education? (  0 = No, 1 = Yes)',
 'AGELOW': 'Lowest age of entry',
 'AGEHIGH': 'Highest age of entry',
 'GENDER': "Indicates whether it's a mixed or single sex school",
 'RELCHAR': 'Religious character',
 'ADMPOL': 'Admissions Policy',
 'OFSTEDRATING': 'Ofsted rating',
 'OFSTEDLASTINSP': 'Ofsted last inspection date'}
```

```python
ks4_school_performance_meta = DataWrangler('data/ks4_meta.xlsx') # this is originally in .xls
school_performance_dict = DataWrangler.make_dictionary(ks4_school_performance_meta, 'Metafile
#school_performance_dict['URN'] = 'URN'  # keep the URN column as it is as this will be used
school_performance_dict
```

```
Excel file loaded successfully from data/ks4_meta.xlsx
```

```
{'RECTYPE': 'Record type (1=mainstream school; 2=special school; 4=local authority; 5=Nationa
 'LEA': 'Local authority code (see separate list of local authorities and their codes)',
 'ESTAB': 'Establishment number',
 'URN': 'School Unique Reference Number',
 'SCHNAME': 'School name',
 'SCHNAME_AC': 'School now known as (used if the school has converted to an academy on or aft
 'ADDRESS1': 'School address (1)',
 'ADDRESS2': 'School address (2)',
 'ADDRESS3': 'School address (3)',
 'TOWN': 'School town',
 'PCODE': 'School postcode',
 'TELNUM': 'School telephone number',
 'PCON_CODE': 'Parliamentary constituency code',
 'PCON_NAME': 'Parliamentary constituency name',
 'CONTFLAG': "Contingency flag - school results 'significantly affected'. This field is zero
 'ICLOSE': 'Closed school flag (0=open; 1=closed; 2=pending closure)',
 'NFTYPE': 'School type (see separate list of abbreviations used in the tables)',
 'RELDENOM': 'School religious character',
 'ADMPOL': 'School admissions policy (self-declared by schools on Edubase)',
 'ADMPOL_PT': 'School admissions policy - new definition from 2019',
 'EGENDER': 'School gender of entry',
 'FEEDER': 'Indicates whether school is a feeder school for sixth form centre/consortia (0=No
 'TABKS2': 'Indicates whether school is published in the primary school (key stage 2) perform
 'TAB1618': 'Indicates whether school is published in the school and college (16-18) performa
 'AGERANGE': 'Age range',
 'TOTPUPS': 'Number of pupils on roll (all ages)',
 'NUMBOYS': 'Total boys on roll (including part-time pupils)',
 'NUMGIRLS': 'Total girls on roll (including part-time pupils)',
 'TPUP': 'Number of pupils at the end of key stage 4',
 'BPUP': 'Number of boys at the end of key stage 4',
 'PBPUP': '% of pupils at the end of key stage 4 who are boys',
 'GPUP': 'Number of girls at the end of key stage 4',
 'PGPUP': '% of pupils at the end key stage 4 who are girls',
 'KS2ASS': 'KS4 cohort average KS2 Scaled Score (average of English reading and maths)',
 'TPRIORLO': 'Number of pupils at the end of key stage 4 with low prior attainment at the end
 'PTPRIORLO': '% of pupils at the end of key stage 4 with low prior attainment at the end of
 'TPRIORAV': 'Number of pupils at the end of key stage 4 with middle prior attainment at the
 'PTPRIORAV': '% of pupils at the end of key stage 4 with middle prior attainment at the end
 'TPRIORHI': 'Number of pupils at the end of key stage 4 with high prior attainment at the en
 'PTPRIORHI': '% of pupils at the end of key stage 4 with high prior attainment at the end of
 'TFSM6CLA1A': 'Number of disadvantaged pupils at the end of key stage 4',
 'PTFSM6CLA1A': '% of pupils at the end of key stage 4 who are disadvantaged',
 'TNOTFSM6CLA1A': 'Number of non-disadvantaged pupils at the end of key stage 4',
 'PTNOTFSM6CLA1A': '% of pupils at the end of key stage 4 who are not disadvantaged',
 'TEALGRP2': 'Number of pupils at the end of key stage 4 with English as additional language
 'PTEALGRP2': '% of pupils at the end of key stage 4 with English as additional language (EAL
 'TEALGRP1': 'Number of pupils at the end of key stage 4 with English as their first language
 'PTEALGRP1': '% of pupils at the end of key stage 4 with English as their first language',
 'TEALGRP3': 'Number of pupils at the end of key stage 4 whose first language is unclassified
 'PTEALGRP3': '% of pupils at the end of key stage 4 whose first language is unclassified',
 'TNMOB': 'Number of pupils at the end of key stage 4 who are non-mobile',
 'PTNMOB': '% of pupils at the end of key stage 4 who are non-mobile',
 'SENE4': 'Number of pupils at the end of key stage 4 with special educational needs (SEN) wi
 'PSENE4': '% of pupils at the end of key stage 4 with special educational needs (SEN) with a
 'SEN_ALL4': 'Number of pupils at the end of key stage 4 with special educational needs (SEN
 'PSEN_ALL4': '% of pupils at the end of key stage 4 with special educational needs (SEN) inc
 'SENK4': 'Number of pupils at the end of key stage 4 with special educational needs (SEN) wi
 'PSENK4': '% of pupils at the end of key stage 4 with special educational needs (SEN) withou
 'TOTATT8': 'Total sum of Attainment 8 scores',
 'ATT8SCR': 'Average Attainment 8 score per pupil',
 'TOTATT8ENG': 'Total sum of Attainment 8 scores for English element',
 'ATT8SCRENG': 'Average Attainment 8 score per pupil for English element',
 'TOTATT8MAT': 'Total sum of Attainment 8 scores for mathematics element',
 'ATT8SCRMAT': 'Average Attainment 8 score per pupil for mathematics element',
 'TOTATT8EBAC': 'Total sum of Attainment 8 scores for EBacc element',
 'ATT8SCREBAC': 'Average Attainment 8 score per pupil for EBacc element',
 'TOTATT8OPEN': 'Total sum of Attainment 8 scores for open element',
 'ATT8SCROPEN': 'Average Attainment 8 score per pupil for open element',
 'TOTATT8OPENG': 'Total sum of Attainment 8 scores for open element - GCSE only',
 'ATT8SCROPENG': 'Average Attainment 8 score per pupil for open element - GCSE only',
 'TOTATT8OPENNG': 'Total sum of Attainment 8 scores for open element - non-GCSE only',
 'ATT8SCROPENNG': 'Average Attainment 8 score per pupil for open element - non-GCSE only',
 'AVGEBACFILL': 'Average number of EBacc slots filled in Attainment 8 per pupil',
 'AVGOPENFILL': 'Average number of Open slots filled in Attainment 8 per pupil',
 'P8PUP': 'Number of pupils included in Progress 8 measure',
 'TP8ADJ': 'Number of pupils who have had P8 score adjusted in average',
 'P8MEACOV': '% of pupils at the end of key stage 4 included in Progress 8 measure',
 'P8MEA': 'Progress 8 measure after adjustment for extreme scores',
 'P8CILOW': 'Progress 8 lower 95% confidence interval for adjusted average',
 'P8CIUPP': 'Progress 8 upper 95% confidence interval for adjusted average',
 'P8MEA_ORIG': 'Progress 8 measure based on unadjusted pupil scores',
 'P8CILOW_ORIG': 'Progress 8 lower 95% confidence interval for unadjusted average',
 'P8CIUPP_ORIG': 'Progress 8 upper 95% confidence interval for unadjusted average',
 'P8MEAENG': 'Progress 8 measure for English element',
 'P8MEAENG_CILOW': 'Lower 95% confidence interval for Progress 8 English element',
 'P8MEAENG_CIUPP': 'Upper 95% confidence interval for Progress 8 English element',
 'P8MEAMAT': 'Progress 8 measure for mathematics element',
 'P8MEAMAT_CILOW': 'Lower 95% confidence interval for Progress 8 maths element',
 'P8MEAMAT_CIUPP': 'Upper 95% confidence interval for Progress 8 maths element',
 'P8MEAEBAC': 'Progress 8 measure for EBacc element',
 'P8MEAEBAC_CILOW': 'Lower 95% confidence interval for Progress 8 EBacc element',
 'P8MEAEBAC_CIUPP': 'Upper 95% confidence interval for Progress 8 EBacc element',
 'P8MEAOPEN': 'Progress 8 measure for open element',
 'P8MEAOPEN_CILOW': 'Lower 95% confidence interval for Progress 8 open element',
 'P8MEAOPEN_CIUPP': 'Upper 95% confidence interval for Progress 8 open element',
 'PTL2BASICS_94': '% of pupils achieving standard 9-4 passes in both English and mathematics
 'PTL2BASICS_95': '% of pupils achieving strong 9-5 passes in both English and mathematics G
 'TOTEBACCAPS': 'Total EBacc APS score per pupil',
 'EBACCAPS': 'Average EBacc APS score per pupil',
 'EBACCAPS_FSM6CLA1A': 'Average EBacc APS score per disadvantaged pupil',
 'EBACCAPS_NFSM6CLA1A': 'Average EBacc APS score per non-disadvantaged pupil',
 'EBACCAPS_LO': 'Average EBacc APS score per pupil with low prior attainment',
 'EBACCAPS_MID': 'Average EBacc APS score per pupil with middle prior attainment',
 'EBACCAPS_HI': 'Average EBacc APS score per pupil with high prior attainment',
 'EBACCAPS_EAL': 'Average EBacc APS score per pupil for whom English is an additional langua
 'EBACCAPS_GIRLS': 'Average EBacc APS score per girl',
 'EBACCAPS_BOYS': 'Average EBacc APS score per boy',
 'EBACCAPS_NMOB': 'Average EBacc APS score per non-mobile pupil',
 'EBACCAPS_21': 'Average EBacc APS score per pupil in 2021',
 'EBACCAPS_FSM6CLA1A_21': 'Average EBacc APS score per disadvantaged pupil in 2021',
 'EBACCAPS_NFSM6CLA1A_21': 'Average EBacc APS score per non-disadvantaged pupil in 2021',
 'EBACCAPS_22': 'Average EBacc APS score per pupil in 2022',
 'EBACCAPS_FSM6CLA1A_22': 'Average EBacc APS score per disadvantaged pupil in 2022',
 'EBACCAPS_NFSM6CLA1A_22': 'Average EBacc APS score per non-disadvantaged pupil in 2022',
 'TEBACC_E_PTQ_EE': 'Number of key stage 4 pupils with entries in all English Baccalaureate s
 'PTEBACC_E_PTQ_EE': '% of key stage 4 pupils with entries in all English Baccalaureate subj
 'PTEBACC_94': '% of pupils achieving the English Baccalaureate with 9-4 passes',
 'PTEBACC_95': '% of pupils achieving the English Baccalaureate with 9-5 passes',
 'TEBACENG_E_PTQ_EE': 'Number of pupils entering the English Baccalaureate English subject a
 'PTEBACENG_E_PTQ_EE': '% of pupils entering the English Baccalaureate English subject area'
 'TEBACMAT_E_PTQ_EE': 'Number of pupils entering the English Baccalaureate Maths subject are
 'PTEBACMAT_E_PTQ_EE': '% of pupils entering the English Baccalaureate Maths subject area',
 'TEBAC2SCI_E_PTQ_EE': 'Number of pupils entering the English Baccalaureate Science subject 
 'PTEBAC2SCI_E_PTQ_EE': '%  of pupils entering the English Baccalaureate Science subject are
 'TEBACHUM_E_PTQ_EE': 'Number of pupils entering the English Baccalaureate Humanities subjec
 'PTEBACHUM_E_PTQ_EE': '%  of pupils entering the English Baccalaureate Humanities subject a
 'TEBACLAN_E_PTQ_EE': 'Number of pupils entering the English Baccalaureate Language subject 
 'PTEBACLAN_E_PTQ_EE': '%  of pupils entering the English Baccalaureate Language subject are
 'PTEBACENG_94': '% of pupils achieving the EBacc English subject area with a standard 9-4 p
 'PTEBACENG_95': '% of pupils achieving the EBacc English subject area with a strong 9-5 pas
 'PTEBACMAT_94': ' % of pupils achieving the EBacc Maths subject area with a standard 9-4 pa
 'PTEBACMAT_95': ' % of pupils achieving the EBacc Maths subject area with a strong 9-5 pass
 'PTEBAC2SCI_94': ' % of entered pupils achieving the EBacc Science subject area with a 9-4 
 'PTEBAC2SCI_95': ' % of entered pupils achieving the EBacc Science subject area with a 9-5 
 'PTEBACHUM_94': ' % of entered pupils achieving the EBacc Humanities subject area with a 9-
 'PTEBACHUM_95': ' % of entered pupils achieving the EBacc Humanities subject area with a 9-
 'PTEBACLAN_94': ' % of entered pupils achieving the EBacc Language subject area with a 9-4 
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'PTEBACLAN_95': ' % of entered pupils achieving the EBacc Language subject area with a 9-5 p
'SCIVAPUP_PTQ_EE': 'Number of pupils included in English Baccalaureate Science Value Added m
'SCIVACOV_PTQ_EE': 'Coverage of the English Baccalaureate Science Value Added indicators of
'HUMVAPUP_PTQ_EE': 'Number of pupils included in English Baccalaureate Humanities Value Adde
'HUMVACOV_PTQ_EE': 'Coverage of the English Baccalaureate Humanities Value Added indicators
'LANVAPUP_PTQ_EE': 'Number of pupils included in English Baccalaureate Language Value Added
'LANVACOV_PTQ_EE': 'Coverage of the English Baccalaureate Language Value Added indicators o
'SCIVAMEA_PTQ_EE': 'English Baccalaureate Science Value Added measure',
'SCIVALOW_PTQ_EE': 'English Baccalaureate Science Value Added lower 95% confidence limit',
'SCIVAUPP_PTQ_EE': 'English Baccalaureate Science Value Added upper 95% confidence limit',
'HUMVAMEA_PTQ_EE': 'EBacc Humanities VA measure',
'HUMVALOW_PTQ_EE': 'English Baccalaureate Humanities Value Added lower 95% confidence limit
'HUMVAUPP_PTQ_EE': 'English Baccalaureate Humanities Value Added upper 95% confidence limit
'LANVAMEA_PTQ_EE': 'English Baccalaureate Languages Value Added measure',
'LANVALOW_PTQ_EE': 'English Baccalaureate Languages Value Added lower 95% confidence limit'
'LANVAUPP_PTQ_EE': 'English Baccalaureate Languages Value Added upper 95% confidence limit'
'TEBACENG_94': 'Number of pupils achieving EBacc English subject area with a standard 9-4 pa
'TEBACENG_95': 'Number of pupils achieving EBacc English subject area with a strong 9-5 pass
'TEBACMAT_94': 'Number of pupils achieving EBacc Maths subject area with a standard 9-4 pass
'TEBACMAT_95': 'Number of pupils achieving EBacc Maths subject area with a strong 9-5 pass
'TEBAC2SCI_94': 'Number of pupils achieving EBacc Science subject area with a 9-4 pass',
'TEBAC2SCI_95': 'Number of pupils achieving EBacc Science subject area with a 9-5 pass',
'TEBACHUM_94': 'Number of pupils achieving EBacc Humanities subject area with a 9-4 pass',
'TEBACHUM_95': 'Number of pupils achieving EBacc Humanities subject area with a 9-5 pass',
'TEBACLAN_94': 'Number of pupils achieving EBacc Language subject area with a 9-4 pass',
'TEBACLAN_95': 'Number of pupils achieving EBacc Language subject area with a 9-5 pass',
'TEBACC91': 'Number of pupils achieving the English Baccalaureate at grades 9-1',
'PTEBACC91': ' % of pupils achieving the English Baccalaureate at grades 9-1 ',
'TEBACENG91': 'Number of pupils achieving EBacc English subject area at grade 9-1',
'PTEBACENG91': '% of pupils achieving the EBacc English subject area at grade 9-1',
'TEBACMAT91': 'Number of pupils achieving EBacc Maths subject area at grade 9-1',
'PTEBACMAT91': ' % of pupils achieving the EBacc Maths subject area at grade 9-1',
'TEBAC2SCI91': 'Number of pupils achieving EBacc Science subject area with grades 9-1',
'PTEBAC2SCI91': ' % entered pupils achieving the EBacc Science subject area with grades 9-1
'TEBACHUM91': 'Number of pupils achieving EBacc Humanities subject area with grades 9-1',
'PTEBACHUM91': ' % entered pupils achieving the EBacc Humanities subject area with grades 9-
'TEBACLAN91': 'Number of pupils achieving EBacc Language subject area with grades 9-1',
'PTEBACLAN91': ' % of entered pupils achieving the EBacc Language subject area with grades 9
'ATT8SCR_FSM6CLA1A': 'Average Attainment 8 score per disadvantaged pupil',
'P8PUP_FSM6CLA1A': 'Number of disadvantaged pupils in Progress 8 measure',
'TP8ADJ_FSM6CLA1A': 'Number of disadvantaged pupils in progress measure with adjusted scores
'P8MEA_FSM6CLA1A': 'Adjusted Progress 8 measure - disadvantaged pupils',
'P8CILOW_FSM6CLA1A': 'Adjusted Progress 8 lower 95% confidence interval - disadvantaged pupi
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'P8CIUPP_FSM6CLA1A': 'Adjusted Progress 8 upper 95% confidence interval - disadvantaged pupi
'P8MEA_FSM6CLA1A_ORIG': 'Unadjusted Progress 8 measure - disadvantaged pupils',
'P8CILOW_FSM6CLA1A_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - disadvanta
'P8CIUPP_FSM6CLA1A_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - disadvanta
'ATT8SCR_NFSM6CLA1A': 'Average Attainment 8 score per non-disadvantaged pupil',
'P8PUP_NFSM6CLA1A': 'Number of non-disadvantaged pupils in Progress 8 measure',
'TP8ADJ_NFSM6CLA1A': 'Number of non-disadvantaged pupils in progress measure with adjusted 
'P8MEA_NFSM6CLA1A': 'Adjusted Progress 8 measure - non-disadvantaged pupils',
'P8CILOW_NFSM6CLA1A': 'Progress 8 lower 95% confidence interval - non-disadvantaged pupils'
'P8CIUPP_NFSM6CLA1A': 'Progress 8 upper 95% confidence interval - non-disadvantaged pupils'
'P8MEA_NFSM6CLA1A_ORIG': 'Unadjusted Progress 8 measure - non-disadvantaged pupils',
'P8CILOW_NFSM6CLA1A_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - non-disadv
'P8CIUPP_NFSM6CLA1A_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - non-disadv
'ATT8SCRENG_FSM6CLA1A': 'Average Attainment 8 score per disadvantaged pupil for English ele
'P8MEAENG_FSM6CLA1A': 'Progress 8 measure for English element - disadvantaged pupils',
'P8MEAENG_CILOW_FSM6CLA1A': 'Lower 95% confidence interval for Progress 8 English element f
'P8MEAENG_CIUPP_FSM6CLA1A': 'Upper 95% confidence interval for Progress 8 English element f
'ATT8SCRMAT_FSM6CLA1A': 'Average Attainment 8 score per disadvantaged pupil for mathematics
'P8MEAMAT_FSM6CLA1A': 'Progress 8 measure for maths element - disadvantaged pupils',
'P8MEAMAT_CILOW_FSM6CLA1A': 'Lower 95% confidence interval for Progress 8 maths element for
'P8MEAMAT_CIUPP_FSM6CLA1A': 'Upper 95% confidence interval for Progress 8 maths element for
'ATT8SCREBAC_FSM6CLA1A': 'Average Attainment 8 score per disadvantaged pupil for EBacc elem
'P8MEAEBAC_FSM6CLA1A': 'Progress 8 measure for EBacc element - disadvantaged pupils',
'P8MEAEBAC_CILOW_FSM6CLA1A': 'Lower 95% confidence interval for Progress 8 EBacc element fo
'P8MEAEBAC_CIUPP_FSM6CLA1A': 'Upper 95% confidence interval for Progress 8 EBacc element fo
'ATT8SCROPEN_FSM6CLA1A': 'Average Attainment 8 score per disadvantaged pupil for open eleme
'P8MEAOPEN_FSM6CLA1A': 'Progress 8 measure for open element - disadvantaged pupils',
'P8MEAOPEN_CILOW_FSM6CLA1A': 'Lower 95% confidence interval for Progress 8 open element for
'P8MEAOPEN_CIUPP_FSM6CLA1A': 'Upper 95% confidence interval for Progress 8 open element for
'ATT8SCRENG_NFSM6CLA1A': 'Average Attainment 8 score per non-disadvantaged pupil for Englis
'P8MEAENG_NFSM6CLA1A': 'Progress 8 measure for English element - non-disadvantaged pupils',
'P8MEAENG_CILOW_NFSM6CLA1A': 'Lower 95% confidence interval for Progress 8 English element 
'P8MEAENG_CIUPP_NFSM6CLA1A': 'Upper 95% confidence interval for Progress 8 English element 
'ATT8SCRMAT_NFSM6CLA1A': 'Average Attainment 8 score per non-disadvantaged pupil for mathem
'P8MEAMAT_NFSM6CLA1A': 'Progress 8 measure for maths element - non-disadvantaged pupils',
'P8MEAMAT_CILOW_NFSM6CLA1A': 'Lower 95% confidence interval for Progress 8 maths element fo
'P8MEAMAT_CIUPP_NFSM6CLA1A': 'Upper 95% confidence interval for Progress 8 maths element fo
'ATT8SCREBAC_NFSM6CLA1A': 'Average Attainment 8 score per non-disadvantaged pupil for EBacc
'P8MEAEBAC_NFSM6CLA1A': 'Progress 8 measure for EBacc element - non-disadvantaged pupils',
'P8MEAEBAC_CILOW_NFSM6CLA1A': 'Lower 95% confidence interval for Progress 8 EBacc element f
'P8MEAEBAC_CIUPP_NFSM6CLA1A': 'Upper 95% confidence interval for Progress 8 EBacc element f
'ATT8SCROPEN_NFSM6CLA1A': 'Average Attainment 8 score per non-disadvantaged pupil for open 
'P8MEAOPEN_NFSM6CLA1A': 'Progress 8 measure for open element - non-disadvantaged pupils',
'P8MEAOPEN_CILOW_NFSM6CLA1A': 'Lower 95% confidence interval for Progress 8 open element fo
'P8MEAOPEN_CIUPP_NFSM6CLA1A': 'Upper 95% confidence interval for Progress 8 open element fo
'ATT8SCROPENG_FSM6CLA1A': 'Average Attainment 8 score per disadvantaged pupil for open eleme
'ATT8SCROPENNG_FSM6CLA1A': 'Average Attainment 8 score per disadvantaged pupil for open ele
'ATT8SCROPENG_NFSM6CLA1A': 'Average Attainment 8 score per non-disadvantaged pupil for open
'ATT8SCROPENNG_NFSM6CLA1A': 'Average Attainment 8 score per non-disadvantaged pupil for ope
'DIFFN_ATT8': 'Difference between Attainment 8 for disadvantaged pupils in school/LA and nor
'DIFFN_P8MEA': 'Difference between Progress 8 measure for disadvantaged pupils in school/LA
'ATT8SCR_LO': 'Average Attainment 8 score per pupil with low prior attainment',
'P8PUP_LO': 'Number of pupils with low prior attainment included in Progress 8 measure',
'TP8ADJ_LO': 'Number of pupils with low prior attainments in progress measure with adjusted
'P8MEA_LO': 'Adjusted Progress 8 measure - pupils with low prior attainments',
'P8CILOW_LO': 'Adjusted Progress 8 lower 95% confidence interval - pupils with low prior at
'P8CIUPP_LO': 'Adjusted Progress 8 upper 95% confidence interval - pupils with low prior at
'P8MEA_LO_ORIG': 'Unadjusted Progress 8 measure - pupils with low prior attainments',
'P8CILOW_LO_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - pupils with low pr
'P8CIUPP_LO_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - pupils with low pr
'ATT8SCR_MID': 'Average Attainment 8 score per pupil with middle prior attainment',
'P8PUP_MID': 'Number of pupils with middle prior attainment included in Progress 8 measure'
'TP8ADJ_MID': 'Number of pupils with middle prior attainments in progress measure with adju
'P8MEA_MID': 'Adjusted Progress 8 measure - pupils with middle prior attainment',
'P8CILOW_MID': 'Progress 8 lower 95% confidence interval - pupils with middle prior attainme
'P8CIUPP_MID': 'Progress 8 upper 95% confidence interval - pupils with middle prior attainme
'P8MEA_MID_ORIG': 'Unadjusted Progress 8 measure - pupils with middle prior attainments',
'P8CILOW_MID_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - pupils with middl
'P8CIUPP_MID_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - pupils with middl
'ATT8SCR_HI': 'Average Attainment 8 score per pupil with high prior attainment',
'P8PUP_HI': 'Number of pupils with high prior attainment included in Progress 8 measure',
'TP8ADJ_HI': 'Number of pupils with high prior attainments in progress measure with adjuste
'P8MEA_HI': 'Adjusted Progress 8 measure - pupils with high prior attainment',
'P8CILOW_HI': 'Progress 8 lower 95% confidence interval - pupils with high prior attainment
'P8CIUPP_HI': 'Progress 8 upper 95% confidence interval - pupils with high prior attainment
'P8MEA_HI_ORIG': 'Unadjusted Progress 8 measure - pupils with high prior attainments',
'P8CILOW_HI_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - pupils with high p
'P8CIUPP_HI_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - pupils with high p
'ATT8SCR_EAL': 'Average Attainment 8 score per pupil for whom English is an additional langu
'ATT8SCRENG_EAL': 'Average Attainment 8 score per pupil for whom English is an additional la
'ATT8SCRMAT_EAL': 'Average Attainment 8 score per pupil for whom English is an additional la
'ATT8SCREBAC_EAL': 'Average Attainment 8 score per pupil for whom English is an additional l
'ATT8SCROPEN_EAL': 'Average Attainment 8 score per pupil for whom English is an additional l
'ATT8SCROPENG_EAL': 'Average Attainment 8 score per pupil for whom English is an additional
'ATT8SCROPENNG_EAL': 'Average Attainment 8 score per pupil for whom English is an additional
'P8PUP_EAL': 'Number of pupils for whom English is an additional language included in Progre
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'TP8ADJ_EAL': 'Number of pupils for whom English is an additional language in progress measu
'P8MEA_EAL': 'Adjusted Progress 8 measure - pupils for whom English is an additional languag
'P8CILOW_EAL': 'Adjusted Progress 8 lower 95% confidence interval - pupils for whom English
'P8CIUPP_EAL': 'Adjusted Progress 8 upper 95% confidence interval - pupils for whom English
'P8MEA_EAL_ORIG': 'Unadjusted Progress 8 measure - pupils for whom English is an additional
'P8CILOW_EAL_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - pupils for whom E
'P8CIUPP_EAL_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - pupils for whom E
'ATT8SCR_GIRLS': 'Average Attainment 8 score per girl',
'ATT8SCRENG_GIRLS': 'Average Attainment 8 score per girl for English element',
'ATT8SCRMAT_GIRLS': 'Average Attainment 8 score per girl for mathematics element',
'ATT8SCREBAC_GIRLS': 'Average Attainment 8 score per girl for EBacc element',
'ATT8SCROPEN_GIRLS': 'Average Attainment 8 score per girl for open element',
'ATT8SCROPENG_GIRLS': 'Average Attainment 8 score per girl - GCSE only',
'ATT8SCROPENNG_GIRLS': 'Average Attainment 8 score per girl - non-GCSE only',
'P8PUP_GIRLS': 'Number of girls included in Progress 8 measure',
'TP8ADJ_GIRLS': 'Number of girls in progress measure with adjusted scores',
'P8MEA_GIRLS': 'Adjusted Progress 8 measure - girls',
'P8CILOW_GIRLS': 'Adjusted Progress 8 lower 95% confidence interval - girls',
'P8CIUPP_GIRLS': 'Adjusted Progress 8 upper 95% confidence interval - girls',
'P8MEA_GIRLS_ORIG': 'Unadjusted Progress 8 measure - girls',
'P8CILOW_GIRLS_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - girls',
'P8CIUPP_GIRLS_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - girls',
'ATT8SCR_BOYS': 'Average Attainment 8 score per boy',
'ATT8SCRENG_BOYS': 'Average Attainment 8 score per boy for English element',
'ATT8SCRMAT_BOYS': 'Average Attainment 8 score per boy for mathematics element',
'ATT8SCREBAC_BOYS': 'Average Attainment 8 score per boy for EBacc element',
'ATT8SCROPEN_BOYS': 'Average Attainment 8 score per boy for open element',
'ATT8SCROPENG_BOYS': 'Average Attainment 8 score per boy - GCSE only',
'ATT8SCROPENNG_BOYS': 'Average Attainment 8 score per boy - non-GCSE only',
'P8PUP_BOYS': 'Number of boys included in Progress 8 measure',
'TP8ADJ_BOYS': 'Number of boys in progress measure with adjusted scores',
'P8MEA_BOYS': 'Adjusted Progress 8 measure - boys',
'P8CILOW_BOYS': 'Adjusted Progress 8 lower 95% confidence interval - boys',
'P8CIUPP_BOYS': 'Adjusted Progress 8 upper 95% confidence interval - boys',
'P8MEA_BOYS_ORIG': 'Unadjusted Progress 8 measure - boys',
'P8CILOW_BOYS_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - boys',
'P8CIUPP_BOYS_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - boys',
'ATT8SCR_NMOB': 'Average Attainment 8 score per non-mobile pupil',
'ATT8SCRENG_NMOB': 'Average Attainment 8 score per non-mobile pupil for English element',
'ATT8SCRMAT_NMOB': 'Average Attainment 8 score per non-mobile pupil for mathematics element
'ATT8SCREBAC_NMOB': 'Average Attainment 8 score per non-mobile pupil for EBacc element',
'ATT8SCROPEN_NMOB': 'Average Attainment 8 score per non-mobile pupil for open element',
'ATT8SCROPENG_NMOB': 'Average Attainment 8 score per non-mobile pupil - GCSE only',
'ATT8SCROPENNG_NMOB': 'Average Attainment 8 score per non-mobile pupil - non-GCSE only',
'P8PUP_NMOB': 'Number of non-mobile pupils included in Progress 8 measure',
'TP8ADJ_NMOB': 'Number of non-mobile pupils in progress measure with adjusted scores',
'P8MEA_NMOB': 'Adjusted Progress 8 measure - non-mobile pupils',
'P8CILOW_NMOB': 'Adjusted Progress 8 lower 95% confidence interval - non-mobile pupils',
'P8CIUPP_NMOB': 'Adjusted Progress 8 upper 95% confidence interval - non-mobile pupils',
'P8MEA_NMOB_ORIG': 'Unadjusted Progress 8 measure - non-mobile pupils',
'P8CILOW_NMOB_ORIG': 'Unadjusted Progress 8 lower 95% confidence interval - non-mobile pupil
'P8CIUPP_NMOB_ORIG': 'Unadjusted Progress 8 upper 95% confidence interval - non-mobile pupil
'ATT8SCR_21': 'Average Attainment 8 score per pupil  - 2021',
'P8PUP_21': 'Number of pupils in progress measure  - 2021',
'P8MEA_21': 'Progress 8 measure  - 2021',
'P8CILOW_21': 'Progress 8 lower 95% confidence interval  - 2021',
'P8CIUPP_21': 'Progress 8 upper 95% confidence interval - 2021',
'ATT8SCR_FSM6CLA1A_21': 'Average Attainment 8 score per disadvantaged pupil - 2021',
'P8PUP_FSM6CLA1A_21': 'Number of disadvantaged pupils in progress measure - 2021',
'P8MEA_FSM6CLA1A_21': 'Progress 8 measure - disadvantaged pupils - 2021',
'P8CILOW_FSM6CLA1A_21': 'Progress 8 lower 95% confidence interval - disadvantaged pupils - 
'P8CIUPP_FSM6CLA1A_21': 'Progress 8 upper 95% confidence interval - disadvantaged pupils - 
'ATT8SCR_NFSM6CLA1A_21': 'Average Attainment 8 score per non-disadvantaged pupil - 2021',
'P8PUP_NFSM6CLA1A_21': 'Number of non-disadvantaged pupils in progress measure - 2021',
'P8MEA_NFSM6CLA1A_21': 'Progress 8 measure - non-disadvantaged pupils - 2021',
'P8CILOW_NFSM6CLA1A_21': 'Progress 8 lower 95% confidence interval - non-disadvantaged pupil
'P8CIUPP_NFSM6CLA1A_21': 'Progress 8 upper 95% confidence interval - non-disadvantaged pupil
'ATT8SCR_22': 'Average Attainment 8 score per pupil - 2022',
'P8PUP_22': 'Number of pupils in progress measure - 2022',
'P8MEA_22': 'Progress 8 measure - 2022',
'P8CILOW_22': 'Progress 8 lower 95% confidence interval - 2022',
'P8CIUPP_22': 'Progress 8 upper 95% confidence interva - 2022',
'ATT8SCR_FSM6CLA1A_22': 'Average Attainment 8 score per disadvantaged pupil - 2022',
'P8PUP_FSM6CLA1A_22': 'Number of disadvantaged pupils in progress measure - 2022',
'P8MEA_FSM6CLA1A_22': 'Progress 8 measure - disadvantaged pupils - 2022',
'P8CILOW_FSM6CLA1A_22': 'Progress 8 lower 95% confidence interval - disadvantaged pupils - 
'P8CIUPP_FSM6CLA1A_22': 'Progress 8 upper 95% confidence interval - disadvantaged pupils - 
'ATT8SCR_NFSM6CLA1A_22': 'Average Attainment 8 score per non-disadvantaged pupil  - 2022',
'P8PUP_NFSM6CLA1A_22': 'Number of non-disadvantaged pupils in progress measure - 2022',
'P8MEA_NFSM6CLA1A_22': 'Progress 8 measure - non-disadvantaged pupils - 2022',
'P8CILOW_NFSM6CLA1A_22': 'Progress 8 lower 95% confidence interval - non-disadvantaged pupil
'P8CIUPP_NFSM6CLA1A_22': 'Progress 8 upper 95% confidence interval - non-disadvantaged pupil
'TEBACC_ELO_PTQ_EE': 'Number of pupils in low prior attainment band with entries in all EBa
'PTEBACC_ELO_PTQ_EE': 'EBacc entered % by low prior attainment',
'PTEBACCLO_94': 'EBacc achieved % by low prior attainment - with standard 9-4 passes in Eng
'PTEBACCLO_95': 'EBacc achieved % by low prior attainment - with 9-5 passes',
'TEBACC_EAV_PTQ_EE': 'Number of pupils in middle prior attainment band with entries in all E
'PTEBACC_EAV_PTQ_EE': 'EBacc entered % by middle prior attainment',
'PTEBACCAV_94': 'EBacc achieved % by middle prior attainment - with 9-4 passes',
'PTEBACCAV_95': 'EBacc achieved % by middle prior attainment - with 9-5 passes',
'TEBACC_EHI_PTQ_EE': 'Number of pupils in high prior attainment band with entries in all EBa
'PTEBACC_EHI_PTQ_EE': 'EBacc entered % by high prior attainment',
'PTEBACCHI_94': 'EBacc achieved % by high prior attainment - with 9-4 passes',
'PTEBACCHI_95': 'EBacc achieved % by high prior attainment - with 9-5 passes',
'PTEBACC_EFSM6CLA1A_PTQ_EE': '% of disadvantaged pupils entering all English Baccalaureate s
'PTEBACC_ENFSM6CLA1A_PTQ_EE': ' % of non-disadvantaged pupils entering all English Baccalau
'PTEBACC_94_FSM6CLA1A': ' % of disadvantaged pupils achieving the English Baccalaureate - wi
'PTEBACC_95_FSM6CLA1A': ' % of disadvantaged pupils achieving the English Baccalaureate - wi
'PTEBACC_94_NFSM6CLA1A': ' % of non-disadvantaged pupils achieving the English Baccalaureate
'PTEBACC_95_NFSM6CLA1A': ' % of non-disadvantaged pupils achieving the English Baccalaureate
'SCIVAMEA_LO_PTQ_EE': 'English Baccalaureate Science Value Added measure for pupils with low
'SCIVAMEA_MID_PTQ_EE': 'English Baccalaureate Science Value Added measure for pupils with mi
'SCIVAMEA_HI_PTQ_EE': 'English Baccalaureate Science Value Added measure for pupils with hig
'SCIVAMEA_FSM6CLA1A_PTQ_EE': 'English Baccalaureate Science Value Added measure for disadvan
'SCIVAMEA_NFSM6CLA1A_PTQ_EE': 'English Baccalaureate Science Value Added measure for non-dis
'HUMVAMEA_LO_PTQ_EE': 'English Baccalaureate Humanities Value Added measure for pupils with
'HUMVAMEA_MID_PTQ_EE': 'English Baccalaureate Humanities Value Added measure for pupils with
'HUMVAMEA_HI_PTQ_EE': 'English Baccalaureate Humanities Value Added measure for pupils with
'HUMVAMEA_FSM6CLA1A_PTQ_EE': 'English Baccalaureate Humanities Value Added measure for disad
'HUMVAMEA_NFSM6CLA1A_PTQ_EE': 'English Baccalaureate Humanities Value Added measure for non-
'LANVAMEA_LO_PTQ_EE': 'English Baccalaureate Languages Value Added measure for pupils with l
'LANVAMEA_MID_PTQ_EE': 'English Baccalaureate Languages Value Added measure for pupils with
'LANVAMEA_HI_PTQ_EE': 'English Baccalaureate Languages Value Added measure for pupils with l
'LANVAMEA_FSM6CLA1A_PTQ_EE': 'English Baccalaureate Languages Value Added measure for disadv
'LANVAMEA_NFSM6CLA1A_PTQ_EE': 'English Baccalaureate Languages Value Added measure for non-d
'SCIVAUPP_FSM6CLA1A_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Science V
'SCIVALOW_FSM6CLA1A_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Science V
'SCIVAUPP_NFSM6CLA1A_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Science
'SCIVALOW_NFSM6CLA1A_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Science
'SCIVAUPP_LO_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Science Value Ad
'SCIVALOW_LO_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Science Value Ad
'SCIVAUPP_MID_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Science Value A
'SCIVALOW_MID_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Science Value A
'SCIVAUPP_HI_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Science Value Ad
'SCIVALOW_HI_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Science Value Ad
'HUMVAUPP_FSM6CLA1A_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Humanitie
'HUMVALOW_FSM6CLA1A_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Humanitie
'HUMVAUPP_NFSM6CLA1A_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Humaniti
'HUMVALOW_NFSM6CLA1A_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Humaniti
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'HUMVAUPP_LO_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Humanities Valu
'HUMVALOW_LO_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Humanities Valu
'HUMVAUPP_MID_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Humanities Val
'HUMVALOW_MID_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Humanities Val
'HUMVAUPP_HI_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Humanities Valu
'HUMVALOW_HI_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Humanities Valu
'LANVAUPP_FSM6CLA1A_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Language
'LANVALOW_FSM6CLA1A_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Language
'LANVAUPP_NFSM6CLA1A_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Languag
'LANVALOW_NFSM6CLA1A_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Languag
'LANVAUPP_LO_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Languages Value
'LANVALOW_LO_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Languages Value
'LANVAUPP_MID_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Languages Valu
'LANVALOW_MID_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Languages Valu
'LANVAUPP_HI_PTQ_EE': 'Upper 95% confidence limit for English Baccalaureate Languages Value
'LANVALOW_HI_PTQ_EE': 'Lower 95% confidence limit for English Baccalaureate Languages Value
'PTEBACC_E_21_PTQ_EE': '% of pupils entering all English Baccalaureate subject areas in 202
'PTEBACC_94_21': '% of KS4 pupils achieving the Ebacc - with standard 9-4 passes in English
'PTEBACC_95_21': '% of KS4 pupils achieving the Ebacc - with strong 9-5 passes in English a
'PTEBACC_E_22_PTQ_EE': '% of  pupils entering all English Baccalaureate subject areas in 20
'PTEBACC_94_22': '% of KS4 pupils achieving the Ebacc - with standard 9-4 passes in English
'PTEBACC_95_22': '% of KS4 pupils achieving the Ebacc - with strong 9-5 passes in English a
'PBEBACC_E_PTQ_EE': '% of boys with entries in all English Baccalaureate subject areas',
'PBEBACC_94': '% of KS4 boys achieving the Ebacc - with 9-4 passes',
'PBEBACC_95': '% of KS4 boys achieving the Ebacc - with 9-5 passes',
'PGEBACC_E_PTQ_EE': '% of girls with entries in all English Baccalaureate subject areas',
'PGEBACC_94': '% of KS4 girls achieving the Ebacc - with 9-4 passes',
'PGEBACC_95': '% of KS4 girls achieving the Ebacc - with 9-5 passes',
'PTEBACC_ENMOB_PTQ_EE': '% of non-mobile pupils with entries in all English Baccalaureate s
'PTEBACCNMOB_94': '% of non-mobile pupils achieving the English Baccalaureate with 9-4 pass
'PTEBACCNMOB_95': '% of non-mobile pupils achieving the English Baccalaureate with 9-5 pass
'PTEBACC_EEAL_PTQ_EE': '% of pupils for whom English is an additional language with entries
'PTEBACCEAL_94': '% of pupils for whom English as an additional language achieving the Engl
'PTEBACCEAL_95': '% of pupils for whom English as an additional language achieving the Engl
'PTEBACC_EFSM6CLA1A_21': '% of disadvantaged pupils entering all English Baccalaureate subj
'PTEBACC_94_FSM6CLA1A_21': '% of disadvantaged pupils achieving the English Baccalaureate a
'PTEBACC_95_FSM6CLA1A_21': '% of disadvantaged pupils achieving the English Baccalaureate a
'PTEBACC_ENFSM6CLA1A_21': '% of non-disadvantaged pupils entering all English Baccalaureate
'PTEBACC_94_NFSM6CLA1A_21': '% of non-disadvantaged pupils achieving the English Baccalaure
'PTEBACC_95_NFSM6CLA1A_21': '% of non-disadvantaged pupils achieving the English Baccalaure
'PTEBACC_EFSM6CLA1A_22': '% of disadvantaged pupils entering all English Baccalaureate subj
'PTEBACC_94_FSM6CLA1A_22': '% of disadvantaged pupils achieving the English Baccalaureate i
'PTEBACC_95_FSM6CLA1A_22': '% of disadvantaged pupils achieving the English Baccalaureate i
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'PTEBACC_ENFSM6CLA1A_22': '% of non-disadvantaged pupils entering all English Baccalaureate
'PTEBACC_94_NFSM6CLA1A_22': '% of non-disadvantaged pupils achieving the English Baccalaurea
'PTEBACC_95_NFSM6CLA1A_22': '% of non-disadvantaged pupils achieving the English Baccalaurea
'PT5EM_94': '% of pupils achieving Level 2 threshold including standard passes 9-4 in both E
'PT5EM_94_21': '% of pupils achieving Level 2 threshold including standard passes 9-4 in bot
'PT5EM_94_22': '% of pupils achieving Level 2 threshold including standard passes 9-4 in bot
'PTANYQ_PTQ_EE': '% of pupils achieving any qualifications',
'PTL2BASICS_94_21': '% of pupils achieving 9-4 passes in GCSE English and maths in 2021',
'PTL2BASICS_95_21': '% of pupils achieving 9-5 passes in GCSE English and maths in 2021',
'PTL2BASICS_94_22': '% of pupils achieving 9-4 passes in GCSE English and maths in 2022',
'PTL2BASICS_95_22': '% of pupils achieving 9-5 passes in GCSE English and maths in 2022',
'PTFSM6CLA1ABASICS_94': '% of disadvantaged pupils achieving standard 9-4 passes in GCSE Eng
'PTNOTFSM6CLA1ABASICS_94': '% of non-disadvantaged pupils achieving standard 9-4 passes in G
'TBASICSLO_94': 'Number of pupils in low prior attainment band who achieved standard 9-4 pas
'PTBASICSLO_94': '% of pupils in low prior attainment band who achieved standard 9-4 passes
'TBASICSAV_94': 'Number of pupils in middle prior attainment band who achieved standard 9-4
'PTBASICSAV_94': '% pupils in middle prior attainment band who achieved standard 9-4 passes
'TBASICSHI_94': 'Number of pupils in high prior attainment band who achieved standard 9-4 pa
'PTBASICSHI_94': '% pupils in high prior attainment band who achieved standard 9-4 passes in
'PBL2BASICS_94': '% of boys achieving standard 9-4 passes in both English and mathematics GC
'PGL2BASICS_94': '% of girls achieving standard 9-4 passes in both English and mathematics G
'PTL2BASICSEAL_94': '% of pupils achieving standard 9-4 passes in both English and mathemati
'PTL2BASICSNMOB_94': '% of non-mobile pupils achieving standard 9-4 passes in both English a
'PTFSM6CLA1ABASICS_95': '% of disadvantaged pupils achieving strong 9-5 passes in GCSE Engli
'PTNOTFSM6CLA1ABASICS_95': '% of non-disadvantaged pupils achieving strong 9-5 passes in GCS
'TBASICSLO_95': 'Number of pupils in low prior attainment band who achieved strong 9-5 passe
'PTBASICSLO_95': '% of pupils in low prior attainment band who achieved strong 9-5 passes in
'TBASICSAV_95': 'Number of pupils in middle prior attainment band who achieved strong 9-5 pa
'PTBASICSAV_95': '% pupils in middle prior attainment band who achieved strong 9-5 passes in
'TBASICSHI_95': 'Number of pupils in high prior attainment band who achieved strong 9-5 pass
'PTBASICSHI_95': '% pupils in high prior attainment band who achieved strong 9-5 passes in E
'PBL2BASICS_95': '% of boys achieving strong 9-5 passes in both English and mathematics GCSE
'PGL2BASICS_95': '% of girls achieving strong 9-5 passes in both English and mathematics GCS
'PTL2BASICSEAL_95': '% of pupils achieving strong 9-5 passes in both English and mathematics
'PTL2BASICSNMOB_95': '% of non-mobile pupils achieving strong 9-5 passes in both English and
'PTFSM6CLA1ABASICS_94_21': '% of disadvantaged pupils achieving 9-4 in GCSE English and math
'PTFSM6CLA1ABASICS_95_21': '% of disadvantaged pupils achieving 9-4 passes in GCSE English a
'PTNOTFSM6CLA1ABASICS_94_21': '% of non-disadvantaged pupils achieving 9-4 passes in GCSE En
'PTNOTFSM6CLA1ABASICS_95_21': '% of non-disadvantaged pupils achieving 9-5 passes in GCSE En
'PTFSM6CLA1ABASICS_94_22': '% of disadvantaged pupils achieving 9-4 passes in GCSE English a
'PTFSM6CLA1ABASICS_95_22': '% of disadvantaged pupils achieving 9-5 passes in GCSE English a
'PTNOTFSM6CLA1ABASICS_94_22': '% of non-disadvantaged pupils achieving 9-4 passes in GCSE En
'PTNOTFSM6CLA1ABASICS_95_22': '% of non-disadvantaged pupils achieving 9-5 passes in GCSE En
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 'PTmultiLan_E': '% of pupils entering more than one language',
 'PTtripleSci_E': '% of pupils entering biology, chemistry and physics',
 'TFSM6CLA1A_21': 'Number of disadvantaged pupils at the end of key stage 4 in 2021',
 'PTFSM6CLA1A_21': '% of pupils at the end of key stage 4 who were disadvantaged in 2021',
 'TNOTFSM6CLA1A_21': 'Number of non-disadvantaged pupils at the end of key stage 4 in 2021',
 'PTNOTFSM6CLA1A_21': '% of pupils at the end of key stage 4 who were not disadvantaged in 20
 'TFSM6CLA1A_22': 'Number of disadvantaged pupils in 2022',
 'PTFSM6CLA1A_22': '% of pupils who were disadvantaged in 2022',
 'TNOTFSM6CLA1A_22': 'Number of non-disadvantaged pupils in 2022',
 'PTNOTFSM6CLA1A_22': '% of pupils who were not disadvantaged in 2022',
 'TAVENT_E_3NG_PTQ_EE': 'Average number of KS4 entries per pupil',
 'TAVENT_E_3NG_LO_PTQ_EE': 'Average number of KS4 entries per pupil with low prior attainmen
 'TAVENT_E_3NG_MID_PTQ_EE': 'Average number of KS4 entries per pupil with middle prior attai
 'TAVENT_E_3NG_HI_PTQ_EE': 'Average number of KS4 entries per pupil with high prior attainme
 'TAVENT_E_3NG_FSM6CLA1A_PTQ_EE': 'Average number of KS4 entries per disadvantaged pupil',
 'TAVENT_E_3NG_NFSM6CLA1A_PTQ_EE': 'Average number of KS4 entries per non-disadvantaged pupi
 'TAVENT_EFSM6CLA1A_21_PTQ_EE': 'Average number of KS4 entries per disadvantaged pupil in 20
 'TAVENT_ENFSM6CLA1A_21_PTQ_EE': 'Average number of KS4 entries per non-disadvantaged pupil
 'TAVENT_EFSM6CLA1A_22_PTQ_EE': 'Average number of KS4 entries per disadvantaged pupil in 20
 'TAVENT_ENFSM6CLA1A_22_PTQ_EE': 'Average number of KS4 entries per non-disadvantaged pupil
 'TAVENT_G_PTQ_EE': 'Average number of GCSE entries per pupil',
 'TAVENT_GLO_PTQ_EE': 'Average number of GCSE entries per pupil with low prior attainment',
 'TAVENT_GAV_PTQ_EE': 'Average number of GCSE entries per pupil with middle prior attainment
 'TAVENT_GHI_PTQ_EE': 'Average number of GCSE entries per pupil with high prior attainment',
 'TAVENT_GFSM6CLA1A_PTQ_EE': 'Average number of GCSE entries per disadvantaged pupil',
 'TAVENT_GNFSM6CLA1A_PTQ_EE': 'Average number of GCSE entries per non-disadvantaged pupil',
 'TAVENT_GFSM6CLA1A_21_PTQ_EE': 'Average number of GCSE entries per disadvantaged pupil in 2
 'TAVENT_GNFSM6CLA1A_21_PTQ_EE': 'Average number of GCSE entries per non-disadvantaged pupil
 'TAVENT_GFSM6CLA1A_22_PTQ_EE': 'Average number of GCSE entries per disadvantaged pupil in 2
 'TAVENT_GNFSM6CLA1A_22_PTQ_EE': 'Average number of GCSE entries per non-disadvantaged pupil
 'TTOTENT_E_TOTAL_PTQ_EE': 'Total volume of entries without discounting',
 'TTOTENT_E_COVID_IMPACTED_PTQ_EE': 'Total volume of covid-impacted entries without discount
 'PTOTENT_E_COVID_IMPACTED_PTQ_EE': '% of covid-impacted entries out of total number of entr
 'P8_BANDING': 'Progress 8 banding shown on school performance tables website'}
```

```python
school_funding_meta = DataWrangler('data/funding_meta.csv') # this is originally in .xlsx fo
school_funding_dict = DataWrangler.make_dictionary(school_funding_meta, 'Variable name','Var
school_funding_dict
```

```
CSV file loaded successfully from data/funding_meta.csv
```

```
{'academy': 'Academy?',
'allocation_per_pupil': 'Allocation per Pupil',
'basic_entitlement_ks3': 'Basic Entitlement KS3',
'basic_entitlement_ks4': 'Basic Entitlement KS4',
'basic_entitlement_primary': 'Basic Entitlement Primary',
'basic_entitlement_total_funding': 'Basic Entitlement Total Funding',
'coronavirus_recovery_premium_funding': 'Coronavirus (COVID-19) recovery premium funding',
'deprivation_total_funding': 'Deprivation Total Funding',
'eal_total_funding': 'EAL Total Funding',
'exceptional_factors_total_funding': 'Exceptional Factors Total Funding',
'fsm_funding': 'FSM Funding',
'fsm6_funding': 'FSM6 Funding',
'idaci_band_a': 'IDACI Band A',
'idaci_band_b': 'IDACI Band B',
'idaci_band_c': 'IDACI Band C',
'idaci_band_d': 'IDACI Band D',
'idaci_band_e': 'IDACI Band E',
'idaci_band_f': 'IDACI Band F',
'idaci_funding': 'IDACI Funding',
'lac_total_funding': 'LAC Total Funding',
'london_fringe': 'London Fringe',
'lump_sum_total_funding': 'Lump Sum Total Funding',
'mfg_protection_or_capping_scaling': 'MFG protection (+ve) or capping/scaling (-ve)',
'minimum_per_pupil_funding': 'Minimum per pupil funding',
'mobility_total_funding': 'Mobility Total Funding',
'national_non_domestic_rates_funding': 'National Non Domestic Rates Funding',
'notional_sen': 'Notional SEN',
'pe_&_sport_premium': 'PE & Sport Premium funding',
'pe_&_sport_premium_pupils': 'PE & Sport Premium pupils',
'pfi_total_funding': 'PFI Total Funding',
'prior_attainment_total_funding': 'Prior Attainment Total Funding',
'pupil_premium': 'Pupil Premium funding',
'pupil_premium_pupils': 'Pupil Premium pupils',
'School_led_tutoring_funding': 'School-led tutoring funding',
'school_phase': 'Phase',
'school_type': 'School type',
'school_ukprn': 'UKPRN',
'schools_supplementary_grant': 'Schools Supplementary Grant funding',
'sparsity_total_funding': 'Sparsity Total Funding',
'split_site_total_funding': 'Split Site Total Funding',
'total_funding': 'Total funding',
'total_number_of_pupils': 'Total Number of Pupils (rounded)',
'total_schools_block_allocation_(post_mfg)': 'Total Schools Block Allocation (Post MFG)',
'total_schools_block_allocation_(pre_mfg)': 'Total Schools Block Allocation (Pre MFG)',
'trust': 'Trust',
'universal_infant_free_school_meals_grant': 'Universal Infant Free School Meals Grant fundi
```

Select Columns from Data

Before re-labeling the columns using the defintions in the dictionaries, it will be more efficient to select the columns needed in each data file. I shall therefor re-define each dataframe according to the selected columns needed.

MAT Performance Data:

```
#only the following columns are needed

ks4_mat_performance_df = ks4_mat_performance.df[['TRUST_NAME','TRUST_UID', 'TRUST_ID', 'NUMI
ks4_mat_performance_df.head()
```

	TRUST_NAME	TRUST_UID	TRUST_ID	NUMINST_MATPTINC	TPUP_MATPTINC	ATT8S
0	ACTIVATE LEARNING EDUCATION TRUST	15710	TR02786	6		
1	ACER TRUST	15720	TR01414	3		
2	RED KITE LEARNING TRUST	15727	TR00969	4		
3	CONSILIUM ACADEMIES	15728	TR00082	8		
4	BATLEY MULTI ACADEMY TRUST	15729	TR00147	3		

Keystage 4 School Performance Data:

```
#following columns are key measures for school performance
ks4_school_performance_df = ks4_school_performance.df[['URN',
    'ATT8SCR',
    'P8MEA',
    'PTFSM6CLA1A_22',
    'PTNOTFSM6CLA1A_22',
    'PTFSM6CLA1ABASICS_95', #462
    'PTNOTFSM6CLA1ABASICS_95',
    'ATT8SCR_NFSM6CLA1A_22',
    'P8MEA_NFSM6CLA1A_22',
'ATT8SCR_FSM6CLA1A_22',
    'P8MEA_FSM6CLA1A_22',
    'P8MEAMAT_FSM6CLA1A',
    'P8MEAENG_FSM6CLA1A',
    'P8MEAMAT_NFSM6CLA1A',
    'P8MEAENG_NFSM6CLA1A'
    ]]


ks4_school_performance_df.head()
```

	URN	ATT8SCR	P8MEA	PTFSM6CLA1A_22	PTNOTFSM6CLA1A_22	PTFSM6CLA1ABASICS
0	100003.0	36.8	NP	NP	NP	NP
1	100001.0	29.4	NP	NP	NP	NP
2	100544.0	6.8	NP	NP	NP	NP
3	NaN	NaN	NaN	NaN	NaN	NaN
4	100053.0	50.3	-0.16	42%	58%	28%

School Demographics:

```
school_demographics_df = school_demographics.df[['URN','LANAME','LA','SCHOOLTYPE','MINORGROU
school_demographics_df.head()
```

	URN	LANAME	LA	SCHOOLTYPE	MINORGROUP	RELCHAR	ADMPOL	GENDER	OFST
0	100000	City of London	201	Voluntary aided school	Maintained school	Church of England	No		
1	100001	City of London	201	Other independent school	Independent school	NaN	Sel		
2	100002	City of London	201	Other independent school	Independent school	Church of England	No		
3	100003	City of London	201	Other independent school	Independent school	NaN	No		
4	100008	Camden	202	Community school	Maintained school	Does not apply	No		

School Funding:

```
school_funding_df = school_funding.df[['school_urn','fsm_funding','pupil_premium','pupil_prem

school_funding_df.head()
```

	school_urn	fsm_funding	pupil_premium	pupil_premium_pupils	School_led_tutoring_funding	tot
0	101247	118662	291560	296	49248	8
1	101241	198479	492993	501	84024	1
2	101202	75028	209135	151	24138	3
3	101231	55872	153735	111	18117	2

	school_urn	fsm_funding	pupil_premium	pupil_premium_pupils	School_led_tutoring_funding	tot
4	136028	211782	511215	519	91017	9

```
#change column name
school_funding_df.rename(columns={'school_urn':'URN'}, inplace=True) # change column name to
school_funding_df.head()
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\65584972.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guid
  school_funding_df.rename(columns={'school_urn':'URN'}, inplace=True) # change column name
```

	URN	fsm_funding	pupil_premium	pupil_premium_pupils	School_led_tutoring_funding	total_fu
0	101247	118662	291560	296	49248	85428
1	101241	198479	492993	501	84024	13420
2	101202	75028	209135	151	24138	34395
3	101231	55872	153735	111	18117	26339
4	136028	211782	511215	519	91017	98362

Academies Membership

- Only URN, Trust ID, School Name and Trust Name are needed

```
academies_membership_df = academies_membership.df[['URN','Group UID','Group ID','Establishme
academies_membership_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 12637 entries, 0 to 12636
Data columns (total 5 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   URN                12618 non-null  float64
 1   Group UID          12463 non-null  float64
 2   Group ID           12463 non-null  object
 3   EstablishmentName  12618 non-null  object
 4   Group Name         12463 non-null  object
dtypes: float64(2), object(3)
memory usage: 493.8+ KB
```

Merging DfE Data

I can now begin merging the various DfE data based on school URN

Merge: school demographics and school funding

```
school_funding_df.columns
school_funding_df.rename(columns={'school_urn': 'URN'}, inplace=True) # change name of URN co
school_funding_df.columns
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\2541994176.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide
  school_funding_df.rename(columns={'school_urn': 'URN'}, inplace=True) # change name of URN
```

```
Index(['URN', 'fsm_funding', 'pupil_premium', 'pupil_premium_pupils',
       'School_led_tutoring_funding', 'total_funding'],
      dtype='object')
```

```
# Merge School Information with Funding Data
merged_df = pd.merge(school_demographics_df, school_funding_df, on='URN', how='inner')
#chosen an inner join, as having incomplete left or right fields will not be of use
print("School Demographics and Funding data merged.")

merged_df.shape
```

```
School Demographics and Funding data merged.
```

```
(19973, 15)
```

```
merged_df.columns
```

```
Index(['URN', 'LANAME', 'LA', 'SCHOOLTYPE', 'MINORGROUP', 'RELCHAR', 'ADMPOL',
       'GENDER', 'OFSTEDRATING', 'POSTCODE', 'fsm_funding', 'pupil_premium',
       'pupil_premium_pupils', 'School_led_tutoring_funding', 'total_funding'],
      dtype='object')
```

Merge MAT info

```
 # Merge with MAT Performance
merged_df = pd.merge(merged_df, academies_membership_df, on= ['URN'], how='left')
# some schools may not have an academy therefore a left join
print("Merged with MAT Performance data.")
```

```
Merged with MAT Performance data.
```

```
merged_df['URN'].nunique() # count how many unique schools exist and therefore if some are du
```

```
19973
```

Some of the URNs may be duplicates and will need to be dropped later on when I conduct data cleaning.

merge school performance

```
merged_df = pd.merge(merged_df, ks4_school_performance_df, on='URN', how='inner')
# inner join essential as having only 'right' or 'left' data wouldnt be of much use
print("School KS4 performance data merged.")
merged_df.head()
```

```
School KS4 performance data merged.
```

	URN	LANAME	LA	SCHOOLTYPE	MINORGROUP	RELCHAR	ADMPOL	GENDER	OFST
0	100049	Camden	202	Community school	Maintained school	Does not apply	Non-selective	Mix	
1	100050	Camden	202	Community school	Maintained school	Does not apply	Non-selective	Girl	
2	100051	Camden	202	Community school	Maintained school	Does not apply	Non-selective	Mix	
3	100052	Camden	202	Community school	Maintained school	Does not apply	Non-selective	Mix	
4	100053	Camden	202	Community school	Maintained school	Does not apply	Non-selective	Mix	

```
merged_df['URN'].nunique()
```

```
3281
```

Observation: The number of unique schools has dropped from 19k to 3k, when the keystage 4 data was merged on an inner join. This is expected as reportedly 3444 state-funded secondary schools in England, with private schools included it is approximately 4175 [7]. Of these a number by newly opened and not have delivered GCSE in 2022/23

[7] Tes. (2024, January 17). How many schools are there in the UK? Retrieved from https://www.tes.com/magazine/analysis/general/how-many-schools-in-the-uk

merged MAT performance data

```
merged_df = pd.merge(merged_df, ks4_mat_performance_df, left_on=['Group ID'], right_on=['TRUS
print("Merged with MAT Performance data.")
```

```
Merged with MAT Performance data.
```

```
merged_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3866 entries, 0 to 3865
Data columns (total 41 columns):
 #   Column                       Non-Null Count  Dtype
---  ------                       --------------  -----
 0   URN                          3866 non-null   int64
 1   LANAME                       3866 non-null   object
 2   LA                           3866 non-null   int64
 3   SCHOOLTYPE                   3866 non-null   object
 4   MINORGROUP                   3866 non-null   object
 5   RELCHAR                      2399 non-null   object
 6   ADMPOL                       3601 non-null   object
 7   GENDER                       3866 non-null   object
 8   OFSTEDRATING                 3822 non-null   object
 9   POSTCODE                     3866 non-null   object
 10  fsm_funding                  3866 non-null   int64
 11  pupil_premium                3866 non-null   object
 12  pupil_premium_pupils         3866 non-null   object
 13  School_led_tutoring_funding  3866 non-null   object
 14  total_funding                3866 non-null   float64
 15  Group UID                    3214 non-null   float64
 16  Group ID                     3214 non-null   object
 17  EstablishmentName            3214 non-null   object
 18  Group Name                   3214 non-null   object
 19  ATT8SCR                      3807 non-null   object
 20  P8MEA                        3807 non-null   object
 21  PTFSM6CLA1A_22               3770 non-null   object
 22  PTNOTFSM6CLA1A_22            3770 non-null   object
 23  PTFSM6CLA1ABASICS_95         3807 non-null   object
 24  PTNOTFSM6CLA1ABASICS_95      3807 non-null   object
 25  ATT8SCR_NFSM6CLA1A_22        3770 non-null   object
 26  P8MEA_NFSM6CLA1A_22          3770 non-null   object
 27  ATT8SCR_FSM6CLA1A_22         3770 non-null   object
 28  P8MEA_FSM6CLA1A_22           3770 non-null   object
 29  P8MEAMAT_FSM6CLA1A           3807 non-null   object
 30  P8MEAENG_FSM6CLA1A           3807 non-null   object
 31  P8MEAMAT_NFSM6CLA1A          3807 non-null   object
 32  P8MEAENG_NFSM6CLA1A          3807 non-null   object
 33  TRUST_NAME                   1346 non-null   object
 34  TRUST_UID                    1346 non-null   float64
 35  TRUST_ID                     1346 non-null   object
 36  NUMINST_MATPTINC             1346 non-null   float64
 37  TPUP_MATPTINC                1346 non-null   float64
 38  ATT8SCR_WGTAVG               1346 non-null   float64
 39  P8MEA_WGTAVG                 1346 non-null   float64
 40  TIME_PERIOD                  1346 non-null   float64
dtypes: float64(8), int64(3), object(30)
memory usage: 1.2+ MB
```

Data Cleaning

Now that the merging is complete, I can now remove rows which are note needed

Remove NaN values

```
merged_df.isna().sum()
```

```
URN                                  0
LANAME                               0
LA                                   0
SCHOOLTYPE                           0
MINORGROUP                           0
RELCHAR                           1467
```

```
ADMPOL                          265
GENDER                            0
OFSTEDRATING                     44
POSTCODE                          0
fsm_funding                       0
pupil_premium                     0
pupil_premium_pupils              0
School_led_tutoring_funding       0
total_funding                     0
Group UID                       652
Group ID                        652
EstablishmentName               652
Group Name                      652
ATT8SCR                          59
P8MEA                            59
PTFSM6CLA1A_22                   96
PTNOTFSM6CLA1A_22                96
PTFSM6CLA1ABASICS_95             59
PTNOTFSM6CLA1ABASICS_95          59
ATT8SCR_NFSM6CLA1A_22            96
P8MEA_NFSM6CLA1A_22              96
ATT8SCR_FSM6CLA1A_22             96
P8MEA_FSM6CLA1A_22               96
P8MEAMAT_FSM6CLA1A               59
P8MEAENG_FSM6CLA1A               59
P8MEAMAT_NFSM6CLA1A              59
P8MEAENG_NFSM6CLA1A              59
TRUST_NAME                     2520
TRUST_UID                      2520
TRUST_ID                       2520
NUMINST_MATPTINC               2520
TPUP_MATPTINC                  2520
ATT8SCR_WGTAVG                 2520
P8MEA_WGTAVG                   2520
TIME_PERIOD                    2520
dtype: int64
```

There may not be a need to drop all NaN values in every variable, as some schools may not have an OFSTED rating nor be part of a Trust in 2022/23, and I wouldnt want to discard the rest of their data from analysis

```
merged_df = merged_df.dropna(subset=['P8MEA_FSM6CLA1A_22'])
# Im not dropping all NaN values, as some schools may not have an OFSTED rating nor be part o
merged_df.isna().sum()
```

```
URN                             0
LANAME                          0
LA                              0
SCHOOLTYPE                      0
MINORGROUP                      0
RELCHAR                      1403
ADMPOL                        248
GENDER                          0
OFSTEDRATING                   33
POSTCODE                        0
fsm_funding                     0
pupil_premium                   0
pupil_premium_pupils            0
School_led_tutoring_funding     0
total_funding                   0
Group UID                     650
Group ID                      650
EstablishmentName             650
Group Name                    650
ATT8SCR                         0
P8MEA                           0
PTFSM6CLA1A_22                  0
PTNOTFSM6CLA1A_22               0
PTFSM6CLA1ABASICS_95            0
PTNOTFSM6CLA1ABASICS_95         0
ATT8SCR_NFSM6CLA1A_22           0
P8MEA_NFSM6CLA1A_22             0
ATT8SCR_FSM6CLA1A_22            0
P8MEA_FSM6CLA1A_22              0
P8MEAMAT_FSM6CLA1A              0
P8MEAENG_FSM6CLA1A              0
P8MEAMAT_NFSM6CLA1A             0
P8MEAENG_NFSM6CLA1A             0
TRUST_NAME                   2474
TRUST_UID                    2474
TRUST_ID                     2474
NUMINST_MATPTINC             2474
TPUP_MATPTINC                2474
```

```
ATT8SCR_WGTAVG              2474
P8MEA_WGTAVG                2474
TIME_PERIOD                 2474
dtype: int64
```

Remove Duplicates

We can now check for duplicates and remove them

```
duplicate_urns = merged_df[merged_df.duplicated('URN', keep=False)]
#keep= False will mark all duplicates as True regardless of position
duplicate_urns.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1114 entries, 600 to 3819
Data columns (total 41 columns):
 #   Column                       Non-Null Count  Dtype
---  ------                       --------------  -----
 0   URN                          1114 non-null   int64
 1   LANAME                       1114 non-null   object
 2   LA                           1114 non-null   int64
 3   SCHOOLTYPE                   1114 non-null   object
 4   MINORGROUP                   1114 non-null   object
 5   RELCHAR                      654 non-null    object
 6   ADMPOL                       1031 non-null   object
 7   GENDER                       1114 non-null   object
 8   OFSTEDRATING                 1106 non-null   object
 9   POSTCODE                     1114 non-null   object
 10  fsm_funding                  1114 non-null   int64
 11  pupil_premium                1114 non-null   object
 12  pupil_premium_pupils         1114 non-null   object
 13  School_led_tutoring_funding  1114 non-null   object
 14  total_funding                1114 non-null   float64
 15  Group UID                    1114 non-null   float64
 16  Group ID                     1114 non-null   object
 17  EstablishmentName            1114 non-null   object
 18  Group Name                   1114 non-null   object
 19  ATT8SCR                      1114 non-null   object
 20  P8MEA                        1114 non-null   object
 21  PTFSM6CLA1A_22               1114 non-null   object
 22  PTNOTFSM6CLA1A_22            1114 non-null   object
 23  PTFSM6CLA1ABASICS_95        1114 non-null   object
 24  PTNOTFSM6CLA1ABASICS_95     1114 non-null   object
 25  ATT8SCR_NFSM6CLA1A_22       1114 non-null   object
 26  P8MEA_NFSM6CLA1A_22         1114 non-null   object
 27  ATT8SCR_FSM6CLA1A_22        1114 non-null   object
 28  P8MEA_FSM6CLA1A_22          1114 non-null   object
 29  P8MEAMAT_FSM6CLA1A          1114 non-null   object
 30  P8MEAENG_FSM6CLA1A          1114 non-null   object
 31  P8MEAMAT_NFSM6CLA1A         1114 non-null   object
 32  P8MEAENG_NFSM6CLA1A         1114 non-null   object
 33  TRUST_NAME                  386 non-null    object
 34  TRUST_UID                   386 non-null    float64
 35  TRUST_ID                    386 non-null    object
 36  NUMINST_MATPTINC            386 non-null    float64
 37  TPUP_MATPTINC               386 non-null    float64
 38  ATT8SCR_WGTAVG              386 non-null    float64
 39  P8MEA_WGTAVG                386 non-null    float64
 40  TIME_PERIOD                 386 non-null    float64
dtypes: float64(8), int64(3), object(30)
memory usage: 365.5+ KB
```

```
#drop duplicates
merged_df = merged_df.drop_duplicates(subset='URN')
#confirm duplicates are removed
duplicate_urns = merged_df[merged_df.duplicated('URN', keep=False)]
duplicate_urns.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 0 entries
Data columns (total 41 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   URN                         0 non-null      int64
 1   LANAME                      0 non-null      object
 2   LA                          0 non-null      int64
 3   SCHOOLTYPE                  0 non-null      object
 4   MINORGROUP                  0 non-null      object
 5   RELCHAR                     0 non-null      object
 6   ADMPOL                      0 non-null      object
 7   GENDER                      0 non-null      object
 8   OFSTEDRATING                0 non-null      object
 9   POSTCODE                    0 non-null      object
 10  fsm_funding                  0 non-null      int64
 11  pupil_premium                0 non-null      object
 12  pupil_premium_pupils         0 non-null      object
 13  School_led_tutoring_funding  0 non-null      object
 14  total_funding                0 non-null      float64
 15  Group UID                    0 non-null      float64
 16  Group ID                     0 non-null      object
 17  EstablishmentName            0 non-null      object
 18  Group Name                   0 non-null      object
 19  ATT8SCR                      0 non-null      object
 20  P8MEA                        0 non-null      object
 21  PTFSM6CLA1A_22               0 non-null      object
 22  PTNOTFSM6CLA1A_22            0 non-null      object
 23  PTFSM6CLA1ABASICS_95         0 non-null      object
 24  PTNOTFSM6CLA1ABASICS_95      0 non-null      object
 25  ATT8SCR_NFSM6CLA1A_22        0 non-null      object
 26  P8MEA_NFSM6CLA1A_22          0 non-null      object
 27  ATT8SCR_FSM6CLA1A_22         0 non-null      object
 28  P8MEA_FSM6CLA1A_22           0 non-null      object
 29  P8MEAMAT_FSM6CLA1A           0 non-null      object
 30  P8MEAENG_FSM6CLA1A           0 non-null      object
 31  P8MEAMAT_NFSM6CLA1A          0 non-null      object
 32  P8MEAENG_NFSM6CLA1A          0 non-null      object
 33  TRUST_NAME                   0 non-null      object
 34  TRUST_UID                    0 non-null      float64
 35  TRUST_ID                     0 non-null      object
 36  NUMINST_MATPTINC             0 non-null      float64
 37  TPUP_MATPTINC                0 non-null      float64
 38  ATT8SCR_WGTAVG               0 non-null      float64
 39  P8MEA_WGTAVG                 0 non-null      float64
 40  TIME_PERIOD                  0 non-null      float64
dtypes: float64(8), int64(3), object(30)
memory usage: 0.0+ bytes
```

Correct Data Types

I will not proceed to check the data is in the format needed, particularly for numerical analysis.

```
merged_df.dtypes
```

```
URN                                  int64
```

```
LANAME                          object
LA                               int64
SCHOOLTYPE                      object
MINORGROUP                      object
RELCHAR                         object
ADMPOL                          object
GENDER                          object
OFSTEDRATING                    object
POSTCODE                        object
fsm_funding                      int64
pupil_premium                   object
pupil_premium_pupils            object
School_led_tutoring_funding     object
total_funding                  float64
Group UID                      float64
Group ID                        object
EstablishmentName               object
Group Name                      object
ATT8SCR                         object
P8MEA                           object
PTFSM6CLA1A_22                  object
PTNOTFSM6CLA1A_22               object
PTFSM6CLA1ABASICS_95            object
PTNOTFSM6CLA1ABASICS_95         object
ATT8SCR_NFSM6CLA1A_22           object
P8MEA_NFSM6CLA1A_22             object
ATT8SCR_FSM6CLA1A_22            object
P8MEA_FSM6CLA1A_22              object
P8MEAMAT_FSM6CLA1A              object
P8MEAENG_FSM6CLA1A              object
P8MEAMAT_NFSM6CLA1A             object
P8MEAENG_NFSM6CLA1A             object
TRUST_NAME                      object
TRUST_UID                      float64
TRUST_ID                        object
NUMINST_MATPTINC               float64
TPUP_MATPTINC                  float64
ATT8SCR_WGTAVG                 float64
P8MEA_WGTAVG                   float64
TIME_PERIOD                    float64
dtype: object
```

A number of the numerical columns are listed as objects and will need to be changed to a numerical type (integer or float). However, before that, we would need to identify and remove any signs in the data e.g. £ or %

Identified columns which have a % in their data and would need removing

```
percentage_columns = [
    'PTFSM6CLA1A_22',
    'PTNOTFSM6CLA1A_22',
    'PTFSM6CLA1ABASICS_95',
    'PTNOTFSM6CLA1ABASICS_95'
]

merged_df[percentage_columns].head()
```

	PTFSM6CLA1A_22	PTNOTFSM6CLA1A_22	PTFSM6CLA1ABASICS_95	PTNOTFSM6CLA1ABA
0	63%	38%	40%	48%
1	39%	61%	53%	76%
2	72%	28%	35%	48%
3	45%	55%	31%	53%
4	42%	58%	28%	74%

```
data_loader = DataWrangler(dataframe=merged_df)

# Convert percentage columns
merged_df = data_loader.convert_percentage_columns(percentage_columns)


print("\nAfter removing '%' signs and converting to float:")
merged_df[percentage_columns].head()
```

```
DataWrangler initialised with the provided DataFrame.
Column 'PTFSM6CLA1A_22' converted
Column 'PTNOTFSM6CLA1A_22' converted
Column 'PTFSM6CLA1ABASICS_95' converted
Column 'PTNOTFSM6CLA1ABASICS_95' converted

After removing '%' signs and converting to float:
```

	PTFSM6CLA1A_22	PTNOTFSM6CLA1A_22	PTFSM6CLA1ABASICS_95	PTNOTFSM6CLA1ABA
0	63	38	40	48
1	39	61	53	76
2	72	28	35	48
3	45	55	31	53
4	42	58	28	74

I can now convert all ‘numerical columns’ to their correct data type

```
columns_to_convert_numeric = [
    'fsm_funding',
    'pupil_premium',
    'pupil_premium_pupils',
    'School_led_tutoring_funding',
    'ATT8SCR',
    'P8MEA',
    'PTFSM6CLA1A_22',
    'PTNOTFSM6CLA1A_22',
    'PTFSM6CLA1ABASICS_95',
    'PTNOTFSM6CLA1ABASICS_95',
    'ATT8SCR_NFSM6CLA1A_22',
    'P8MEA_NFSM6CLA1A_22',
    'ATT8SCR_FSM6CLA1A_22',
    'P8MEA_FSM6CLA1A_22',
    'P8MEAMAT_FSM6CLA1A',
    'P8MEAENG_FSM6CLA1A',
    'P8MEAMAT_NFSM6CLA1A',
    'P8MEAENG_NFSM6CLA1A',
]

# Convert specified columns to numeric, coercing errors to NaN
merged_df[columns_to_convert_numeric] = merged_df[columns_to_convert_numeric].apply(pd.to_nu

print("Data types after conversion:")
merged_df.dtypes
```

```
Data types after conversion:
```

```
URN                                int64
LANAME                            object
```

```
LA                                int64
SCHOOLTYPE                       object
MINORGROUP                       object
RELCHAR                          object
ADMPOL                           object
GENDER                           object
OFSTEDRATING                     object
POSTCODE                         object
fsm_funding                       int64
pupil_premium                     int64
pupil_premium_pupils              int64
School_led_tutoring_funding    float64
total_funding                   float64
Group UID                       float64
Group ID                         object
EstablishmentName                object
Group Name                       object
ATT8SCR                         float64
P8MEA                           float64
PTFSM6CLA1A_22                    int64
PTNOTFSM6CLA1A_22                 int64
PTFSM6CLA1ABASICS_95            float64
PTNOTFSM6CLA1ABASICS_95         float64
ATT8SCR_NFSM6CLA1A_22           float64
P8MEA_NFSM6CLA1A_22             float64
ATT8SCR_FSM6CLA1A_22            float64
P8MEA_FSM6CLA1A_22              float64
P8MEAMAT_FSM6CLA1A              float64
P8MEAENG_FSM6CLA1A              float64
P8MEAMAT_NFSM6CLA1A             float64
P8MEAENG_NFSM6CLA1A             float64
TRUST_NAME                       object
TRUST_UID                       float64
TRUST_ID                         object
NUMINST_MATPTINC                float64
TPUP_MATPTINC                   float64
ATT8SCR_WGTAVG                  float64
P8MEA_WGTAVG                    float64
TIME_PERIOD                     float64
dtype: object
```

Nomenclature

Using the dictionaries created earlier from the meta data, I can run the column rename function to only rename the columns available in merged_df

```python
data_loader = DataWrangler(dataframe=merged_df)

#rename columns based on dictionary
merged_df = data_loader.column_rename(school_performance_dict)
merged_df = data_loader.column_rename(ks4_mat_performance_dict)
merged_df = data_loader.column_rename(school_demographics_dict)
merged_df = data_loader.column_rename(school_funding_dict)
merged_df.info()
```

```
DataWrangler initialised with the provided DataFrame.
Columns renamed successfully.
Columns renamed successfully.
Columns renamed successfully.
Columns renamed successfully.
<class 'pandas.core.frame.DataFrame'>
Index: 3190 entries, 0 to 3862
Data columns (total 41 columns):
 #   Column                                                                               Nor
---  ------                                                                               ---
 0   School Unique Reference Number                                                       319
 1   Local authority name                                                                 319
 2   Local authority number                                                               319
 3   School Type eg Voluntary Aided school                                                319
 4   Type of school / college eg maintained school                                        319
 5   Religious character                                                                  202
 6   School admissions policy (self-declared by schools on Edubase)                       298
 7   Indicates whether it's a mixed or single sex school                                  319
 8   Ofsted rating                                                                        316
 9   School postcode                                                                      319
 10  FSM Funding                                                                          319
 11  Pupil Premium funding                                                                319
 12  Pupil Premium pupils                                                                 319
 13  School-led tutoring funding                                                          318
 14  Total funding                                                                        319
 15  Group UID                                                                            254
 16  Group ID                                                                             254
 17  EstablishmentName                                                                    254
 18  Group Name                                                                           254
 19  Average Attainment 8 score per pupil                                                 319
 20  Progress 8 measure after adjustment for extreme scores                               318
 21  % of pupils who were disadvantaged in 2022                                           319
 22  % of pupils who were not disadvantaged in 2022                                       319
 23  % of disadvantaged pupils achieving strong 9-5 passes in GCSE English and maths      314
 24  % of non-disadvantaged pupils achieving strong 9-5 passes in GCSE English and maths  314
 25  Average Attainment 8 score per non-disadvantaged pupil  - 2022                       314
 26  Progress 8 measure - non-disadvantaged pupils - 2022                                 314
 27  Average Attainment 8 score per disadvantaged pupil - 2022                            314
 28  Progress 8 measure - disadvantaged pupils - 2022                                     313
 29  Progress 8 measure for maths element - disadvantaged pupils                          313
 30  Progress 8 measure for English element - disadvantaged pupils                        313
 31  Progress 8 measure for maths element - non-disadvantaged pupils                      314
 32  Progress 8 measure for English element - non-disadvantaged pupils                    314
 33  Trust name                                                                           107
 34  Trust Unique identifier                                                              107
 35  Trust Identifier                                                                     107
 36  Number of academies in the trust, included in performance measures                   107
 37  Number of pupils at the end of ks4, included in performance measures                 107
 38  Average Attainment 8 score per pupil at the end of KS4, weighted average             107
 39  Progress 8 measure after adjustment for extreme scores, weighted average             107
 40  nan                                                                                  107
dtypes: float64(21), int64(7), object(13)
memory usage: 1.0+ MB
```

The columns have a new name based on a description. This can now be changed to a more column friendly format using a new dectionary:

```
# A dictionary mapping old column names to new column names
column_rename_dict = {
    'School Unique Reference Number': 'URN',
    'Local authority name': 'Local_Authority_Name',
    'Local authority number': 'Local_Authority_Number',
    'School Type eg Voluntary Aided school': 'School_Type',
    'Type of school / college eg maintained school': 'School_College_Type',
    'Religious character': 'Religious_Character',
    'School admissions policy (self-declared by schools on Edubase)': 'Admissions_Policy',
    'Indicates whether it\'s a mixed or single sex school': 'School_Gender',
    'Ofsted rating': 'Ofsted_Rating',
    'FSM Funding': 'FSM_Funding',
    'Pupil Premium funding': 'Pupil_Premium_Funding',
    'Pupil Premium pupils': 'Pupil_Premium_Pupils',
    'School-led tutoring funding': 'School_Led_Tutoring_Funding',
    'Total funding': 'Total_Funding',
    'Group UID': 'Group_UID',
    'Group ID': 'Group_ID',
    'EstablishmentName': 'School_Name',
    'Group Name': 'Trust_Name', #first option for Trust Name
    'Average Attainment 8 score per pupil': 'Attainment8',
    'Progress 8 measure after adjustment for extreme scores': 'Progress8',
    '% of pupils who were disadvantaged in 2022': 'Percent_Disadvantaged_2022',
    '% of pupils who were not disadvantaged in 2022': 'Percent_Not_Disadvantaged_2022',
    '% of disadvantaged pupils achieving strong 9-5 passes in GCSE English and maths': 'Perc
    '% of non-disadvantaged pupils achieving strong 9-5 passes in GCSE English and maths': 'I
    'Average Attainment 8 score per non-disadvantaged pupil - 2022': 'Attainment8_NonDisadvar
    'Progress 8 measure - non-disadvantaged pupils - 2022': 'Progress8_NonDisadvantaged_2022
    'Average Attainment 8 score per disadvantaged pupil - 2022': 'Attainment8_Disadvantaged_
    'Progress 8 measure - disadvantaged pupils - 2022': 'Progress8_Disadvantaged_2022',
    'Progress 8 measure for maths element - disadvantaged pupils': 'Progress8_Maths_Disadvant
    'Progress 8 measure for English element - disadvantaged pupils': 'Progress8_English_Disac
    'Progress 8 measure for maths element - non-disadvantaged pupils': 'Progress8_Maths_NonDi
    'Progress 8 measure for English element - non-disadvantaged pupils': 'Progress8_English_I
    'Trust name': 'trust_name', # second option to match Trust and quality assure data
    'Trust Unique identifier': 'Trust_UID',
    'Trust Identifier': 'Trust_ID',
    'Number of academies in the trust, included in performance measures': 'Num_Academies_Per
    'Number of pupils at the end of ks4, included in performance measures': 'Num_Pupils_KS4_I
    'Average Attainment 8 score per pupil at the end of KS4, weighted average': 'Avg_Attainme
    'Progress 8 measure after adjustment for extreme scores, weighted average': 'Progress8_Ac
    'nan': 'Time_Period'  # I can remove if not needed and time analysis isnt conducted
}
```

This new dictionary will now be used to rename the columns to a more userfriendly format

```
# Rename the columns in the DataFrame using new dictionary
merged_df.rename(columns=column_rename_dict, inplace=True)

merged_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 3190 entries, 0 to 3862
Data columns (total 41 columns):
 #   Column                                                       Non-Null Count  Dtype
---  ------                                                       --------------  -----
 0   URN                                                          3190 non-null   int64
 1   Local_Authority_Name                                         3190 non-null   object
 2   Local_Authority_Number                                       3190 non-null   int64
 3   School_Type                                                  3190 non-null   object
 4   School_College_Type                                          3190 non-null   object
 5   Religious_Character                                          2028 non-null   object
 6   Admissions_Policy                                            2985 non-null   object
 7   School_Gender                                                3190 non-null   object
 8   Ofsted_Rating                                                3161 non-null   object
 9   School postcode                                              3190 non-null   object
 10  FSM_Funding                                                  3190 non-null   int64
 11  Pupil_Premium_Funding                                        3190 non-null   int64
 12  Pupil_Premium_Pupils                                         3190 non-null   int64
 13  School_Led_Tutoring_Funding                                  3188 non-null   float64
 14  Total_Funding                                                3190 non-null   float64
 15  Group_UID                                                    2540 non-null   float64
 16  Group_ID                                                     2540 non-null   object
 17  School_Name                                                  2540 non-null   object
 18  Trust_Name                                                   2540 non-null   object
 19  Attainment8                                                  3190 non-null   float64
 20  Progress8                                                    3187 non-null   float64
 21  Percent_Disadvantaged_2022                                   3190 non-null   int64
 22  Percent_Not_Disadvantaged_2022                               3190 non-null   int64
 23  Percent_Disadvantaged_Strong_Passes                          3145 non-null   float64
 24  Percent_Not_Disadvantaged_Strong_Passes                      3147 non-null   float64
 25  Average Attainment 8 score per non-disadvantaged pupil  - 2022  3149 non-null   float64
 26  Progress8_NonDisadvantaged_2022                              3147 non-null   float64
 27  Attainment8_Disadvantaged_2022                               3147 non-null   float64
 28  Progress8_Disadvantaged_2022                                 3139 non-null   float64
 29  Progress8_Maths_Disadvantaged                                3134 non-null   float64
 30  Progress8_English_Disadvantaged                              3134 non-null   float64
 31  Progress8_Maths_NonDisadvantaged                             3142 non-null   float64
 32  Progress8_English_NonDisadvantaged                           3142 non-null   float64
 33  trust_name                                                   1077 non-null   object
 34  Trust_UID                                                    1077 non-null   float64
 35  Trust_ID                                                     1077 non-null   object
 36  Num_Academies_Performance                                    1077 non-null   float64
 37  Num_Pupils_KS4_Performance                                   1077 non-null   float64
 38  Avg_Attainment8_KS4_Weighted                                 1077 non-null   float64
 39  Progress8_Adjusted_Weighted                                  1077 non-null   float64
 40  nan                                                          1077 non-null   float64
```

```
dtypes: float64(21), int64(7), object(13)
memory usage: 1.0+ MB
```

```
merged_df.head()
```

	URN	Local_Authority_Name	Local_Authority_Number	School_Type	School_College_Type	Reli
0	100049	Camden	202	Community school	Maintained school	
1	100050	Camden	202	Community school	Maintained school	
2	100051	Camden	202	Community school	Maintained school	
3	100052	Camden	202	Community school	Maintained school	
4	100053	Camden	202	Community school	Maintained school	

Add Deprivation Index

I will now add the deprivation information from the Ministry of Housing, Communities and Local Government. The website return deprivation information based on a postcode. However before that, I will create a variable from the school demographics, which has a postcode for each school's URN

```
school_demographics_df.columns
```

```
Index(['URN', 'LANAME', 'LA', 'SCHOOLTYPE', 'MINORGROUP', 'RELCHAR', 'ADMPOL',
       'GENDER', 'OFSTEDRATING', 'POSTCODE'],
      dtype='object')
```

```
urn_postcode = school_demographics_df[['URN','POSTCODE']]
urn_postcode.dropna(inplace=True)
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\3856292752.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guid
  urn_postcode.dropna(inplace=True)
```

```
urn_postcode.drop_duplicates(subset='URN', inplace=True) # drop duplicates
total_postcodes = len(urn_postcode)
total_postcodes
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\3769423262.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide
  urn_postcode.drop_duplicates(subset='URN', inplace=True) # drop duplicates
```

```
25112
```

As the MHCLG website only allows for 10,000 postcodes to be uploaded at a time, I will need to split the urn_postcode into smaller groups, to upload to the website

```
total_postcode_1 = urn_postcode.iloc[0:9000]
total_postcode_2 = urn_postcode.iloc[9001:18000]
total_postcode_3= urn_postcode.iloc[18001:25135]

output_path1 = 'data/urn_postcode_list1.csv'
output_path2 = 'data/urn_postcode_list2.csv'
output_path3 = 'data/urn_postcode_list3.csv'
total_postcode_1['POSTCODE'].to_csv(output_path1, index=False)
total_postcode_2['POSTCODE'].to_csv(output_path2, index=False)
total_postcode_3['POSTCODE'].to_csv(output_path3, index=False)
```

Read and convertthe deprivation data download from the MHCLG website into data frames

```
deprivation_by_index1 = pd.read_csv(r'data\deprivation-by-postcode (1).csv')
deprivation_by_index2 = pd.read_csv(r'data\deprivation-by-postcode (2).csv')
deprivation_by_index3 = pd.read_csv(r'data\deprivation-by-postcode (3).csv')
```

Check on the shape of the data

```
deprivation_by_index1.shape, deprivation_by_index2.shape, deprivation_by_index3.shape
```

```
((9001, 28), (9000, 28), (7135, 28))
```

Combine the three data frames together

```
combined_deprivation = pd.concat([deprivation_by_index1, deprivation_by_index2, deprivation_

combined_deprivation.shape
```

```
(25136, 28)
```

Check columns and data types

```
combined_deprivation.dtypes
```

```
Postcode                                      object
Postcode Status                               object
LSOA code                                     object
LSOA Name                                     object
Index of Multiple Deprivation Rank           float64
Index of Multiple Deprivation Decile         float64
Income Rank                                  float64
Income Decile                                float64
Income Score                                 float64
Employment Rank                              float64
Employment Decile                            float64
Employment Score                             float64
Education and Skills Rank                    float64
Education and Skills Decile                  float64
Health and Disability Rank                   float64
Health and Disability Decile                 float64
Crime Rank                                   float64
Crime Decile                                 float64
Barriers to Housing and Services Rank        float64
Barriers to Housing and Services Decile      float64
Living Environment Rank                      float64
Living Environment Decile                    float64
IDACI Rank                                   float64
IDACI Decile                                 float64
IDACI Score                                  float64
IDAOPI Rank                                  float64
IDAOPI Decile                                float64
IDAOPI Score                                 float64
dtype: object
```

```
urn_postcode.dtypes
```

```
URN          int64
POSTCODE    object
dtype: object
```

```
#rename postcode to match
combined_deprivation.rename(columns={'Postcode':'POSTCODE'}, inplace=True)
```

I can now combine deptivation with school URN fields

```
deprivation_urn = combined_deprivation.merge(urn_postcode, on='POSTCODE', how='inner')
#I selected an inner join as I am only interested in deprivation data that can be linked to a
deprivation_urn.shape
deprivation_urn.head()
```

	POSTCODE	Postcode Status	LSOA code	LSOA Name	Index of Multiple Deprivation Rank	Index o
0	EC3A 5DE	Live	E01032739	City of London 001F E01032739	20391.0	
1	EC2Y 8BB	Live	E01000002	City of London 001B E01000002	30379.0	
2	EC4M 9AD	Live	E01032739	City of London 001F E01032739	20391.0	
3	EC4V 3AL	Live	E01032739	City of London 001F E01032739	20391.0	
4	WC1H 9EG	Live	E01000941	Camden 025C E01000941	4860.0	

Of the various columns available from the MHCLG, I will use Index of Multiple Deprivation Decile as this gives a values between 1-10 for each postcode or small geographic areas know as LSOA (lower-layer super output areas); with decile 1 represting the most 10% of deprived areas and a decile of 10 representing the least deprived areas. The multiple deprivation index is calculated from several domains including income, employment, education, health, crime, barriers to housing and services and living environment. The LSOA Name is also selected to verify against merged_df columns when combined later, as a data integrity measure.

```
deprivation_urn= deprivation_urn[['Index of Multiple Deprivation Decile','LSOA Name','POSTCOD
]
```

```
merged_df = merged_df.merge(deprivation_urn, on= 'URN', how ='inner')
# i will do an inner join here as deprivation is an essential criteria for analysis
```

```
merged_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3685 entries, 0 to 3684
Data columns (total 44 columns):
 #   Column                                                          Non-Null Count  Dtype
---  ------                                                          --------------  -----
 0   URN                                                             3685 non-null   int64
```

```
1   Local_Authority_Name                                            3685 non-null   object
2   Local_Authority_Number                                          3685 non-null   int64
3   School_Type                                                     3685 non-null   object
4   School_College_Type                                             3685 non-null   object
5   Religious_Character                                             2353 non-null   object
6   Admissions_Policy                                               3440 non-null   object
7   School_Gender                                                   3685 non-null   object
8   Ofsted_Rating                                                   3653 non-null   object
9   School postcode                                                 3685 non-null   object
10  FSM_Funding                                                     3685 non-null   int64
11  Pupil_Premium_Funding                                           3685 non-null   int64
12  Pupil_Premium_Pupils                                            3685 non-null   int64
13  School_Led_Tutoring_Funding                                     3681 non-null   float64
14  Total_Funding                                                   3685 non-null   float64
15  Group_UID                                                       2893 non-null   float64
16  Group_ID                                                        2893 non-null   object
17  School_Name                                                     2893 non-null   object
18  Trust_Name                                                      2893 non-null   object
19  Attainment8                                                     3685 non-null   float64
20  Progress8                                                       3682 non-null   float64
21  Percent_Disadvantaged_2022                                      3685 non-null   int64
22  Percent_Not_Disadvantaged_2022                                  3685 non-null   int64
23  Percent_Disadvantaged_Strong_Passes                             3636 non-null   float64
24  Percent_Not_Disadvantaged_Strong_Passes                         3639 non-null   float64
25  Average Attainment 8 score per non-disadvantaged pupil  - 2022  3642 non-null   float64
26  Progress8_NonDisadvantaged_2022                                 3640 non-null   float64
27  Attainment8_Disadvantaged_2022                                  3640 non-null   float64
28  Progress8_Disadvantaged_2022                                    3629 non-null   float64
29  Progress8_Maths_Disadvantaged                                   3624 non-null   float64
30  Progress8_English_Disadvantaged                                 3624 non-null   float64
31  Progress8_Maths_NonDisadvantaged                                3632 non-null   float64
32  Progress8_English_NonDisadvantaged                              3632 non-null   float64
33  trust_name                                                      1253 non-null   object
34  Trust_UID                                                       1253 non-null   float64
35  Trust_ID                                                        1253 non-null   object
36  Num_Academies_Performance                                       1253 non-null   float64
37  Num_Pupils_KS4_Performance                                      1253 non-null   float64
38  Avg_Attainment8_KS4_Weighted                                    1253 non-null   float64
39  Progress8_Adjusted_Weighted                                     1253 non-null   float64
40  nan                                                             1253 non-null   float64
41  Index of Multiple Deprivation Decile                            3682 non-null   float64
42  LSOA Name                                                       3682 non-null   object
43  POSTCODE                                                        3685 non-null   object
```

```
dtypes: float64(22), int64(7), object(15)
memory usage: 1.2+ MB
```

Feature Engineering - Gaps

A number of features are needed as part of the analysis which include gaps between disadavantaged and advantaged puppils, and pupil premium funding per pupil. These will therfore be feature engineered

```
# Gap between progress 8 scores
merged_df['progress8_gap'] = merged_df['Progress8_NonDisadvantaged_2022']-merged_df['Progress

#Gap between attainment 8
merged_df['attainment8_gap'] = merged_df['Average Attainment 8 score per non-disadvantaged pu


#Gap between maths scores
merged_df['maths_gap'] = merged_df['Progress8_Maths_NonDisadvantaged']- merged_df['Progress8_

#Gap between English scores
merged_df['english_gap'] = merged_df['Progress8_English_NonDisadvantaged']- merged_df['Progre

#Gap between 5 GCSE strong pass percentages
merged_df['5_GCSE_gap'] = merged_df['Percent_Not_Disadvantaged_Strong_Passes'] - merged_df['P

#Pupil premium per pupil calculation
merged_df['pupilpremium_per_pupil'] = merged_df['Pupil_Premium_Funding'] / merged_df['Pupil_I
```

Another check for NaN values and duplicates given earlier data wrangling work

```
merged_df.isna().sum()
```

```
URN                                                                      0
Local_Authority_Name                                                     0
Local_Authority_Number                                                   0
School_Type                                                              0
School_College_Type                                                      0
Religious_Character                                                   1332
Admissions_Policy                                                      245
School_Gender                                                            0
Ofsted_Rating                                                           32
```

```
School postcode                                                      0
FSM_Funding                                                          0
Pupil_Premium_Funding                                                0
Pupil_Premium_Pupils                                                 0
School_Led_Tutoring_Funding                                          4
Total_Funding                                                        0
Group_UID                                                          792
Group_ID                                                           792
School_Name                                                        792
Trust_Name                                                         792
Attainment8                                                          0
Progress8                                                            3
Percent_Disadvantaged_2022                                           0
Percent_Not_Disadvantaged_2022                                       0
Percent_Disadvantaged_Strong_Passes                                 49
Percent_Not_Disadvantaged_Strong_Passes                             46
Average Attainment 8 score per non-disadvantaged pupil  - 2022      43
Progress8_NonDisadvantaged_2022                                     45
Attainment8_Disadvantaged_2022                                      45
Progress8_Disadvantaged_2022                                        56
Progress8_Maths_Disadvantaged                                       61
Progress8_English_Disadvantaged                                     61
Progress8_Maths_NonDisadvantaged                                    53
Progress8_English_NonDisadvantaged                                  53
trust_name                                                        2432
Trust_UID                                                         2432
Trust_ID                                                          2432
Num_Academies_Performance                                         2432
Num_Pupils_KS4_Performance                                        2432
Avg_Attainment8_KS4_Weighted                                      2432
Progress8_Adjusted_Weighted                                       2432
NaN                                                               2432
Index of Multiple Deprivation Decile                                 3
LSOA Name                                                            3
POSTCODE                                                             0
progress8_gap                                                       57
attainment8_gap                                                     45
maths_gap                                                           65
english_gap                                                         65
5_GCSE_gap                                                          49
pupilpremium_per_pupil                                               0
dtype: int64
```

Not all NaN rows need to be dropped. Essential ones are URN and 'Progress8_Maths_Disadvantaged','Index of Multiple Deprivation Decile','Progress8_Maths_NonDisadvantaged','Progress8_Disadvantaged_2022','Progr
which will impact analysis.

```
merged_df.isna().sum()
merged_df = merged_df.dropna(subset=['Progress8_Maths_Disadvantaged','Index of Multiple Depri
merged_df.isna().sum()
```

```
URN                                                                  0
Local_Authority_Name                                                 0
Local_Authority_Number                                               0
School_Type                                                          0
School_College_Type                                                  0
Religious_Character                                               1126
Admissions_Policy                                                  235
School_Gender                                                        0
Ofsted_Rating                                                       32
School postcode                                                      0
FSM_Funding                                                          0
Pupil_Premium_Funding                                                0
Pupil_Premium_Pupils                                                 0
School_Led_Tutoring_Funding                                          4
Total_Funding                                                        0
Group_UID                                                            0
Group_ID                                                             0
School_Name                                                          0
Trust_Name                                                           0
Attainment8                                                          0
Progress8                                                            0
Percent_Disadvantaged_2022                                           0
Percent_Not_Disadvantaged_2022                                       0
Percent_Disadvantaged_Strong_Passes                                  0
Percent_Not_Disadvantaged_Strong_Passes                              0
Average Attainment 8 score per non-disadvantaged pupil  - 2022       0
Progress8_NonDisadvantaged_2022                                      0
Attainment8_Disadvantaged_2022                                       0
Progress8_Disadvantaged_2022                                         0
Progress8_Maths_Disadvantaged                                        0
Progress8_English_Disadvantaged                                      0
Progress8_Maths_NonDisadvantaged                                     0
Progress8_English_NonDisadvantaged                                   0
trust_name                                                        1579
```

```
Trust_UID                                                              1579
Trust_ID                                                               1579
Num_Academies_Performance                                              1579
Num_Pupils_KS4_Performance                                             1579
Avg_Attainment8_KS4_Weighted                                           1579
Progress8_Adjusted_Weighted                                            1579
NaN                                                                    1579
Index of Multiple Deprivation Decile                                      0
LSOA Name                                                                 0
POSTCODE                                                                  0
progress8_gap                                                             0
attainment8_gap                                                           0
maths_gap                                                                 0
english_gap                                                               0
5_GCSE_gap                                                                0
pupilpremium_per_pupil                                                    0
dtype: int64
```

Remaining NaN values:

- Religious_Character 1126
- Admissions_Policy 235
- Ofsted_Rating 32

These cant be filled with a mean, median, mode or 0, and as they are categorical variables, I am not too concerned for now. To check data integrity, I will need to ensure, each row for each school as a unique URN

Also check and remove duplicates based on URN so each school has only 1 row

```
duplicate_urns = merged_df[merged_df.duplicated('URN', keep=False)]
#keep= False will mark all duplicates as True regardless of position
duplicate_urns.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 644 entries, 754 to 3664
Data columns (total 50 columns):
 #   Column                                                    Non-Null Count  Dtype
---  ------                                                    --------------  -----
 0   URN                                                       644 non-null    int64
 1   Local_Authority_Name                                      644 non-null    object
 2   Local_Authority_Number                                    644 non-null    int64
 3   School_Type                                               644 non-null    object
```

```
4   School_College_Type                                            644 non-null    object
5   Religious_Character                                            378 non-null    object
6   Admissions_Policy                                              575 non-null    object
7   School_Gender                                                  644 non-null    object
8   Ofsted_Rating                                                  638 non-null    object
9   School postcode                                                644 non-null    object
10  FSM_Funding                                                    644 non-null    int64
11  Pupil_Premium_Funding                                          644 non-null    int64
12  Pupil_Premium_Pupils                                           644 non-null    int64
13  School_Led_Tutoring_Funding                                    640 non-null    float64
14  Total_Funding                                                  644 non-null    float64
15  Group_UID                                                      644 non-null    float64
16  Group_ID                                                       644 non-null    object
17  School_Name                                                    644 non-null    object
18  Trust_Name                                                     644 non-null    object
19  Attainment8                                                    644 non-null    float64
20  Progress8                                                      644 non-null    float64
21  Percent_Disadvantaged_2022                                     644 non-null    int64
22  Percent_Not_Disadvantaged_2022                                 644 non-null    int64
23  Percent_Disadvantaged_Strong_Passes                            644 non-null    float64
24  Percent_Not_Disadvantaged_Strong_Passes                        644 non-null    float64
25  Average Attainment 8 score per non-disadvantaged pupil  - 2022 644 non-null    float64
26  Progress8_NonDisadvantaged_2022                                644 non-null    float64
27  Attainment8_Disadvantaged_2022                                 644 non-null    float64
28  Progress8_Disadvantaged_2022                                   644 non-null    float64
29  Progress8_Maths_Disadvantaged                                  644 non-null    float64
30  Progress8_English_Disadvantaged                                644 non-null    float64
31  Progress8_Maths_NonDisadvantaged                               644 non-null    float64
32  Progress8_English_NonDisadvantaged                             644 non-null    float64
33  trust_name                                                     316 non-null    object
34  Trust_UID                                                      316 non-null    float64
35  Trust_ID                                                       316 non-null    object
36  Num_Academies_Performance                                      316 non-null    float64
37  Num_Pupils_KS4_Performance                                     316 non-null    float64
38  Avg_Attainment8_KS4_Weighted                                   316 non-null    float64
39  Progress8_Adjusted_Weighted                                    316 non-null    float64
40  nan                                                            316 non-null    float64
41  Index of Multiple Deprivation Decile                           644 non-null    float64
42  LSOA Name                                                      644 non-null    object
43  POSTCODE                                                       644 non-null    object
44  progress8_gap                                                  644 non-null    float64
45  attainment8_gap                                                644 non-null    float64
46  maths_gap                                                      644 non-null    float64
```

```
 47  english_gap                                                    644 non-null    float64
 48  5_GCSE_gap                                                     644 non-null    float64
 49  pupilpremium_per_pupil                                         644 non-null    float64
dtypes: float64(28), int64(7), object(15)
memory usage: 256.6+ KB
```

```
#drop duplicates
merged_df = merged_df.drop_duplicates(subset='URN')
duplicate_urns = merged_df[merged_df.duplicated('URN', keep=False)]
#keep= False will mark all duplicates as True regardless of position
duplicate_urns.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 0 entries
Data columns (total 50 columns):
 #   Column                                                         Non-Null Count  Dtype
---  ------                                                         --------------  -----
 0   URN                                                            0 non-null      int64
 1   Local_Authority_Name                                           0 non-null      object
 2   Local_Authority_Number                                         0 non-null      int64
 3   School_Type                                                    0 non-null      object
 4   School_College_Type                                            0 non-null      object
 5   Religious_Character                                            0 non-null      object
 6   Admissions_Policy                                              0 non-null      object
 7   School_Gender                                                  0 non-null      object
 8   Ofsted_Rating                                                  0 non-null      object
 9   School postcode                                                0 non-null      object
 10  FSM_Funding                                                    0 non-null      int64
 11  Pupil_Premium_Funding                                          0 non-null      int64
 12  Pupil_Premium_Pupils                                           0 non-null      int64
 13  School_Led_Tutoring_Funding                                    0 non-null      float64
 14  Total_Funding                                                  0 non-null      float64
 15  Group_UID                                                      0 non-null      float64
 16  Group_ID                                                       0 non-null      object
 17  School_Name                                                    0 non-null      object
 18  Trust_Name                                                     0 non-null      object
 19  Attainment8                                                    0 non-null      float64
 20  Progress8                                                      0 non-null      float64
 21  Percent_Disadvantaged_2022                                     0 non-null      int64
 22  Percent_Not_Disadvantaged_2022                                 0 non-null      int64
 23  Percent_Disadvantaged_Strong_Passes                            0 non-null      float64
 24  Percent_Not_Disadvantaged_Strong_Passes                        0 non-null      float64
 25  Average Attainment 8 score per non-disadvantaged pupil  - 2022  0 non-null      float64
 26  Progress8_NonDisadvantaged_2022                                 0 non-null      float64
 27  Attainment8_Disadvantaged_2022                                  0 non-null      float64
 28  Progress8_Disadvantaged_2022                                    0 non-null      float64
 29  Progress8_Maths_Disadvantaged                                   0 non-null      float64
 30  Progress8_English_Disadvantaged                                 0 non-null      float64
 31  Progress8_Maths_NonDisadvantaged                                0 non-null      float64
 32  Progress8_English_NonDisadvantaged                              0 non-null      float64
 33  trust_name                                                      0 non-null      object
 34  Trust_UID                                                       0 non-null      float64
 35  Trust_ID                                                        0 non-null      object
 36  Num_Academies_Performance                                       0 non-null      float64
 37  Num_Pupils_KS4_Performance                                      0 non-null      float64
 38  Avg_Attainment8_KS4_Weighted                                    0 non-null      float64
 39  Progress8_Adjusted_Weighted                                     0 non-null      float64
 40  nan                                                             0 non-null      float64
 41  Index of Multiple Deprivation Decile                            0 non-null      float64
 42  LSOA Name                                                       0 non-null      object
 43  POSTCODE                                                        0 non-null      object
 44  progress8_gap                                                   0 non-null      float64
 45  attainment8_gap                                                 0 non-null      float64
 46  maths_gap                                                       0 non-null      float64
 47  english_gap                                                     0 non-null      float64
 48  5_GCSE_gap                                                      0 non-null      float64
 49  pupilpremium_per_pupil                                          0 non-null      float64
dtypes: float64(28), int64(7), object(15)
memory usage: 0.0+ bytes
```

Descriptive Statistics

Before delving into investigating the merged_df data, I will conduct some basic descript statistics to get a feel of the distribution and spread of the data

```
#distribution of deprivation decile
merged_df['Index of Multiple Deprivation Decile'].value_counts()
```

```
Index of Multiple Deprivation Decile
9.0     275
4.0     258
3.0     255
2.0     253
```

```
7.0     249
10.0    248
8.0     246
5.0     245
6.0     236
1.0     204
Name: count, dtype: int64
```

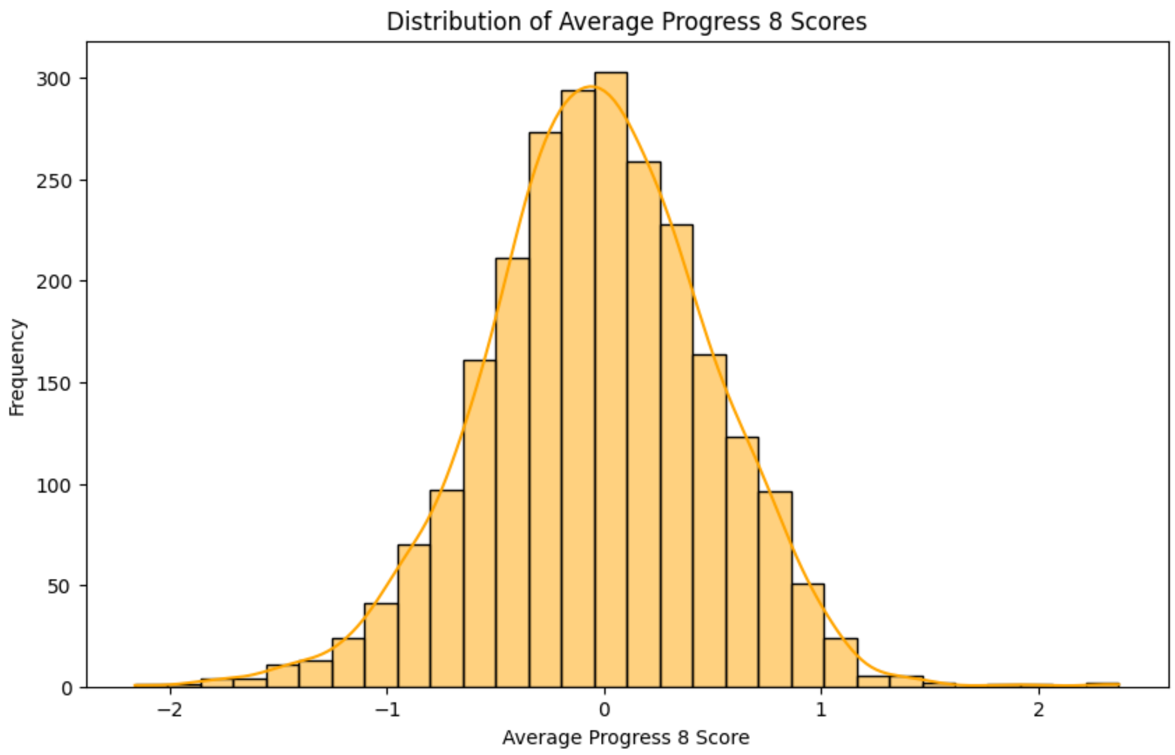
```
## Descriptive Statistics
descriptive_stats = merged_df[['Progress8', 'Attainment8',
                                 'Total_Funding', 'Pupil_Premium_Funding', 'School_Led_Tutori
print(descriptive_stats)
```

```
         Progress8  Attainment8  Total_Funding  Pupil_Premium_Funding  \
count  2469.000000  2469.000000   2.469000e+03           2.469000e+03
mean     -0.033925    46.391009   6.360708e+06           2.538846e+05
std       0.516867     8.851594   2.156262e+06           1.533941e+05
min      -2.160000    12.000000   4.100040e+05           1.379000e+04
25%      -0.360000    40.700000   4.946905e+06           1.408550e+05
50%      -0.030000    45.600000   6.317928e+06           2.260580e+05
75%       0.310000    51.100000   7.629306e+06           3.329300e+05
max       2.370000    86.400000   1.770485e+07           1.098175e+06

       School_Led_Tutoring_Funding  Index of Multiple Deprivation Decile
count                  2467.000000                           2469.000000
mean                  43365.633563                              5.594978
std                   25025.220705                              2.846063
min                    2430.000000                              1.000000
25%                   24916.500000                              3.000000
50%                   39042.000000                              6.000000
75%                   56587.500000                              8.000000
max                  162450.000000                             10.000000
```

View the distribution of progress 8 scores nationally

```
# Histogram for Progress 8 scores
plt.figure(figsize=(10, 6))
sns.histplot(merged_df['Progress8'], bins=30, kde=True, color='orange')
plt.title('Distribution of Average Progress 8 Scores')
plt.xlabel('Average Progress 8 Score')
plt.ylabel('Frequency')
```

```
images_dir = 'images'
image_path = os.path.join(images_dir,'Obj1_progress8_distribution_nationally.png' )
plt.savefig(image_path)

plt.show()
```



Objective 1 Code: Analysing Gaps Between Disadvantaged and Advantaged Pupils

I'll start by finding the mean and gaps of key performance indicators

```
# Calculate mean scores
mean_scores = {
    'Attainment 8 Disadvantaged': merged_df['Attainment8_Disadvantaged_2022'].mean(),
    'Attainment 8 Non-Disadvantaged': merged_df['Average Attainment 8 score per non-disadvan
    'Progress 8 Disadvantaged': merged_df['Progress8_Disadvantaged_2022'].mean(),
    'Progress 8 Non-Disadvantaged': merged_df['Progress8_NonDisadvantaged_2022'].mean(),
    'Maths Disadvantaged': merged_df['Progress8_Maths_Disadvantaged'].mean(),
    'Maths Non-Disadvantaged': merged_df['Progress8_Maths_NonDisadvantaged'].mean(),
    'English Disadvantaged': merged_df['Progress8_English_Disadvantaged'].mean(),
    'English Non-Disadvantaged': merged_df['Progress8_English_NonDisadvantaged'].mean(),
    'Percentage Disadvanted EngMaths_95': merged_df['Percent_Disadvantaged_Strong_Passes'].m
    'Percentage Nondisadv Student EngMaths_95': merged_df['Percent_Not_Disadvantaged_Strong_
}


gaps = {
    'Attainment 8 Gap': merged_df['attainment8_gap'].mean(),
    'Progress 8 Gap': merged_df['progress8_gap'].mean(),
    'Maths Gap':  merged_df['maths_gap'].mean(),
    'English Gap':  merged_df['english_gap'].mean(),
    'percentage_95':  merged_df['5_GCSE_gap'].mean()
}

print("\nMean Scores:")
for key, value in mean_scores.items():
    print(f"{key}: {value:.2f}") #round to 2 decimal places

print("\nGaps Between Groups:")
for key, value in gaps.items():
    print(f"{key}: {value:.2f}") #round to 2 decimal places
```

```
Mean Scores:
Attainment 8 Disadvantaged: 40.22
Attainment 8 Non-Disadvantaged: 51.83
Progress 8 Disadvantaged: -0.47
Progress 8 Non-Disadvantaged: 0.13
Maths Disadvantaged: -0.44
Maths Non-Disadvantaged: 0.11
English Disadvantaged: -0.46
English Non-Disadvantaged: 0.12
Percentage Disadvanted EngMaths_95: 28.09
Percentage Nondisadv Student EngMaths_95: 50.01

Gaps Between Groups:
Attainment 8 Gap: 11.61
Progress 8 Gap: 0.60
Maths Gap: 0.55
English Gap: 0.58
```

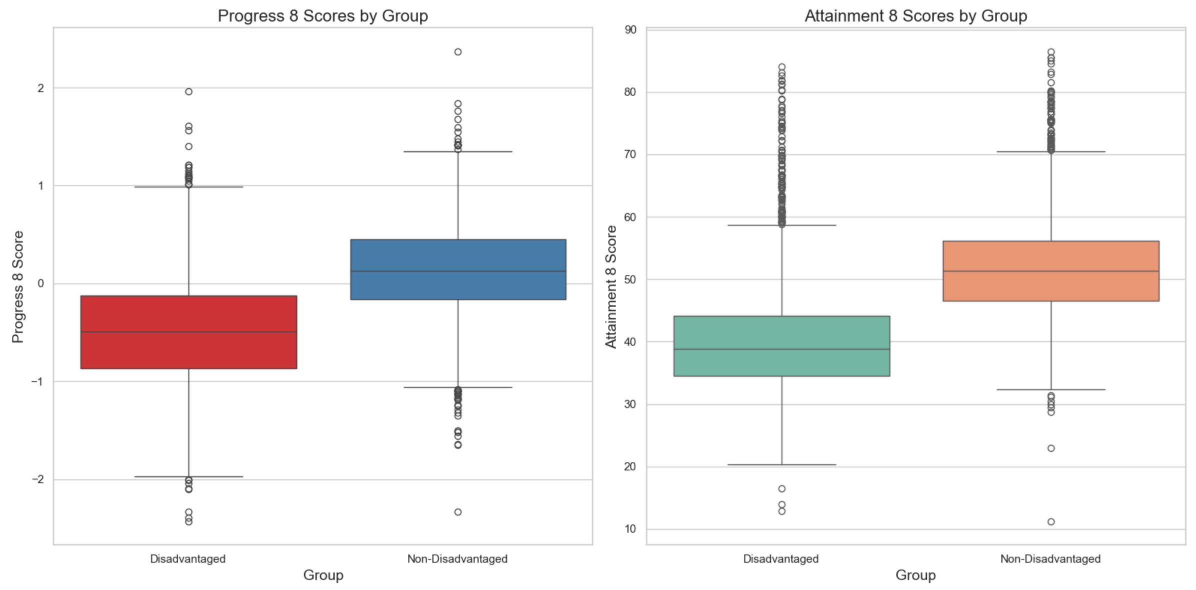
```
percentage_95: 21.92
```

So as to avoid repition, I will interpret the results when discussing objectives later in this notebook. For now, it is worth noting, all the gaps are positive, suggesting disadvantaged pupils are on average are underperforming in every area compared to non-disadvantaged pupils

```
# DataFrames for Progress 8 and Attainment 8

#style
sns.set(style="whitegrid")

# Progress 8 Performance Data
progress8_data = merged_df[['Progress8_Disadvantaged_2022', 'Progress8_NonDisadvantaged_2022
progress8_melted = progress8_data.melt(var_name='Group', value_name='Progress 8 Score')
progress8_melted['Group'] = progress8_melted['Group'].map({
    'Progress8_Disadvantaged_2022': 'Disadvantaged',
    'Progress8_NonDisadvantaged_2022': 'Non-Disadvantaged'
})

# Attainment 8 Performance Data
attainment8_data = merged_df[['Attainment8_Disadvantaged_2022', 'Average Attainment 8 score p
attainment8_melted = attainment8_data.melt(var_name='Group', value_name='Attainment 8 Score')
attainment8_melted['Group'] = attainment8_melted['Group'].map({
    'Attainment8_Disadvantaged_2022': 'Disadvantaged',
    'Average Attainment 8 score per non-disadvantaged pupil  - 2022': 'Non-Disadvantaged'
})


fig, axes = plt.subplots(1, 2, figsize=(16, 8))

# Box Plot for Progress 8 Scores
sns.boxplot(
    x='Group',
    y='Progress 8 Score',
    data=progress8_melted,
    palette="Set1",
    ax=axes[0]
)
axes[0].set_title('Progress 8 Scores by Group', fontsize=16)
axes[0].set_xlabel('Group', fontsize=14)
axes[0].set_ylabel('Progress 8 Score', fontsize=14)
```

```
# Box Plot for Attainment 8 Scores
sns.boxplot(
    x='Group',
    y='Attainment 8 Score',
    data=attainment8_melted,
    palette="Set2",
    ax=axes[1]
)
axes[1].set_title('Attainment 8 Scores by Group', fontsize=16)
axes[1].set_xlabel('Group', fontsize=14)
axes[1].set_ylabel('Attainment 8 Score', fontsize=14)
plt.tight_layout() #adjust plot for better fit

#save the file to the images folder
images_dir = 'images'
image_path = os.path.join(images_dir,'obj1_progress8_attainment8_boxplot.png' )
plt.savefig(image_path)

plt.show()
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\2793708818.py:26: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assig

  sns.boxplot(
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\2793708818.py:38: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assig

  sns.boxplot(
```



```
# Calculate summary statistics for Attainment 8 Scores
attainment8_grouped = attainment8_melted.groupby('Group')['Attainment 8 Score']

# Calculate statistics for Attainment 8
attainment8_stats = attainment8_grouped.describe()
attainment8_q1 = attainment8_grouped.quantile(0.25)
attainment8_q3 = attainment8_grouped.quantile(0.75)
attainment8_iqr = attainment8_q3 - attainment8_q1
attainment8_range = attainment8_grouped.max() - attainment8_grouped.min()
attainment8_median = attainment8_grouped.median()
attainment8_min = attainment8_grouped.min()
attainment8_max = attainment8_grouped.max()

#
attainment8_summary = pd.DataFrame({
    'Median': attainment8_median,
    'Q1 (25%)': attainment8_q1,
    'Q3 (75%)': attainment8_q3,
    'IQR': attainment8_iqr,
    'Min': attainment8_min,
    'Max': attainment8_max,
    'Range': attainment8_range
})

print("\nAttainment 8 Scores Summary:")
print(attainment8_summary)


# Calculate summary statistics for Progress 8 Scores


progress8_grouped = progress8_melted.groupby('Group')['Progress 8 Score']

# Calculate statistics for Progress 8
progress8_stats = progress8_grouped.describe()
progress8_q1 = progress8_grouped.quantile(0.25)
progress8_q3 = progress8_grouped.quantile(0.75)
progress8_iqr = progress8_q3 - progress8_q1
progress8_range = progress8_grouped.max() - progress8_grouped.min()
progress8_median = progress8_grouped.median()
progress8_min = progress8_grouped.min()
progress8_max = progress8_grouped.max()


progress8_summary = pd.DataFrame({
    'Median': progress8_median,
    'Q1 (25%)': progress8_q1,
    'Q3 (75%)': progress8_q3,
    'IQR': progress8_iqr,
    'Min': progress8_min,
    'Max': progress8_max,
    'Range': progress8_range
})


print("\nProgress 8 Scores Summary:")
print(progress8_summary)
```

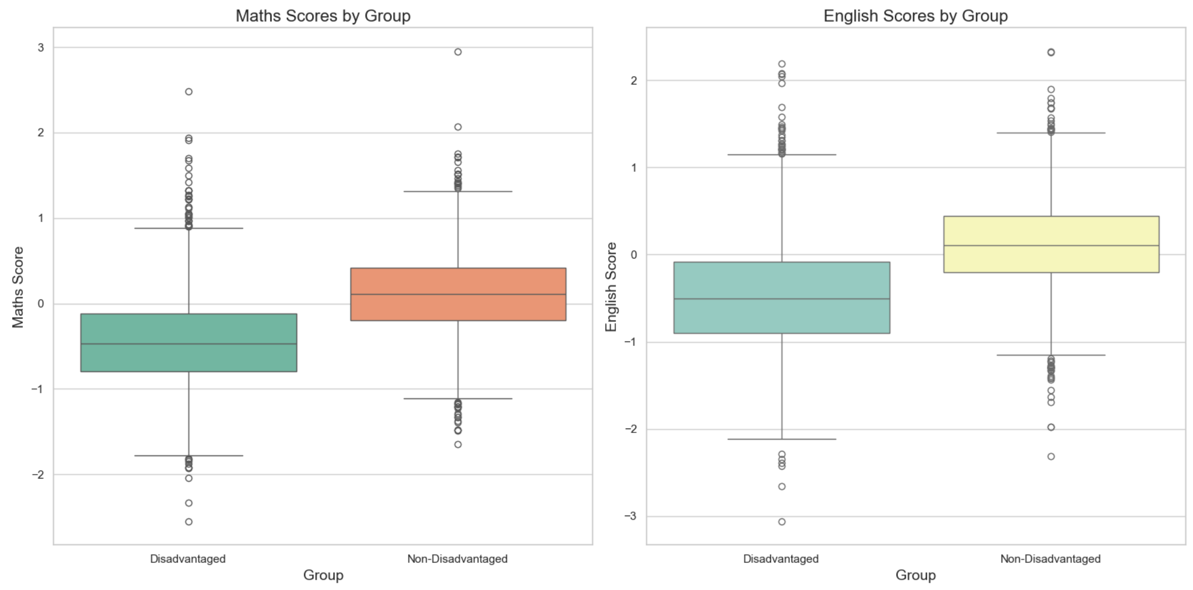
```
Attainment 8 Scores Summary:
                   Median  Q1 (25%)  Q3 (75%)  IQR   Min   Max  Range
Group
Disadvantaged        38.8      34.5      44.2  9.7  12.9  84.1   71.2
Non-Disadvantaged    51.3      46.6      56.2  9.6  11.2  86.5   75.3

Progress 8 Scores Summary:
                   Median  Q1 (25%)  Q3 (75%)   IQR   Min   Max  Range
```

```
Group
Disadvantaged       -0.49      -0.87      -0.12  0.75 -2.43  1.96   4.39
Non-Disadvantaged    0.13      -0.16       0.45  0.61 -2.33  2.37   4.70
```

```
# Dataframes for Maths and English

# Style
sns.set(style="whitegrid")

# Maths Performance Data
maths_data = merged_df[['Progress8_Maths_Disadvantaged', 'Progress8_Maths_NonDisadvantaged']]
maths_melted = maths_data.melt(var_name='Group', value_name='Maths Score')
maths_melted['Group'] = maths_melted['Group'].map({
    'Progress8_Maths_Disadvantaged': 'Disadvantaged',
    'Progress8_Maths_NonDisadvantaged': 'Non-Disadvantaged'
})

# English Performance Data
english_data = merged_df[['Progress8_English_Disadvantaged', 'Progress8_English_NonDisadvanta
english_melted = english_data.melt(var_name='Group', value_name='English Score')
english_melted['Group'] = english_melted['Group'].map({
    'Progress8_English_Disadvantaged': 'Disadvantaged',
    'Progress8_English_NonDisadvantaged': 'Non-Disadvantaged'
})


fig, axes = plt.subplots(1, 2, figsize=(16, 8))

# Box Plot for Maths Scores
sns.boxplot(
    x='Group',
    y='Maths Score',
    data=maths_melted,
    palette="Set2",
    ax=axes[0]
)
axes[0].set_title('Maths Scores by Group', fontsize=16)
axes[0].set_xlabel('Group', fontsize=14)
axes[0].set_ylabel('Maths Score', fontsize=14)


# Box Plot for English Scores
```

```python
sns.boxplot(
    x='Group',
    y='English Score',
    data=english_melted,
    palette="Set3",
    ax=axes[1]
)
axes[1].set_title('English Scores by Group', fontsize=16)
axes[1].set_xlabel('Group', fontsize=14)
axes[1].set_ylabel('English Score', fontsize=14)
plt.tight_layout() # Adjust layout for better fit

# Save the combined box plots as a PNG file in images folder

images_dir = 'images'
image_path = os.path.join(images_dir,'obj1_maths_english_scores_boxplot.png')
plt.savefig(image_path)


plt.show()
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\367155346.py:26: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assig

  sns.boxplot(
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\367155346.py:39: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assig

  sns.boxplot(
```



```
# Calculate summary statistics for Maths Scores

maths_grouped = maths_melted.groupby('Group')['Maths Score']

# Calculate statistics for Maths
maths_stats = maths_grouped.describe()
maths_q1 = maths_grouped.quantile(0.25)
maths_q3 = maths_grouped.quantile(0.75)
maths_iqr = maths_q3 - maths_q1
maths_range = maths_grouped.max() - maths_grouped.min()
maths_median = maths_grouped.median()
maths_min = maths_grouped.min()
maths_max = maths_grouped.max()


maths_summary = pd.DataFrame({
    'Median': maths_median,
    'Q1 (25%)': maths_q1,
    'Q3 (75%)': maths_q3,
    'IQR': maths_iqr,
    'Min': maths_min,
    'Max': maths_max,
    'Range': maths_range
})
```

```
print("\nMaths Scores Summary:")
print(maths_summary)


# Calculate summary statistics for English Scores


english_grouped = english_melted.groupby('Group')['English Score']

english_stats = english_grouped.describe()
english_q1 = english_grouped.quantile(0.25)
english_q3 = english_grouped.quantile(0.75)
english_iqr = english_q3 - english_q1
english_range = english_grouped.max() - english_grouped.min()
english_median = english_grouped.median()
english_min = english_grouped.min()
english_max = english_grouped.max()


english_summary = pd.DataFrame({
    'Median': english_median,
    'Q1 (25%)': english_q1,
    'Q3 (75%)': english_q3,
    'IQR': english_iqr,
    'Min': english_min,
    'Max': english_max,
    'Range': english_range
})


print("\nEnglish Scores Summary:")
print(english_summary)
```

```
Maths Scores Summary:
                   Median  Q1 (25%)  Q3 (75%)   IQR   Min   Max  Range
Group
Disadvantaged       -0.47     -0.79     -0.12  0.67 -2.55  2.48   5.03
Non-Disadvantaged    0.11     -0.20      0.42  0.62 -1.65  2.95   4.60

English Scores Summary:
```

```
                    Median  Q1 (25%)  Q3 (75%)   IQR   Min   Max  Range
Group
Disadvantaged        -0.50      -0.9     -0.08  0.82 -3.06  2.19   5.25
Non-Disadvantaged     0.11      -0.2      0.44  0.64 -2.31  2.33   4.64
```

Objective 2 Code: Identify and Analyse Outlier Schools in Positive Progress 8 of Disadavantaged Pupils

For simplicity, I have chosen to use the Interquarticle Range approach to identify outliers, rather than Z-score. This also allows for easier visualisation using a boxplot. I will begin by establishing quartiles for a box plot to see the distribtion of progress-8 disadvantaged students and then determine outliers using standard approach of interquartile range. As I am interested in high performing schools, I will only take the positive outlier schools

```
merged_df_2= merged_df.copy() # copy of merged_df is used for data integrity
merged_df_2.head()
```

	URN	Local_Authority_Name	Local_Authority_Number	School_Type	School_College_Type	Reli
207	105135	Greenwich	203	Academy sponsor led	Academy	
718	129342	Solihull	334	Academy sponsor led	Academy	
722	130247	Reading	870	Academy sponsor led	Academy	
723	130908	Middlesbrough	806	Academy sponsor led	Academy	
724	130909	Bradford	380	Academy sponsor led	Academy	

```
#  Outlier detection of schools in progress 8 performance of disadavantaged pupils

Q1 = merged_df_2['Progress8_Disadvantaged_2022'].quantile(0.25)
Q3 = merged_df_2['Progress8_Disadvantaged_2022'].quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
 # only upper bound is taken as we are interested in high-performing schools
outliers_p8_disadv = merged_df_2[(merged_df_2['Progress8_Disadvantaged_2022'] > upper_bound)]
outliers_p8_disadv[['School_Name','Trust_Name','Progress8_Disadvantaged_2022']].sort_values(
```

	School_Name	Trust_Name	Progress8_Disadvantaged_2022
2699	Michaela Community School	MICHAELA COMMUNITY SCHOOLS TRUST	
3545	St Peter's Catholic School	XAVIER CATHOLIC EDUCATION TRUST	
2826	Tauheedul Islam Girls' High School	STAR ACADEMIES	

	School_Name	Trust_Name	Progress8_Disadvantaged_2022
3528	Eden Girls' Leadership Academy, Birmingham	STAR ACADEMIES	
2058	St Mark's Catholic School	THE DIOCESE OF WESTMINSTER ACADEMY T	
2368	Sacred Heart Catholic School	SACRED HEART CATHOLIC SCHOOL	
2830	The Hurlingham Academy	UNITED LEARNING TRUST	
2981	Ealing Fields High School	TWYFORD CHURCH OF ENGLAND ACADEMIE	
2884	Eden Boys' School, Preston	STAR ACADEMIES	
3530	St Francis Xavier School - a Joint Catholic an...	NICHOLAS POSTGATE CATHOLIC ACADEMY T	
2950	Bolton Muslim Girls School	PROSPER MULTI ACADEMY TRUST	
1475	Birmingham Ormiston Academy	BIRMINGHAM ORMISTON ACADEMY	
3158	Dartford Grammar School for Girls	THE ARETÉ TRUST	
1120	Lancaster Girls' Grammar School	LANCASTER GIRLS' GRAMMAR SCHOOL	
833	Ashcroft Technology Academy	PROSPECT EDUCATION (TECHNOLOGY) TRUS	
2162	Ark Bolingbroke Academy	ARK SCHOOLS	
1279	Wilson's School	WILSON'S SCHOOL	
1919	Featherstone High School	GRAND UNION MULTI ACADEMY TRUST	
849	Wren Academy Finchley	WREN ACADEMIES TRUST	
1645	Bentley Wood High School	THE BENTLEY WOOD TRUST	
2264	Nishkam High School	NISHKAM SCHOOL TRUST	

Similarly, I will repear the process for non-disadvantaged pupils' progress-8 score

```
Q1 = merged_df_2['Progress8_NonDisadvantaged_2022'].quantile(0.25)
Q3 = merged_df_2['Progress8_NonDisadvantaged_2022'].quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
outliers_p8_adv = merged_df_2[(merged_df_2['Progress8_NonDisadvantaged_2022'] > upper_bound)]
outliers_p8_adv[['School_Name','Trust_Name','Progress8_NonDisadvantaged_2022']].sort_values(
```

	School_Name	Trust_Name	Progress8_NonDisadvantaged_2022
2699	Michaela Community School	MICHAELA COMMUNITY SCHOOLS TRUST	
3528	Eden Girls' Leadership Academy, Birmingham	STAR ACADEMIES	
2826	Tauheedul Islam Girls' High School	STAR ACADEMIES	
1748	Hillcrest School and Sixth Form Centre	HILLCREST SCHOOL AND SIXTH FORM CENTR	
2779	Levenshulme High School	EDUCATION AND LEADERSHIP TRUST	
815	Ark King Solomon Academy	ARK SCHOOLS	
1645	Bentley Wood High School	THE BENTLEY WOOD TRUST	
2883	Eden Girls' School, Slough	STAR ACADEMIES	
787	Northampton Academy	UNITED LEARNING TRUST	

	School_Name	Trust_Name	Progress8_NonDisadvantaged_2022
2128	Avonbourne Girls Academy	AVONBOURNE INTERNATIONAL BUSINESS AND	
2587	Glenmoor Academy	UNITED LEARNING TRUST	
2830	The Hurlingham Academy	UNITED LEARNING TRUST	
2722	Eden Girls' School Coventry	STAR ACADEMIES	
2981	Ealing Fields High School	TWYFORD CHURCH OF ENGLAND ACADEMIES	
3545	St Peter's Catholic School	XAVIER CATHOLIC EDUCATION TRUST	

Categorical Variables

To investigate the impact of demographics and socioeconomic influence on outlier schools for Progress 8 - disadvantaged pupils, I will use Religious character, Ofsted Rating, Free School Meal Funding, School_Led_Tutoring_Funding,pupilpremium_per_pupil,Percent_Not_Disadvantaged_2022, Percent_Disadvantaged_2022, Index of Multiple Deprivation Decile

```
demographics_columns = ['Religious_Character','Ofsted_Rating','FSM_Funding','School_Led_Tuto

descriptive_stats_disadv = outliers_p8_disadv[demographics_columns].describe()
descriptive_stats_disadv.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 8 entries, count to max
Data columns (total 6 columns):
 #   Column                              Non-Null Count  Dtype  
---  ------                              --------------  -----  
 0   FSM_Funding                         8 non-null      float64
 1   School_Led_Tutoring_Funding         8 non-null      float64
 2   pupilpremium_per_pupil              8 non-null      float64
 3   Percent_Not_Disadvantaged_2022      8 non-null      float64
 4   Percent_Disadvantaged_2022          8 non-null      float64
 5   Index of Multiple Deprivation Decile  8 non-null      float64
dtypes: float64(6)
memory usage: 448.0+ bytes
```

```
descriptive_stats_adv = outliers_p8_adv[demographics_columns].describe()
descriptive_stats_adv
```

	FSM_Funding	School_Led_Tutoring_Funding	pupilpremium_per_pupil	Percent_Not_Disadvantage
count	15.000000	15.000000	15.000000	15.000000
mean	86227.333333	43651.800000	999.404370	66.333333
std	50555.511646	21600.087911	58.855940	14.110111
min	0.000000	12150.000000	977.869565	37.000000
25%	50749.000000	29889.000000	985.000000	57.500000
50%	82107.000000	40662.000000	985.000000	69.000000
75%	122693.500000	52717.500000	985.000000	73.000000
max	182830.000000	86994.000000	1212.046263	95.000000

Analysis may not be conclusive of the above descriptive statistics as some schools maybe in both groups of outliers: progress 8 outliers for disadvantaged pupils and progress 8 outliers for non-disadvantaged pupils. To better understand the differences, we should differentiate between schools which are

a) only progress 8 outliers for diadavtanged pupils

b) only for advatanged

c) those which are outliers for both.

To differentiate the schools, I will select and split based on their URN numbers

```
#URN list for non-disadvantaged ouliers
nondisadv_outliers= set(outliers_p8_adv['URN'])
nondisadv_outliers
```

```
{134814,
 135242,
 137178,
 137346,
 138193,
 140008,
 140862,
 140958,
 141196,
 141565,
 141617,
 141970,
 142654,
 147201,
 147430}
```

```
#URN list for disadvantaged ouliers

disadv_outliers = set(outliers_p8_disadv['URN'])
disadv_outliers
```

```
{135316,
 135507,
 136381,
 136621,
 136944,
 137178,
 137729,
 137995,
 138267,
 138586,
 138960,
 140862,
 141565,
 141617,
 141971,
 142340,
 142654,
 144100,
 147201,
 147213,
 147430}
```

```


# Define outlier sets
only_disadvp8_outliers = disadv_outliers - nondisadv_outliers
only_nondisadvp8_outliers = nondisadv_outliers - disadv_outliers
both_p8_outliers = disadv_outliers & nondisadv_outliers


merged_df_2['Outlier_Category'] = 'None'
merged_df_2.loc[merged_df['URN'].isin(both_p8_outliers), 'Outlier_Category'] = 'Both'
merged_df_2.loc[merged_df['URN'].isin(only_disadvp8_outliers), 'Outlier_Category'] = 'Only_Di
merged_df_2.loc[merged_df['URN'].isin(only_nondisadvp8_outliers), 'Outlier_Category'] = 'Only


category_counts = merged_df_2['Outlier_Category'].value_counts()
```

```
print("Distribution of Outlier Categories:")
print(category_counts)
```

```
Distribution of Outlier Categories:
Outlier_Category
None              2440
Only_Disadv         14
Only_NonDisadv       8
Both                 7
Name: count, dtype: int64
```

I will now use the categories to reate an outlier dataframe which can be used for analysing just the progress 8 school outliers against each other

```
outlier_df = merged_df_2[merged_df_2['URN'].isin(both_p8_outliers|only_nondisadvp8_outliers|


category_counts = outlier_df['Outlier_Category'].value_counts()
print("Distribution of Outlier Categories:")
print(category_counts)
```

```
Distribution of Outlier Categories:
Outlier_Category
Only_Disadv       14
Only_NonDisadv     8
Both               7
Name: count, dtype: int64
```

Check for null values

```
merged_df_2.isnull().sum()
```

```
URN                                                                  0
Local_Authority_Name                                                 0
Local_Authority_Number                                               0
School_Type                                                          0
School_College_Type                                                  0
Religious_Character                                                984
```

```
Admissions_Policy                                                   197
School_Gender                                                         0
Ofsted_Rating                                                        29
School postcode                                                       0
FSM_Funding                                                           0
Pupil_Premium_Funding                                                 0
Pupil_Premium_Pupils                                                  0
School_Led_Tutoring_Funding                                           2
Total_Funding                                                         0
Group_UID                                                             0
Group_ID                                                              0
School_Name                                                           0
Trust_Name                                                            0
Attainment8                                                           0
Progress8                                                             0
Percent_Disadvantaged_2022                                            0
Percent_Not_Disadvantaged_2022                                        0
Percent_Disadvantaged_Strong_Passes                                   0
Percent_Not_Disadvantaged_Strong_Passes                               0
Average Attainment 8 score per non-disadvantaged pupil  - 2022        0
Progress8_NonDisadvantaged_2022                                       0
Attainment8_Disadvantaged_2022                                        0
Progress8_Disadvantaged_2022                                          0
Progress8_Maths_Disadvantaged                                         0
Progress8_English_Disadvantaged                                       0
Progress8_Maths_NonDisadvantaged                                      0
Progress8_English_NonDisadvantaged                                    0
trust_name                                                         1405
Trust_UID                                                          1405
Trust_ID                                                           1405
Num_Academies_Performance                                          1405
Num_Pupils_KS4_Performance                                         1405
Avg_Attainment8_KS4_Weighted                                       1405
Progress8_Adjusted_Weighted                                        1405
NaN                                                                1405
Index of Multiple Deprivation Decile                                  0
LSOA Name                                                             0
POSTCODE                                                              0
progress8_gap                                                         0
attainment8_gap                                                       0
maths_gap                                                             0
english_gap                                                           0
5_GCSE_gap                                                            0
```

```
pupilpremium_per_pupil                                               0
Outlier_Category                                                     0
dtype: int64
```

View mean Deprivation Index spread across across all categories of schools

```
outlier_performance_index = merged_df_2.groupby('Outlier_Category')[['Index of Multiple Depri
outlier_performance_index
```

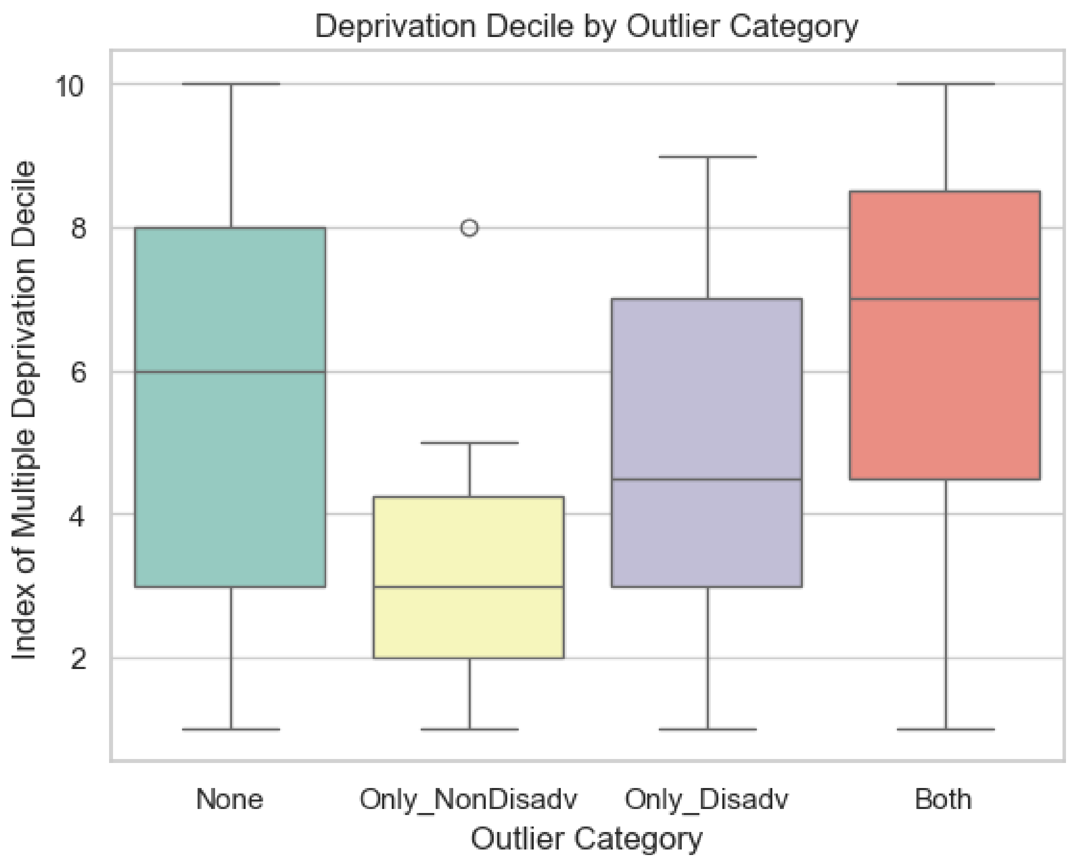
	Outlier_Category	Index of Multiple Deprivation Decile
0	Both	6.285714
1	None	5.603279
2	Only_Disadv	5.000000
3	Only_NonDisadv	3.500000

To analyse various fields of the outlier schools, based on their categories, I will plot some graphs and generate summary statistics

```
#represent deprivation index against outlier category

sns.boxplot(
    x='Outlier_Category',
    y='Index of Multiple Deprivation Decile',
    data=merged_df_2,
    palette='Set3'
)
plt.title('Deprivation Decile by Outlier Category')
plt.xlabel('Outlier Category')
plt.ylabel('Index of Multiple Deprivation Decile')

images_dir = 'images'
image_path = os.path.join(images_dir,'Obj2_Deprivation_by_Outlier_Category.png')
plt.savefig(image_path)

plt.show()
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\1565168097.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assi
```

```
sns.boxplot(
```



```
#  calculate descriptive statistics for outlier categories and index of multiple deprivation

# groupby method used to group merged_df_2 by outlier category, then select IMDC column for i
grouped = merged_df_2.groupby('Outlier_Category')['Index of Multiple Deprivation Decile']


median = grouped.median()
q1 = grouped.quantile(0.25)
q3 = grouped.quantile(0.75)
iqr = q3 - q1
minimum = grouped.min()
maximum = grouped.max()
range_ = maximum - minimum
```

```
summary = pd.DataFrame({
    'Median': median,
    'Q1 (25%)': q1,
    'Q3 (75%)': q3,
    'IQR': iqr,
    'Min': minimum,
    'Max': maximum,
    'Range': range_
})

#
print("Summary Statistics for 'Index of Multiple Deprivation Decile' by 'Outlier_Category':")
print(summary)
```

```
Summary Statistics for 'Index of Multiple Deprivation Decile' by 'Outlier_Category':
                  Median  Q1 (25%)  Q3 (75%)   IQR  Min   Max  Range
Outlier_Category
Both                 7.0       4.5      8.50  4.00  1.0  10.0    9.0
None                 6.0       3.0      8.00  5.00  1.0  10.0    9.0
Only_Disadv          4.5       3.0      7.00  4.00  1.0   9.0    8.0
Only_NonDisadv       3.0       2.0      4.25  2.25  1.0   8.0    7.0
```

```
outlier_performance = merged_df_2.groupby('Outlier_Category')[['Progress8','Progress8_Disadva
outlier_performance
```

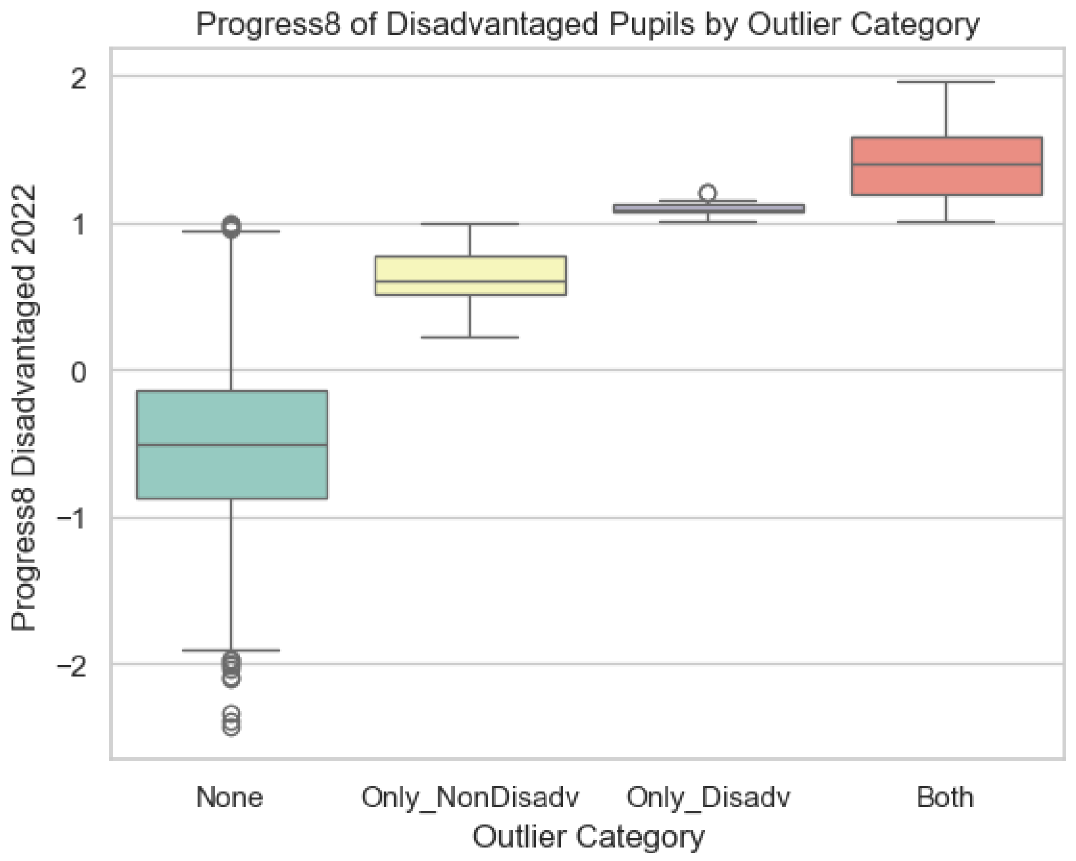
	Outlier_Category	Progress8	Progress8_Disadvantaged_2022	Progress8_NonDisadvantaged_2022
0	Both	1.614286	1.417143	1.664286
1	None	-0.047791	-0.486266	0.118369
2	Only_Disadv	0.946429	1.100000	0.950714
3	Only_NonDisadv	1.037500	0.626250	1.492500

Plot box plot of progress 8 of disadvantaed pupils by outlier category

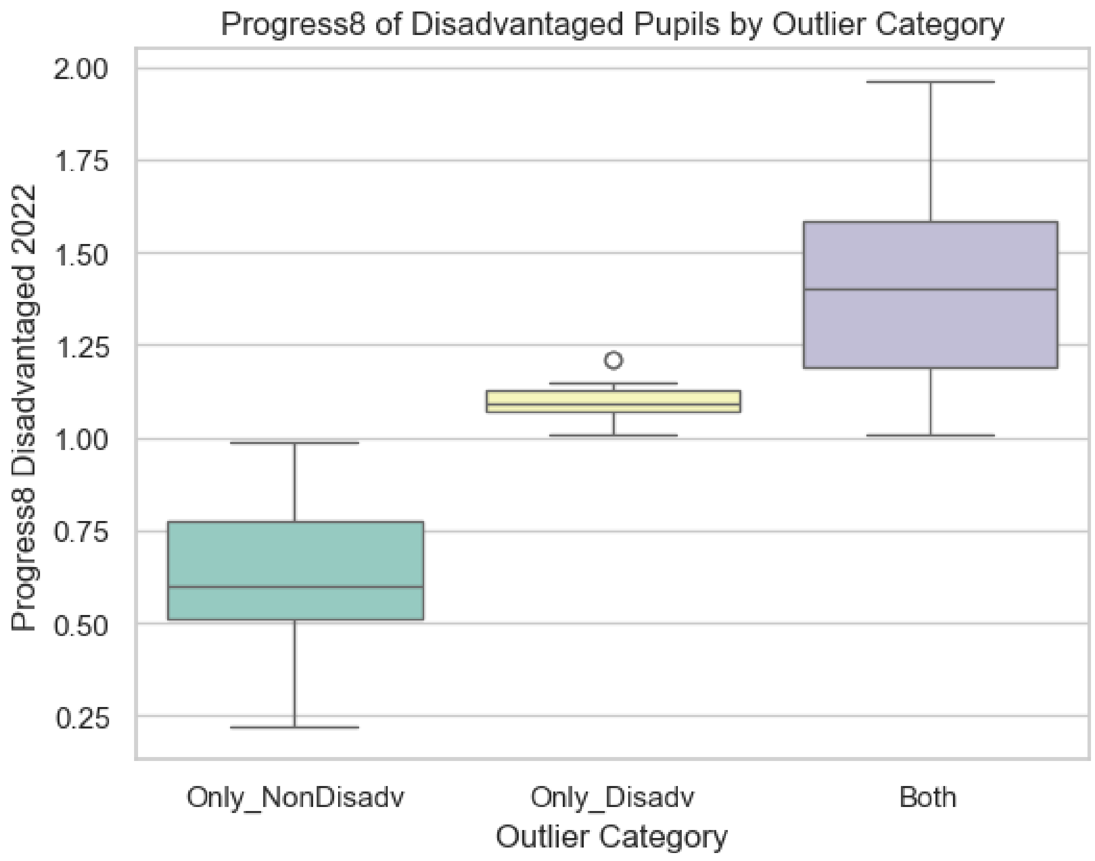
```
sns.boxplot(
    x='Outlier_Category',
    y='Progress8_Disadvantaged_2022',
    data= merged_df_2,
    palette='Set3'
)
```

```
plt.title('Progress8 of Disadvantaged Pupils by Outlier Category')
plt.xlabel('Outlier Category')
plt.ylabel('Progress8 Disadvantaged 2022')

plt.show()


sns.boxplot(
    x='Outlier_Category',
    y='Progress8_Disadvantaged_2022',
    data= outlier_df,
    palette='Set3'
)
plt.title('Progress8 of Disadvantaged Pupils by Outlier Category')
plt.xlabel('Outlier Category')
plt.ylabel('Progress8 Disadvantaged 2022')

images_dir = 'images'
image_path = os.path.join(images_dir,'Obj2_Progress8 of Disadvantaged Pupils by Outlier Categ
plt.savefig(image_path)

plt.show()
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\3617201507.py:1: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assig

  sns.boxplot(
```



```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\3617201507.py:14: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assig

  sns.boxplot(
```



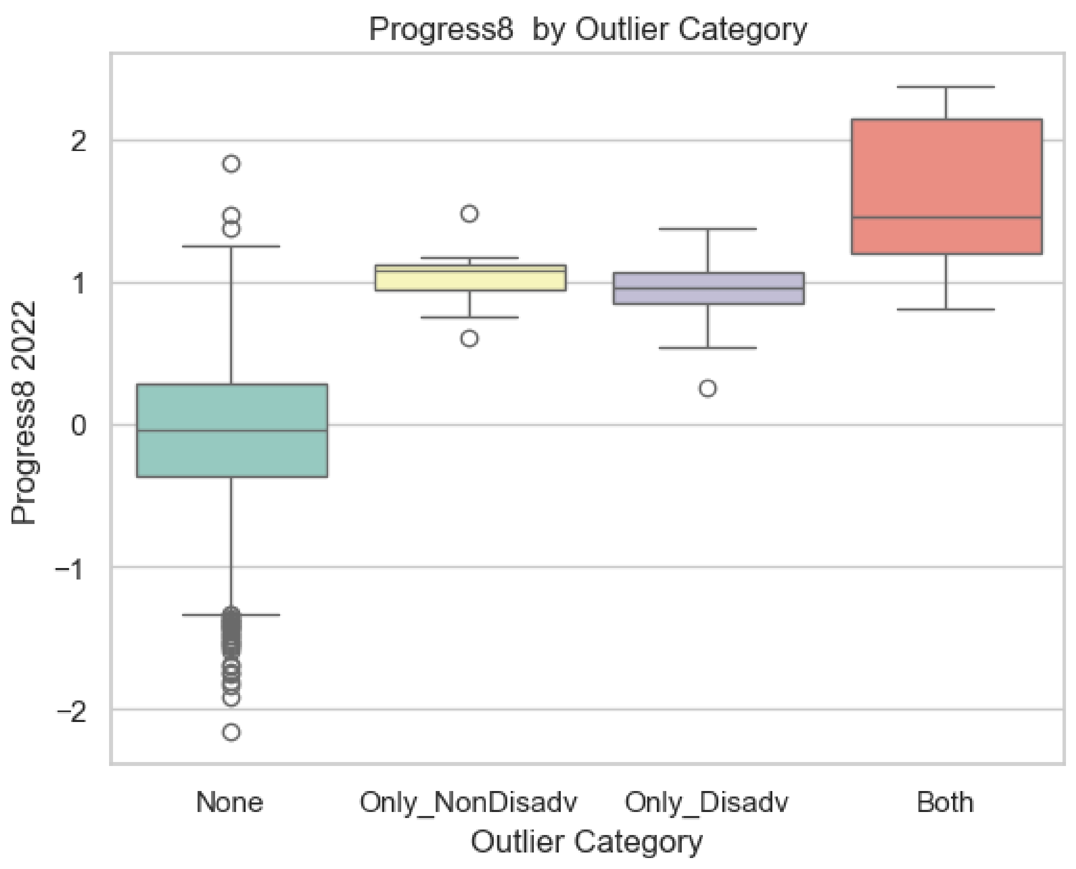
```
#calculate summary statistics for the box plot above
grouped = merged_df_2.groupby('Outlier_Category')['Progress8_Disadvantaged_2022']


median = grouped.median()
q1 = grouped.quantile(0.25)
q3 = grouped.quantile(0.75)
iqr = q3 - q1
minimum = grouped.min()
maximum = grouped.max()
range_ = maximum - minimum


summary = pd.DataFrame({
    'Median': median,
    'Q1 (25%)': q1,
    'Q3 (75%)': q3,
    'IQR': iqr,
    'Min': minimum,
    'Max': maximum,
    'Range': range_
})

print("Summary Statistics for 'Progress8_Disadvantaged_2022' by 'Outlier_Category':")
print(summary)
```

```
Summary Statistics for 'Progress8_Disadvantaged_2022' by 'Outlier_Category':
                  Median  Q1 (25%)  Q3 (75%)    IQR   Min   Max  Range
Outlier_Category
Both                1.40      1.19     1.585  0.395  1.01  1.96   0.95
None               -0.50     -0.87    -0.140  0.730 -2.43  0.99   3.42
Only_Disadv         1.09      1.07     1.125  0.055  1.01  1.21   0.20
Only_NonDisadv      0.60      0.51     0.775  0.265  0.22  0.99   0.77
```

Plot a box plot to show progress 8 scores for all outlier category types

```
sns.boxplot(
    x='Outlier_Category',
    y='Progress8',
    data= merged_df_2,
    palette='Set3'
)
plt.title('Progress8  by Outlier Category')
plt.xlabel('Outlier Category')
plt.ylabel('Progress8 2022')


images_dir = 'images'
image_path = os.path.join(images_dir,'Obj2_Progress8 by Outlier Category.png')
plt.savefig(image_path)

plt.show()
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\3243744368.py:1: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assi

  sns.boxplot(
```



```
# Calculate summary statistics
grouped = merged_df_2.groupby('Outlier_Category')['Progress8']


median = grouped.median()
q1 = grouped.quantile(0.25)
q3 = grouped.quantile(0.75)
iqr = q3 - q1
minimum = grouped.min()
maximum = grouped.max()
range_ = maximum - minimum


summary = pd.DataFrame({
    'Median': median,
    'Q1 (25%)': q1,
    'Q3 (75%)': q3,
    'IQR': iqr,
    'Min': minimum,
    'Max': maximum,
    'Range': range_
})


print("Summary Statistics for 'Progress8' by 'Outlier_Category':")
print(summary)
```

```
Summary Statistics for 'Progress8' by 'Outlier_Category':
                  Median  Q1 (25%)  Q3 (75%)     IQR   Min   Max  Range
Outlier_Category
Both               1.450    1.1950     2.140  0.9450  0.81  2.37   1.56
None              -0.040   -0.3600     0.290  0.6500 -2.16  1.83   3.99
Only_Disadv        0.955    0.8500     1.070  0.2200  0.25  1.38   1.13
Only_NonDisadv     1.085    0.9375     1.125  0.1875  0.61  1.49   0.88
```

Using the get_school_details function defined earlier, I can extract schoool details based on a URN list

```
columns = ['School_Name',
 'Trust_Name', 'Percent_Disadvantaged_2022', 'Progress8',
 'Progress8_NonDisadvantaged_2022', 'Progress8_Disadvantaged_2022',
  'Percent_Not_Disadvantaged_2022',
 'Religious_Character',
'Admissions_Policy',
'School_Gender',
'Ofsted_Rating',]

data_loader = DataWrangler(dataframe=outlier_df)
# Schools only in outliers_disadvantaged
schools_only_disdv_outliers = data_loader.get_school_details(only_disadvp8_outliers, columns
print("schools_only_disdv_outliers:")
print(schools_only_disdv_outliers.to_string(index=False), "\n")
```

```
DataWrangler initialised with the provided DataFrame.
schools_only_disdv_outliers:
                                                                    School_Name
                                                     Ashcroft Technology Academy PROSPECT
```

```
                                                            Wren Academy Finchley
                                                   Lancaster Girls' Grammar School
                                                                  Wilson's School
                                                      Birmingham Ormiston Academy
                                                         Featherstone High School
                                                        St Mark's Catholic School      THE
                                                          Ark Bolingbroke Academy
                                                              Nishkam High School
                                                     Sacred Heart Catholic School
                                                       Eden Boys' School, Preston
                                                       Bolton Muslim Girls School
                                                 Dartford Grammar School for Girls
St Francis Xavier School - a Joint Catholic and Church of England Voluntary Academy      NICI
```

```
# Schools only in outliers_not disadvantaged
data_loader = DataWrangler(dataframe=outlier_df)
schools_only_nondisadv_outliers = data_loader.get_school_details(only_nondisadvp8_outliers, c
print("schools_only_nondisadv_outliers:")
print(schools_only_nondisadv_outliers.to_string(index=False), "\n")
```

```
DataWrangler initialised with the provided DataFrame.
schools_only_nondisadv_outliers:
                          School_Name                                                     T
                  Northampton Academy                                          UNITED LEARNI
                Ark King Solomon Academy                                                ARI
Hillcrest School and Sixth Form Centre                          HILLCREST SCHOOL AND SIXTH FOI
             Avonbourne Girls Academy AVONBOURNE INTERNATIONAL BUSINESS AND ENTERPRISE ACADI
                     Glenmoor Academy                                          UNITED LEARNI
           Eden Girls' School Coventry                                                 STAR A
               Levenshulme High School                                   EDUCATION AND LEADERSI
            Eden Girls' School, Slough                                                 STAR A
```

```
# Schools in both outliers_disadvantaged only and outliers_not disadvantaged

data_loader = DataWrangler(dataframe=outlier_df)

schools_both = data_loader.get_school_details(both_p8_outliers, columns)
print("Schools in both disadv and nondisadv outliers:")
print(schools_both.to_string(index=False))
```

```
DataWrangler initialised with the provided DataFrame.
```

```
Schools in both disadv and nondisadv outliers:
                                School_Name                                Trust_Name  Percer
                   Bentley Wood High School                    THE BENTLEY WOOD TRUST
                  Michaela Community School          MICHAELA COMMUNITY SCHOOLS TRUST
         Tauheedul Islam Girls' High School                            STAR ACADEMIES
                     The Hurlingham Academy                    UNITED LEARNING TRUST
                  Ealing Fields High School TWYFORD CHURCH OF ENGLAND ACADEMIES TRUST
Eden Girls'  Leadership Academy, Birmingham                            STAR ACADEMIES
                  St Peter's Catholic School           XAVIER CATHOLIC EDUCATION TRUST
```

I will also evaluate the categorical columns in the outlier schools

```
categorical_columns= outlier_df[['School_Type','School_College_Type',
'Religious_Character',
'Admissions_Policy',
 'School_Gender',
'Ofsted_Rating','Trust_Name','Outlier_Category']]
```

```
numerical_variables = outlier_df[['FSM_Funding',
                                                'Pupil_Premium_Funding',
                                                 'Pupil_Premium_Pupils',
                                          'School_Led_Tutoring_Funding',
                                                        'Total_Funding','Attainment8',
                                                            'Progress8',
                                           'Percent_Disadvantaged_2022',
                                       'Percent_Not_Disadvantaged_2022',
                                  'Percent_Disadvantaged_Strong_Passes',
                              'Percent_Not_Disadvantaged_Strong_Passes',
       'Average Attainment 8 score per non-disadvantaged pupil  - 2022',
                                      'Progress8_NonDisadvantaged_2022',
                                   'Attainment8_Disadvantaged_2022',
                                         'Progress8_Disadvantaged_2022',
                                        'Progress8_Maths_Disadvantaged',
                                      'Progress8_English_Disadvantaged',
                                     'Progress8_Maths_NonDisadvantaged',
                                   'Progress8_English_NonDisadvantaged', 'Index of Multiple I
```

```
numerical_variables.describe()
```

	FSM_Funding	Pupil_Premium_Funding	Pupil_Premium_Pupils	School_Led_Tutoring_Funding	T
count	29.000000	29.000000	29.000000	29.000000	
mean	105475.413793	221438.344828	219.586207	36555.517241	
std	138064.982769	143085.321561	131.774027	21375.221128	
min	0.000000	39400.000000	40.000000	6480.000000	
25%	37515.000000	129035.000000	131.000000	22194.000000	
50%	74260.000000	183210.000000	186.000000	31590.000000	
75%	121260.000000	279740.000000	284.000000	46818.000000	
max	730864.000000	681170.000000	562.000000	86994.000000	

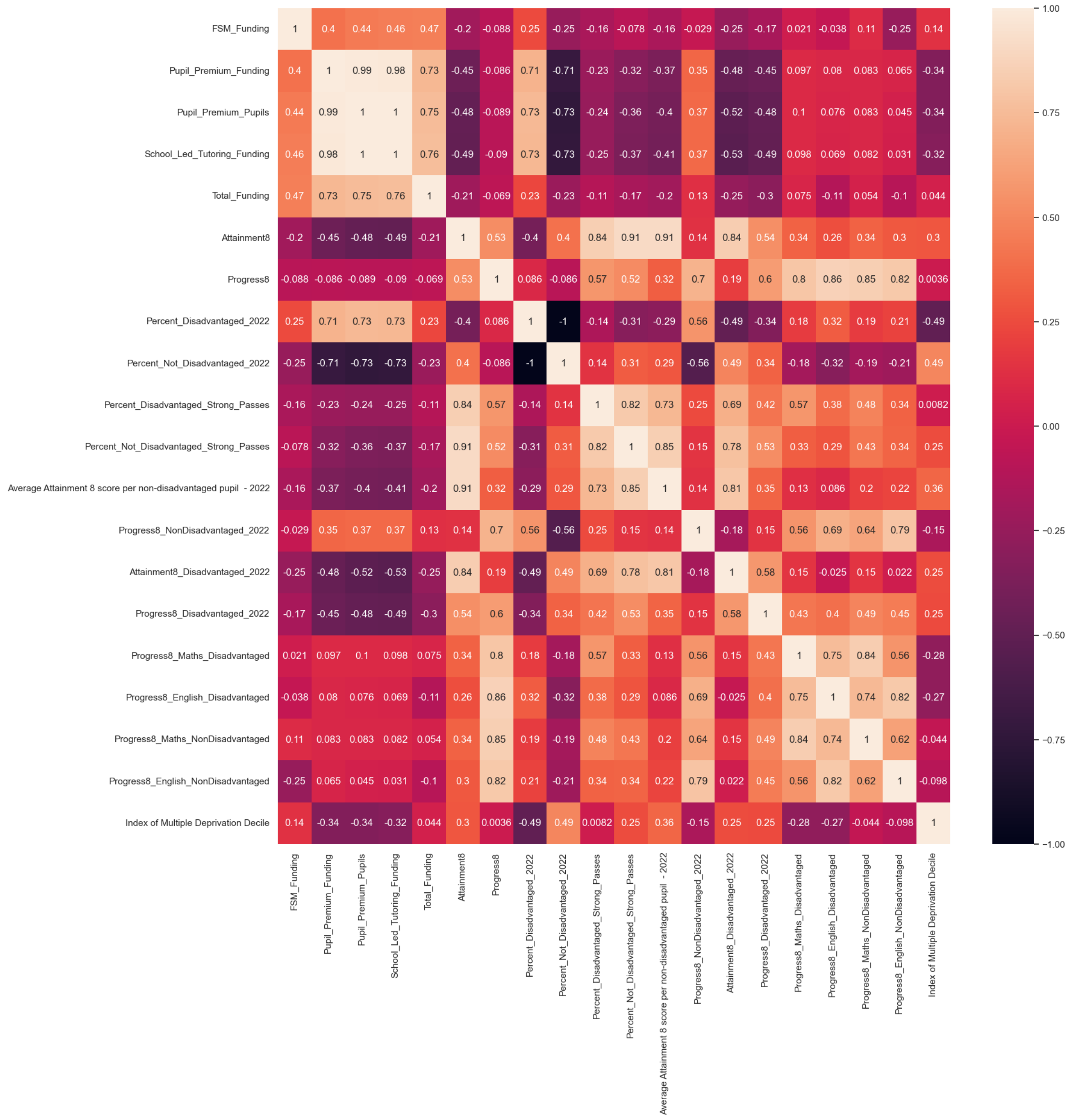
```
#Standardise the numerical values to ensure accurate corrlation

scaler = StandardScaler() # use standard scaler which will make each feature have 0 mean and

scaled_data = scaler.fit_transform(numerical_variables)


scaled_numerical_df = pd.DataFrame(scaled_data, columns=numerical_variables.columns)


merged_df_2[scaled_numerical_df.columns] = scaled_numerical_df


scaled_numerical_df.head()
```

	FSM_Funding	Pupil_Premium_Funding	Pupil_Premium_Pupils	School_Led_Tutoring_Funding	T
0	0.341747	1.458545	1.648210	1.768970	
1	0.199734	3.269861	2.644487	2.401438	
2	4.609846	0.901583	1.038088	1.136931	
3	-0.213244	0.050084	-0.089481	-0.105293	
4	-0.652757	-1.273738	-1.363788	-1.401080	

As part of the analysis, I will create a heatmap of numerical variables

```
# Correlation matrix
corr_matrix = numerical_variables.corr()
plt.figure(figsize=(18,18))
```

```
images_dir = 'images'
image_path = os.path.join(images_dir,'Obj2_Heatmap_Outlier_Schools.png')
plt.savefig(image_path)


# Heatmap
sns.heatmap(corr_matrix, annot=True)
plt.show()
```



Objective 3 Code: Identify and evaluate the top performing multi-academy trusts in supporting disadvantaged pupils

```
merged_df_3=merged_df.copy() # make another copy of merged_df
```

```
# group schools by MAT for analysis
MAT_performance = merged_df_3.groupby('Trust_Name')[['Progress8','Progress8_Disadvantaged_20
                                                       'attainment8_gap',
                                                             'maths_gap',
                                                           'english_gap',
                                                            '5_GCSE_gap',
                                                'pupilpremium_per_pupil','Progress8_NonDisadva
MAT_performance.head()
```

	Trust_Name	Progress8	Progress8_Disadvantaged_2022	progress8_gap	attainment8_gap	maths_g
0	5 DIMENSIONS TRUST		-0.13	-0.89		0.930
1	ABBEY ACADEMIES TRUST		-0.43	-1.11		0.930
2	ABBEY COLLEGE, RAMSEY		-0.10	-0.55		0.690
3	ABBEY MULTI ACADEMY TRUST		0.07	-0.05		0.305
4	ABBS CROSS ACADEMY AND ARTS COLLEGE		0.04	-1.17		0.990

```
MAT_performance_sorted = MAT_performance.sort_values(by='Progress8_Disadvantaged_2022', ascen
#we can now sort by progress 8 score of disadvantaged pupils
MAT_performance_sorted.head()
```

	Trust_Name	Progress8	Progress8_Disadvantaged_2022	progress8_gap	attainment8_gap	maths_g
654	MICHAELA COMMUNITY SCHOOLS TRUST		2.37	1.96		0.41
833	SACRED HEART CATHOLIC SCHOOL		1.38	1.21		0.14
780	PROSPER MULTI ACADEMY TRUST		1.01	1.11		-0.13
111	BIRMINGHAM ORMISTON ACADEMY		0.25	1.10		-0.52
587	LANCASTER GIRLS' GRAMMAR SCHOOL		0.54	1.09		-0.41

```
# Group by Trust and calculate mean scores along with the count of schools
MAT_performance = merged_df_3.groupby('Trust_Name').agg(
    avg_progress8_score=('Progress8', 'mean'),
    prog8_score_disadv=('Progress8_Disadvantaged_2022', 'mean'),
    prog8_score_nondisadv=('Progress8_NonDisadvantaged_2022', 'mean'),
    progress8_gap=('progress8_gap', 'mean'),
    attainment8_gap=('attainment8_gap', 'mean'),
    maths_gap=('maths_gap', 'mean'),
    english_gap=('english_gap', 'mean'),
    FiveGCSE_gap=('5_GCSE_gap', 'mean'),
 deprivation_index= ('Index of Multiple Deprivation Decile','mean'),
    school_count=('URN', 'count')  # Counting the number of schools per Group Name
).reset_index()

# Sort the MAT_performance DataFrame by 'avg_progress8_score' in descending order
MAT_performance_sorted = MAT_performance.sort_values(by='prog8_score_disadv', ascending=Fals

MAT_performance_sorted.head()
```

	Trust_Name	avg_progress8_score	prog8_score_disadv	prog8_score_nondisadv	progress8_gap	att
654	MICHAELA COMMUNITY SCHOOLS TRUST	2.37	1.96	2.37		
833	SACRED HEART CATHOLIC SCHOOL	1.38	1.21	1.35		
780	PROSPER MULTI ACADEMY TRUST	1.01	1.11	0.98		
111	BIRMINGHAM ORMISTON ACADEMY	0.25	1.10	0.58		
587	LANCASTER GIRLS' GRAMMAR SCHOOL	0.54	1.09	0.68		

A number of MATs have 1 or 2 schools, so I will filter for those with at least 4 schools as I want to explore organisational impact of Trusts working with mutiple schools

```
# Filter MATs with school_count >= 4
MAT_performance_filtered = MAT_performance[MAT_performance['school_count'] >= 4]

# top 10 MATs with the highest average Progress 8 scores disadvantaged and at least 4 schools
MAT_performance_sorted = MAT_performance_filtered.sort_values(by='prog8_score_disadv', ascend


Top_10MAT = MAT_performance_sorted.head(10)
print(Top_10MAT)
```

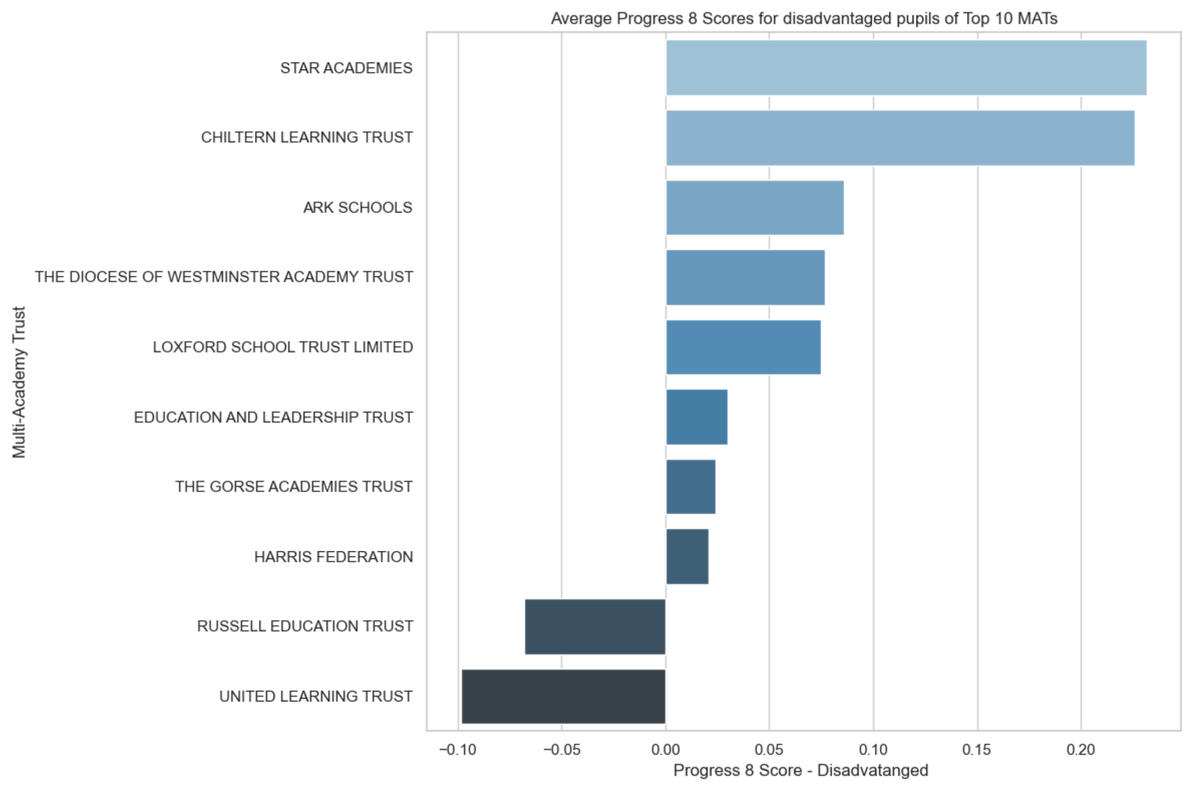
```
                                    Trust_Name  avg_progress8_score  \
975                             STAR ACADEMIES             0.640526
219                     CHILTERN LEARNING TRUST            0.424000
57                                 ARK SCHOOLS             0.208421
1096  THE DIOCESE OF WESTMINSTER ACADEMY TRUST             0.645000
628                 LOXFORD SCHOOL TRUST LIMITED           0.337500
335               EDUCATION AND LEADERSHIP TRUST           0.260000
1123                   THE GORSE ACADEMIES TRUST           0.435714
451                          HARRIS FEDERATION             0.265652
827                      RUSSELL EDUCATION TRUST           0.466000
1323                       UNITED LEARNING TRUST           0.146757
```

```
      prog8_score_disadv  prog8_score_nondisadv  progress8_gap  \
975             0.231579               0.495789       0.264211
219             0.226000               0.634000       0.408000
57              0.085789               0.435789       0.350000
1096            0.076667               0.691667       0.615000
628             0.075000               0.422500       0.347500
335             0.030000               0.762500       0.732500
1123            0.024286               0.645714       0.621429
451             0.020870               0.644348       0.623478
827            -0.068000               0.534000       0.602000
1323           -0.098378               0.487297       0.585676

      attainment8_gap  maths_gap  english_gap  FiveGCSE_gap  \
975          6.247368   0.294737     0.244211     10.210526
219          7.680000   0.456000     0.348000     17.000000
57           6.131579   0.437368     0.290526     16.263158
1096        10.700000   0.303333     0.161667     20.833333
628          5.075000   0.312500     0.147500     15.250000
335         10.450000   0.575000     0.527500     18.500000
1123        12.842857   0.675714     0.810000     25.571429
451         10.065217   0.574783     0.400435     19.826087
827         15.380000   0.730000     0.836000     34.000000
1323         9.802703   0.518108     0.507027     18.297297

      deprivation_index  school_count
975            2.421053            19
219            4.600000             5
57             3.157895            19
1096           5.833333             6
628            5.000000             4
335            3.000000             4
1123           5.714286             7
451            4.956522            23
827            5.200000             5
1323           4.297297            37
```

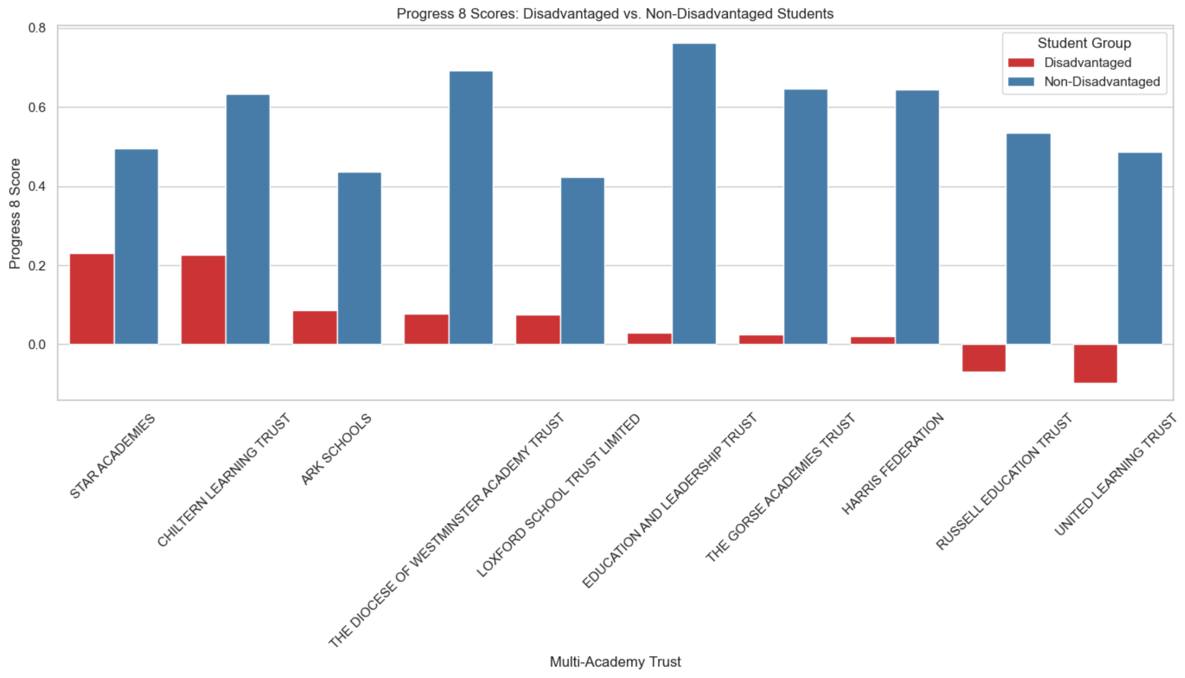
```
#represent data on a graphs

# Set the style
sns.set(style="whitegrid")
```

```
# Pconfigure the barplot
plt.figure(figsize=(12, 8))
sns.barplot(
    x='prog8_score_disadv',
    y='Trust_Name',
    data=MAT_performance_sorted.head(10),
    palette='Blues_d'
)
plt.title('Average Progress 8 Scores for disadvantaged pupils of Top 10 MATs')
plt.xlabel('Progress 8 Score - Disadvatanged ')
plt.ylabel('Multi-Academy Trust')
plt.tight_layout()


#save image in data folder
images_dir = 'images'
image_path = os.path.join(images_dir,'Obj3_Progress8 disadvatanged top 10 MATs.png')
plt.savefig(image_path)

plt.show()
```

```
C:\Users\saqib\AppData\Local\Temp\ipykernel_27276\2443691115.py:8: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assig

  sns.barplot(
```

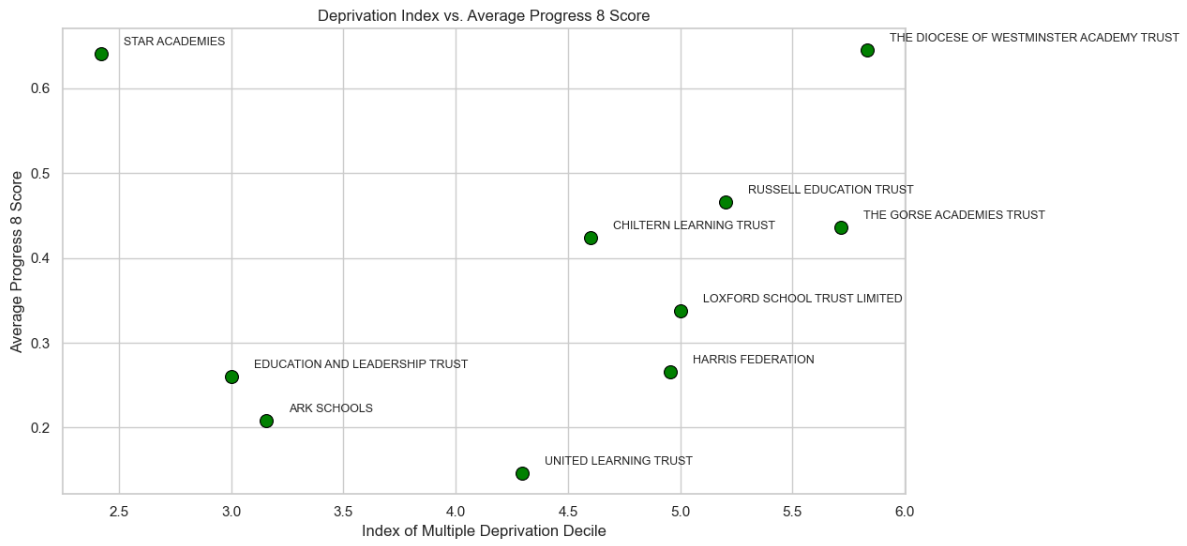


```python
# Melt the DataFrame for easier plotting
top_10_MATs= MAT_performance_sorted.head(10)
prog8_melted = top_10_MATs.melt(
    id_vars='Trust_Name',
    value_vars=['prog8_score_disadv', 'prog8_score_nondisadv'],
    var_name='Group',
    value_name='Progress8_Score'
)

# Replace group names for clarity
prog8_melted['Group'] = prog8_melted['Group'].map({
    'prog8_score_disadv': 'Disadvantaged',
    'prog8_score_nondisadv': 'Non-Disadvantaged'
})

# Plot
plt.figure(figsize=(14, 8))
sns.barplot(
    x='Trust_Name',
    y='Progress8_Score',
    hue='Group',
    data=prog8_melted,
    palette='Set1'
)
plt.title('Progress 8 Scores: Disadvantaged vs. Non-Disadvantaged Students')
plt.xlabel('Multi-Academy Trust')
plt.ylabel('Progress 8 Score')
plt.legend(title='Student Group')
plt.xticks(rotation=45)
plt.tight_layout()

#save the image in data folder
images_dir = 'images'
image_path = os.path.join(images_dir,'Obj3_Progress8 disadv vs advantaged in top 10 MATs.png
plt.savefig(image_path)

plt.show()
```



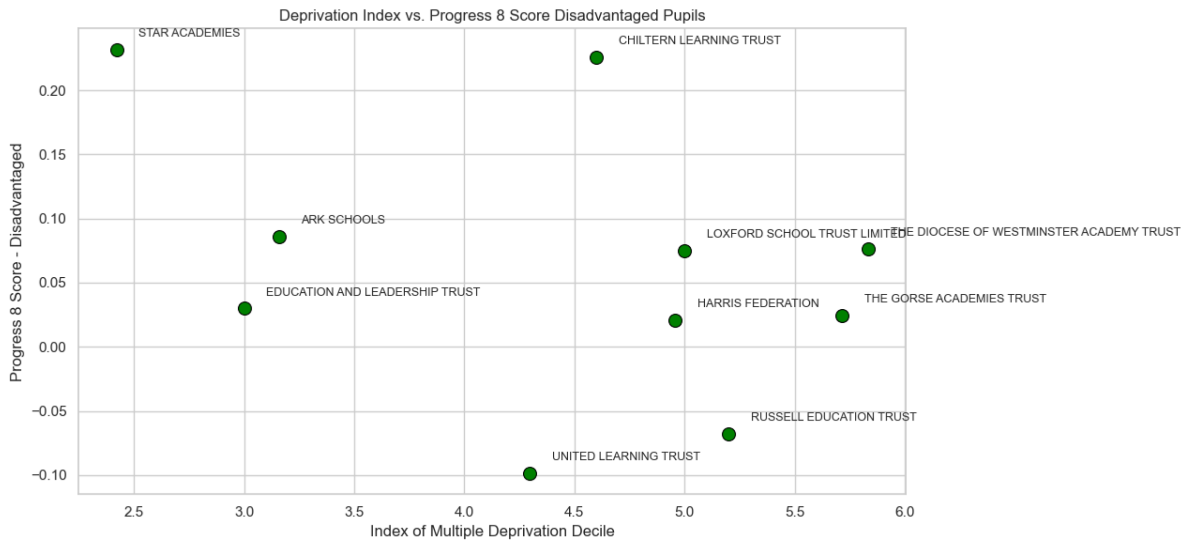
Plot a scatterplot of MATs and average progress 8

```
plt.figure(figsize=(10, 6))
sns.scatterplot(
    x='deprivation_index',
    y='avg_progress8_score',
    data=top_10_MATs,
    s=100,
    color='green',
    edgecolor='black'
)
plt.title('Deprivation Index vs. Average Progress 8 Score')
plt.xlabel('Index of Multiple Deprivation Decile')
plt.ylabel('Average Progress 8 Score')
plt.tight_layout()


# Annotate MAT names
for idx, row in top_10_MATs.iterrows():
    plt.text(row['deprivation_index']+0.1, row['avg_progress8_score']+0.01,
             row['Trust_Name'], fontsize=9)

images_dir = 'images'
image_path = os.path.join(images_dir,'Obj3_Deprivation Index vs P8 top 10 MATS.png')
plt.savefig(image_path)

plt.show()
```



Plot a scatter plor of MATs and progres 8 disadvantages

```
plt.figure(figsize=(10, 6))
sns.scatterplot(
    x='deprivation_index',
    y='prog8_score_disadv',
    data=top_10_MATs,
    s=100,
    color='green',
    edgecolor='black'
)
plt.title('Deprivation Index vs. Progress 8 Score Disadvantaged Pupils')
plt.xlabel('Index of Multiple Deprivation Decile')
plt.ylabel('Progress 8 Score - Disadvantaged')
plt.tight_layout()

# Annotate MAT names
for idx, row in top_10_MATs.iterrows():
    plt.text(row['deprivation_index']+0.1, row['prog8_score_disadv']+0.01,
             row['Trust_Name'], fontsize=9)


images_dir = 'images'
image_path = os.path.join(images_dir,'Obj3_Progress8 Disadv vs Deprivation Index for Top 10 M
plt.savefig(image_path)

plt.show()
```



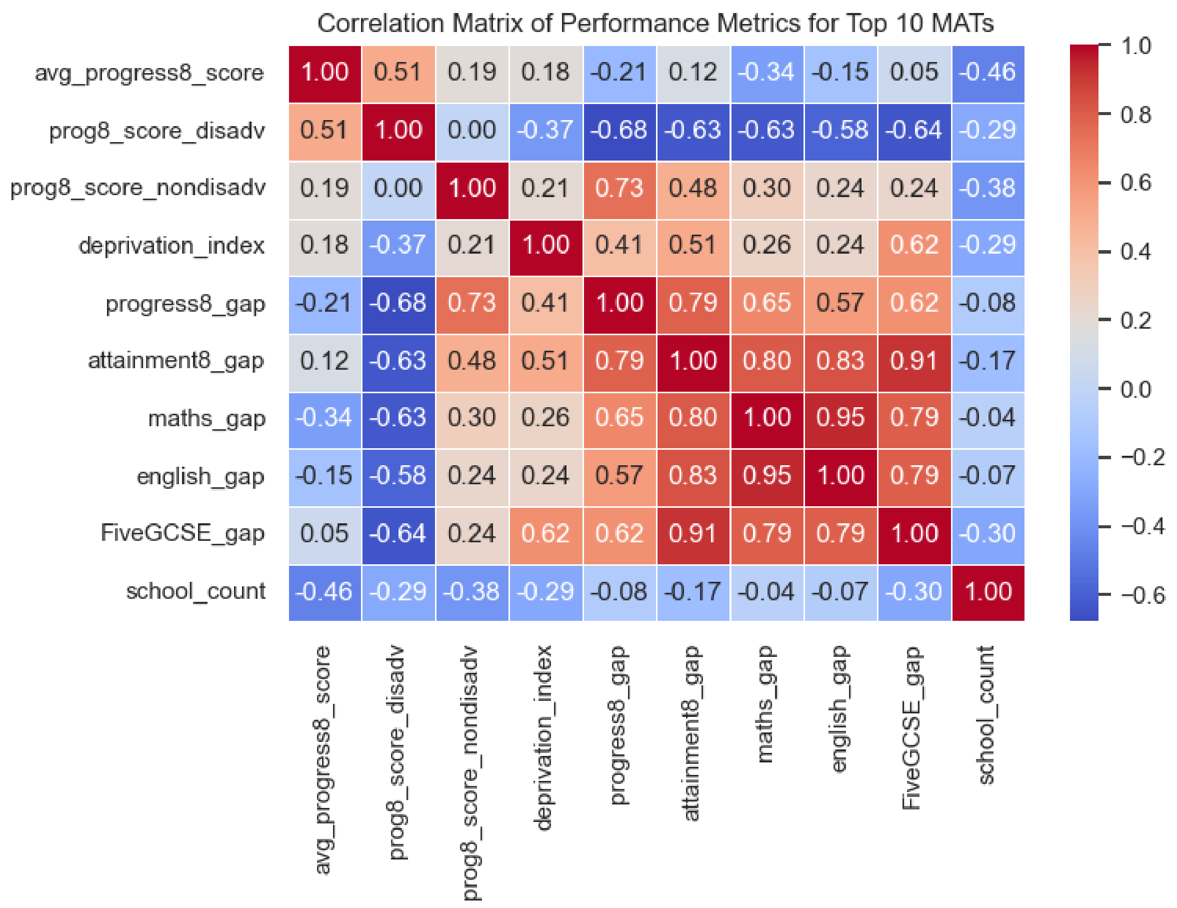
Before we can analyse the correlation coefficients I would need to standardise the data

```
# Columns to standardise
corr_columns = ['avg_progress8_score', 'prog8_score_disadv',
                'prog8_score_nondisadv', 'deprivation_index', 'progress8_gap',
                'attainment8_gap', 'maths_gap', 'english_gap', 'FiveGCSE_gap',
                'school_count']

scaler = StandardScaler() # this will give a mean of 0 and SD of 1

#fiter data
top_10_MATs_standardized = top_10_MATs.copy()
top_10_MATs_standardized[corr_columns] = scaler.fit_transform(top_10_MATs[corr_columns])


print(top_10_MATs_standardized.head())
```

```
                                    Trust_Name  avg_progress8_score  \
975                            STAR ACADEMIES             1.586519
219                    CHILTERN LEARNING TRUST            0.252807
57                                ARK SCHOOLS            -1.075069
1096  THE DIOCESE OF WESTMINSTER ACADEMY TRUST            1.614075
628                LOXFORD SCHOOL TRUST LIMITED           -0.279996

      prog8_score_disadv  prog8_score_nondisadv  progress8_gap  \
975             1.684115              -0.725355      -1.680816
219             1.629234               0.534547      -0.717045
57              0.249948              -1.272304      -1.105799
1096            0.160204               1.060226       0.670404
628             0.143809              -1.393449      -1.122556

      attainment8_gap  maths_gap  english_gap  FiveGCSE_gap  \
975         -1.044491  -1.314392    -0.789312     -1.534426
219         -0.575425  -0.216238    -0.341835     -0.421951
57          -1.082402  -0.343113    -0.589626     -0.542685
1096         0.413372  -1.255853    -1.145190      0.206152
628         -1.428343  -1.193430    -1.206268     -0.708694

      deprivation_index  school_count
975           -1.782039      0.575651
219            0.162376     -0.745515
```

```
57             -1.124507      0.575651
1096            1.262959     -0.651146
628             0.519322     -0.839884
```

```
# Selecting rthe needed columns for correlation
corr_columns = ['avg_progress8_score', 'prog8_score_disadv',
                'prog8_score_nondisadv', 'deprivation_index', 'progress8_gap', 'attainment8_g
       'maths_gap', 'english_gap', 'FiveGCSE_gap',
                'school_count']

# Compute the correlation matrix
corr_matrix = top_10_MATs[corr_columns].corr()

# Plot the heatmap
plt.figure(figsize=(8, 6))
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm', fmt=".2f", linewidths=0.5)
plt.title('Correlation Matrix of Performance Metrics for Top 10 MATs')
plt.tight_layout()

#save the file in the data folder
images_dir = 'images'
image_path = os.path.join(images_dir,'Obj3_Correlation Matrix top 10 MATS.png')
plt.savefig(image_path)

plt.show()
```



	avg_progress8_score	prog8_score_disadv	prog8_score_nondisadv	deprivation_index	progress8_gap	attainment8_gap	maths_gap	english_gap	FiveGCSE_gap	school_count
avg_progress8_score	1.00	0.51	0.19	0.18	-0.21	0.12	-0.34	-0.15	0.05	-0.46
prog8_score_disadv	0.51	1.00	0.00	-0.37	-0.68	-0.63	-0.63	-0.58	-0.64	-0.29
prog8_score_nondisadv	0.19	0.00	1.00	0.21	0.73	0.48	0.30	0.24	0.24	-0.38
deprivation_index	0.18	-0.37	0.21	1.00	0.41	0.51	0.26	0.24	0.62	-0.29
progress8_gap	-0.21	-0.68	0.73	0.41	1.00	0.79	0.65	0.57	0.62	-0.08
attainment8_gap	0.12	-0.63	0.48	0.51	0.79	1.00	0.80	0.83	0.91	-0.17
maths_gap	-0.34	-0.63	0.30	0.26	0.65	0.80	1.00	0.95	0.79	-0.04
english_gap	-0.15	-0.58	0.24	0.24	0.57	0.83	0.95	1.00	0.79	-0.07
FiveGCSE_gap	0.05	-0.64	0.24	0.62	0.62	0.91	0.79	0.79	1.00	-0.30
school_count	-0.46	-0.29	-0.38	-0.29	-0.08	-0.17	-0.04	-0.07	-0.30	1.00

Project Outcome

Overview of Results

Objective 1: Evaluate National Disparities in Educational Performance

There significant gaps between non-disadvantaged and disadvantaged pupils including attainment 8, progress 8, Maths, English and strong passes in both. Disadvantaged pupils lag behind by approximately 1.45 GCSE grades per subject and have an attainment 8 gap of 11.6 points. Their Progress 8 scores are 0.6 grades lower across subjects than their peers, suggesting significant performance gaps.

Objective 2: Identify and Analyse Outlier Schools in Positive Progress 8 of Disadvantaged Pupils

Schools excelling in progress 8 for disadvantaged students, tend to support all students very well and have a strong positive correlation (0.85) between overall and disadvantaged pupils. Funding has a negative correlation with Progress 8 scores for disadvantaged pupils, and could be investigated further.

Objective 3: Identify and Evaluate Top Performing Multi-Academy Trusts (MATs)

High performing MAT have shown a strong positive correlation (0.51) between progress 8 scores for disadvantaged students and overall scores. Although socio-economic factors negatively correlate (-0.37) with progress, for high performing MATs this hasn't been seen to be a barrier; Star Academies for example is one of the highest performing MATs in the country, yet faces the highest deprivation average of all MATs, suggesting a robust pedagogical strategy and governance to run its schools. Such high performing MATs are good at closing the gap (smallest is 0.264 progress 8) between disadvantaged and advantaged students, demonstrating efficient use of funding and better equity.

Objective 1: Evaluate National Disparities in Educational Performance Between Advantaged and Disadvantaged Pupils

Explaination of Results:

There are positive gaps in all categories measured between advantaged and disadvantaged pupils, confirming that nationally, isadvanteged pupils are behind in every academic measure.

Attainment 8 Gap:

- Attainment 8 Disadvantaged: 40.22
- Attainment 8 Non-Disadvantaged: 51.83
- Attainment 8 Gap: 11.61

Analysis: The attainment 8 gap of 11.6 points between disadvantaged and advantaged pupils nationally, suggest approximately 1.45 GCSE grades lower per subject for disadvantaged stidents (11.61/8 = 1.45125 - as each subject is given a point based on the GCSE grade e.g. grade 9 = 9 points).

Progress 8 Gap:

- Progress 8 Disadvantaged: -0.47
- Progress 8 Non-Disadvantaged: 0.13
- Progress 8 Gap: 0.60

Analysis: Progress 8 gap of 0.60 that disadvantaged pupils are making 0.6 grades less progress across 8 subjects between keystage 2 and keystage 4 nationally. This would amount to 0.075 grade point less in each of the 8 subjects (0.60/8=0.0.075)

Subject Specific Gaps:

- Maths Disadvantaged: -0.44
- Maths Non-Disadvantaged: 0.11
- Maths Gap: 0.55
- English Disadvantaged: -0.46
- English Non-Disadvantaged: 0.12
- English Gap: 0.58

Analysis: Maths gap of 0.55 and English gap of 0.58 suggest, nationally, disadvanted students are underperforming or making 0.55 grade less progress in maths and 0.58 less progress in English, between keystage 2 and keystage 4 nationally.

Perventage 9-5 Gap:

- Percentage Disadvanted EngMaths_95: 28.09
- Percentage Nondisadv Student EngMaths_95: 50.01
- Percentage_95 Gap: 21.92

Analysis: Signficcant gap of 21.92 percentage points nationally between disadvatanged and advantaged students achieving grade 5 or above in English and Maths, suggests this needs to be addressed.

Visualisation

Distribution of Progress 8 Scores

Attainment 8 Scores Summary:

Group	Median	Q1 (25%)	Q3 (75%)	IQR	Min	Max	Range
Disadvantaged	38.8	34.5	44.2	9.7	12.9	84.1	71.2
Non-Disadvantaged	51.3	46.6	56.2	9.6	11.2	86.5	75.3

Progress 8 Scores Summary:

Group	Median	Q1 (25%)	Q3 (75%)	IQR	Min	Max	Range
Disadvantaged	-0.49	-0.87	-0.12	0.75	-2.43	1.96	4.39
Non-Disadvantaged	0.13	-0.16	0.45	0.61	-2.33	2.37	4.70

The histrogram showes an approximately normal distribution, as expected, since the results are standardised by exam boards. Most sudents would therfore have a progress 8 score of 0, with 68% of students falling within +1 or -1 standard deviations from the mean and 95% falling within +2 or -2 standard deviations from the mean.

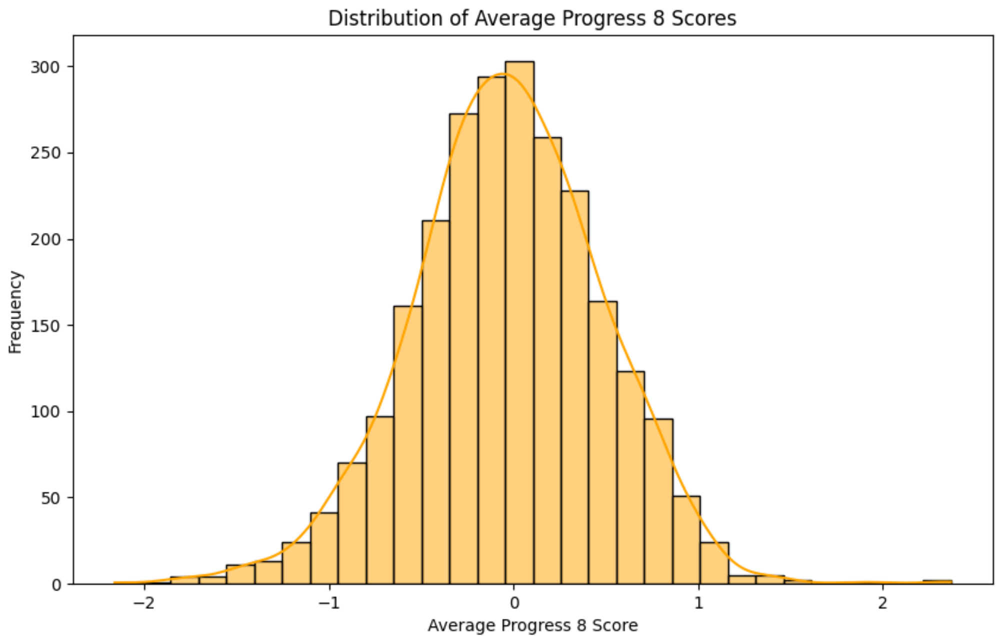


Figure 2: Obj1_progress8_distribution_nationally.png

Progess 8 and Attainment 8 Box Plots

Both box plots show disadvantaged students under performing. For progress 8, disadvatanged students have a negative progress 8 of -0.49 median score while advtanged students have a positive median score of 0.13, suggesting significant disparity. Both have a similar range and interqruatile range with a number of outliers. For attainment 8, the gap and distribution is as expected given the results.

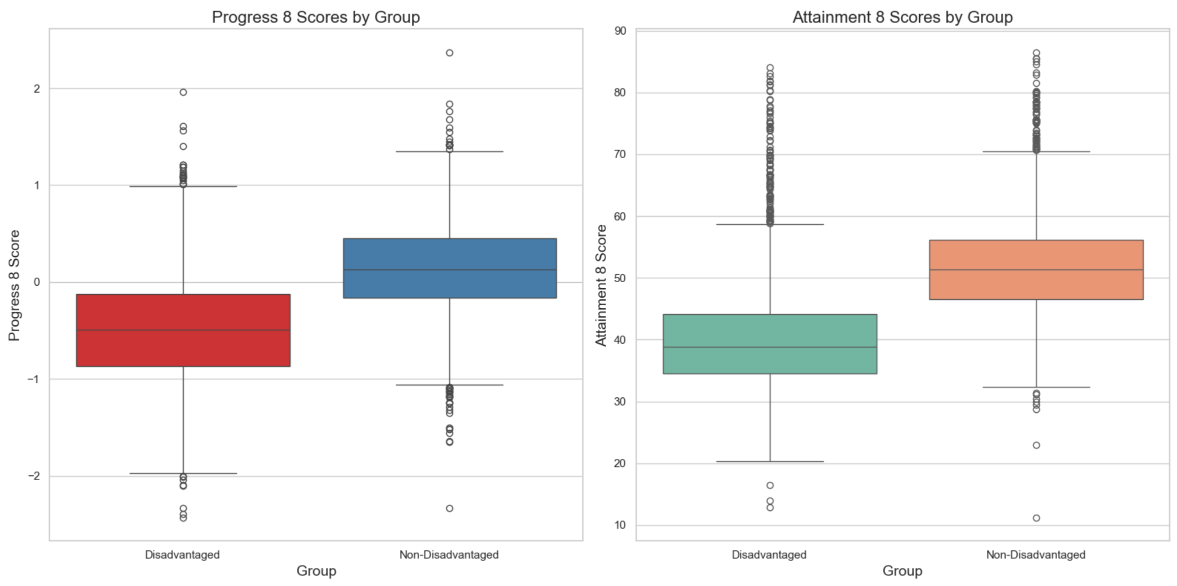


Figure 3: progress8_attainment8_boxplot.png

Percentage English and Mathematics Five Plus Box Plots

Maths Scores Summary	Median	Q1 (25%)	Q3 (75%)	IQR	Min	Max	Range
Disadvantaged	-0.47	-0.79	-0.12	0.67	-2.55	2.48	5.03
Non-Disadvantaged	0.11	-0.20	0.42	0.62	-1.65	2.95	4.60

English Scores Summary	Median	Q1 (25%)	Q3 (75%)	IQR	Min	Max	Range
Disadvantaged	-0.50	-0.90	-0.08	0.82	-3.06	2.19	5.25
Non-Disadvantaged	0.11	-0.20	0.44	0.64	-2.31	2.33	4.64

Both Maths and English have a negative median of -0.47 and -0.50 which is very concerning, given this is a national pattern, showing progress made by students between keystage 2 and keystage 4. English has a wider interquartile range for disadvantaged students, suggesting more variability. In both subjects, there is a greater difference between the minimum values, then between the maximum values, suggesting the disadvatnaged students will significiantly underperform than over perform.

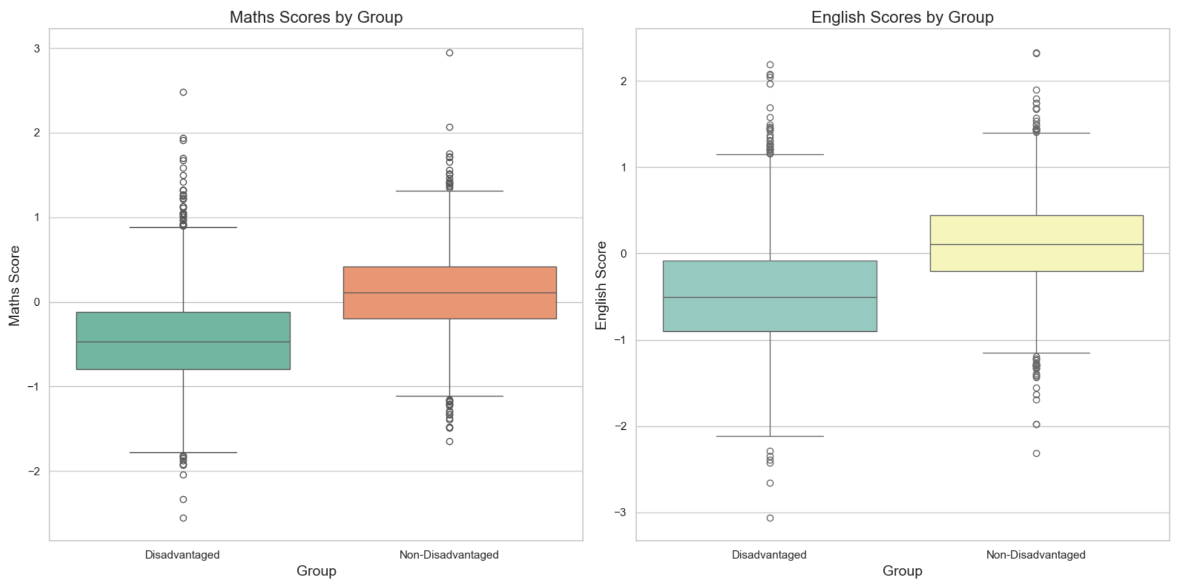


Figure 4: maths_english_scores_boxplot.png

Objective 2 Identify and Analyse Outlier Schools in Positive Progress 8 of Disadavantaged Pupils

Explanation of Results

Outlier schools for progress 8 were identified and then further categories as:

a) Schools which are outliers only for non-disadvantaged pupils

b) Schools which are outliers only for disadvantaged pupils

c) schools which are outliers for both non-disadvantaged and disadvantaged

- Overall schools which are outliers in both categories will do significantly better for disadvantaged pupils.
- There is also a higher correlation (0.85) between progress 8 disadvantaged pupils and progress 8 in general, suggesting success breeds success.
- Unexpectedly, funding (FSM(-0.45), total (-0.48) and pupil premium (-0.45)) all have negative correlation with progress 8 disadvantaged. This would need to be explored further as the range of the funding may be very small, and not being a good measure of proportionality.
- Small postitive correlation of progress 8 disadvantaged with percentage of disadvantage pupils (0.19) suggest disadvantaged pupils may do better where there are more such pupils.