Rationale

Determining the number of fire engines to be allocated in the fire stations is fundamental as a good prediction can:

- Contribute to cost optimisation
- Reduce the response times
- Allow mutual assistance
- Increase safety in the area

Aims

- Predict the number of fire engines that will have to be allocated per fire station in London
- Predict the areas in London with the highest risk

Data acquisition

The dataset has been obtained from the London Fire Brigade Mobilisation (LFB) Records

Information considered

Daily number of fire engines deployed per incident across 102 LFB stations from 2014 to 2021

Model development

The prediction of the number of fire engines per station for 2022 has been determined based on the daily average vehicles that were deployed during the previous years

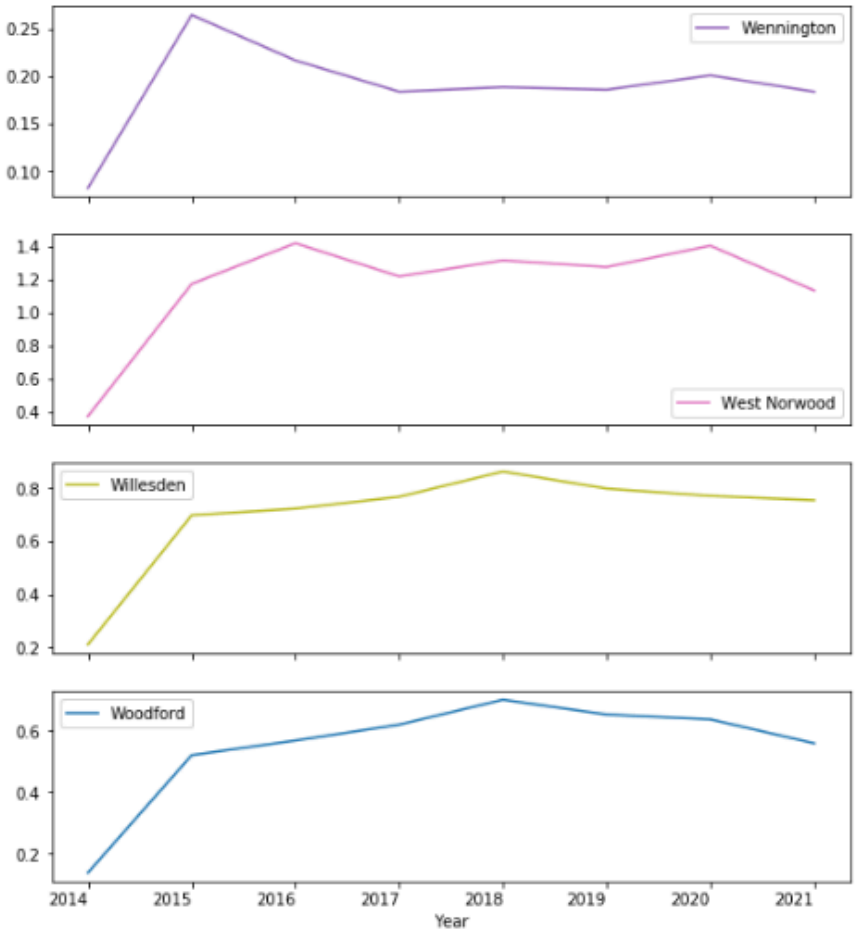
	DeployedFromStation_Name	CalYear	Yearly Tot Eng Deployed	Avg Daily Eng Deployed
0	Acton	2014	351	0.240411
1	Acton	2015	1191	0.815753
2	Acton	2016	1446	0.990411
3	Acton	2017	1302	0.891781
4	Acton	2018	1308	0.895890
5	Acton	2019	1371	0.939041
6	Acton	2020	1338	0.916438
7	Acton	2021	1245	0.852740
8	Addington	2014	266	0.182192
9	Addington	2015	737	0.504795
10	Addington	2016	811	0.555479
11	Addington	2017	690	0.472603
12	Addington	2018	669	0.458219
13	Addington	2019	761	0.521233
14	Addington	2020	748	0.512329
15	Addington	2021	616	0.421918
16	Barking	2014	492	0.336986

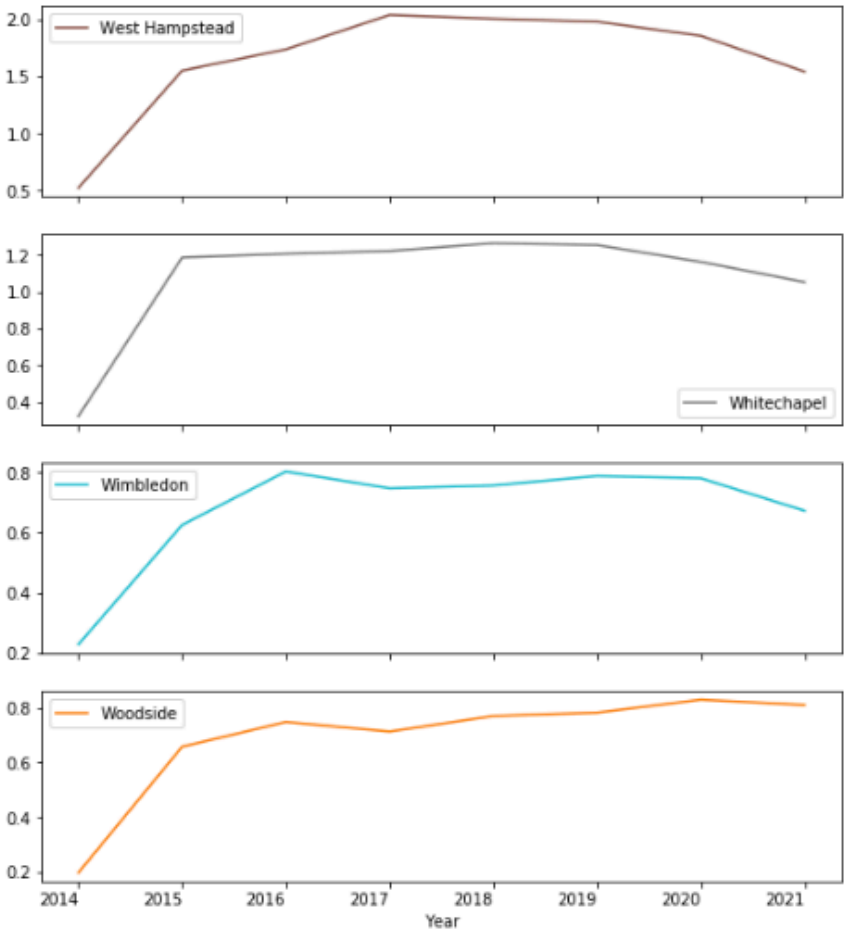
$$A|_{Station\ n} = \frac{\sum_{i} F|_{t}}{365\ B}\ , i = 1, 2 \ldots k$$

A= daily average fire engines deployed from fire station n during year t
F= fire engines deployed
t= year (from 2014 to 2021)
B= single use of the same vehicles per day across 4 shifts allowed by LFB (B= 4)

Data Visualisation

The daily average fire engines deployed on yearly basis has been plotted for each individual station from 2014 to 2021





Justification of the selected model

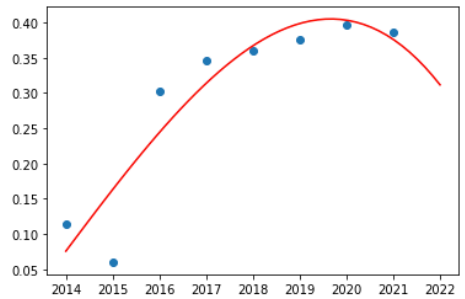
- The training curves plotted were similar and suggested to use linear regression model
- A polynomial regression order 3 allowed the polynomial function to fit well the training data as R^2 and P-Value on average performs better compared to other orders

- The number of vehicles to be allocated in each station for 2022 is based on the following equation:

$$y_{2022} = C_1 X^3 + C_2 X^2 + C_3 X + C_4$$

X= 2022

```
Purley
Coefficients
[-8.59624627e-04  5.19334202e+00 -1.04582752e+04  7.02018037e+06]
```




```
yfit
586    0.075778
587    0.162963
588    0.243971
589    0.313642
590    0.366821
591    0.398348
592    0.403067
593    0.375820
Name: Year, dtype: float64
Actual y= training data
586    0.114384
587    0.060274
588    0.302055
589    0.345890
590    0.359589
591    0.375342
592    0.397260
593    0.385616
Name: Avg Daily Eng Deployed, dtype: float64
Coefficient of Determination R^2: 0.72512
Coefficient P-Value: 0.00730
The number of required fire engines predicted for year 2022 is: 1
```

Prediction and Interpretation of the results

- The prediction has been determined for every station using the same model
- In case R^2 and p-value are not optimal for some of the stations, a case by case investigation is required
- Four scenarios are possible:
    1. Low R^2 and low p-value (p-value <= 0.05)
    2. Low R^2 and high p-value (p-value > 0.05)
    3. High R^2 and low p-value
    4. High R^2 and high p-value

Interpretation

1. means that the model doesn't explain much of variation of the data but it is significant (better than not having a model)
2. means that the model doesn't explain much of variation of the data and it is not significant (worst scenario)
3. means that the model explains a lot of variation within the data and is significant (best scenario)
4. means that the model explains a lot of variation within the data but is not significant (model is worthless)

Conclusions

- The total fire engines in London predicted for 2022 is **146**
- Based on the "Statement of Accounts 2020–2021 London Fire Brigade", during the year 2020-2021 there were **142** fire engines in total
- This result suggests that the current fleet should be increased by 4 units

- The higher is the number of fire engines, the higher is the risk in the area
- Based on the results of the model, **Paddington and Soho** are the areas with the highest number of vehicles, both with 3 fire engines.