Electric Vehicle Support Infrastructure

Executive Summary

Task 1: Basic Analysis

In this task, the dataset was explored, cleaned, and summarised [1].
We observed the number of missing values in each column and it was found that there was no road length data for minor roads.
To fix this issue, another dataset was used [2] which contained the total length of all minor roads in the UK. With these figures, the minor road vehicle mileage was estimated and added to the calculated mileage of cars in major roads.
Finally, the annual mileage per region and the annual mileage per vehicle type were plotted.

Task 2: Regression

For the 2nd task, basic regression was performed to forecast vehicle mileage in the next 30 years.
The model that was chosen is called ARIMA [3], which is a popular statistical method for time series forecasting [4] which is what we are interested in. This model is appropriate for this task because it takes into account the known values of the time series, the lags, and the lagged forecast errors to forecast future values in a comprehensive way that includes an appropriate confidence interval [5].
In its predictions for annual mileage between 2021 and 2050, the model was heavily influenced by the 2021 data which showed a sudden drop in mileage due to covid. Because of this, the model may forecast mileage that is too high if there will be more lockdowns (and less transportation) in the future, or mileage that is too low if lockdowns end and transportation goes back to normal.

Task 3: Research

In the research task, the first step was to forecast electric vehicle miles for the next 30 years. Existing data [6] on the proportion of electric vehicles over the years was used to interpolate up until 2050, and then this proportion was directly translated to mileage. Note that considerable error can occur from this estimation since there are too many factors determining electric car use in the future.
Then, using the referenced average energy consumption of EVs [7] we get the estimated power consumption for the next 30 years.
Finally, using the annual electricity consumption figure from statista [8] (assuming consistency in the following years), we estimated the additional power generation needed, which was slightly higher but almost in agreement with independent sources [9, 10].

Task 4: Recommendation

The final task involved the generation of recommendations for optimised energy generation via various technologies.
Firstly, the levelised cost of each generic energy technology was obtained [11] together with some insights on energy need for EVs [12].
Along with the cost of each technology, the other relevant factors in the optimisation included the Average Load Factor (reflects consistency of energy supply), Plant Size (required land for the energy source), and Hurdle Rates (reflects the risk of investing in a technology). Values for these factors were obtained from the Department for Business, Energy and Strategy (BEIS) [14].
After the optimisation, the recommendations were plotted for years 2025, 2030, 2035, and 2040 across five main energy technologies (CCGT H Class, Offshore Wind, Onshore Wind, Solar, and CCGT + CCS Post Combustion).
Note that this optimisation task involves tens if not hundreds of more parameters that were not considered.

Bibliography

[1]https://roadtraffic.dft.gov.uk/downloads
[2]https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fassets.publishing.service.gov.uk%2Fgovernment%2Fuploads%2Fsystem%2Fuploads%2Fattachment_data%2Ffile%2F1059892%2Frdl0103.ods&wdOrigin=BROWSELINK&fbclid=IwAR3pvimXGk1VHtNMWiOEG7NXOX5z6c5wgXtlH8v_j7Av62V30TKfKToWjvs
[3]https://www.statsmodels.org/devel/generated/statsmodels.tsa.arima.model.ARIMA.html
[4]https://machinelearningmastery.com/arima-for-time-series-forecasting-with-python/
[5]https://www.machinelearningplus.com/time-series/arima-model-time-series-forecasting-python/

[6]https://www.zap-maEnergy consumption of electric vehicles cheatsheet - EV Databasep.com/ev-market-statistics/#:~:text=As%20shown%20in%20the%20chart,BEV%20and%207.0%25%20PHEV
[7]https://ev-database.uk/cheatsheet/energy-consumption-electric-car
[8]https://www.statista.com/statistics/322874/electricity-consumption-from-all-electricity-suppliers-in-the-united-kingdom/
[9]https://www.virta.global/blog/myth-buster-electric-vehicles-will-overload-the-power-grid
[10]https://www.carboncommentary.com/blog/2017/7/26/100-evs-can-be-easily-accommodated-on-the-uk-grid

[11]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911817/electricity-generation-cost-report-2020.pdf
[12]https://energysavingtrust.org.uk/advice/charging-electric-vehicles/
[13]https://www.gov.uk/government/publications/beis-electricity-generation-costs-2020
[14]https://www.gov.uk/government/collections/energy-generation-cost-projections