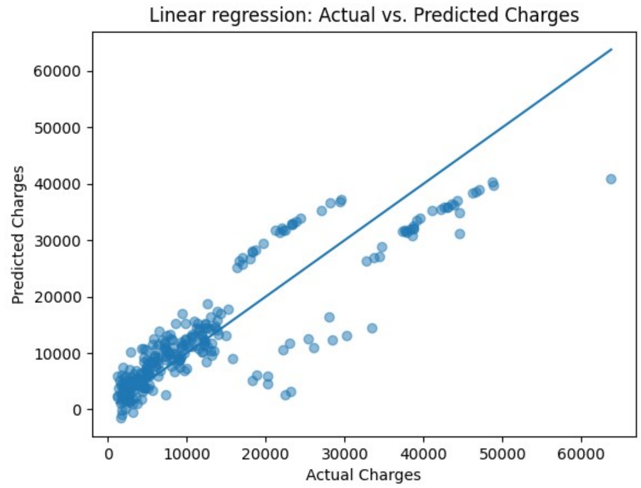
<u>Report Task 1: Model summaries</u>

**Linear regression**

Learned Coefficients:

| Feature | Coefficient |
|---|---|
| sex_male | -18.592 |
| smoker_yes | 23651.129 |
| region_northwest | -370.677 |
| region_southeast | -657.864 |
| region_southwest | -809.799 |
| age | 3614.975 |
| bmi | 2036.228 |
| children | 516.890 |

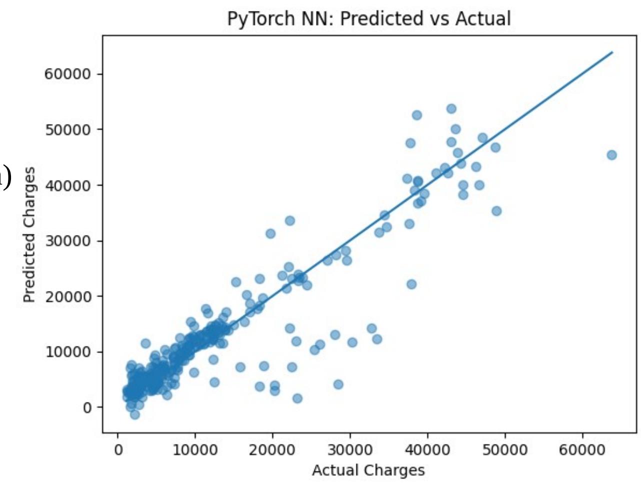
Root Mean Squared Error:
Training Set: 6105.545
Test Set: 5796.285



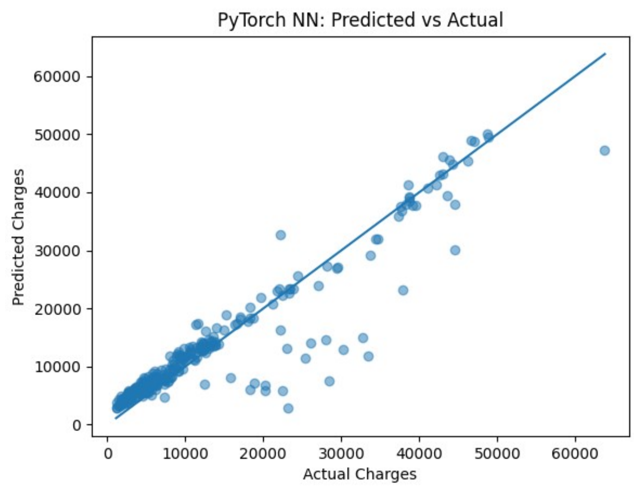

**Neural network**

<u>First iteration:</u>
Root Mean Squared Error:
Training Set: 3668.89
Test Set: 5039.16

<u>Second iteration:</u> (after dropout and L2 regularisation)
Root Mean Squared Error:
Training Set: 4075.14
Test Set: 4483.49




*First iteration*




*After dropout and regularisation*

**Bayesian linear regression**

Posterior means for coefficients:

| Feature | Mean Est. |
|---|---|
| Intercept | -0.348 |
| sex_male | -0.011 |
| smoker_yes | 1.968 |
| region_northwest | -0.030 |
| region_southeast | -0.085 |
| region_southwest | -0.079 |
| age | 0.298 |
| bmi | 0.171 |
| children | 0.047 |

Noise mean: 0.501

# Report Task 2: Model comparison

The Neural Network achieved the lowest error on the test set, outperforming the Linear Regression model by approximately 1313 points.

The complexity of linear regression is very low - the model simply fits a straight line (or hyperplane) to the data. In comparison, neural networks are much more complex; they use hidden layers and non-linear activation functions to capture complex patterns.
On the other hand, the interpretability is a different story, with neural networks being much harder to interpret than linear regression models. They act as a ‘black box’, and do not offer a simple table of coefficients to explain why a specific prediction was made. This is in direct contrast to linear regression, which does provide clear coefficients that explain exactly how much each feature contributes to the model, making it much easier to understand why certain predictions have been made.

When I first created the neural network model, I did so without taking any steps to prevent overfitting. As you can see from the data above, this meant that while the error on the training set was relatively low, the error on the test data was much higher. Noticing this sign of overfitting, I added L2 regularisation and dropout to the model, which, despite making the training error slightly worse, reduced the test error - showing that overfitting had been somewhat reduced.

Overall, with the overfitting changes, the neural network performs much better than the linear regression model. This is to be expected, given the complexity of the model – it is more able to capture complex non-linear relationships in the data. If the goal is to explain the model’s output, then perhaps linear regression is a better choice, however if the primary goal is to minimise prediction error, then the neural network is clearly the better choice.