Begin

Good evening everyone. We are the Economics Specialist Group, and we will be presenting our milestone 4: Progress Report for our group project.

Introduction

Our group project is about the application of neural network models in economics. Specifically, we wanted to see how well a neural network performs in predicting change in real GDP when using both macroeconomics indicators and a combination of other short term economic factors. In the previous milestone 3, our experimental design managed to show good overall performance and also showed that some long-term variables are better than others when predicting real GDP change.  For  milestone 4, we focused on redesigning the experiment to overcome the barriers that hampered the overall performance of our model in milestone 3.

Data set and data processing

Max

For each country, the training data is the first 13 years. The testing data is the last year.

Short-term variables are “Cost of starting a business % of income per capita”, “Real interest rate: Bank lending rate minus inflation”, “Stock market capitalization w/o top 10 firms percent of total market cap”, “Ratio of car sales to population”, and “Ratio of commercial vehicles sales to population”.

Long term variables are "Capital\_Investment\_test", "Labor\_Force\_Participation\_test", "Fixed\_Broadband\_test", "RandD\_test", "Property\_Rights\_test", Freedom\_From\_Corruption\_test", "Fiscal\_Freedom\_test", "Business\_Freedom\_test", "Labor\_Freedom\_test", "Monetary\_Freedom\_test", "Trade\_Freedom\_test", "Investment\_Freedom\_test", "Financial\_Freedom\_test", "Economic\_Freedom\_Overall\_test", "Pop\_Above\_65\_test", "Savings\_As\_GDP\_test"

For each long-term variable, combined with all the 5 short term inputs, the model estimated what the final economic growth could be. The result would then be compared with the actual economic growth of that year of that country and mean absolute error would be computed.

While training, all values are divided by 100 as it seems to improve the model’s performance.

NN Architecture

Max

From this image, there are 3 places where inputs will get introduced to the model: Input layer 1, input layer 2, input layer 3, where the first 2 are short-term variables while the last consists of long-term variables. First, short-term variables from input layer 2 will get trained with 3 dense layers with 50 nodes each. The activation function is LeakyReLU. LeakyReLU differs from ReLU in that if x < 0, x = x \* alpha instead of 0. Alpha is 0.2 in this case. There are also dropout layer after the first and second cell with rate as 0.35, 0.5 respectively. Then, the output is concatenated to a newly introduced short-term variable inputs and long-term variables. On the other hand, long-term variables are also trained on a separate branch (the second on in the image) while the concatenate layer continue to train with Dense layer and 4 LSTM cells with 100, 100, 200, 100 nodes respectively. They are all followed by a Dropout layer with rate as 0.35.  Finally, both branches get merged and reached the final Output layer. There is no activation function for the output layer.

Experimental Setup (Milestone 3)

Ryan

Experimental setup. This image is a snapshot of how we setup our data for milestone 3. The next slide will show how we set it up for milestone 4 to show the difference. The Yellow represents the 5 short term variables while the green represents the long-term variables. Not all variables fit on the screen.  The blue represents the training data associated with those variables and the orange represents the testing data. For milestone 3 we specifically looked at each country individually. We trained each model on all 5 short term variables and one long term variable. When then reran the model on the same 5 short term variables, keeping them constant while adding a new long-term variable to see if using different long term variables impacted the overall accuracy of our model.

Experimental Setup (Milestone 4) Ryan

For milestone 4 we excluded the country as a variable and trained our model on all data associated with each variable increasing the total number of data points used for training. We kept the last time stamp from each country for testing purposes. Just like in milestone 3 we tested each individual long term variable plus the 5 short term variable, replacing each long term variable for each run. We then collected the mean accuracy for each run with the associated variable

For milestone 5

Talk about milestone 5.

Evaluation

We used Mean absolute error to evaluate the performance of our model.

Experimental Results/Discussion

Ryan

Table 4.1 shows the results in mean absolute error as a percentage of running our model on the short term plus each of the individual long term variable across all countries.

Table 4.2 shows the highlights of Table 4.1. The minimum error we had on a single variable was 1.11% and the max was 1.53% with a Median of 1.16% and mean of 1.214%. The 95% confidence was between 1.149, and 1.278

Table 4.3 shows the highlights of the results we got in milestone 3. Where the minimum error for a single variable was a 0.74%, max of 4.34%, Median of 2.455% and Mean 2.302%. The 95% confidence was between 2.156 and 2.451

The median and mean of the error distribution of the long term variables for Milestone 4 was much lower than Milestone 3 (1.2% vs 2.3%)

There was also no overlap in the 95% confidence Intervals. With Milestone 4’s CI being much lower than Milestone3’s CI

Hence, we can say for certain that the redesign of experiment worked in improving the performance of the model for milestone 4.

Discussion some variables did better than others was discussed in milestone 3.

Explanation for better performance

Based on the results, the reason the model performed better is because the changes in the experiment design allowed for greater amounts of training data for our model, and the full utilization of the LSTM architecture. Specifically, the training data in milestone 4 increased by around 9 times higher compared to milestone 3.  Besides that, the continuity in the training of the model allowed the LSTM cell to remember information and patterns that exist in a long term variable. Thus, allowing for greater performance overall.

Conclusion

In conclusion, the redesign of experiment allowed our neural network model to perform optimally. While limitations for the model still exists, it mostly revolves around the collection and preprocessing of the data. This is in the field of mathematics and statistical sampling, which is out of the scope of this project. Hence, we have successfully achieved our objective for milestone 4, which is to improve our experiment design to improve the performance for our neural network model. That concludes our presentation. Does anyone have any questions.