Report Project 2 – AI for Finance

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Point 1-A

Parameters

NBER Recessions data from Federal Reserve Bank of St. Louis.

Treasury TERM spread calculate as the difference between 10 year and 3 months U.S. Treasuries.

Results

In the probit model, I used the TERM variable as the independent/explanatory variable to predict the NBER recession binary variable, which is the dependent variable. The results of the model are shown in the table, which includes the lag number, the R-squared value, and the p-value for each lag.

The R-squared value describes how well the model fits the data, with a value of 0 indicating that the model explains none of the variation in the dependent variable and a value of 1 indicating that the model explains all of the variation. In my model, the R-squared values range from 0.02 to 0.27, which suggests that the model explains only a moderate amount of the variation in the dependent variable. Furthermore, R-squared values increase from lag 1 to lag 4, after which they decrease. This suggests that the 4th lag of the term variable has the highest explanatory power for the NBER recession variable.

The p-value measures the significance of each lag term in the model. A p-value less than 0.05 indicates that the lag term is statistically significant, meaning that it has an impact on the dependent variable. In this case, all of the lag terms have p-values less than 0.05, which suggests that they are all statistically significant predictors of the dependent variable.

Data

Lag	1.000000	2.000000	3.000000	4.000000	5.000000	6.000000	7.000000	8.000000	9.000000	10.000000	11.000000	12.000000
R-squared	0.031173	0.139373	0.230783	0.269432	0.246816	0.184441	0.125452	0.079923	0.054532	0.054461	0.045859	0.024201
P-value	0.015944	0.000002	0.000000	0.000000	0.000000	0.000000	0.000006	0.000197	0.001747	0.001732	0.003824	0.033008

Point 1-B

Parameters

NBER Recessions data from Federal Reserve Bank of St. Louis.

Treasury TERM spread calculate as the difference between 10 year and 3 months U.S. Treasuries.

Results

The Area Under the Receiver Operating Characteristic curve (AUROC) is a metric to evaluate the performance of binary classification models. It ranges from 0 to 1, with 1 representing a perfect classifier and 0.5 representing a random classifier.

Running the Probit, Logit, PNN and MLP models I obtained results in the range: 0.609 (Lag 12) – 0.832 (Lag 4). This means that all models perform better than a random guess, with the best performance in the 4th Lag. In particular, the PNN model has a slightly better AUROC score compared to the other models, making it the best performing model in this analysis. However, the differences in performance between the models are quite small and the performance of all models tends to degrade as the number of lags increases, which might suggest that

the most recent lags (around 4 quarters) have a more significant impact on predicting recessions than the older ones.

Data

Lag	1.000000	2.000000	3.000000	4.000000	5.000000	6.000000	7.000000	8.000000	9.000000	10.000000	11.000000	12.000000
Probit Auroc[IS]	0.626351	0.740396	0.809244	0.832473	0.818607	0.786735	0.743097	0.691897	0.652221	0.662365	0.648980	0.609424
Logit Auroc[IS]	0.626471	0.739976	0.809244	0.832413	0.818607	0.786675	0.743097	0.691897	0.652281	0.662365	0.648920	0.609424
PNN Auroc[IS]	0.622329	0.740336	0.809664	0.832473	0.818727	0.786675	0.743217	0.691957	0.652341	0.662305	0.648800	0.609244
MLP Auroc[IS]	0.627011	0.740036	0.809244	0.832413	0.818547	0.786735	0.743157	0.691957	0.652341	0.661104	0.648860	0.609244

Point 1-C

Parameters

NBER Recessions data from Federal Reserve Bank of St. Louis.

Treasury TERM spread calculate as the difference between 10 year and 3 months U.S. Treasuries.

Results

These results are calculated as an average of the AUROC scores obtained by iterating 30 times the model for each lag (at each iteration the training and validation dataset are recomputed).

The Probit model performance, as measured by the AUROC, improves with increasing lags up to lag 6, with the highest AUROC score of 0.765671. After lag 6, the performance declines, indicating that the 6 quarter lag of the term variable provides the best predictive power within the Probit model.

The Logit model's performance is very similar to the Probit model and the highest AUROC score for the Logit model is 0.765609, also at lag 6.

PNN Model has the best performance among all four models, with the highest AUROC score of 0.765692 at lag 6. This means that, for the given dataset and lags, the PNN model performs marginally better than the Probit and Logit models in predicting recessions.

The MLP model's performance is consistently lower than the other three models across all lags, with the highest AUROC score of 0.763581 at lag 6.

In summary, the performance of the Probit, Logit, and PNN models is quite similar, with their AUROC scores being highest at a 6-quarter lag of the term variable. The PNN model has the best performance overall, with the highest AUROC score of 0.765692 at lag 6 and the MLP model's performance is lower than the other three models across all lags.

Data

Lag	1.000000	2.000000	3.000000	4.000000	5.000000	6.000000	7.000000	8.000000	9.000000	10.000000	11.000000	12.000000
Probit Auroc[OS]	0.630188	0.678683	0.715258	0.746881	0.758496	0.765671	0.762726	0.755045	0.743623	0.733401	0.724459	0.714884
Logit Auroc[OS]	0.630114	0.678598	0.715173	0.746819	0.758445	0.765609	0.762664	0.754992	0.743576	0.733356	0.724417	0.714846
PNN Auroc[OS]	0.630273	0.678757	0.715322	0.746929	0.758535	0.765692	0.762743	0.755070	0.743646	0.733407	0.724463	0.714880
MLP Auroc[OS]	0.620437	0.673706	0.711402	0.743878	0.756099	0.763581	0.760367	0.750732	0.738898	0.728240	0.719058	0.708435

Point 2

Parameters

NBER Recessions data from Federal Reserve Bank of St. Louis.

Treasury TERM spread calculate as the difference between 10 year and 3 months U.S. Treasuries.

Results

These results are calculated as an average of the AUROC scores obtained by iterating 30 times the model for each lag (at each iteration the training and validation dataset are recomputed).

Probit and Logit models have very similar AUROC scores across all lags, which suggests that they perform comparably in predicting recessions. The highest AUROC score for both models are achieved with a lag of 1, which indicates that the most recent term spread and NBER recession binary variable have the most significant impact on their predictions. As the lag value increases, their performance tends to decrease, implying that older data has a weaker predictive power for these models.

The MLP model performs better than the Probit and Logit models and similarly to the PNN, the highest AUROC score for the MLP model is observed at lag 1, and the performance tends to decrease as the lag value increases.

PNN consistently outperforms the other three models across all lags, with the highest AUROC score observed at lag 1. The PNN model's performance remains relatively high even as the lag value increases, this suggests that the PNN model is better at capturing the underlying patterns in the data and can still maintain reasonable predictive power even when using older data. This might be because PNN is a more flexible model compared to the linear models (Probit and Logit).

In summary, the PNN model consistently outperforms the other models at predicting recessions based on the term spread and its lags. The performance of all models decreases as the number of lags increases, which is expected since the relationship between the term spread, and recessions may become weaker moving further back in time.

Data

Lag	1.000000	2.000000	3.000000	4.000000	5.000000	6.000000	7.000000	8.000000	9.000000	10.000000	11.000000	12.000000
Probit Auroc[IS]	0.891733	0.854217	0.837167	0.836192	0.836837	0.829412	0.819348	0.803214	0.787899	0.773021	0.761207	0.749466
Logit Auroc[IS]	0.891058	0.852772	0.835297	0.834926	0.835742	0.828656	0.818734	0.802634	0.787280	0.772466	0.760708	0.749157
PNN Auroc[IS]	0.930222	0.888740	0.861789	0.854700	0.851332	0.841484	0.829351	0.811702	0.794665	0.778320	0.765422	0.753853
MLP Auroc[IS]	0.921798	0.875428	0.848678	0.844367	0.844138	0.836050	0.824467	0.807324	0.791178	0.774738	0.763057	0.751162