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LSTM 1m recession

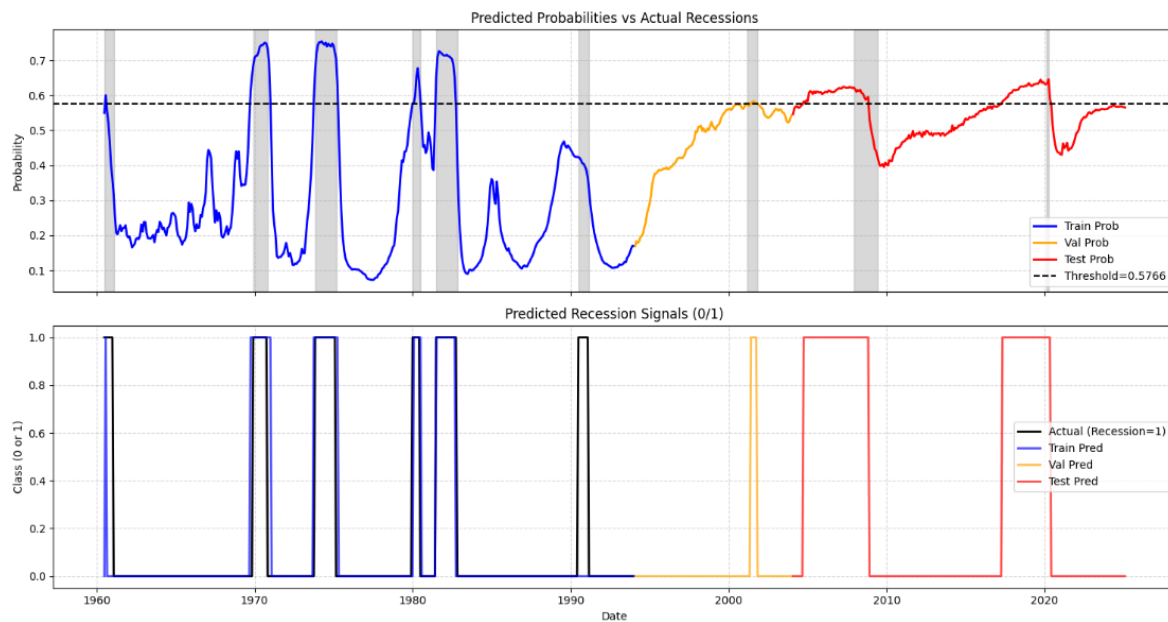| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	12
recession	1m recession

```
LSTM for dataset 1959 - 1m recession
Accuracy   : 0.6877
Precision  : 0.1609
Recall     : 0.7000
F1 Score   : 0.2617
ROC-AUC    : 0.6326
PR-AUC     : 0.1274

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9639    0.6867    0.8020       233
         1.0     0.1609    0.7000    0.2617        20

    accuracy                         0.6877       253
   macro avg     0.5624    0.6933    0.5318       253
weighted avg     0.9004    0.6877    0.7593       253
```

```
# --- W&B INIT ---
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 12,
        "lstm_units": 32,
        "dense_units": 16,
        "dropout": 0.1,
        "batch_size": 32,
        "learning_rate": 0.001,
        "epochs": 50,

    }
)
```


Predicted Probabilities vs Actual Recessions

Predicted Recession Signals (0/1)

LSTM 3m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	12
recession	3m recession

```
Accuracy   : 0.3834
Precision  : 0.1000
Recall     : 0.8500
F1 Score   : 0.1789
ROC-AUC    : 0.6833
PR-AUC     : 0.1373

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9639    0.3433    0.5063       233
         1.0     0.1000    0.8500    0.1789        20

    accuracy                         0.3834       253
   macro avg     0.5319    0.5967    0.3426       253
weighted avg     0.8956    0.3834    0.4804       253
```
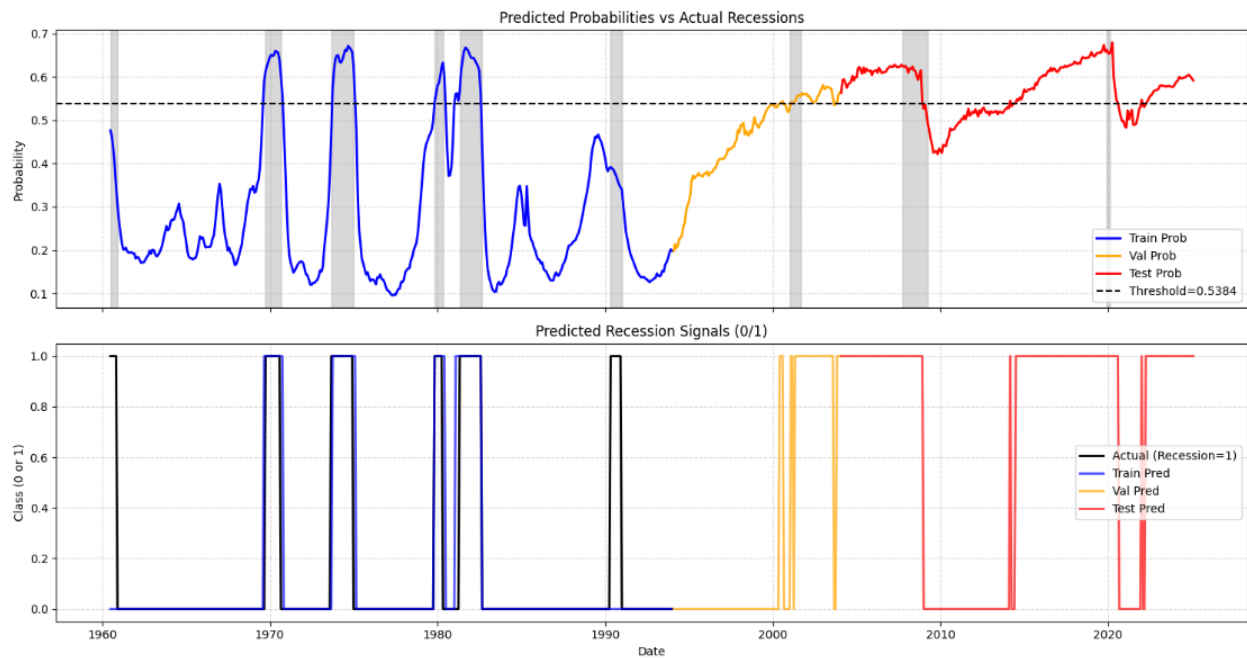
```
# --- W&B INIT ---
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 12,
        "lstm_units": 32,
        "dense_units": 16,
        "dropout": 0.1,
        "batch_size": 32,
        "learning_rate": 0.001,
        "epochs": 50,
    }
)
```


Predicted Probabilities vs Actual Recessions

Predicted Recession Signals (0/1)

LSTM 6m recession

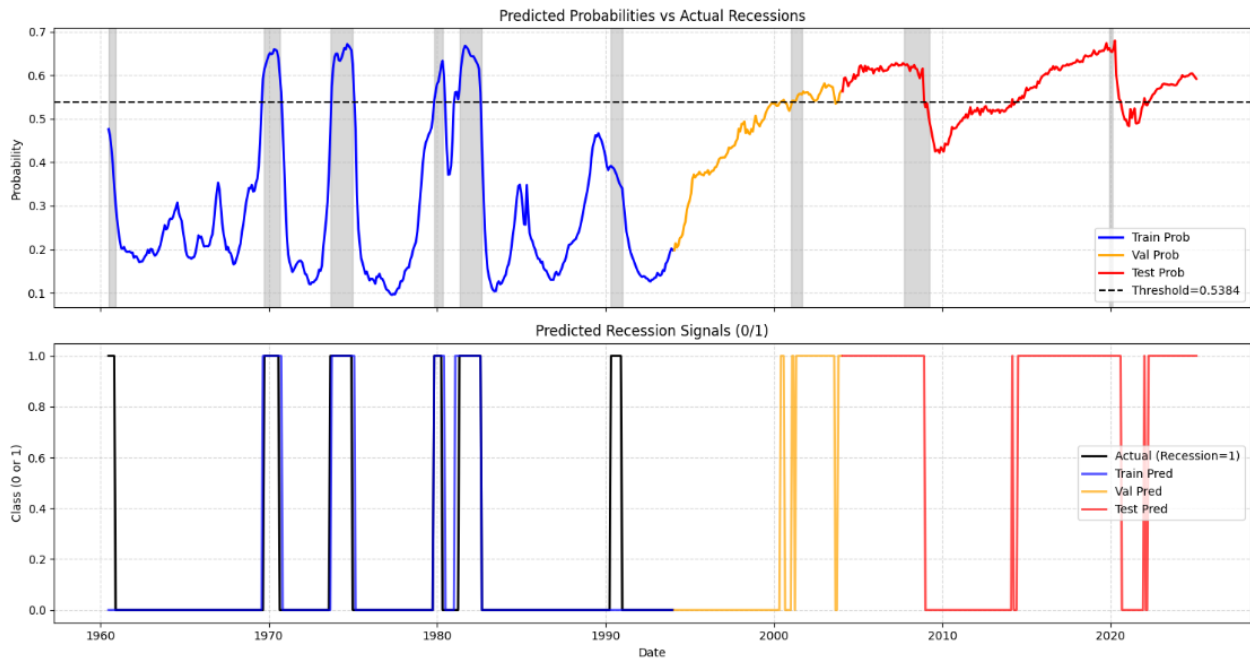| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	12
recession	6m recession

```
LSTM for dataset 1959 - 1m recession
Accuracy    : 0.1976
Precision   : 0.0897
Recall      : 1.0000
F1 Score    : 0.1646
ROC-AUC     : 0.6760
PR-AUC      : 0.1545

Classification Report:
              precision    recall  f1-score   support

         0.0     1.0000    0.1288    0.2281       233
         1.0     0.0897    1.0000    0.1646        20

    accuracy                         0.1976       253
   macro avg     0.5448    0.5644    0.1964       253
weighted avg     0.9280    0.1976    0.2231       253
```

```python
# --- W&B INIT ---
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 12,
        "lstm_units": 32,
        "dense_units": 16,
        "dropout": 0.1,
        "batch_size": 32,
        "learning_rate": 0.001,
        "epochs": 50,

    }
)
```


Predicted Probabilities vs Actual Recessions

Predicted Recession Signals (0/1)

BiLSTM 1m recession

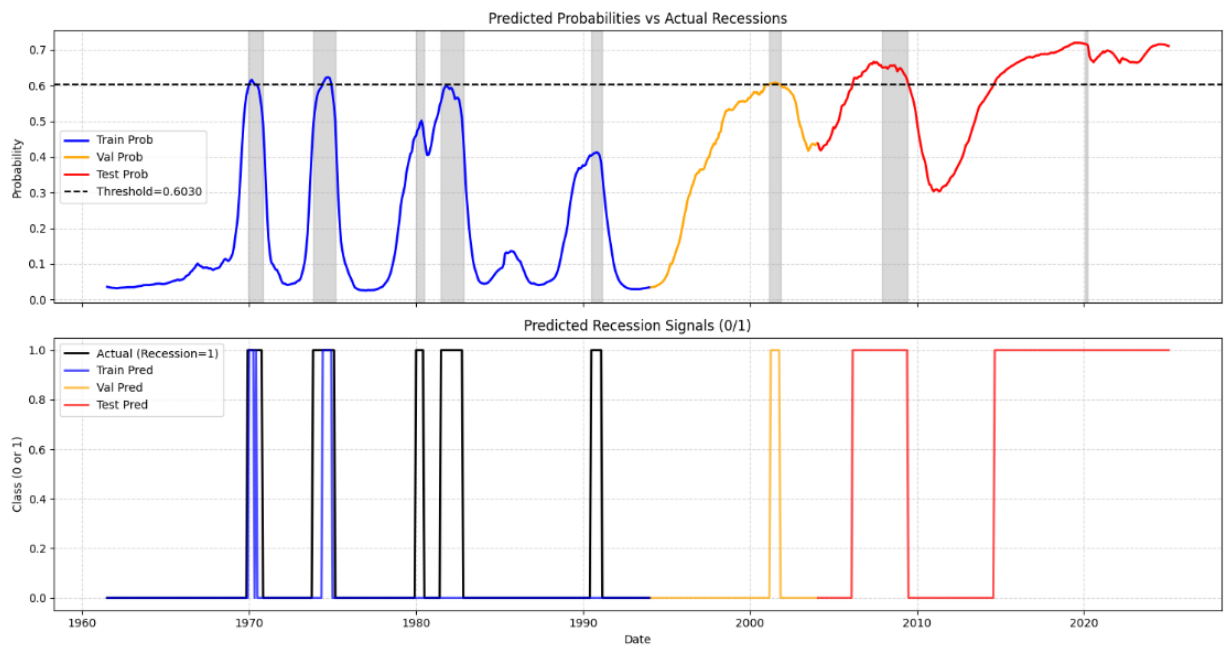| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	24
recession	1m recession

```
BiLSTM for dataset 1959 - 1m recession
Accuracy   : 0.4229
Precision  : 0.1205
Recall     : 1.0000
F1 Score   : 0.2151
ROC-AUC    : 0.5152
PR-AUC     : 0.0869

Classification Report:
              precision    recall  f1-score   support

         0.0     1.0000    0.3734    0.5437       233
         1.0     0.1205    1.0000    0.2151        20

    accuracy                         0.4229       253
   macro avg     0.5602    0.6867    0.3794       253
weighted avg     0.9305    0.4229    0.5178       253
```

```
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 24,
        "lstm_units": 64,
        "dense_units": 32,
        "dropout": 0.1,
        "batch_size": 64,
        "learning_rate": 0.001,
        "epochs": 100,
        #"threshold": 0.4
    }
```


Predicted Probabilities vs Actual Recessions

Predicted Recession Signals (0/1)

BiLSTM 3m recession

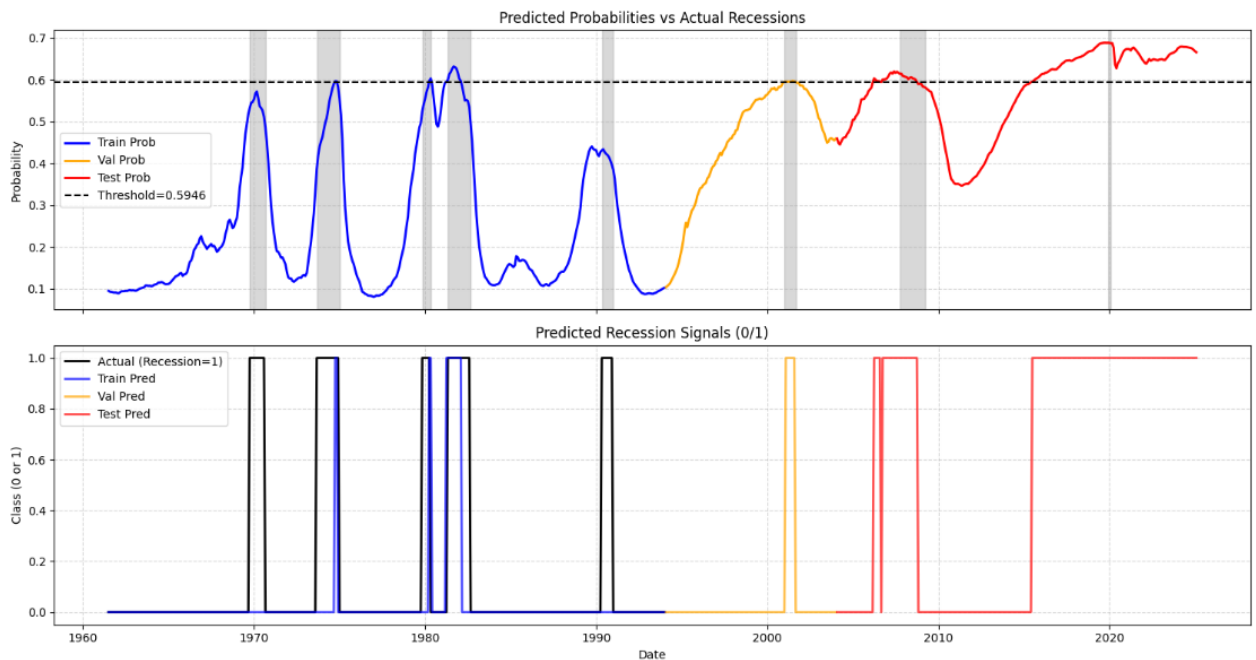| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	24
recession	3m recession

```
BiLSTM for dataset 1959 - 3m recession
Accuracy   : 0.4625
Precision  : 0.1027
Recall     : 0.7500
F1 Score   : 0.1807
ROC-AUC    : 0.5219
PR-AUC     : 0.1189

Classification Report:
              precision    recall  f1-score   support

         0.0    0.9533    0.4378    0.6000       233
         1.0    0.1027    0.7500    0.1807        20

    accuracy                        0.4625       253
   macro avg    0.5280    0.5939    0.3904       253
weighted avg    0.8860    0.4625    0.5669       253
```

```
# --- W&B INIT ---
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 24,
        "lstm_units": 64,
        "dense_units": 32,
        "dropout": 0.1,
        "batch_size": 64,
        "learning_rate": 0.001,
        "epochs": 100,
        #"threshold": 0.4
    }
)
```


Predicted Probabilities vs Actual Recessions

Predicted Recession Signals (0/1)

BiLSTM 6m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	24
recession	6m recession

```
BiLSTM for dataset 1959 - 6m recession
Accuracy   : 0.7747
Precision  : 0.0488
Recall     : 0.1000
F1 Score   : 0.0656
ROC-AUC    : 0.6785
PR-AUC     : 0.1791

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9151    0.8326    0.8719       233
         1.0     0.0488    0.1000    0.0656        20

    accuracy                         0.7747       253
   macro avg     0.4819    0.4663    0.4687       253
weighted avg     0.8466    0.7747    0.8082       253
```
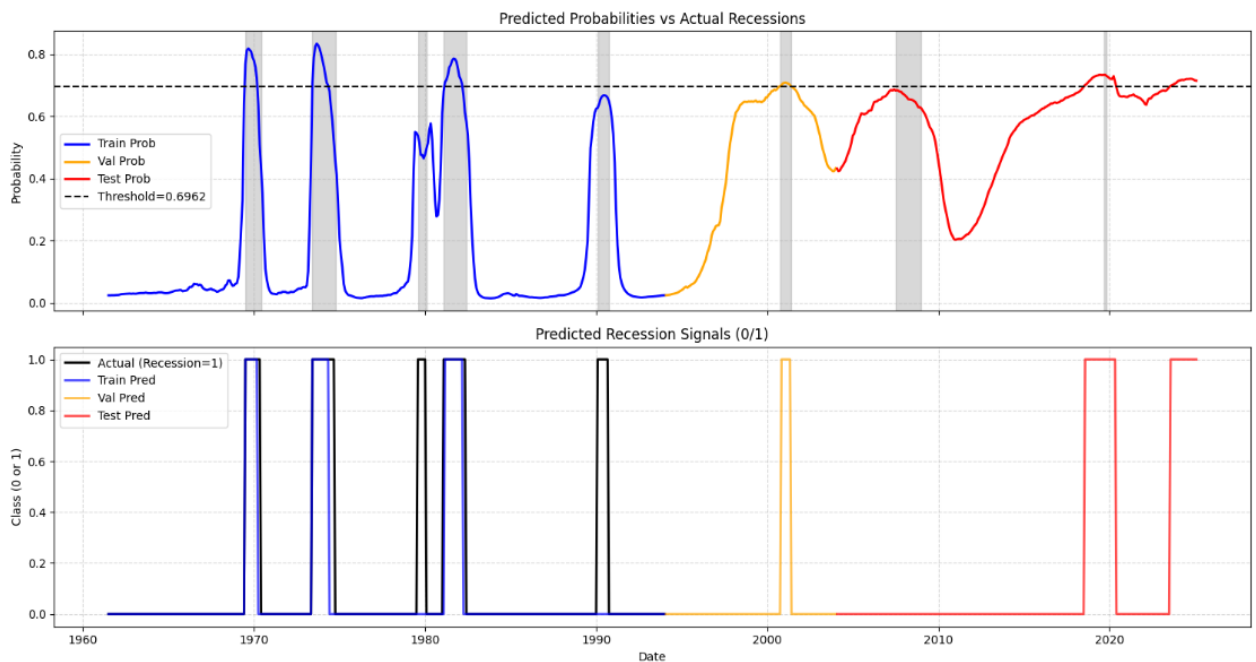
```
# --- W&B INIT ---
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 24,
        "lstm_units": 64,
        "dense_units": 32,
        "dropout": 0.1,
        "batch_size": 64,
        "learning_rate": 0.001,
        "epochs": 100,
        #"threshold": 0.4
    }
)
```


Predicted Probabilities vs Actual Recessions

Predicted Recession Signals (0/1)

GRU 1m recession

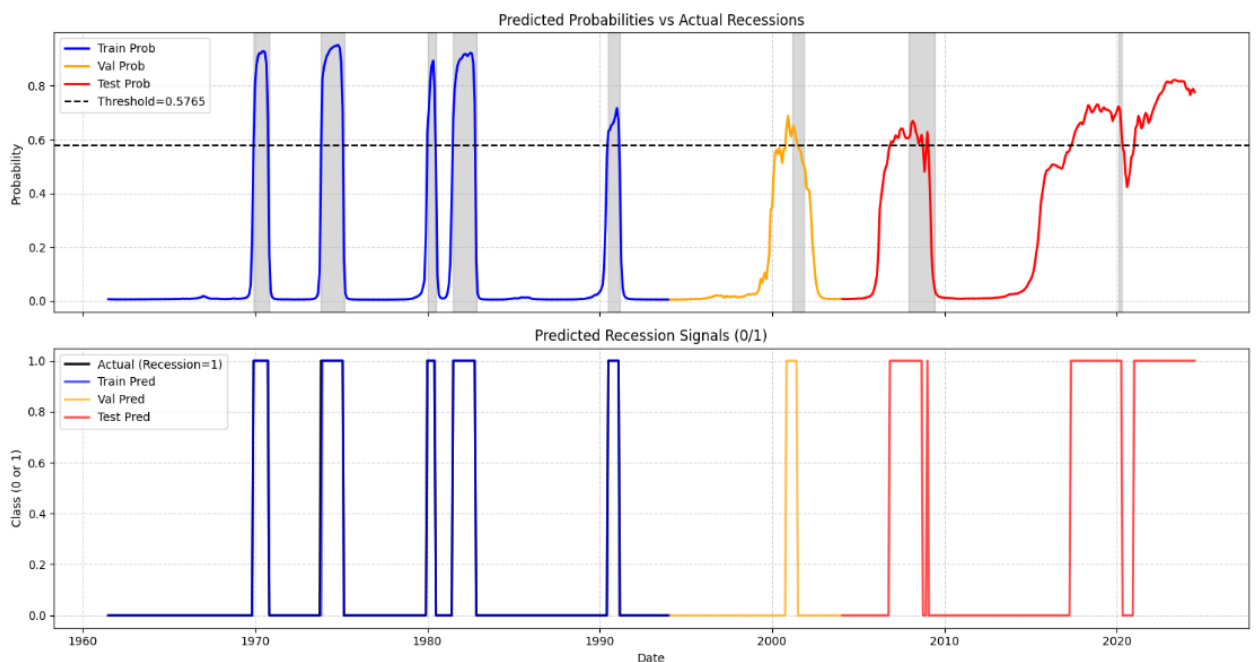| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	24
recession	1m recession

```
GRU for dataset 1959 - 1m recession
Accuracy    : 0.6057
Precision   : 0.1262
Recall      : 0.6500
F1 Score    : 0.2114
ROC-AUC     : 0.6288
PR-AUC      : 0.1015

Classification Report:
              precision    recall  f1-score   support

         0.0    0.9510    0.6018    0.7371       226
         1.0    0.1262    0.6500    0.2114        20

    accuracy                        0.6057       246
   macro avg    0.5386    0.6259    0.4743       246
weighted avg    0.8840    0.6057    0.6944       246
```

```
# --- W&B INIT ---
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 24,
        "lstm_units": 64,
        "dense_units": 32,
        "dropout": 0.2,
        "batch_size": 64,
        "learning_rate": 0.001,
        "epochs": 100,
        #"threshold": 0.4
    }
)
```

GRU 3m recession

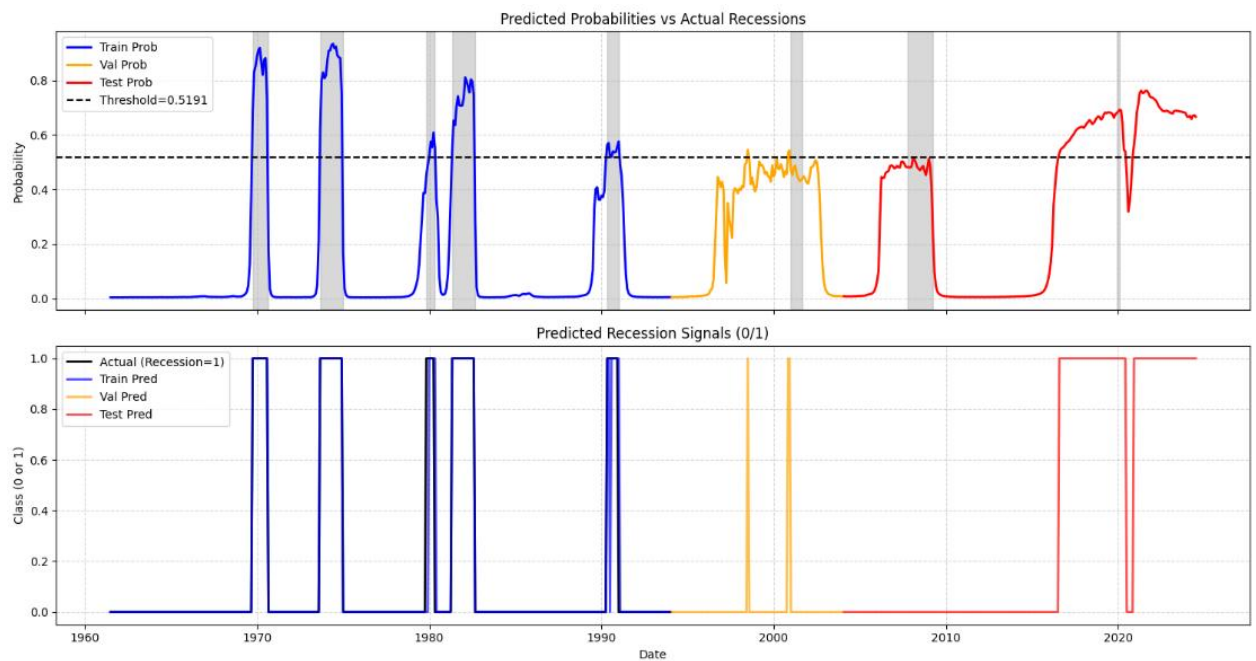| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	24
recession	3m recession

```
GRU for dataset 1959 - 3m recession
Accuracy   : 0.5650
Precision  : 0.0220
Recall     : 0.1000
F1 Score   : 0.0360
ROC-AUC    : 0.5889
PR-AUC     : 0.0941

Classification Report:
              precision    recall  f1-score   support

         0.0     0.8839    0.6062    0.7192       226
         1.0     0.0220    0.1000    0.0360        20

    accuracy                         0.5650       246
   macro avg     0.4529    0.3531    0.3776       246
weighted avg     0.8138    0.5650    0.6636       246
```

```
# --- W&B INIT ---
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 24,
        "lstm_units": 64,
        "dense_units": 32,
        "dropout": 0.2,
        "batch_size": 64,
        "learning_rate": 0.001,
        "epochs": 100,
        #"threshold": 0.4
    }
)
```


Predicted Probabilities vs Actual Recessions

Predicted Recession Signals (0/1)

GRU 6m recession

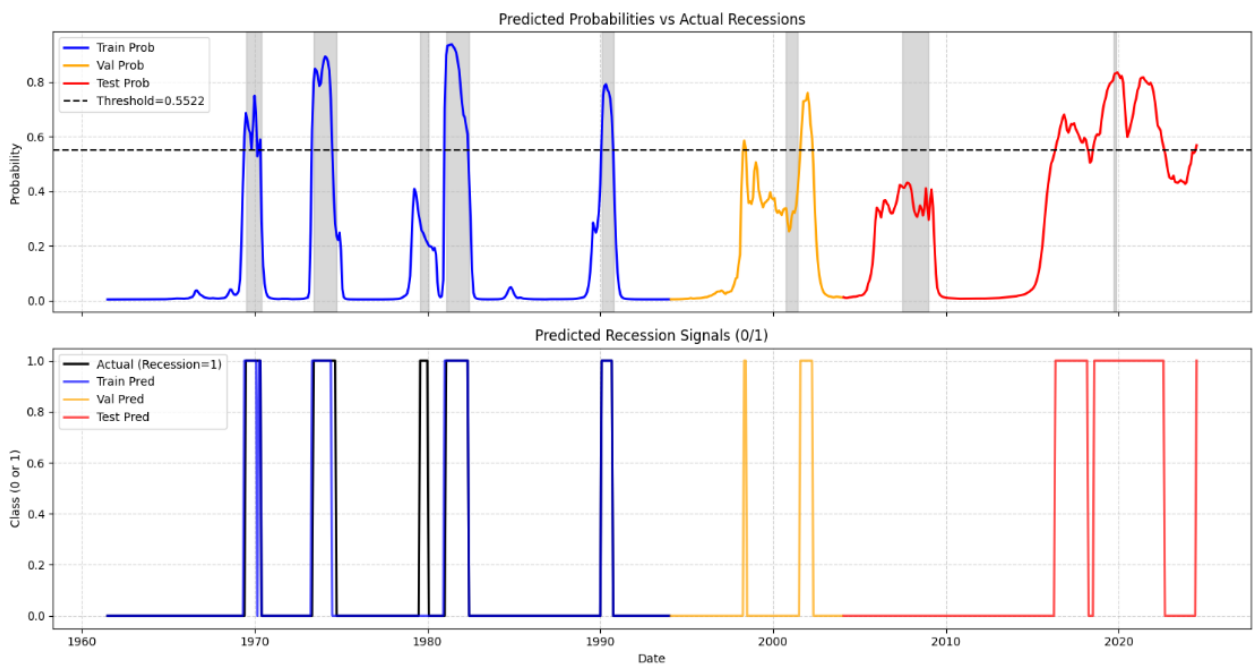| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	24
recession	6m recession

```
GRU for dataset 1959 - 6m recession
Accuracy    : 0.6382
Precision   : 0.0274
Recall      : 0.1000
F1 Score    : 0.0430
ROC-AUC     : 0.5538
PR-AUC      : 0.1067

Classification Report:
              precision    recall  f1-score   support

         0.0    0.8960    0.6858    0.7769       226
         1.0    0.0274    0.1000    0.0430        20

    accuracy                        0.6382       246
   macro avg    0.4617    0.3929    0.4100       246
weighted avg    0.8253    0.6382    0.7173       246
```

```
# --- W&B INIT ---
wandb.init(
    project="us-recession-lstm",
    config={
        "seq_length": 24,
        "lstm_units": 64,
        "dense_units": 32,
        "dropout": 0.2,
        "batch_size": 64,
        "learning_rate": 0.001,
        "epochs": 100,
        #"threshold": 0.4
    }
)
```


Predicted Probabilities vs Actual Recessions

Transformer 1m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	12
recession	1m recession

```
Transformer Model Results 1m recession
Accuracy   : 0.7905
Precision  : 0.0541
Recall     : 0.1000
F1 Score   : 0.0702
ROC-AUC    : 0.5255
PR-AUC     : 0.0799

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9167    0.8498    0.8820       233
         1.0     0.0541    0.1000    0.0702        20

    accuracy                         0.7905       253
   macro avg     0.4854    0.4749    0.4761       253
weighted avg     0.8485    0.7905    0.8178       253
```

```
wandb.init(
    project="us-recession-transformer",
    config={
        "seq_length": 12,
        "d_model": 32,
        "num_heads": 2,
        "ff_dim": 64,
        "num_layers": 1,
        "dropout": 0.1,
        "batch_size": 32,
        "learning_rate": 0.001,
        "epochs": 100,
    }
)
```

Transformer 3m recession

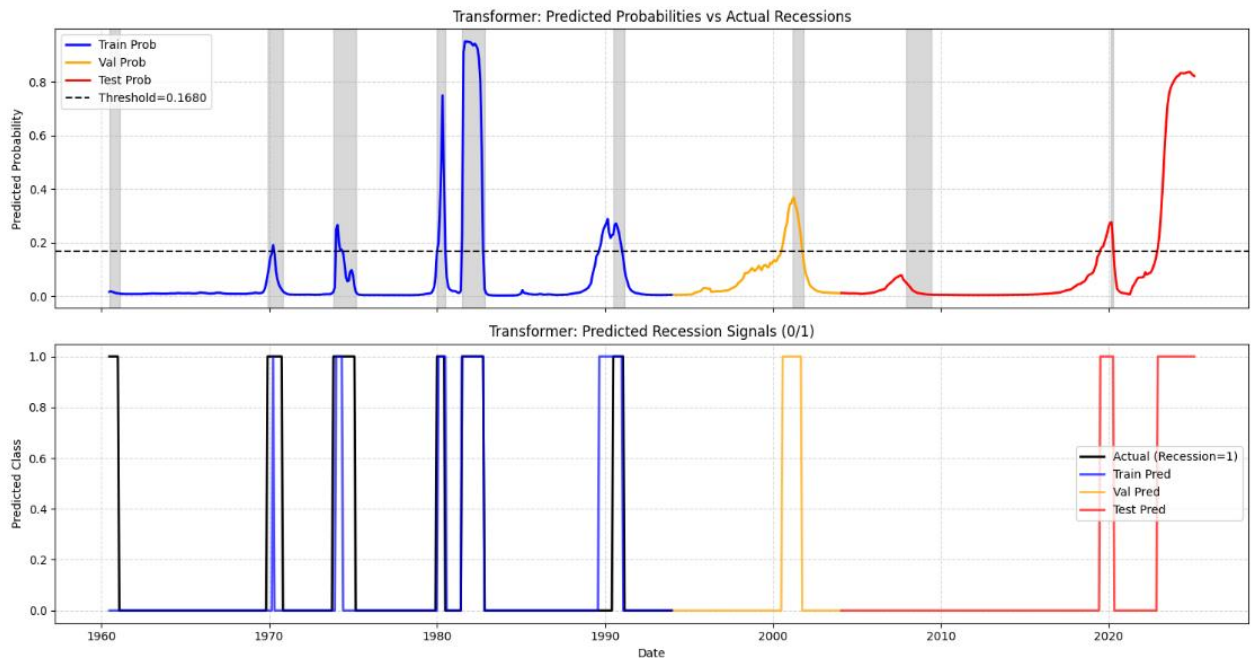| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	24
recession	3m recession

```
Transformer Model Results 3m recession
Accuracy   : 0.8814
Precision  : 0.0000
Recall     : 0.0000
F1 Score   : 0.0000
ROC-AUC    : 0.6964
PR-AUC     : 0.1180

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9177    0.9571    0.9370       233
         1.0     0.0000    0.0000    0.0000        20

    accuracy                         0.8814       253
   macro avg     0.4588    0.4785    0.4685       253
weighted avg     0.8452    0.8814    0.8629       253
```

```
wandb.init(
    project="us-recession-transformer",
    config={
        "seq_length": 24,
        "d_model": 32,
        "num_heads": 2,
        "ff_dim": 64,
        "num_layers": 1,
        "dropout": 0.2,
        "batch_size": 32,
        "learning_rate": 0.001,
        "epochs": 100,
    }
)
```


Transformer: Predicted Probabilities vs Actual Recessions

Transformer: Predicted Recession Signals (0/1)

Transformer 6m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Using validation set (f1 score)
Seq_length	12
recession	6m recession

```
Transformer Model Results 6m recession
Accuracy   : 0.8419
Precision  : 0.0000
Recall     : 0.0000
F1 Score   : 0.0000
ROC-AUC    : 0.6908
PR-AUC     : 0.1187

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9142    0.9142    0.9142       233
         1.0     0.0000    0.0000    0.0000        20

    accuracy                         0.8419       253
   macro avg     0.4571    0.4571    0.4571       253
weighted avg     0.8419    0.8419    0.8419       253
```
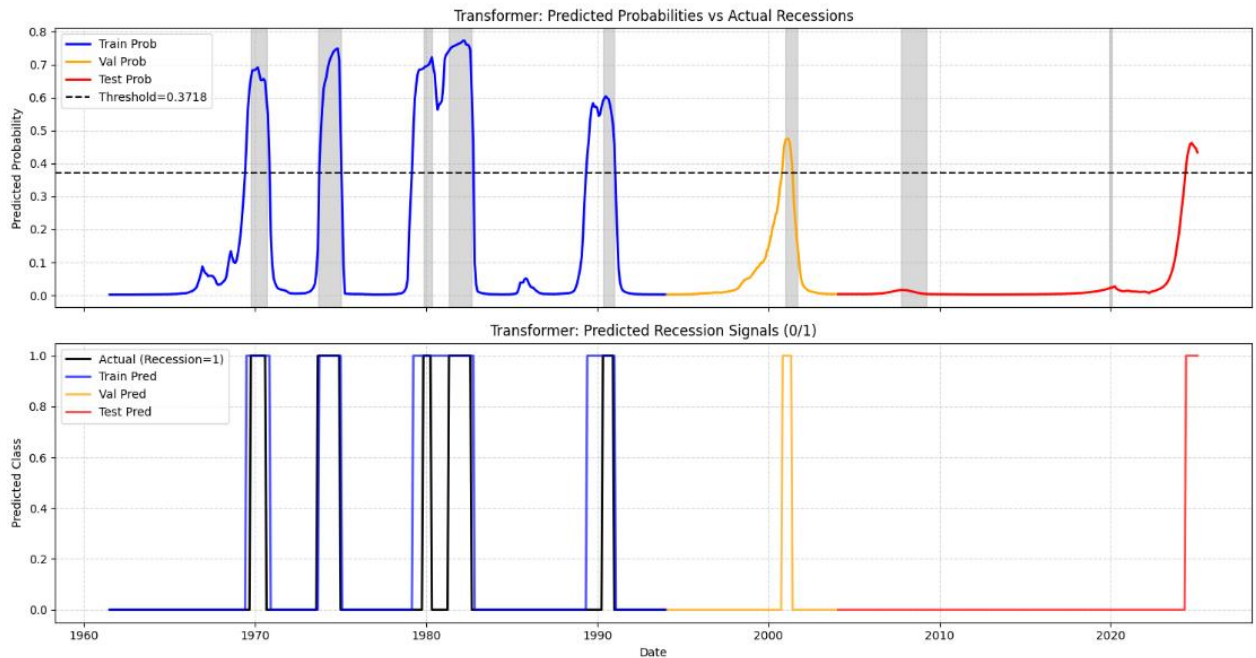
```
wandb.init(
    project="us-recession-transformer",
    config={
        "seq_length": 12,
        "d_model": 32,
        "num_heads": 2,
        "ff_dim": 64,
        "num_layers": 1,
        "dropout": 0.1,
        "batch_size": 32,
        "learning_rate": 0.001,
        "epochs": 100,
    }
)
```

LSTM + Transformer 1m recession

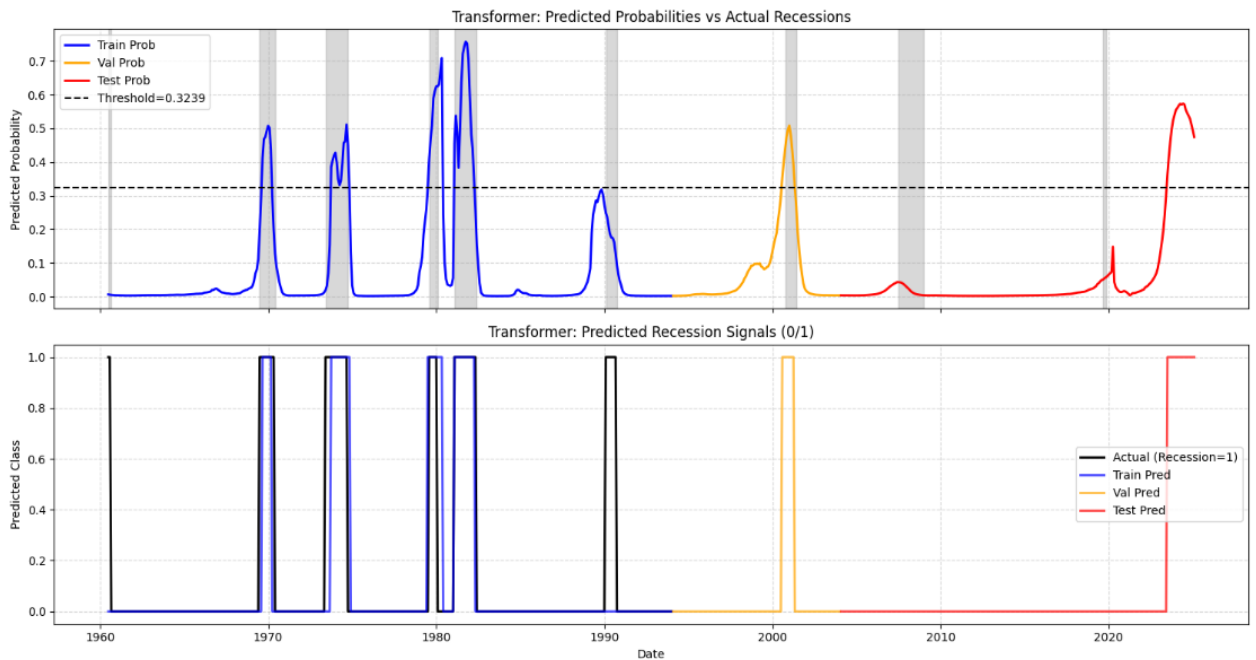| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Hardcoded
Seq_length	12
recession	1m recession

```
Hybrid LSTM + Transformer Model Results - 1m recession
Accuracy    : 0.8063
Precision   : 0.2623
Recall      : 0.8000
F1 Score    : 0.3951
ROC-AUC     : 0.8936
PR-AUC      : 0.3678

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9792    0.8069    0.8847       233
         1.0     0.2623    0.8000    0.3951        20

    accuracy                         0.8063       253
   macro avg     0.6207    0.8034    0.6399       253
weighted avg     0.9225    0.8063    0.8460       253
```
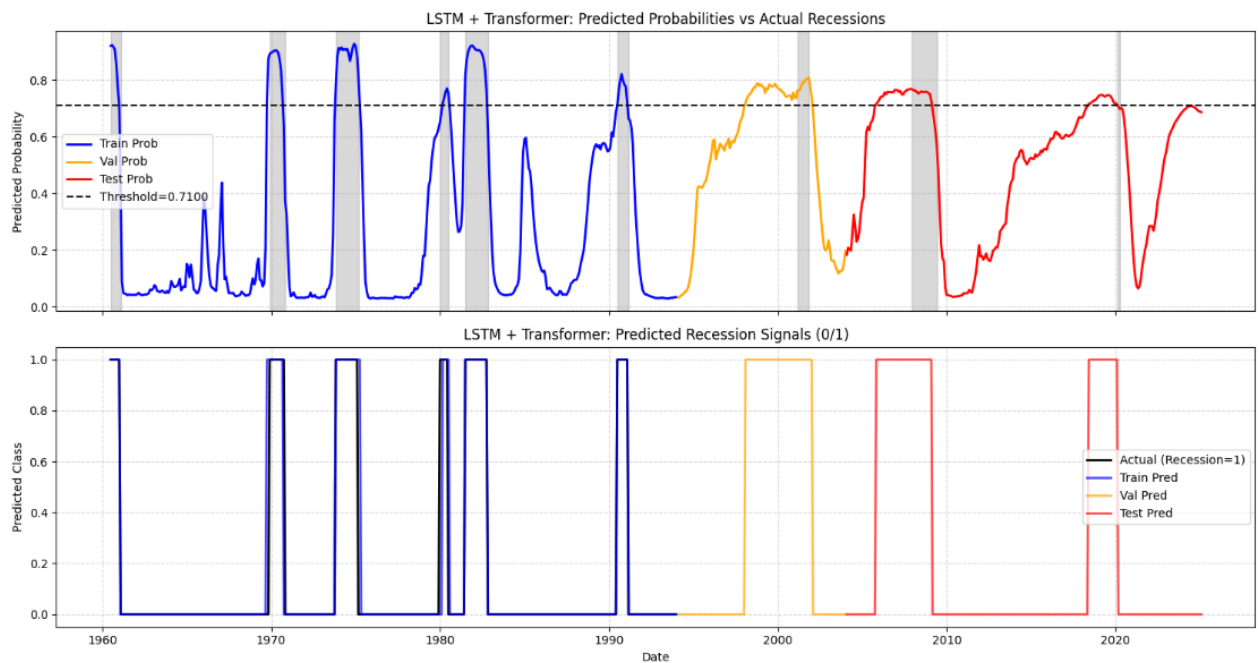
```
wandb.init(
    project="us-recession-transformer-lstm-hybrid",
    config={
        "seq_length": 12,
        "lstm_units": 64,
        "d_model":32,
        "num_heads": 2,
        "ff_dim": 64,
        "num_layers": 1,
        "dropout": 0.1,
        "batch_size": 16,
        "learning_rate": 5e-4,
        "epochs": 200,
        "focal_gamma": 2.0,
        "focal_alpha": 0.9,
        "use_class_weight": True,
        "class_weight_pos": 12.0,
    }
)
```


LSTM + Transformer: Predicted Probabilities vs Actual Recessions

LSTM + Transformer: Predicted Recession Signals (0/1)

LSTM + Transformer 3m recession

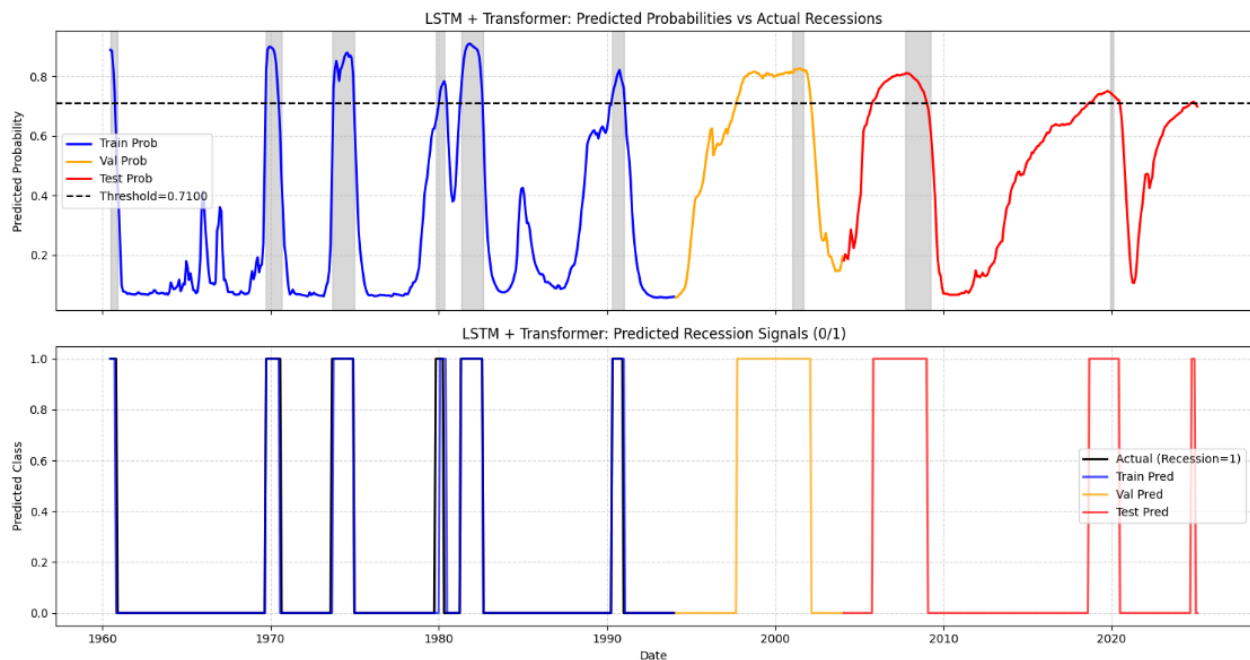| Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Hardcoded
Seq_length	12
recession	3m recession

```
Hybrid LSTM + Transformer Model Results - 3m recession
Accuracy    : 0.8103
Precision   : 0.2812
Recall      : 0.9000
F1 Score    : 0.4286
ROC-AUC     : 0.9167
PR-AUC      : 0.5073

Classification Report:
              precision    recall   f1-score   support

        0.0     0.9894    0.8026    0.8863       233
        1.0     0.2812    0.9000    0.4286        20

    accuracy                        0.8103       253
   macro avg    0.6353    0.8513    0.6574       253
weighted avg    0.9334    0.8103    0.8501       253
```

```
wandb.init(
    project="us-recession-transformer-lstm-hybrid",
    config={
        "seq_length": 12,
        "lstm_units": 64,
        "d_model":32,
        "num_heads": 2,
        "ff_dim": 64,
        "num_layers": 1,
        "dropout": 0.18,
        "batch_size": 16,
        "learning_rate": 5e-4,
        "epochs": 200,
        "focal_gamma": 2.0,
        "focal_alpha": 0.9,
        "use_class_weight": True,
        "class_weight_pos": 12.0,
    }
```


LSTM + Transformer: Predicted Probabilities vs Actual Recessions

LSTM + Transformer: Predicted Recession Signals (0/1)

LSTM + Transformer 6m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Class imbalance	Focal loss
Early stopping Used	Yes – val_pr_auc
Threshold selected	Hardcoded
Seq_length	12
recession	6m recession

```
Hybrid LSTM + Transformer Model Results - 6m recession
Accuracy   : 0.9091
Precision  : 0.4651
Recall     : 1.0000
F1 Score   : 0.6349
ROC-AUC    : 0.9680
PR-AUC     : 0.6273

Classification Report:
              precision    recall  f1-score   support

         0.0     1.0000    0.9013    0.9481       233
         1.0     0.4651    1.0000    0.6349        20

    accuracy                         0.9091       253
   macro avg     0.7326    0.9506    0.7915       253
weighted avg     0.9577    0.9091    0.9233       253
```
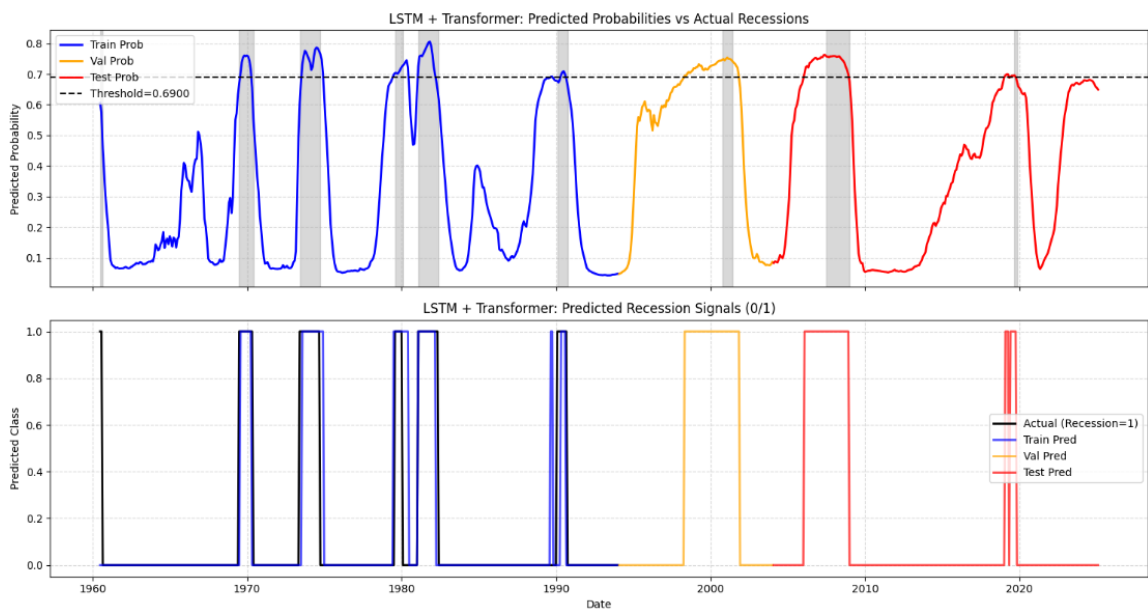
```
wandb.init(
    project="us-recession-transformer-lstm-hybrid",
    config={
        "seq_length": 12,
        "lstm_units": 64,
        "d_model":32,
        "num_heads": 2,
        "ff_dim": 64,
        "num_layers": 1,
        "dropout": 0.1,
        "batch_size": 16,
        "learning_rate": 5e-4,
        "epochs": 200,
        "focal_gamma": 2.0,
        "focal_alpha": 0.9,
        "use_class_weight": True,
        "class_weight_pos": 12.0,
    }
)
```
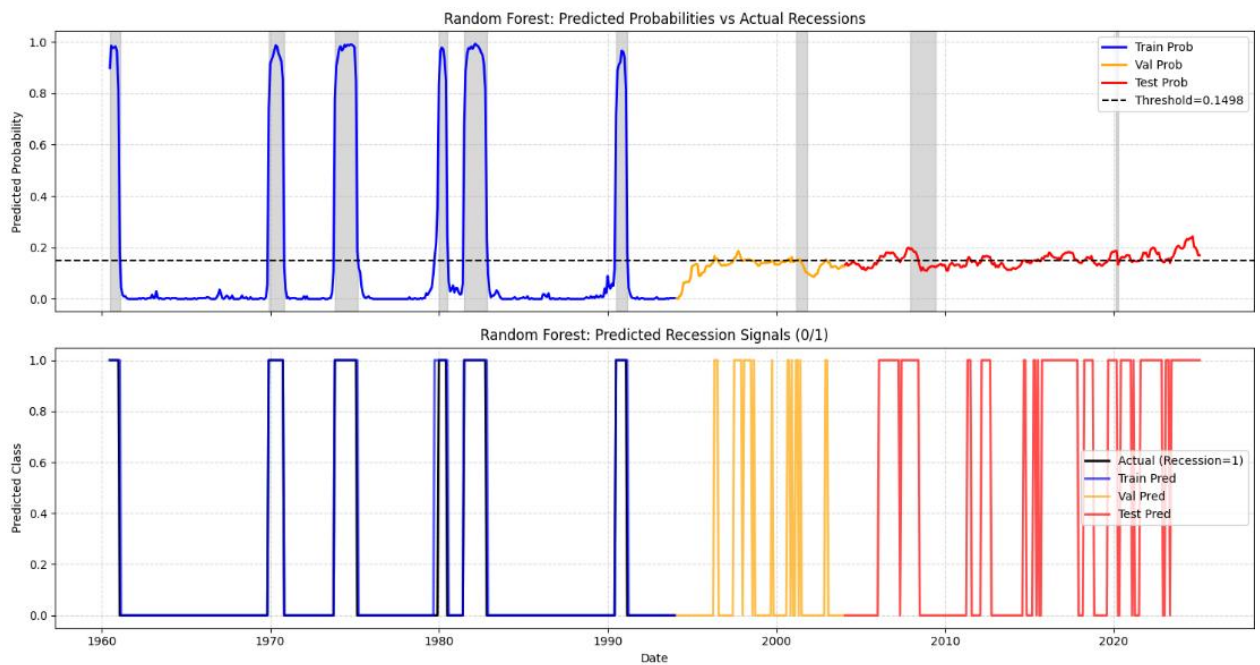
Random Forest 1m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	1m recession

```
Random Forest Model Results 1m recession
Accuracy   : 0.4704
Precision  : 0.0682
Recall     : 0.4500
F1 Score   : 0.1184
ROC-AUC    : 0.4148
PR-AUC     : 0.0992

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9091    0.4721    0.6215       233
         1.0     0.0682    0.4500    0.1184        20

    accuracy                         0.4704       253
   macro avg     0.4886    0.4611    0.3699       253
weighted avg     0.8426    0.4704    0.5817       253
```
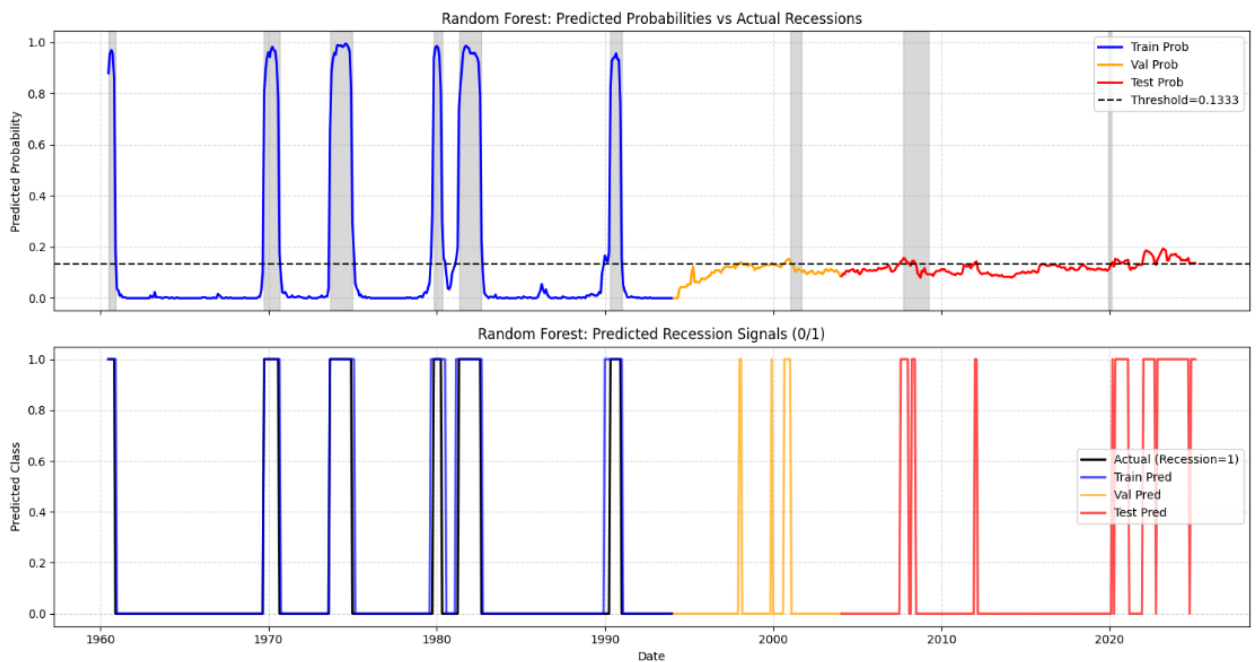
Random Forest 3m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	3m recession

```
Random Forest Model Results 3m recession
Accuracy   : 0.7470
Precision  : 0.1207
Recall     : 0.3500
F1 Score   : 0.1795
ROC-AUC    : 0.5285
PR-AUC     : 0.0922

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9333    0.7811    0.8505       233
         1.0     0.1207    0.3500    0.1795        20

    accuracy                         0.7470       253
   macro avg     0.5270    0.5656    0.5150       253
weighted avg     0.8691    0.7470    0.7974       253
```
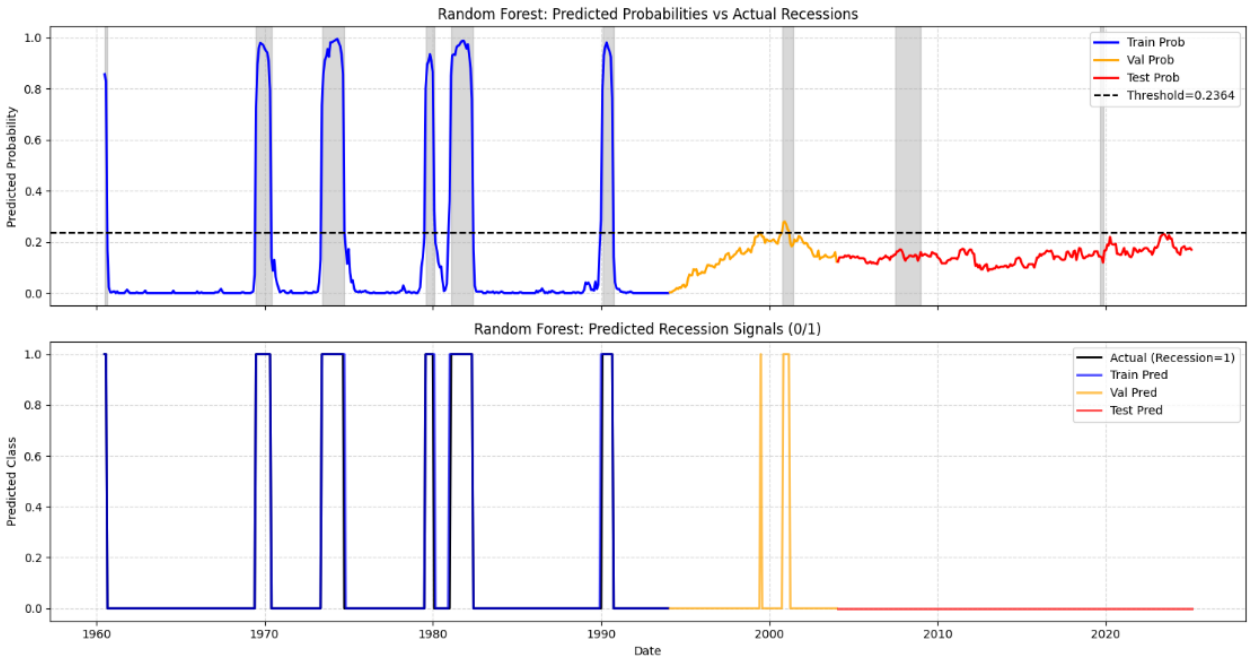

Random Forest: Predicted Probabilities vs Actual Recessions

Random Forest: Predicted Recession Signals (0/1)

Random Forest 6m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	6m recession

```
Random Forest Model Results 6m recession
Accuracy   : 0.9209
Precision  : 0.0000
Recall     : 0.0000
F1 Score   : 0.0000
ROC-AUC    : 0.5223
PR-AUC     : 0.0814

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9209    1.0000    0.9588       233
         1.0     0.0000    0.0000    0.0000        20

    accuracy                         0.9209       253
   macro avg     0.4605    0.5000    0.4794       253
weighted avg     0.8481    0.9209    0.8830       253
```
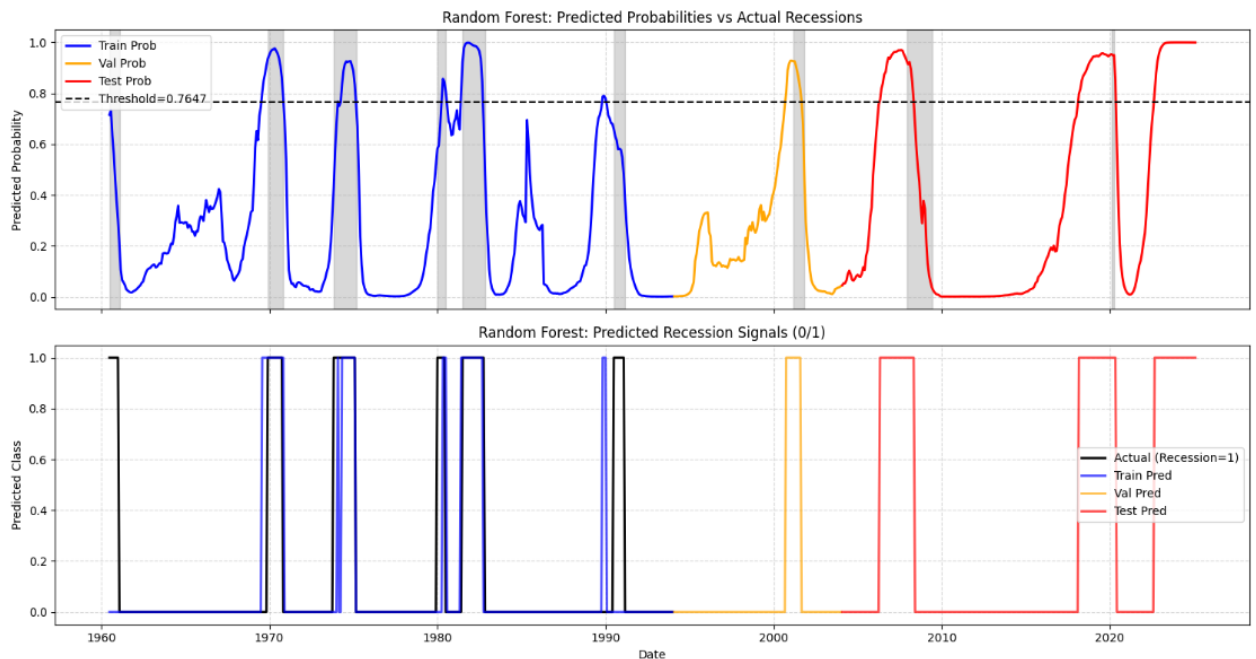

Random Forest: Predicted Probabilities vs Actual Recessions

Random Forest: Predicted Recession Signals (0/1)

Logistic Regression 1m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	1m recession

```
Logistic Regression Model Results 1m recession
Accuracy   : 0.6601
Precision  : 0.0976
Recall     : 0.4000
F1 Score   : 0.1569
ROC-AUC    : 0.6345
PR-AUC     : 0.1001

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9298    0.6824    0.7871       233
         1.0     0.0976    0.4000    0.1569        20

    accuracy                         0.6601       253
   macro avg     0.5137    0.5412    0.4720       253
weighted avg     0.8640    0.6601    0.7373       253
```
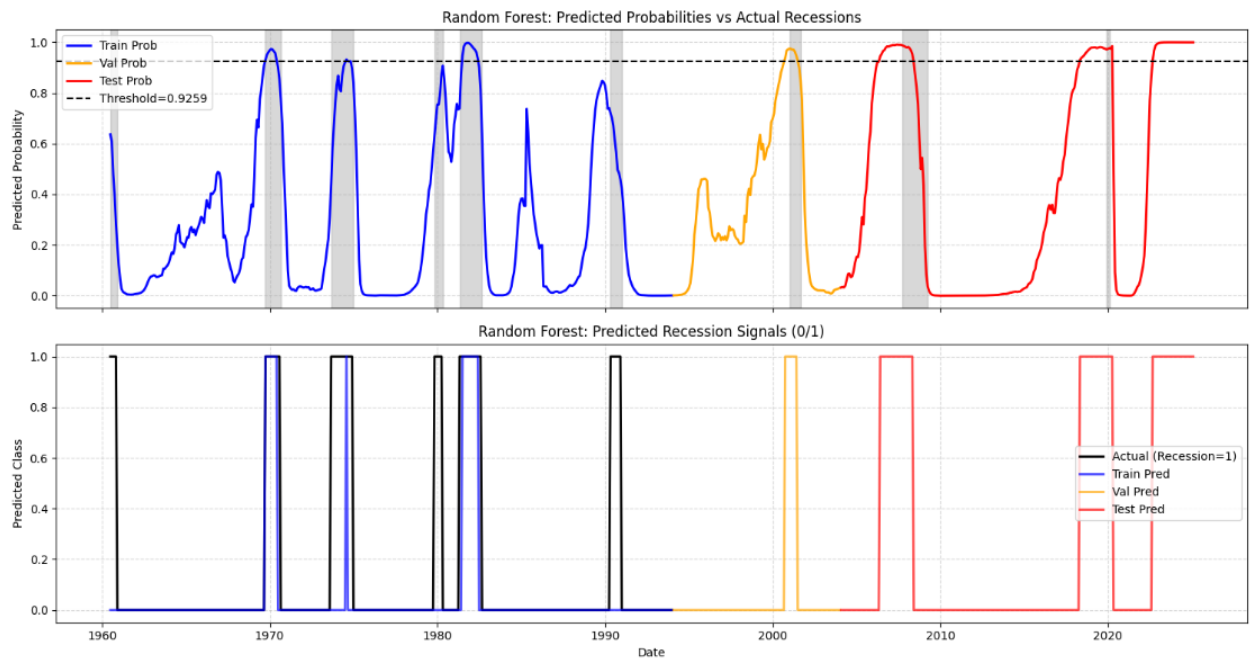

Random Forest: Predicted Probabilities vs Actual Recessions

Random Forest: Predicted Recession Signals (0/1)

Logistic Regression 3m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	3m recession

```
Logistic Regression Model Results 3m recession
Accuracy   : 0.6917
Precision  : 0.1282
Recall     : 0.5000
F1 Score   : 0.2041
ROC-AUC    : 0.7013
PR-AUC     : 0.1205

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9429    0.7082    0.8088       233
         1.0     0.1282    0.5000    0.2041        20

    accuracy                         0.6917       253
   macro avg     0.5355    0.6041    0.5065       253
weighted avg     0.8785    0.6917    0.7610       253
```
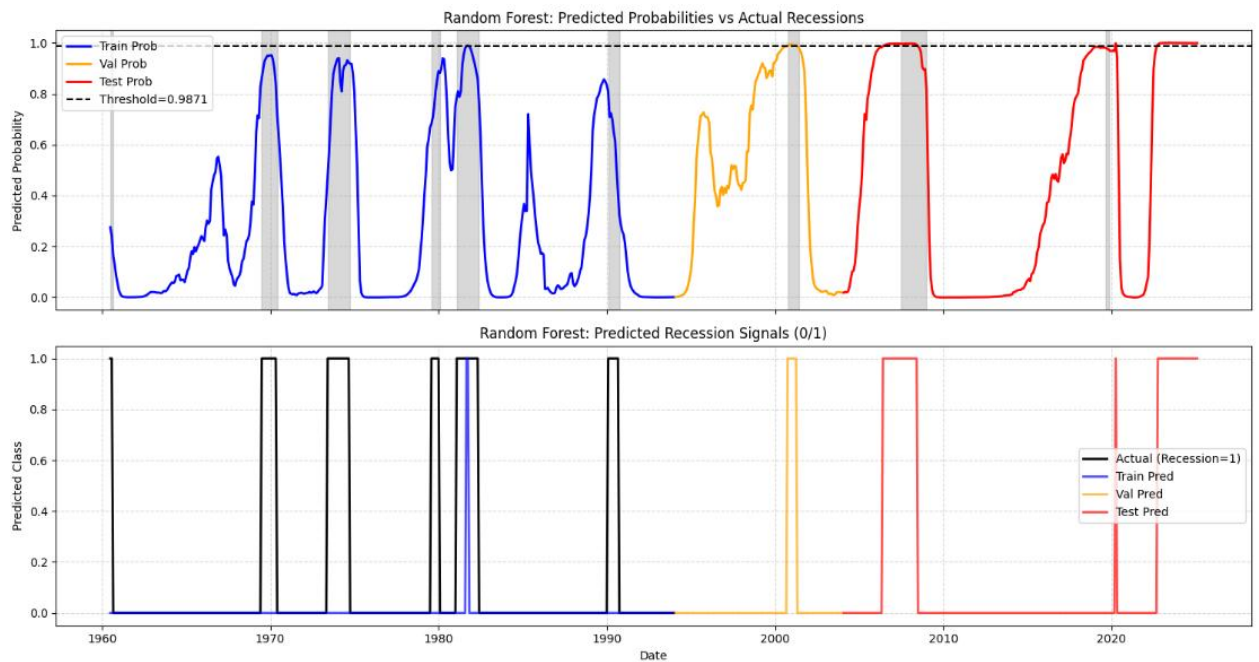

Random Forest: Predicted Probabilities vs Actual Recessions

Random Forest: Predicted Recession Signals (0/1)

Logistic Regression 6m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	6m recession

```
Logistic Regression Model Results 6m recession
Accuracy   : 0.7984
Precision  : 0.2182
Recall     : 0.6000
F1 Score   : 0.3200
ROC-AUC    : 0.8071
PR-AUC     : 0.1755

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9596    0.8155    0.8817       233
         1.0     0.2182    0.6000    0.3200        20

    accuracy                         0.7984       253
   macro avg     0.5889    0.7077    0.6008       253
weighted avg     0.9010    0.7984    0.8373       253
```
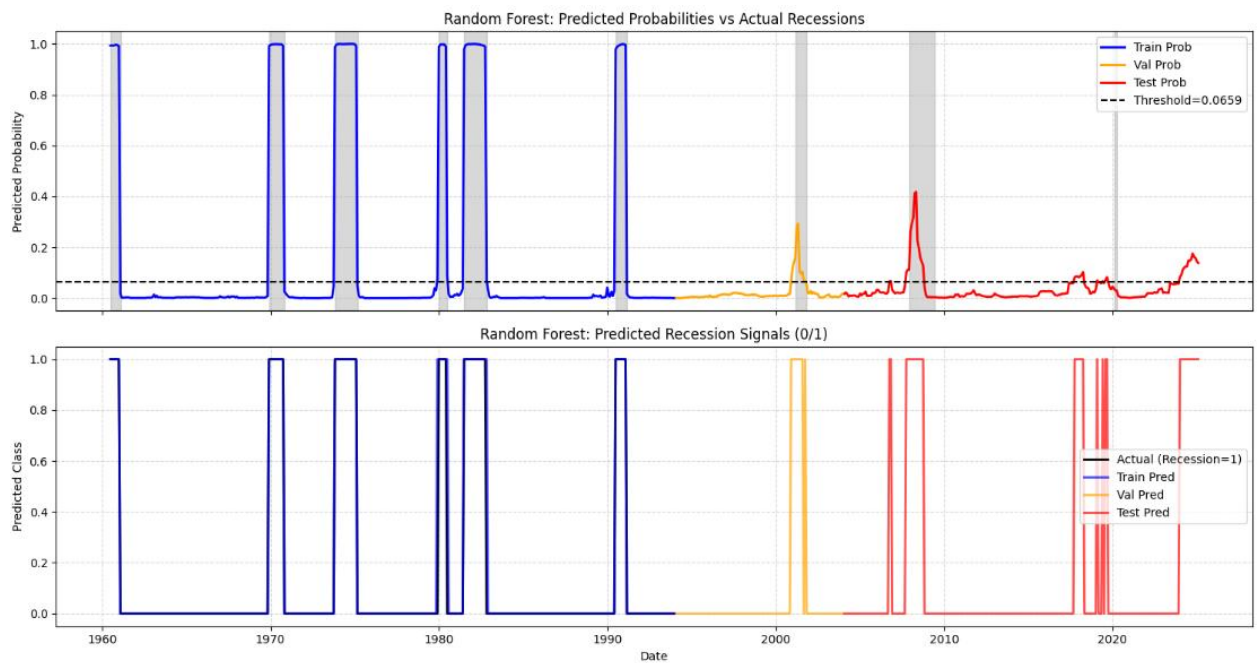

Random Forest: Predicted Probabilities vs Actual Recessions

Random Forest: Predicted Recession Signals (0/1)

Xgboost 1m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	1m recession

```
XGBoost Model Results 1m Recession
Accuracy   : 0.8498
Precision  : 0.2750
Recall     : 0.5500
F1 Score   : 0.3667
ROC-AUC    : 0.7084
PR-AUC     : 0.5240

Classification Report:
              precision    recall  f1-score   support

         0.0    0.9577    0.8755    0.9148       233
         1.0    0.2750    0.5500    0.3667        20

    accuracy                        0.8498       253
   macro avg    0.6164    0.7128    0.6407       253
weighted avg    0.9038    0.8498    0.8715       253
```
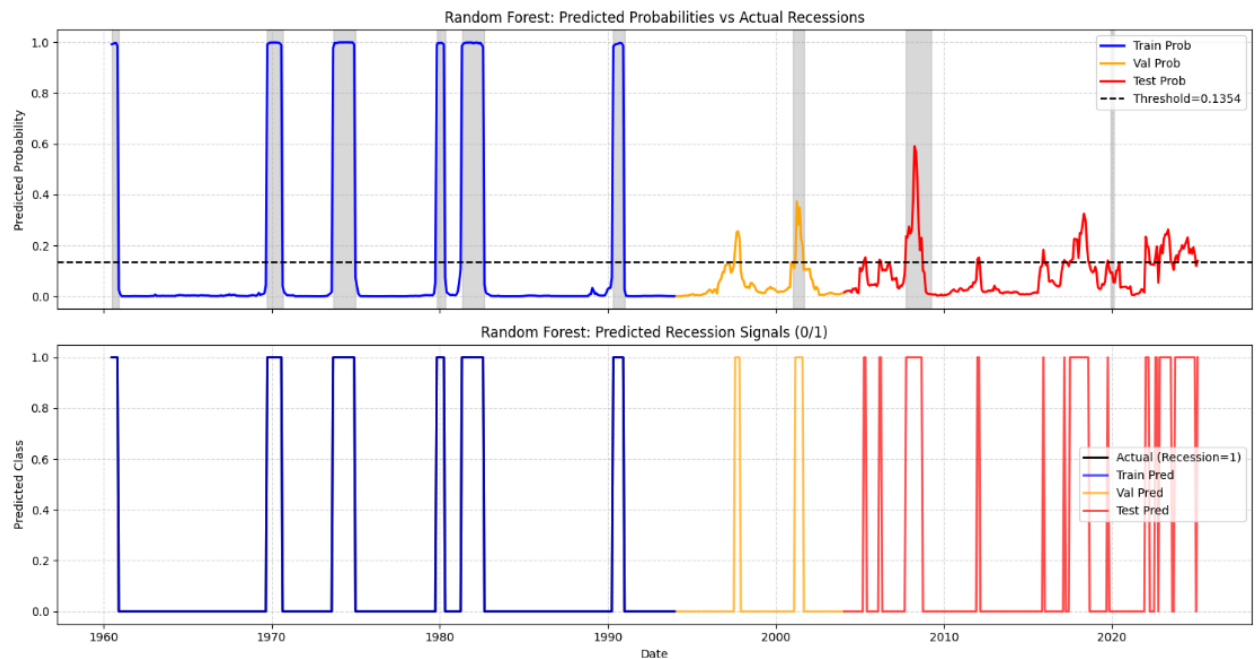
Xgboost 3m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	3m recession

```
XGBoost Model Results 3m Recession
Accuracy   : 0.7589
Precision  : 0.1846
Recall     : 0.6000
F1 Score   : 0.2824
ROC-AUC    : 0.7380
PR-AUC     : 0.4663

Classification Report:
              precision    recall  f1-score   support

         0.0     0.9574    0.7725    0.8551       233
         1.0     0.1846    0.6000    0.2824        20

    accuracy                         0.7589       253
   macro avg     0.5710    0.6863    0.5687       253
weighted avg     0.8964    0.7589    0.8098       253
```


Random Forest: Predicted Probabilities vs Actual Recessions

Random Forest: Predicted Recession Signals (0/1)

Xgboost 6m recession

Dataset	1959 -07-01 to 2025 -08-01
Train test split	Fixed Date method Train end -1994, Val end -2004
Threshold selected	Using validation set (f1 score)
recession	6m recession

```
XGBoost Model Results 6m Recession
Accuracy   : 0.8419
Precision  : 0.2826
Recall     : 0.6500
F1 Score   : 0.3939
ROC-AUC    : 0.8620
PR-AUC     : 0.2342

Classification Report:
              precision    recall  f1-score   support

        0.0     0.9662    0.8584    0.9091       233
        1.0     0.2826    0.6500    0.3939        20

    accuracy                        0.8419       253
   macro avg     0.6244    0.7542    0.6515       253
weighted avg     0.9121    0.8419    0.8684       253
```


Random Forest: Predicted Probabilities vs Actual Recessions

Random Forest: Predicted Recession Signals (0/1)