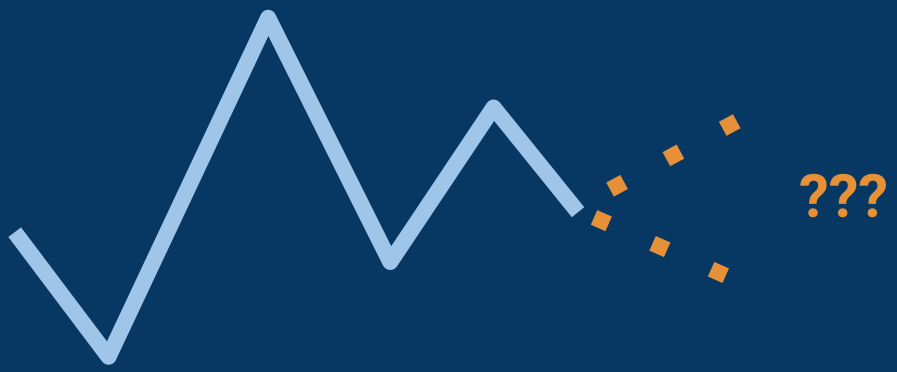
Forecasting Lease Delinquency

Leases

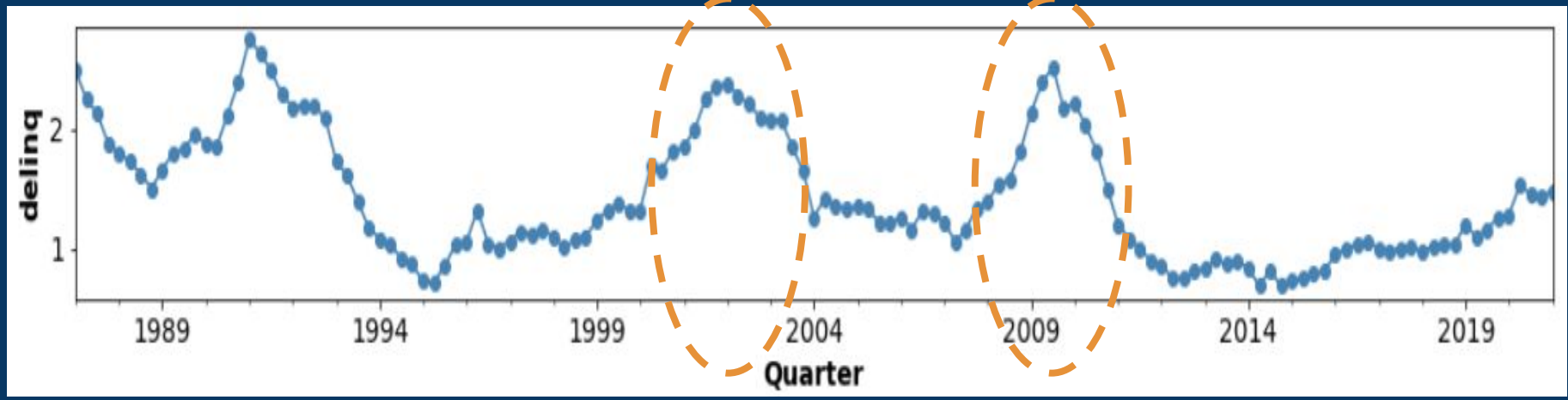
1) Economics like loans
2) Delinquent >>> Charge-Off >>> -$ Income
3) Predict delinquency trends, save +$



Time Series Data

1 Target Variable

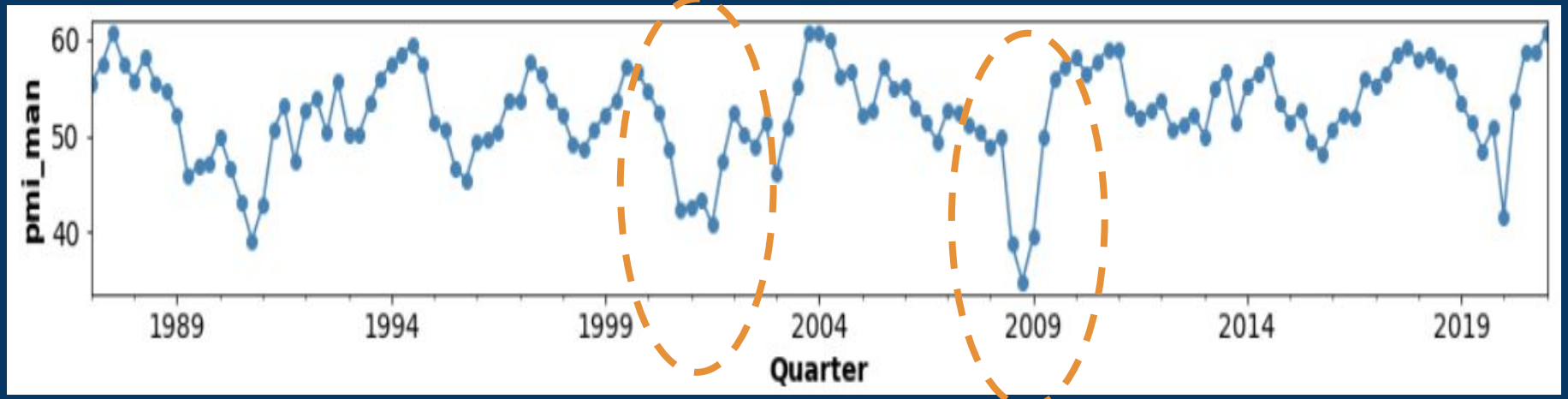
- **Lease Delinquency Rate** (US, all banks)



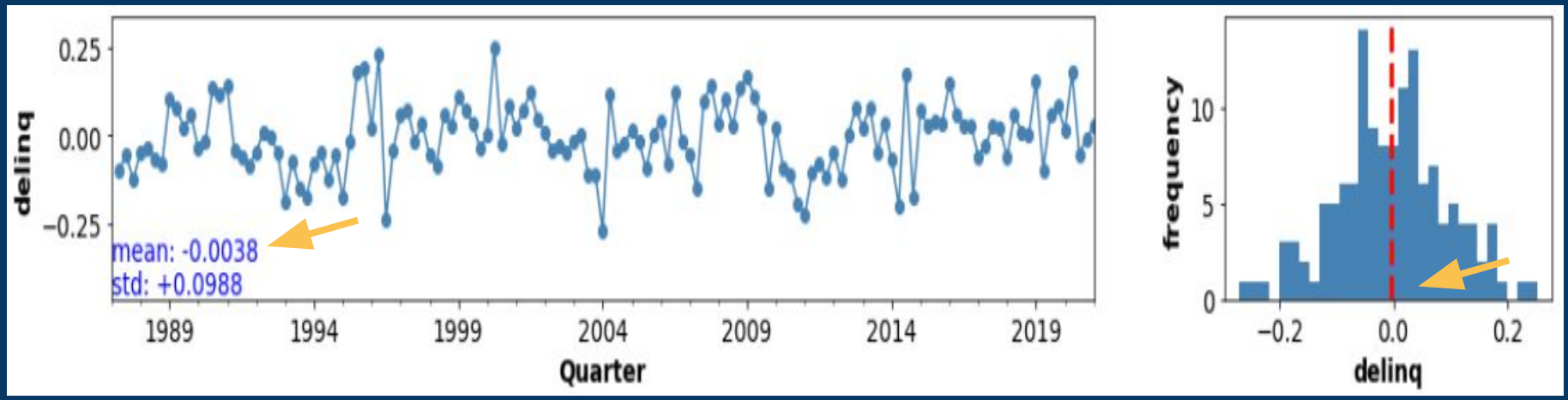
Time Series Data

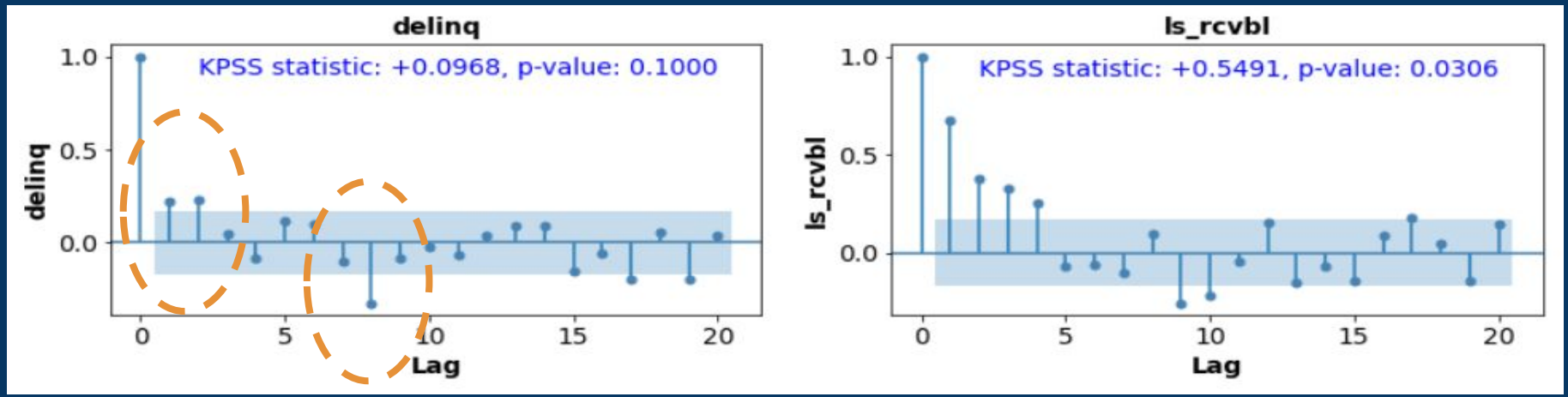
7 Features

- Lease Receivable Balance
- ISM Purchasing Managers Index
- Consumer Sentiment (UofM)
- S&P 500 Price Index
- Loan Standard Tightening
- Business Inventories
- Retail Sales



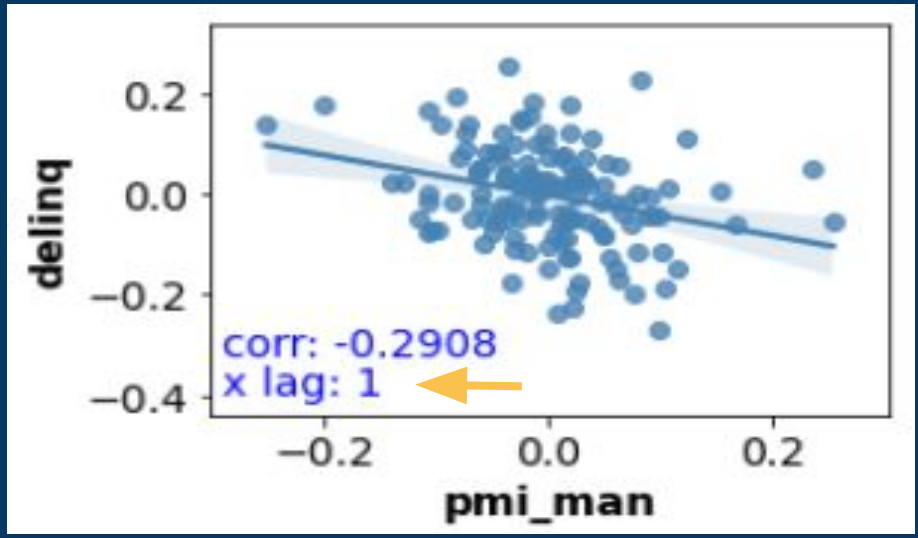
Diagnostics



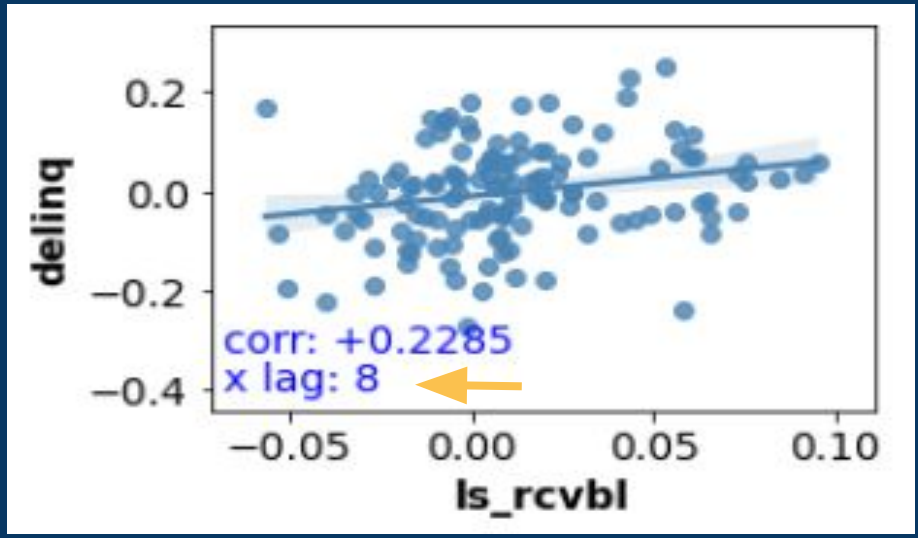


Correlations

- Short Lags (1 to 3)



- Longer Lags (7 to 9)



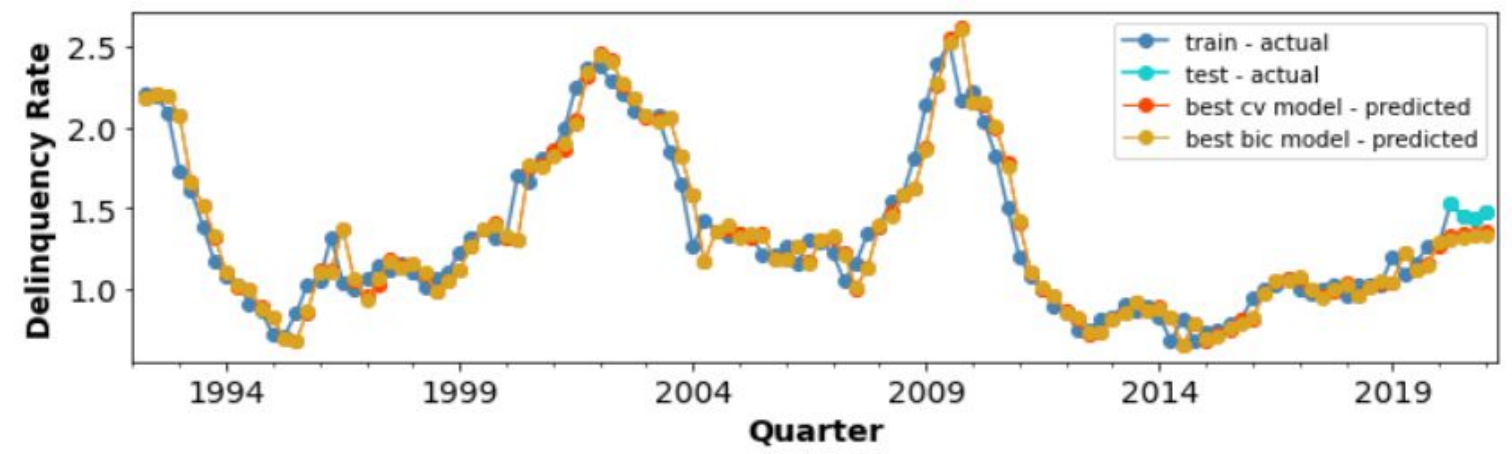
Time Series Models

Alternative Models

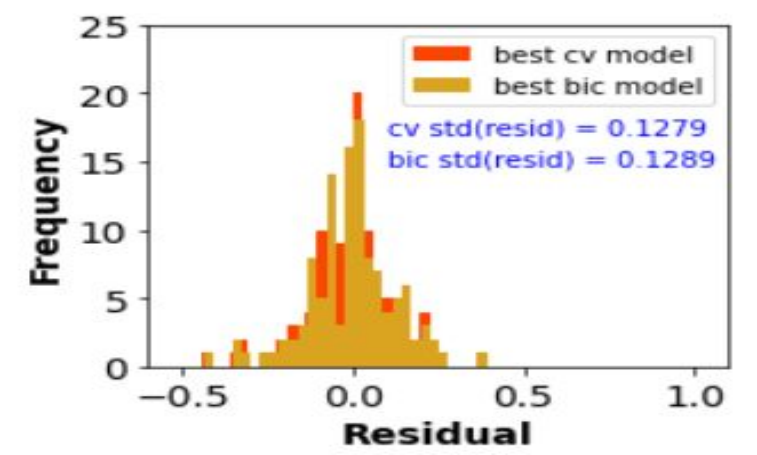
1) Baseline ARIMA
    a) ARIMA(p,1,q) univariate model
2) Null ARIMA Exog
    a) ARIMA(0,1,0) with exogenous variables
3) Full ARIMA
    a) ARIMA(p,1,0) with exogenous variables

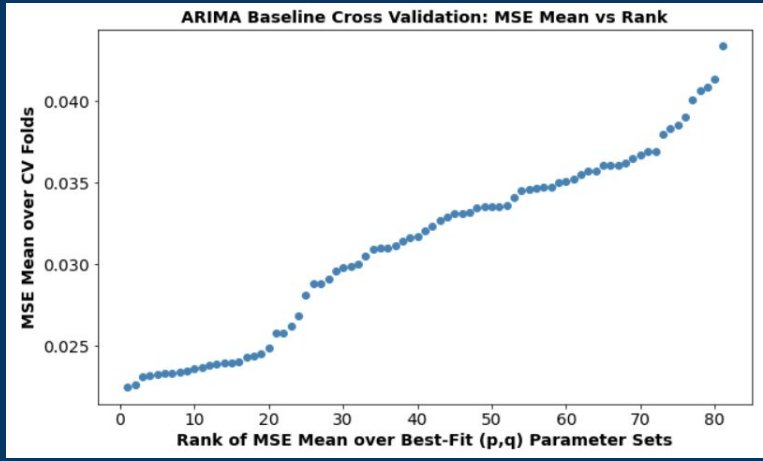
Time Series Results: Fit

- **Baseline ARIMA**: Train, Test ARIMA(p,1,q)



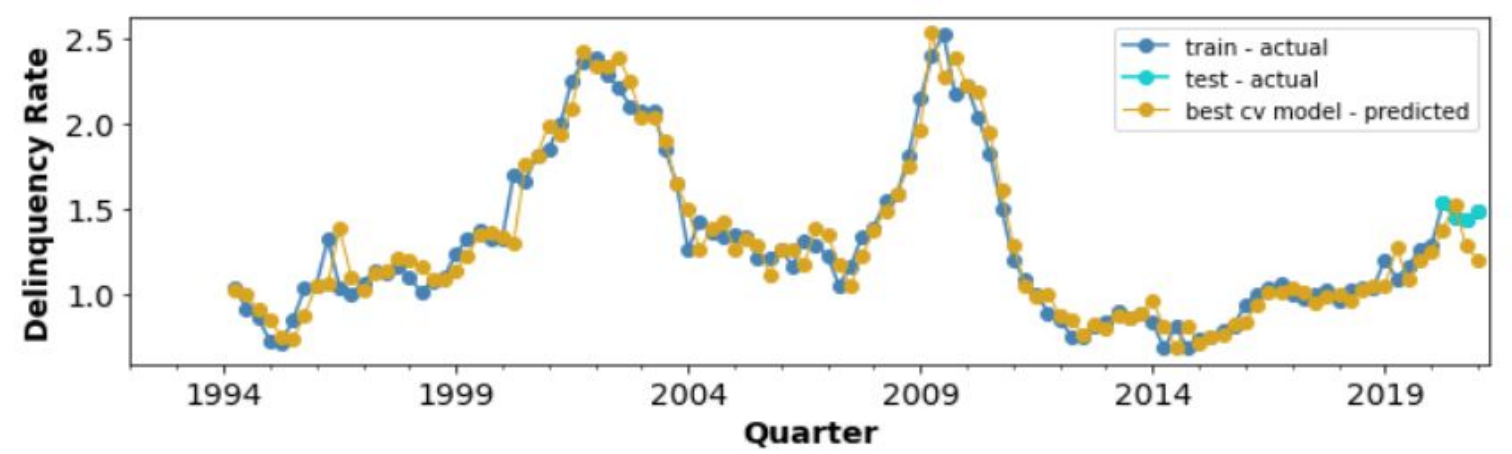
- **Baseline ARIMA**: Residuals, Model Selection



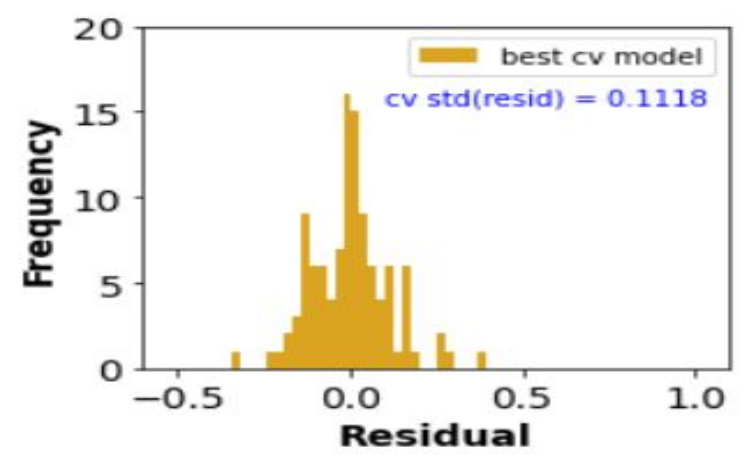


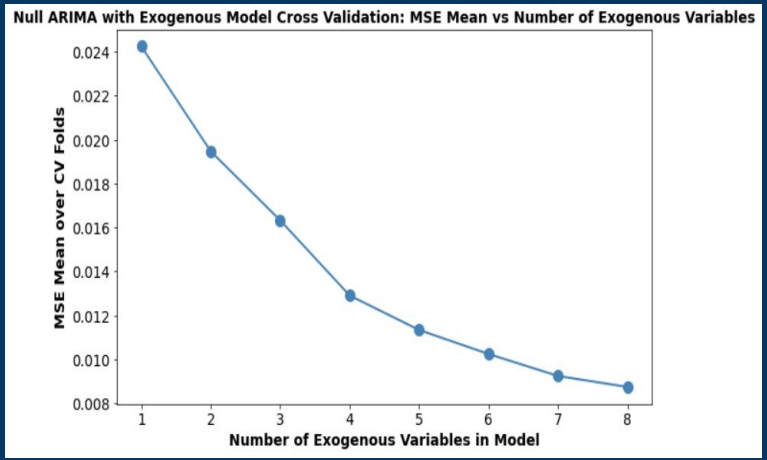
Time Series Results: Fit

- **Null ARIMA Exog**: Train, Test ARIMA(0,1,0) with Exogenous



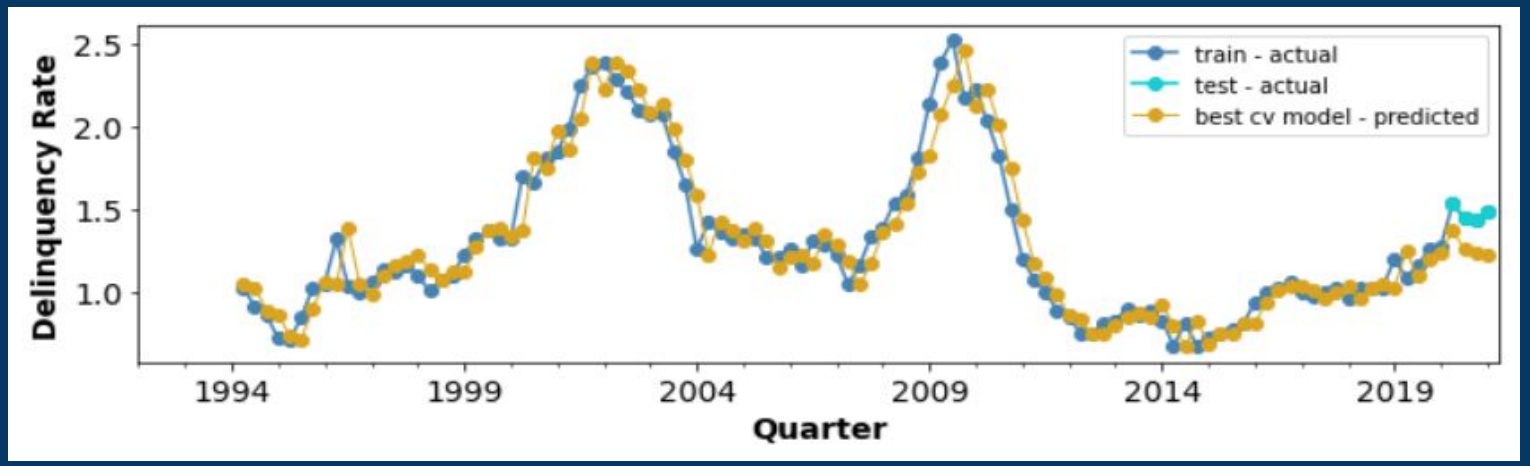
- **Null ARIMA Exog**: Residuals, Model Selection



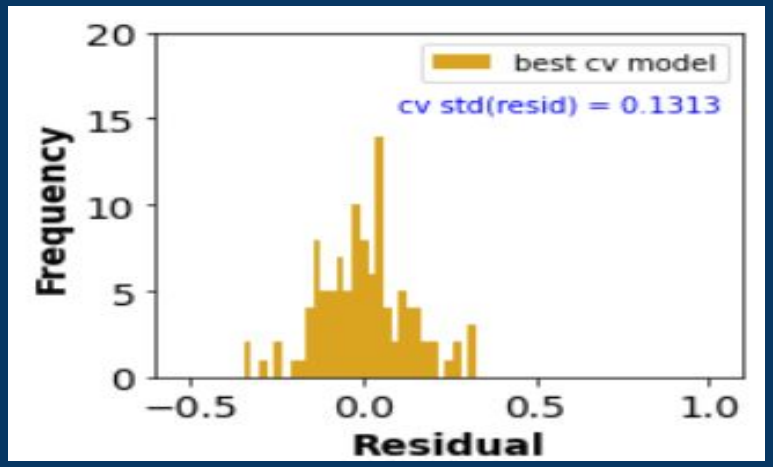


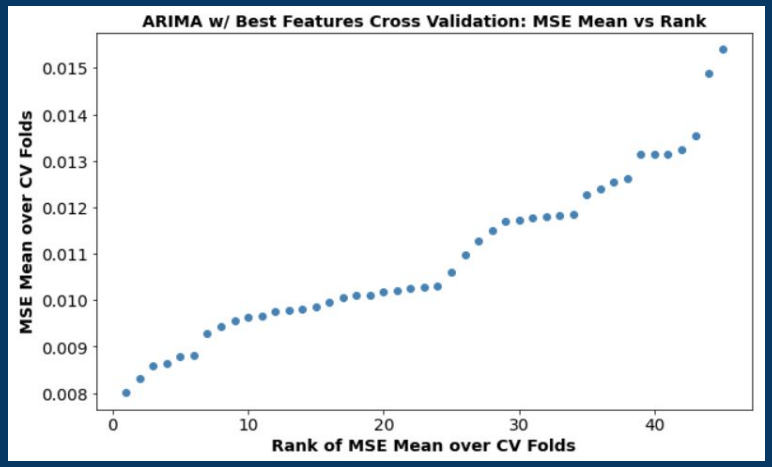
Time Series Results: Fit

- **Full ARIMA**: Train, Test ARIMA(p,1,0) with Exogenous



- **Full ARIMA**: Residuals, Model Selection





Time Series Results: Best Models

1) **Baseline ARIMA**
   a) ARIMA(2,1,0)
2) **Null ARIMA Exog**
   a) ARIMA(0,1,0)
      with { tot_bus_inv_8, ret_sales_2, pmi_man_1, ls_rcvbl_8 }
3) **Full ARIMA**
   a) ARIMA(1,1,0)
      with { pmi_man_1, ls_rcvbl_8 }

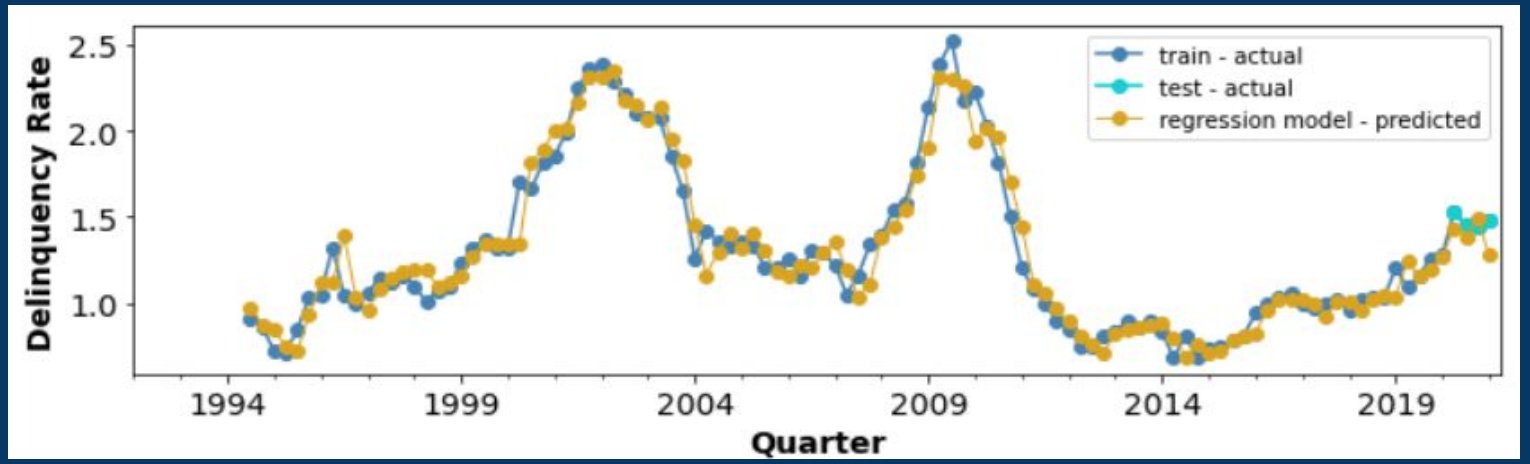
- Autocorrelation at short lags
- Correlations at short and longer lags

Regression Model

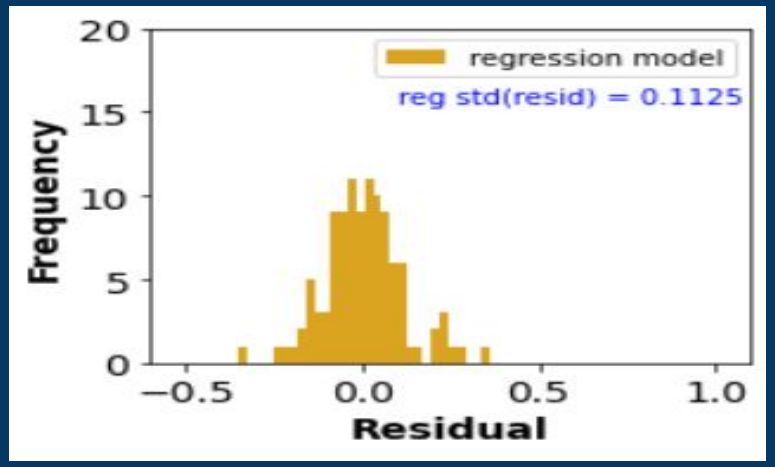
1) Baseline ARIMA
    a) ARIMA(2,1,0)
2) Null ARIMA Exog
    a) ARIMA(0,1,0)
        with { tot_bus_inv_8, ret_sales_2, pmi_man_1, ls_rcvbl_8 }
3) Full ARIMA
    a) ARIMA(1,1,0)
        with { pmi_man_1, ls_rcvbl_8 }
4) Regression Model
    a) delinq_1, delinq_2,
        pmi_man_1, pmi_man_2, pmi_man_3,
        ls_rcvbl_7, ls_rcvbl_8, and ls_rcvbl_9

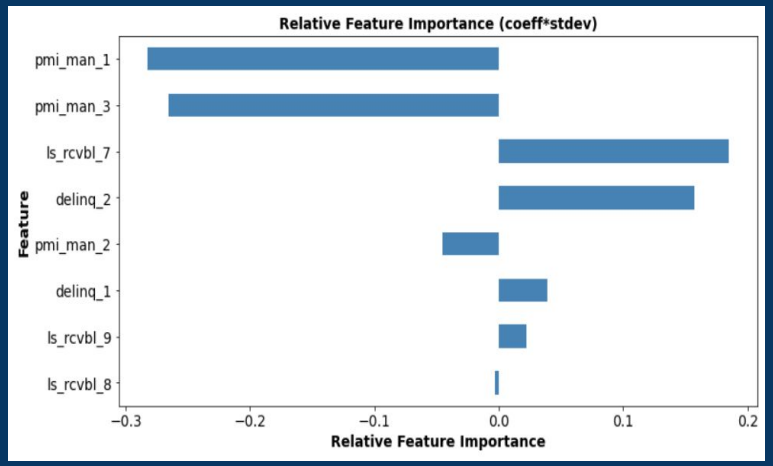
Regression Results: Fit

- **Regression**: Train, Test



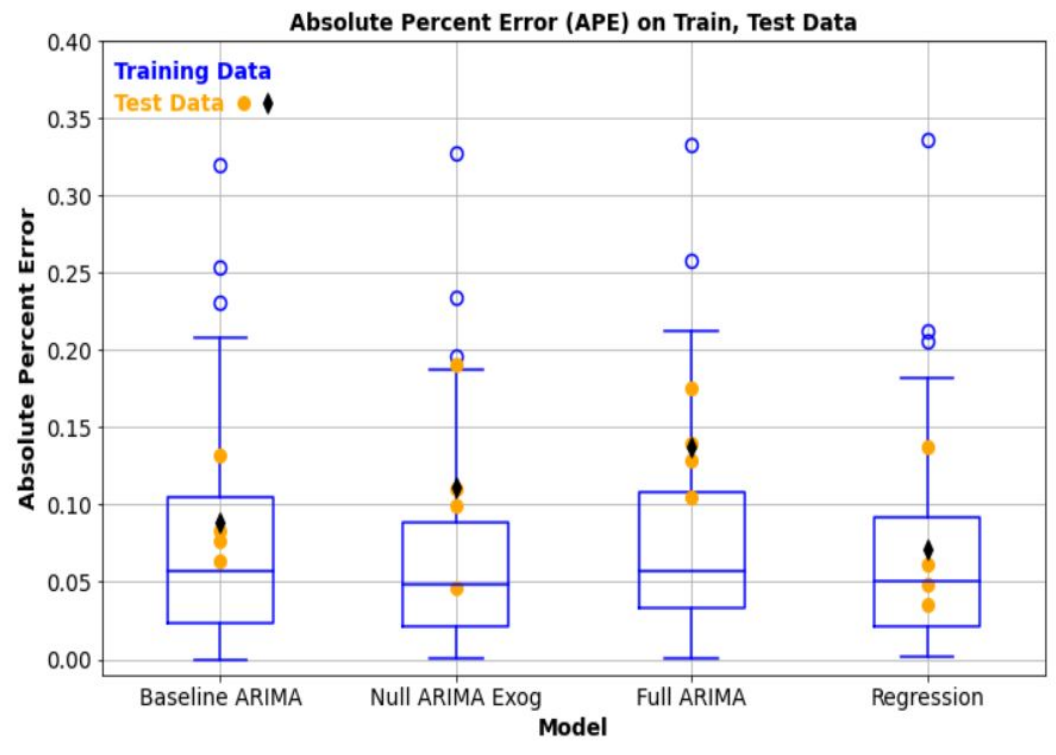
- **Regression**: Residuals, Feature Importance





Comparing Models

- All models fit training data similarly
- Regression, Baseline ARIMA fit test data best



Forecast Test Data

- Test data: { 2020Q2, … , 2021Q1 }
- One-Quarter-Ahead: 2020Q2, 1.53% delinquency rate

Model	MAPE - Test Data	Forecast - 2020Q2	APE - 2020Q2
Baseline ARIMA	8.8%	1.31%	14.5%
Null ARIMA Exog	11.2%	1.38%	10.0%
Full ARIMA	13.2%	1.37%	10.5%
Regression	7.1%	1.44%	6.2%

Recommendations & Next Steps

Recommendations

- Regression for one-quarter-ahead forecast
- Monitor economic series as qualitative leading indicators
- Consider analysis with company-specific data

Next Steps

- Feature engineering to include more features
- Interactions among features, nonlinearity
- Principal Component Analysis for dimensionality reduction