Transmission Trouble Trends

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01 BACKGROUND

- Commercial vehicles generate large volumes of diagnostic data through Diagnostic Trouble Codes (DTCs).
- Identifying patterns across vehicles is challenging, but analyzing DTC sequences and timing can support maintenance and early fault detection

02 OBJECTIVE

Identify Patterns in DTC sequences and Timing. To support predictive maintenance

This Project explores whether machine learning models can:

- Predict which DTC is likely to occur next
- Estimate when a DTC event may occur
- Detect early warning signals of potential transmission issues

03 TOOLS

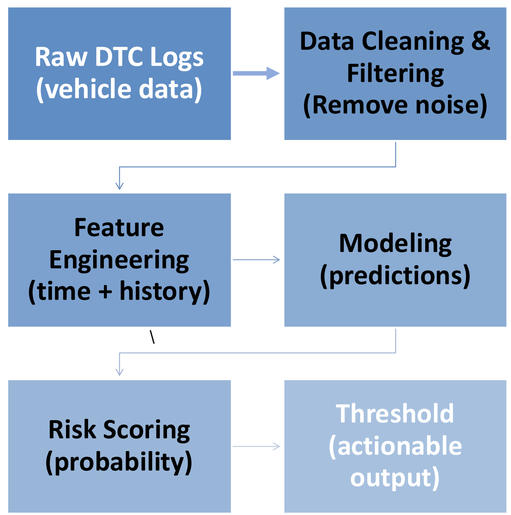
Python | Language for data cleaning, analysis, and TPM modelling.

Python Libraries | matplotlib, pandas, numpy, lifelines (CoxPHFitter, concordance_index)

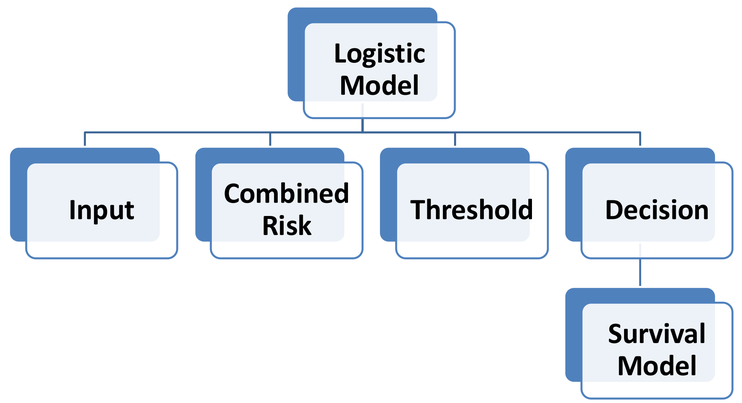
Jupyter | An interactive web-based environment for live-code execution and results, and data visualization.

04 METHODS & PROGRESS

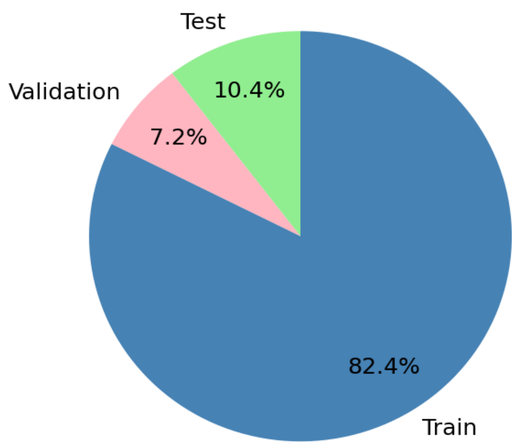
Pipeline



Predictive Decision Framework



Dataset Split by Rows



Top 6 Sequences

Sequence 1: P1 → P3 → P1
Next: P1 | 100% | 184.5 min

Sequence 2: P3 → P1 → P3
Next: 3| 100% | 194.4 min

Sequence 3: P1 → P4 → P1
Next: P1 100% | 438.7 min

Sequence 4: P23 → P9 → P1
Next: P1 | 66.7% | 47.6 min

Sequence 5: P1 → P9 → P1
Next: P1 | 50.0% | 18.7 min

Sequence 6: P9 → P23 → P1
Next: P1 | 22.2% | 527.9 min

05 CONCLUSIONS

We developed a combined modeling approach using:

- Logistic regression for occurrence prediction
- Survival analysis for timing prediction
- Threshold-based classification for actionable decisions

This approach improves both prediction and interpretability

Business Impact

- Enables early detection of potential transmission issues
- Supports proactive maintenance scheduling
- Reduces unexpected downtime and operational costs

06 FUTURE GOALS

- Identify **peak failure timing.**
- Optimize threshold selection.
- Expand to additional fault codes.
- Quantify impact on downtime
- Integrate prediction into maintenance workflows

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