

INTRODUCTION

BACKGROUND

Costco manages a high-velocity supply chain where efficient routing is critical to maintaining warehouse stock. For perishable goods like romaine lettuce, even minor delays can lead to rapid spoilage and unmet consumer demand. While Costco's logistics are robust, severe weather events remain a volatile source of disruption, often forcing reactive rather than proactive decision-making.

PROJECT GOALS

- Anticipate weather-related delays across multiple transit corridors.
- Quantify the financial risk by translating time delays into projected revenue loss.
- Optimize recovery through actionable rerouting recommendations visualized via a real-time command dashboard.

RESULTS

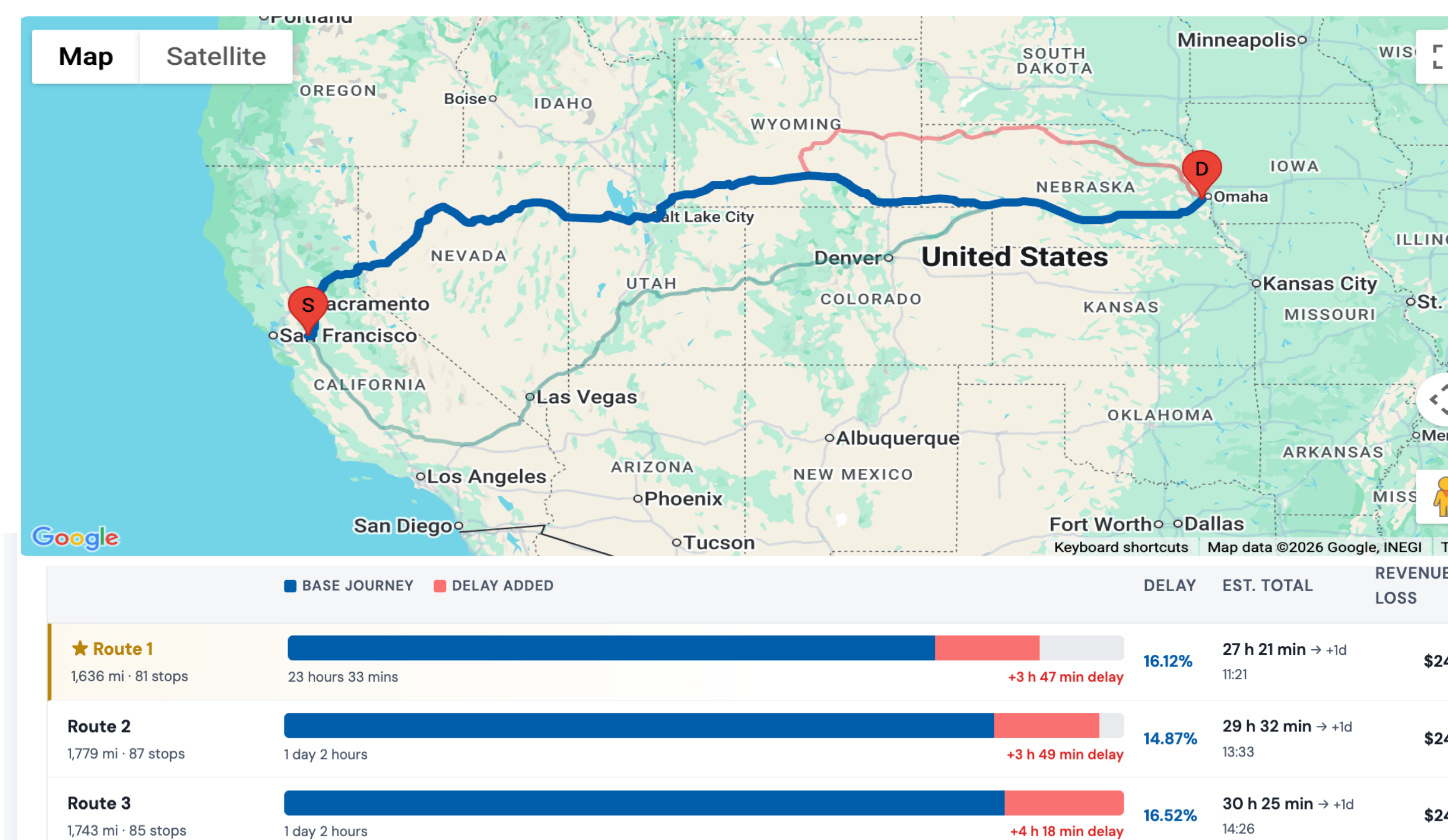
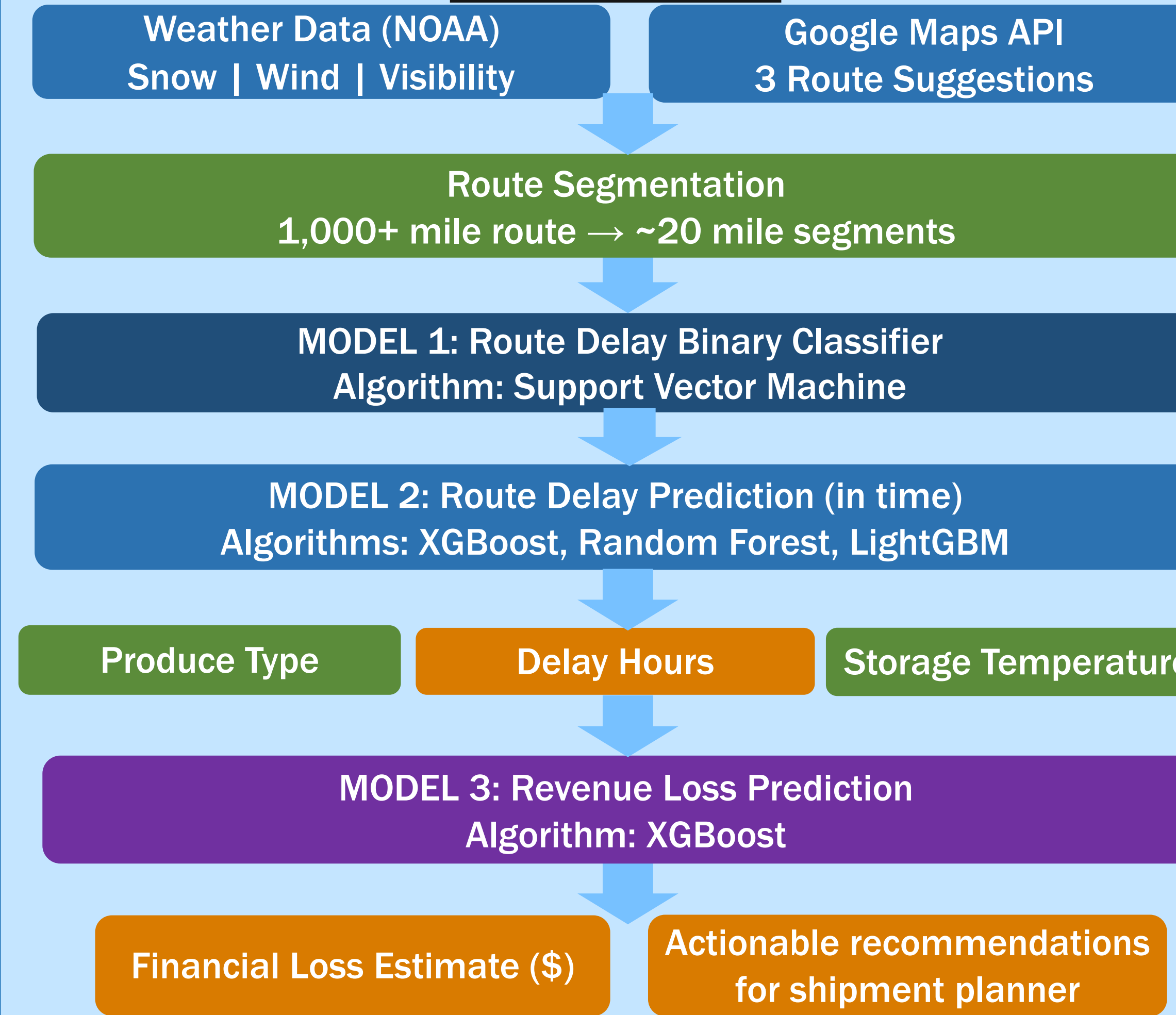
Model	Target Metric	Algorithm	R ² Score
Model 1	Transit Delay %	Random Forest	0.89
Model 2	Revenue Loss \$	XGBoost	0.86

Weather Impact Analysis

HIGH	MED	LOW
Snow (>5cm) 60-70% delay	Low Vis (<0.5mi) 30-40% delay	Rain (>10mm) 10-20% delay

Financial Impact: The "So What?"
72-hr delay, Romaine Lettuce → 99.7% Spoilage → ~\$3,006 Loss

METHODOLOGY



Recommendations Engine

Rule-based engine generates actionable supply chain advice for Costco logistics teams

CRITICAL	Loss > 50%	Postpone shipment, activate backup supplier
WARNING	Loss > 30%	Reduce shipment size, notify stores to adjust inventory
WARNING	Loss > 15%	Monitor weather closely, prepare contingency routing
WARNING	Delay > 48h	Consider alternate route or split shipment
WARNING	Supply HIGH	Source from alternate region, pre-order inventory
INFO	All normal	Proceed with standard shipment schedule

CONCLUSION & FUTURE WORK

3 ML models forming end-to-end prediction pipeline

Weather → **Model 1** (Delay (Y/N)) → **Model 2** (Delay hours) → **Model 3** (Loss \$ with supply risk) → **Action**

Action

- Google Maps API provides 3 candidate routes
- Critical/High risk → reroute or reschedule shipment
- Recommends optimal route to supply chain planner
- Interactive web demo with real-time predictions

Impact

50K+ samples 23 tests 3 ML models \$0-3K loss range

Future Work

- Real Delivery Data** — Replace semi-synthetic training data with actual Costco shipment logs for supervised learning
- Beyond Lettuce** — Extend to other perishable categories (fruits, dairy) with different spoilage characteristics

REFERENCES/ACKNOWLEDGEMENTS

- Thank you to **Costco**, especially our mentors **Pankaj Andhale** and **Prakash Bhandi**, for your guidance and aid during this project.
- Thank you to **The Data Mine** staff and our TAs, **Amruta Gokhale** and **Ronald Tsai**, for their continued support and coordination.
- Thank you to **Varsha Prasanna**, **Preetham Yerragudi**, **Colin Wu**, **Eric Park**, **Bo Zhang**, **Samuel Zhao** and **Claire Mui**, our former project members for their contributions