

# OPTIMIZING CONDITIONED-BASED MAINTENANCE AND INVESTMENT IN SHARED FREIGHT AND PASSENGER CORRIDORS

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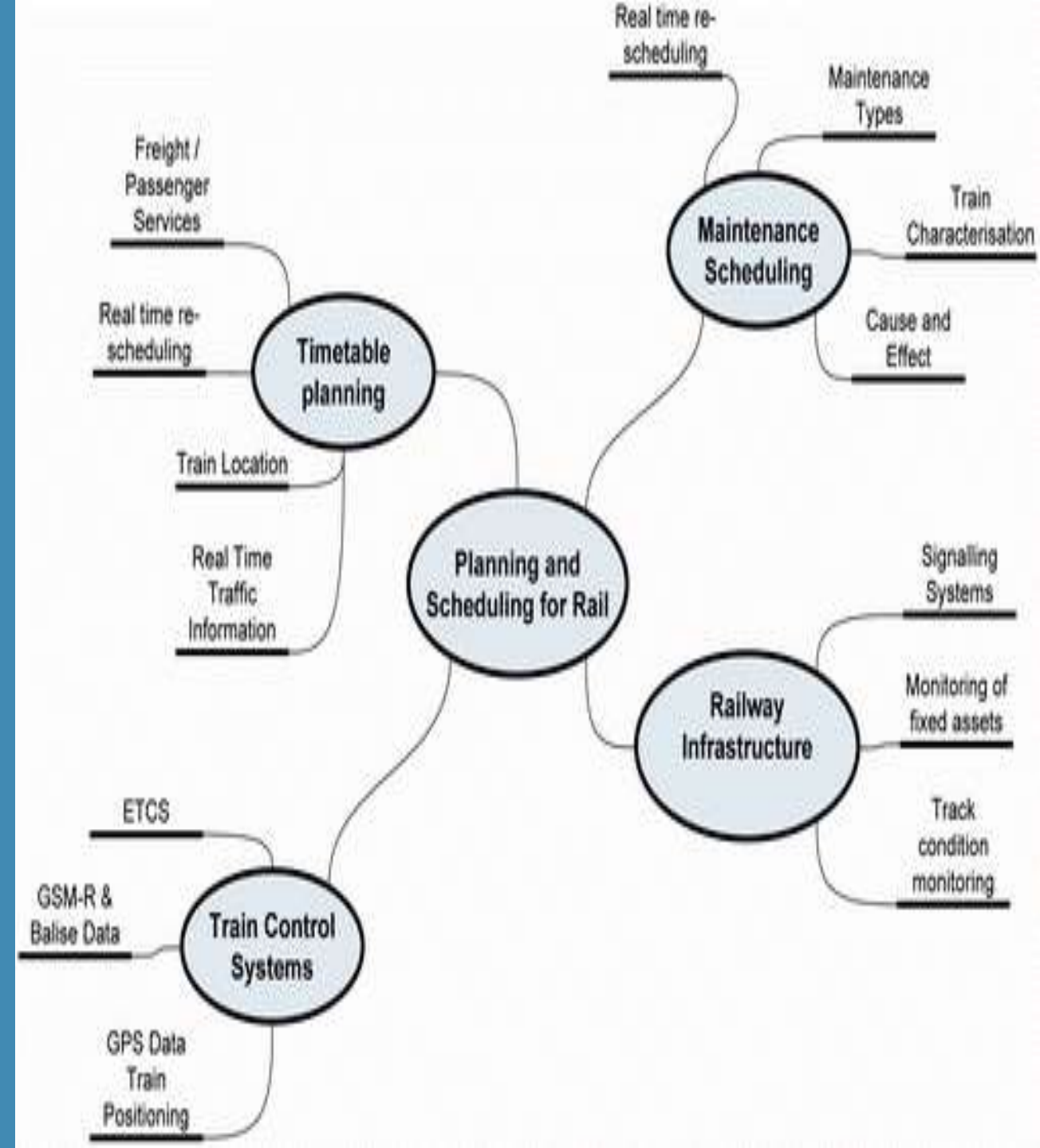
Joint RAS Session/Practice curated: railroad  
maintenance



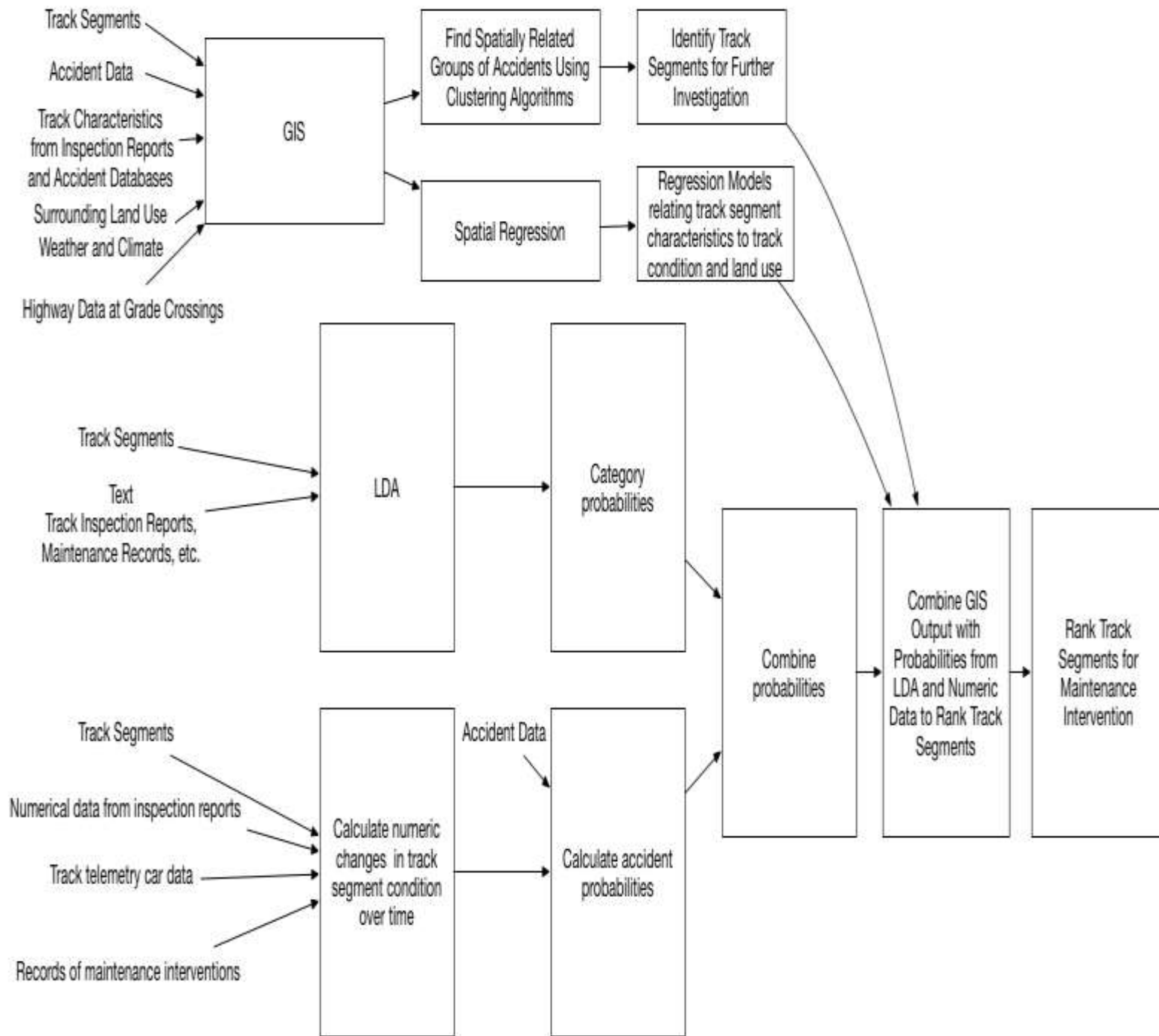
## TOPICS TO BE COVERED

- Calculating Conditional Probabilities in Network-level Scheduling Problems
- Integrating Track Inspection Optimization Models with ERM Optimization Models
- Q & A

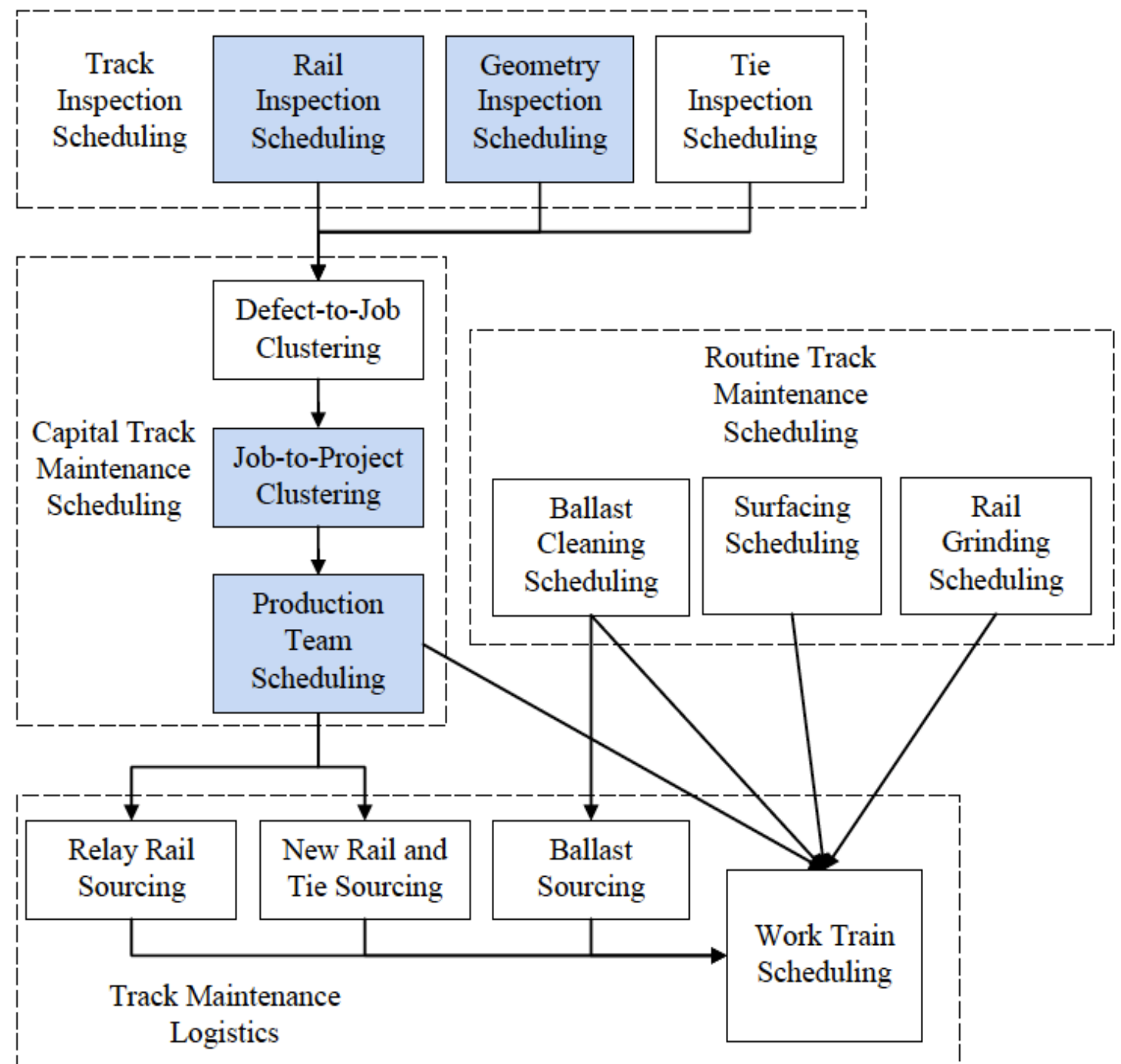
# CALCULATING CONDITIONAL PROBABILITIES IN NETWORK-LEVEL SCHEDULING PROBLEMS



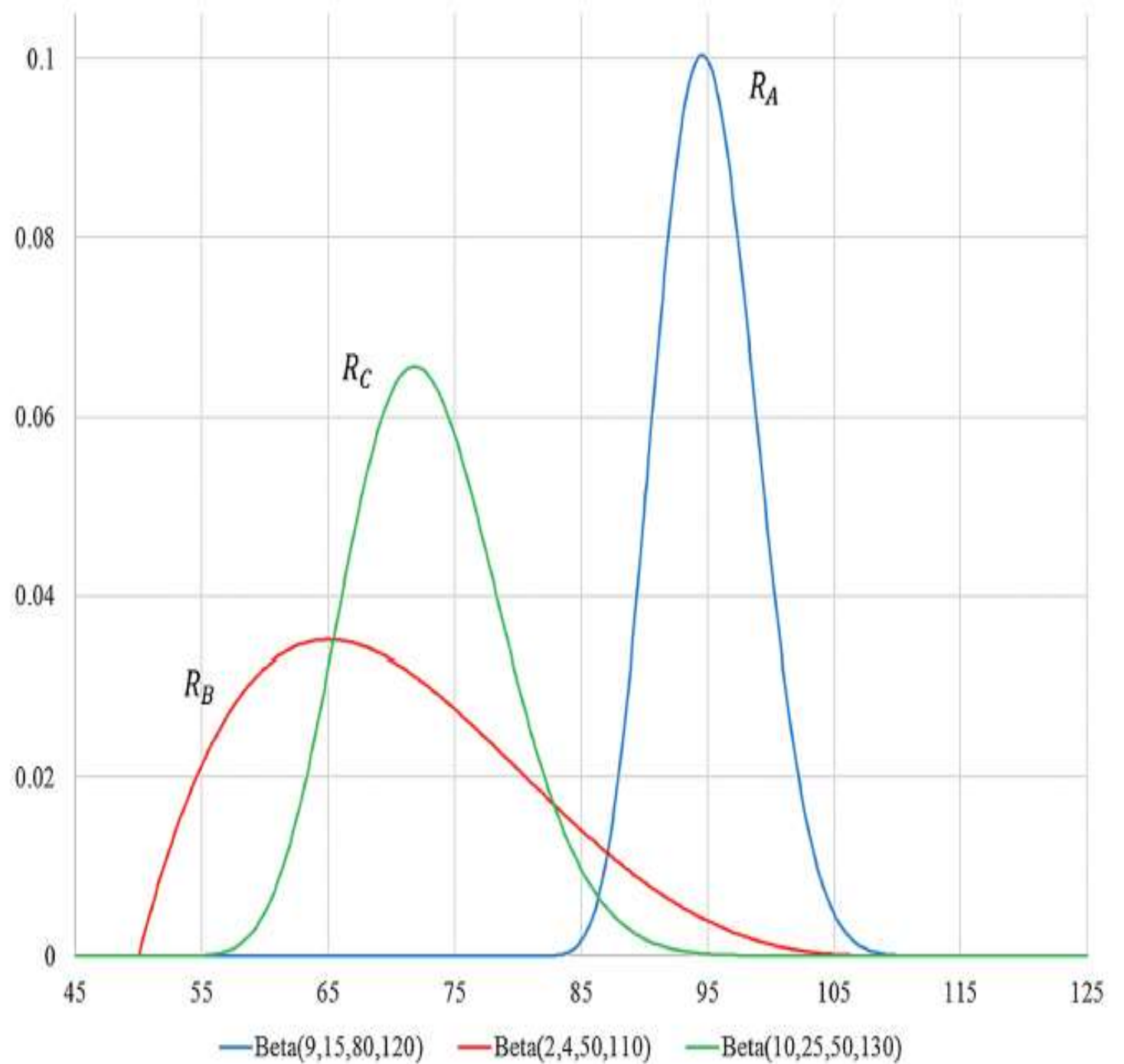
# SPATIAL CLUSTERING / REGRESSION CONDITIONAL PROBABILITIES AND AUTOMATED TEXT & NUMERIC DATA



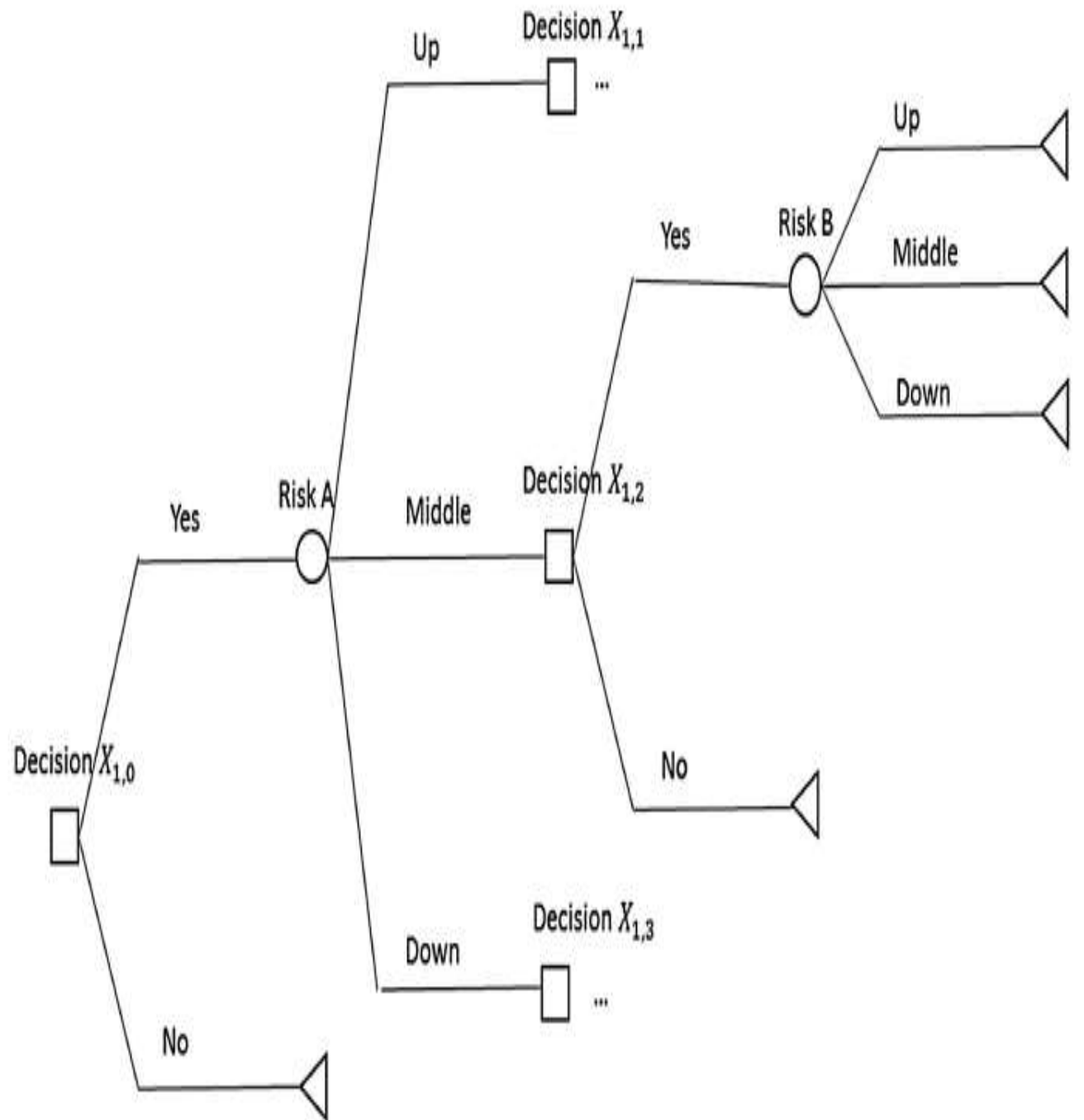
# TRACK INSPECTION SCHEDULING PROBLEM (TISP)



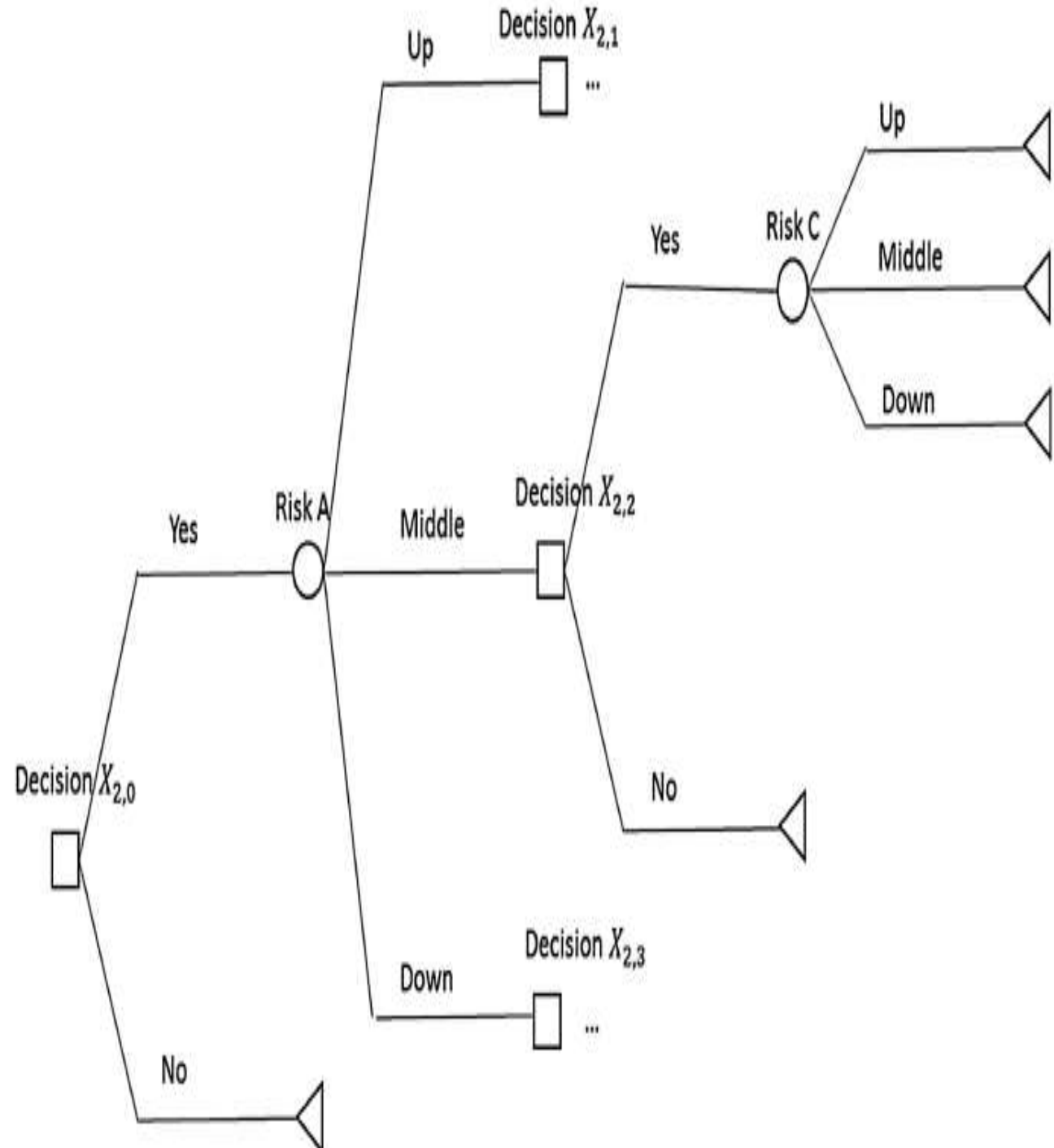
# GRAPHICAL ILLUSTRATION OF MARGINAL DISTRIBUTIONS OF RISK



# TREE STRUCTURE FOR FREIGHT RAILROAD DECISION STRUCTURE



# TREE STRUCTURE FOR PASSENGER RAILROAD DECISION STRUCTURE



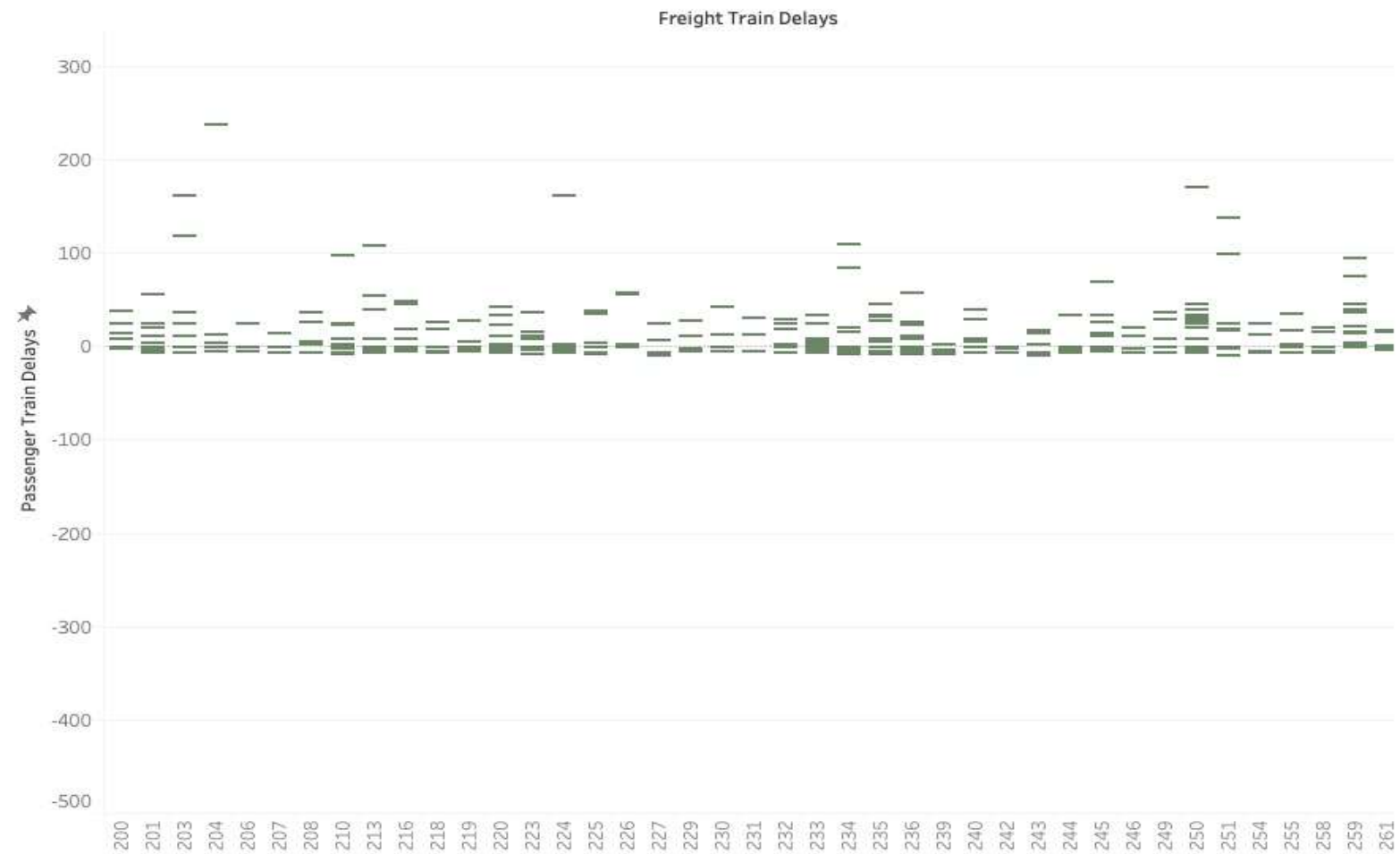


## SHARED CORRIDOR EXAMPLE

- Three Railroads Operate in Shared Corridor
- Owner Railroad is a Freight Railroad – Five Trains per Day
- Passenger Railroad – Six Trains per Day

PASSENGER  
VS FREIGHT  
TRAIN  
DELAYS IN  
MINUTES

Passenger Delays vs. Freight Delays at CP-1



# CONDITIONAL PROBABILITY ESTIMATES OF TRAIN DELAYS

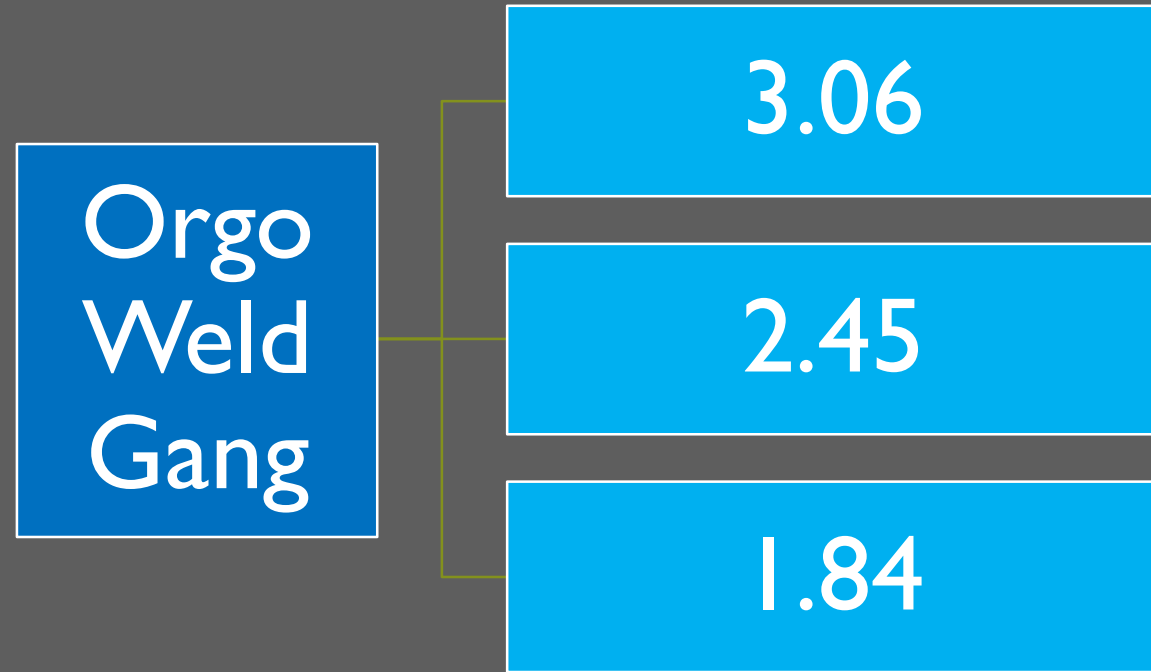
Example of LDA Topic Weights

Delay	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10
1	2.45	-2.06	0.60	-5.34	0.74	-0.82	0.17	-0.08	0.85	0.77
2	-2.15	-1.62	-0.77	0.52	-0.44	-1.25	0.38	0.19	-0.26	-0.48

RISK DIAGRAM  
FOR FREIGHT  
RAILROAD BASED  
UPON  
CONDITIONAL  
PROBABILISTIC  
RATING AND RISK  
APPETITE



RISK DIAGRAM  
FOR PASSENGER  
RAILROAD BASED  
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## CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

- Maintenance log LDA text mining can yield meaningful insights into service delays
- Conditional probability estimates derived from text mining can be used to better inform capital track maintenance scheduling decisions and timing to minimize service delays
- Understanding differing risk appetites for freight vs passenger service delays can assist in coordinating capital track maintenance
- There are significant data cleaning challenges to develop appropriate topic categories but once SME input has been captured, then topics can be used in automated analytics
- Next steps are integrating these tools into dashboard visualizations that can be utilized in the planning and scheduling processes for owner and tenant railroads