

DSLs for Risk Management

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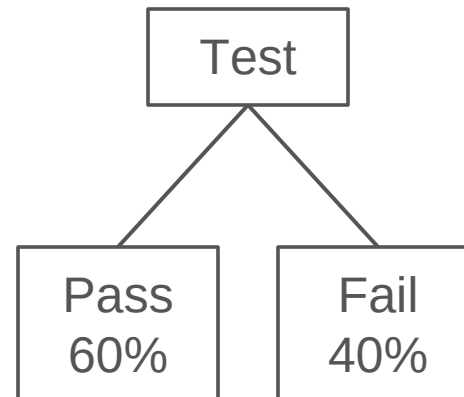
Risks

Risk and probabilities are notoriously difficult to grasp intuitively.

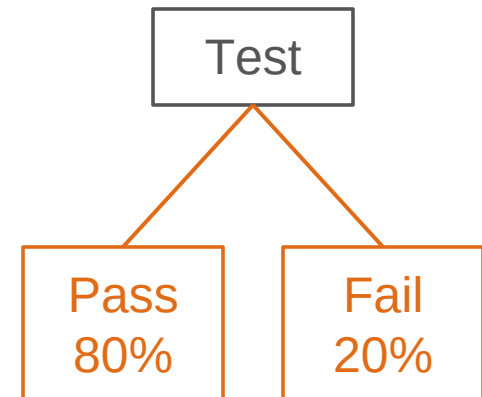
DSLs

Describe complex relationships.
Manipulate assumptions directly.
Explore “what-if” scenarios.

Before



After



Context

Bachelor's thesis in Computer Engineering

Juan José Amores Arenas



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA

METADDEV

Escola Tècnica
Superior d'Enginyeria
Informàtica



etsinf



State of the Art



Statistical tools

SPSS, Minitab
@RISK, Crystal Ball
MATLAB, Mathematica



Modelling foundations

Bayesian networks
Montecarlo simulation
DSLs with Daga

Focus of this work

Interactive Risk Models with probabilities on the graph



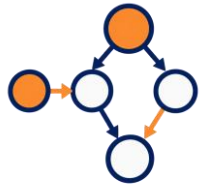
Work done

- Built two DSLs for risk modelling
- Defined the domain concepts and probability rules
- Integrated Daga as the visual diagram editor
- Implemented path calculations, Bayesian inference and Monte Carlo simulation
- Validated both modes with realistic examples



Work done

Two DSLs



Binomial

Weighted paths
Theoretical probabilities
Monte Carlo simulation

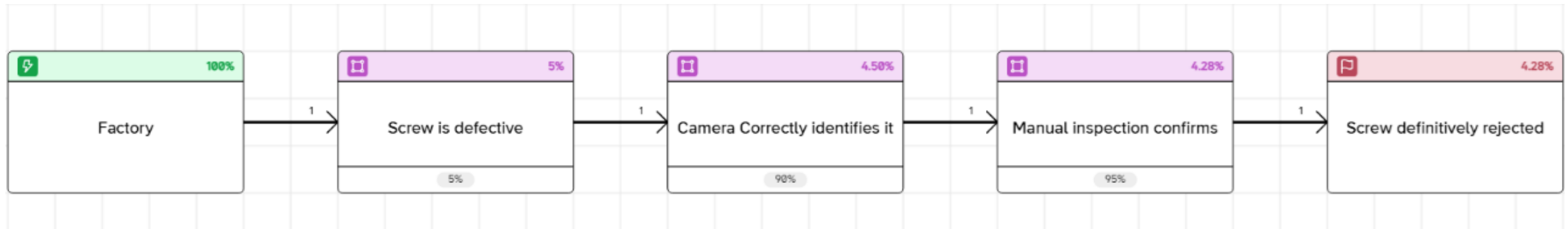


Bayesian

Conditional probability tables
Evidence and inference
Updated marginal probabilities

Demo 1. Binomial. Quality Control

What percentage of all produced screws are definitively rejected?



Binomial model

Change a detection probability and watch the rejection rate update

Demo 2. Bayesian. Falcon 9 Mission

QUESTION

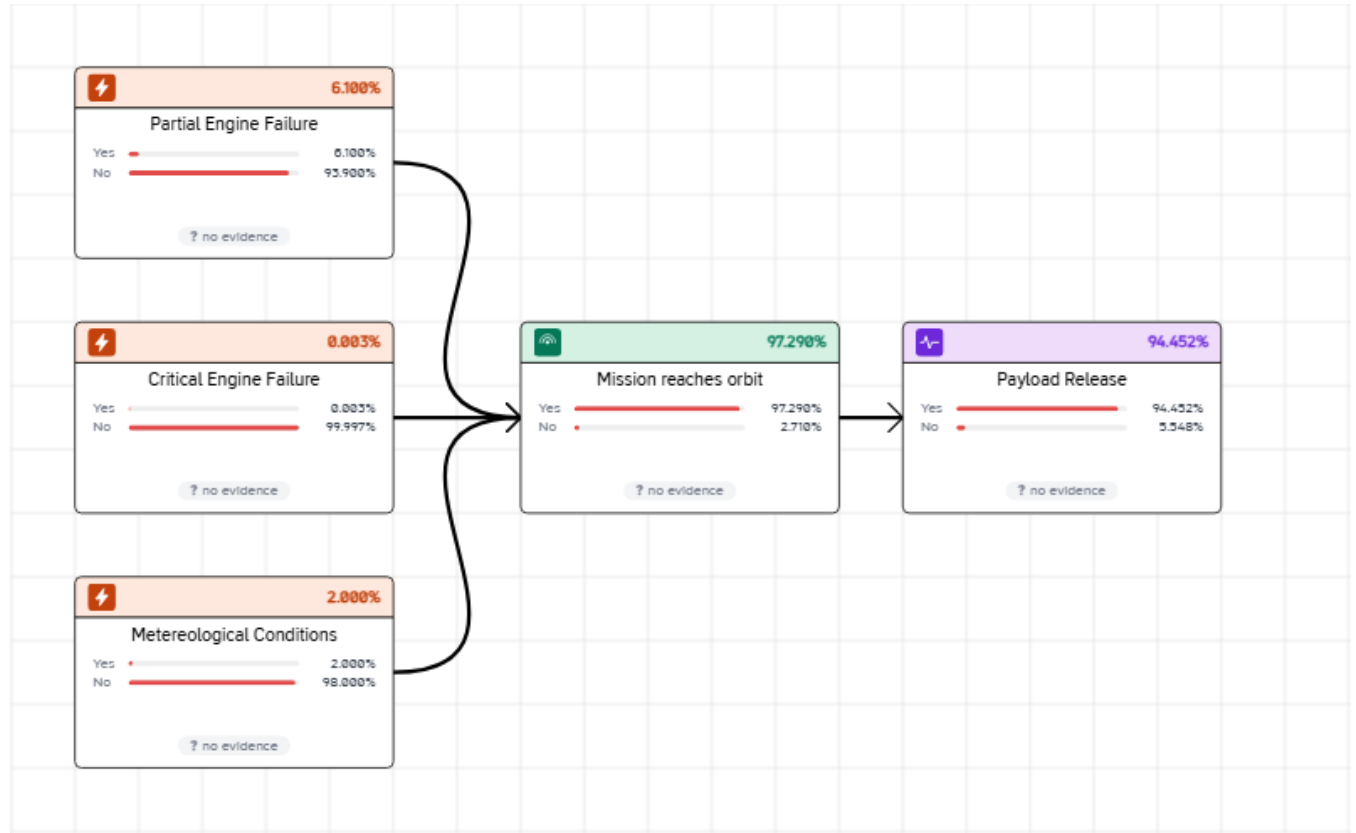
If an engine fails during ascent,
what is $P(\text{reaching orbit})$?

BINOMIAL SUMMARY

9 engines, 0.7% failure risk each.
Group 1–2, and 3+ failures.
Avoid 512 engine combinations.

BAYESIAN UPDATE

Engine status and weather shape orbit
success.
Evidence updates orbit and payload risk.



Potential Use Cases



Engineering

Aerospace and automotive
Fault tree analysis (FTA)



Life sciences

Clinical trial planning



Business

Investment scenarios
Supply chains
Market risk



Security and geopolitics

Cybersecurity risks
Geopolitical scenarios



Roadmap



01

Apricot

Fault Tree Analysis
Mitigation decisions
SysML v2 extension



02

Cybersecurity

Threat modelling
Risk analysis



03

Geopolitics

Scenario analysis
What-if analysis



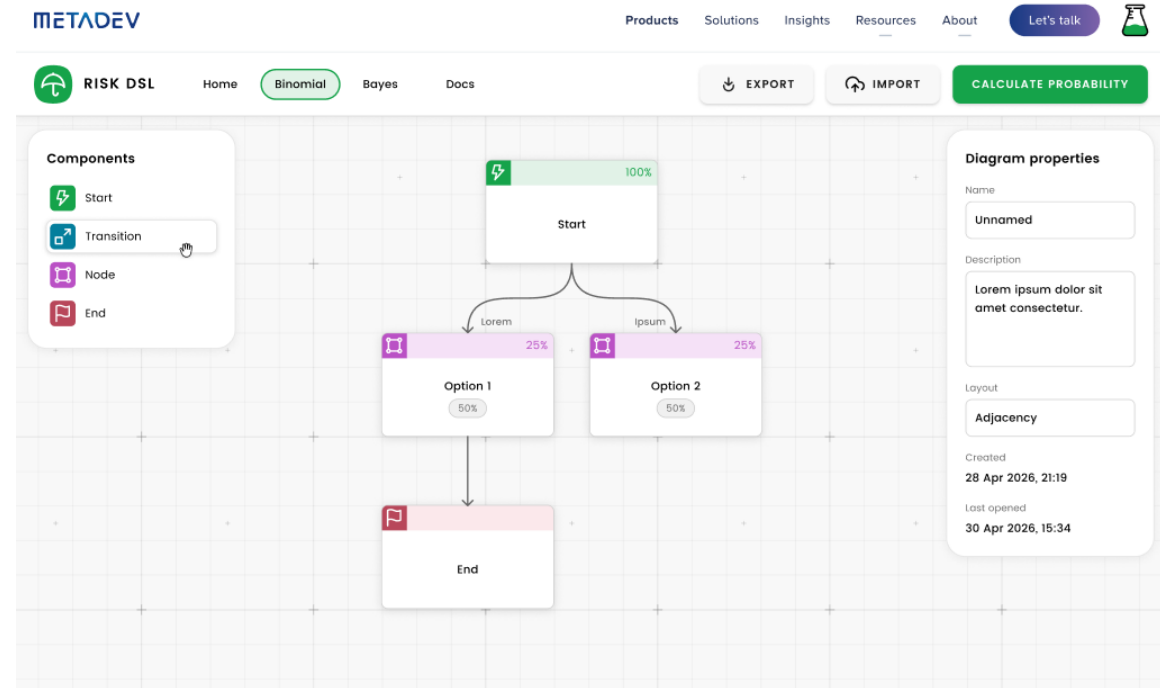
Conclusion

2 DSLs

1 Interactive playground

Model dependencies.
Explore new assumptions.

<https://risk.metadev.pro>



Risk Playground

<https://risk.metadev.pro>