Quant Co. Risk Intelligence Strategy: Parametric Insurance for CAT Events

Team Name: Insuring CAT
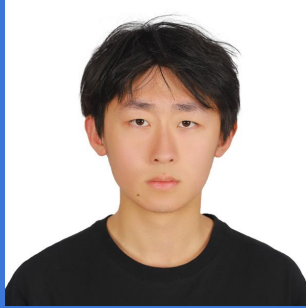Team Number: 20
Quantify 2025 Case Competition

Meet the Team

Bozhao Wang

4th Year Economics / University of Calgary

Data Analyst

www.linkedin.com/in/bozhao-wang-2a63aa218

Min Young Lee

Applied Mathematics / York University

Business Strategic Analyst

www.linkedin.com/in/jason-min-young-lee/

End-to-End Project Flow

CAT Risk Assessment

Identified and analyzed key catastrophic risks impacting Quant Co.'s operations using historical loss data.
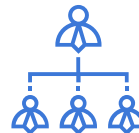
Trigger Development & Validation

Proposed and validated thresholds for wind speed and hail size using public benchmarks and event data.

Machine Learning Modeling

Developed and evaluated models to predict high-loss events. Assessed AUC, precision, and recall.

Strategic Insurance Alignment

Assessed business implications of adopting parametric insurance with Stronghold, focusing on renewable expansion.

Recommendations & Risk Transfer Strategy

Delivered a tailored risk intelligence strategy combining parametric design and coverage diversification.

Project Overview & Research Objective

Company Overview

- Founded in Alberta, Canada, 1954.

- Integrated oil & gas: exploration, refinement, distribution.

- Expanded operations: BC, Prairies, Maritimes.

- Now diversifying into wind & solar farms (ESG-driven).

Objectives

- Identify which CAT events cause the highest financial losses.

- Validate if Stronghold's proposed triggers (wind ≥ 119 km/h, hail ≥ 6.5 cm) are appropriate.

- Build predictive models to classify high-loss events using weather-related features.

- Recommend improved trigger points and support data-informed underwriting.

Data Preparation & CAT Event Landscape

Data Sources & Structure

- Merged 4 datasets: hail, fire, flood, winter storm.

- Unified fields: wind speed, hail size, rainfall, structures destroyed, etc.

- Created binary target variable: "High-Loss Event" = top 25% of losses

- Final dataset: 152 CAT events across 10 years, 4 event types, 11 features

	CAT_Event	Event_year	Total_exposure_in_billions	Total_losses_in_billions	Max_wind_km/h	Hail_scale	Max_rainfall_mm	Hectares_burned
0	Hail_1	2014	537.39536	0.04964	114.33	5.0	0.0	0.0
1	Hail_2	2014	634.39485	0.03346	92.29	0.0	0.0	0.0
2	Hail_3	2015	625.37511	0.14947	75.00	5.0	0.0	0.0
3	Hail_4	2015	463.39562	0.03594	107.96	2.0	0.0	0.0
4	Hail_5	2015	689.34053	0.09089	75.00	3.0	0.0	0.0
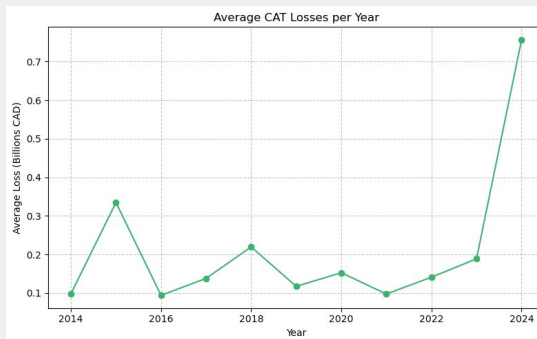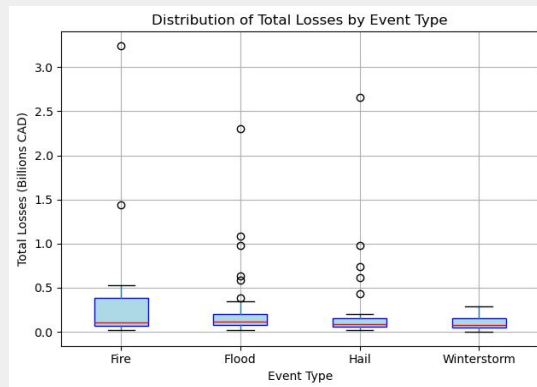
Identifying Major Risks for Renewable Energy Expansion

- Winterstorms and fires drive the highest loss ratios.

- CAT events in provinces like BC and the Prairies show heightened vulnerability.

- Given the concentration of severe losses in winterstorms and extreme wind events, features such as wind speed and hail size are strong candidates for parametric trigger variables.
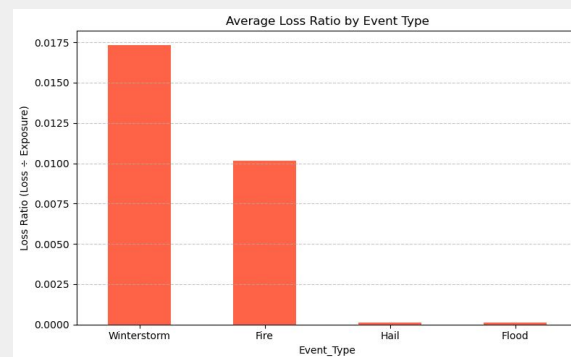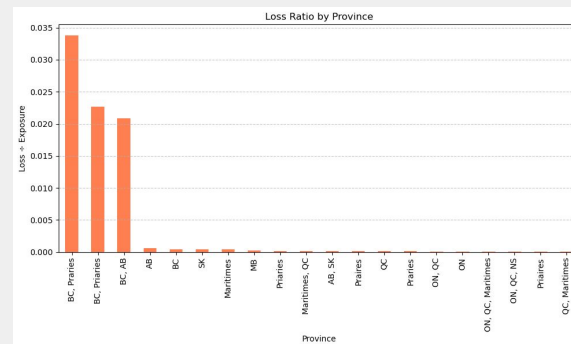
Are the Parametric Triggers Effective?

Wind Trigger (≥119 km/h):

- Based on Saffir-Simpson Scale (hurricane force)
- Threshold appears reasonable, several historical events exceed it
- Aligns with mechanical stress risks in wind turbines

Hail Trigger (≥6.5 cm):

- Based on CatIQ Hail Scale
- Very few events exceed 6.5 cm → risk of undercoverage
- Suggest reducing to 5.5 cm to better match real-world damage while maintaining selectivity

Conclusion:
Stronghold's wind trigger is well-justified, but hail trigger should be refined for practical coverage.
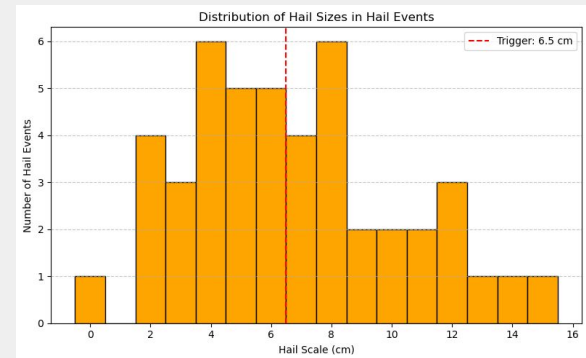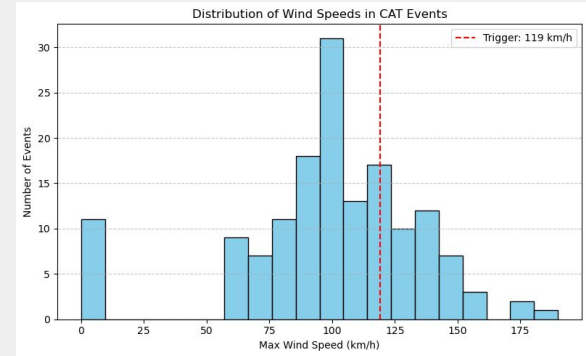
Predicting High-Loss Events: Modeling Approach

Objective: Predict whether a CAT event results in high financial loss using weather-based features.

Target Variable: "High-Loss Event" = top 25% of events by total loss.

Features Used:
- Wind speed, hail size, rainfall
- Structures destroyed, hectares burned
- Event type & exposure

Techniques:
- Supervised classification models:
  Logistic Regression
  Random Forest
  XGBoost

Class Imbalance Handling:
- Used SMOTE to oversample rare high-loss cases.

| Model	Type	Notes
Logistic Regression	Interpretable	Baseline model
Random Forest	Ensemble	Robust to outliers
XGBoost	Gradient Boosted	Best precision, AUC

Model Results & Performance Comparison

Evaluation Focus: Predicting *high-loss* (minority class) accurately
Metrics Used:

- Precision (for payout accuracy)
- Recall (for risk coverage)
- AUC (overall classification power)

Results Summary:

- Logistic Regression: Most balanced recall/precision

- Random Forest: Strong accuracy, weaker recall

- XGBoost: Best precision, good AUC
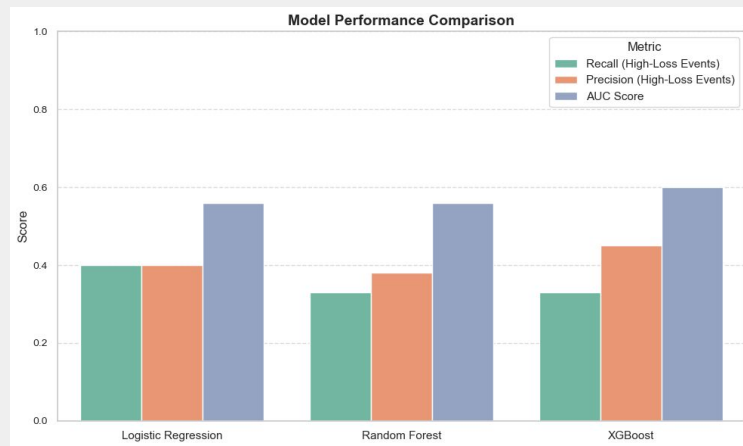
Takeaway:
 While all models support risk segmentation, Logistic Regression and XGBoost offer the best tradeoffs for parametric insurance applications.

Feature Importance Analysis

Top Predictors Identified:

- Wind Speed: consistently top-ranked across all models.
- Structures Destroyed: strongest feature in XGBoost → a proxy for vulnerability.
- Hail Size & Rainfall: significant in hail/flood events.
- Event Type: high-level signal of risk pattern.
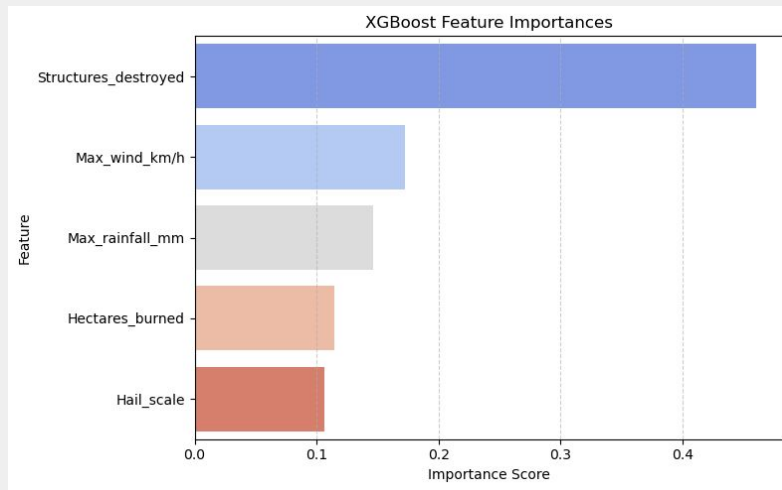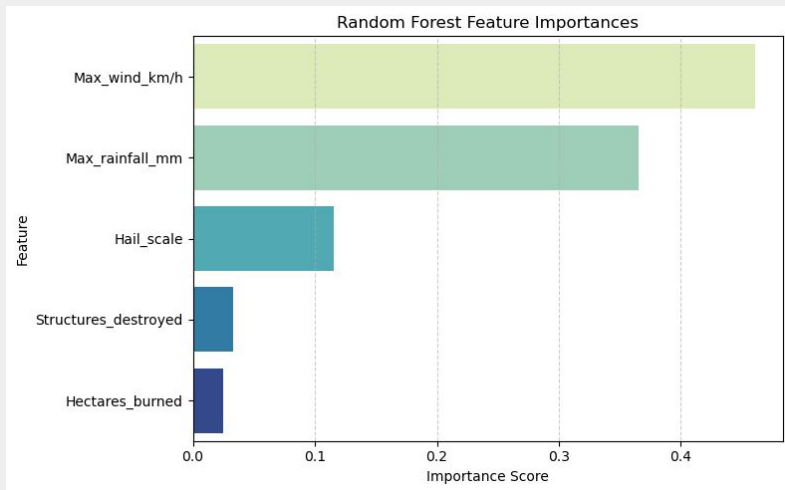
Strategic Strengths of Quant Co.

Vertical Integration	Strong Market Position	Stable Financial Base
Quant Co. owns and controls the full supply chain from exploration to refinement and distribution.	Long-established network across Alberta, BC, Prairies, and Maritimes.	18.85% CAGR in earnings since 2019, with efficient margins even post-pandemic.
Enables greater efficiency, cost control, and adaptability in operations.	Access to infrastructure, contractors, and political capital.	Ample liquidity to support diversification into renewables.

Challenges Facing Oil & Gas Operations

Reputational & ESG Pressures	Regulatory Risk & Carbon Policies	CAT Risk Exposure
Stakeholders are increasingly prioritizing environmental, social, and governance (ESG) criteria. Quant Co. faces rising scrutiny from investors and regulators demanding cleaner, more sustainable operations.	New federal and provincial regulations are imposing stricter emissions targets and reducing incentives for carbon-heavy industries. This increases compliance costs and uncertainty for traditional operations.	Climate-related CAT events such as wildfires and floods have become more frequent and severe, threatening infrastructure, delaying production, and inflating insurance costs for existing oil & gas sites.

Strategic Need for Energy Diversification

Policy Momentum & Public Support	Land Availability in Rural Areas	Complementary to Existing Capabilities	Energy Diversification Reduces Long-Term Risk
Governments across Canada are investing in clean energy infrastructure, offering subsidies, tax incentives, and regulatory support for renewable energy development. Public sentiment is also shifting in favor of sustainable energy, enhancing social license to operate.	Remote regions in Alberta, the Prairies, and the Maritimes provide abundant land for deploying solar panels and wind turbines. These areas also offer favorable wind and solar exposure, improving energy yield and efficiency.	Quant Co.'s logistical experience, energy infrastructure, and contractor relationships can be leveraged to build and manage renewable operations efficiently, creating a low-barrier entry into the new energy sector.	Transitioning into renewables helps hedge against long-term oil demand decline and builds resilience to regulatory and reputational risks.

Feasibility of Renewable Expansion

1. Financial Capability

- Quant Co. has maintained strong earnings growth (18.85% CAGR) and stable cash flow.
- Existing capital reserves can support large-scale infrastructure investment.

2. Operational Synergy

- Existing logistics, contractor networks, and energy infrastructure can be adapted for renewables.
- Vertical integration gives Quant Co. a competitive edge in project rollout and maintenance.

3. Government Support & Market Trends

- Federal and provincial incentives are increasing for wind and solar projects.
- ESG-aligned investment trends make renewable energy more attractive to financiers.

4. Strategic Fit

- Renewable expansion aligns with Quant Co.'s long-term vision for diversification and climate resilience.
- Sitting in rural areas reduces land cost and offers access to natural energy resources (wind, sun).

Natural Disaster Risks Facing Solar & Wind Projects

Wind Farms

- High wind speeds (>119 km/h) can damage turbine blades and stress internal components, even with automatic shutdown systems.
- Rural wind farm sites may be more exposed to extreme wind events due to flat terrain and fewer windbreaks.

Solar Farms

- Large hail (>6.5 cm) can crack or shatter solar panels despite hail-resistant design.
- Risk is elevated in central and western provinces, especially the Prairies and Alberta.

Shared Risks

- Limited emergency response infrastructure in rural areas can delay recovery.
- Rebuild costs and downtime from CAT events may be significant without proper coverage.

These risks emphasize the need for tailored parametric insurance, using event-trigger thresholds aligned with wind speed and hail impact severity.

Strategic Recommendation

We recommend Quant Co. proceed with renewable energy expansion with a regionally tailored parametric insurance strategy to safeguard against natural disaster risks.

Why Proceed with Expansion?

- Strong financial foundation & political capital support investment in solar and wind.
- Long-term ESG alignment strengthens investor and partner appeal.
- Existing infrastructure and rural access support project feasibility.

Mitigate CAT Risk with Parametric Insurance

- Trigger thresholds:
- Wind: ≥ 119 km/h
- Hail: ≥ 5.5 cm
- Benefits:
- Fast payout → quicker recovery
- Fixed premium → predictable budgeting
- Data-driven → transparent & fair

By Prioritize Alberta and Prairies for wind, BC for solar, Quant Co. can make the best use of local weather, lower costs, and existing infrastructure to build clean energy projects more effectively and safely.
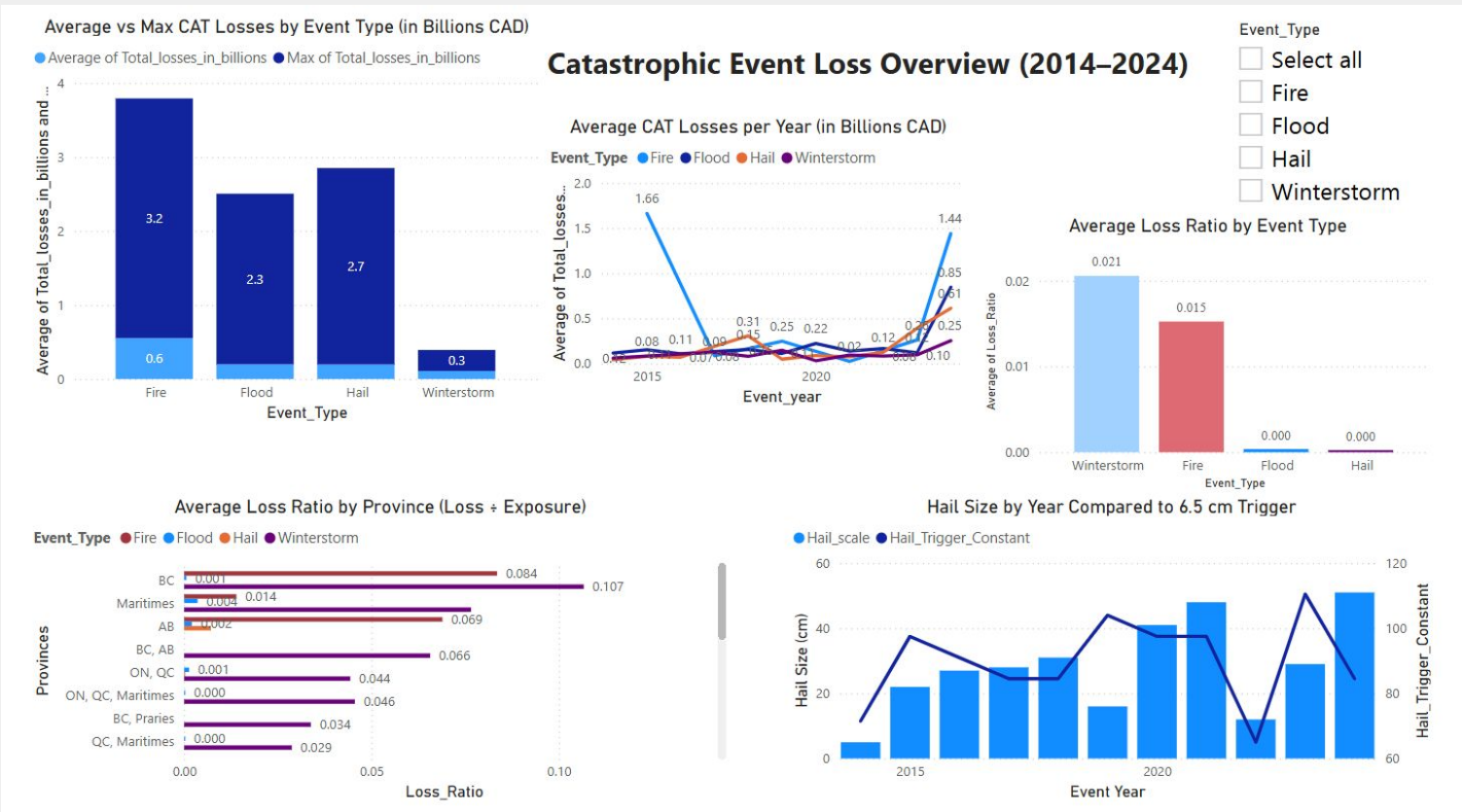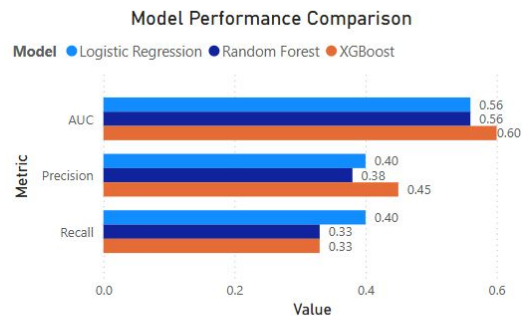
Power BI Demo

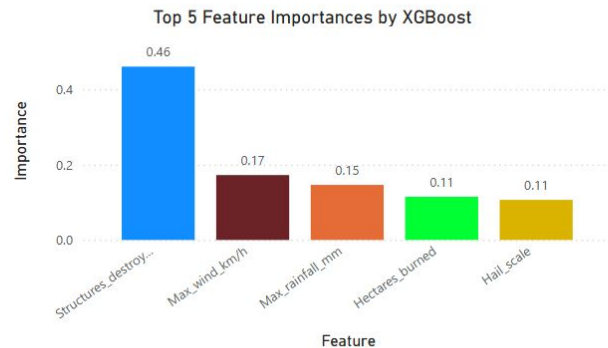For privacy reasons, public access is restricted.

Power BI Dashboard Summary

Power BI Dashboard Summary

Thank You!

Any Questions?