📄 **Case Study**

**AI-Powered Climate Claims Risk Analysis for Munich Re**

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## 1. Executive Summary

This case study presents a full-stack data pipeline developed to analyze and classify climate-related insurance claims for Munich Re. Using a synthetic dataset of 50 records, the project combines Excel for raw data preparation, Python for machine learning and NLP, and Power BI for business visualization. The goal is to enhance claim triaging by identifying high-risk claims and offering actionable insights through automated models and dashboards.

## 2. Introduction

Munich Re is one of the world's leading reinsurers, facing increasing challenges from climate change and extreme weather events. Timely identification of high-risk claims is critical to reduce losses, ensure fair payouts, and improve customer experience. This case study explores an end-to-end AI-driven solution that allows Munich Re to leverage structured data and unstructured text to make smarter decisions faster.

## 3. Methodology

### A. Data Collection & Excel Preprocessing

The pipeline began with a synthetic dataset consisting of 50 climate-related claims. Four sheets were used:

- **Raw Data**: Original data including Date, Location, Event Type, Claim Amount, and Descriptions.
- **Data Cleaning**: Filled missing values, standardized categories, handled nulls.
- **Feature Engineering**: Created new columns such as:
    - Temp_Range (Cold, Moderate, Hot)
    - Rain_Category (None, Light, Heavy)
    - Claim_Risk_Level (Low, Medium, High)
- **Pivot Analysis**: Summary tables for aggregated insights.

### B. Python Processing & Machine Learning

Using pandas, scikit-learn, and LabelEncoder, the cleaned data was transformed and classified using a **Random Forest Classifier**. The model predicted the Claim_Risk_Level based on features such as:

- Event Type

- Temperature
- Rainfall
- Year & Month

**Model Accuracy:** 86% on test set
**Key Influencers:** Rainfall, Event Type, Temperature

**C. NLP with Hugging Face Transformers**

Customer claim descriptions were analyzed using the facebook/bart-large-mnli model. Each report was categorized into severity levels:

- Minor
- Moderate
- Severe

**Example:**

*"Storm caused major damage to the roof and flooded the basement."*
→ Predicted as: **Severe**

**4. Power BI Visualization**

The processed data was visualized using Power BI. Key visuals included:

- **Bar Chart**: Total Claim Amount by State
- **Stacked Column Chart**: Event Type vs Risk Level
- **Donut Chart**: Distribution of Claim Risk Levels
- **Line Chart**: Monthly Trends
- **Slicers**: Interactive filters for Year, Event Type, and State

These visualizations offered a clear, real-time view of how claims are distributed and where the company should focus resources.

**5. Key Insights**

- Flood and Storm events contributed to the highest volume of high-risk claims.
- Bavaria consistently showed higher claim averages.
- NLP analysis revealed ~15% of customer descriptions indicated severe damages.
- Winter months showed an increase in snow-related high-risk events.

**6. Business Impact for Munich Re**

The pipeline provides the following benefits:

- 🎯 **Faster triage** of risky claims
- 🧠 **NLP-enhanced severity detection**
- 📈 **Predictive modeling** of future high-risk trends
- 📉 **Reduced fraud and overpayment risks**

This AI-powered framework supports Munich Re's efforts to modernize its operations in the face of increasing climate volatility.

**7. Conclusion & Recommendations**

This project successfully implemented a full-stack insurance analytics solution tailored for Munich Re. The models and visuals built can be scaled to larger datasets, integrated with weather forecasting APIs, and used to auto-prioritize incoming claims.

**Next Steps:**

- Automate monthly data refresh
- Integrate real weather feeds
- Deploy NLP engine on live customer reports

**Appendix (Optional)**

| Feature Name | Derived From | Description |
|---|---|---|
| Temp_Range | Temperature (°C) | Cold (<10°C), Moderate (10–25°C), Hot |
| Rain_Category | Rainfall (mm) | None, Light (<20 mm), Heavy (≥20 mm) |
| Claim_Risk_Level | Claim_Amount (€) | Low (<€7K), Medium (€7K–13K), High |

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