Credit Card Fraud Risk Analysis & Monitoring Dashboard

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Tools Used: Power BI, SQL, MS Excel, MS Word

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Version: 1.0

Executive Summary

The **Credit Card Fraud Risk Monitoring Dashboard** project was undertaken to identify, evaluate, and monitor potential fraud risks within a credit card transaction dataset. With financial institutions experiencing a steady rise in fraudulent activities, this project aimed to leverage **data analytics and visualization** to uncover underlying trends, detect anomalies, and enhance decision-making for proactive risk mitigation.

The analysis began with **data cleaning and preprocessing in Microsoft Excel**, ensuring the removal of inconsistencies and noise to improve data integrity. Structured **SQL queries** were then utilized to explore key fraud indicators such as transaction volume, fraud ratio by region, and temporal risk patterns. Subsequently, **Microsoft Power BI** was employed to design an interactive dashboard using the Power Query feature for data transformation and advanced visualization.

The final dashboard provides an **integrated view of Key Performance Indicators (KPIs)** and **Key Risk Indicators (KRIs)** such as total transactions, fraud percentage, high-risk segments, and state-wise fraud distribution. It enables business stakeholders to efficiently monitor fraud trends, identify vulnerable areas, and make informed policy and operational decisions.

Objectives

The main objectives of this project are to:

- Identify and visualize fraudulent credit card transactions across regions, categories, and time periods.
- Monitor fraud risk levels and classify transactions into low, medium, high, and critical risk categories.
- Enable data-driven decision-making to mitigate financial risk exposure and strengthen anti-fraud controls.
- Support strategic and operational risk functions by tracking both key performance indicators (KPIs) and key risk indicators (KRIs).
- Design an interactive Power BI dashboard that allows stakeholders to filter and analyze fraud trends dynamically by state, category, or fraud type.

Data Description

- Data Source: Simulated/aggregated transactional data from credit card systems.
- Total Records: ~200,000 transactions.
- Key Fields:
    - Transaction_ID – Unique transaction identifier.
    - Transaction_Amount – Total transaction value.
    - Fraud_Type – Categorized as *Card Not Present*, *Card Skimming*, etc.
    - Fraud_Risk_Level – Categorized into *Low, Medium, High, Critical*.
    - Transaction_Category – Apparel, E-commerce, Electronics, Food Delivery, Groceries.
    - State – Geographical region where the transaction occurred.
    - Month – Time dimension to study seasonal or periodic fraud patterns.
    - Is_Fraudulent – Binary variable (Yes/No).

- Data Cleaning:
    - Removed duplicates and null values.
    - Standardized categorical values (e.g., “E-comm” → “E-commerce”).
    - Applied data type corrections for numerical and date fields.

Methodology

- Data Ingestion
  Imported transactional dataset into Power BI Desktop and pre-processed using Power Query.
- Data Modeling
  - Created relationships between Transaction, Fraud_Type, and Risk_Level tables.
  - Built DAX measures for KPIs like total fraud amount, fraud rate %, and high-risk transaction count.
- Dashboard Design
  - Adopted professional-level color palette (lime green and white background for clarity).
  - Used cards for top-level KPIs and bar/line/donut charts for trend and categorical analysis.
  - Added slicers (filters) for *Fraud Type, Risk Level, State,* and *Transaction Category* for dynamic interactivity.
- Fraud Risk Segmentation
  - Defined risk thresholds based on the percentage of fraudulent transactions and transaction amount distribution.
  - Classified risk levels as:
    - Low: < 15% fraud ratio
    - Medium: 15–30%
    - High: 30–45%
    - Critical: >45%
- KPIs and KRIs were defined to measure fraud trends and operational risk exposure.

Metric Type	Metric Name	Formula / Calculation Logic	Interpretation
KRI	Fraudulent Transaction %	Fradulent Transaction % = DIVIDE('Credit Card Fraud Risk Analysis'[FRAUDULANT TRANSACTION],COUNTROWS('Credit Card Fraud Risk Analysis'),0)*100	Measures percentage of fraud incidents.
KPI	Fraudulent Transaction Amount	Fradulent Transaction Amount = CALCULATE([Total Transaction Amount],'Credit Card Fraud Risk Analysis'[IsFraud]=1)	Indicates total financial impact of fraud.
KRI	Critical Risk Transaction %	Critical Risk Transaction = DIVIDE(CALCULATE(COUNTROWS('Credit Card Fraud Risk Analysis'),'Credit Card Fraud Risk Analysis'[Fraud Risk]="Critical"),COUNTROWS('Credit Card Fraud Risk Analysis'),0)*100	Identifies portion of severe frauds.
KPI	Fraudulent Transactions Count	FRAUDULANT TRANSACTION = CALCULATE(COUNTROWS('Credit Card Fraud Risk Analysis'),'Credit Card Fraud Risk Analysis'[IsFraud]=1)	Assesses organization's count of total Fraudulent transactions happened.

Metric Type	Metric Name	Formula / Calculation Logic	Interpretation
KPI	Top fraud type	Top Fraud Type = VAR TopType= TOPN(1,SUMMARIZE('Credit Card Fraud Risk Analysis', 'Credit Card Fraud Risk Analysis'[Fraud Type], "Fradulent Count", CALCULATE(COUNTROWS('Credit Card Fraud Risk Analysis'),'Credit Card Fraud Risk Analysis'[IsFraud]=1)),[Fradulent Count],DESC) RETURN MAXX(TopType, 'Credit Card Fraud Risk Analysis'[Fraud Type])	Identifies most common type of fraud.

Table 1.0: KPIs and KRIs

Insights & Observations

1. Fraud Distribution:
    - Total fraudulent transactions: 286, representing 28.6% of total transactions.
    - Fraud is concentrated in Card Not Present transactions, especially under E-commerce and Electronics categories.
2. Risk Exposure:
    - Critical risk transactions account for 10.7%, indicating a substantial exposure to high-value frauds.
    - Low-risk category holds 42.42%, suggesting strong fraud control mechanisms in certain transaction segments.
3. Geographical Trends:
    - States such as Maharashtra, Karnataka, and Rajasthan report higher fraudulent transaction volumes.
    - Indicates potential need for region-specific fraud control frameworks.
4. Temporal Pattern:
    - A visible surge in fraudulent transactions in December, suggesting seasonal fraud risk peaks during the holiday period.
    - The lowest fraudulent activity is seen in February, implying effectiveness of post-holiday monitoring efforts.

Strategic Recommendations

- **Strengthen Controls for Card-Not-Present Transactions**
  - Implement multi-factor authentication and AI-based anomaly detection to reduce this risk category.
- **Enhance Regional Monitoring**
  - Deploy regional fraud detection units in high-risk states to address localized patterns.
- **Predictive Risk Scoring Integration**
  - Apply ML-based predictive scoring (using logistic regression or random forest) to classify upcoming transactions as potentially fraudulent.
- **Automated Alerts and Workflow Integration**
  - Integrate Power BI dashboard with email alerts for high or critical risk thresholds.
- **Compliance and Strategic Risk Alignment**
  - Align findings with **ISO 31000** risk management principles and **Basel II/III operational risk frameworks**.
  - Develop KRIs that continuously monitor operational, compliance, and reputational risks.

Tools & Technologies

1. Microsoft Excel – Utilized for initial data cleaning, removing noise, and handling missing or inconsistent values from the raw CSV dataset.
2. SQL – Applied to extract insights and perform exploratory data analysis by running key aggregation and filtering queries on the cleaned dataset.
3. Microsoft Power BI – Used for data pre-processing through *Power Query*, building data models, and developing an interactive dashboard that visualizes key insights, KPIs, and KRIs.
4. Microsoft Word – Employed for documenting the analysis process, insights, and recommendations in a structured project report format.

Conclusion

The Credit Card Fraud Risk Monitoring Dashboard successfully transforms raw transactional data into actionable intelligence for risk mitigation and decision-making. Through a structured approach involving data cleaning, SQL-based exploration, and Power BI visualization, this project highlights how data-driven strategies can identify, monitor, and control potential financial risks in real time.

The analysis revealed a fraud rate of 28.6%, with critical-risk transactions accounting for 10.7% of the total volume, underscoring the need for enhanced fraud detection mechanisms. The concentration of fraud incidents in specific states and months suggests clear geospatial and temporal patterns that can help financial institutions strengthen region-specific controls and season-based monitoring.

The dashboard provides a unified view of KPIs and KRIs, enabling stakeholders to assess both performance and exposure across multiple dimensions — fraud type, category, risk severity, and geography. By integrating such analytics into ongoing business operations, organizations can transition from reactive monitoring to proactive risk management, enhancing their overall resilience against fraud.

Future improvements could include predictive modeling for fraud probability scoring, automation of alerts using AI-driven anomaly detection, and integration with compliance dashboards for holistic strategic risk oversight.

References

1. Simulated Credit Card Dataset (Kaggle / Synthetic Data)
2. ISO 31000 Risk Management Principles
3. Power BI Official Documentation