

Mathematics & Statistics

Indian Institute of Technology Kanpur

Project 6

Credit Card Risk

Presented by

~ Group 14

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Model & Results

Objective: Assess whether the number of consumer complaints increased significantly in the last 2 years (post-Jan 2022).

Model: $\text{Complaints}_t = \beta_0 + \beta_1 \cdot \text{Time}_t + \beta_2 \cdot \text{Intervention}_t + \beta_3 \cdot (\text{Time}_t \times \text{Intervention}_t) + \epsilon_t$

where Time_t : Time trend

Intervention_t : 1 if $t \geq \text{Jan 2022}$, else 0

$\text{Time}_t \times \text{Intervention}_t$: Captures change in slope post-intervention

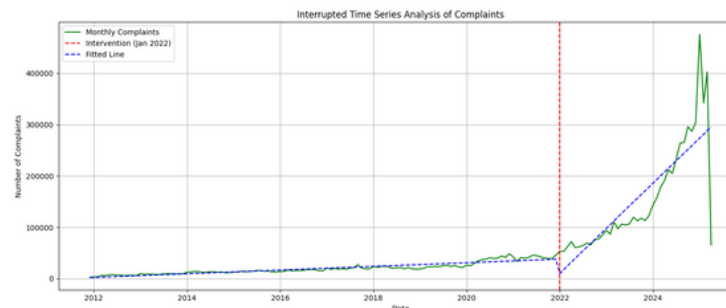
Results:

Variable	Coef.	Std. Err.	t	P-value
Intercept (β_0)	1749.37	5545.06	0.32	0.753
Time (β_1)	298.32	78.89	3.78	<0.001
Intervention (β_2)	-884,400	59,200	-14.94	<0.001
Time \times Intervention (β_3)	7020.16	422.58	16.61	<0.001

Conclusions: Strong statistical evidence of a structural change post-Jan 2022. Both the level and slope of complaints have significantly increased.

$$R^2 = 0.852, \text{AIC} = 3784, \text{F-stat} = 301.2 (p < 0.001)$$

Visualisation of Results:



Approach to Analyzing Complaint Growth

➤ **Objective:** Investigate which banks show the steepest growth in complaints volume using time-series analysis.

➤ **Steps Taken:**

01

Aggregated complaints over time for each company and found CAGR for Complaints.

02

Retrieved company stock values in 2011 and 2025 to compute CAGR (Compound Annual Growth Rate) of financial performance through stock price.

03

Introduced a new metric:

$$\text{New Metric} = \frac{\text{Complaint CAGR}}{\text{Stock CAGR}}$$

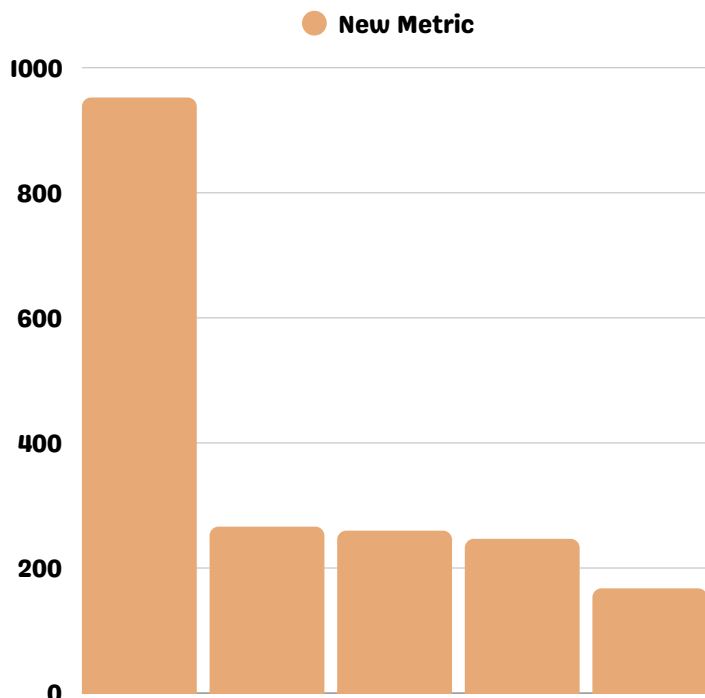
04

Ranked companies by:

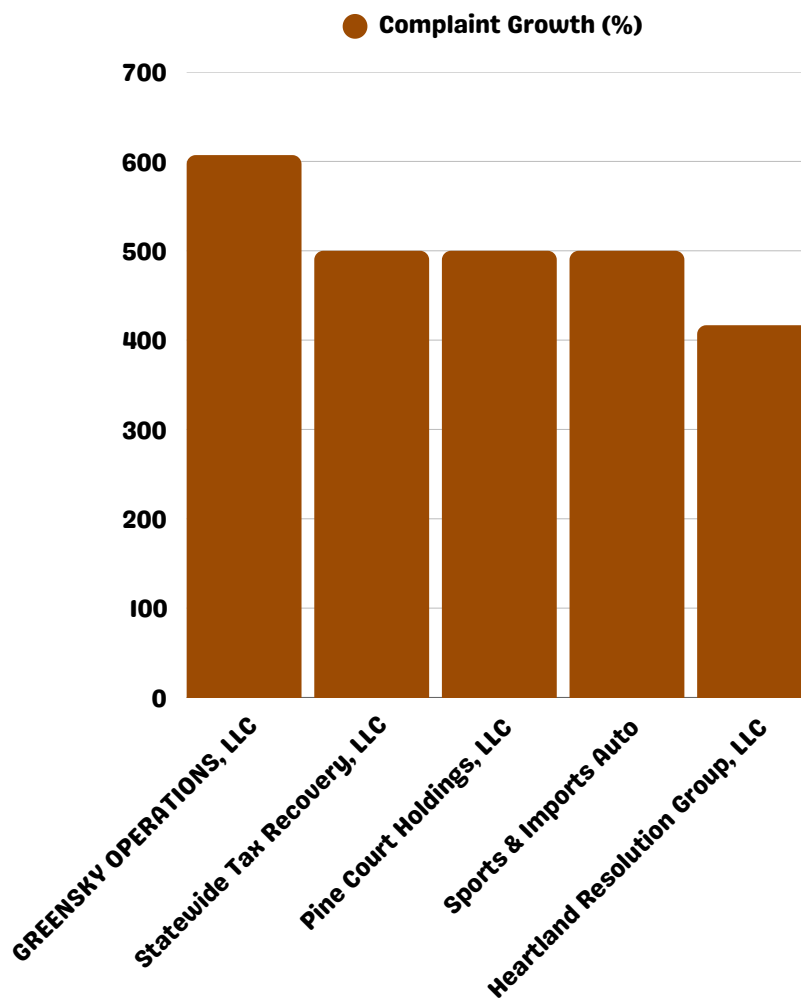
- Highest complaint growth rates.
- Highest value of the new metric to capture disproportionate complaint growth.

Ranking of Banks Based on Complaint Analysis

Top 5 Banks by New Metric
(Complaint Growth / Stock Growth):

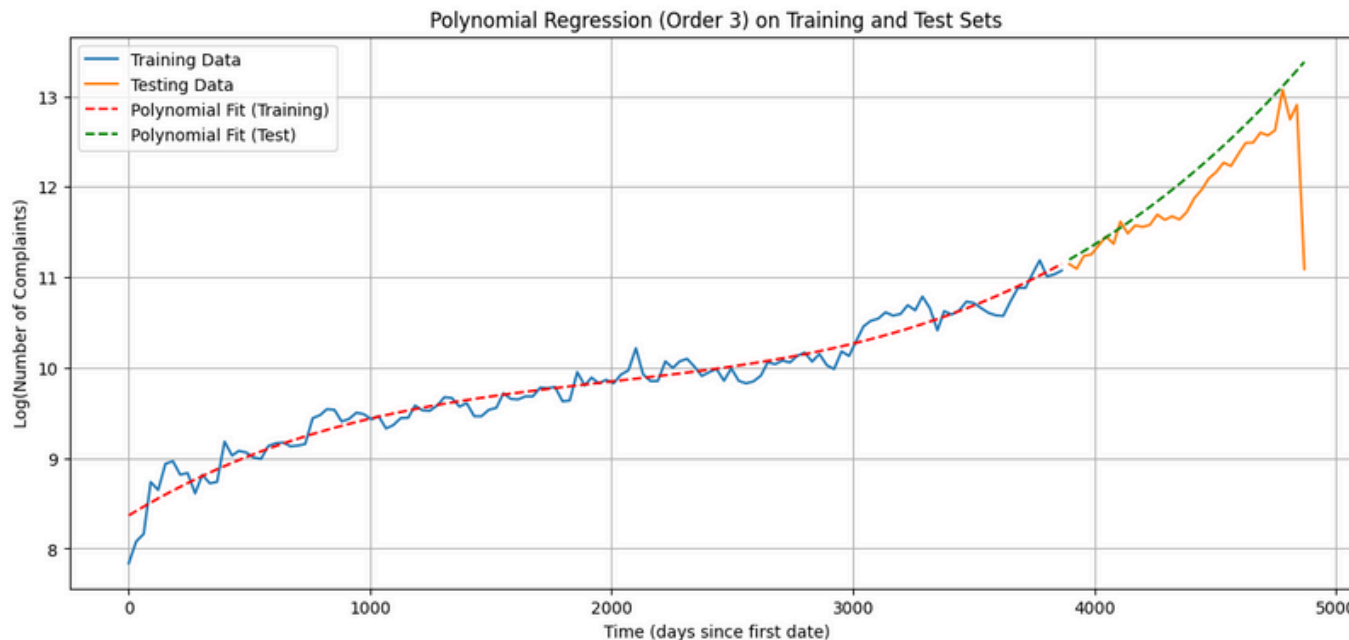


Top 5 Banks by Raw Complaint Growth:



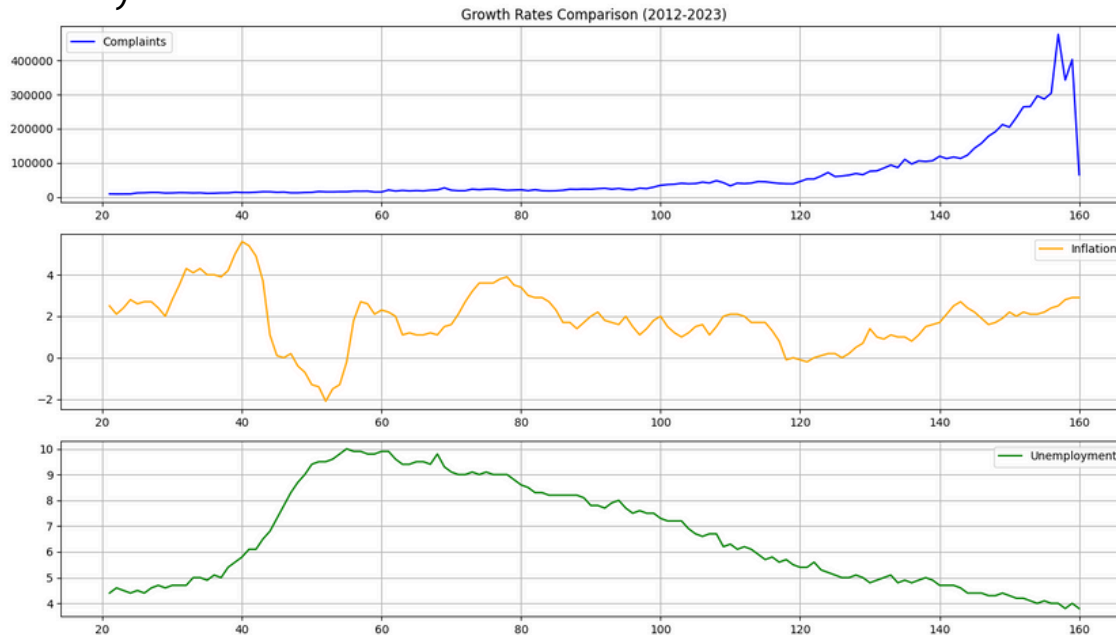
Polynomial Regression on UDAAP Complaint Trends

- **Model:** $\log(\text{Complaints}_t) = \beta_0 + \beta_1 \cdot \text{Time}_t + \beta_2 \cdot \text{Time}_t^2 + \beta_3 \cdot \text{Time}_t^3 + \varepsilon_t$
- **Observations:**
 - Model fits training data trend well.
 - Overestimates recent complaints in test data.
- **Conclusions:** Polynomial regression (order 3) is effective with heavy regularization.



Key Findings: Complaints vs Macroeconomic Factors

- Analyzed 11 years of data (2012–2023) from CFPB complaints and Bureau of Labor Statistics database.
- Calculated Pearson correlation coefficients:
 - Complaints & Inflation: $r = 0.021$ (negligible correlation)
 - Complaints & Unemployment: $r = -0.534$ (moderate negative correlation)



**Figure: Growth Trends Comparison
(2012–2023)**



Top UDAAP-related Issues by Firm

Capital One Financial Corp.

- Fraud: 10,099
- Credit Score: 3,683
- Unauthorized: 2,105
- Unfair: 1,707
- Deceptive: 1,424

Wells Fargo & Company

- Fraud: 10,949
- Scam: 2,820
- Unauthorized: 2,619
- Credit Score: 1,983
- Unfair: 1,633

JPMorgan Chase & Co.

- Fraud: 13,229
- Scam: 3,202
- Unauthorized: 2,967
- Credit Score: 2,468
- Unfair: 1,675

Bank of America, N.A.

- Fraud: 13,378
- Scam: 2,746
- Unauthorized: 2,319
- Credit Score: 2,004
- Unfair: 1,586

Comparing the complaints with delay in resolution with leading US banks

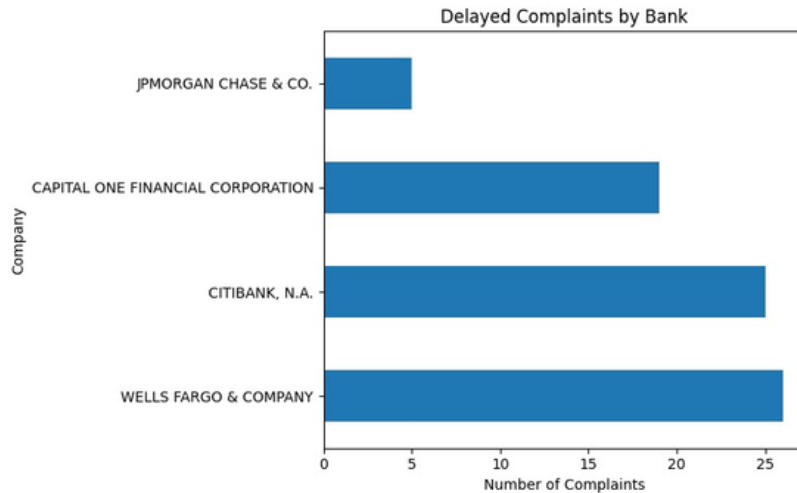


Figure: Comparing Delayed Complaints between Leading Banks



Figure: Theme in Delayed Complaints in the Leading Banks

Consumers frequently complain about:

Credit card and account-related delays Mishandled credit reports, Disputes and fraud not being resolved timely, Poor communication and follow-up from banks

The repetition of xxxx or xxxxx reflects redacted or anonymized information in the complaint text, often replacing sensitive info like: Account numbers, Personal details, Dates or amounts, This shows consumers often reference personal details that get auto-masked by the complaint system.

Relationship between negative sentiment in complaints and the duration of resolution times

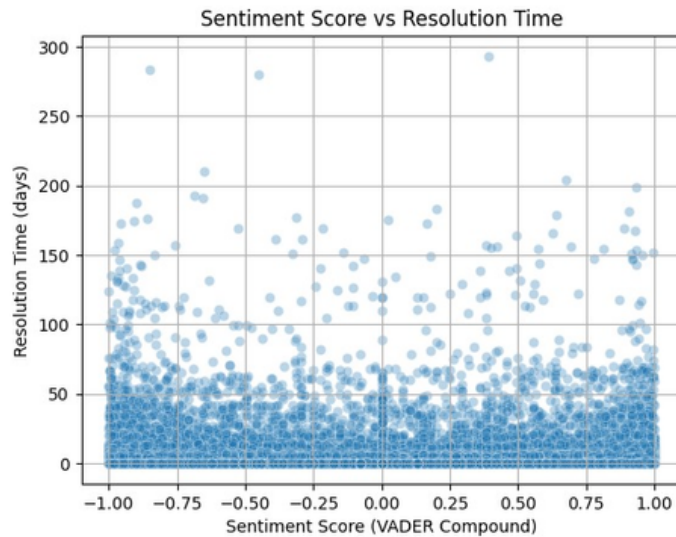


Figure: Scatter plot of Sentiment Score vs Resolution Time

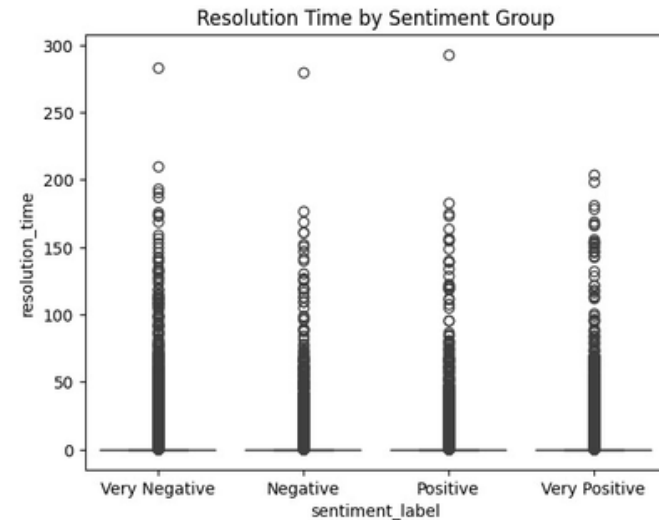


Figure: Resolution time by Sentiment Group

Spearman correlation = -0.0427, p-value = 0

Interpretation: As sentiment becomes more negative, resolution time slightly increases, but the relationship is extremely weak. The p-value is effectively < 0.0001 , which is statistically significant. This means: There is evidence that the correlation is not due to random chance.

Table: Comparison of Sentiment Label and Resolution Time

Sentiment label	Very Negative	Negative	Positive	Very Positive
Resolution time	0.279915	0.234692	0.204973	0.235003

Impact of Regulatory Enforcement Actions on UDAAP Complaint Volumes

- Regulation Rollbacks (p-value = 0.0077): Statistically significant. Likely led to changes in complaint volumes.
- Debt Collection Scrutiny (p-value = 0.0000): Highly significant, showing a clear impact on complaints.
- Enhanced Lending Oversight (p-value = 0.0001): Statistically significant intervention, indicating that complaints may have reduced post-action.
- Payday Loan Enforcement (p-value = 0.6301): Not significant, showing no clear effect on complaints.
- Dodd-Frank Act Amendments (p-value = 0.3675): Not significant, suggesting little to no impact on complaint volumes.

