**Credit Smart**

**Understanding Financial Stress and Responsible Credit Behavior**

**DA/MATH 220**
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**Abstract**

Credit cards have a significant impact on the financial system in the U.S., yet it could lead to significant financial strain on consumers if they rely too heavily on credit cards and cannot repay what they have borrowed. This study analyzes credit card trends, repayment behavior, and financial stress from 2012-2024 using data from the Federal Reserve Bank of Philadelphia's Large Bank Credit Card Dataset.

By using descriptive statistics, correlation analyses, multiple linear regression and ANOVA, we were able to show that there are three distinct phases of consumer credit behaviour: a stable before the COVID-19 pandemic phase, a temporary improvement phase during the COVID-19 pandemic phase as a result of federal programs, and a subsequent decline phase after the end of the COVID-19 pandemic with increased borrowings by consumers, higher credit card usages, and increasing levels of delinquency.

Our findings show that credit utilization is the most important predictor of credit delinquency, while making full payments on the credit card balance is correlated with lower financial distress for consumers. In addition, there were statistically significant differences in the spending behaviour of consumers across the credit score cohorts, with those in the lower credit score bands having more financial constraints.

These findings could help people to have a better understanding of how consumer credit card behaviour relates to the economic shocks and find out indicators that can help consumers with financial decision making, financial education and policy development to enhance the financial stability of households.

# 1. Introduction

Households use credit cards to help manage short-term liquidity needs and increase their spending based on fluctuations in income. This can help support financial stability by allowing consumers to use credit flexibly. However, this flexibility also increases the financial stress for consumers if their borrowing and repayment behaviours become unsustainable. There are disparities in the levels of utilization, repayment choices, and rates of delinquency. These differences indicate that there are substantial disparities in financial resilience among various consumer segments.

The total amount of credit card debt in the United States rose during the 2010s. By the start of the COVID-19 pandemic, U.S. credit card debt had hit record highs (Federal Reserve Bank of New York, 2019), indicating increasing access to and reliance on credit card debt for discretionary purchases and unexpected expenses. In addition, the rise in credit card balances has not affected everyone. Data from the Survey of Consumer Finances conducted by the Federal Reserve Board indicate that households with lower incomes and credit scores tend to have higher credit card balances relative to their total income, increasing their risk of facing significant hardship (Board of Governors of the Federal Reserve System, 2022).

The COVID-19 pandemic caused a major change in consumer credit behavior. Through the years 2020 and 2021, both credit card balances and delinquency rates decreased, even though the economy was undergoing severe economic disruption due to COVID-19. As consumer spending decreased and a number of households paid off their credit cards, credit card debt levels fell (Federal Reserve Bank of New York, 2021). However, the positive trend of decreasing credit card debt and delinquency rates was only temporary, as inflation increased and the economy began tightening after the pandemic ended. This results in a rapid increase of credit card balances and an increase in delinquency rates above the levels that existed prior to the pandemic (Federal Reserve Bank of St. Louis, 2024). Although the trend of falling credit card debt during the COVID-19 pandemic is well researched, there is much less documentation and research on which specific credit behaviors tend to be related to people who experience financial distress, and whether those behaviors appear to differ among various consumer risk groups. Most previous research has suggested that individuals with a high level of credit utilization and a consistent reliance to use the minimum payment option for their credit cards are at the greatest risk of delinquency. However, there has been limited research comparing credit utilization and use of minimum payments among different credit score cohort groups over time. As such, understanding these patterns is an important part of understanding the impact of credit scores on broader systemic inequalities in access to credit, borrowing costs, and financial resilience.

This Consumer Credit Behaviour Project examines how credit card borrower usage and repayment patterns as well as financial stress have changed nationally from 2012 to 2024 as reflected in the consumer data from the Federal Reserve Bank of Philadelphia. In addition to providing descriptive terms, we used statistical methods to explore the relationships between usage, repayment performance, missed payments and credit default risk among consumers. We conducted analyses to answer three research questions:

(1) How have borrowing patterns and financial stress evolved over time?

(2) How are repayment behaviors related to delinquency and financial stress?

(3) Do different credit score groups experience different levels of financial stress?

These research findings will lead to identifying behavioral indicators of increased vulnerability to financial risk and identifying specific consumer demographics that are more vulnerable to increased credit risks. We also expect that their research findings will be advantageous for consumers attempting to manage credit efficiently, for financial educators seeking to provide targeted programs for various demographics and for regulators and lenders concerned about household financial stability.

## 2. Data Source and Variables

This research utilizes the data from the Federal Reserve Bank of Philadelphia's Large Banking Credit Card Dataset, which is open to the public. Using information that was collected quarterly from large banking institutions in the United States provides a broad overview of how account holders behaved while using the credit card market from 2012-2024. The dataset contains data from millions of credit card accounts.

The main variables being studied include:

- Total Credit Card Balances: The total outstanding credit card debt owed by consumers.
- Credit Utilization: The ratio of available credit being used, indicating the level of borrowing intensity.
- Proportion of Accounts Making Minimum Payments: The percentage of consumers who only pay their minimum balance.
- Proportion of Accounts Paying in Full: The percentage of consumers who pay their entire balance each month.
- Delinquency Rates: The percentage of overdue credit card balances at different periods of time, which tells how much consumer credit card debt is overdue.
- 30-Day Delinquent: Balances that are at least one month past due.
- 60-day delinquent: Balances that are two months past due
- 90-day delinquent: Balances that are three months or more past due.
- Credit score cohorts group consumers based on their credit risk and financial reliability, allowing comparisons across different levels of financial stability.
- Credit Score below 660:
  Consumers in this group are generally considered higher risk. They often face higher interest rates, lower credit limits, and greater difficulty accessing affordable credit.
- Credit Score between 660 and 719:
  This group represents moderate credit risk. These consumers typically have reasonable access to credit but still face some borrowing constraints and higher sensitivity to financial shocks.
- Credit Score above 720:
  Consumers in this group are considered low risk. They usually have strong repayment histories, lower interest rates, higher credit limits, and greater financial flexibility.
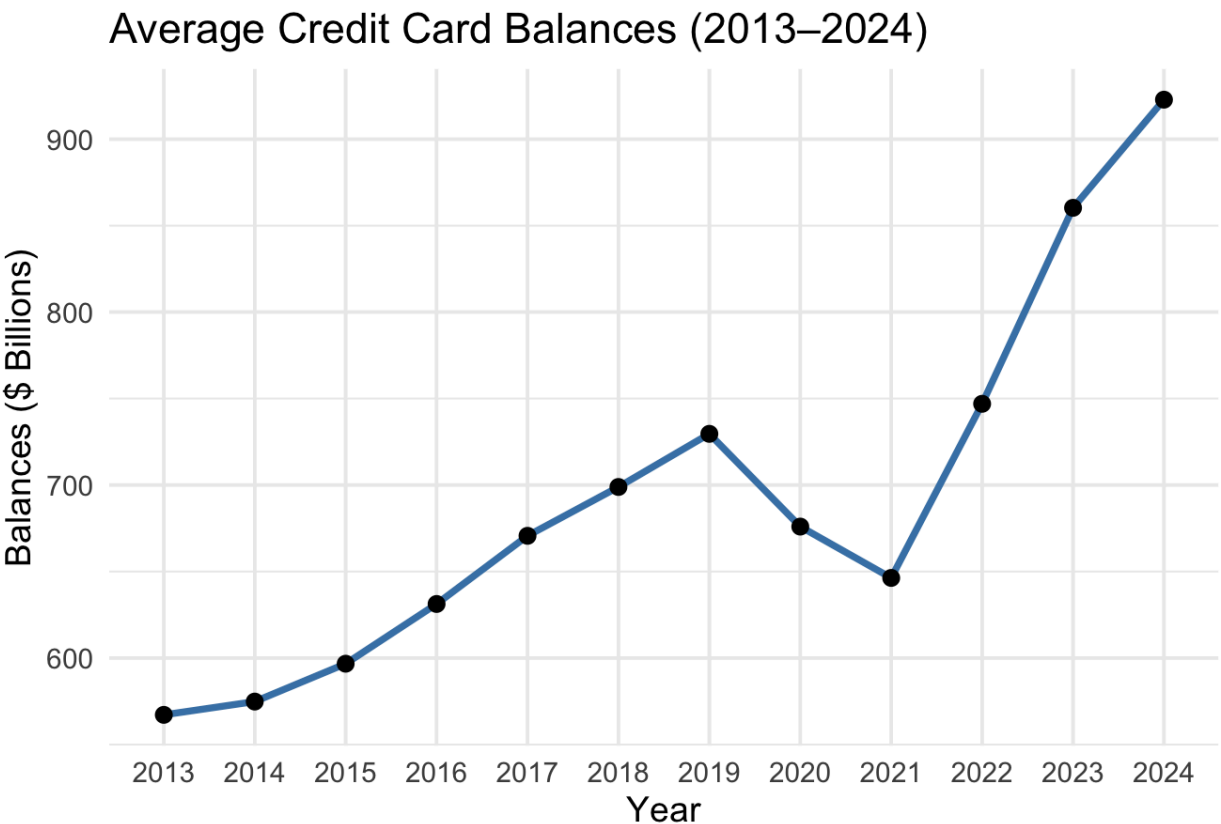
These variables will be the basis for research in the present study regarding borrowing behavior and repayment decisions with respect to borrowing experiences and stress for the different consumer risk classifications.

**5. Analysis**

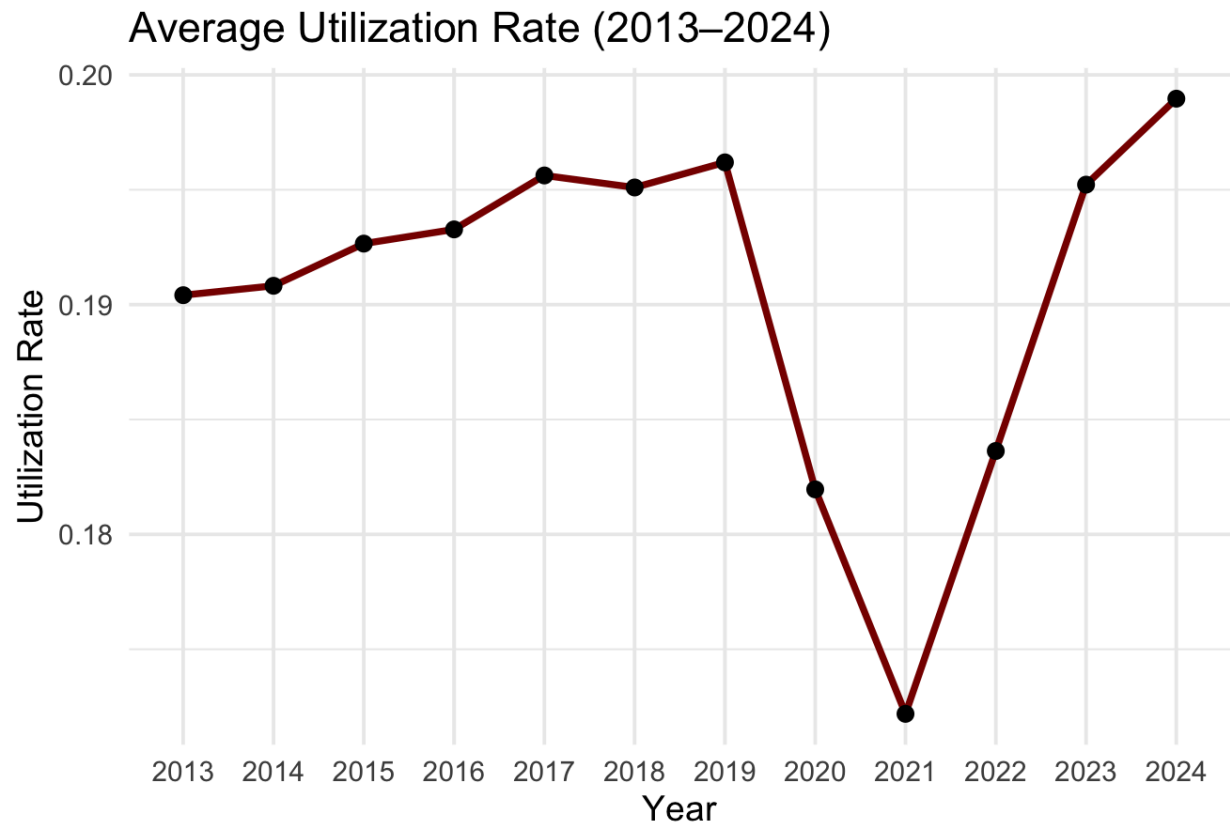**5.1 Borrowing Patterns and Financial Stress Over Time (Q1)**

To address Research Question 1, we examine how credit card borrowing behavior and financial stress indicators in the United States have evolved from 2012 to 2024. We analyze four main key variables: total credit card balances, credit utilization rates, delinquency rates, and charge-off rates. Together, these indicators provide a comprehensive picture of consumer credit conditions and financial health over time.

**Trends in Credit Card Balances**



Average Credit Card Balances (2013–2024)

Between 2013 and 2019, overall credit card debt saw an upward trend that illustrated an overall robust economy before the COVID-19 pandemic (2020-2021). During the COVID-19 pandemic (2020–2021), debt levels decreased sharply as consumers reduced discretionary spending and used financial assistance to pay down existing debt. As the economy began to improve post-pandemic, beginning in 2022, there was once again a marked increase in credit card debt, eventually reaching all time record levels in 2024, which indicates an increased and accelerated dependence on using credit cards for daily living expenses. This significant jump in credit cards post-pandemic illustrates the growing financial strain on the average consumer.
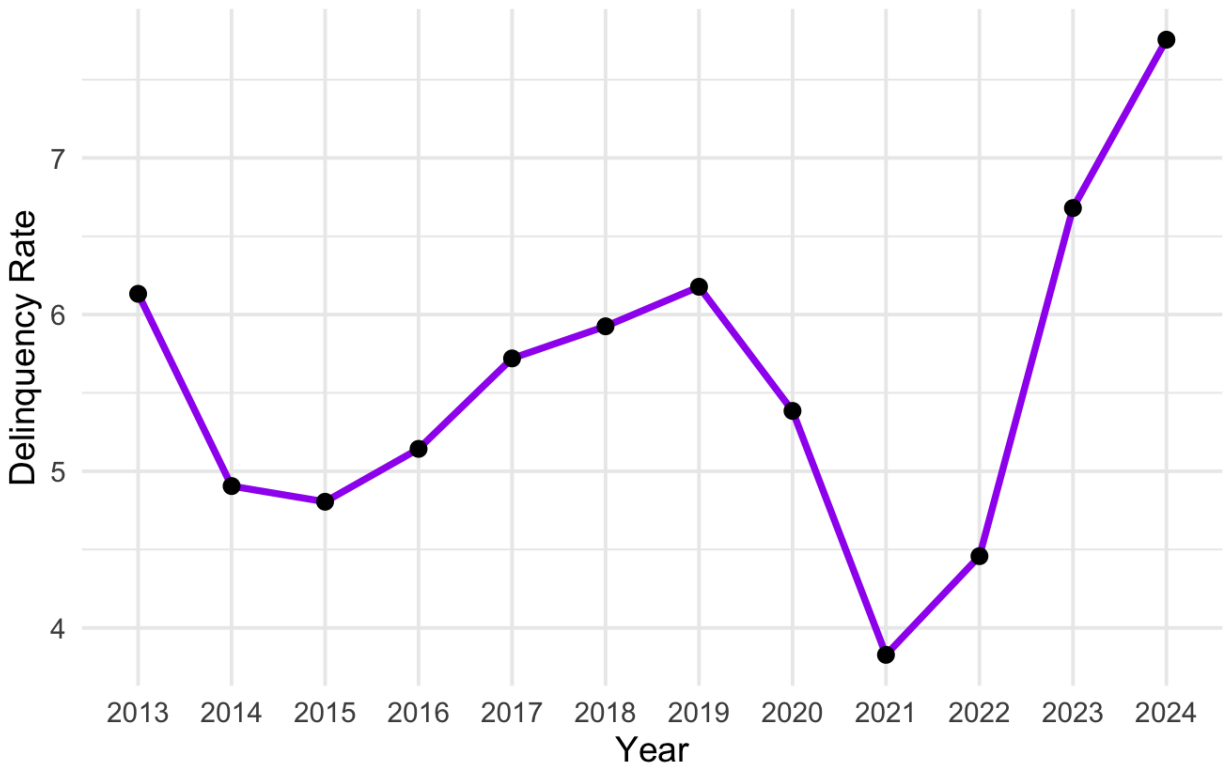
**Trends in Credit Utilization Rates**



Prior to COVID-19, credit utilization rates were relatively consistent, indicating that consumers had reliable borrowing habits and sufficient amounts of available credit. When the pandemic occurred, credit utilization rates dropped significantly because consumers were spending less and using government assistance to pay down their debt. Since 2021, credit utilization rates have risen sharply to the highest levels seen in over ten years, meaning that consumers are relying on higher amounts of available credit. As such, this rising amount of credit use is viewed as an initial indicator of increased financial stress, which translates into a decreased level of financial flexibility.
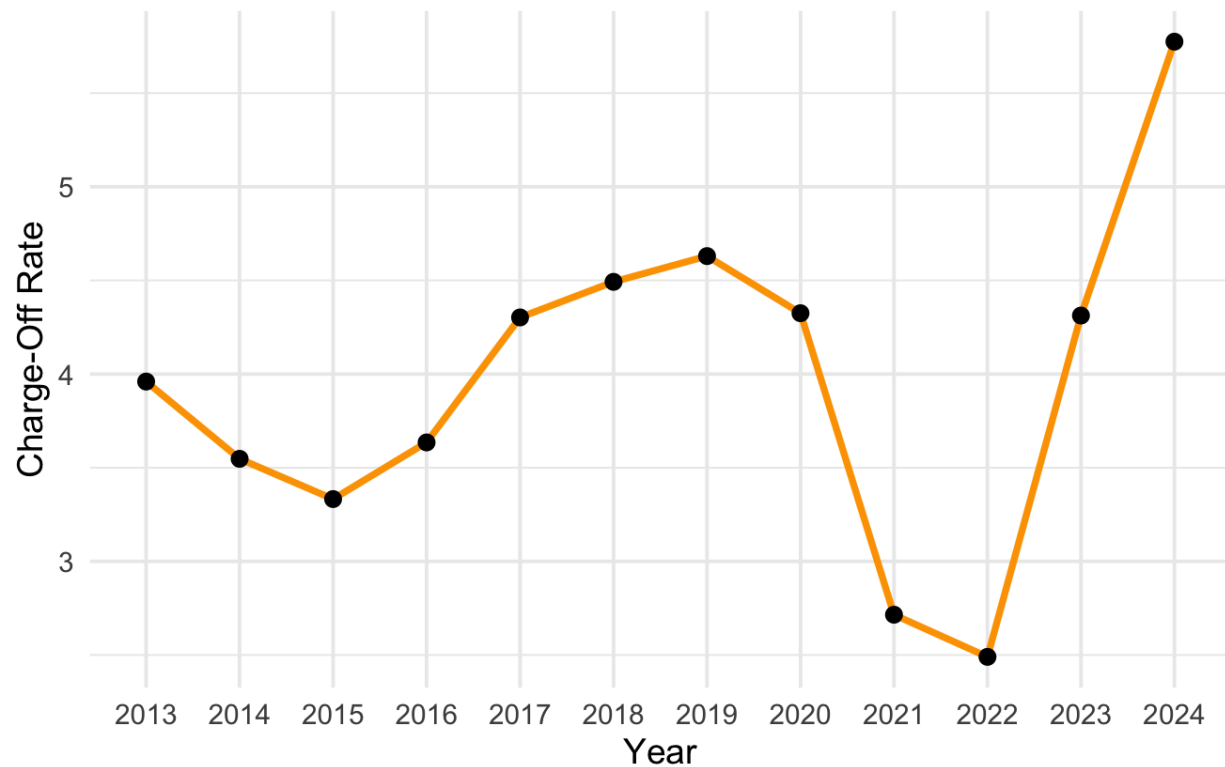
**Trends in Delinquency Rates**

## Average Delinquency (30+60+90 DPD) (2013–2024)



Before the COVID-19 Pandemic hit, there was a general stability in terms of delinquency rates. However, once the pandemic commenced, delinquency rates dropped drastically to historically low rates. The drop was not necessarily an indicator of significant long-term improvement in the financial health of households; rather, it was due to several short-term factors like the provision of support payments, deferring debts for a period of time, and extending deadlines on repayments. After 2021, delinquency rates quickly climbed back up to higher than they were before the pandemic by the time we reach 2024. The quick spike in delinquency rates shows that many households struggled with making their required payments due to the end of the temporary assistance they received.

## Average Charge-Off Rate (2013–2024)



The bad debt charge-off rate followed a similar pattern to the delinquency rate. Before the COVID-19 pandemic, the bad debt charge-off rate remained relatively stable, reflecting a moderate level of defaults. During the pandemic, the charge-off rate decreased sharply because lending institutions were providing payment deferral options for borrowers who were struggling to make payments, as well as providing loans to people so that they would not have to pay their mortgages. After 2021, the bad debt charge-off rate increased rapidly and reached its highest level in the data in 2024. This increase in charge-off rates shows that consumers were having trouble making payments and eventually defaulting on payments altogether, and that consumers were experiencing significantly lower credit health levels.

Overall, the charts show that during the COVID-19 pandemic, financial stress temporarily decreased due to significant policy support and reduced spending. However, these positive effects did not last long. Due to rising inflation, increasing interest rates, and the cessation of post-pandemic support programs, consumers became increasingly reliant on credit cards, using them more frequently and experiencing higher rates of delinquency or default. Consequently, post-pandemic financial stress is higher than pre-pandemic levels, highlighting the importance of responsible credit use and early intervention when problems arise.

## 5.2 Repayment Behavior and Delinquency (Q2)

|  | Avg_MinPay | Avg_FullPay | Avg_Utilization | Avg_Delinquency |
|---|---|---|---|---|
| **Avg_MinPay** | 1.0 | 0.2 | 0.76 | 0.81 |
| **Avg_FullPay** | 0.2 | 1.0 | -0.45 | 0.02 |
| **Avg_Utilization** | 0.76 | -0.45 | 1.0 | 0.76 |
| **Avg_Delinquency** | 0.81 | 0.02 | 0.76 | 1.0 |

Firstly, before using the Multiple Linear Regression to answer the research question 2, we conducted a correlation analysis to examine the relationships among repayment behavior, credit usage, and financial stress indicators. As we can see in the matrix, the used variables are average minimum payment rate (Avg_MinPay), average full-balance payment rate (Avg_FullPay), average credit utilization (Avg_Utilization), and average delinquency rate (Avg_Delinquency). We choose these variables because they represent key dimensions of consumer credit behavior: repayment choices, intensity of credit use, and realized financial stress.

The correlation results show strong positive relationships between minimum payment behavior and delinquency, and also between credit utilization and delinquency. The result indicates that both behaviors are closely associated with financial stress. In addition, minimum payment behavior and utilization are themselves highly correlated, suggesting that consumers who use a larger share of their available credit are also more likely to make only minimum payments.

Although minimum payment behavior exhibits a slightly higher correlation with delinquency than utilization, correlation alone does not determine variable inclusion in a multivariate regression. Since both the utilization rate and minimum payment variables are highly correlated, including both in the same model can lead to multicollinearity. This can result in errors and reduce the model's explanatory power. Therefore, including both variables in the same regression model may lead to an inaccurate and ineffective model.

The credit utilization ratio was retained in the regression model because it represents a more fundamental and direct measure of financial stress. It reflects how close consumers are to their credit limits and is a widely used risk indicator by lending institutions. In contrast, minimum payment behavior is primarily a behavioral response to high credit utilization rather than an independent factor causing delinquency. Therefore, we decided to remove the minimum payment behavior to improve the model's stability while still maintaining its explanatory power and interpretability.

Overall, the correlation analysis confirms the strong relationship between repayment behavior, credit utilization levels, and delinquency status. This analysis also provides a basis for removing minimum payment behavior from the multivariate regression model to avoid redundancy and multicollinearity.

|  | Estimate | p_value |
|---|---|---|
| Intercept | -25.88 | 0.003 |
| Avg_Utilization | 133.46 | 0.0006 |
| Avg_FullPay | 0.18 | 0.041 |

In answering Research Question 2, we examined how repayment behavior is associated with financial stress by estimating a multivariate linear regression model. In the model, the average delinquency rate is defined as the response variable. The predictors included average credit utilization and average full-balance payment rate.

Minimum payment behavior was excluded from the final model because it was highly correlated with utilization. It also did not provide any additional information when the utilization was included.

The result of the regression model shows that the multiple $R^2$ is 0.7405 and the adjusted $R^2$ is 0.6828. This indicates that the model explains a large and meaningful portion of the variation in delinquency rates over time. Therefore, both repayment behaviour and credit usage were significant predictors of financial stress.

Credit utilization was the strongest predictor in the model, and it had a positive and highly statistically significant coefficient. For every 1-point increase in utilization rate, Delinquency increases by 133.46 basis points, while other variables are constant. This indicates that as consumers use a larger share of their available credit, delinquency rates increase substantially, reflecting higher levels of financial stress. Full-balance payment behavior had a smaller coefficient. For each 1 percentage increase in full-balance payments, there is a slight reduction in delinquency. This suggests that higher rates of full payment are associated with lower delinquency and healthier financial outcomes.
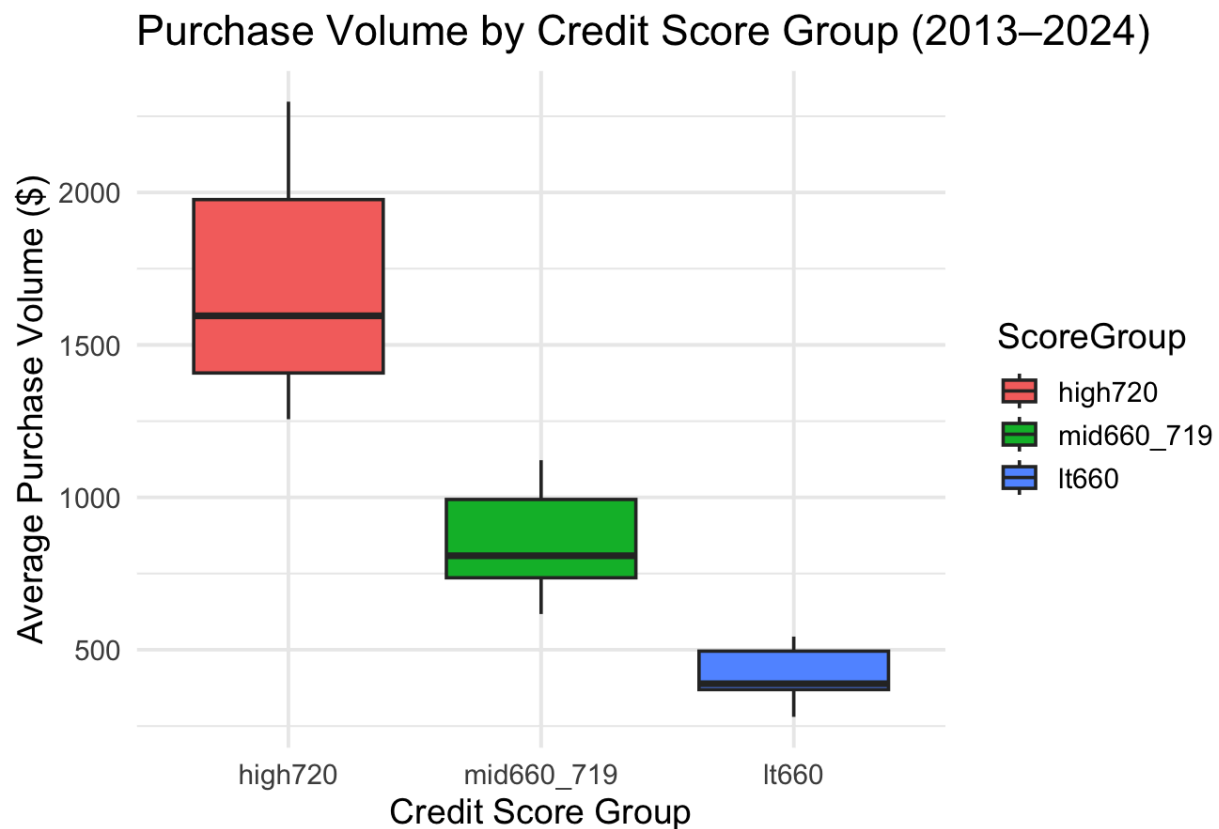
Overall, these findings reinforce the conclusion that credit utilization rates are a primary driver of financial stress, while full payment behavior plays a protective but secondary role.

**5.3 Credit Score Cohorts and Financial Stress (Q3)**

In the research question 3, we will determine how various credit score bands affect people's spending behaviour and financial stability. We will compare how much each band of consumer spends on average by credit score cohorts: Consumers with High-Credit-Scores with credit score 720 and higher, Consumers with Mid-Credit-Scores with credit score 660-719, and Consumers with Low-Credit-Scores with credit score of less than 660.

A one-way ANOVA will be used to compare each consumer group's average spending levels to determine if the differences we see between the groups represent differences in behaviour or if they are a result of random variation in the sample data.

The ANOVA results for this study are very strong. The F-statistic for this study is 88.77 and the p-value is less than 0.001. This provides strong statistical evidence that there are significant differences in the average spending levels of consumers within the three credit score bands.
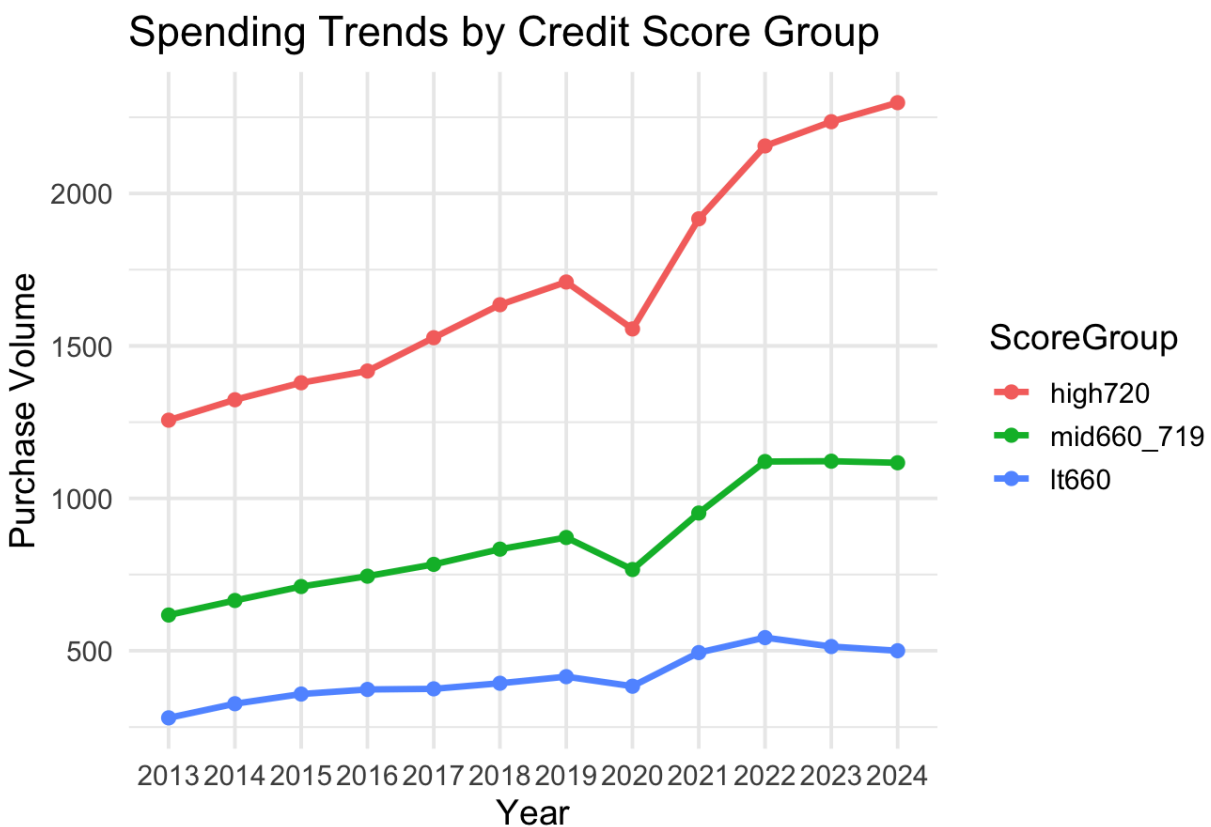


A boxplot visual representation showed distinctions in spending behaviours amongst groups based on their credit scores. Spending behaviour demonstrates the ability and stability of each group financially over a longer duration rather than how much they spent any given day or month.

High credit scores with 720 points and above generally correlate with higher amounts of money spent. This result suggests their greater access to credit, higher financial health and stability, and thus allow them for higher levels of consumption with less immediate financial stress occurring.

The mid-tier credit score group with 660 to 719 points represents a middle ground in terms of overall volume of purchases compared to two other score groups. This group is more aware of their limits compared to the higher scoring group. It suggests that this group has access to credit, but due to financial constraints, limited amounts of credit and higher overall costs of borrowing, they spend less when compared to individuals who have a higher score than them.

The final group having lower credit scores represents lower amounts consistently spent, representing tighter limits on available credit and financial pressure created by limited resources. Therefore, it is not a choice that they have made to spend less than other consumers, but rather a natural consequence of having reduced access to credit opportunities, higher rates of borrowing, and the financial pressures associated with those.



Spending Trends by Credit Score Group

The line graph demonstrates that while all consumers experienced a decline in their purchase volume during the early stages of the COVID-19 pandemic due to restrictions, decreased mobility, and increased uncertainty in economic activities. There were substantial differences among credit score groups in regard to: timing of the decline, how much it fell, and how fast the respective groups recovered from the decline.

Consumers with high credit scores showed a dramatic decline in purchases in the early stages of the pandemic, likely because they were unable to engage in many types of discretionary activities such as traveling and purchasing non-essential goods. For this group, it seems that their reduced overall purchasing volume was more a result of opportunity than financial distress. Once conditions began to improve, this group quickly resumed their previous level of discretionary purchasing activity, which demonstrates the ability of this group to be financially resilient as well as their ability to adapt their spending patterns quickly in order to meet their needs.

Consumers in the mid-credit score category saw a slower recovery than consumers in higher credit score categories, as indicated by their spending patterns. While spending decreased during the COVID-19 pandemic, the slower recovery indicates that consumers in this category were hesitant to resume spending because of uncertainty about future income, tighter household budgets, and an increased need to carefully manage their credit obligations after the pandemic.

When looking at consumers with low credit scores, we see a sustained weak recovery post-pandemic. Despite overall improvement in the economy and other areas, spending for consumers in this group was only slightly increased from its previous level. This suggests that consumers in this group remain constrained in terms of their ability to borrow, experience higher rates of borrowing costs, and are experiencing greater levels of financial stress. The slow uptick over time for this group indicates that there are structural barriers to recovery rather than just behavioral trends.

The line chart presents a comparative analysis of the financial resilience of credit score segments and provides insight into the disparities between the ability of credit score segments to adjust to economic shocks and return to pre-disruption levels of spending after periods of economic disruptions. Prior analyses indicate that credit score is correlated with the capacity to spend, and this line graph will provide evidence that credit score is a significant factor in how quickly consumers respond to economic shocks and return to normal spending patterns following periods of economic disruptions.

## 6. Conclusion

The research provided insight into how American consumers' credit card use, borrowing behaviour, repayment behaviour, and financial stress have changed over time. This study analysed consumer behaviours from 2012 through to 2024 using raw data from the Federal Reserve Bank of Philadelphia's Large Bank Credit Card Data Set by way of descriptive statistics, correlation analysis, multiple linear regression, and ANOVA. In addition to presenting its findings, this study addressed three core questions about the changing patterns of credit card borrowing behaviour, the relationship of delinquency to repayment behaviour, and the impact of credit score cohort difference upon the financial outcomes of consumers.

It was found that three distinct phases exist in relation to consumer credit behaviour when borrowing from creditors during this period. Before the start of the COVID-19 pandemic, which is before February 2020, there was an increasing trend to take on greater balances and credit usage through the increase in credit card debt and the relatively low amount of delinquent bills charged off as bad debts. Therefore, it suggests that the conditions for borrowing at this time were manageable. When the COVID-19 Pandemic hit in February 2020, there was a rapid decrease in the financial stress level of consumers due to Government stimulus payments reducing consumers' total bills, consumers being encouraged to spend less money, and also the impact of loan forbearance programs.

As a result of the above supports associated with the pandemic, financial stress levels were reduced significantly, but as can be seen from the data following the expiration of Government supports, after the COVID -19 Pandemic, a renewed increase in credit card debt and usage is found, along with an increase in the delinquency and charge-off rate by creditors. The levels of financial stress were greater than those experienced at the start of the pandemic.

The study of credit utilization has shown to be a predictor for delinquency by demonstrating that when someone has high credit utilization, they are under more financial stress, which increases their chances of missing a payment. Conversely, making full balance payments is correlated with lower delinquency rates, and it provides an indication of financial stability because of the reduced risk of defaulting on payments. Minimum payment behavior is often used as a predictor of delinquency as well. However, due to the fact that it is highly correlated with credit utilization, it is excluded from the regression analysis in order to maintain the stability, interpretability, and statistical validity of the regression analysis.

The differences between credit score cohorts also indicate that while there is significant disparity between the financial resilience of the credit score cohorts, high credit score consumers demonstrate the highest average spending and highest resilience to economic shocks, mid-credit score consumers tend to be more cautious with their spending, and low-credit score consumers continue to demonstrate constrained spending patterns, limited access to capital and heightened levels of financial stress. This indicates that lower-credit-score consumers are disproportionately impacted by financial shocks, thereby furthering the inequality in financial outcomes between credit score cohorts.

In summary, these findings have major implications for consumers, lenders and policy makers. Consumers should watch their credit utilization closely. Low credit utilization and frequent

payments in full every month are indicators of good financial health for consumers that will help these individuals make informed decisions about borrowing money in times of need. Financial educators can use the findings of this study as a basis for creating new and better-targeted educational programs focused on credit usage ratio management, instead of focusing solely on encouraging consumers to make at least the minimum payment each month. Lenders and policy makers should use credit usage ratio metrics as an effective early warning indicator of increasing levels of financial stress within a household so they can intervene sooner to prevent delinquency or default from occurring. This study helps identify patterns of behaviour that may be indicative of financial vulnerability, defining how credit can be used responsibly. It also gives us evidence-based information about how to promote financial stability for vulnerable groups within our society.

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