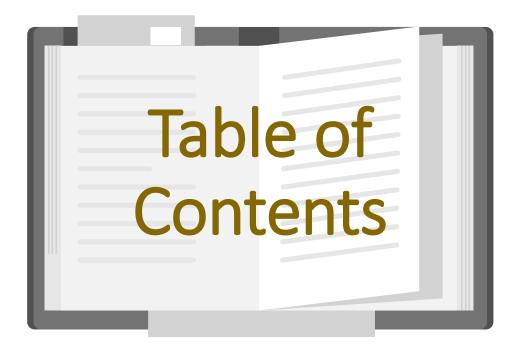
# **Bad Credit Prevention**

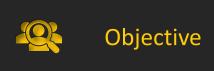
Nguyen Hoang Minh linkedin.com/in/minhhoangnguyen123/

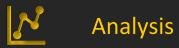


Last Updated: 23 Jun 2023

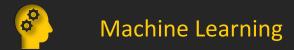












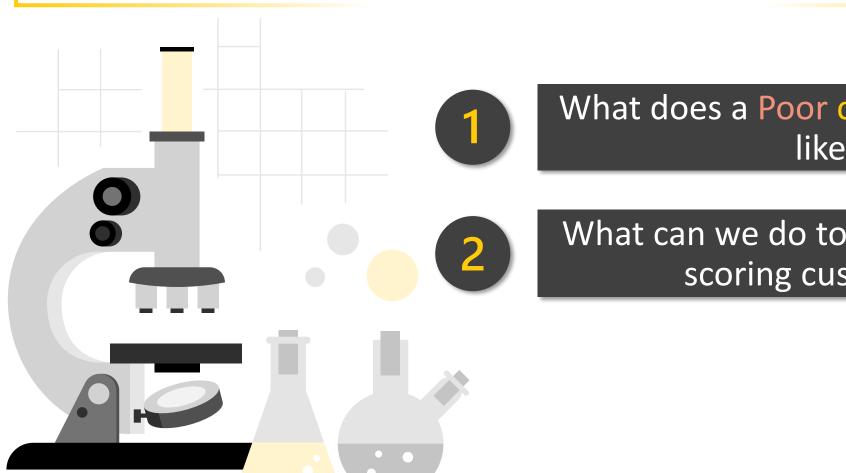


# Objective

What we are looking for



### Objective



What does a Poor credit scorer look like?

What can we do to avoid low credit scoring customers?

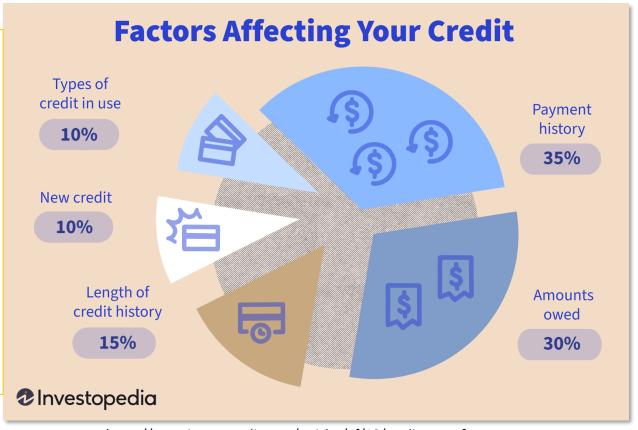
# Analysis

What we found



### FICO Score 8

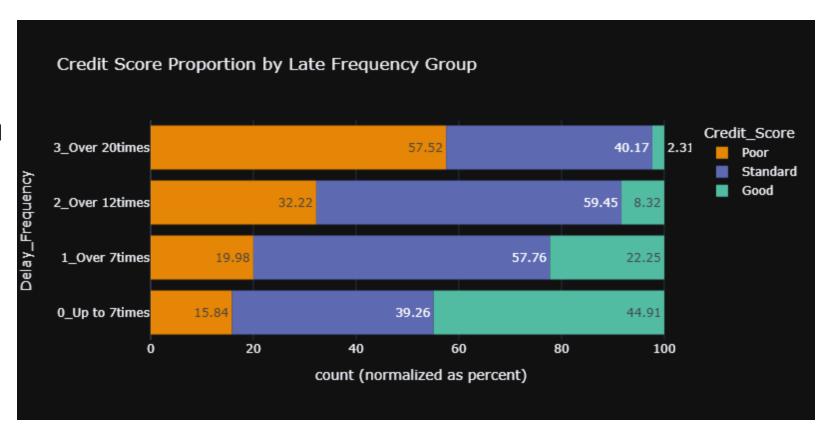
- 1. Late Payment
- 2. Loans Amount & Types
- 3. Credit Age
- 4. Payment Behavior
- 5. Income
- 6. Age



https://www.investopedia.com/articles/pf/10/credit-score-factors.asp

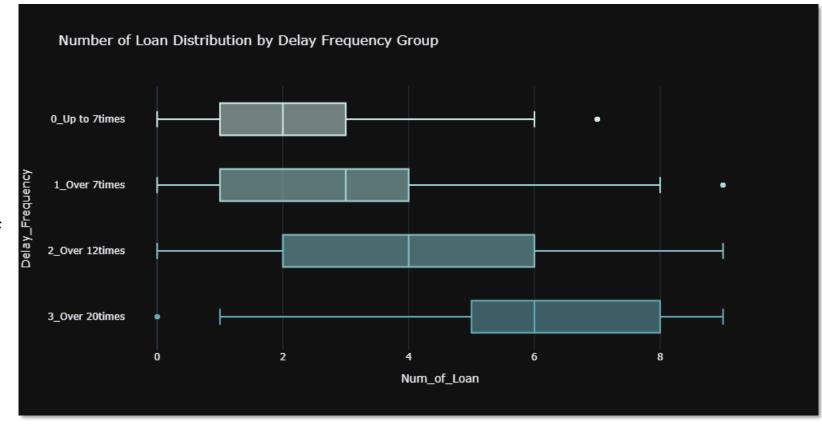
### Late Frequency

- Negative Correlation
   between Credit Score and
   late debt payment.
- Poor scorer increase when late over 12 times.
- → Auto-pay, change due date and refinance.



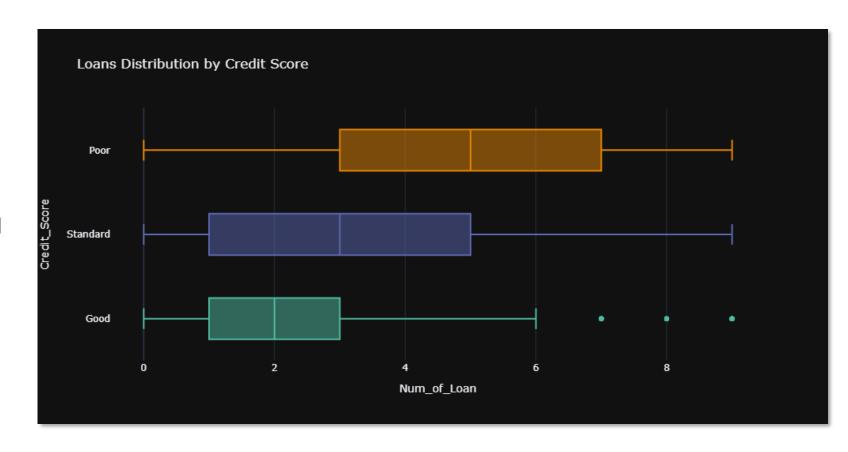
## Late Frequency

- More loans means more late payment.
- Late payment is dependent on number of loans.



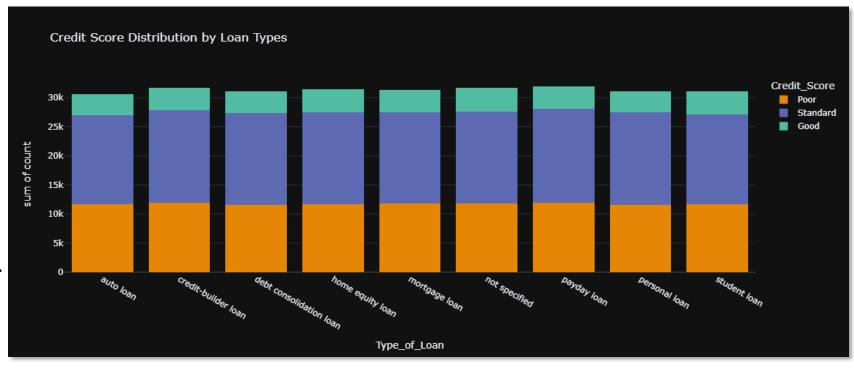
### Loans

- Large number of loans correlates with lower Credit Scores.
- Risk in ability to pay and on time.
- → No more than around 3 loans.



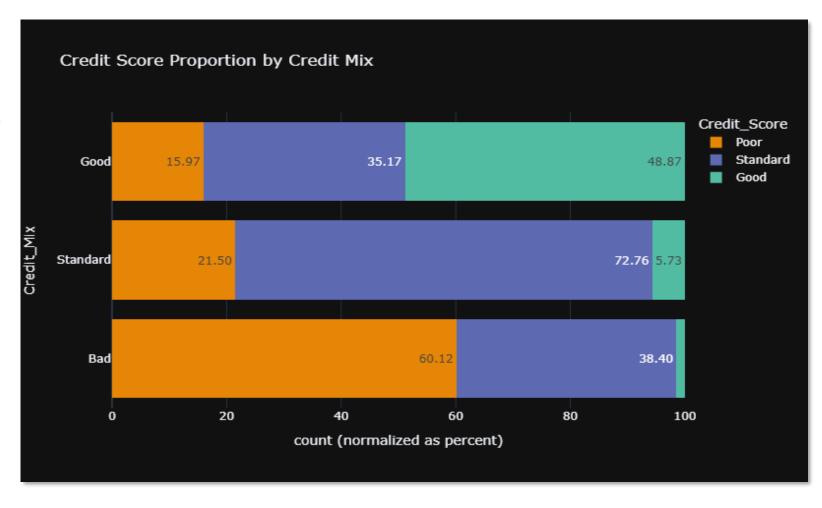
## Loan Types

- No correlation
   between Loan types
   and Credit Score.
- E.g., Personal loans are usually unsecured.



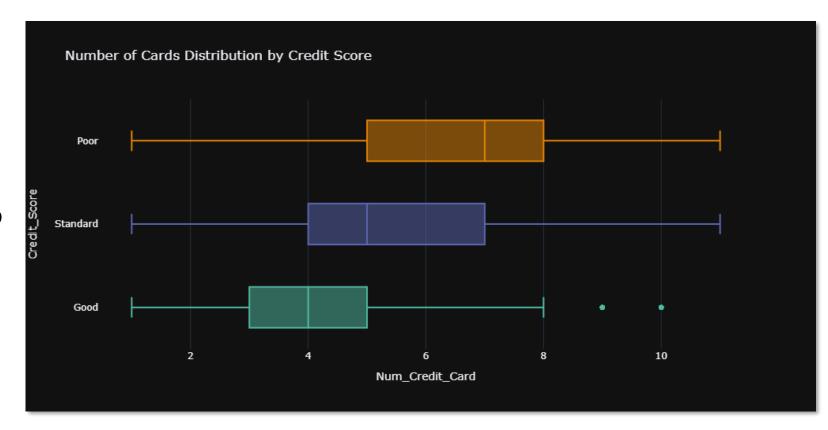
### Credit Mix

- Greater Credit Mix are like to have better Scores.
- Shows ability to manage different accounts.
- → Incentivize loans for different purposes (e.g., business loan discount for high value mortgage).



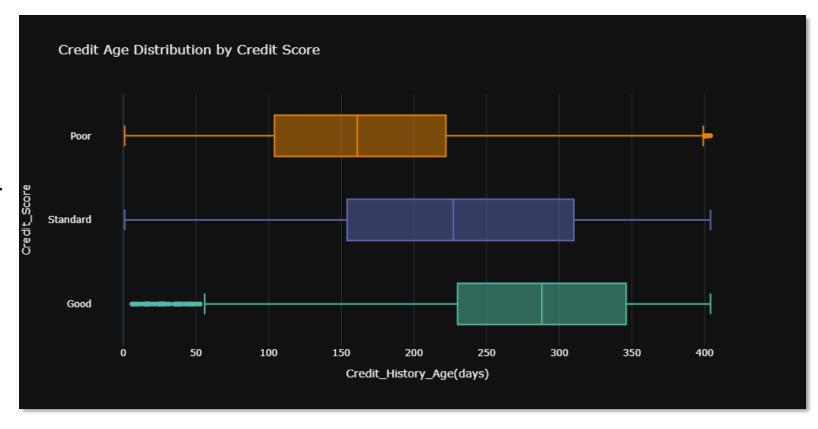
### **Credit Accounts**

- More credit accounts results in low Credit Scores.
- Hard to manage and keep track of due dates.
- → Less than 5 credit accounts.



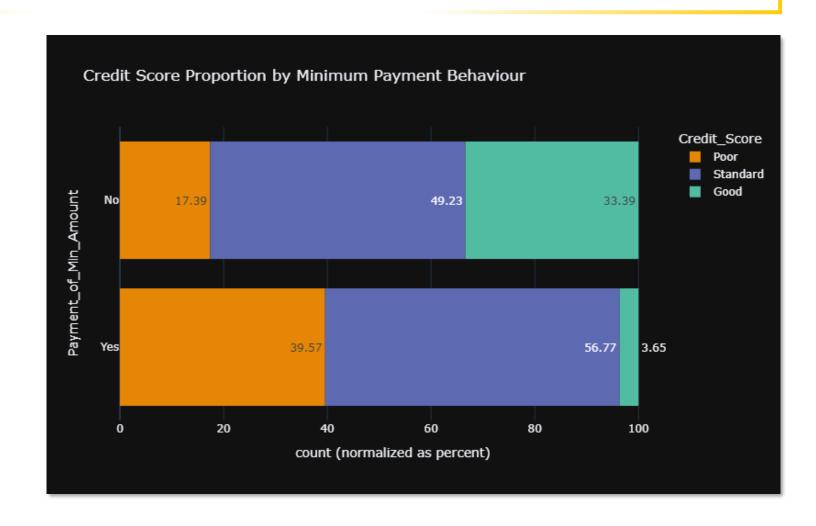
## Credit Age

- Longer Credit History allows Higher Credit Score.
- Larger information on credit user.

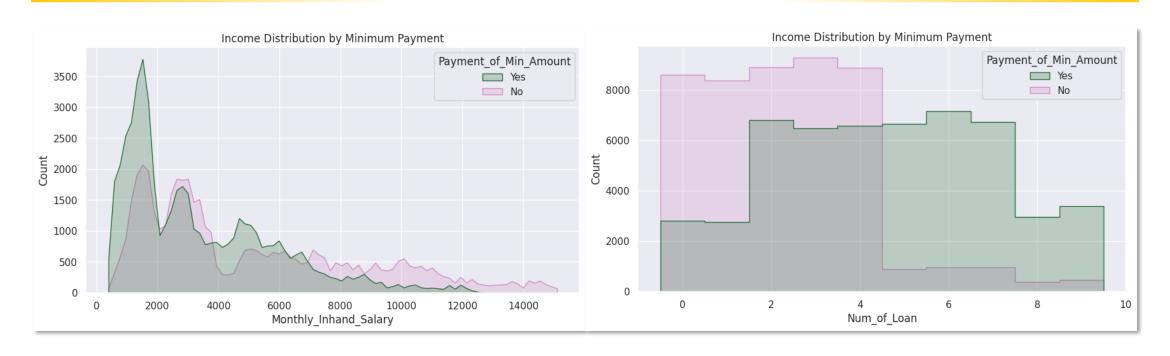


## Minimum Payment Behaviors

- Paying the minimum amount signify low Credit Score.
- This should not affect score.



### Minimum Payment Behaviors



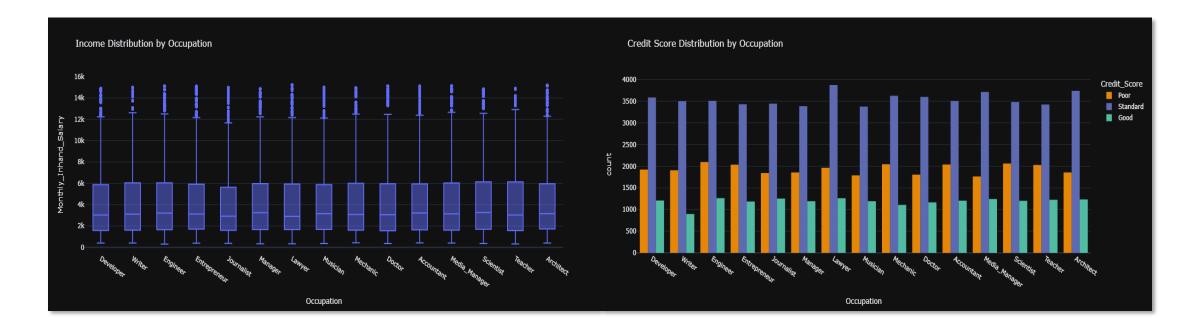
 Minimum payment is an indicator for lower income and higher debt.

### Income

- Positive correlation between Income and Credit Score.
- Higher income allows more debt and better financial management.



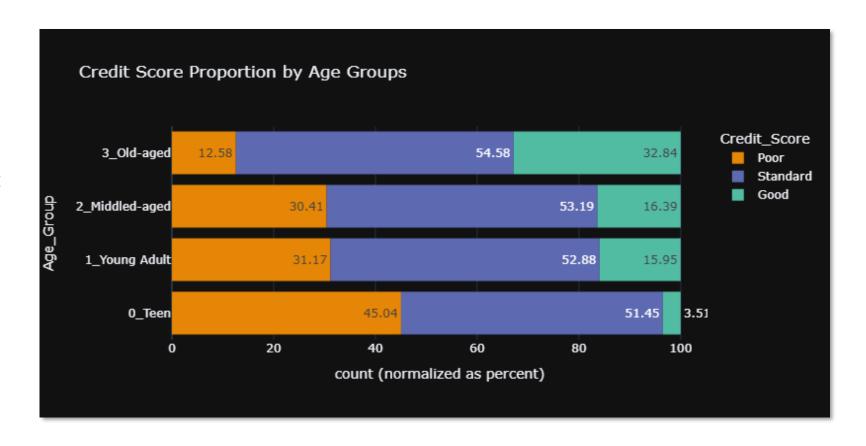
### Occupation



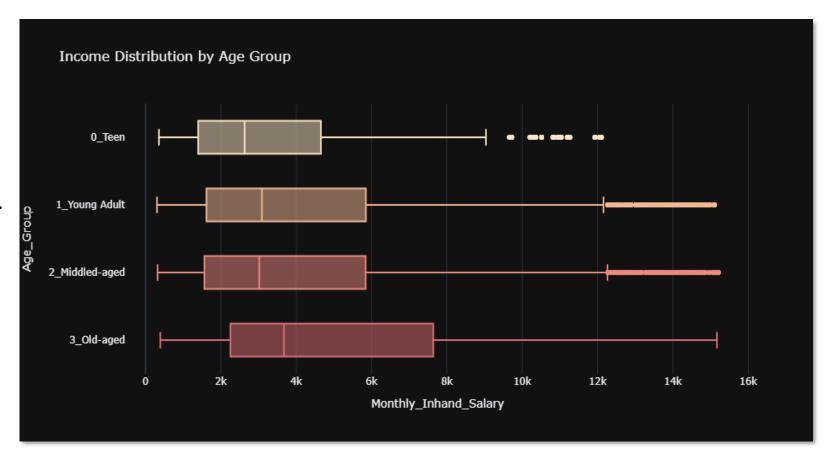
Income are even across jobs (no bias).

• Occupation has **no effect** on Credit Score.

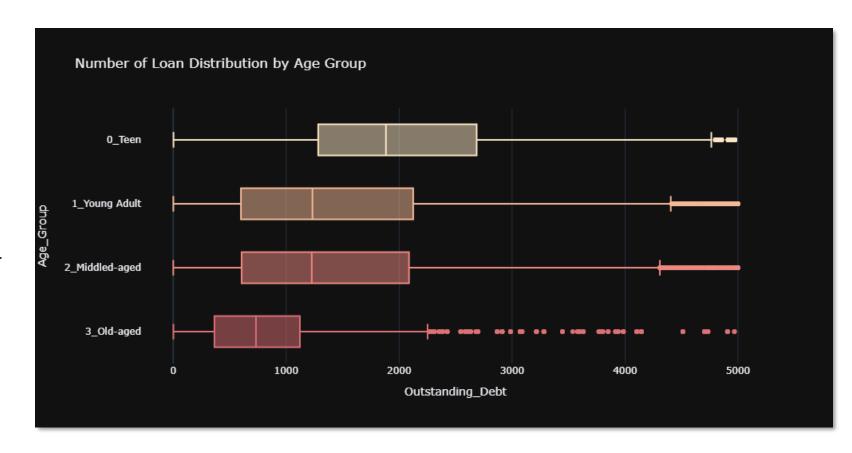
- Positive correlation between Age and Credit Score.
- Does age explain Credit Score?



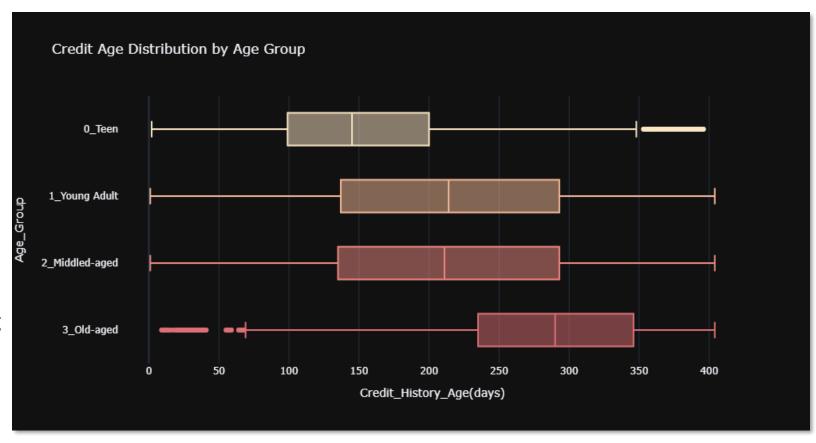
- Positive correlation between Age and Income.
- Older people have higher positions in their career.



- Negative correlation between Age and Debt.
- Working-age is from 15-64.



- Longer you've lived,
   longer Credit history you have.
- Age indirectly influence Credit Score.
- → Cooperate with top universities to educate young customers.



# Conclusion

What we have learned



### Conclusion



Low Credit Scorers tends to be late for their payment due to holding too many loans.

They don't manage different type of loans. Or managing too many credit accounts.

They have new accounts with short history.

Younger people inherently are poorer, has short credit history and is holding more debts.

Therefore, they tends to have lower credit scores.

### Recommendation



#### Late frequency 7 times

Auto-pay, change due date and refinance.

#### Loans 3 loans

Disallow taking more loans.

#### Credit Mix

Incentivize loans for different purposes (e.g., business loan discount for high value mortgage).

#### Credit cards 5 accounts

Disallow opening new credit accounts.

#### Credit Age

Cooperate with top universities to educate young customers. Welcoming bonuses for opening accounts (e.g., cashback, points...).

# Machine Learning

**Predicting Credit Scores** 



## Model

index	Model	Train_Accuracy	Test_Accuracy	Train_F1	Test_F1
0	VotingClassifier	0.89	0.81	0.89	0.8
1	RandomForestClassifier	0.94	0.8	0.94	0.79
2	KNeighborsClassifer	0.85	0.78	0.84	0.77
3	HistGradientBoostingClassifier	0.84	0.78	0.84	0.77

### **Confusion Matrix**



### **Bad Credit Prevention**

Last Updated: 23 Jun 2023

# Thank You!

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# Appendix

Other findings

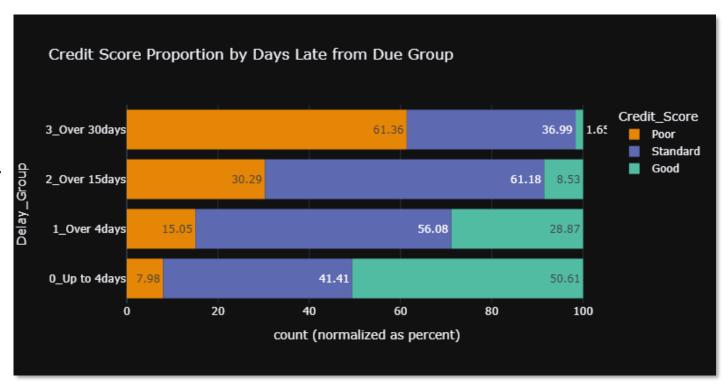


# Features HeatMap

																				1
Age	1.00	0.09	0.09	-0.19	-0.15	-0.22	-0.21	-0.17	-0.18	-0.16	-0.25	-0.20	0.03	0.23	-0.05	0.07	0.12	0.16		
Annual_Income	0.09	1.00	1.00	-0.28	-0.22	-0.30	-0.26	-0.25	-0.29	-0.18	-0.28	-0.27	0.18	0.27	0.44	0.81	0.63	0.21		
Monthly_Inhand_Salary	0.09	1.00	1.00	-0.28	-0.22	-0.30	-0.25	-0.25	-0.29	-0.18	-0.28	-0.27	0.18	0.27	0.42	0.81	0.63	0.21		
Num_Bank_Accounts	-0.19	-0.28	-0.28	1.00	0.44	0.58	0.47	0.56	0.60	0.33	0.52	0.51	-0.07	-0.49	0.05	-0.23	-0.29	-0.39		0.5
Num_Credit_Card	-0.15	-0.22	-0.22	0.44	1.00	0.50	0.42	0.48	0.42	0.26	0.46	0.49	-0.06	-0.42	0.06	-0.17	-0.23	-0.40		
Interest_Rate	-0.22	-0.30	-0.30	0.58	0.50	1.00	0.56	0.59	0.57	0.37	0.63	0.63	-0.08	-0.58	0.07	-0.24	-0.32	-0.49		
Num_of_Loan	-0.21	-0.26	-0.25	0.47	0.42	0.56	1.00	0.50	0.47	0.37	0.57	0.64	-0.10	-0.61	0.33	-0.21	-0.43	-0.36		
Delay_from_due_date	-0.17	-0.25	-0.25	0.56	0.48	0.59	0.50	1.00	0.54	0.30	0.54	0.57	-0.06	-0.49	0.08	-0.20	-0.27	-0.43		
Num_of_Delayed_Payment	-0.18	-0.29	-0.29	0.60	0.42	0.57	0.47	0.54	1.00	0.33	0.50	0.50	-0.07	-0.48	0.05	-0.23	-0.29	-0.37		0
Changed_Credit_Limit	-0.16	-0.18	-0.18	0.33	0.26	0.37	0.37	0.30	0.33	1.00	0.38	0.46	-0.05	-0.43	0.07	-0.15	-0.20	-0.17		-
Num_Credit_Inquiries	-0.25	-0.28	-0.28	0.52	0.46	0.63	0.57	0.54	0.50	0.38	1.00	0.60	-0.08	-0.61	0.10	-0.22	-0.31	-0.44		
Outstanding_Debt	-0.20	-0.27	-0.27	0.51	0.49	0.63	0.64	0.57	0.50	0.46	0.60	1.00	-0.07	-0.63	0.11	-0.22	-0.32	-0.39		
Credit_Utilization_Ratio	0.03	0.18	0.18	-0.07	-0.06	-0.08	-0.10	-0.06	-0.07	-0.05	-0.08	-0.07	1.00	0.07	0.02	0.14	0.22	0.05		
Credit_History_Age	0.23	0.27	0.27	-0.49	-0.42	-0.58	-0.61	-0.49	-0.48	-0.43	-0.61	-0.63	0.07	1.00	-0.11	0.23	0.32	0.39		
Total_EMI_per_month	-0.05	0.44	0.42	0.05	0.06	0.07	0.33	0.08	0.05	0.07	0.10	0.11	0.02	-0.11	1.00	0.35	0.07	0.02		-0.5
Amount_invested_monthly	0.07	0.81	0.81	-0.23	-0.17	-0.24	-0.21	-0.20	-0.23	-0.15	-0.22	-0.22	0.14	0.23	0.35	1.00	0.48	0.17		
Monthly_Balance	0.12	0.63	0.63	-0.29	-0.23	-0.32	-0.43	-0.27	-0.29	-0.20	-0.31	-0.32	0.22	0.32	0.07	0.48	1.00	0.20		
Credit_Score																		1.00		
	$Ag_{e}$	Ann	Mon Jual Inc	thly I	Nun Bank Shand	T. Cred	Nun rest Re it Card ints	Dele Ple	Nun Ny fron	Cha.	Nun nged ov.	Out Tredit Sedit L Payme	Cred Standin E Inqui	Cred	Tota dit Hist Sation	N EMI	Mon Ount in Per me	Credithly_Ball vested_n	Ċs	
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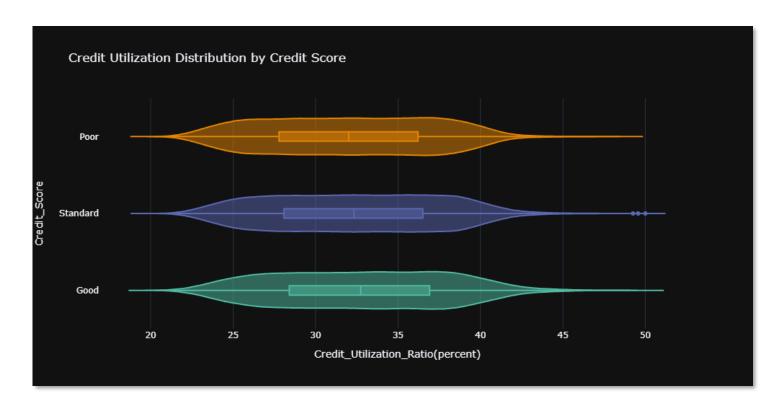
### Late Payment

- Negative Correlation between Credit Score and late debt payment.
- Chance for lower Credit Score doubled after 30 days late.

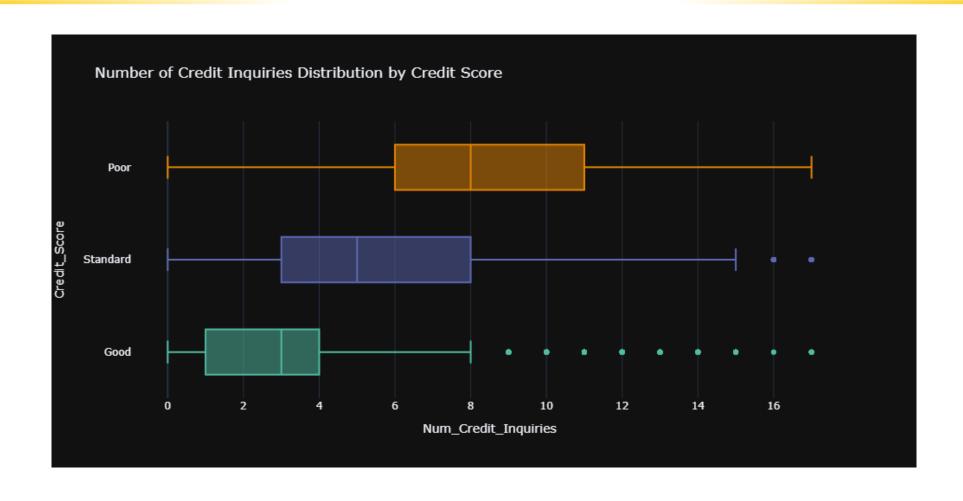


## **Credit Usage**

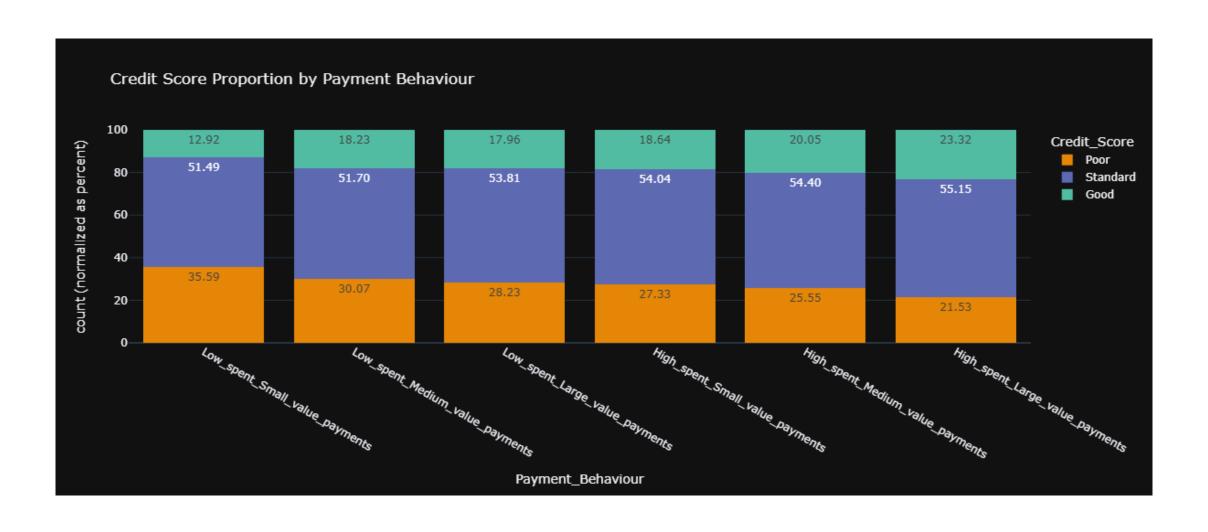
- No visible effect on Credit Score by Utilization ratio.
- This Bank does not place importance on utilization.



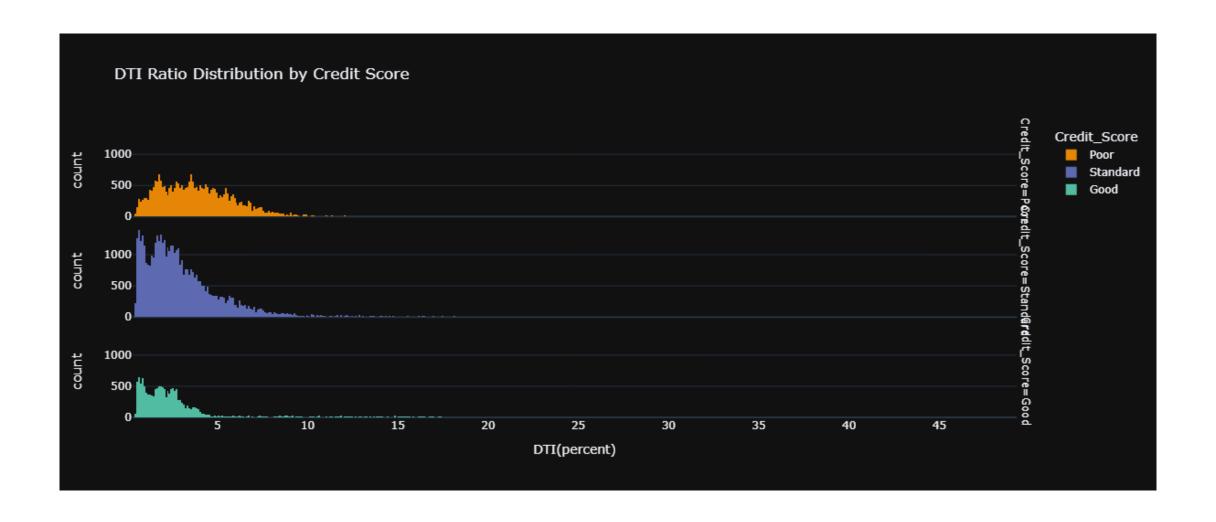
## **Credit Inquiries**



### **Payment Behaviours**

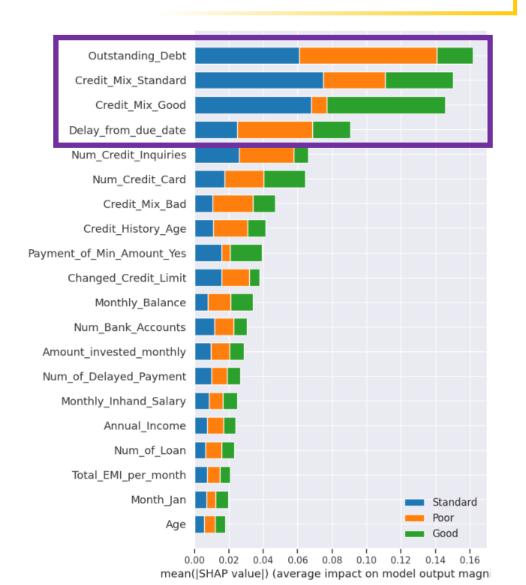


### Debt to Income Ratio



### Features Importance

- SHAP values as feature importance.
- Credit Score is explained by Debt, Credit Mix and Late Payment mostly.



<sup>\*</sup> SHAP assume features are independent, and it explains the feature importance to the model not to the real world.

### Features Importance by Class

