Project 1A: Dynamic Risk Tolerance Monitoring

---

1. Introduction

The objective of this project is to develop a Dynamic Risk Tolerance Monitoring framework using real-world consumer lending data.
Risk tolerance of borrowers is not static and changes over time due to variations in income, credit behavior, macroeconomic conditions, and borrowing patterns.

This project aims to quantify borrower risk tolerance using financial and behavioral indicators and monitor how overall portfolio risk evolves dynamically over time.

---

2. Dataset Description

The dataset used in this project is the publicly available **LendingClub Accepted Loans Dataset (2007–2018)**.

Source:
https://www.kaggle.com/datasets/wordsforthewise/lending-club

The dataset contains loan-level information such as borrower income, loan amount, credit score, interest rate, and repayment behavior.

Dataset Size Used

Due to hardware memory constraints, a representative sample was used.

- Total records used: **200,000**
- Total variables selected: **21**
- Data size after optimization: **~32 MB**

This sampling approach is statistically sufficient for robust risk modeling.

---

3. Selected Variables

Category	Variables
Loan	loan_amnt, term, int_rate
Borrower	annual_inc, emp_length, home_ownership
Credit History	fico_range_low, fico_range_high
Credit Usage	revol_util, open_acc, total_acc
Risk Behavior	delinq_2yrs, dti
Time	issue_d
Target	loan_status

---

4. Data Preprocessing

The following preprocessing steps were applied:

• Handling missing values

- Numerical variables filled using median values.
- Categorical variables filled using mode.

• Data type correction

- `term` converted from string to integer.
- `emp_length` converted to numeric.
- `issue_d` converted to datetime format.

• Memory optimization

- Only relevant columns were loaded.
- Large dataset handled using row sampling.

---

5. Feature Engineering

New risk-related variables were created:

- **Average FICO Score**

$FICOavg$=$FICOlow$+$FICOhigh$2FICOavg=2FICOlow+FICOhigh

- **Credit Utilization Ratio**

$revol\_util$/100revol_util/100

- **Loan-to-Income Ratio**

$loan_amount/annual_income$loan_amount/annual_income

- **Delinquency Flag**

1 if delinq_2yrs > 0 else 01 if delinq_2yrs > 0 else 0

---

6. Risk Tolerance Model

A composite **Risk Score** was constructed using weighted indicators.

Risk Score Formula

$Risk$=0.30(1−$FICOnorm$)+0.25($DTInorm$)+0.20($IntRatenorm$)+0.10($CreditUtilnorm$)+0.10($Delinq Flagnorm$)+0.05($LoanIncomenorm$)Risk=0.30(1−FICOnorm)+0.25(DTInorm)+0.20(IntRatenorm)+0.10(CreditUtilnorm)+0.10(DelinqFlagnorm)+0.05(LoanIncomenorm)

Scores were normalized using **Min-Max Scaling** and converted to a 0–100 scale.

---

7. Risk Tolerance Classification

Risk Score	Category
< 30	High Risk Tolerance
30–60	Moderate Risk Tolerance
> 60	Low Risk Tolerance

---

8. Dynamic Risk Monitoring

To analyze time-based behavior:

- Loans were grouped monthly using `issue_d`.
- Monthly average risk scores were computed.
- Risk movement was visualized using time-series plots.

This allowed identification of periods where borrower risk tolerance increased or decreased.

---

9. Results & Observations

Key observations:

- Borrower risk tolerance shows significant temporal variation.
- Higher interest rates and rising debt-to-income ratios lead to increased risk.
- Credit score remains the strongest determinant of risk tolerance.
- Periods of financial stress exhibit upward movement in portfolio risk.

---

10. Business Applications

This model can be used for:

- Dynamic portfolio risk monitoring
- Early warning systems
- Credit policy adjustments
- Interest rate pricing
- Stress testing and scenario analysis

---

11. Conclusion

This project demonstrates that borrower risk tolerance is not static but evolves dynamically over time.
By combining credit, income, and behavioral variables, a quantitative risk framework can be developed to support data-driven decision-making in the BFSI sector.

---

12. Tools & Technologies

- Python
- Pandas
- NumPy
- Scikit-learn
- Matplotlib
- Seaborn
- VS Code
- GitHub