

1. Background

Flexibuy utilizes an Internal Rating Based (IRB) model to determine probability of default for its users. The output of this model is a score from 0-1 dictating the probability of default.

Table 1: Risk Score Output and Interpretation

Model Output	Interpretation
0	User will never default
1	User will default

2. Methodology

A good credit risk model is mandated to be:

- Intuitive:** Regardless of academic background, users (credit officers, management) should understand why a customer gets a certain score.
- Reproducible:** Another person should be able to get the same score if they input the same variables
- Explainable:** Each input's impact on the final score should be clear

To achieve this we utilize a multilayered credit scoring system

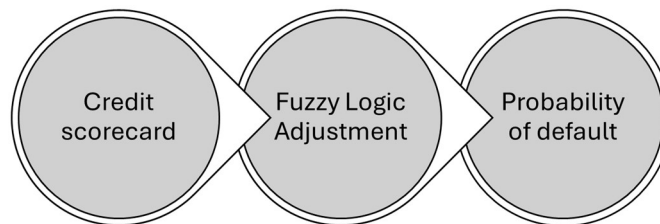


Figure 1: Credit Scoring Architecture

Step 1: Completion of the 5C's Scorecard

Each applicant is first evaluated using FlexiBuy's **5C Credit Scorecard**, which measures five key dimensions:

- Character (Willingness to Repay)
- Capacity (Ability to Repay)
- Capital (Financial Buffer)
- Collateral (Social Collateral)
- Conditions (External Factors)

Table 2: FlexiBuy Credit Score Card

Category	Question	Responses	Coefficient	Rationale
Character (Willingness to Repay) & Capacity (Ability to Repay)	How much do you earn every month?	Above 1800 GHS	5	High income provides a strong buffer.
		1401 GHS – 1800 GHS	4	
		1001 GHS – 1400 GHS	3	
		701 GHS – 1000 GHS	2	
		351 GHS – 700 GHS	1	
		Below 350 GHS	0	Very low income indicates high risk.
	How long have you worked at your current job?	More than 10 years	5	Very high job stability.
		8 – 10 years	4	
		4 – 8 years	3	
		2 – 4 years	2	
		Less than 2 years	1	Low job stability; higher risk.
	In the last 12 months, who did you borrow from?	Banks / Other Financial apps	5	Experience with formal credit systems.
		Mobile Money providers	4	Semi-formal credit experience.
		Money lenders	2	Suggests potential exclusion from formal systems.
		Friends or family	2	Informal; may indicate lack of credit access.
		Not applicable	3	Neutral.
Capital (Financial Buffer)	Who owns the house or building where you live?	You	5	Homeownership is a strong indicator of capital.
		Family	3	Indicates stability but not direct ownership.
		Landlord	2	Standard, but less stable than ownership.
		Other	1	Ambiguous and potentially unstable.
	Do you own a business?	Yes, I have my own business	5	Indicates potential for capital and additional income.
		I own a business with another partner	4	
		No, I don't own a business	3	Neutral; reflects a standard employment situation.
	What is your education level?	Masters or higher	5	Often correlates with higher, more stable income.
		University (first degree)	4	
		A-Level / SHS / Professional	3	
		O-Level / JHS / Primary	2	
		I did not go to school at all	1	
Collateral (Social Collateral)	Family contact provided?	Yes	5	Willingness to provide a reference is a positive sign.
		No	0	Unwillingness is a negative sign.
	What is your relationship with this contact?	Spouse	5	A spouse is a strong, verifiable link.
		Parent / Sibling	4	
Conditions (External Factors)	What industry do you work in?	Child	3	
		Government / Healthcare / Education	5	Typically stable industries.
		Banking / Finance / Telco	4	Generally stable.
		Oil & Gas / Mining / Manufacturing	3	Can be cyclical but often well-paying.
		Retail / Hospitality / Construction	2	Often less stable with higher turnover.
		Agriculture / Informal Sector	1	Can be volatile and subject to seasonality.
	Are you physically challenged?	No	5	Neutral from a risk perspective.
		Yes	5	For data purposes only; cannot negatively impact the score.

Each question on the scorecard is rated from **0 to 5**, based on the applicant’s responses and supporting evidence. After completion, scores within each category are summed to produce five raw totals representing the customer’s overall standing across the 5C framework.

Step 2: Derivation of Composite Scores

The raw 5C scores are converted into standardized composite values suitable for use in the risk model.

1. Combining Related Dimensions

- *Character Composite* = Character + Conditions
- *Capacity Composite* = Capacity + Collateral

2. Normalization

To ensure comparability, each composite score is scaled to a range of **1–5**, where 1 indicates weak performance and 5 indicates strong performance.

$$Character_{scaled} = 1 + \frac{(Character + Conditions)}{28} \times 4$$

$$DebtHonesty_{scaled} = 1 + \frac{(Capacity + Collateral)}{42} \times 4$$

These two normalized indicators—**Character** and **DebtHonesty**—represent the behavioural component of the customer’s credit profile.

Step 3: Extraction of Financial Behaviour Metrics

Quantitative financial metrics are obtained from the customer’s **bank or mobile-money statements**. These metrics reflect income patterns, spending behaviour, and financial stability.

Metric	Definition	Purpose
Average Monthly Income	Mean value of inflows	Indicates earning capacity
Average Monthly Expenditure	Mean value of outflows	Measures repayment burden
Average Minimum Balance	Lowest average balance per month	Measures financial cushion
Volatility	Variation in balance over time	Indicates income stability
Disposable Income	Income – Expenditure	Determines available repayment room

From these, three ratios are derived:

$$DTI = \frac{\text{Expenditure}}{\text{Income}}$$

$$\text{MinBalance} = \frac{\text{AverageMinimumBalance}}{\text{Income}}$$

$$\text{Volatility} = \text{Standardized balance variability (0–3 scale)}$$

These ratios serve as the quantitative inputs to the fuzzy risk model.

Step 4: Risk Evaluation through Fuzzy Logic

FlexiBuy employs a **fuzzy inference system** to evaluate risk more dynamically than traditional linear models.

The system uses five input variables:

Variable	Source	Desirable Range
DTI (Debt-to-Income Ratio)	From statement data	Lower values preferred
Volatility	From balance history	Lower values preferred
MinBalance	From savings patterns	Higher values preferred
DebtHonesty	Derived from Capacity + Collateral	Higher values preferred
Character	Derived from Character + Conditions	Higher values preferred

Fuzzy Rules

The model applies pre-defined logical rules such as:

- If **DTI** is *high* or **Volatility** is *volatile*, then **Risk** is *high*.
- If **DebtHonesty** is *good* and **Character** is *strong* and **DTI** is *low*, then **Risk** is *low*.
- If **DebtHonesty** is *poor* or **Character** is *weak*, then **Risk** is *high*.

Through fuzzy aggregation and defuzzification, the system computes a continuous **Risk Score** between **0** and **1**, where:

- 0** = Low Risk (very safe borrower)
- 1** = High Risk (unsafe borrower)

Step 5: Conversion to Safety Index

For interpretability, the model inverts the Risk Score to derive a **User Safety Score**, defined as:

$$UserSafety = 1 - RiskScore$$

This transformation ensures that higher values reflect lower credit risk and greater repayment reliability.

Step 6: Credit Limit Computation

The customer's **credit limit** is determined by combining behavioural and financial components as follows:

$$InitialLimit = 30\%ofincome \times CorrectionFactor \times UserSafety \times 2$$

Where:

- a. **Disposable Income** = Net available monthly surplus
- b. **Correction Factor** = Adjustment constant (default 0.8)
- c. **UserSafety** = Inverted fuzzy score
- d. **×2** = Scaling multiplier approximating two repayment cycles

This computation balances affordability with risk exposure.

NB: This model is highly experimental since limited population data was used in its creation. As such the model is extremely conservative leading to higher-than-expected rejection rates . Hence a **Correction Factor** is needed to manually tune the model based on its live performance.