ODD Protocol ~ Agent Based Simulation Model for the prediction of debt accumulation by Kenyans.

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Introduction

Financial inclusion refers to providing all individuals and businesses access to affordable financial services to meet their needs. In the last 15 years the world bank has stepped up efforts to promote financial inclusion with a focus on developing countries in Africa as a means to reduce extreme poverty around the world. This initiative has so far ensured that approximately 67% of adults around the globe have access to an account. In countries such as Kenya where at least 80% of the population have access to an account the drive for financial inclusion has been extended further by encouraging Kenyans to use their accounts often.

The adoption of mobile money services by government and private sector has been very effective in promoting financial inclusion in Kenya. It is estimated that nine in every ten Kenyans have access to mobile money services. Through these services they are able to transact funds between family and friends, make payments for government services and have access to personal unsecured loans. Mobile money services have in a big way contributed in uplifting millions of Kenyans from extreme poverty.

However, the success of mobile money in Kenya has also contributed to unforeseen effects. More startup companies providing the same mobile money services have been introduced into the market and are offering very stiff competition to more established financial institutions such as banks. Due to this over supply of financial services consumers are able to acquire unsecured loans from different startup companies simultaneously, therefore accumulating huge debts that they are unable to pay. This excess borrowing has resulted in some consumers being blacklisted by the credit reference bureau when they default on their loan payments, hence being ineligible for any financial aid from any financial institution within the country.

Purpose.

The aim of this agent based model is to simulate the adoption of mobile loan applications among Kenyans and to predict the rate of debt accumulation among individuals using these services and how long it takes before being blacklisted by the credit referencing board.

This model can be extended to investigate the strategies banks and other legacy financial institutions have used to counter the effect of mobile loan services and remain profitable.

This simulation can also be used in other industries to predict the rate at which consumers take up new alternative products and to investigate how markets respond when new alternative products/services are introduced.

Entities, State Variables and Scales

The environment of this model is a city. Agents of the model are represented by banks, startups and customers. The customers are linked to each other by social circles representing friends, family and colleagues. The time step represents a month.

Banks	Agent
Variable Name	**brief description**
Location	Spatial location of the bank within the neighbourhood
Interest rate	Amount to be paid by the customer over the borrowed loan amount
Loan maturity	Time taken between loan application and actual availability of funds to the customer
Max amount	Maximum amount that can be borrowed for each loan
Min amount	Minimum amount that can be borrowed for each loan
Asset attachment	Yes/No. Do any assets need to be attached against the borrowed loan amount.

Startups	Agent
Variable Name	**brief description**
Location	Spatial location of the bank within the neighbourhood
Interest rate	Amount to be paid by the customer over the borrowed loan amount
Loan maturity	Time taken between loan application and actual availability of funds to the customer
Max amount	Maximum amount that can be borrowed for each loan
Min amount	Minimum amount that can be borrowed for each loan
Asset attachment	Yes/No. Do any assets need to be attached against the borrowed loan amount.

Customers	Agent
Variable Name	**brief description**
Number of loans	The total number of loans applied by a single customer
Amount earned	Amount earned by a customer on a monthly basis
Total loan repayment amount	Total amount a customer pays on a monthly basis for the repayment of loans.
Credit reference bureau listing	Yes/No. Is the customer blacklisted by the credit reference bureau.

Customers	Agent
Requires loan	Yes/No

Social Circle	Collective
Variable Name	**brief description**
Maximum number of customers within the social circle	Maximum number of customers that can be part of the same social circle.
Number of customers linked to a particular customer	The number of linked customers within a social circle. Can not be more than the maximum number.

Environment	Environment
Variable Name	**brief description**
Market size	The total number of customers available to banks and startups
Initial number of banks	Numeric variable
Number of months before startups start operating	Number of months required to establish a customer's history

Process overview and scheduling

At the beginning of the model simulation, only banks are available to customers for the first few months. Customers randomly get assigned which banks they account holders of and can apply for a loan.

Each month customers get to choose which banks they want to be an account holder. This decision is based on knowledge gained from the linked customers.

At every step the history of the customer is updated, the amount earned by every customer is updated, the total loan debt is updated, the total number of loans acquired is updated and the total loan repayment amount is updated.

After a few months startup companies are introduced into the model, and their variables are randomly assigned. Customers now have another alternative for getting financial aid.

The number of customers at the banks is updated. The number of customers at the startup companies is updated.

Customers apply for loans from different startup companies in addition to the loans that they already have at the various banks.

The total loan repayment amount is updated.

If the total loan repayment amount is larger than the amount earned by a customer then the customer is blacklisted by the credit reference bureau.

The credit reference bureau list is updated at each step.

Design Concepts

Emergence

The number of customers using startup services will grow massively and startups will be able to turn a profit since startups have lux regulations for issuing loans than banks.

It is unlikely that banks will close down because of the loss customers since certain services can only be offered by banks. I addition banks will to some extent adapt to the changing market demands in order to retain their customers.

The number of customer agents that will be blacklisted by the credit reference bureau will increase.

Objectives

The objective of banks is to retain their customers and to grow profit.

The of objective startup companies is to offer more favourable loan services than those offered by banks so that they can increase their customer numbers and to grow profit.

The objective of the customers is to take advantage of the most affordable and convenient loan services in order to meet their financial needs.

Adaptation

Banks have to adapt by tailoring their loan services to be as attractive as those being offered by startups.

Learning

Banks learn that their loan services are not as attractive a those offered by startups.

Customers learn that startups are offering better loan services that are tailored to their specific needs than those offered by banks.

Prediction

The model predicts how long it will take for an a customer to accumulate a large amount of loans that he/she can not repay and eventually get blacklisted by the credit reference bureau.

Sensing

Customers have knowledge of bank variables and startup variables. They also have knowledge of the linked customer history which helps in making a decision when choosing a bank or a startup.

Interactions

Since customers have an active social life, through the links that they make within their social circle their decisions on which financial services to use may get influenced. As time passes by links between customer agents are randomly created and dropped.

Stochasticity

Initially customers randomly choose the banks or startups that they apply for a loan from. The initial variables for banks and startups are randomly assigned.

Initially the customer variables are randomly assigned. Bank and startup variables vary randomly depending on the business environment.

Collectives

Customers that apply for loan services belong to the same social circle and often share financial advice.

Observations

At every step the number of customers that have applied for a loan from a bank or a startup is updated and recorded. The total amount of debt owed by every customer is updated and recorded at each step.

At each step amount earned by a customer is recorded. The credit reference bureau list is also updated at each step.