CREDIT RISK MANAGEMENT FOR SOLAR ASSET FINANCE

November 18, 2020

CGAP

GCGLA
Logistics

- Today’s session will NOT be recorded. Please speak freely.

- We will be sharing the presentations following the event

- Please post questions during the session in the Chat (send to ‘EVERYONE’)

- Add your organization to your name – for example ‘Daniel Waldron (CGAP)’:
  - Click ‘Participants’,
  - Right click your name
  - Click ‘Rename’
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00</td>
<td>Introduction</td>
</tr>
<tr>
<td>11:10</td>
<td>Transaction Risk</td>
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<tr>
<td>11:15</td>
<td>Product Design</td>
</tr>
<tr>
<td>11:35</td>
<td>Credit Assessment</td>
</tr>
<tr>
<td>12:20</td>
<td>Monitoring &amp; Collections</td>
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<tr>
<td>12:45</td>
<td>Break</td>
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<tr>
<td>13:00</td>
<td>Expected Loss</td>
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<tr>
<td>13:20</td>
<td>Metrics and Analytics</td>
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<tr>
<td>14:00</td>
<td>Case Studies</td>
</tr>
<tr>
<td>14:30</td>
<td>Data and Dashboards</td>
</tr>
</tbody>
</table>
Poll Question #1:
What is your personal risk appetite?

1. Zero: I don’t go outside if it might rain
2. Low: I wore a mask everywhere before the pandemic
3. Moderate: I do not always wear a helmet on motorcycles
4. High: I go rock-climbing on the weekend, without ropes
Rebecca Rhodes

Project Manager, Consumer Protection and Technology

GOGLA
Objective of this webinar

➢ Understand the nature and drivers of default in credit
➢ Understand credit assessment techniques
➢ Interpret credit portfolio performance
➢ Best practices for credit losses
CREDIT TRANSACTION RISK
Credit Risk Fundamentals

Credit Risk – Definition

- **Credit risk**: possibility that a borrower or other contractual counterparty might default, i.e. might fail to honor their contractual obligations.

- **Migration risk**: potential deterioration of the credit quality of an un-defaulted exposure.

- **Transaction risk** refers to individual loans and essentially measures (1) the standalone probability that the borrower will be able to repay, as well as (2) the ultimate loss in the case of a borrower default after use of collateral and other mitigating factors.

- **Portfolio credit risk** is concerned with measuring correlations between individual borrower defaults, the effects of diversification, the cyclicality of collateral values and the implications of reputation and contagion effects.
Credit Transaction Risk

THE CREDIT LIFE CYCLE

- Similar to financial institution
- Disbursement requires exchange of physical goods
- Collections may include repossession
- Operational risk arises at all stages of the credit life cycle
- Consumer protection should guide all aspects of customer interaction
Product Design
Technological innovation has been a key enabler in reaching low-income customers

- Remote lock-out
- GPS tracking
- Communication platforms
- Analytics

Main considerations for the ‘financial product’ include

- Tenor
- Repayment flexibility
- Risk-based pricing and provisioning
- Interest rates
Product Design

Asset finance begins with the physical product design. Key risk factors to consider include

| Quality          | • Objective measures e.g. hours of light
|                  | • Subjective measures e.g. product features |
| Durability       | • Product malfunctions |
| Longevity        | • Depreciation
|                  | • Resale/ Refurbishment |
| Dependency       | • Required infrastructure to operate product |
| Interoperability | • Links with other products
|                  | • Impact of proprietary product ecosystems |
| Value for Money  | • Do product benefits far outweigh costs |
Effective Interest Rates

Traditional Interest Rate Components:

- Cost of funds
- Loan loss expense
- Operating expense
- Profit

This gets significantly more complicated in vertically-integrated models…
**Repayment flexibility**

Most PAYGo companies allow borrowers to make flexible repayments, without forcing them to repay missed payments (‘arrears’)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Aligns with sporadic incomes of low-income households</td>
<td>• Failure to develop repayment discipline</td>
</tr>
<tr>
<td>• Creates a more ‘on-demand’ customer experience</td>
<td>• Early repayers may pay higher effective interest rates</td>
</tr>
<tr>
<td>• Allows poorer customers to lower the effective price by regularly skipping days</td>
<td>• Makes portfolio health difficult to assess and communicate</td>
</tr>
</tbody>
</table>

The only way to solve these problems is with data, which requires iteration
Extreme affordability is the key to universal energy access. But lengthening tenors is not the same thing.

Imagine a $120 SHS with a $20 deposit.

<table>
<thead>
<tr>
<th>Months</th>
<th>Monthly Payment</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>$10.24</td>
<td>$142.88</td>
</tr>
<tr>
<td>24</td>
<td>$6.11</td>
<td>$166.66</td>
</tr>
<tr>
<td>36</td>
<td>$4.80</td>
<td>$192.89</td>
</tr>
</tbody>
</table>

At first glance, one of these seems obviously preferable. But it’s not that simple.
Loan tenor and credit risk, continued

But if we hold loan principal constant and increase the tenor, a few things happen:

- **Cost of funds and OpEx go up**
- **Iterative learning decreases**
- **Cost of risk goes up, fast**
In our experience the cost of risk is often not provisioned fully, nor is it always priced in…
We owe it to customers to minimize the cost of risk
There is no perfect PAYGo product, but we can get closer

➢ Keep loans as short as possible, and as long as necessary
➢ Price in expected losses, and reduce prices by managing credit risk
➢ Acknowledge the time value of money
➢ Experiment with risk-based pricing
➢ Iterate!
Q&A
Credit risk assessment
Poll Question #2: What does your company’s credit assessment look like?

1. There is no assessment beyond basic KYC. If a customer can afford the deposit, they get the unit.

2. We ask a few questions to weed out potential fraud, but we reject very few customers.

3. We have a robust credit scorecard that we administer for every potential client and reject more than 10% of applicants.

4. Our process looks like #1 for small systems, and #3 for larger systems.
Credit risk assessment

• Involves assessing likelihood that loan shall be repaid
• Two primary dimensions:
  • Ability to pay
  • Willingness to pay
• Consumer credit assessments conducted via:
  • Judgment, based on client interviews
  • Automation, especially statistical credit scoring
  • Credit ratings, especially for larger loan sizes
  • Judgment, supported by scoring or rating
Credit risk assessment

Ability/Willingness matrix

- Uncertain cash flows
  - Acceptable behavioral character
  - Unacceptable character traits

- Appropriate cash flows
  - Acceptable character traits
  - Unacceptable character traits

Willingness

Ability
Credit assessment

• PAYGo providers have experienced rapid growth in portfolio with limited use of assessment best practices
  • Use of group solidarity lending techniques such as upfront savings, group guarantees etc
  • Home visits prior to lending
  • Use of credit bureaus where available esp. for larger value transactions
  • Requiring guarantors/ references
  • Credit approval limits based on hierarchy or performance

• Providers should aim for optimal trade-off between growth and risk management
1 What is Scoring?

Statistical Credit Scoring

- Scorecards use predictive statistical models (discriminant analysis or logistic regression) applied to the behavior of previous customers: i.e. a database of descriptors / demographics combined with a subsequent performance record.
- With credit scoring, lenders obtain ex-ante visibility of the Probability of Default.
- Together with LGD & EAD estimates, lenders now have a basis for risk-based pricing of individual clients, particular products or client groups.

**Database**
- Loan Contract
- Socioeconomic descriptors
- Default (yes/no)

**Statistical Model**

**Score Result**

<table>
<thead>
<tr>
<th>Score Value</th>
<th>High Risk:</th>
<th>Medium Risk:</th>
<th>Low Risk:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reject</td>
<td>Review</td>
<td>Accept</td>
</tr>
</tbody>
</table>
Statistical credit scoring: Data points

- Track a wide variety of predictive points
- Loan cycles must be completed
- Back testing on separate data
- Periodic review of scoring model

<table>
<thead>
<tr>
<th>Qualitative</th>
<th>Personal Data</th>
<th>Age</th>
<th>Marital Status</th>
<th>Gender</th>
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<tbody>
<tr>
<td></td>
<td>Education</td>
<td></td>
<td>Banking Experience</td>
<td>Years at Address</td>
</tr>
<tr>
<td>Living</td>
<td>No. of Dependents</td>
<td>No. of Children</td>
<td></td>
<td>Region</td>
</tr>
<tr>
<td>Business</td>
<td>Sector</td>
<td>Location</td>
<td></td>
<td>No. of Employees</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Financial</th>
<th>Seasonality of cash-flows</th>
<th>Requested Loan Amount</th>
<th>Loan Product</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ratios</td>
<td></td>
<td></td>
<td>Credit Bureau</td>
</tr>
<tr>
<td></td>
<td>Land Value</td>
<td></td>
<td></td>
<td>Movable Collateral</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Collateral</th>
<th>Land Value</th>
<th>Personal Guarantee</th>
<th>Movable Collateral</th>
</tr>
</thead>
</table>
2 Rating & Expert Scoring

SME Rating Models

- Rating models should be reasonably evenly distributed across a minimum number of grades borrowers.
- The need for competitive pricing for risk also requires a finely graded rating model or scoring system.

![Graph showing Good System and Poor System for default rate vs rating]

S&P Rating Grades and PD
2 Rating & Expert Scoring

Expert Scoring versus Rating

- An expert scoring looks much like a simplified rating model that is specifically tailored to consumer credit.
- Expert scoring typically assesses credit risk directly in terms of an all-in expected loss in the technical sense of $EL = PD \times EAD \times LGD$.
- An expert scoring model will contain risk factors that may impact any of the three risk parameters PD, EAD or LGD.
- Who are the experts: Credit staff from entity
3 Rating & Expert Scoring

What is better: statistical scoring or judgment-based expert scoring?

- The predictive performance of expert scoring will have to be statistically validated.
- The statistical scoring measures not how we think or wish that the borrowers might behave, but how they actually paid.
- A statistical model also has a built-in algorithm for determining the criteria weights that combine the various risk factors into a single score result. This summary score optimally discriminates between probable good and probable bad clients.
What is better: statistical scoring or judgment-based expert scoring?

The central challenge in expert scoring is how to weigh and combine the scoring elements. This synthesis remains arbitrary and is always a source of debate in expert scoring.

Most lenders opt for expert scoring out of necessity, because the data history for calculating a statistical credit scoring model just is not there:

- Few disbursed loans
- Insufficient data
- Few defaulted loans in the data history
4 Expert Scoring

Practical considerations

• Use minimally invasive customer data such as age, gender, family size etc.
• Collecting data, say incomes, to assess ability to pay is very difficult
• Consider asset based information eg. Using the Poverty Probability Index (PPI)
• Build internal data on customer behavior e.g. expert scores, repayment behaviour, location. Ultimately this would be used to develop statistical credit scoring tools
# Sample PPI: Kenya 2015

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. In which county does the household reside?</strong></td>
<td>A Mombasa</td>
</tr>
<tr>
<td></td>
<td>B Kwale</td>
</tr>
<tr>
<td></td>
<td>C Nairobi</td>
</tr>
<tr>
<td></td>
<td>D ...</td>
</tr>
<tr>
<td><strong>2. What is the highest educational level that the female household head/spouse reached?</strong></td>
<td>A Pre-primary, none, or other</td>
</tr>
<tr>
<td></td>
<td>B Primary</td>
</tr>
<tr>
<td></td>
<td>C Secondary or post-primary, vocational</td>
</tr>
<tr>
<td></td>
<td>D College level or higher</td>
</tr>
<tr>
<td></td>
<td>E There is no female household head/spouse</td>
</tr>
<tr>
<td><strong>3. What is the highest educational level that any member of the household reached?</strong></td>
<td>A Pre-primary, none, or other</td>
</tr>
<tr>
<td></td>
<td>B Primary</td>
</tr>
<tr>
<td></td>
<td>C Secondary or post-primary, vocational</td>
</tr>
<tr>
<td></td>
<td>D College level or higher</td>
</tr>
<tr>
<td><strong>4. Over the past 7 days, did the household either purchase/consume/acquire any bread?</strong></td>
<td>A Yes</td>
</tr>
<tr>
<td></td>
<td>B No</td>
</tr>
<tr>
<td><strong>5. Over the past 7 days, did the household either purchase/consume/acquire any meat or fish?</strong></td>
<td>A Yes</td>
</tr>
<tr>
<td></td>
<td>B No</td>
</tr>
<tr>
<td><strong>6. Over the past 7 days, did the household either purchase/consume/acquire any ripe bananas?</strong></td>
<td>A Yes</td>
</tr>
<tr>
<td></td>
<td>B No</td>
</tr>
<tr>
<td><strong>7. Does your household own any towels?</strong></td>
<td>A Yes</td>
</tr>
<tr>
<td></td>
<td>B No</td>
</tr>
<tr>
<td><strong>8. Does your household own any thermos flasks?</strong></td>
<td>A Yes</td>
</tr>
<tr>
<td></td>
<td>B No</td>
</tr>
<tr>
<td><strong>9. What is the predominant wall material of the main dwelling unit?</strong></td>
<td>A Finished walls (cement, stone with lime/cement, bricks, cement blocks, covered adobe, or wood planks/shingles)</td>
</tr>
<tr>
<td></td>
<td>B Uncovered adobe, plywood, cardboard, reused wood, or corrugated iron sheets</td>
</tr>
<tr>
<td></td>
<td>C Natural walls (cane/palm/trunks, grass/reeds, or mud/cow dung), no walls, bamboo with mud, stone with mud, or other</td>
</tr>
<tr>
<td><strong>10. What is the predominant floor material of the main dwelling unit?</strong></td>
<td>A Natural floor (earth/sand or dung) or palm/bamboo</td>
</tr>
<tr>
<td></td>
<td>B Other (including wood planks/shingles, parquet or polished wood, vinyl or asphalt strips, ceramic tiles, cement, or carpet)</td>
</tr>
</tbody>
</table>
Holger Siek
Senior Risk Mgmt. Expert,
Frankfurt School of Finance and Management
Who has had success or challenges with credit assessment that you can share?
Credit Documentation

*Clients are most responsive before disbursement*
Disbursement and risk management

1. Verification – opportunity to verify self reported data
2. Training – the better the client is trained on how to handle the asset, the more likely they will be inclined to pay
3. Time - delays in installation and delivery could impact repayment e.g. water pumps and seasonality
Credit Monitoring

Daily tracking by key management
Objectives of Credit Monitoring

1. Keep track of borrower’s willingness/ability to pay

2. Early detection of potential default. Some warning signs for individuals include:

   i. Request to extend the grace period or restructure account

   ii. Arrears on the account e.g. increasing cumulative days not topped up

   iii. Customer is no longer available or non-responsive

   iv. Increased largesse and expensive lifestyle

   v. Change in customer behaviour – arrogance, rudeness, dishonoring commitments
Credit monitoring cycle

Notification before payment is due
• Appreciation if payment is on time

Follow up call with overdue customer
• Commitment on payment date

Visit overdue customer
• Reassess ability/willingness to pay
Collections

Collections start with effective credit assessment
Typical collections flowchart

1. Update Data and Analysis to most recent period end
2. Calls and SMS to low risk clients
3. Calls, SMS and visits to moderate risk clients
4. Repossession for High risk customers
5. Repossession if viable for defaulting customers
6. Legal recourse
Tools to ease collections

1. Device lock-out
2. Witholding future financial services
3. Reporting default to credit bureaus
4. Repossession of asset
5. Legal recourse

Repossession and Resale

1. Existence of policies and procedures
2. Signaling effect of repossession
3. Tracking post-default cashflows
4. Repossesion of asset. Useful for
   i. Repossession rates
   ii. Salvage and resale values
   iii. LGD calculation
## Collections

**Framework for best practice**

### Arrears Management

- Pre-disbursement
- Post-disbursement
- Policies / Processes
- Limits
- Loan Analysis
- Decision-making
- Loan covenants
- Collateral / Co-debtors

**GOGLA Consumer Protection Code**

- Restructuring
- Outsourcing
- Legal actions

### Customer Protection
Poll Question #3: What is your approach to repossession?

1. We only repossess when it is economical. The unit has to have residual value and be easily accessible.

2. We repossess whenever economical, as well as occasionally to send a signal.

3. Customers can return our assets, but we will never repossess them.
How have your repossession practices evolved over the years?
Time for a 15-minute Break
PORTFOLIO MANAGEMENT
EXPECTED LOSS
Expected and Unexpected Loss

The basis for accounting for credit losses

Expected Loss (EL) = PD * LGD * EAD

- PD = Probability of Default, % per annum
- LGD = Loss Given Default, %
- EAD = Exposure at Default, currency units

Unexpected Loss

= annual portfolio credit loss amount in excess of the average expected loss.

- Correlation of borrowers’ economic situation (concentrations)
- External events (macroeconomic crisis, currency devaluation, natural disasters, …)
- Need to budget exposure by geography and market segment (ex-ante diversification)
Calculating Expected Loss

What is the Expected Loss on this portfolio on 31/12/2019? Make a reasonable LGD assumption based on your market experience.

\[ \text{Expected Loss} = 6,788,835 \times \text{LGD} \]
Pricing in Expected Loss

Expected Loss (EL) = PD * LGD * EAD

• Refers to amount the entity can expect to lose under ordinary business conditions
• IFRS 9 requires initial recognition upon disbursement
• This amount should be priced into lease contract
• An entity with high PD, should strive to minimize LGD and EAD
  • Robust collections/ recovery processes to lower LGD
  • Minimize fraudulent cases to decrease EAD
  • Frequent monitoring of portfolio to identify problem loans early
Theoretical Annual Loss Distribution in a Credit Portfolio

- **Expected Loss** (priced in)
- **Unexpected Losses** (covered by capital)
- **Stress Loss** (at specified confidence level)
- **Catastrophic Loss** (not priced in / not covered by capital)
Expected and Unexpected Loss

Shorten maturities to minimize Unexpected Loss
IFRS 9: Impairment basics

The 3-Stage Model for IFRS 9 Impairments

Increase in credit risk since initial recognition

- **Stage 1**: Unchanged or Low Credit Risk, 0-30 days arrears
- **Stage 2**: Significant Increase in Credit Risk, 31-90 days arrears
- **Stage 3**: Non-Performing, “credit-impaired”, 91+ days arrears

Impairment recognition

- **Stage 1**: 12-month expected credit losses
- **Stage 2**: Lifetime expected credit losses
- **Stage 3**: Lifetime expected credit losses

Sample ECL Provision Rates

- e.g. 0.5%
- e.g. 25%
- e.g. 65%
Poll Question #4:
How do you provision for loan losses?

1. We don’t provision anything at all, we use a different accounting framework.

2. We provision for some loss on an annual basis. It may not be sufficient.

3. We provision on a regular basis and try to update our EL frequently, but it’s a challenge.

4. We update our EL on a product and segment basis automatically, and provision upfront for every customer in close to real-time.
Guest Speaker

Alison Boess
Head of Credit Operations
ENGIE Energy Access
PORTFOLIO METRICS AND ANALYSIS
Guest Speaker

Nicky Khaki
Senior Financial Sector Specialist
CGAP
Portfolio at Risk

A basic measure for portfolio quality

Portfolio at risk measures a lender’s credit risk position at a specific point in time (X days). Usu. Tracked for 1, 7, 30 and 90 day arrears

\[ \text{PaR}_X(\%) = \frac{\text{Principal outstanding} \times X \text{ days} + \text{principal written off \ (over last YEAR)}}{\text{Total gross portfolio outstanding}} \]

- **PAR 1-day**
  - Usu. smaller value assets
  - Field officer level tracking

- **PAR 30-day**
  - Assets < $20,000
  - At branch/ HQ level

- **PAR 90-day**
  - Assets > $20,000
  - LArger SMEs/ Corporates
Receivables at Risk

A basic measure for portfolio quality where repayments are flexible

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>Collections Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer #1</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>70%</td>
</tr>
<tr>
<td>Customer #2</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>20%</td>
</tr>
<tr>
<td>Customer #3</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>40%</td>
</tr>
<tr>
<td>Customer #4</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>90%</td>
</tr>
</tbody>
</table>

- Using PAR would flag all clients by Month 5
- Customers with high collections rate may not be risky

Receivables at Risk (RAR) an asset finance company to identify receivables that are owed by clients who are paying too infrequently, but may still be paying

\[
RaR(\%) = \frac{\text{Remaining Value of Outst. Receivables for Which Overall Collection Rate} < [X]\% + \text{write offs}}{\text{Value of Total Future Receivables Due}}
\]
Default is a function of time

Address fundamental weakness of PAR/RAR measures

\[ \text{Bad Rate}_t = \frac{\text{Bad} \, \text{Principal}_t + \text{Written off Principal}_{T0 \text{ until } t}}{\text{Disbursed Amount}_{T0}} \]

How a typical vintage curve might look like?
(e.g. for all loans disbursed in January 2017)
Vintage curves

Shorter curves should plot below the older ones for a given period

% of portfolio disbursed in month y in PaR 90 x months after disbursement
### Vintage curves

The same concept may be numerically expressed

<table>
<thead>
<tr>
<th>Days Since Disbursement</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
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<td>1%</td>
<td>1%</td>
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</tr>
<tr>
<td>60</td>
<td>2%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>2%</td>
<td>1%</td>
<td>2%</td>
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<td>3%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
<td>1%</td>
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<tr>
<td>90</td>
<td>4%</td>
<td>4%</td>
<td>5%</td>
<td>4%</td>
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<td>2%</td>
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<td>4%</td>
<td>4%</td>
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<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>120</td>
<td>6%</td>
<td>6%</td>
<td>7%</td>
<td>5%</td>
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</tbody>
</table>
Portfolio metrics

Vintage Curves vs. Portfolio at Risk/ Receivables at Risk

- Portfolio at Risk is a lagging indicator of borrower performance.
- In rapidly growing portfolios, PaR may seriously underestimate the bad rate.
- New loans always perform well. It takes a while for borrowers to fall into arrears. Even the worst borrowers should manage to pay a few installments with the money they just borrowed …
- If there are always more new loans than older loans because the portfolio is growing rapidly, then it is no surprise that the PaR will be excellent.
- When portfolio growth slows or turns negative, the PaR goes up.
- Vintage curves can serve as a leading indicator:
  - i.e. an early warning of emerging negative portfolio trends in a disbursement boom, but also …
  - as a visualization of improving performance in newer loan generations.
Transition matrix

- Client repayment behaviour evolves over a loan tenor. Clients who used to pay on time may deteriorate and vice versa.
- Transition matrix captures this repayment behavior in a tabular manner, showing how a portfolio in a given month evolved in the subsequent month.
- It is useful in guiding and tracking the effectiveness of monitoring, collections, and recovery activities.
- May be used in calculating Expected Loss of a portfolio.

### Transition Matrix

<table>
<thead>
<tr>
<th>Status</th>
<th>Month End x+1 -&gt;</th>
<th>Settled</th>
<th>Current</th>
<th>1-30 d</th>
<th>31-60d</th>
<th>61-90d</th>
<th>91-120d</th>
<th>121-150d</th>
<th>151-180d</th>
<th>181-210d</th>
<th>211-240d</th>
<th>241-270d</th>
<th>271-300d</th>
<th>301-330d</th>
<th>≥ 331-360d</th>
</tr>
</thead>
<tbody>
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<td>Current</td>
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<td>91.68%</td>
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<tr>
<td>1 - 30 d</td>
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<tr>
<td>31 - 60 d</td>
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<tr>
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<td>0.60%</td>
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<tr>
<td>91 - 120 d</td>
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<td>4.13%</td>
<td>24.55%</td>
<td>68.92%</td>
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<tr>
<td>121 - 150 d</td>
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<td>4.14%</td>
<td>15.47%</td>
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<tr>
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<td>0.00%</td>
<td>3.59%</td>
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<tr>
<td>271 - 300 d</td>
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<tr>
<td>301 - 330 d</td>
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<tr>
<td>331 - 360 d</td>
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</tr>
</tbody>
</table>

**Empirical Default Rate**

- 0.22%
- 44.67%
- 71.49%
- 85.28%
- 89.72%
- 90.40%
- 90.80%
- 91.77%
- 92.71%
- 93.02%
- 98.72%
- 100.00%
## Transition matrix

**Getting the Matrix**

<table>
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<th>Loan</th>
<th>March</th>
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<tbody>
<tr>
<td></td>
<td>E</td>
<td>Arrears</td>
</tr>
<tr>
<td>A</td>
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<td>0</td>
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<tr>
<td>B</td>
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<td>12</td>
</tr>
<tr>
<td>C</td>
<td>7,000</td>
<td>18</td>
</tr>
<tr>
<td>D</td>
<td>10,000</td>
<td>65</td>
</tr>
<tr>
<td>E</td>
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<tr>
<td>SUM</td>
<td>57,000</td>
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</table>

*E = outstanding loan volume, arrears = days overdue*
## Transition matrix

### Getting the Matrix

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<th>31-60d</th>
<th>61-90d</th>
<th>91+d</th>
<th>SUM</th>
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<tr>
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<tr>
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## Transition matrix

### Getting the Matrix

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<th>31-60d</th>
<th>61-90d</th>
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<tbody>
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<tr>
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<td>61-90d</td>
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<tr>
<td>91+d</td>
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### Transition Matrix

<table>
<thead>
<tr>
<th></th>
<th>E</th>
<th>Arrears</th>
<th>E</th>
<th>Arrears</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10,000</td>
<td>0</td>
<td>9,000</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
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## Transition matrix

### Getting the Matrix

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<th>Current</th>
<th>1-30d</th>
<th>31-60d</th>
<th>61-90d</th>
<th>91+d</th>
<th>SUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
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<td>14,000</td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>13,000</td>
<td></td>
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<td>13,000</td>
</tr>
<tr>
<td>31-60d</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>61-90d</td>
<td>2,000</td>
<td>8,000</td>
<td></td>
<td></td>
<td>8,000</td>
<td></td>
<td>18,000</td>
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<tr>
<td>91+d</td>
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<td></td>
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<td>8,000</td>
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<tr>
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<td>0</td>
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<td>16,000</td>
<td>57,000</td>
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## Transition matrix

### Getting the Matrix

<table>
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<th>Current</th>
<th>1-30d</th>
<th>31-60d</th>
<th>61-90d</th>
<th>91+d</th>
<th>SUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
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<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>1-30d</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
<td>100%</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>31-60d</td>
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<td></td>
<td>-</td>
</tr>
<tr>
<td>61-90d</td>
<td>11.1%</td>
<td>44.4%</td>
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<td>44.4%</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>91+d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
End of July your existing portfolio is UGX 20,000,000. 80% thereof is in current status while 5% is in arrears between 1 and 30 days. An additional 500,000 is in arrears between 31 and 60 days and finally again 500,000 is in arrears between 61 and 90 days.

a) Which amount do you expect to be in arrears 1-30 days end of August?

b) Which amount do you expect to be in arrears 1-30 days end of September?
Transition matrix

The Power of the Matrix! - What to look at:

- Month by month elementary transitions for the total portfolio, by segment.
- Rolling x-month average monthly matrix for total portfolio or by segment.
- $N^{th}$ exponential =MMULT{} providing a n-month forward portfolio status, using either an average monthly matrix or just the most recent 1-month matrix.

→ Matrix rules: $M^n \times M^m = M^{n+m}$

- Seasonalized matrix forecast – concatenating prior calendar month matrixes.

Transition Matrix

<table>
<thead>
<tr>
<th>Starting Status</th>
<th>Status +6 months -&gt;</th>
<th>1-30d</th>
<th>31-60d</th>
<th>61-90d</th>
<th>91-120d</th>
<th>121-150d</th>
<th>151-180d</th>
<th>181-210d</th>
<th>211-240d</th>
<th>241-270d</th>
<th>271-300d</th>
<th>301-330d</th>
<th>331-360d</th>
<th>Empirical Default Rate +6m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>39.31% 59.60% 0.36%</td>
<td>0.29%</td>
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</table>
Recovery Analysis

- Refers to funds collected after default
- Net Present Value of recoveries are used to determine Loss Given Default (LGD)
  
  \[
  \text{LGD} = 1 - \text{Recovery ratio}
  \]
  
  Where recovery ratio is the proportion of recovery to the default amount. Discount factors are determined using the effective interest rate

- Recoveries are usually higher when there is collateral in place. This has implications for
  
  - Timing of repossessions (the earlier the better)
  - KYC – knowing where the asset is deployed
  - Impairment provisions – the higher the recoveries, the lower the provisions (using Expected Loss/ IFRS 9)
Portfolio concentration

- By which categories a loan portfolio can be concentrated?
  - Regions (geographical)
  - Industries (sectoral)
  - Loan amounts
  - Loan products
  - Currency
  - Loan maturities → liquidity risk?
  - ...

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Portfolio concentration

Gini Coefficient – a basic measure of concentration

\[ Gini = \frac{B - A}{B} = [0; 1] \]

The closer Gini is to 1, the higher the concentration!
Sector / activity diversification is often too superficial in low income finance.

Effective diversification in housing, consumer, SME credit etc. always requires a strong **geographical element.**
# Case Studies!

<table>
<thead>
<tr>
<th>Company</th>
<th>Analysts</th>
<th>Executives</th>
</tr>
</thead>
<tbody>
<tr>
<td>SolarSun</td>
<td>Breakout Room 1 (Walter)</td>
<td>Breakout Room 2 (Rebecca)</td>
</tr>
<tr>
<td>SunMoon</td>
<td>Breakout Room 3 (Dan)</td>
<td>Breakout Room 4 (Roan)</td>
</tr>
</tbody>
</table>

Your Task is to Answer:
- What is the health of the portfolio?
- How does it align with Appetite?
- What is the trend?
- What additional information do you need?
- What actions do you recommend to the board?

15 minutes to discuss
2 minutes to present (that’s it!)
PORTFOLIO MANAGEMENT
KRI, KPI and DASHBOARDS
Poll Question #5:
How often do you monitor your portfolio?

1. Hourly
2. Daily
3. Weekly
4. Monthly
5. Quarterly
KRI, KPI and Dashboards

- An entity should develop a set of indicators to track all risk categories
- All indicators should have targets and/or limits to guide decision-making
- Regular reporting and tracking of key indicators
  - Daily for credit and liquidity risk
  - Monthly for other risk categories
Guest Speakers

Jonathan Saunders
COO
SunCulture

Dr. Joachim Bald
Practice Leader – Risk Management
Frankfurt School of Finance and Management
Thank you

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