

# Combatting fraudulent fintech with machine learning

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October 20, 2021

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1. There have been increased concerns over problematic finance mobile apps in recent years
2. Efforts to combat “scam apps” limited by various issues:
  - Lack understanding of scale and scope of problem in app stores
  - Reactive rather than proactive solutions
  - “Whack-a-mole” approach of “scam app” developers
3. We leverage varied app data to systematize evidence and classify problematic apps
4. We complement existing solutions by applying ML techniques to **increase efficiency and speed of ex-ante vetting and ex-post monitoring**
5. Preliminary results are promising

# Today's agenda

## 1. The problem

Framing the problem

Systematizing evidence with new data

## 2. The proposed solution

Methodology

Results

Model evaluation

## 3. Next Steps & Conclusion

## 4. Q & A / Feedback

## The problem

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## Anecdotal Evidence & Media Coverage

There has been increased media coverage highlighting problematic finance mobile applications. Examples of recent sources include:



**Forbes**

**The New York Times**



**THE TIMES OF INDIA**

**QUARTZ AFRICA**

**MANILA BULLETIN**

Stakeholders have started documenting issues and developing solutions:

### 1. Supervisory / Regulatory responses

- Creation of / improvement of complaints channels
- Registering digital lenders and platforms (e.g., PH-SEC, OJK)
- Ensuring data privacy regulation (e.g., RBI, PH-NPC)
- Expanding role of associations and codes of conduct (RBI-DLAI, OJK-AFPI, PH- SEC-Fintech Alliance)
- Cautioning the public (e.g., RBI, PH-NPC)
- Direct action to remove problematic apps (e.g., RBI)

### 2. External stakeholders

- Monitoring social media (CGAP/World Bank)
- RBI Working Group developing strategies

## Limitations of current knowledge and solutions

1. Lack systematic understanding of scale and scope of problem amongst mobile finance apps
2. Reactive rather than proactive solutions
3. “Whack-a-mole” approach of “scam app” developers
4. Based on our recent review, still large number of problematic apps and users falling victim


### Our proposed solution

- Leverage existing high-frequency app data and apply machine learning techniques to both static and real-time data
- Complement current solutions by offering method that can *improve both ex-ante vetting and ex-post monitoring.*

1. **Primary data source:** Third-party app intelligence provider
2. **Types of data obtained / used:**
  - App meta-data
  - App review data
  - Historical download data
3. **Data coverage:** all “finance” category apps in Google Play store for 63 countries
4. **Time coverage:**
  - App meta-data: monthly from January 2020 - April 2021; does not include if *unpublished* prior to 2020
  - App review data: historical, covering until April 2021
  - App download data: historical, covering until April 2021



# Example of app meta data (from legitimate provider)



## Tala - Instant Loans

Tala Mobile Finance


★★★★★ 5,705

PEGI 3


⚠️ You don't have any devices

📌 Add to Wishlist


50 lakh people world over have trusted Tala




Friendly customer support



Loan approval in 10 seconds



No hidden charges, know what you're getting from the start



Join lakhs of satisfied Tala customers who have managed expenses, paid for school fees, and grown their businesses with peace of mind.

### How do I get a loan?

- Download the app and fill a quick form in the app
- Get your loan offer approval in under 10 seconds
- Verify your identity through our secure system
- Get your loan directly in your bank account
- No salary slip, bank statement or credit score needed.

### What is the loan amount?

Your first loan amount starts from ₹500 - ₹1000. Grow with Tala and build your limit up to ₹10,000 with every on-time payment. Each loan has a tenure of 60 days.

### How do I repay my loan?


- Make easy electronic payment in the app
- Choose to pay with debit card, UPI, netbanking, or wallets.
- Easy payment schedule keeps you on track with your payments

Get started. Download the Tala app now.

Tala accepts applications on behalf of its partners DMI Finance Private Limited and Apollo Finvest India Limited, licensed NBFCs regulated by RBI, to provide loans to its customers.

<b>Updated</b>	<b>Size</b>	<b>Installs</b>
September 27, 2021	13M	100,000+
<b>Current Version</b>	<b>Requires Android</b>	<b>Content Rating</b>
1.29.0	5.0 and up	PEGI 3
		<a href="#">Learn more</a>
<b>Permissions</b>	<b>Report</b>	<b>Offered By</b>
<a href="#">View details</a>	<a href="#">Flag as inappropriate</a>	Tala Mobile
<b>Developer</b>		
hello@tala.co.in		
<a href="#">Privacy Policy</a>		
1633 26th St. 3rd Floor		
Santa Monica, CA 90404		

# Example of app meta data (from legitimate provider)




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**Content Rating**

PEGI 3

[Learn more](#)

**Permissions**

[View details](#)

**Report**

[Flag as inappropriate](#)

**Offered By**

Tala Mobile

**Developer**

[hello@tala.co.in](mailto:hello@tala.co.in)

[Privacy Policy](#)

1633 26th St. 3rd Floor  
Santa Monica, CA 90404

# Meta data variables


## Visible data

Title  
Short/long text description  
Screenshots  
Date last updated  
Byte size  
External version number  
App developer  
Developer website  
Developer email  
Developer physical address  
Download / installs estimate (bucket)  
# of ratings  
# of reviews  
Promo video

## Hidden data

Date created  
Disaggregated # ratings (1-5)  
Internal version code  
Software Development Kit (SDK) list  
Permissions list  
Whether contains ads  
Number of reviews  
App price  
In-app purchases  
Min/Max price for in-app purchases  
Interactive elements  
Countries available in  
Main language  
Languages available in  
Other app-stores available in  
Downloads (country-day level)

# Example of review data (from legitimate provider)



## Tala - Instant Loans

Tala Mobile Finance

★★★★★ 5,705

PEGI 3

You don't have any devices


Add to Wishlist

REVIEWS

Review policy and info

Most relevant All Devices All Ratings

User reviews




**Akilesh**

★★★★★ August 25, 2021

Borrowed the loan 3 times never gets late or any issues but every time one 1000 is increasing in my loan so please increase the loan amount that's my request, overall fantastic when in urgent Tala is there thanks for everything

Tala Mobile August 25, 2021

Hi Akilesh, thanks a lot for the review and for your valuable feedback. We are constantly trying to improve the user experience and rolling out regular updates. We will have this suggestion regarding the loan limit looked into.




**Subrata**

★★★★★ August 22, 2021

Best loan app with customer friendly experience... Loved it!!

Tala Mobile August 23, 2021

Hi Subrata, it is delightful to hear such positive feedback. We hope to serve you in the future too. Thank you for choosing and trusting us!



**Manthri**

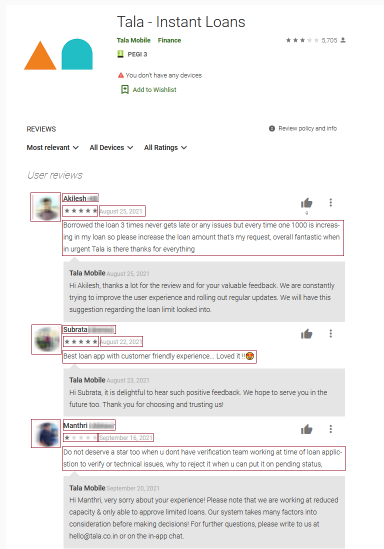
★★★★ September 16, 2021

Do not deserve a star too when u dont have verification team working at time of loan application to verify or technical issues, why to reject it when u can put it on pending status.

Tala Mobile September 20, 2021

Hi Manthri, very sorry about your experience! Please note that we are working at reduced capacity & only able to approve limited loans. Our system takes many factors into consideration before making decisions! For further questions, please write to us at hello@tala.co.in or on the in-app chat.

# Example of review data (from legitimate provider)



The screenshot shows the Google Play Store page for the 'Tala - Instant Loans' app. The app is categorized under 'Finance' and has a 4.5-star rating from 5,705 reviews. It is a PEGI 3 rated app. Below the app details, there are filters for reviews: 'Most relevant', 'All Devices', and 'All Ratings'. The 'User reviews' section displays three reviews, each with a user profile picture, name, rating, date, and the review text. The first review is from Akilesh, dated August 25, 2021, with a 5-star rating. The second review is from Subrata, dated August 22, 2021, with a 5-star rating. The third review is from Manthri, dated September 16, 2021, with a 4-star rating. Each review is followed by a response from Tala Mobile.

**Tala - Instant Loans**  
Tala Mobile Finance ★★★★★ 5,705  
PEGI 3  
You don't have any devices  
Add to Wishlist

REVIEWS Review policy and info

Most relevant All Devices All Ratings

User reviews

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## Review data

Rating (1 to 5)

Date of review

Review text

User name\*

Profile pic\*

*\*Not included in 3rd-party data provider's data but manually collecting*

To make pilot tractable, we categorize and narrow down to a subset of pure-play personal loan apps of interest:

1. Full sample: 134,744 “finance” category apps
2. We categorize apps broadly by product and provider type
  - Currently: “regular expressions” on meta-data titles, short, and long descriptions to tag product and provider types
    - *E.g., to tag personal loans: parse texts for “personal loan(s)”, “consumer loan(s)”, “payday loan(s)”, etc.*
  - Apply combinations of tags to filter to more precise subcategories
3. Current limitation
  - Note: About 65% of apps have English as main language (e.g., meta data descriptions)
  - Our analysis thus currently overlooks about one-third of finance-related apps

## The scale and scope of the finance app market (2/2)

**Table:** Categorization of finance apps in sample (Jan 2020-April 2021)

	# of apps	% of apps	Est. # down-loads (in M)	Avg. down-loads per app
<i>Panel A. Finance apps by EN vs. non-EN main language</i>				
All finance	134,744	100.0%	6,970M	51,728
- <b>All finance (EN main lang.)</b>	<b>87,426</b>	<b>64.9%</b>	<b>4,080M</b>	<b>46,668</b>
- All finance (non-EN main lang.)	47,318	35.1%	2,890M	61,076
<i>Panel B. Finance apps by product categories (EN only)</i>				
<b>All finance (EN main lang.)</b>	<b>87,426</b>	–	<b>4,080M</b>	<b>46,668</b>
- General banking	18,015	20.6%	1,640M	91,035
- Payments	17,544	20.1%	1,830M	104,309
- Insurance	4,999	5.7%	397M	79,416
- Investment	4,325	4.9%	251M	58,035
- Credit, excl. personal loans	16,252	18.6%	1,290M	79,375
- <b>Personal loans</b>	<b>5,106</b>	<b>5.8%</b>	<b>826M</b>	<b>161,770</b>

## Suggestive evidence of problems in personal lending apps (1/2)

We observe high “churn rates” (i.e., new entry and exits) among personal lending apps relative to other finance app categories.

**Table:** Percentage of finance apps newly-released & unpublished during study period (Jan 2020-April 2021)

	(1) All	(2) Banking	(3) Payments	App product category		(6) General credit	(7) Personal loan
				(4) Insurance	(5) Investment		
<i>Panel A. Entry and exit</i>							
% New release	34%	22%	43%	30%	35%	39%	70%
% Unpublished	24%	13%	25%	20%	20%	26%	52%
<i>Panel B. Time on app store</i>							
Avg. app age (in mths.)	29.3	41.0	24.8	27.9	27.5	27.5	11.4
Observations	134,744	18,015	17,544	4,999	4,325	16,252	5,106



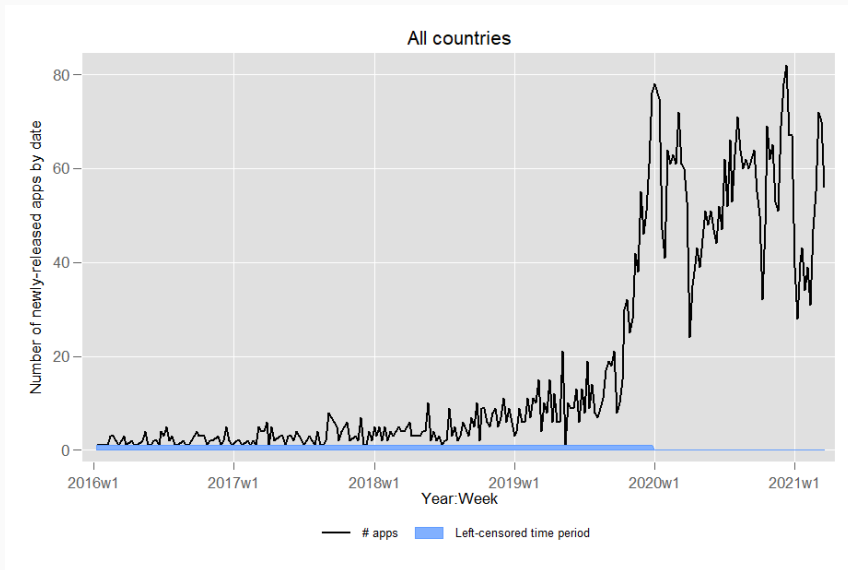
## Suggestive evidence of problems in personal loan apps (2/2)

- “Churn” fairly consistent across different country markets. Signs many apps operate in multiple markets.
- Removals increase another  $\approx 10\%$  as we tag up until Sep. 2021

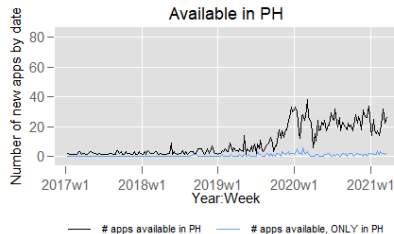
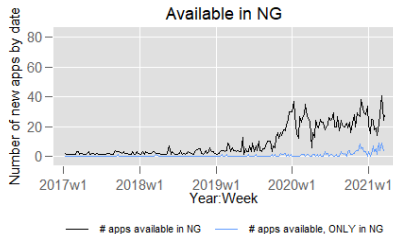
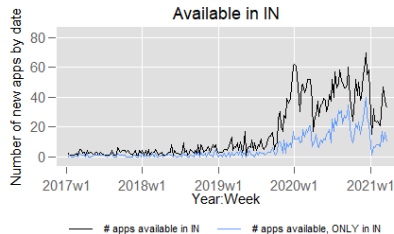
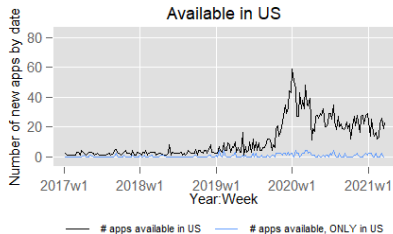
**Table:** Percentage of personal loan apps newly-released & unpublished during extended period (Jan 2020-Sep 2021)

	(1) Personal loan apps	App market availability			
		(2) Available in US	(3) Available in IN	(4) Available in NG	(5) Available in PH
New release	71%	65%	71%	69%	67%
Unpublished by Apr. 2021	52%	54%	56%	46%	47%
Unpublished by Sep. 2021	63%	65%	67%	61%	61%
Observations	5,106	2,613	3,810	2,281	2,241

## Proliferation of personal lending apps in aggregate: supply side



# Proliferation of personal lending apps by country: supply side



# A typology of personal lending apps

We systematically review the 5,106 pure-play personal lending (or related) apps. We identify several broad types (and subtypes) of lending apps:

## A. DIRECT PERSONAL LENDING APPS (74.9%)

- Pure-play lending apps that claim to directly provide personal loans (including payday, consumer, MSME, etc.)
- Any provider type (e.g., commercial bank, neobank, fintech, MFI, NBF, others)

## B. INDIRECT PERSONAL LENDING APPS (19.8%)

- Indirect lender apps that do not directly offer loans, but serve as “marketplace/guide” to access personal loans
- In practice, some are more or less transparent about their intermediary role


## C. PERIPHERAL APPS RELATED TO PERSONAL LENDING (5.3%)

- Loan / EMI calculators
- Credit report / score apps


# Classification of suspect apps (1/3)

## 1. “Pure fraud” app example (from India)

Characterized by existence of fake reviews.



**Rupee**  
India-credit Provider Finance  
★★★★★ 927  
PEGI 3  
You don't have any devices  
Add to Wishlist



Rupee is a mobile financial platform, which can provide users with the safe loan service. The new mode of simple, convenient, flexible loan eliminates the tedious process and application program.

**Eligibility**

1. Indian citizen
2. 18-55 years old
3. Have a stable income

**Features:**  
Loan Amount: from ₹2000 to 200000  
Tenure: Minimum of 91 days and Maximum of 365 days  
Maximum Annual Percentage Rate (APR): 0.08% per day, also is 29.2% per annum.  
Processing Fee: Up to 5% of Loan Amount (additional 18% GST)

**Example:**  
For ₹10000 loan of 91 days duration  
Applicable fees: ₹10000 \* 5% = ₹500  
GST: ₹500 \* 18% = ₹90  
Interest payable: ₹10000 \* 29.2% / 365days \* 91days = ₹728  
Total cost of the loan: ₹500 + ₹90 + ₹728 = ₹1318  
Total repayment amount(91 days): ₹10000 + ₹1318 = ₹11318

**WHAT'S NEW**  
Fix bugs

**ADDITIONAL INFORMATION**

<b>Updated</b> September 14, 2021	<b>Size</b> 5.1M	<b>Installs</b> 50,000+
<b>Current Version</b> 1.0.15	<b>Requires Android</b> 5.0 and up	<b>Content Rating</b> PEGI 3 <a href="#">Learn more</a>
<b>Permissions</b> <a href="#">View details</a>	<b>Report</b> <a href="#">Flag as inappropriate</a>	<b>Offered by</b> India
<b>Developer</b> <a href="#">indu@gmail.com</a> <a href="#">Privacy Policy</a>		

# Classification of suspect apps (1/3)

## 1. “Pure fraud” app example (from India)

Characterized by existence of fake reviews.

The image displays two side-by-side screenshots of the Google Play Store page for the 'Rupee' app, categorized under 'Finance'. Both screenshots show the app's icon, name, and a 5-star rating with 927 reviews. The left screenshot shows a list of user reviews, including several negative ones. The right screenshot shows a list of user reviews, including several positive ones. The reviews are sorted by 'Newest' and 'All Devices'.

**Left Screenshot (Reviews):**

- Shapesh Singh** (September 28, 2021): It asked me to pay money to get the amount but it has been a month I didn't get my money back or my loan account I also contacted its mail id but there's also no response.
- Munna Ali** (September 23, 2021): Mother chod app.
- Srijith** (September 23, 2021): A very big fraud application Please remove this from playstore I lost 600 rupees and I don't get any money till now. I am going to lodge a police complaint and consumer court to this application.
- Abhishek Vissam** (September 16, 2021): Very Very bad experience. I have applied for loan and also paid for processing fees but it's near about a month loan disbursing is showing but loan has not received return my money. fake app fraud.
- Himanshu Singh** (September 14, 2021): It's been 3 months they approved my loan and asked me to pay charges and since then the loan is still in disbursement mode and all the more they replied on email that due to some uncertain problems it got delayed and will do the same in few days ...the few days I now more than 45 days ... Kindly ...
- Mr. Shashank Chaur** (September 14, 2021): Fraud hai ye sb ... Phle 1000 Rs. ke fee lete hain then disbursing show karte hain bas ... Inko ek Rs. 300 int dana.
- teghri go** (September 9, 2021): One of the worst app which Google Play platform has allowed. No response from the dev or the team they just ask you to make the payment and when u make the payment the app just shows as disbursing. Worst app and it should be removed and not allowed on such platform.

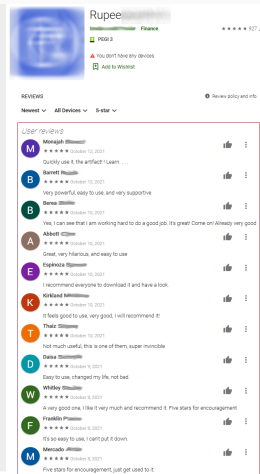
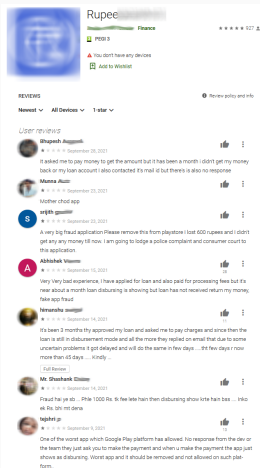
**Right Screenshot (Reviews):**

- Monejah** (October 12, 2021): Quickly use it, the amount! Laxmi ....
- Barrett Russell** (October 12, 2021): Very powerful, easy to use, and very supportive.
- Berna** (October 10, 2021): Yes, I can see that I am working hard to do a good job. It's great! Come on! Already very good.
- Abbott** (October 10, 2021): Great, very hilarious, and easy to use.
- Esprince** (October 10, 2021): I recommend everyone to download it and have a look.
- Kirkland Robinson** (October 10, 2021): It feels good to use, very good, I will recommend it.
- Thuz** (October 10, 2021): Just much useful, this is one of them, super invincible.
- Dina** (October 9, 2021): Easy to use, changed my life, not bad.
- Wholey** (October 8, 2021): A very good one, I like it very much and recommend it. Five stars for encouragement.
- Franklin** (October 8, 2021): It's so easy to use, I can't put it down.
- Mercado** (October 8, 2021): Five stars for encouragement, just get used to it.

# Classification of suspect apps (1/3)

## 1. “Pure fraud” app example (from India)

Characterized by existence of fake reviews.



### Examples of signals

- Idiosyncratic review dates
- Abnormal user names
- Idiosyncratic text

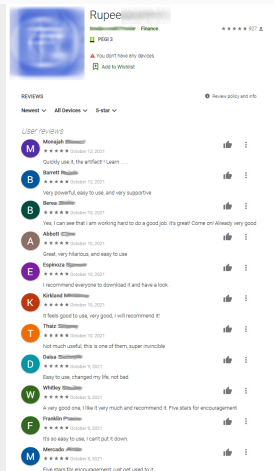
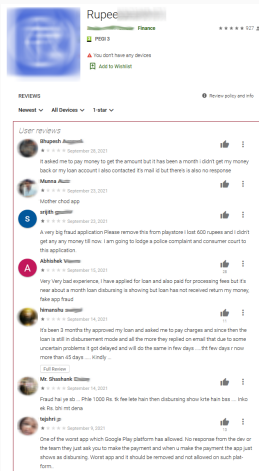
# Classification of suspect apps (1/3)

## 1. “Pure fraud” app example (from India)

Characterized by existence of fake reviews.

### Examples of signals

- Regularly distributed review dates
- Complaints about app/reviews being fake
- Paid “registration fees” but no service





**Table:** Reviews across multiple personal lending apps for suspected (fake) reviewer

<i>package_name</i>	<i>reviewer_name</i>	<i>profile_pic</i>	<i>rating</i>	<i>review_date</i>	<i>review_body_text</i>
com.pearloans.#####	ajayi #####	0	5	23-Jun-21	Very reliable and trustworthy
com.smartloans.#####	ajayi #####	0	5	28-Jun-21	Very reliable and trustworthy
com.flycashloans.#####	ajayi #####	0	5	1-Jul-21	Very reliable and trustworthy
com.loan#####	ajayi #####	0	5	1-Jul-21	Very reliable and dependable
com.liberty#####	ajayi #####	0	5	1-Jul-21	Very reliable and trustworthy
com.oc.ourr_#####	ajayi #####	0	5	1-Jul-21	Very reliable and dependable
com.ttilocash.#####	ajayi #####	0	5	3-Jul-21	Very reliable and trustworthy
com.value#####	ajayi #####	0	5	4-Jul-21	Very reliable and dependable

# Classification of suspect apps (2/3)

## 2. “Predatory” app example (from Nigeria)

Characterized by signs of i) **no real services provided** or ii) abusive lending practices.

The screenshot shows the interface of a mobile application titled "Personal Loan Online , 7\*24 hour". It features a red header bar with the app name and a green "Loan Finance" button. Below the header, there's a section with a red triangle warning icon and the text "You don't have any devices" and a green "Add to Wishlist" button. The main content area is divided into four vertical panels: "Loan Amount from ₦5,000 to ₦50,000", "Register via entering simple information", "Paperless and digital process on your mobile", and "3 step info". Below these panels, there's a section titled "makes it efficient for you to access credit anytime, anywhere" with a list of bullet points: "Loans Online amount: from ₦5,000 to ₦50,000", "Loans period range from 91 to 180 days", "Annual interest rates from 36.5% to 300%. The interest rate is calculated on a daily basis.", "Flexible repayment Plan", and "Interest and service rate: With a minimum of 0.1% up to 1%". Below this list, there's an "Example:" section with the text: "Borrow NGN50,000 over 3 months", "Interest (total cost of the loan): NGN19,000 (NGN50,000 \* 38% = NGN19,000 interest)", "Representative APR: 120%", "Total amount to repay will be NGN 69,000", and "Three monthly repayments of NGN 23,000". On the right side of the app interface, there's a "WHATS NEW" section with the text: "Thank you, users, for your support. We have launched the Golden Egg Smashing event, welcome to participate!". Below this, there's an "ADDITIONAL INFORMATION" section with a table of app details.

ADDITIONAL INFORMATION		
Updated	Size	Installs
April 28, 2021	9.1M	50,000+
Current Version	Requires Android	Content Rating
1.4	4.4 and up	PEGI 3 Learn more
Permissions	Report	Offered By
View details	Flag as inappropriate	Loan
Developer		
email79@gmail.com		
Privacy Policy		

# Classification of suspect apps (2/3)

## 2. “Predatory” app example (from Nigeria)

Characterized by signs of i) **no real services provided** or ii) abusive lending practices.

**Personal Loan Online , 7\*24 hour**  
Loan Finance  
PEGI 3  
You don't have any devices  
Add to Wishlist

**REVIEWS** Review policy and info

Most relevant All Devices 1-star

*User reviews*

**blessing** ★★★★★ July 17, 2021  
If you guys are not ready to give someone loan just say, instead of wasting one's time on filling up their details without any positive result. work on your app especially binding of cards

**Adeniyi** ★★★★★ July 6, 2021  
Please beware of this APP, they are crooks, they deceived me to pay twice knowing that the first payment went through, they denied seeing the payment and they made me pay another #8500. Going to my bank to complain, I was told that the first payment was successful. Please people be careful with them...

**Bethel** ★★★★★ May 19, 2021  
App navigation is quite easy. initially I used my verve card it didn't work, then I tried my master card I was debited #50. Yet I was asked to try in the next 7 days. Why the debit knowing its not gonna work. Pls clear my data from your system. Thanks

**Prince** ★★★★★ June 2, 2021  
This app is frustrating and annoying customer service zero I paid back my loan at my repayment date yet they have not cleared it instead they are adding up overdue charge for me I even sent them my debit alert instead of checking it themselves they asking for session id telling me to go to bank plzz...

**REVIEWS** Review policy and info

Most relevant All Devices 5-star

*User reviews*

**Nicole** ★★★★★ May 6, 2021  
The application was fast and smooth. Beautiful interface. Waiting for my loan to be approved

**Chris** ★★★★★ May 11, 2021  
This is the most efficient loan App ever seen. My account was credited with 10 mins wow. I recommend this app for everyone

**Bet** ★★★★★ June 23, 2021  
I do not what is wrong with the Application.. I can't bind Error message "Pay system Error". Please What's the way forward?

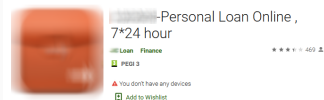
**david** ★★★★★ May 26, 2021  
It's a great loan application, very effective but no loan yet approved

**Abubakar** ★★★★★ September 15, 2021  
I trying to enter many more times my only problem is otp why we don't send me otp this rubbish application

# Classification of suspect apps (2/3)

## 2. “Predatory” app example (from Nigeria)

Characterized by signs of i) **no real services provided** or ii) abusive lending practices.

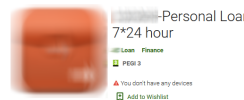


### REVIEWS

Most relevant ▾ All Devices ▾ 1-star ▾

#### User reviews

- blessing** ★★★★★ July 17, 2021  
If you guys are not ready to give someone loan just say, instead of wasting one's time on filling up their details without any positive result. work on your app especially binding of cards
- Adeniyi** ★★★★★ July 6, 2021  
Please beware of this APP, they are crooks, they deceived me to pay twice knowing that the first payment went through, they denied seeing the payment and they made me pay another #8500. Going to my bank to complain... i was told that the first payment was successful. Please people be careful with them...
- Bethel** ★★★★★ May 19, 2021  
App navigation is quite easy. initially i used my verve card it didn't work, then i tried my master card i was debited #50. Yet i was asked to try in the next 7 days. Why the debit knowing its not gonna work. Pls clear my data from your system. Thanks
- Prince** ★★★★★ June 2, 2021  
This app is frustrating and annoying customer service zero i paid back my loan at my repayment date yet they have not cleared it instead they are adding up overdue charge for me i even sent them my debit alert instead of checking it themselves they asking for session id telling me to go to bank plz...



### REVIEWS

Most relevant ▾ All Devices ▾ 5-star ▾

#### User reviews

- Nicole** ★★★★★ May 6, 2021  
The application was fast and smooth. Beautiful interface. Waiting for approval
- Chris** ★★★★★ May 11, 2021  
This is the most efficient loan App ever seen. My account was created and approved. I recommend this app for everyone
- Bet** ★★★★★ June 23, 2021  
I do not what is wrong with the Application.. I can't bind Error message. Please What's the way forward?
- david** ★★★★★ May 28, 2021  
It's a great loan application, very effective but no loan yet approved
- Abubakar** ★★★★★ September 15, 2021  
I trying to enter many more times my only problem is otp why we don't send me otp this rubbish application

### Examples of signals

- Reviews seem from real users
- However, no signs services provided (e.g., review seems positive but still awaiting approval)
- Signs 5-star ratings “coerced” to increase chances of loan approval

# Classification of suspect apps (2/3)

## 2. “Predatory” app example (from Nigeria)

Characterized by signs of i) **no real services provided** or ii) abusive lending practices.

### Examples of signals

- Consistent signs services not provided
- Applications submitted (often including PII) but no approvals
- Sometimes complaints over fees or unsanctioned debits

The image displays two side-by-side screenshots of the Google Play Store for an app titled "Personal Loan Online, 7\*24 hour". The app is categorized under "Loan" and "Finance", has a PEGI 3 rating, and shows 469 reviews. A warning message states: "You don't have any devices. Add to Wishlist".

**Left Screenshot (Reviews Highlighted):** The "User reviews" section is highlighted with a red box. It shows five reviews:


- blissing** (July 17, 2021): "If you guys are not ready to give someone loan just say, instead of wasting one's time on filling up their details without any positive result. work on your app especially binding of cards"
- Adeniyi** (July 6, 2021): "Please beware of this APP, they are crooks, they deceived me to pay twice knowing that the first payment went through, they denied seeing the payment and they made me pay another #8500. Going to my bank to complain, I was told that the first payment was successful. Please people be careful with them..."
- Bethel** (May 19, 2021): "App navigation is quite easy. initially I used my verve card it didn't work, then I tried my master card I was debited #50. Yet I was asked to try in the next 7 days. Why the debit knowing its not gonna work. Pls clear my data from your system. Thanks"
- Prince** (June 2, 2021): "This app is frustrating and annoying customer service zero I paid back my loan at my repayment date yet they have not cleared it instead they are adding up overdue charge for me I even sent them my debit alert instead of checking it themselves they asking for session id telling me to go to bank plzz..."

**Right Screenshot (Full App Page):** This screenshot shows the full app page with the same reviews visible. It includes additional reviews:

- Nicole** (May 6, 2021): "The application was fast and smooth. Beautiful interface. Waiting for my loan to be approved"
- Chris** (May 11, 2021): "This is the most efficient loan App ever seen. My account was credited with 10 mins wow. I recommend this app for everyone"
- Bet** (June 23, 2021): "I do not what is wrong with the Application.. I can't bind Error message 'Pay system Error'. Please What's the way forward?"
- david** (May 26, 2021): "It's a great loan application, very effective but no loan yet approved"
- Abubakar** (September 15, 2021): "I trying to enter many more times my only problem is otp why we don't send me otp this rubbish application"

## 3. “Predatory” app example (from the Philippines)

Characterized by signs of i) no real services provided or ii) abusive lending practices.



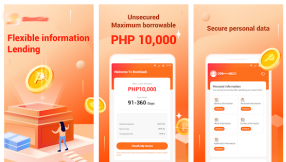
### Cash

Eastman Finance

PEGI 3

You don't have any devices

Add to Wishlist



**Flexible information Lending**

**Unsecured Maximum borrowable PHP10,000**

**Secure personal data**

Easy to apply: Fill out an application online in just a few steps without having to sign a paperless contract

Payment: After approval, just wait 1 hour to 2 hours to pay

Low interest rate: For those who have a good track record on **Cash**, they will get the lowest interest rate.

Faster refinancing: Once the customer pays off the loan, you will be eligible to refinance

Quick Help: A customer service representative will resolve all your loan issues immediately

Safe and reliable: **Cash** will protect and keep all customer information confidential

#### WHAT'S NEW

Update to new version

#### ADDITIONAL INFORMATION

Updated	Size	Installs
August 20, 2021	7.0M	500,000+

Current Version	Requires Android	Content Rating
1.0.7	5.0 and up	PEGI 3 <a href="#">Learn more</a>

Permissions	Report	Offered By
<a href="#">View details</a>	<a href="#">Flag as inappropriate</a>	<b>Eastman</b>

**Developer**

[manb71@gmail.com](#)  
[Privacy Policy](#)

**Cash** develops new loan products

- Maximum amount ₱10000
- Loan Term: 91 days-365days
- APR: 10.8%
- Service fee: 0.2%
- Transaction fee: 0

Example: ₱10000 for 91 days (interest 0.03%/daily)  
 $\text{₱10000} \times 91 = 10000 \times (1 + 0.03\%) \times 91 + 10000 \times 0.2\% = \text{₱10296}$   
Total 91 days ₱10296

**Cash** - An online lending platform for loans in the Philippines that provides Filipinos with secure and affordable fast cash online lending services for peso loans.

# Classification of suspect apps (3/3)

## 3. “Predatory” app example (from the Philippines)

Characterized by signs of i) no real services provided or ii) abusive lending practices.

The image displays two side-by-side screenshots of the 'Cash' app's user reviews on the Google Play Store. Both screenshots show the app's name 'Cash', its category 'Finance', and a warning message: 'You don't have any devices'. The left screenshot shows a 1-star rating, while the right screenshot shows a 5-star rating. Both screenshots include a 'Reviews' section with user comments and ratings.

**Left Screenshot (1-star rating):**

- ChristyAnne** (October 6, 2021): NO MATTER HOW BADLY YOU NEED MONEY, DON'T EVER DOWNLOAD THIS APP AND DON'T LOAN HERE. IT'S THE WORST DAY BEFORE YOUR DUE DATE THEY WILL SEND YOU HARASSING MESSAGES USING THE WORD NBI AND SCAMMER. THEY WILL TELL YOU YOUR LOAN IS DAYS OVERDUE A DAY BEFORE YOUR DUE DATE. NO MATTER HOW YOU COORDINATE A...
- Michelle** (August 5, 2021): Very greedy online loan app! 3500 upfront but you'll only get 2000. 1500 fee! Wow! Read before you agree and get a loan from here. This app is way better and has less interest rates.
- Cyrel John** (August 3, 2021): I don't recommend. If you want to live your life to the fullest don't try this app. It gives you stress and problem. Especially when they invade your data privacy. Text blast to your contacts even if it's not your references. Rude agents.
- Joan** (October 26, 2020): DO NOT DOWNLOAD THIS APP! IT IS ONE OF LOAN SHARKS. I have paid my loan on the due date but still they were calling my references. My God is that a customer service? Definitely I will not re-engage in this app again. Misleading info and too high interest just for 7 days. I want to report this to high...
- Maddie** (July 27, 2021): These are the worse application. don't try to file a loan here. my due date must be today cost 10-7 days. If I lend 3,500 they will give u only 2,000 then after u claim it money 3days before ur due date they will not stop calling and texting u. they will harass u also and even I paid my loan today t...

**Right Screenshot (5-star rating):**

- Joemar** (October 5, 2021): Still on process and waiting to transfer to my account.
- Grace** (December 1, 2020): I will give 5 stars I hope the loan application will be approved.
- John** (June 2, 2021): Easy safe and trusted online loan apps
- Trisha Mae** (August 20, 2021): Waiting for approval
- Daniel** (August 20, 2021): How to claim my loan?
- arishad** (November 1, 2020): easy fill up the application hoping po for past approval. thanks po in advance
- Cindy** (July 2, 2021): I don't know it is fast approval but I give u 5 star.
- Blessie** (January 25, 2021): I've been declined on my first try I hope I'll get approved this time
- Maryrose** (April 14, 2021): im Waiting for approval. god bless and very nice apps I will give a 5 star

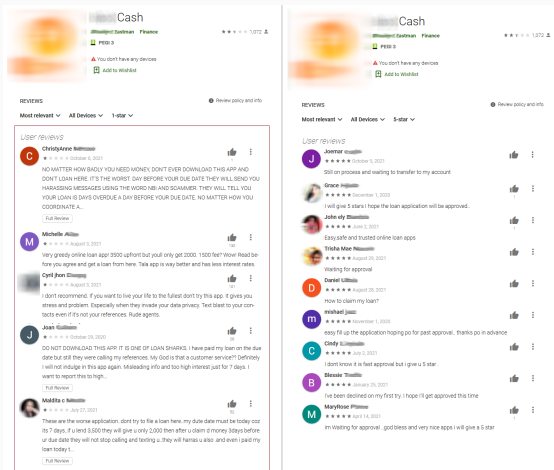
# Classification of suspect apps (3/3)

## 3. “Predatory” app example (from the Philippines)

Characterized by signs of i) no real services provided or ii) abusive lending practices.

### Examples of signals

- High prevalence of complaints on interest rates, fees, or short tenure
- Common complaints on abusive debt collection practices
- Concerns over data privacy





# Classification of suspect apps (3/3)

## 3. “Predatory” app example (from the Philippines)

Characterized by signs of i) no real services provided or ii) abusive practices.

The image displays two side-by-side screenshots of the 'Cash' app interface, illustrating how the same app can be presented with different user reviews to create a false sense of legitimacy.

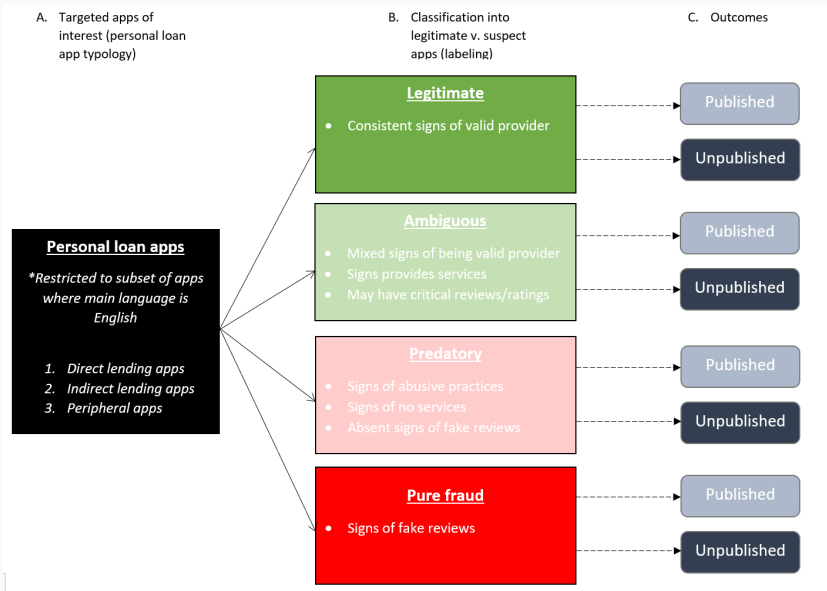
**Left Screenshot (1-star rating):** The app is titled 'Cash' with a 1-star rating and 1,072 reviews. The reviews are predominantly negative, with users expressing frustration and warning others. For example, one review states: "NO MATTER HOW BADLY YOU NEED MONEY, DON'T EVER DOWNLOAD THIS APP AND DON'T LOAN HERE. IT'S THE WORST DAY BEFORE YOUR DUE DATE THEY WILL SEND YOU HARASSING MESSAGES USING THE WORD NBI AND SCAMMER. THEY WILL TELL YOU YOUR LOAN IS DAYS OVERDUE A DAY BEFORE YOUR DUE DATE. NO MATTER HOW YOU COORDINATE A..." Another review says: "Very greedy online loan app! 3500 upfront but you'll only get 2000. 1500 fee! Wow! Read before you agree and get a loan from here. This app is way better and has less interest rates."

**Right Screenshot (5-star rating):** The app is titled 'Cash' with a 5-star rating and 1,072 reviews. The reviews are predominantly positive, with users praising the app's ease of use and service. For example, one review states: "Still on process and waiting to transfer to my account." Another review says: "I will give 5 stars I hope the loan application will be approved." A third review says: "Easy safe and trusted online loan app."

### Examples of signals

- Sometimes signs of “coerced” 5-star ratings, where mismatch between rating and tone of review
- Signs that some form of services provided for some users

# Recap: overview of typology and classification



## Outcomes for legitimate vs. suspect personal lending apps

<i>Prevalence to be “unpublished” (as of Apr. 2021)</i>	
# of all personal loan apps	5, 106
<i>4-category classification</i>	
% Legitimate	16.4%
% Ambiguous	9.3%
% Predatory	70.1%
% Pure fraud	7.7%
<i>Binary classification</i>	
% Likely legitimate	13.8%
% Likely suspect	67.2%

## Estimates on prevalence of legitimate vs. suspect personal lending apps (1/3)

	<i>Prevalence of app in category</i>				
	All	Available in US	Available in IN	Available in NG	Available in PH
	(1)	(2)	(3)	(4)	(5)
<i>Panel A. Number of personal lending apps</i>					
# of apps	5,106	2,613	3,810	2,281	2,241
<i>Panel B. Percent of apps falling in legitimate vs. suspect classification buckets</i>					
<i>% in 4-category classification</i>					
- Legitimate	16.8%	16.6%	15.7%	16.4%	16.9%
- Ambiguous	9.9%	11.1%	9.2%	11.7%	12.2%
- Predatory	68.8%	69.1%	71.4%	68.1%	67.2%
- Pure fraud	4.6%	3.3%	3.7%	3.9%	3.8%
<i>% in Binary classification</i>					
- Likely legitimate	26.7%	27.7%	25.0%	28.1%	29.0%
- Likely suspect	73.3%	72.3%	75.0%	71.9%	70.9%

## Estimates on uptake of legitimate vs. suspect personal lending apps (2/3)

	<i>Estimated downloads in millions (M)</i>				
	All	Available in US	Available in IN	Available in NG	Available in PH
	(1)	(2)	(3)	(4)	(5)
All personal lending apps	834M	418M	670M	394M	407M
<i>4-category classification</i>					
- Legitimate	616M	369M	522M	343M	344M
- Ambiguous	38M	17M	29M	16M	27M
- Predatory	149M	24M	106M	26M	29M
- Pure fraud	31M	8M	14M	9M	8M
<i>Binary classification</i>					
- Likely legitimate	654M	386M	551M	359M	371M
- Likely suspect	180M	32M	119M	35M	36M

*\*Note: these values reflect cumulative downloads since initial release of apps. For some apps, this may include downloads prior to Jan. 1st, 2020.*

## Estimates on average uptake of legitimate vs. suspect personal lending apps (3/3)

	<i>Average downloads per app in category</i>				
	All	Available in US	Available in IN	Available in NG	Available in PH
	(1)	(2)	(3)	(4)	(5)
All personal lending apps	163,337	159,969	175,853	172,731	181,615
<i>4-category classification</i>					
- Legitimate	716,279	850,230	871,452	914,667	910,053
- Ambiguous	76,342	59,170	82,102	59,023	97,802
- Predatory	42,246	13,172	38,757	16,582	18,857
- Pure fraud	144,651	116,020	109,756	124,801	113,034
<i>Binary classification</i>					
- Likely legitimate	479,824	533,887	579,390	560,062	569,892
- Likely suspect	48,103	16,781	41,638	21,293	22,782

*\*Note: these values reflect cumulative downloads since initial release of apps. For some apps, this may include downloads prior to Jan. 1st, 2020.*

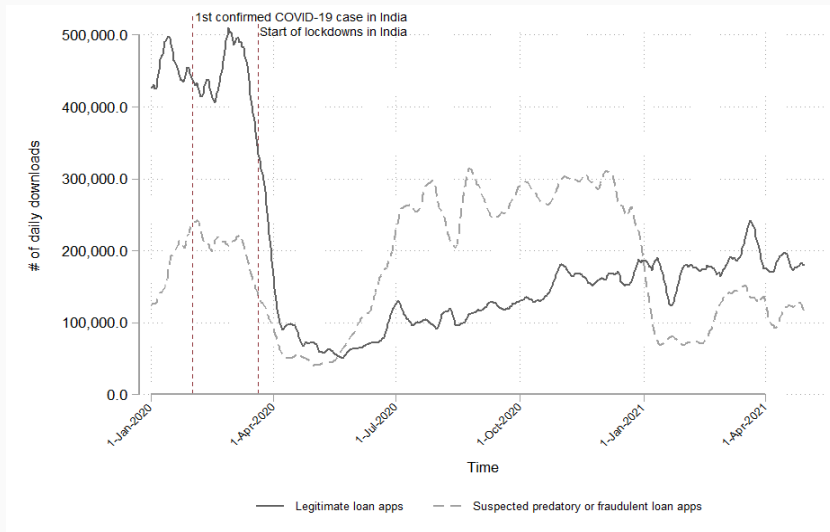
### Measurable harm

- Financial loss due to direct fraud (e.g., payment of fees for non-existent services)
- Financial loss due to predatory practices (e.g., difference in fees and interest paid between predatory lender relative to similar legitimate lenders serving market)

### Other adverse outcomes / Immeasurable

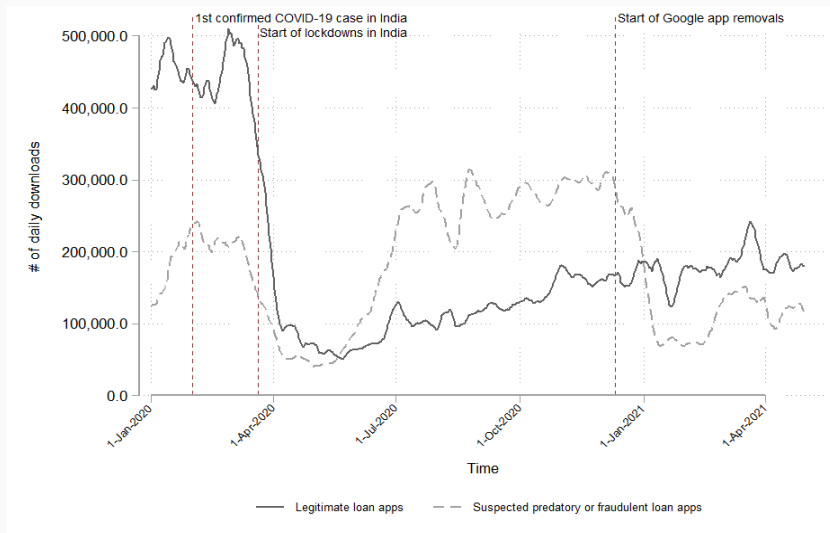
- Loss of private / sensitive data
- Harassment or abuse encountered
- Loss of trust in financial institutions

## Negative externalities on legitimate providers?





## Policy solutions have had shorter-term success (but insufficient..)



## The proposed solution

---

1. We set up ML models as proof-of-concept of proposed solution
2. The labeled data (for the 5,106 personal loan apps) serve as main output variables. We run the following models:
  - **Binary classification model:** i) “likely legitimate” vs. ii) “likely suspect”
  - **3-category classification model:** i) “likely legitimate” vs. ii) “predatory” vs. iii) “pure fraud”
3. For model input variables, we prioritize use of app meta-data
  - Motivation is to see if these mostly static and ex-ante indicators can flag problematic apps
  - We intend to integrate review data, but these data can be noisy and imply being ex-post after problems have arisen
4. In practice, we split the sample into a training-validation and test datasets
  - **Training-validation dataset** uses apps released until Jan. 15th, 2021
  - **Test dataset** uses apps released after Jan. 15th, 2021 and is used to assess out-of-sample performance of the model on completely unseen data

Based on our exploration, we use a **subset** of meta data variables in our current models. These include both visible and hidden data and often imply various transformations.


## Visible data

- Short/long text description
- Screenshots
- Date last updated
- Byte size
- Developer website
- Developer email
- Promo video

## Hidden data

- Date created
- Disaggregated # ratings (1-5)
- Internal version code
- Whether contains ads
- Number of reviews
- App price
- In-app purchases
- Min/Max price for in-app purchases
- Interactive elements
- Countries available in
- Languages available in
- Other app-stores available in
- Downloads (country-day level)

# Input variable transformation: Example 1



## Tala - Instant Loans

Tala Mobile Finance

★★★★★ 5,705


PEGI 3

You don't have any devices


Add to Wishlist

50 lakh people world over have trusted Tala


★★★★★




Friendly customer support



Loan approval in 10 seconds



No hidden charges



Join lakhs of satisfied Tala customers who have managed expenses, paid for school fees, and grown their businesses with peace of mind.

### How do I get a loan?

- Download the app and fill a quick form in the app
- Get your loan offer approval in under 10 seconds
- Verify your identity through our secure system
- Get your loan directly in your bank account
- No salary slip, bank statement or credit score needed.

### What is the loan amount?

Your first loan amount starts from ₹500 - ₹1000. Grow with Tala and build your limit up to ₹10,000 with every on-time payment. Each loan has a tenure of 60 days.

### How do I repay my loan?

- Make easy electronic payment in the app
- Choose to pay with debit card, UPI, netbanking, or wallets.
- Easy payment schedule keeps you on track with your payments


Get started. Download the Tala app now.

Tala accepts applications on behalf of its partners DMI Finance Private Limited and Apollo Fininvest India Limited, licensed NBFCs regulated by RBI, to provide loans to its customers.

<b>Updated</b>	<b>Size</b>	<b>Installs</b>
September 27, 2021	13M	100,000+
<b>Current Version</b>	<b>Requires Android</b>	<b>Content Rating</b>
1.29.0	5.0 and up	PEGI 3 <a href="#">Learn more</a>
<b>Permissions</b>	<b>Report</b>	<b>Offered By</b>
<a href="#">View details</a>	Flag as inappropriate	Tala Mobile
<b>Developer</b>		
hello@tala.co.in <a href="#">Privacy Policy</a>		
1633 26th St. 3rd Floor Santa Monica, CA 90404		

Can use address variable to construct dummies for:

# Input variable transformation: Example 2



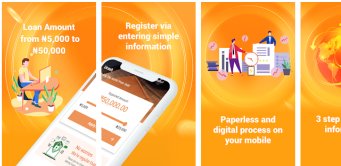
## Personal Loan Online , 7\*24 hour

Loan Finance

PEGI 3

⚠️ You don't have any devices

➕ Add to Wishlist



makes it efficient for you to access credit anytime, anywhere. 🐼🐼🐼

- ✔️ Loans Online amount: from ₦5,000 to ₦50,000
- ✔️ Loans period range from 91 to 180 days
- ✔️ Annual interest rates from 36.5% to 300%. The interest rate is calculated on a daily basis.
- ✔️ Flexible repayment Plan
- ✔️ Interest and service rate: With a minimum of 0.1% up to 1%


→ Example:  
Borrow NGN50,000 over 3 months  
Interest (total cost of the loan): NGN19,000 (NGN50,000 \* 38% = NGN19,000 interest)  
Representative APR: 120%


Total amount to repay will be NGN 69,000  
Three monthly repayments of NGN 23,000

→ Loan Applicant Minimum Requirement


- ✔️ Nigeria Resident
- ✔️ Age above 20 and below 55

→ How to get Started.

To apply for online loans on  app you need an android phone and internet.


We are working hard to provide you with the best services to make your life better. Very soon you can look to  for your electricity bill payments, current account, savings and much more!

### WHAT'S NEW

Thank you,  users, for your support.

We have launched the Golden Egg Smashing event, welcome to participate!


### ADDITIONAL INFORMATION

<b>Updated</b> April 26, 2021	<b>Size</b> 9.1M	<b>Installs</b> 50,000+
<b>Current Version</b> 1.4	<b>Requires Android</b> 4.4 and up	<b>Content Rating</b> PEGI 3 <a href="#">Learn more</a>
<b>Permissions</b> <a href="#">View details</a>	<b>Report</b> <a href="#">Flag as inappropriate</a>	<b>Offered By</b>  Loan
<b>Developer</b> <a href="#">etic79@gmail.com</a> <a href="#">Privacy Policy</a>		

Can use email address variable to construct dummies:

- Any email provided? (0/1)

# Input variable transformation: Example 3



## Golden Egg Smashing - Personal Loan Online ,

7\*24 hour

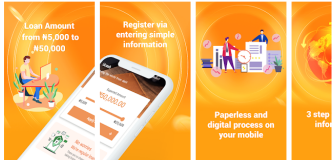
Loan Finance

★★★★★ 450

PEGI 3

You don't have any devices

Add to Wishlist



Loan Amount from ₦5,000 to ₦50,000

Register via entering simple information

Paperless and digital process on your mobile

3 step info

Golden Egg Smashing makes it efficient for you to access credit anytime, anywhere. 🐣🐣🐣

- ✓ Loans Online amount: from ₦5,000 to ₦50,000
- ✓ Loans period range from 91 to 180 days
- ✓ Annual interest rates from 36.5% to 300%. The interest rate is calculated on a daily basis.
- ✓ Flexible repayment Plan
- ✓ Interest and service rate: With a minimum of 0.1% up to 1%

→ Example

Borrow NGN50,000 over 3 months

Interest (total cost of the loan): NGN19,000 (NGN50,000 \* 38% = NGN19,000 interest)

Representative APR: 120%

Total amount to repay will be NGN 69,000

Three monthly repayments of NGN 23,000

→ Loan Applicant Minimum Requirement

- ✓ Nigeria Resident
- ✓ Age above 20 and below 55

→ How to get Started

To apply for online loans on Golden Egg Smashing app you need an android phone and internet.

We are working hard to provide you with the best services to make your life better. Very soon you will look to Golden Egg Smashing for your electricity bill payments, current account, savings and much more!

### WHAT'S NEW

Thank you Golden Egg Smashing users, for your support.

We have launched the Golden Egg Smashing event, welcome to participate!

### ADDITIONAL INFORMATION

<b>Updated</b>	<b>Size</b>	<b>Installs</b>
April 26, 2021	9.1M	50,000+
<b>Current Version</b>	<b>Requires Android</b>	<b>Content Rating</b>
1.4	4.4 and up	PEGI 3
		<a href="#">Learn more</a>
<b>Permissions</b>	<b>Report</b>	<b>Offered By</b>
<a href="#">View details</a>	<a href="#">Flag as inappropriate</a>	Golden Egg Smashing
<b>Developer</b>		
<a href="#">Email: goldenegg79@gmail.com</a>		
<a href="#">Privacy Policy</a>		

## Current version vs. version code:

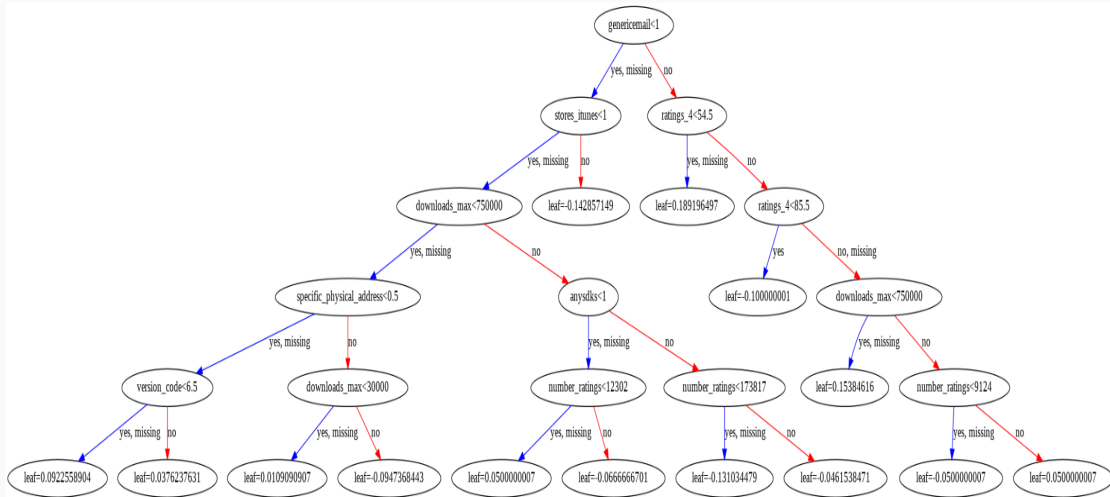
- The **current version** listed on the url is set by the developer.
- The meta-data has a field **version code**, which reflects the number of iterations of the app. We use this directly.

1. We use an ML technique called “gradient boosting” (specifically *xgboost*)
2. *XGboost* considered state-of-art for many predictive classification tasks
  - It builds an ensemble of shallow and weak successive trees with each tree learning and improving on the previous
  - When combined, these many weak successive trees produce a powerful “committee” that are often hard to beat with other algorithms
3. Key advantages:
  - Generally more accurate compare to other modes
  - Lots of flexibility – can optimize on different loss functions and provides several hyperparameter tuning options that make function fit very flexible
  - Handles missing data - imputation not required
4. Some disadvantages:
  - More likely to overfit
  - Training time scales with data size



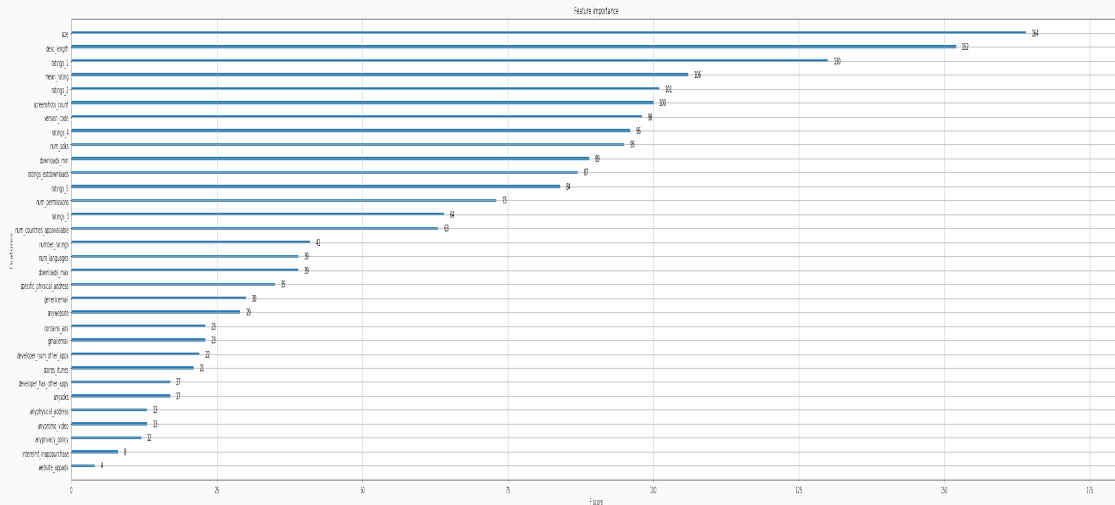
## Results for binary classification model (1/2)

Figure: Decision tree



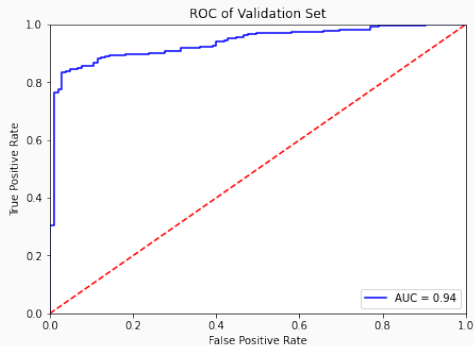
## Results for binary classification model (2/2)

Figure: Feature importance

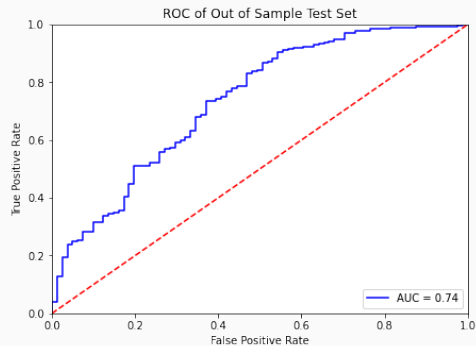


	Validation Set	Out of Sample
% Accuracy	90.17%	84.45%

## Evaluation of binary classification model performance – ROC curve



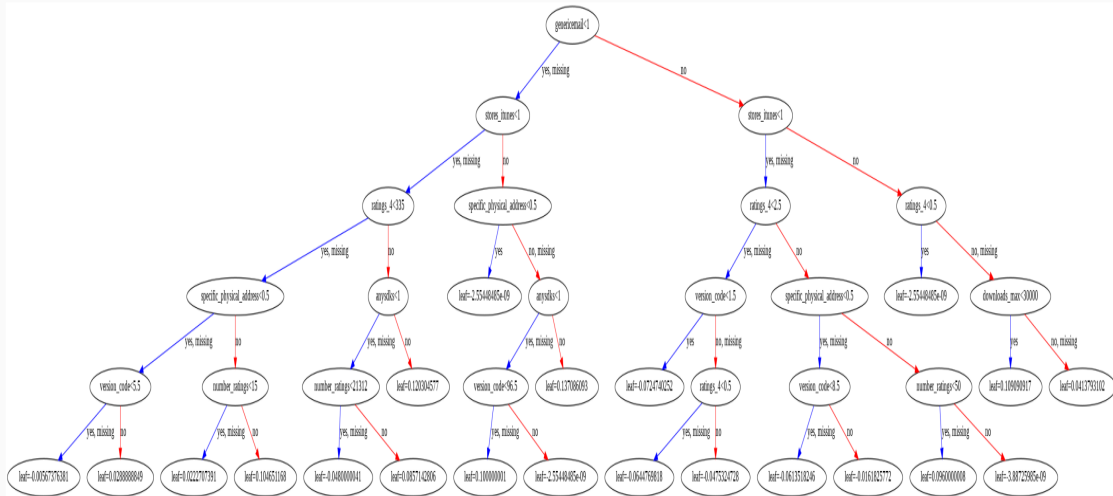
ROC for validation sample



ROC for test sample

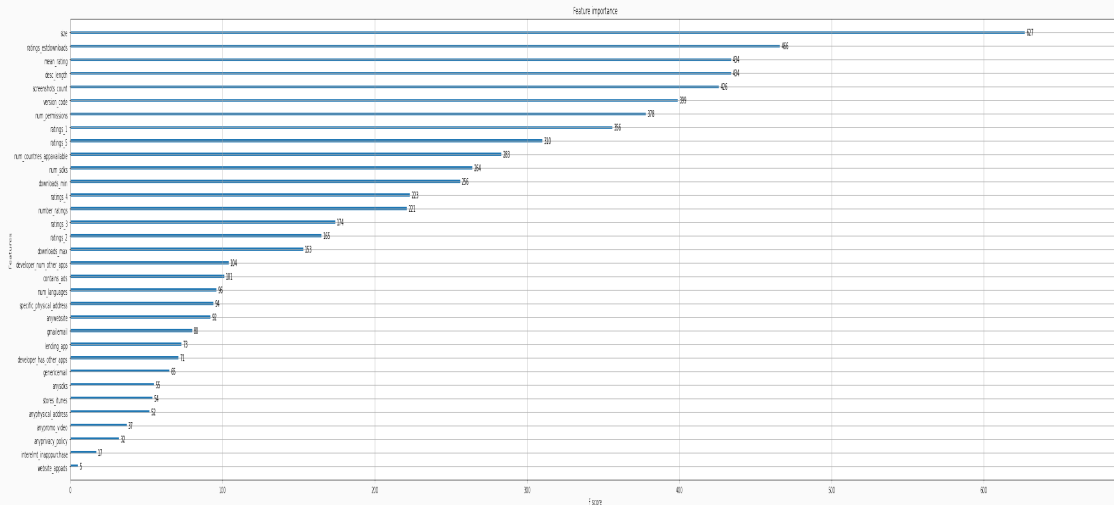
## Results for multi-class classification model (1/2)

Figure: Decision tree



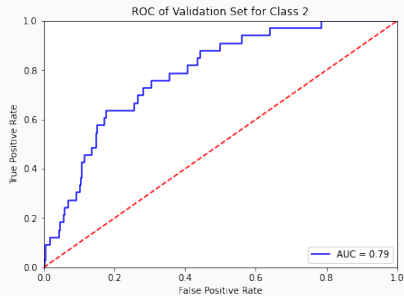
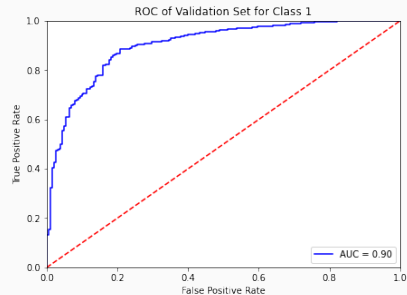
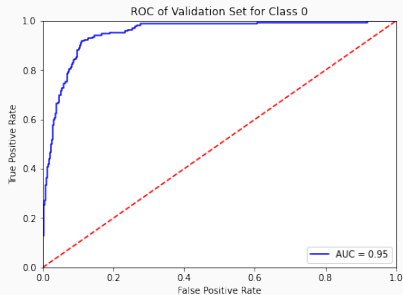
## Results for binary classification model (2/2)

Figure: Feature importance



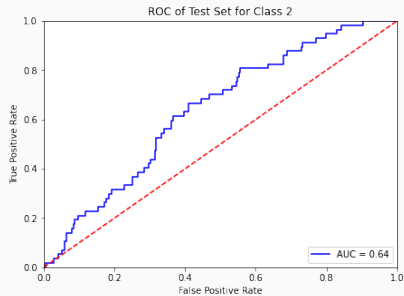
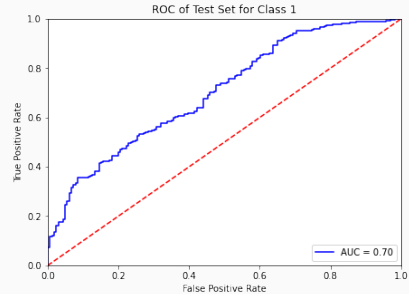
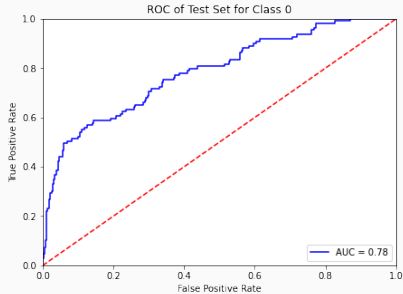
	Validation Set	Out of Sample
% Accuracy	85.61%	71.96%

## Evaluation of multi-class classification model performance – ROC curves (1/2)





# Evaluation of multi-class classification model performance – ROC curves (1/2)

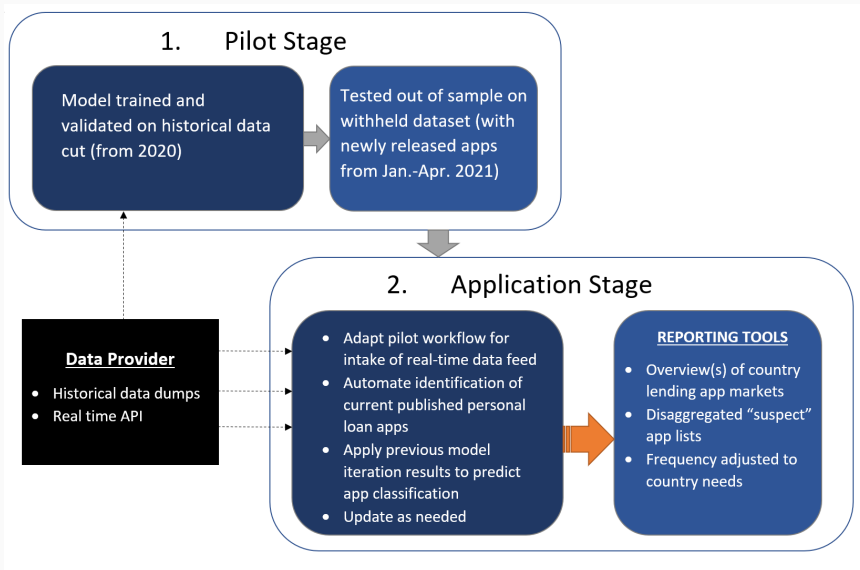


1. Increase data sample size (e.g., extend prior to Jan 2020 or after April 2021)
2. Model-specific adjustments: e.g., further variable construction/transformation, hyperparameter tuning, etc.
3. Test whether narrowing windows between train-validation and out-of-sample increases precision (i.e., by potentially comparing more similar apps)
4. Test how much integration of (ex-post) review data improves performance

## Next Steps & Conclusion

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# Moving from a proof-of-concept to real-time tool



1. Integrate review data into analysis and ML models
2. Further validate results by downloading and using random subset of apps
3. Systematize evidence on adverse consumer outcomes
4. Expand coverage into other finance app categories and non-English country markets

Q & A / Feedback

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We'd like to obtain feedback from possible end users on how these findings and analyses may fit or be better tailored to applied policy, regulatory, or industry needs – e.g.:

1. Is interest more in ex-ante or ex-post tools?
  - If former, what is acceptable tolerance for error margin? Or leverage in requiring more stringent vetting process?
  - If latter, what type of reporting tools and info most desired?
2. Frequency of desired reporting?
3. Expand into other country markets?
4. Expand into other non-lending product coverage?
5. Other comments or suggestions?