

Brussels Data Science Meetup
@VUB - April 23, 2015




Data4Good proof-of-concept: a Micro-Finance Loan Funding Predictor for kiva.org

Frederik Durant



<http://frederikdurant.com/projects/>

Frederik Durant

- MA, MSc, MBA
- 20 years of **software engineering, research, management** and **consulting** positions in **Speech and Natural Language Processing**
- Currently R&D Manager of Natural Language Understanding at Nuance Communications
- About to finish a self-sponsored 4-month **sabbatical**
- Just returned from 12-week **Data Science Bootcamp** in New York City
- **Final project:** loan funding predictor for 



<http://frederikdurant.com/projects/>



a global micro-finance platform

- **Non-profit** organization based in San Francisco, CA
- Mission: connect people through **lending** to **alleviate poverty**
- Worldwide **network of micro-finance institutions** (“field partners”)
- Lets individuals lend as little as **\$25** to help create opportunity

Since Kiva was founded in 2005:

1,283,922 Kiva lenders

\$698,814,300 in loans

98.72% repayment rate

We work with:

296 Field Partners

450 volunteers around the world

86 different countries

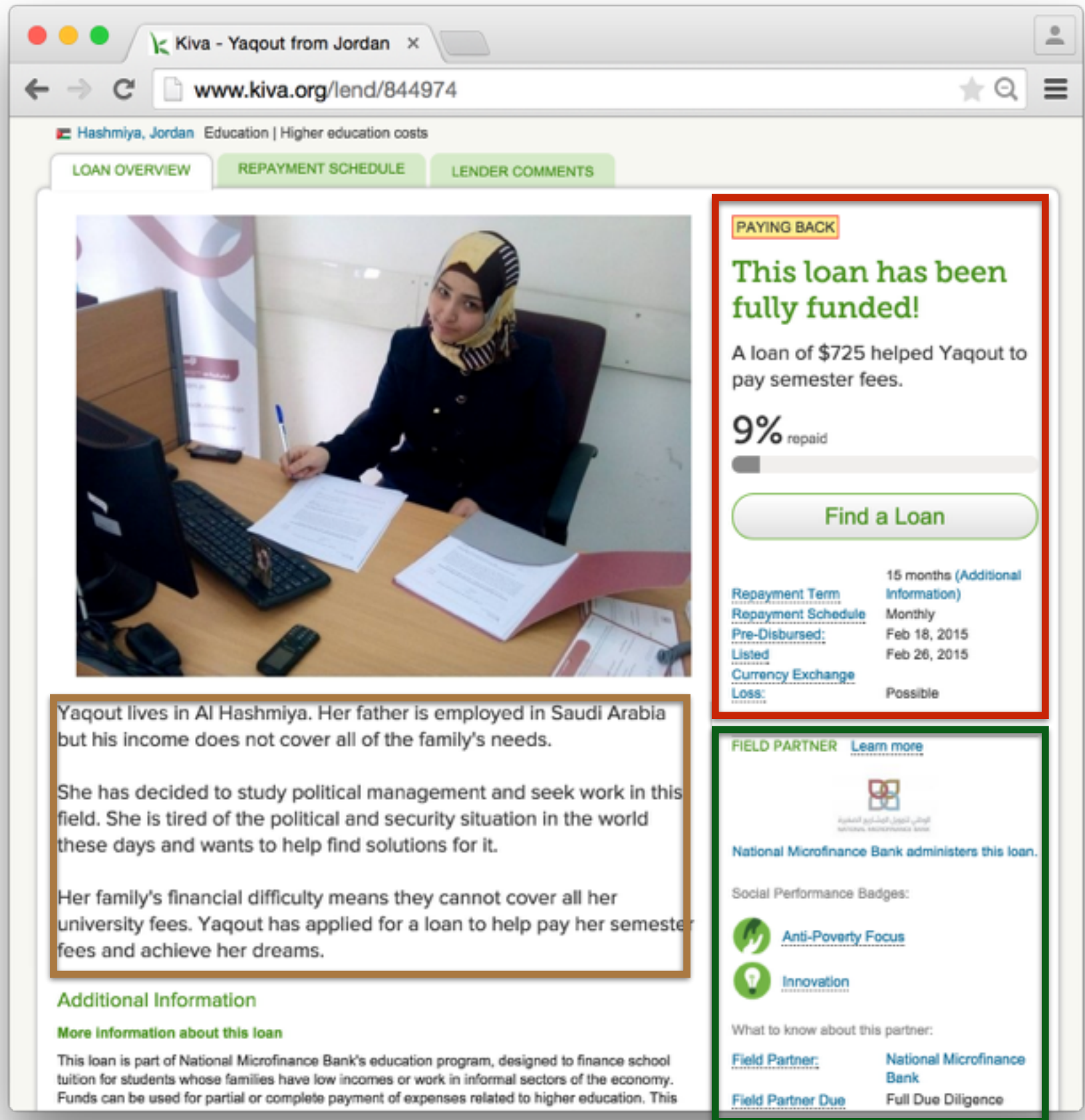
Source: <http://www.kiva.org/about> (April 23, 2015)



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Meet Yaqout from Jordan

- When **selecting** my first borrower & loan, I was probably **influenced** by:
- [Image features]
- **Loan features**
- **Loan description features**
(unstructured text)
- **Field partner features**
- [...]



Kiva - Yaqout from Jordan

www.kiva.org/lend/844974

Hashmiya, Jordan Education | Higher education costs

LOAN OVERVIEW REPAYMENT SCHEDULE LENDER COMMENTS

PAYING BACK

This loan has been fully funded!

A loan of \$725 helped Yaqout to pay semester fees.

9% repaid

[Find a Loan](#)

Repayment Term 15 months (Additional Information)
Repayment Schedule Monthly
Pre-Disbursed: Feb 18, 2015
Listed Feb 26, 2015
Currency Exchange Possible
Loss:

Yaqout lives in Al Hashmiya. Her father is employed in Saudi Arabia but his income does not cover all of the family's needs.

She has decided to study political management and seek work in this field. She is tired of the political and security situation in the world these days and wants to help find solutions for it.


Her family's financial difficulty means they cannot cover all her university fees. Yaqout has applied for a loan to help pay her semester fees and achieve her dreams.

Additional Information

More information about this loan


This loan is part of National Microfinance Bank's education program, designed to finance school tuition for students whose families have low incomes or work in informal sectors of the economy. Funds can be used for partial or complete payment of expenses related to higher education. This


FIELD PARTNER [Learn more](#)


البنك المرفحي الوطني
National Microfinance Bank

National Microfinance Bank administers this loan.

Social Performance Badges:

 [Anti-Poverty Focus](#)

 [Innovation](#)

What to know about this partner:

Field Partner: National Microfinance Bank
Field Partner Due: Full Due Diligence



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Some loans might *not* get fully funded, though

- Is this a bad thing?
- If so, for whom?
- If so, can we do something about this?

Kiva - Loans that change li x

www.kiva.org/lend?sortBy=expiringSoon

Choose a Borrower Need help selecting a loan?

3,589 loans available

Search borrowers Search Clear Filters Sort by: Expiring Soon

1 2 3 4 ... 180 next

RECENT SEARCHES

★ #InspiringStory

Click ★ to save a search.

COUNTRY Clear

GENDER

Male 1,449

Female 2,140

SECTOR

Agriculture 1,459

Arts 4

Clothing 197

Construction 33

Education 18

Entertainment

Food 623

Health 9

Housing 239

Manufacturing 2

Personal Use 51

Retail 629

Services 219

Transportation 103

Wholesale 3

GROUPS OR INDIVIDUAL

Claudia Catalina

Colombia | Retail | General Store

A loan of \$4,150 helps Claudia Catalina buy wholesale assortment of "mecato" (snacks, potato chips, pork rinds, pastries and other packaged potato and plantain products...

27% funded

Only 1 day left!

\$3,000 to go

Lend \$25

Read their story »

Funding via Interactuar

Erik Dagoberto

El Salvador | Food | Food Production/Sales

A loan of \$1,500 helps Erik Dagoberto purchase bread, chicken, dressings, tomatoes, etc., as well as a new cart.

70% funded

Only 1 day left!

\$450 to go

Lend \$25

Read their story »

Funding via PADECOMSM

Ruben Argenis

Colombia | Retail | Retail

A loan of \$1,150 helps Ruben Argenis to buy beauty products and clothes in order to increase his inventory.

23% funded

Only 1 day left!

\$875 to go

Lend \$25

Read their story »

Funding via Interactuar

John

Kenya | Retail | Retail

A loan of \$725 helps John to purchase sugar, salt, cooking oil and maize flour

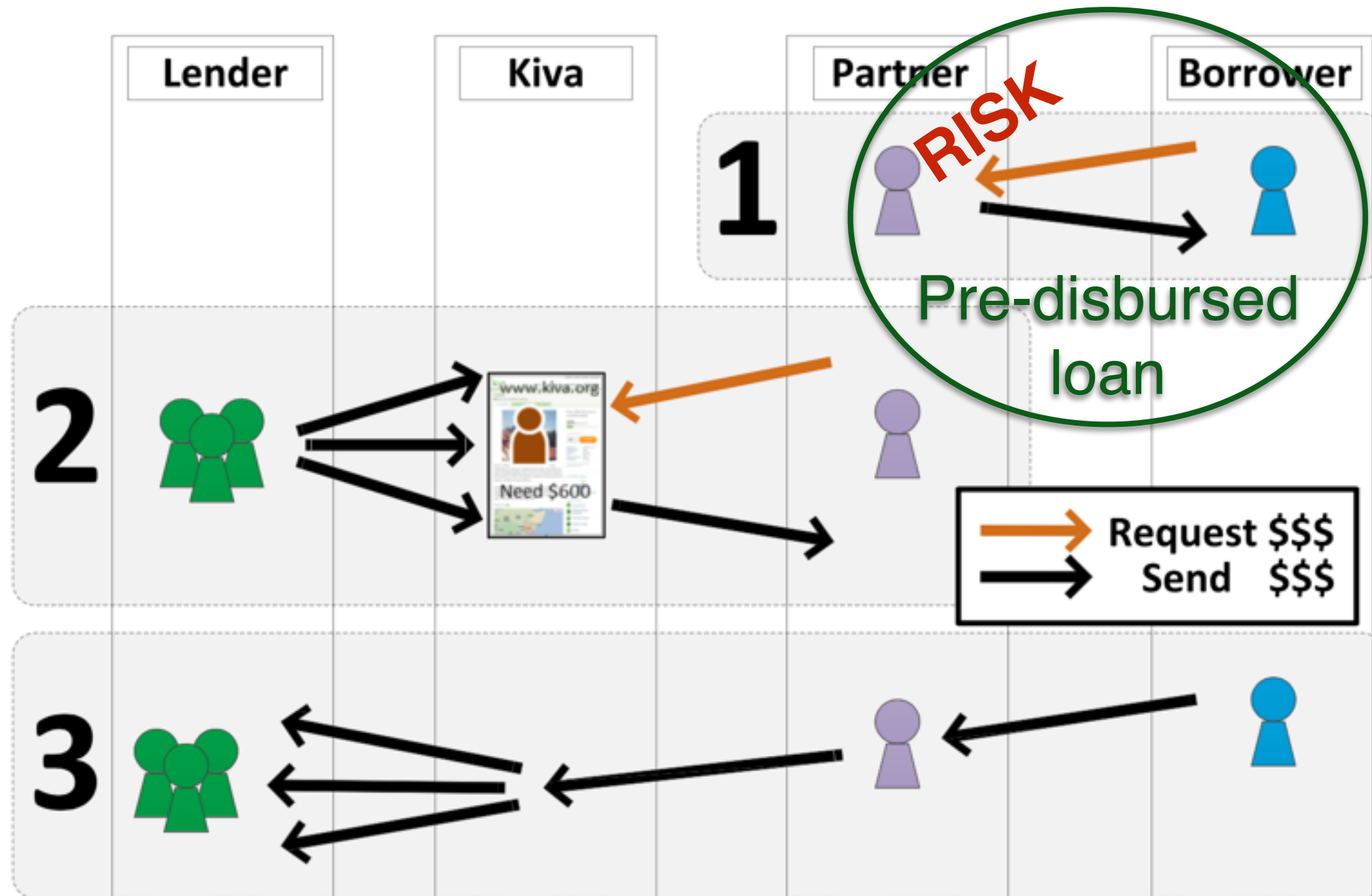
62% funded

Only 1 day left!



<http://frederikdurant.com/projects/>

The Kiva lending process

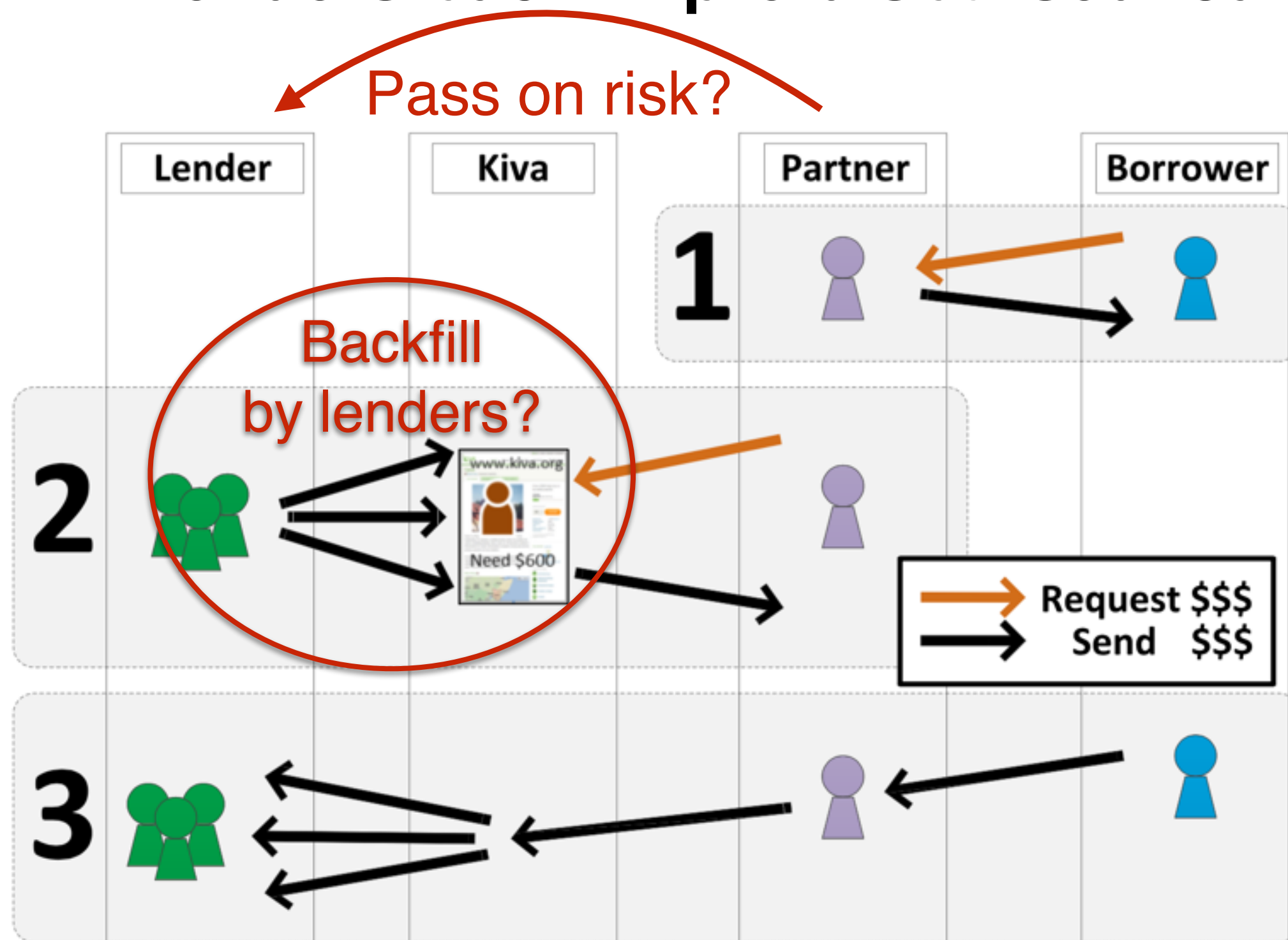


Source: http://www.cc.gatech.edu/~joyfull/resources/2014_wsdm_kiva.pdf



<http://frederikdurant.com/projects/>

Q: Will lenders backfill pre-disbursed loans?

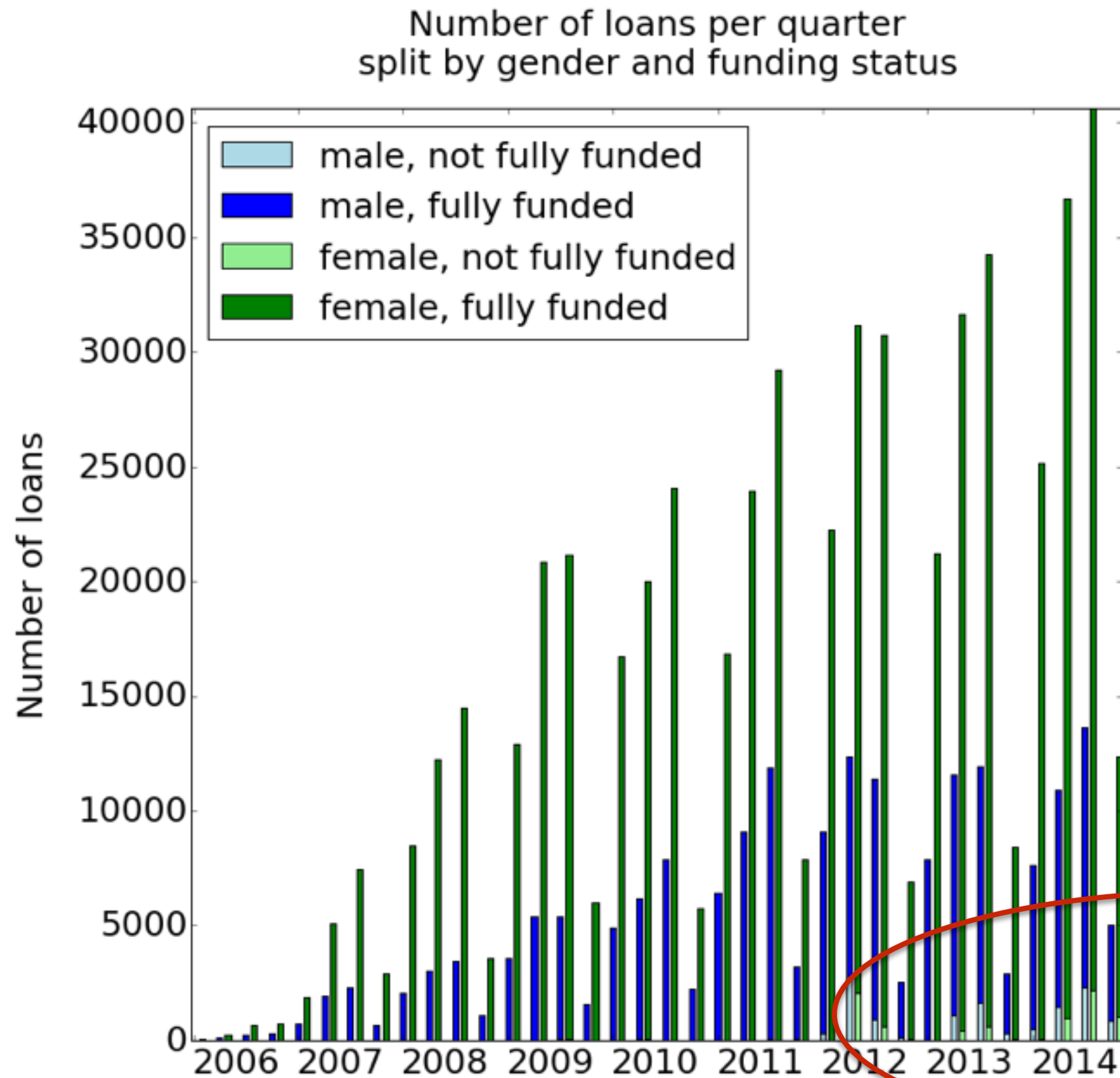


Source: http://www.cc.gatech.edu/~joyfull/resources/2014_wsdm_kiva.pdf



<http://frederikdurant.com/projects/>

Non-backfilled loans appeared in 2012



5% of loans not
fully funded!

Kiva Micro-Finance is Big

2012 through 2014, combined

Lending regions and countries

Borrowing countries and regions



<http://frederikdurant.com/projects/>

[Interactive D3 Sankey diagram]



Solution: an end2end loan funding predictor

2

Train and evaluate logistic regression model using a.o. topic modelling features

1

GET data snapshot

http://s3.kiva.org/snapshots/kiva_ds_json.zip



[http://www.kiva.org/lend/844974,](http://www.kiva.org/lend/844974)

3

Deploy model

Deployed predictor embedded in Flask web app

6

GET loan from Kiva

[http://api.kivaws.org/v1/loans/844974.json,](http://api.kivaws.org/v1/loans/844974.json)

5

Get prediction from predictor

<http://104.236.210.43/kivapredictor/api/v1.0/loanprediction?loanid=844974>



TRY

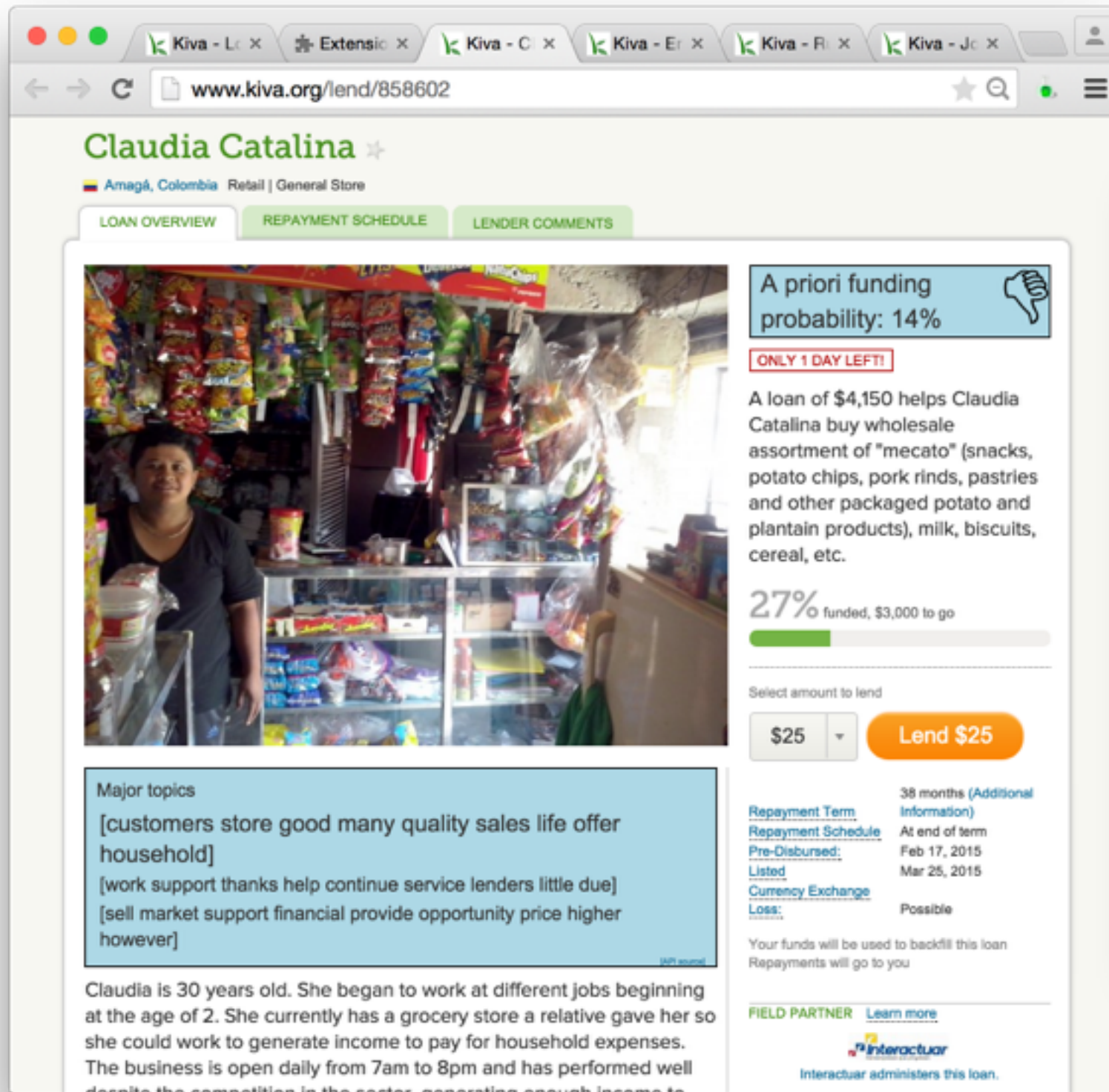
Google Chrome with self-developed plugin

<http://www.kiva.org/browse>

data

<http://frederikdurant.com/projects/>

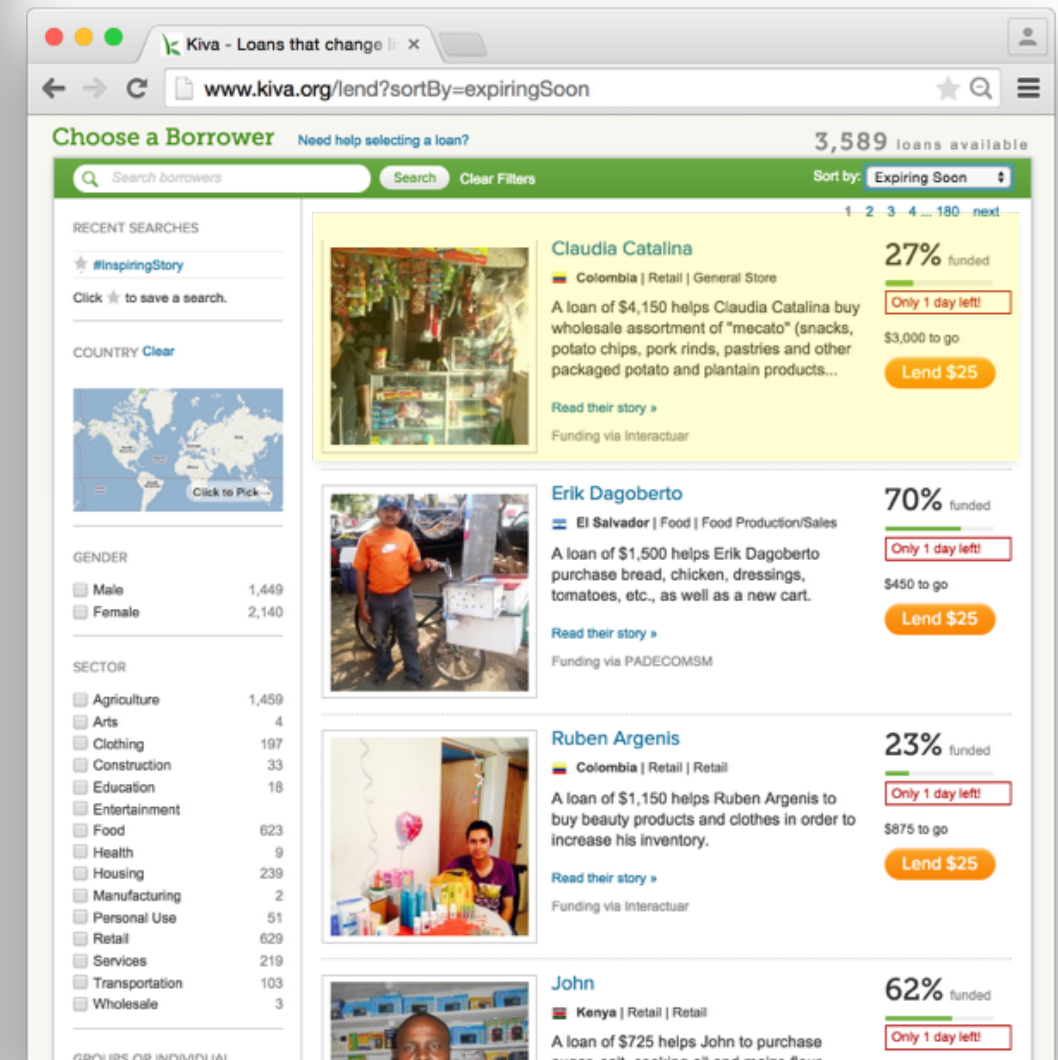
Reality check: prediction results (1/4)



The screenshot shows a Kiva loan page for Claudia Catalina, a 30-year-old woman from Amagá, Colombia, who runs a general store. The page includes a photo of her in her store, which is filled with various goods. The loan details are as follows:

- A priori funding probability:** 14% (indicated by a thumbs down icon)
- ONLY 1 DAY LEFT!**
- Loan Amount:** \$4,150
- Current Status:** 27% funded, \$3,000 to go
- Repayment Term:** 36 months (Additional Information)
- Repayment Schedule:** At end of term
- Pre-Disbursed:** Feb 17, 2015
- Listed:** Mar 25, 2015
- Currency Exchange:** Possible
- Loss:** Possible

The page also features a section for "Major topics" with text about the store's quality and the lender's support. At the bottom, there is a "FIELD PARTNER" section for Interactuar, which administers the loan.



The screenshot shows a Kiva search results page for loans expiring soon. The page displays a list of three loan opportunities, each with a photo of the borrower, their name, location, and business details. The search results are as follows:

- Claudia Catalina** (Colombia | Retail | General Store): A loan of \$4,150 helps Claudia Catalina buy wholesale assortment of "mecato" (snacks, potato chips, pork rinds, pastries and other packaged potato and plantain products...). 27% funded, \$3,000 to go. Only 1 day left! Lend \$25.
- Erik Dagoberto** (El Salvador | Food | Food Production/Sales): A loan of \$1,500 helps Erik Dagoberto purchase bread, chicken, dressings, tomatoes, etc., as well as a new cart. 70% funded, \$450 to go. Only 1 day left! Lend \$25.
- Ruben Argenis** (Colombia | Retail | Retail): A loan of \$1,150 helps Ruben Argenis to buy beauty products and clothes in order to increase his inventory. 23% funded, \$875 to go. Only 1 day left! Lend \$25.

The page also includes a sidebar with filters for recent searches, country, gender, and sector. The total number of loans available is 3,589.


Reality check: prediction results (2/4)

www.kiva.org/lend/858607

Erik Dagoberto

El Salvador | Food | Food Production/Sales

LOAN OVERVIEW | REPAYMENT SCHEDULE | LENDER COMMENTS



A priori funding probability: 39%

ONLY 1 DAY LEFT!

A loan of \$1,500 helps Erik Dagoberto purchase bread, chicken, dressings, tomatoes, etc., as well as a new cart.

70% funded, \$450 to go

Select amount to lend

\$25 Lend \$25

Repayment Term: 20 months (Additional Information)
Repayment Schedule: Monthly
Pre-Disbursed: Mar 3, 2015
Listed: Mar 25, 2015
Currency Exchange: N/A
Loss: N/A

Your funds will be used to backfill this loan
Repayments will go to you

FIELD PARTNER [Learn more](#)

PADECOMSM CREDITO
PADECOMSM administers this loan.

Major topics
[meet every help household week expenses clients daily fellowship]
[Income new conditions local start cover purchase credit lives]
[increase shop capital clothing started sells clothes ago working]

Erik is single and lives alone. He earns a living by selling chicken, ham, and other sandwiches, as well as beverages. He sells his foods everyday from 8:00 am to 5:00 pm. His business is mobile and he travels throughout the community he lives in.

He is in need of this loan to purchase bread, chicken, dressings, tomatoes, etc., and to purchase a new cart. He hopes that with this investment his productivity will increase and he will be able to cover

www.kiva.org/lend?sortBy=expiringSoon

3,589 loans available

Sort by: Expiring Soon

Choose a Borrower

RECENT SEARCHES

- #InspiringStory

Click ★ to save a search.

COUNTRY Clear

Click to Pick...

GENDER

- Male 1,449
- Female 2,140

SECTOR

- Agriculture 1,459
- Arts 4
- Clothing 197
- Construction 33
- Education 18
- Entertainment 623
- Food 9
- Health 239
- Housing 2
- Manufacturing 51
- Personal Use 629
- Retail 219
- Services 103
- Transportation 3
- Wholesale 3

GROUPS OR INDIVIDUAL

Claudia Catalina
Colombia | Retail | General Store
A loan of \$4,150 helps Claudia Catalina buy wholesale assortment of "mecato" (snacks, potato chips, pork rinds, pastries and other packaged potato and plantain products...)
27% funded
Only 1 day left!
\$3,000 to go
Lend \$25

Erik Dagoberto
El Salvador | Food | Food Production/Sales
A loan of \$1,500 helps Erik Dagoberto purchase bread, chicken, dressings, tomatoes, etc., as well as a new cart.
70% funded
Only 1 day left!
\$450 to go
Lend \$25

Ruben Argenis
Colombia | Retail | Retail
A loan of \$1,150 helps Ruben Argenis to buy beauty products and clothes in order to increase his inventory.
23% funded
Only 1 day left!
\$875 to go
Lend \$25

John
Kenya | Retail | Retail
A loan of \$725 helps John to purchase sugar, salt, cooking oil and maize flour.
62% funded
Only 1 day left!


Reality check: prediction results (3/4)

www.kiva.org/lend/858570

Ruben Argenis

Rionegro, Colombia | Retail | Retail

LOAN OVERVIEW | REPAYMENT SCHEDULE | LENDER COMMENTS



A priori funding probability: 30%

ONLY 1 DAY LEFT!

A loan of \$1,150 helps Ruben Argenis to buy beauty products and clothes in order to increase his inventory.

23% funded, \$875 to go

Select amount to lend

\$25 Lend \$25

Repayment Term: 26 months (Additional Information)
Repayment Schedule: At end of term
Pre-Disbursed: Feb 17, 2015
Listed: Mar 25, 2015
Currency Exchange:
Loss: Possible

Your funds will be used to backfill this loan
Repayments will go to you

FIELD PARTNER [Learn more](#)

Interactuar
Interactuar administers this loan.

Social Performance Badges:

Anti-Poverty Focus

Major topics

- [customers store good many quality sales life offer household]
- [work support thanks help continue service lenders little due]
- [increase shop capital clothing started sells clothes ago working]

Rubén is an enterprising man who has the drive to push forward and make progress. For the past year, he has been selling products through catalogs such as clothes, accessories, beauty products, and household goods. He sells these products mostly to friends, neighbors, and relatives who know him and want to see him succeed in his business.

www.kiva.org/lend?sortBy=expiringSoon

3,589 loans available

Sort by: Expiring Soon

1 2 3 4 ... 180 next

Choose a Borrower [Need help selecting a loan?](#)

Search borrowers Search Clear Filters

RECENT SEARCHES

- #InspiringStory
- Click ☆ to save a search.

COUNTRY Clear

Click to Pick...

GENDER

- Male 1,449
- Female 2,140

SECTOR

- Agriculture 1,459
- Arts 4
- Clothing 197
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\$3,000 to go

Lend \$25

Read their story

Funding via Interactuar

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70% funded

Only 1 day left!

\$450 to go

Lend \$25

Read their story

Funding via PADECOMSM

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23% funded

Only 1 day left!

\$875 to go

Lend \$25

Read their story

Funding via Interactuar

John

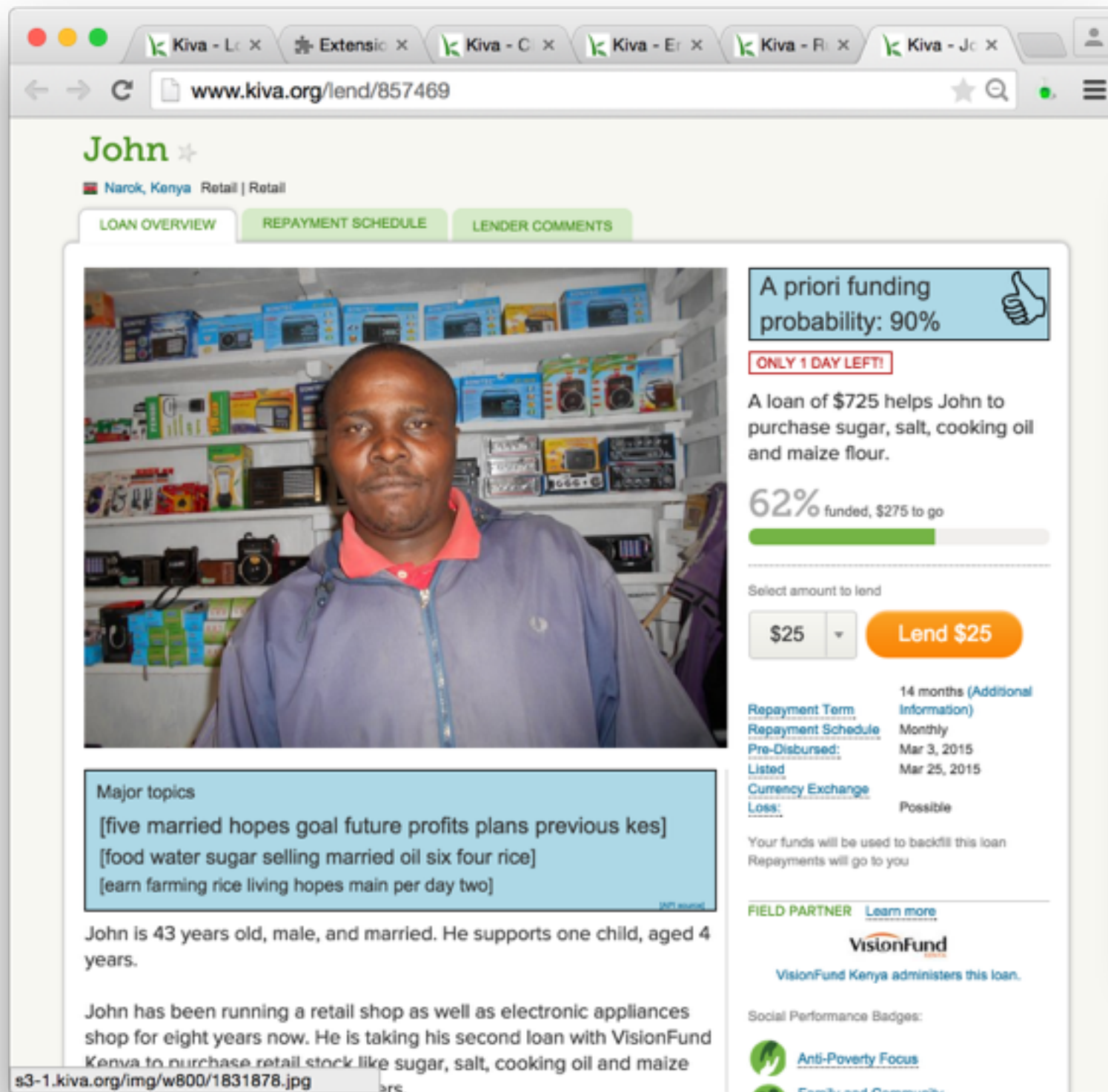
Kenya | Retail | Retail

A loan of \$725 helps John to purchase sugar, salt, cooking oil and maize flour.

62% funded

Only 1 day left!

Reality check: prediction results (4/4)



John ★
Narok, Kenya Retail | Retail

LOAN OVERVIEW REPAYMENT SCHEDULE LENDER COMMENTS

A priori funding probability: 90%

ONLY 1 DAY LEFT!

A loan of \$725 helps John to purchase sugar, salt, cooking oil and maize flour.

62% funded, \$275 to go

Select amount to lend
\$25 **Lend \$25**

Repayment Term: 14 months (Additional Information)
Repayment Schedule: Monthly
Pre-Disbursed: Mar 3, 2015
Listed: Mar 25, 2015
Currency Exchange: Possible
Loss: Possible

Your funds will be used to backfill this loan
Repayments will go to you

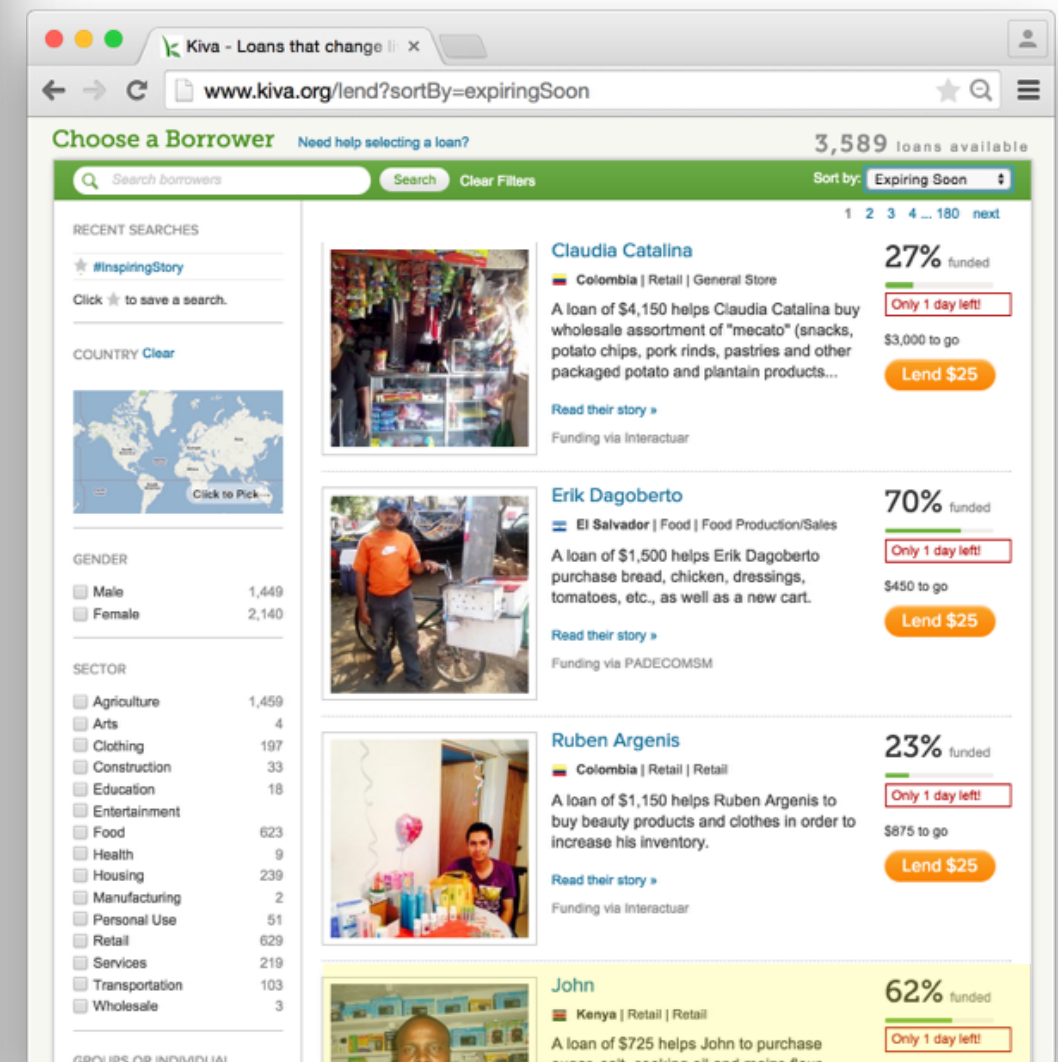
FIELD PARTNER [Learn more](#)
VisionFund
VisionFund Kenya administers this loan.

Social Performance Badges:
 [Anti-Poverty Focus](#)
 [Family and Community](#)

Major topics
[five married hopes goal future profits plans previous kes]
[food water sugar selling married oil six four rice]
[earn farming rice living hopes main per day two]

John is 43 years old, male, and married. He supports one child, aged 4 years.

John has been running a retail shop as well as electronic appliances shop for eight years now. He is taking his second loan with VisionFund Kenya to purchase retail stock like sugar, salt, cooking oil and maize



Choose a Borrower Need help selecting a loan? 3,589 loans available

Search borrowers Search Clear Filters Sort by: Expiring Soon

RECENT SEARCHES
★ #InspiringStory
Click ★ to save a search.

COUNTRY Clear

GENDER
☐ Male 1,449
☐ Female 2,140

SECTOR
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☐ Clothing 197
☐ Construction 33
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☐ Personal Use 629
☐ Retail 219
☐ Services 103
☐ Transportation 3
☐ Wholesale

GROUPS OR INDIVIDUAL

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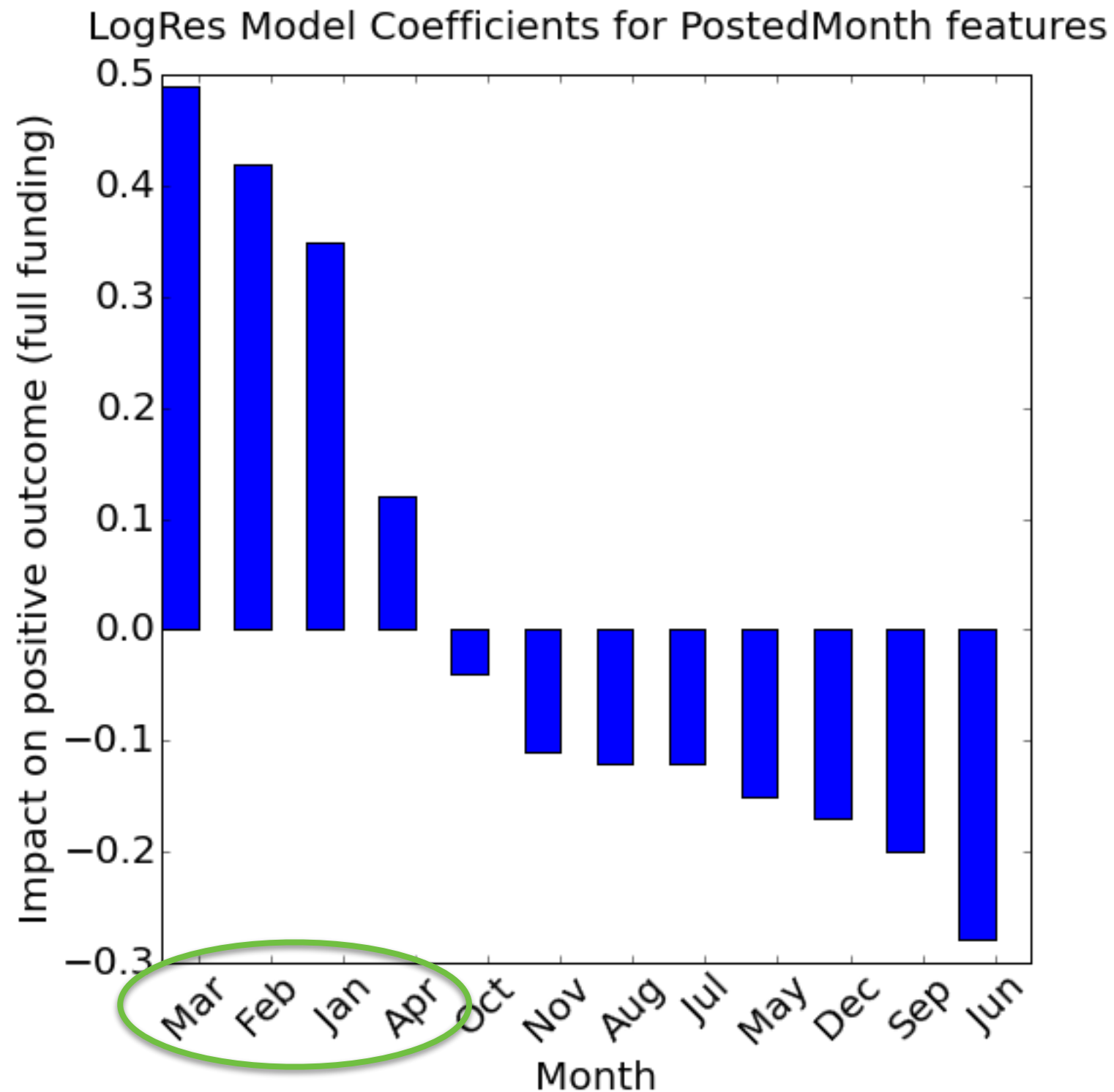
Incremental feature contributions

Feature	ROC Area Under Curve	Percentage point delta
Baseline	50.00%	-
Log10LoanAmount	76.50%	+ 26.50
20 Loan Desc. Topics	80.72%	+ 4.22
PostedMonth[Jan..Dec]	83.55%	+ 2.83
MajorityGender	85.99%	+ 2.44
Log10NumberOfBorrowers	87.13%	+ 1.14
[Partner] LoansPosted + TotalAmountRaised	87.42%	+ 0.29
GeoLatitude + GeoLongitude	87.63%	+ 0.21
RepaymentTerm	87.77%	+ 0.14
[Partner] DelinquencyRate + Rating	87.77%	+ 0.00
BonusCreditEligibility	87.82%	+ 0.05



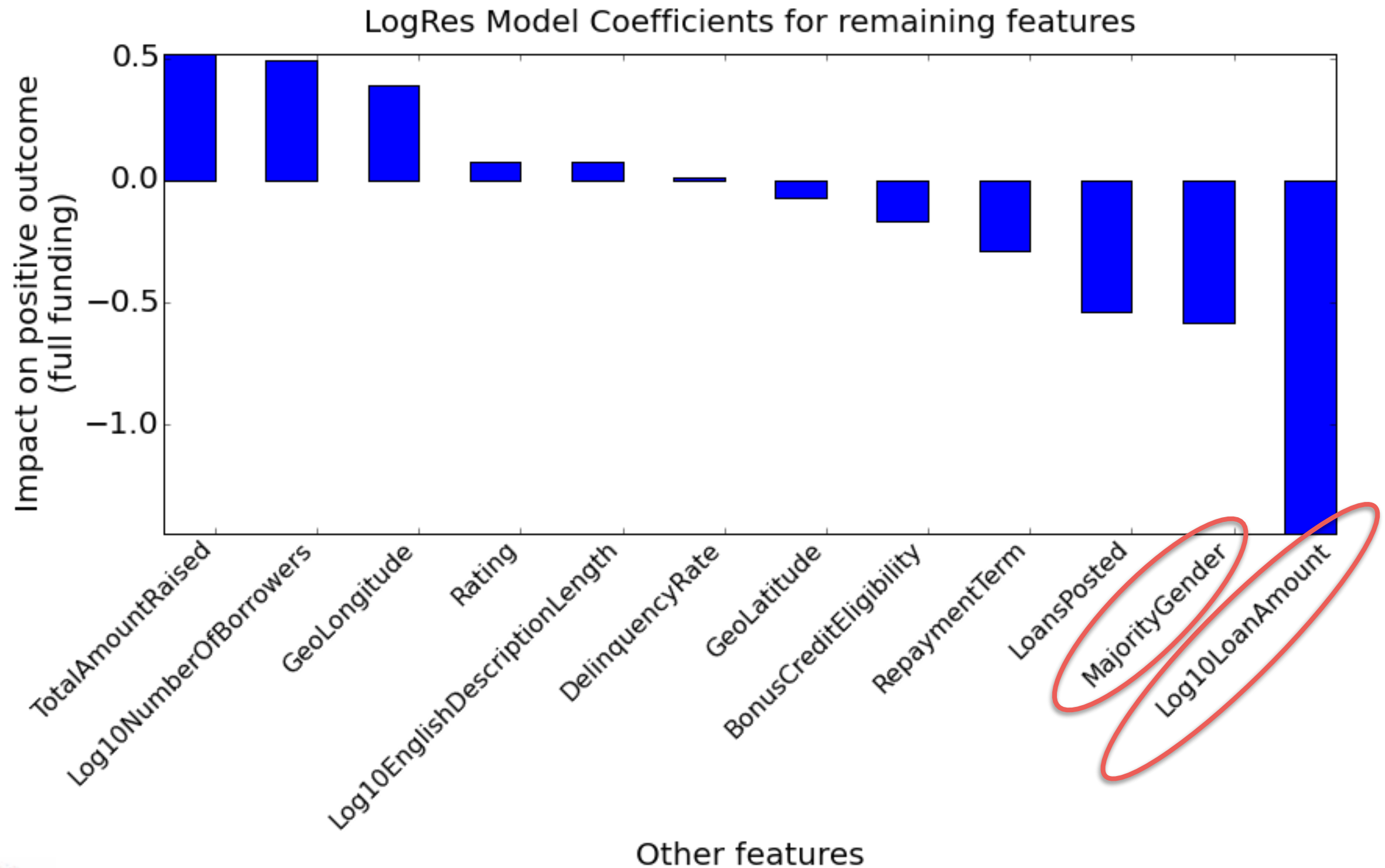
<http://frederikdurant.com/projects/>

Loan posted early in year => funded more easily



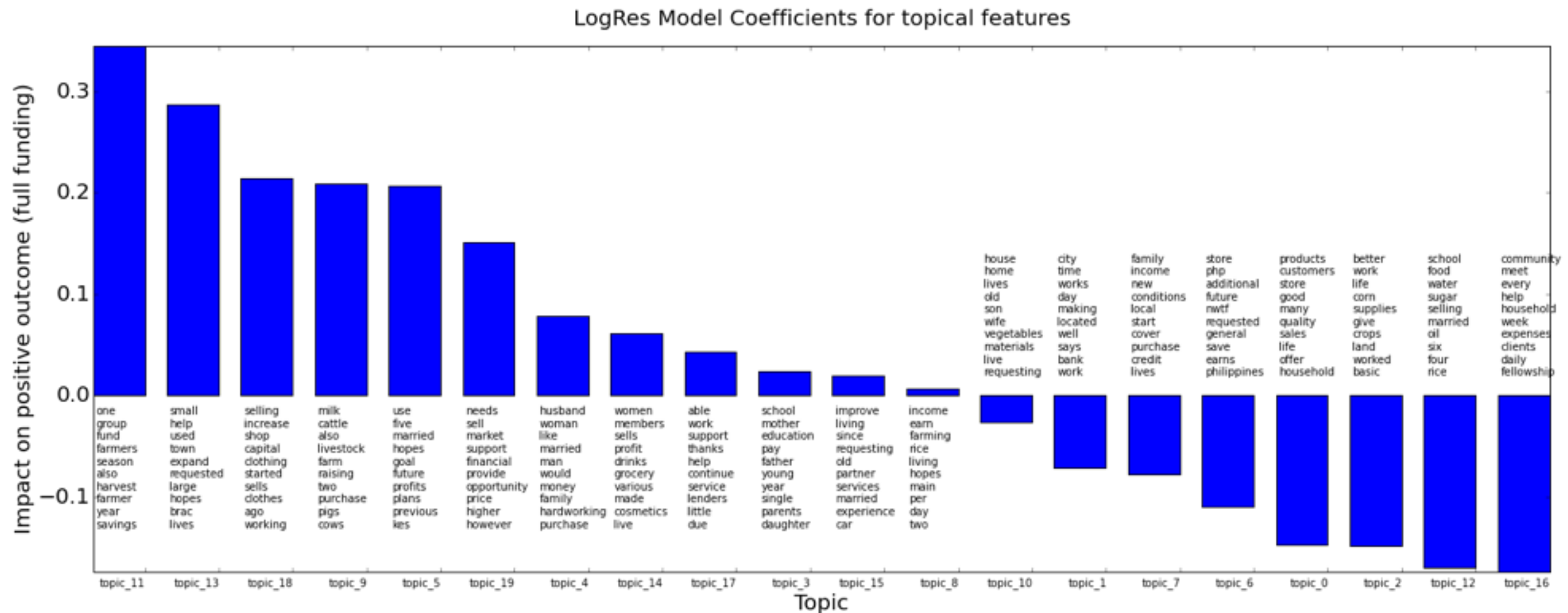
<http://frederikdurant.com/projects/>

Bigger loans to male borrowers => funded less easily



<http://frederikdurant.com/projects/>

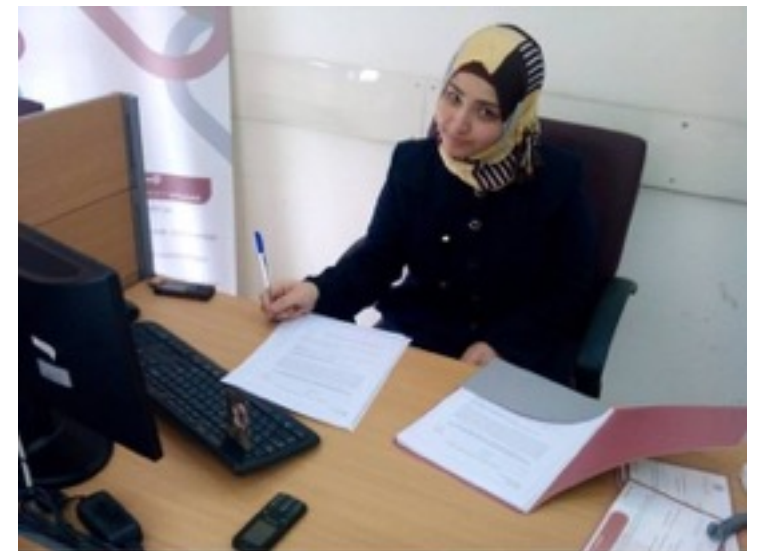
Feature polarity: topics in loan descriptions



<http://frederikdurant.com/projects/>

Status & follow-up

- Received **very positive feedback** from Kiva
- To be discussed: potential internal **deployment**
 - Not just a technical, also an ethical/behavioral matter!
 - The predictor can be used by different actors for different purposes
- Cool idea: improve model by adding *automated* **trust/sympathy detection in images**
 - See Jenq, Pan & Theseira: “What Do Donors Discriminate On? Evidence from kiva.org” (based on image assessment by humans)



<http://frederikdurant.com/projects/>

Thank you!



<http://frederikdurant.com/projects/>

