Redefining Loan Approvals

A New Analytical Approach for NHB
Post-Recession

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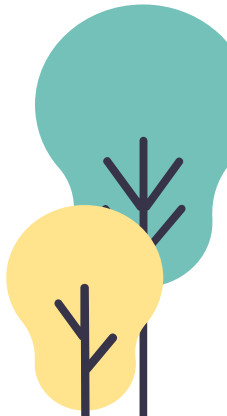Details the results and the improvements made by our model

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Case Overview

NHB (Non Humongous Bank) historically relied on credit scores and judgement for loan approvals.

2008 financial crisis led to substantial rise in loan defaults, especially those with mortgages.

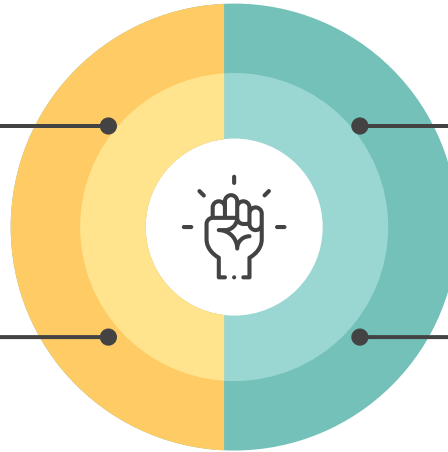Bank reluctant to use Credit Scores and seeking data-driven approach

GOALS OF OUR MODEL

Data Driven Guidance
To eliminate NHB's reliability on traditional credit score as a factor for loan approval

Profit Optimization
To optimize and improve the net profit NHB able to gain from loan approvals

Risk Mitigation
To reduce the loan approval risks from individuals with mortgages

Long Term Option
To be a sustainable long term solution to address NHB's loan approval problems

CREDIT RATING AGENCIES

> **Rating agencies were accused of misrepresenting the risks associated with mortgage-related securities.**

Dominant position in the market
95% of the market is captured by only 3 companies

Third party data
Reliance on third-party's data and calculations

Mortgage-Backed Securities (MBS) Downgrades

Rating agencies (e.g., S&P and Moody's) have downgraded the credit ratings on nearly $1.9 trillion in MBS. This places pressure on financial institutions holding these securities to write down their value, potentially requiring banks to acquire additional capital

$ Billions

Q3 07	Q4 07	Q1 08	Q2 08
85	237	739	841

Source data: Fortune Magazine, 9/4/08
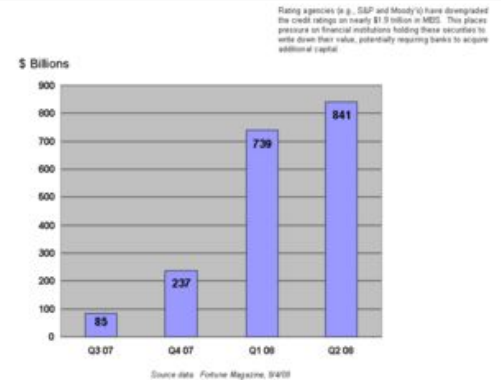
Historical data

Used existing customer database, with relevant variables

Statistical Model

Developed calculation-based model to predict default probability of each consumer
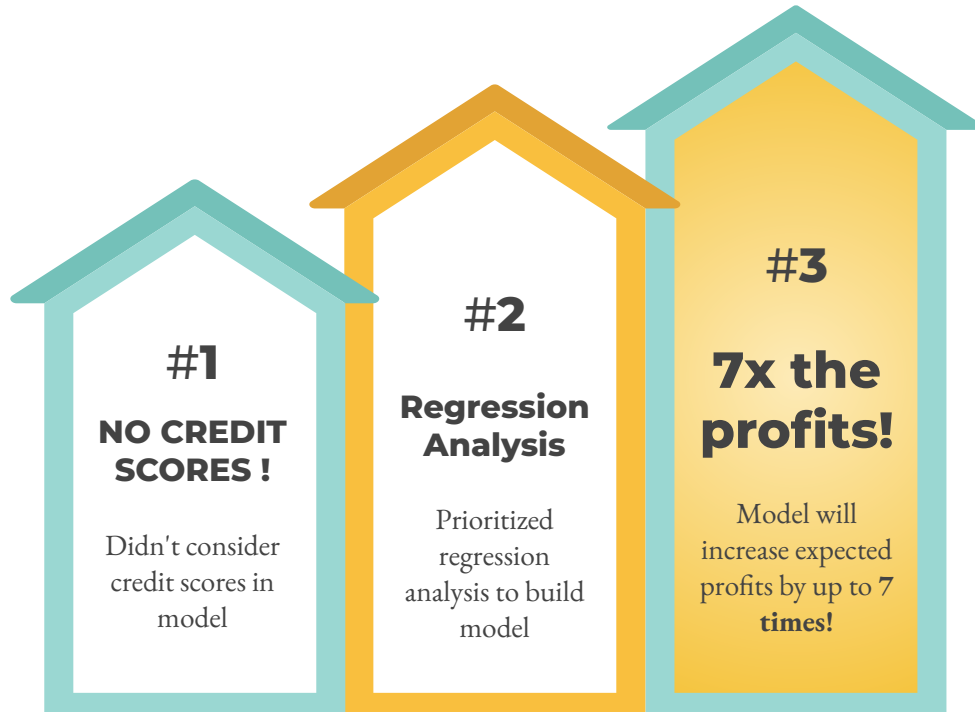
Future Approvals

Model can be applied to predict default for individual

#1

NO CREDIT SCORES !

Didn't consider credit scores in model

#2

Regression Analysis

Prioritized regression analysis to build model

#3

7x the profits!

Model will increase expected profits by up to **7 times!**

Factors Most Related to Default Percentage

Mortgage Balance

Amount a customer owes on their mortgage

Years Employed

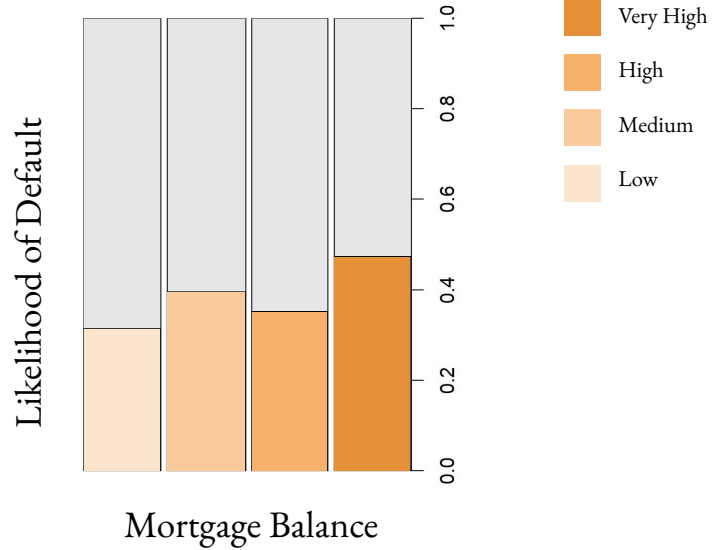Amount of years a customer has been with their current employer

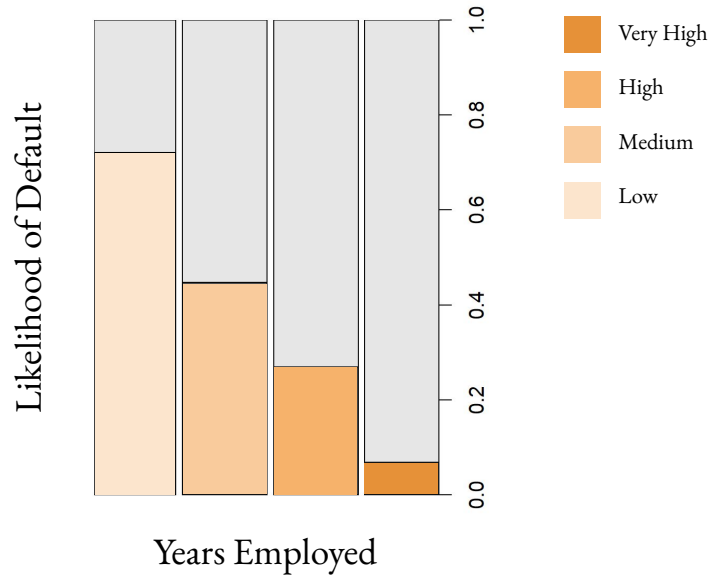**Income**

Amount a customer makes per calendar year

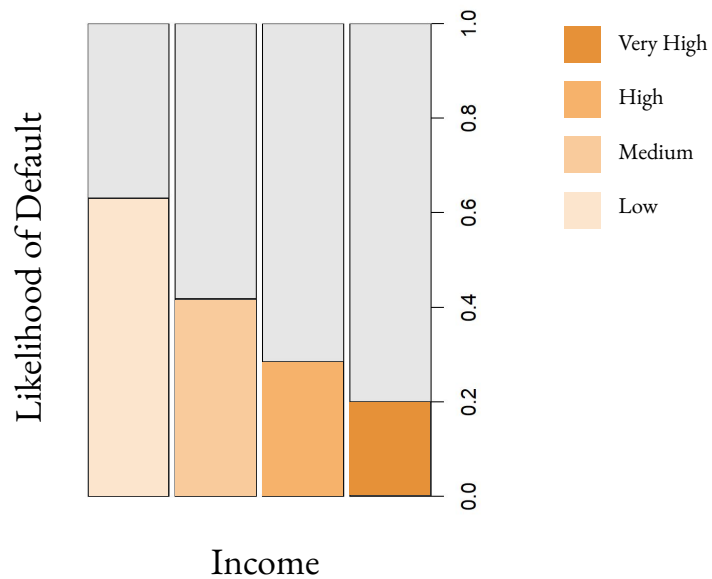- As mortgage balance goes up, likelihood of default increases

- Want customers with lower mortgage balances

- As years employed goes up, likelihood of default decreases

- Want customers with higher years of employment

- As income goes up, likelihood of default decreases

- Want customers with higher incomes

LOAN AMOUNT
Applied for $10,000 loan

TERM AND INTEREST
1-year term, 6% interest

Bank's Evaluation
New Model

AGE
25
Employed 4 yrs

INCOME
$37,327

MORTGAGE BALANCE
$158,000

DEFAULT RISK
25.9%

MARY'S LOAN PROFILE

AGE
51
Employed 13 yrs

INCOME
$56,687

MORTGAGE BALANCE
$758,000

DEFAULT RISK
6.4%

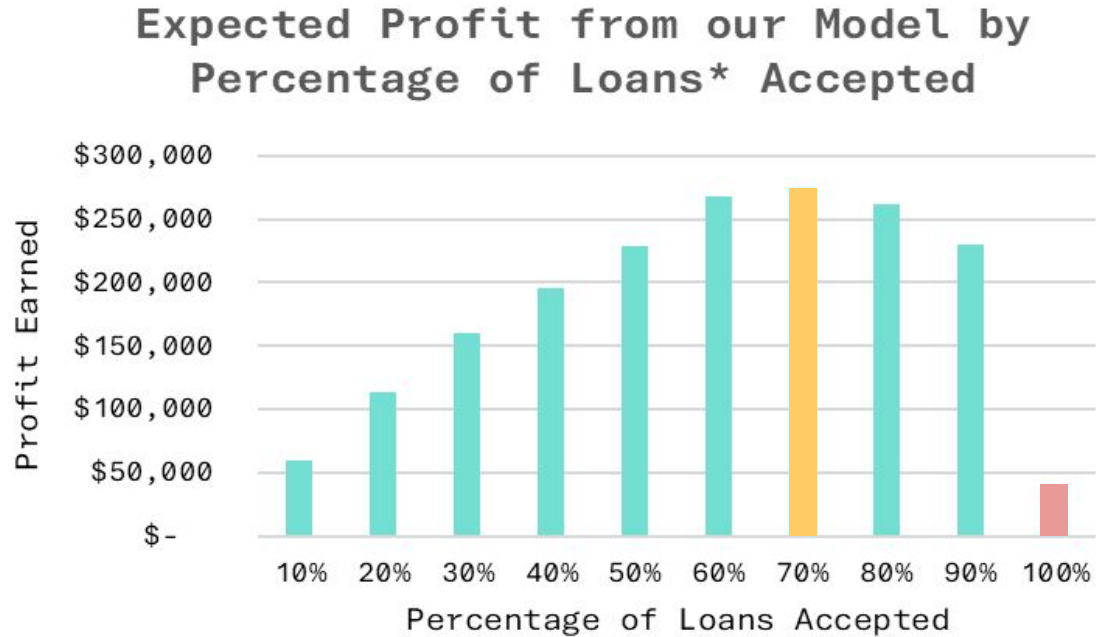**Maximum Profit**

Accepting top 700 (70%) loans = expected profit of **$273,582**

Baseline (No Model)

Accepting all 1000 (100%) loans = expected profit of **$38,163**

Expected Profit from our Model by Percentage of Loans* Accepted

Profit Earned

*Assumes 1000 1-year loans were requested, each for $10,000 at 6% interest rate

LIMITATIONS

- Model factors in applicants' income for default probability

- Caution: Violation of ECOA with public assistance income

- Use model to complement decision-making

- Justification needed for applicant rejection

- Model's predictions are not guaranteed

YOUR DECISION

Use Our Model

Implement our model in your loan approval decision-making process

- Optimal if your experts **cannot** select loans to approve so profit increased by 700% vs accepting all loans
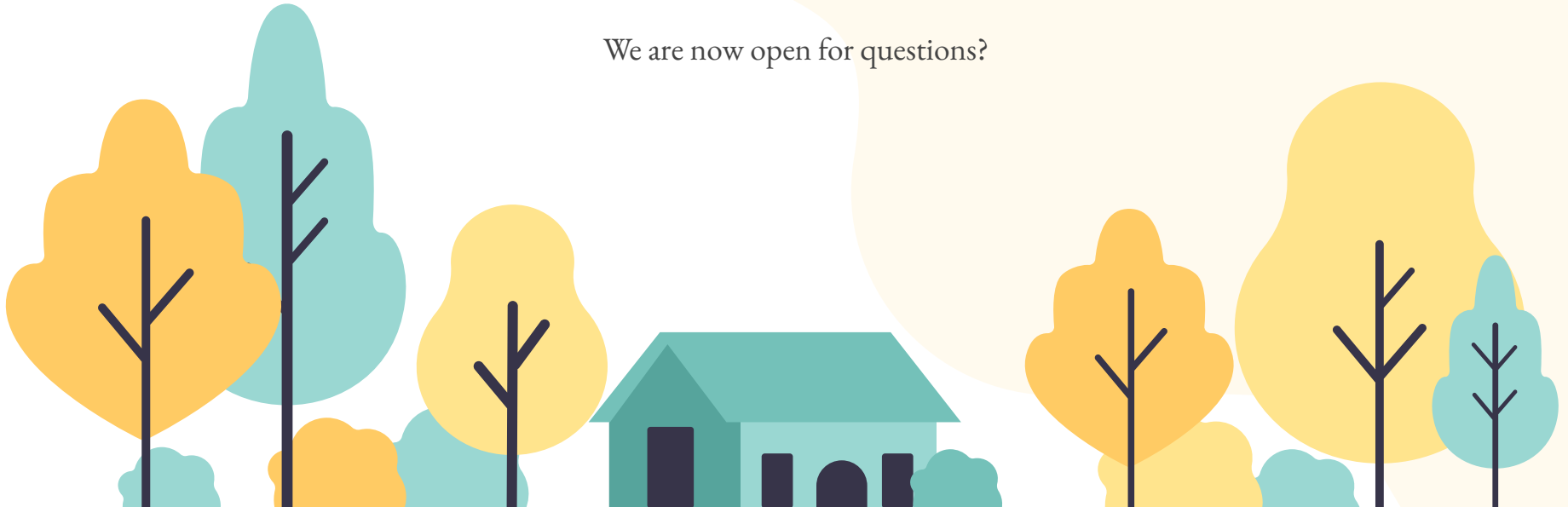
Continue Without Our Model

Continue evaluating loans using your experts' opinions

- Optimal if your experts **can** select loans to approve so profit increased by 700% vs accepting all loans

THANK YOU

We are now open for questions?

Appendix A - Expected Profit by Percentage of Loans Accepted

% accepted	number of defaults	default rate	expected value	number loans given	expected profit
10%	0	0	600	100	$ 60,000
20%	2	0.003212335	565.9492451	200	$ 113,190
30%	6	0.006424671	531.8984902	300	$ 159,570
40%	13	0.01044009	489.3350466	400	$ 195,734
50%	21	0.013491809	456.9868294	500	$ 228,493
60%	27	0.014455509	446.771603	600	$ 268,063
70%	43	0.019732917	390.8310771	700	$ 273,582
80%	64	0.025698683	327.5939608	800	$ 262,075
90%	91	0.03248028	255.7090338	900	$ 230,138
100%	165	0.053003534	38.16254417	1000	$ 38,163

Assuming 1000 loans were requested, each a 1-year loan for $10,000 at 6% interest

Appendix B - Positive vs Negative Expected Value of Loans

- Loans with an estimated probability of default of **6% or higher** (based on our model) are expected to **lose money** on average

- Loans with an estimated probability of default of **5% or lower** (based on our model) are expected to **make money** on average

Expected value ($) of a 1-year, $10,000 loan at 6% interest - **5% PROBABILITY OF DEFAULT**	
Probability of Default	5%
Probability of No Default	95%
Loss if Default	$10,000
Profit if No Default	$600
EXPECTED VALUE OF LOAN	-$70

Expected value ($) of a 1-year, $10,000 loan at 6% interest - **6% PROBABILITY OF DEFAULT**	
Probability of Default	6%
Probability of No Default	94%
Loss if Default	$10,000
Profit if No Default	$600
EXPECTED VALUE OF LOAN	$36

Appendix C - Expected Value of John & Mary

Expected Value of John

if they default, lose 10k	26.0%	$2,600.00	-$2,156.00
if they don't, get $600	74.0%	$444.00	

(26.0% * -$10,000) + (74.0% * $600) = -$2,156

Expected Value of Mary

if they default, lose 10k	6.4%	$640.00	-$78.40
if they don't, get $600	93.6%	$561.60	

(6.4% * -$10,000) + (93.6% * $600) = -$78.40

Appendix D - Predictions of John & Mary

Expected Value of Mary

Mary's predictions	
linear predictor	-0.2767
Probability default	0.43126
corrected Prob of default	0.06391

Expected Value of John

John's predictions	
linear predictor	1.35475
Prob of default	0.7949
corrected Prob of default	0.25868