

Application of Alternative Data in Credit Decisioning

April 2018

Moody's Analytics Helps Capital Markets and Credit Risk Management Professionals Worldwide

Outstanding Success

- » Part of 100-year-old organization
- » Continually awarded for credit expertise and risk and regulatory solutions
- » Recognized expertise across all main industry sectors

Top Clients World-Wide

- » 247 of top 450 asset managers
- » 55 of top 100 largest corporations
- » 291 of top 500 commercial banks
- » 64 of top 100 insurance companies
- » Over 1,200 community banks

Deep Expertise

- » Leading credit insight
- » World-class quantitative credit and portfolio analytics
- » Award-winning software and services to manage risk and performance

Global Reach

- » 16 offices in 11 countries
- » 2,400 employees world-wide
- » Global partnerships
- » Clients represent 3,900 institutions worldwide operating in 120 countries



Alternative Data in Credit Decisioning



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Moderator
Director of Product
Management

Location and Behavior Analytics Create New Frontiers in Commercial Loan Credit Decisions

Underwriting CRE Loan		Risk Dimensions	Solutions
		Location, location, location	Location Analytics
		Property-specific attributes	Lender due diligence and reporting data requirements
		Loan-specific characteristics	Moody's AnalyticsCMM and CRE Scorecard
Underwriting C&I Loan		Risk Dimensions	Solutions
		Borrowing entity business and operating financials	Moody's Analytics RiskCalc and C&I Scorecard
		Location of the business, especially for SME companies	Location Analytics
		Behavior of the business / customers	Behavior Analytics

Where Do People Get Location Info Today?

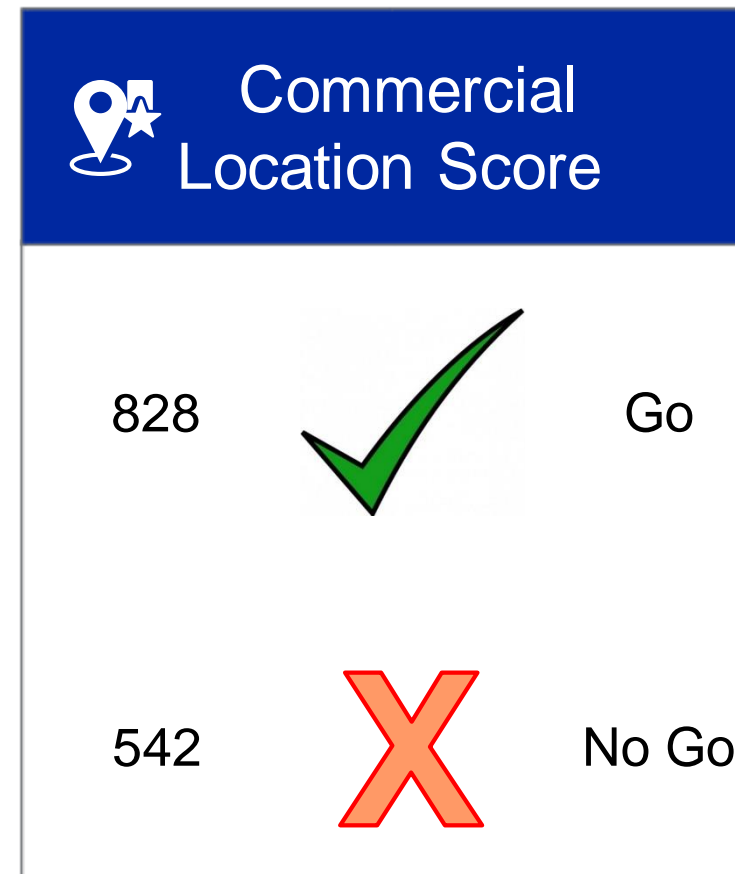
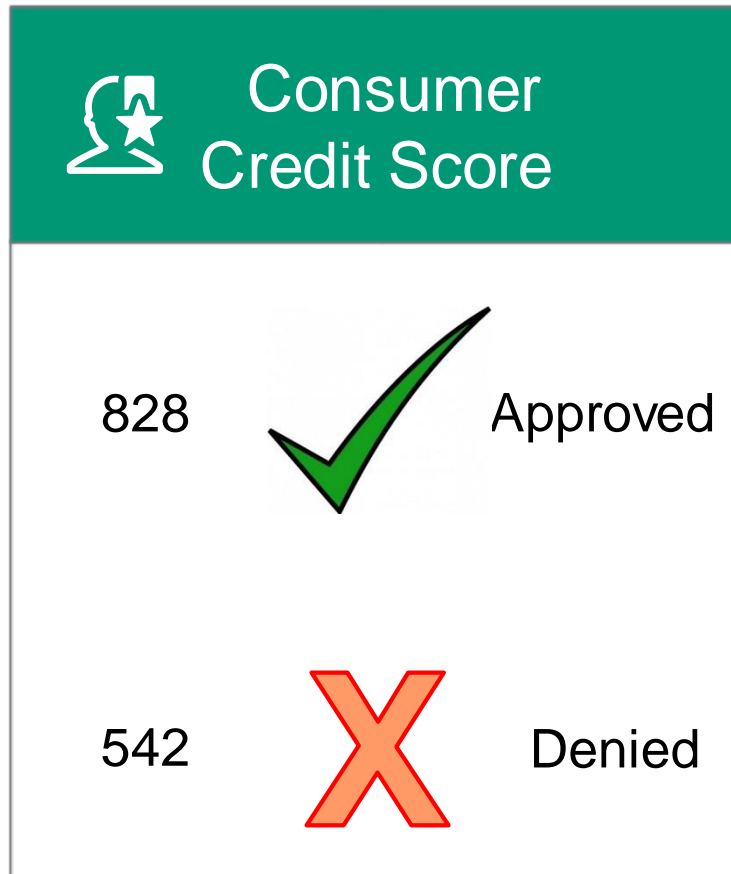
- » Real estate brokers
- » Sales/lease comps
- » Your trusted local business contacts
- » Google/Bing maps
- » Social media
- » Property intelligence platforms

All good ideas. But
very fragmented,
and sometimes very
subjective.

A consistent,
objective measure
would be better!

Let's disrupt the entire business!

Location Score – A Parallel of Consumer Score

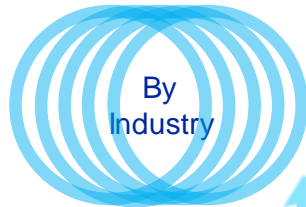


Unique ID: Social Security Number (SSN)

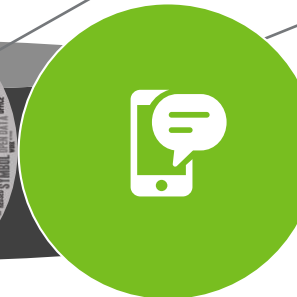
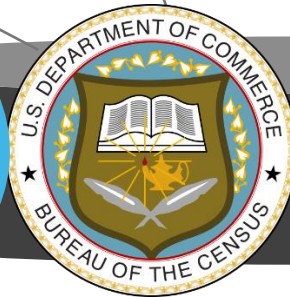
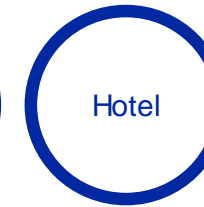
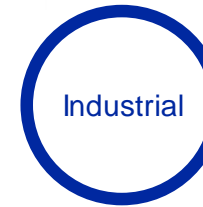
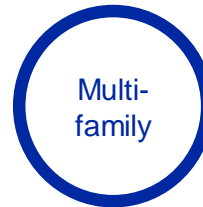
Assessor's Parcel Number (APN)

Business Applications of Location Score

C&I Location Scores

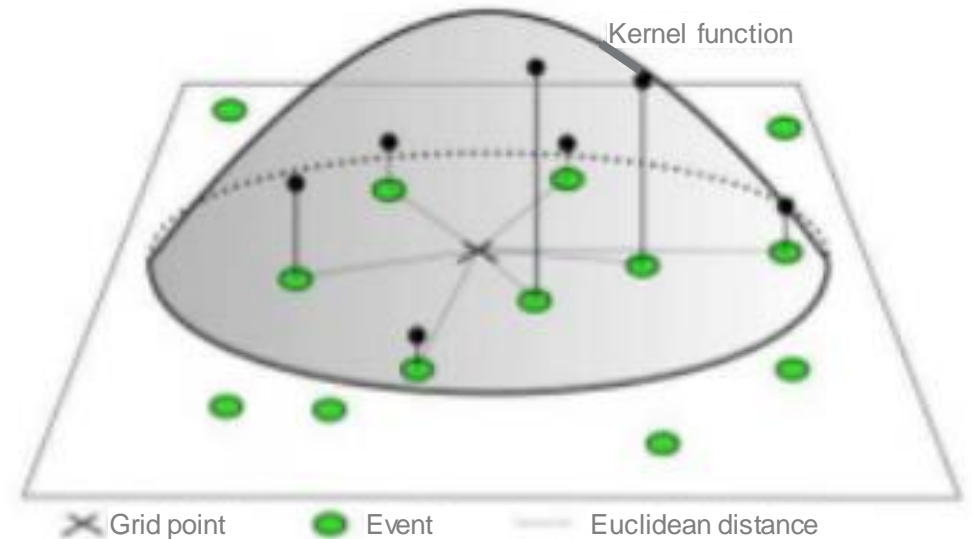


CRE Location Scores



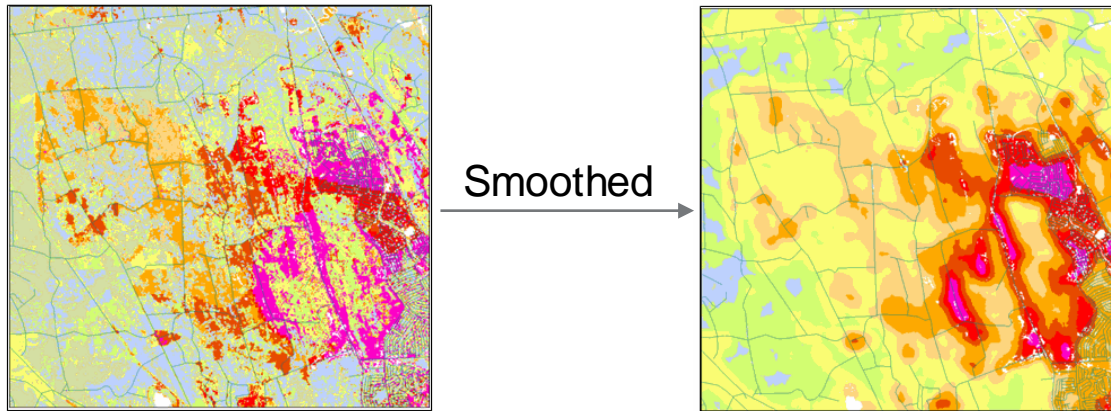
Geospatial Methodology – Spatial Kernel Density

- » Based on discrete points of observation scattered across space, we want to develop a continuous density to cover the entire space
- » Using safety as an example
 - Crime incidents occurs at discontinuous locations
 - Our method helps evaluate the safety of every location in space based on nearby incidents



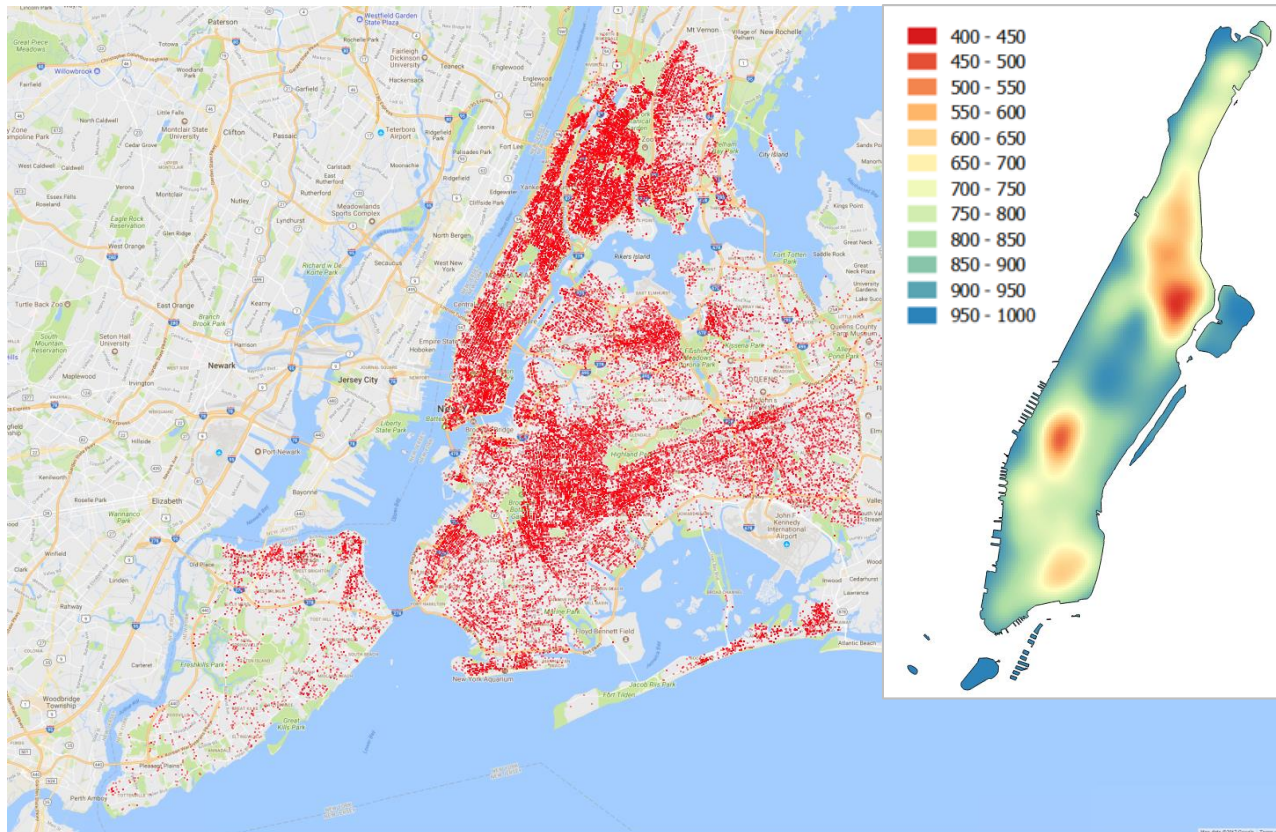
Geospatial Methodology – Spatial Smoothing

- » The opening of a trendy restaurant benefits the residents who live on the block
- » Meanwhile, people who live within a few blocks of the restaurants also benefit albeit to a less degree
- » We apply a spatial smoother to “spread” the accessibility to urban amenities



Safety Scores Based on Open Data

RPT_DT	OFNS_DESC	CRM_ATPT_CPTD_CD	LAW_CAT_CD	Latitude	Longitude
9/30/2017	MURDER & NON-NEGL. MANSLAUGHTER	COMPLETED	FELONY	40.80106379	-73.95048191
9/30/2017	ASSAULT 3 & RELATED OFFENSES	COMPLETED	MISDEMEANOR	40.6774067	-74.00639712
9/30/2017	INTOXICATED & IMPAIRED DRIVING	COMPLETED	MISDEMEANOR	40.62322682	-74.14922697
9/30/2017	HARRASSMENT 2	COMPLETED	VIOLATION	40.65469792	-73.9076236
9/30/2017	ROBBERY	COMPLETED	FELONY	40.74749494	-73.88532107



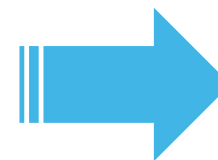
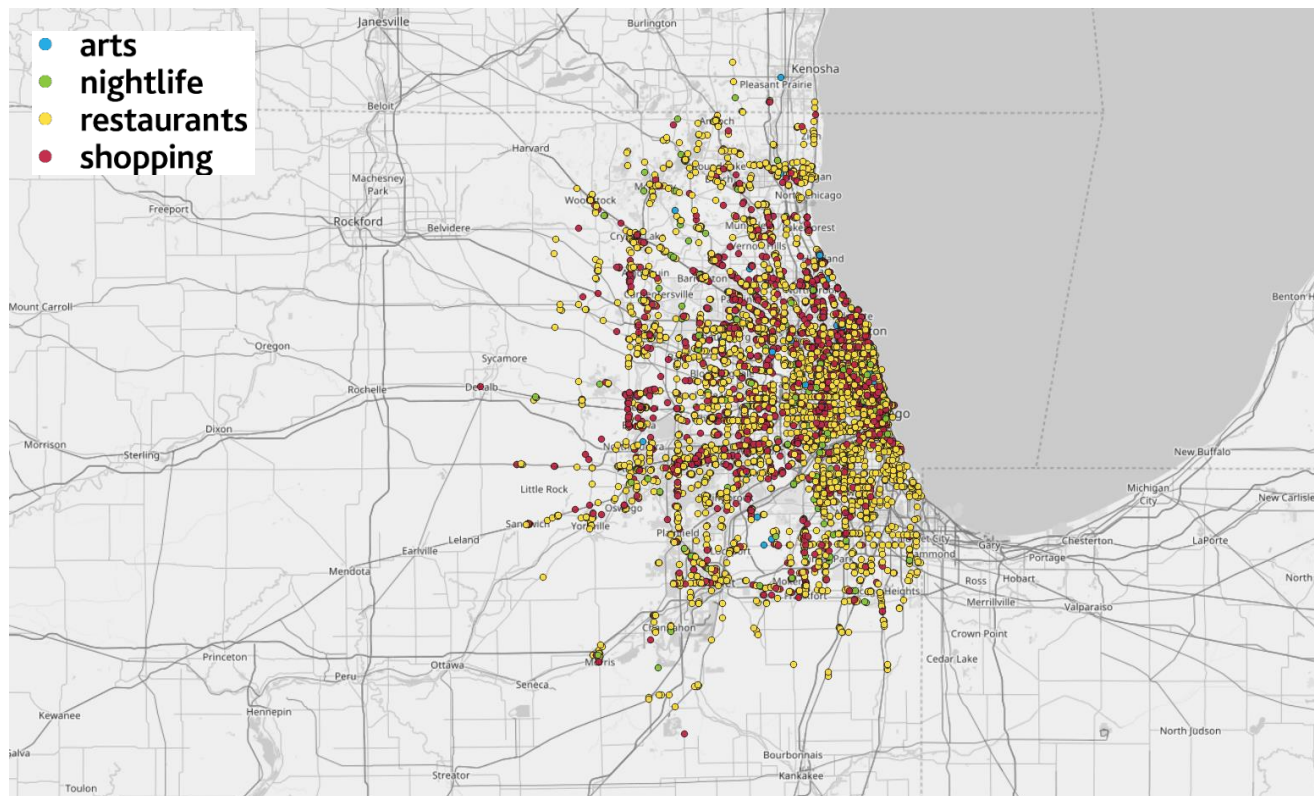
Amenity Scores Based on Social Media Data

 3,062

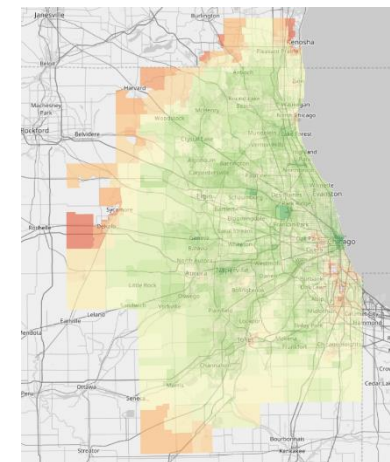
 5,766

 510

 126

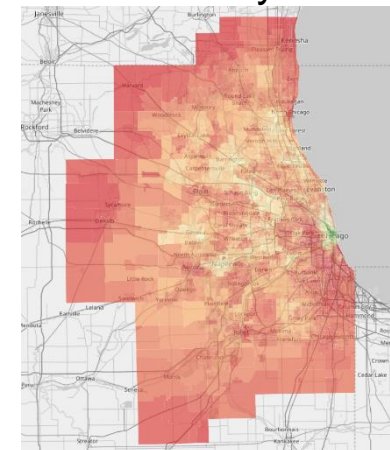


Volume



Normalized Score
400 - 500
500 - 600
600 - 700
700 - 800
800 - 900
900 - 1000

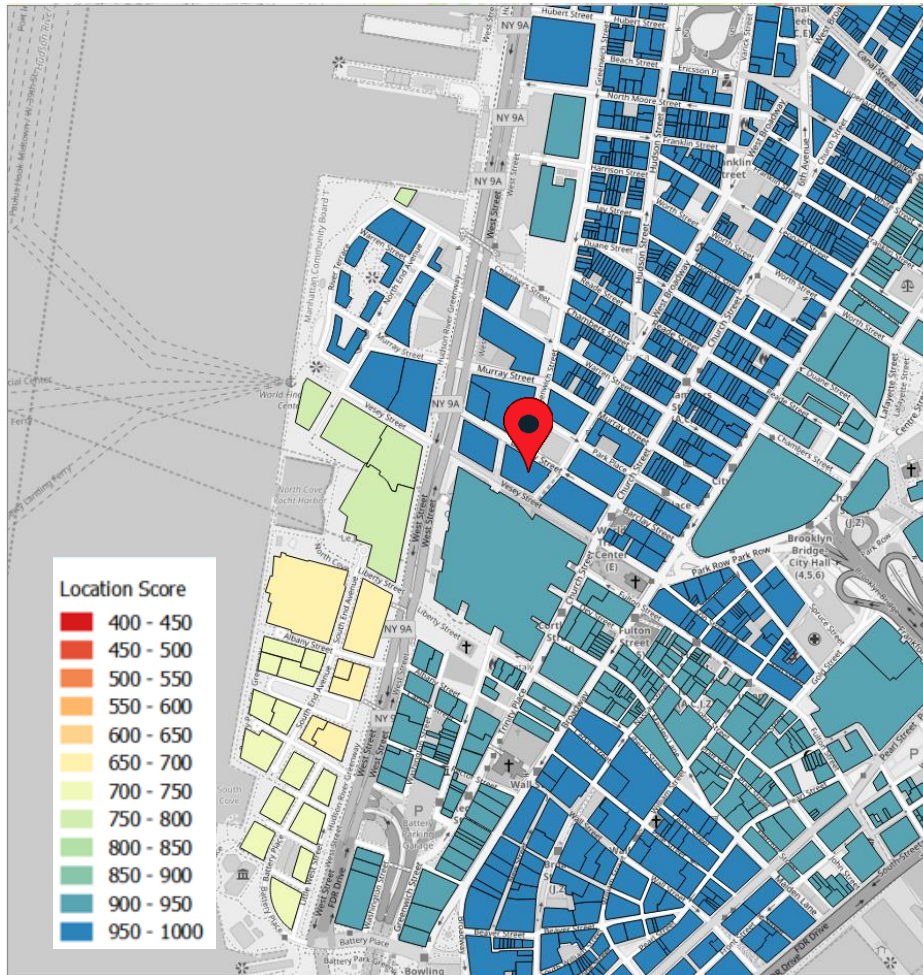
Variety



Normalized Score
400 - 500
500 - 600
600 - 700
700 - 800
800 - 900
900 - 1000

Location Score Demo

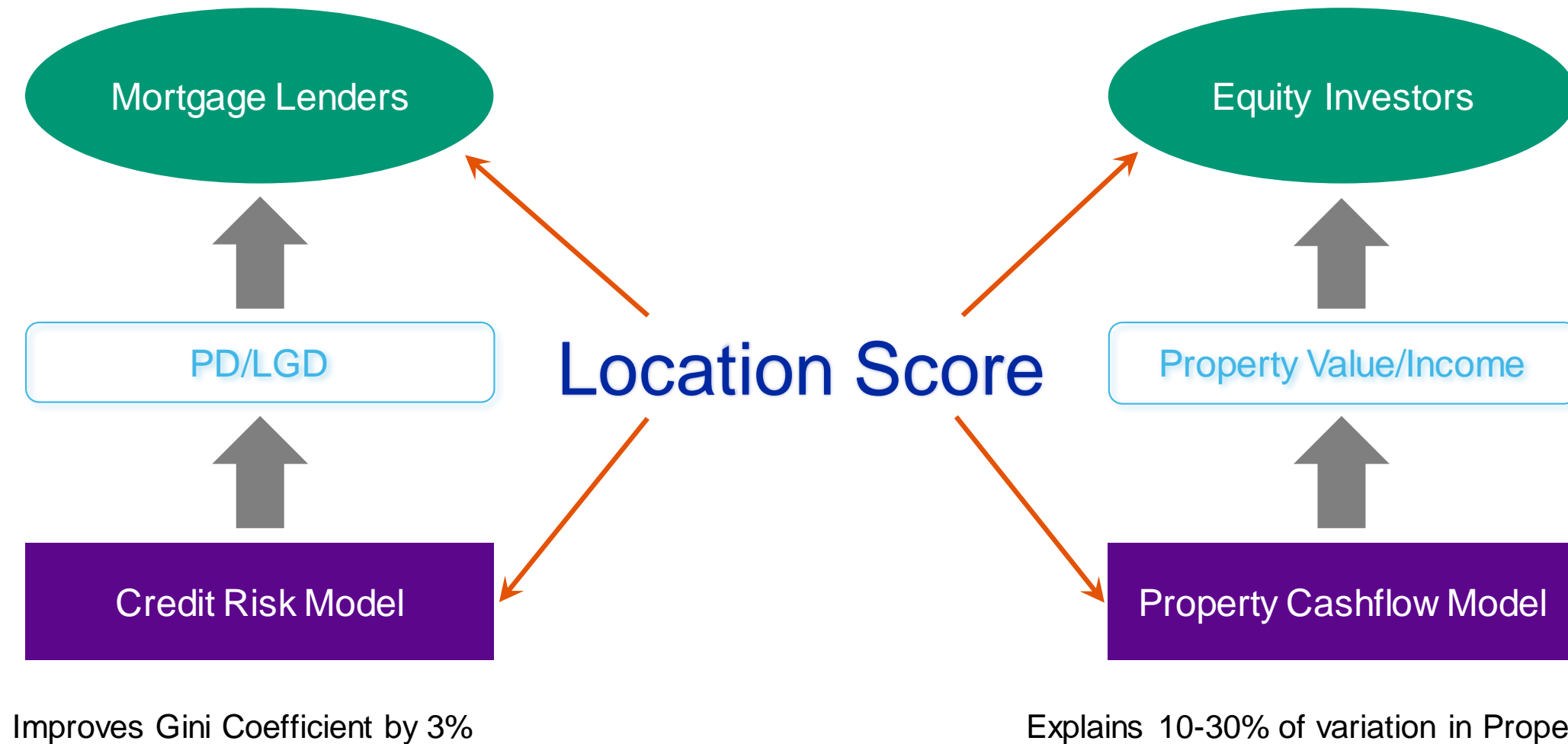
Address: 250 Greenwich St, New York, NY 10007



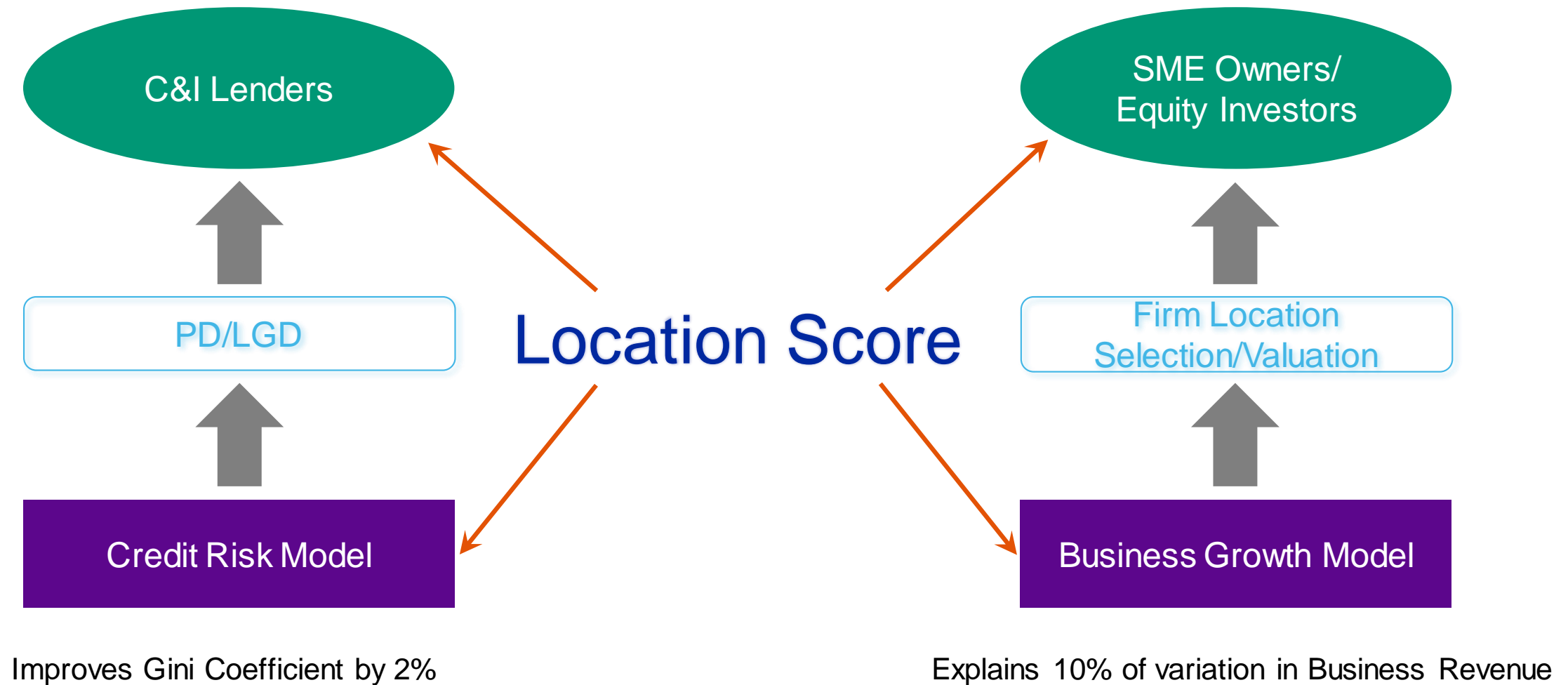
952

Per-capita Personal Income	\$71,599
Business Establishments	463
Average Payroll	\$6.8 bil
Distance to Subway	0.2 mi
Fair Market Rent	\$58 psf
Nearby Restaurants	14
Violent Crime Rate	1.75‰

Using Location Score for CRE Assessment


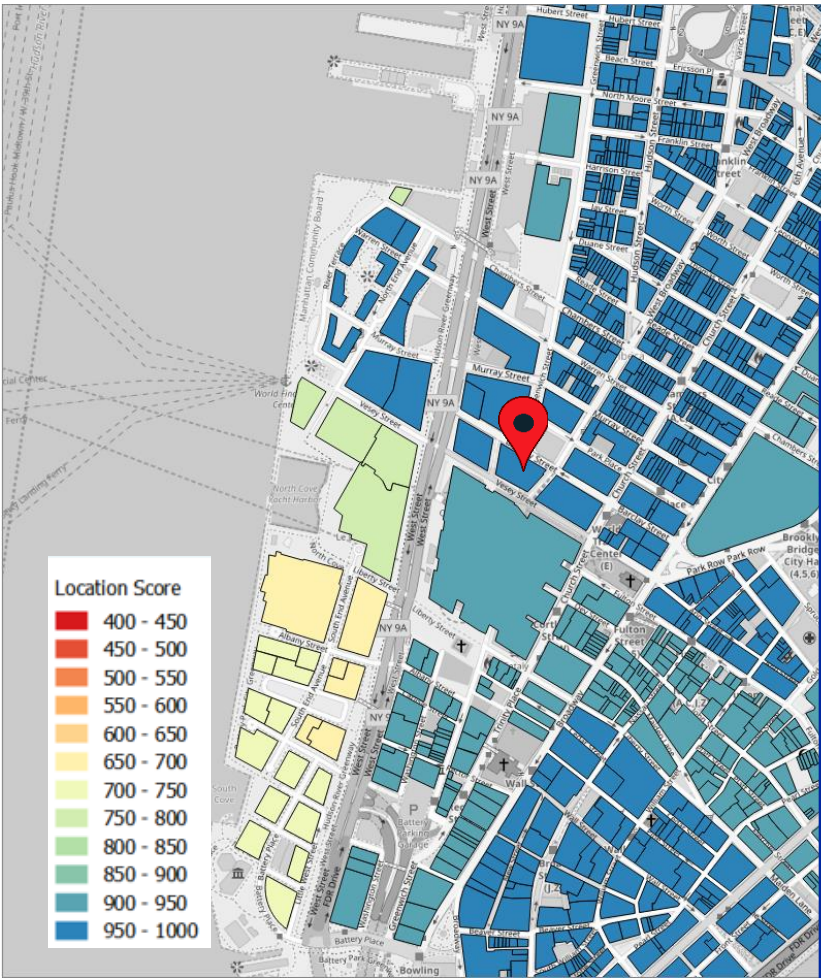


Using Location Score for C&I (SMEs) Assessment



C&I Location Score: How is it Different from CRE and Why

Address: 250 Greenwich St, New York, NY 10007



		C&I 845	CRE 952
Per-capita Personal Income	\$71,599	+	+
Business Establishments	463	-	+
Average Payroll	\$6.8 bil	+	+
Distance to Subway	0.2 mi	+	+
Fair Market Rent	\$58 psf	-	+
Nearby Restaurants	14	+	+
Violent Crime Rate	1.75‰	-	-

- C&I score weighs location factors differently

C&I	Competition
CRE	Higher Property Price

C&I	Higher Operation Cost
CRE	Higher Property Revenue

C&I Location Score Works Better for Geo-Sensitive Industries and Smaller Firms

- Geo-sensitive sectors
 - Retail
 - Business Service
 - etc...
- Geo-insensitive sectors
 - Constructions
 - Transportation
 - etc...



- ✓ Location score improves default prediction
- ✓ Location score predicts firm revenue

Sales < \$2 Mil

- Gini coefficient **↑ 2%**
- Explain **10%** variation in firm revenue

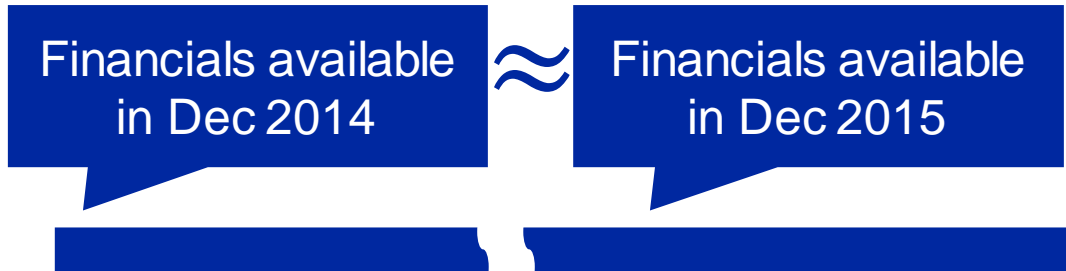
Sales > \$2 Mil

Muted effect



The role of location score less obvious

Behavior Analytics Further Enhance C&I Credit Scores









The main chef asked for a sharp increase in the salary. The owner had to let go the main chef in Jan 2016

Date	Rating
2016-1-21	2
2016-1-19	1
2015-12-5	4
2015-11-1	5

Defaulted in Apr 2016



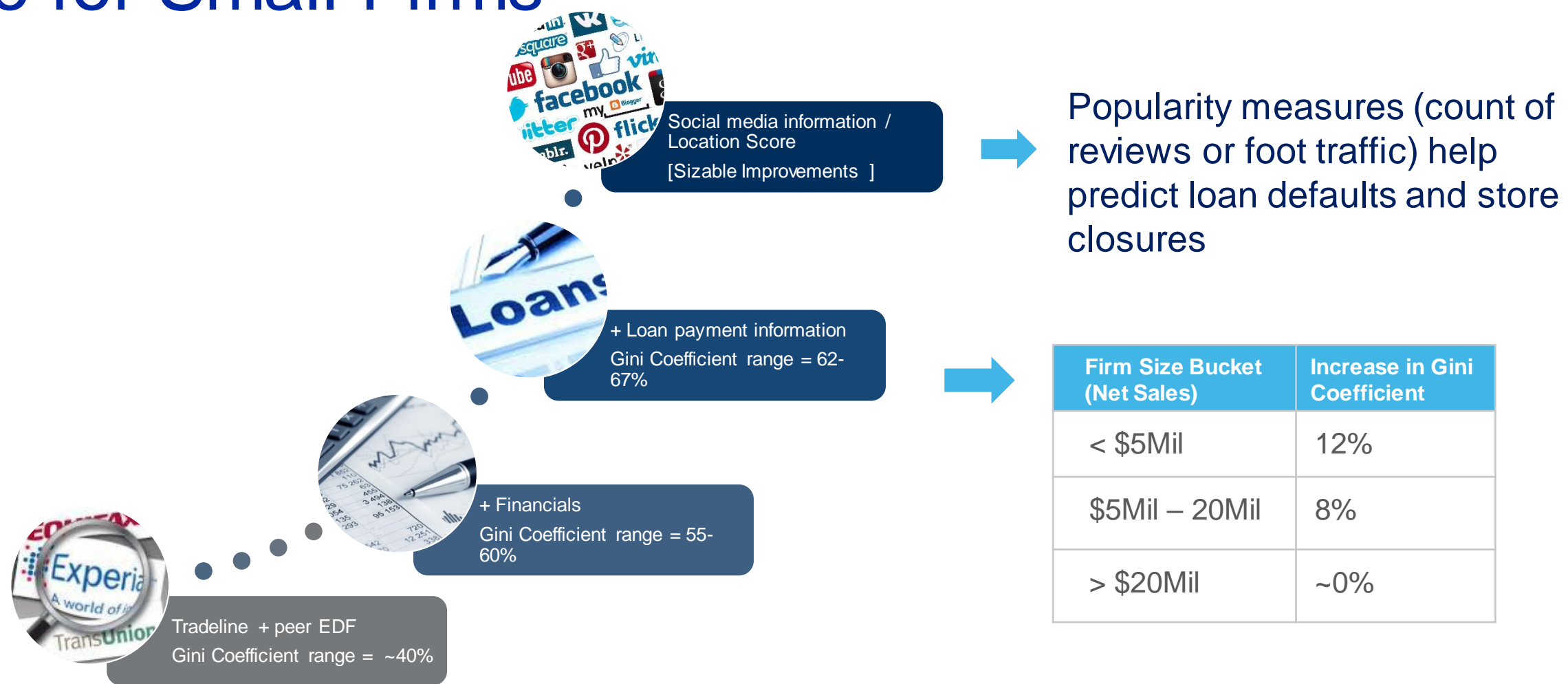
Combining Various Information Sources to Better Measure C&I Credit Risk

						
Data Type	Financial	Loan Payment Behavior	Trade Payment Behavior	Business Characteristics	Social Media	Location
Examples	Income statement, Balance sheet, General ledger	Current and historical loan payment status, credit lines utilization ...	Accounts payable status, trade lines utilization ...	Ownership structure, global cash flow, age of the firm ...	customer reviews/ratings, foot traffic, web traffic ...	crime rate, economic condition, neighborhood amenity, park ...
Possible Sources	Business, BVD, tax returns	Lending institutions, business	Credit Bureaus, Business	Business, Moody's Analytics CRD, BVD	Social media companies	Open data sources, Census, vendors
Level of Standardization	High	Medium	Medium	Medium	Low	Low
Frequency	Low	Medium	Medium	Medium	High	High

An Example: A Suite of Models that Combine Business, Financial, Trade Behavior, and/or Loan Behavior Inputs Into Credit Scores

Firm A	Firm B	Firm C
<p>Trade Line payment: Debt payment status – Current → Total balance owed – \$25,000 Highest balance in last 12m – \$45,000 Presence of tax liens and Civil judgments – Yes</p> <p>Peer Financial Ratio Score – 1%</p>	<p>Trade Line payment: ... → Financial Ratios Return on Assets – 15% → Debt coverage – 10x Sales growth – 20%</p>	<p>Trade Line payment: ... Financial Ratios Loan payment: Loan payment status – Past due 0-30 days Utilization – 80% Late payment in last 1 year – Yes</p>
<div><div>69</div><div>1.85% 1-YEAR</div><div>Ba3.edf</div></div>	<div><div>72</div><div>1.22% 1-YEAR</div><div>Ba2.edf</div></div>	<div><div>65</div><div>3.25% 1-YEAR</div><div>B1.edf</div></div>

Alternative Data Improve Default Prediction, More So for Small Firms



Utilize Suitable Analytical Models

Generalized Additive Model	Alternative Approaches (e.g. Boosting)
With functional form, assumptions such as variable correlation matter.	No functional form, more data mining
Guided by economic theory and business intuition.	Results may not be intuitive, more of a “black box”
Does not work as well on complex relationships.	Fit complex, non-linear relationships better, easier to account for interaction across variables.
Spend more time on variable selection use fewer variables in the final model.	Spend less time on variable selection, use more variables.
Good performance	Performance can exceed GAM

Motivation for looking into social media

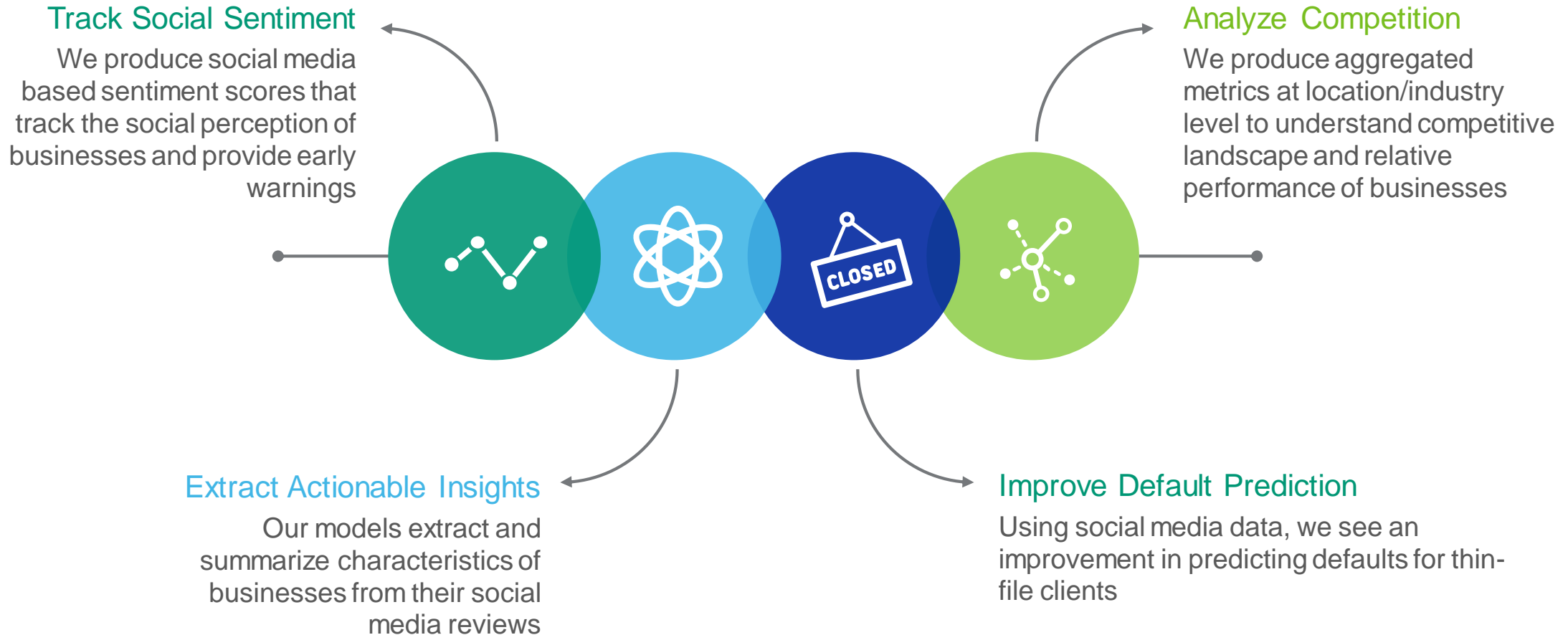
The screenshot shows the TripAdvisor page for Town Hall, a restaurant in San Francisco. The page includes a header with navigation links, a banner for "Visit REDDING.com", and a section for "Town Hall" with a 4.0 rating and 296 reviews. A "Reserve with OpenTable" button is visible. The "Overview" section shows a bar chart of review ratings (Excellent, Very good, Average, Poor, Terrible) and a map of the restaurant's location in the Financial District. A "TRAVELERS TALK ABOUT" section lists popular dishes like "fried chicken", "combread", and "chocolate pot de creme".

The screenshot shows the hotel page for The Westin St. Francis San Francisco on Union Square. The page includes a "Reserve" button, a "We Price Match" badge, and a search form with fields for destination, check-in date, check-out date, number of adults, and number of rooms. A "Search" button is at the bottom. The right side of the page shows a large image of a hotel room and a "Very Good 8.3" rating based on 3,063 reviews. A sidebar on the right lists various amenities and their ratings, such as Location (9.3), Cleanliness (8.4), Staff (8.4), Comfort (8.3), Facilities (8.8), Value for money (7.2), and Free WiFi (8.1).

The screenshot shows the Yelp page for Town Hall restaurant in San Francisco. The page includes a "Find tacos, cheap dinner, Max's" search bar, a "Near Financial District, San Francisco, CA" filter, and a "Sign Up" button. The restaurant's profile shows a 4.5 rating and 1857 reviews. A "Write a Review" button is prominent. Below the profile, there are several photos of food and a "See all 740" link. A "Taste of the south! Super spicy though by Ellie P." review is highlighted. The bottom right corner shows the restaurant's hours and a "Full menu" link.

- » Review, social media, and booking sites show useful information about a company from a perspective of a user.
- » From a lender's perspective who wants to learn/monitor public perception about a business, social media presentation is not concise/directly helpful.
- » Lenders would have to read the reviews and get a general sense of business's operations.

Use cases



Track Social Sentiment

To create sentiment scores for social media reviews

We use deep recurrent neural networks to produce *positive*, *negative*, *neutral* class probabilities for each review.

“excellent hotel . room and location are amazing. staff is exceptionally helpful.”

Positive	Neutral	Negative
99.97%	0.029%	0.001%

“nothing was taken care of by the management and the 100 % money back guarantee is FALSE marketing . Beware”

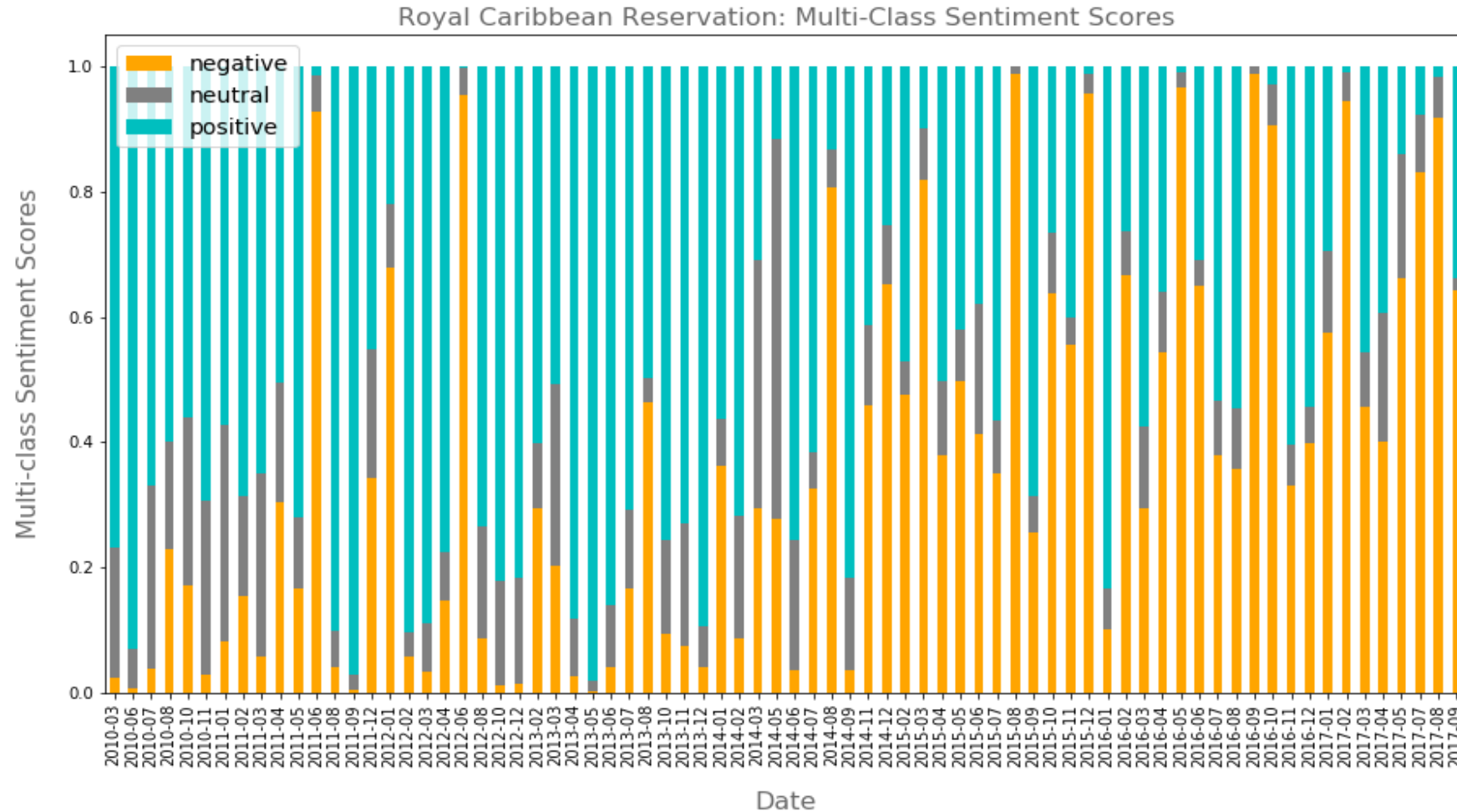
0.02%	0.33%	99.65%
-------	-------	--------

“had the sausage combo plate . food was alright. sausages & potatoes were somewhat good.”

14.46%	78.04%	7.50%
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Track Social Sentiment

Royal Caribbean: increase in negative sentiment since mid-2014



Extract Actionable Insights

Royal Caribbean Reservation

Top Positive Reviews

great customer services , with professionals and amazing people , more than 62 nation ship and work together .

best trip of my life !!!! went on the 3 day majesty of the sea cruise from feb 13th-16th and it was the most magical experience ever ! best service . most awesome people . royal caribbean is the pinnacle of cruising . will most def be back . thanks for some amazing memories ! -

Top Negative Review

this company is run by arrogant liars. they left my family stranded 6000 miles from home when their travel office failed to make our flight reservations. they emailed us confirmation of our tickets but no tickets had been purchased. after paying an additional \$ 10,000 at the airport in europe in order to get home, the president office at royal caribbean refused to refund what we had paid them for the tickets they never bought. they are crooks.

Extract Actionable Insights

We summarize hundreds of reviews into few actionable insights

Top Positive Insights

my ultimate favorite

amazing ships and destinations

the most magical experience ever

the best vacations

the food was amazing

Top Negative Insights

racial profiling

a putrid smell

the incompetence and rudeness of the customer service reps

complete waste of time and money

I simply had food poisoning from their dirty kitchen

Extract Actionable Insights

Early warnings on operational risks

- » We can extract topics/themes that are relevant from a large corpus of reviews.
- » We can customize our algorithms to look for specific business relevant keywords of importance.

Royal Caribbean Reservation

I've taken several (5) Royal Caribbean Cruises. Each one worse than the next and I'm done.

The Europe cruise --- the sewage backed up, the sink filled the cabin, and I could not use the shower. Complaining to the front desk they told me they would have the Captain throw me off the ship! (Since it was a family outing 20+ people i decided not to pursue) (They did fix it by the second day)
Caribbean Cruise -- No problems, except 90% of the food was terrible. Can you say deep fried? The best food was the lunch buffet as long you a made a hamburger.

Operational Risks

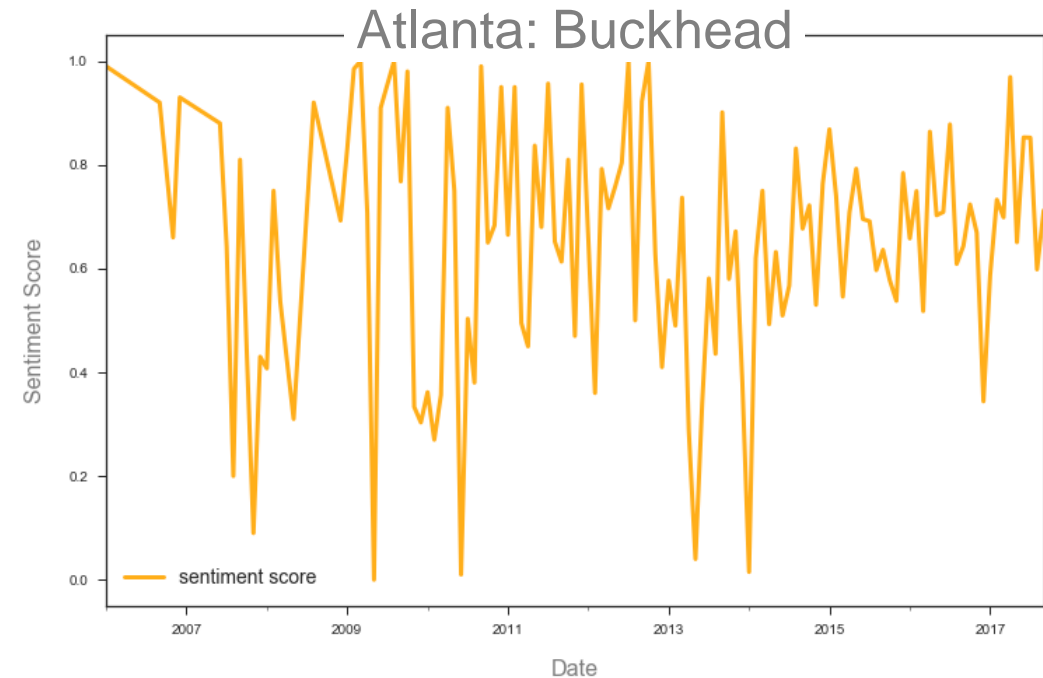
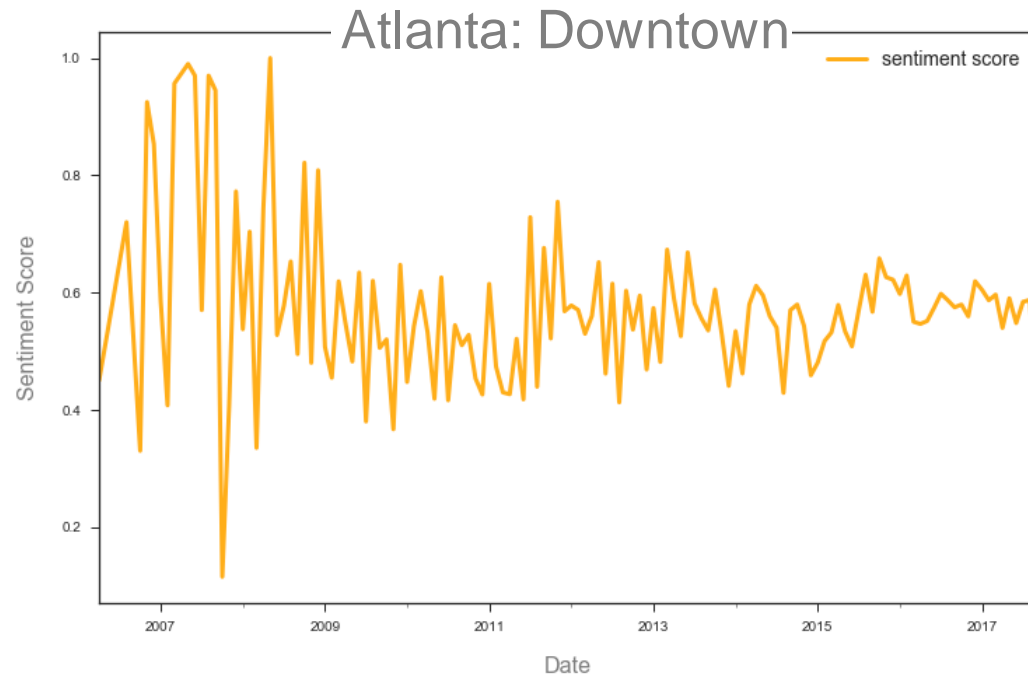
Sewage problems

Poor dining choices

Poor customer service

Analyze Competition

Comparing locations



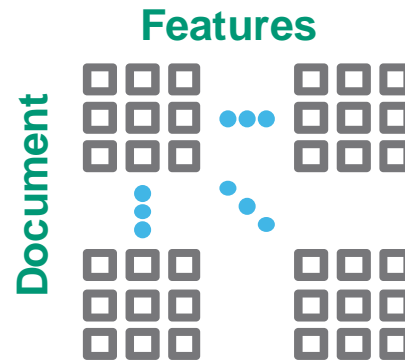
" Good service and very reasonable prices. Wine was amazing (because we brought our own). **I hope this restaurant can make it as it's a terrible location that has seen numerous other restaurants fail.** I believe their food and prices should create a good following."

Improve Default Prediction

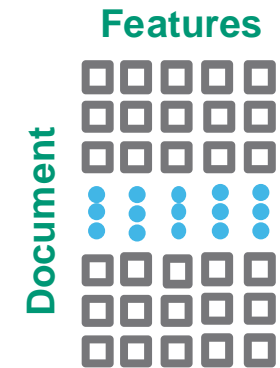
We extract credit relevant themes



Extract Terms



Create Document Term Matrix



Reduce Dimensionality

Improve Default Prediction

We use Latent Semantic Analysis to extract text features

- » In addition to Sentiment Scores, we used Latent Semantic Analysis (LSA) on the review text and extracted theme based features.
- » Theme based features and review based Sentiment Scores improved accuracy by 3% in predicting defaults.

Conclusion

Today, you've heard insights on our alternative data research in the credit process.



Drive innovation further with us!

Complete the post conference survey to engage with us on these solutions.

Thank You!

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May 16th in New York

Small Business Lending – Client Advisory Roundtable
June 12th & 13th in New York

Moody's Analytics Commercial & Ag Lending Conference (CALC)
September 24th – 26th in Omaha, Nebraska

Moody's Analytics Summit
October 22nd – 24th in Phoenix, Arizona

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