COVID-19 Public Firm Response Analysis

NLP process with Machine Learning Algorithm on Text Information

PRESENTED BY : Group 6

MARCH 12th, 2021

BACKGROUND

With the outbreak of COVID-19 coronavirus pandemic, the heightened economic uncertainty and risk have significant financial implications on companies in difference sectors. Many firms have thus taken actions including closing out office, laying off employees, giving public donations etc.

By collecting and analyzing the S&P 500 firms' public release materials , this project aims to get the enterprises' responses to COVID-19, which also reflect how the companies intend to deliver messages, maximize the return of shareholders and reflect their sense of corporate social responsibility.

DATA
&
METHODOLOGIES

DATA DECOMPOSITION

Earnings Call Scripts and Financial Reports constitute 80% of total data

EARNINGS CALL SCRIPT
Script for the quarterly/yearly conference call of the public firm

FINANCIAL REPORTS
Quarterly/yearly financial reports from SEC website

DEFINITIVE PROXY STATEMENT
Yearly DEF reports from SEC website
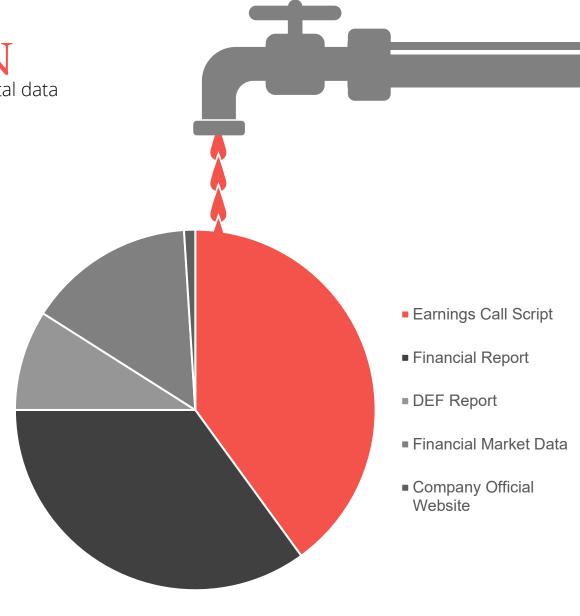
FINANCIAL STATEMENT AND MARKET DATA
Key indicators in financial statement and the stock Market

COMPANY OFFICIAL WEBSITE

- Earnings Call Script
- Financial Report
- DEF Report
- Financial Market Data
- Company Official Website

METHODOLOGY CHART

1 DATA COLLECTION

2 COVID-19 POSITIONING

3 SENTENCE CATEGORIZATION

4 FOLLOW-UP ANALYSIS

Web Scrapping

Direct Downloading

Manual Searching

Unsupervised Learning

- Rules for filtering, normalization and tokenization
- Word2Vec+Sentence Distance
- K-means cluster

- Training: 25% manual tagging

- Dictionary-Based Approach
- BERT

Supervised Learning

+

Industry Information

+

Financial Information
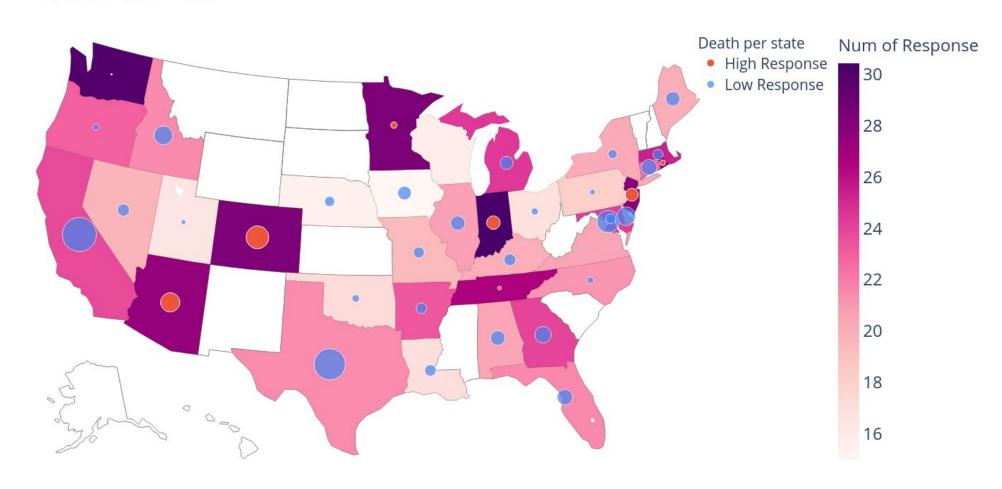
Response Overview

Company Categorization by Response Speed

Company Categorization by Response Type

Individual Case Study

OVERALL ANALYSIS

OVERALL ANALYSIS

Analyze the average response of each state based on the number of deaths due to COVID-19 in each state
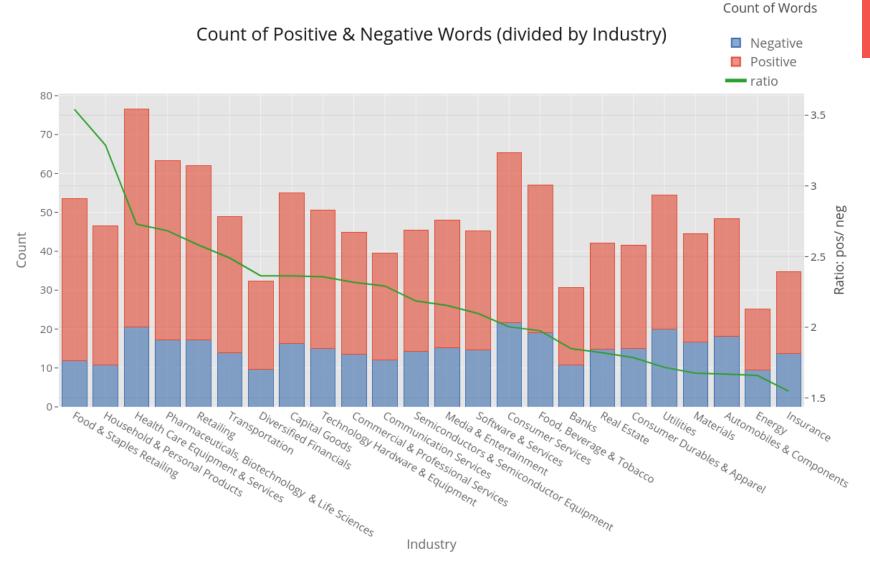
Num of Response per Corp

Death per state
- High Response
- Low Response

Num of Response
30
28
26
24
22
20
18
16

OVERALLANALYSIS
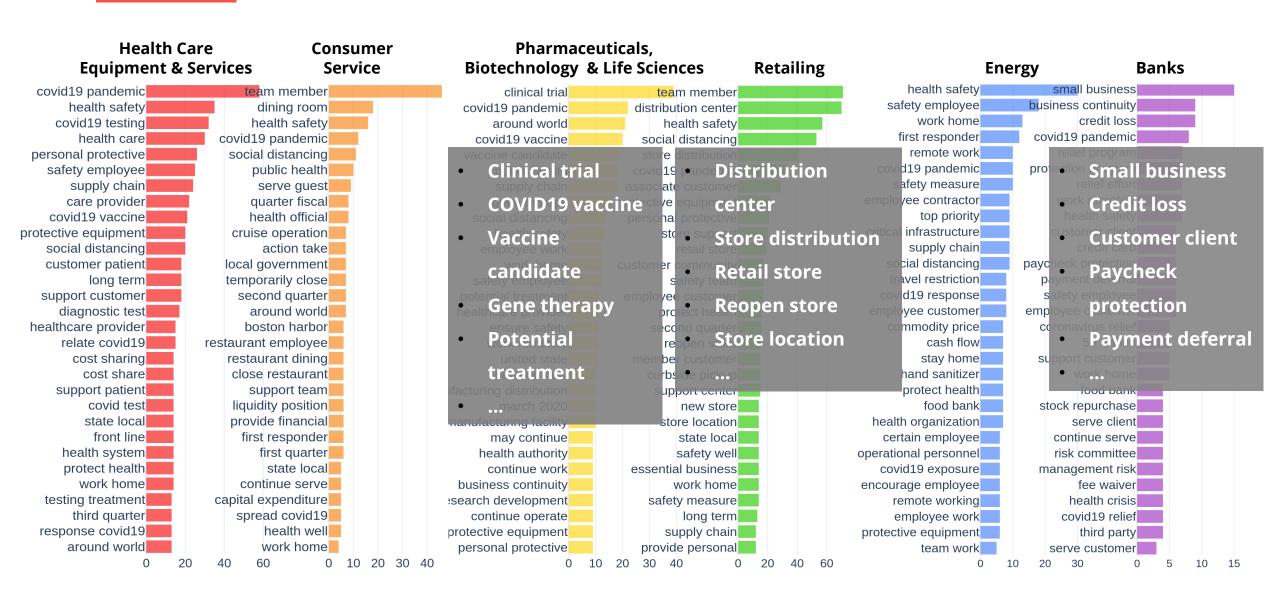
Analyze the response of each industry and whether the attitude is positive or negative

Count of Positive & Negative Words (divided by Industry)

Representative Industries

- Being directly and violently impacted by COVID-19:
  - Health Care Equipment & Services
  - Consumer Services

- Having response with apparent industry feature:
  - Pharmaceuticals, Biotechnology & Life Sciences
  - Retailing

- Receiving long-term impact of COVID-19:
  - Energy
  - Banks

OVERALL ANALYSIS

Draw bigrams bar charts based on different industries and analyze industrial characteristics

Health Care Equipment & Services

- covid19 pandemic
- health safety
- covid19 testing
- health care
- personal protective
- safety employee
- supply chain
- care provider
- covid19 vaccine
- protective equipment
- social distancing
- customer patient
- long term
- support customer
- diagnostic test
- healthcare provider
- relate covid19
- cost sharing
- cost share
- support patient
- covid test
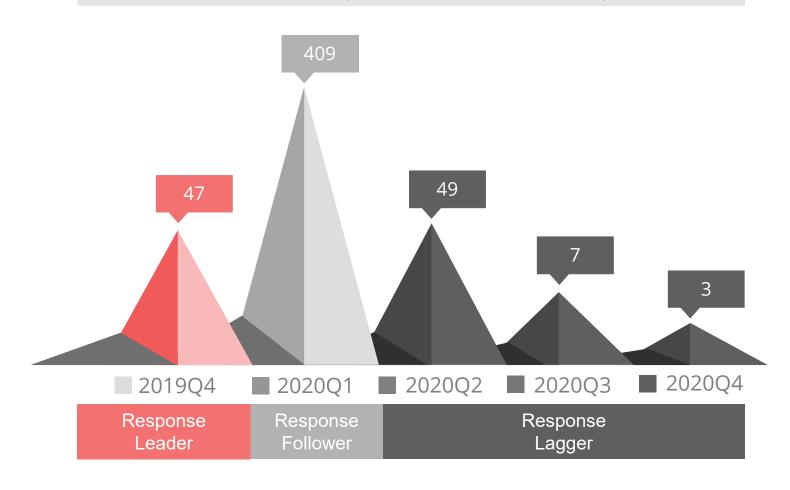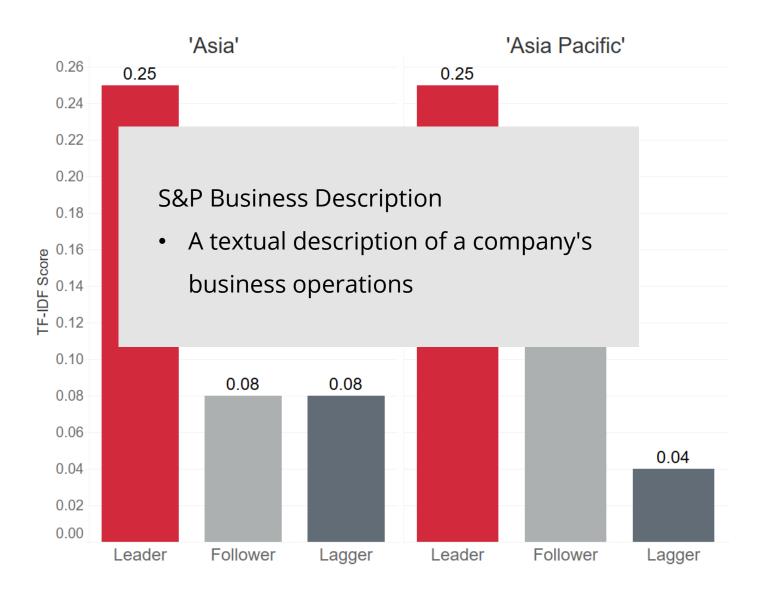- state local
- front line
- health system
- protect health
- work home
- testing treatment
- third quarter
- response covid19
- around world

Consumer Service

- team member
- dining room
- health safety
- covid19 pandemic
- social distancing
- public health
- serve guest
- quarter fiscal
- health official
- cruise operation
- action take
- local government
- temporarily close
- second quarter
- around world
- boston harbor
- restaurant employee
- restaurant dining
- close restaurant
- support team
- liquidity position
- provide financial
- first responder
- first quarter
- state local
- continue serve
- capital expenditure
- spread covid19
- health well
- work home

Pharmaceuticals, Biotechnology & Life Sciences

- clinical trial
- covid19 pandemic
- around world
- covid19 vaccine

- **Clinical trial**
- **COVID19 vaccine**
- **Vaccine candidate**
- **Gene therapy**
- **Potential treatment**
- **…**

- may continue
- health authority
- continue work
- business continuity
- research development
- continue operate
- protective equipment
- personal protective

Retailing

- team member
- distribution center
- health safety
- social distancing

- **Distribution center**
- **Store distribution**
- **Retail store**
- **Reopen store**
- **Store location**
- **…**

- new store
- store location
- state local
- safety well
- essential business
- work home
- safety measure
- long term
- supply chain
- provide personal

Energy

- health safety
- safety employee
- work home
- first responder
- remote work
- covid19 pandemic
- safety measure
- employee contractor
- top priority
- critical infrastructure
- supply chain
- social distancing
- travel restriction
- covid19 response
- employee customer
- commodity price
- cash flow
- stay home
- hand sanitizer
- protect health
- food bank
- health organization
- certain employee
- operational personnel
- covid19 exposure
- encourage employee
- remote working
- employee work
- protective equipment
- team work

Banks

- small business
- business continuity
- credit loss
- covid19 pandemic

- **Small business**
- **Credit loss**
- **Customer client**
- **Paycheck protection**
- **Payment deferral**
- **…**

- food bank
- stock repurchase
- serve client
- continue serve
- risk committee
- management risk
- fee waiver
- health crisis
- covid19 relief
- third party
- serve customer

RESPONSE ANALYSIS

- Response Speed
- Response Type

SPEED DIMENSION
Response Speed Type

When did the companies start to take response?

47

409

49

7

3

| 2019Q4 | 2020Q1 | 2020Q2 | 2020Q3 | 2020Q4 |

Response Leader

Response Follower

Response Lagger

SPEED DIMENSION

S&P Business Description – location comparison across classes

S&P Business Description
- A textual description of a company's business operations
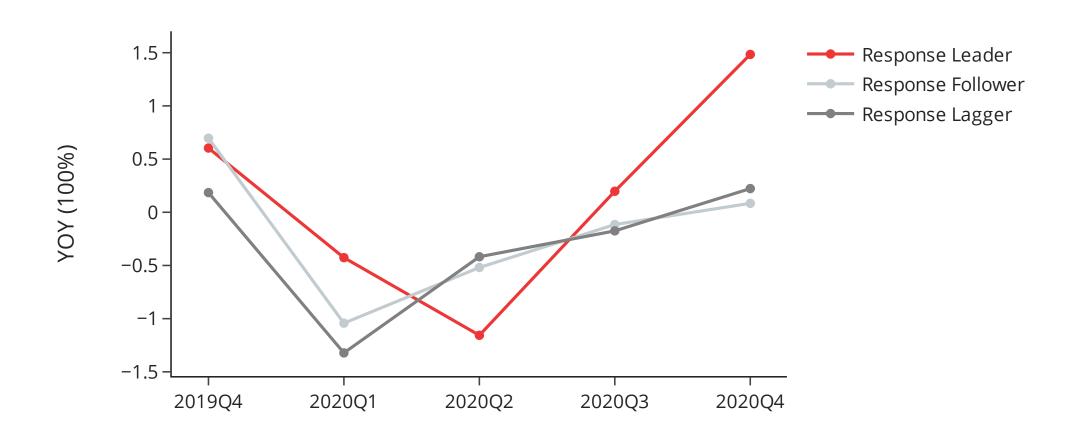
SPEED DIMENSION
Action Takers in Various Groups

Legend:
- Response Lagger
- Response Follower
- Response Leader

Groups (x-axis):
Consumer Services, Pharmaceuticals, Biotechnology & Life Sciences, Capital Goods, Semiconductors & Semiconductor Equipment, Materials, Technology Hardware & Equipment, Automobiles & Components, Household & Personal Products, Media & Entertainment, Consumer Durables & Apparel, Health Care Equipment & Services, Retailing, Food, Beverage & Tobacco, Diversified Financials, Energy, Utilities, Real Estate, Software & Services, Transportation, Communication Services, Insurance, Banks, Commercial & Professional Services, Food & Staples Retailing

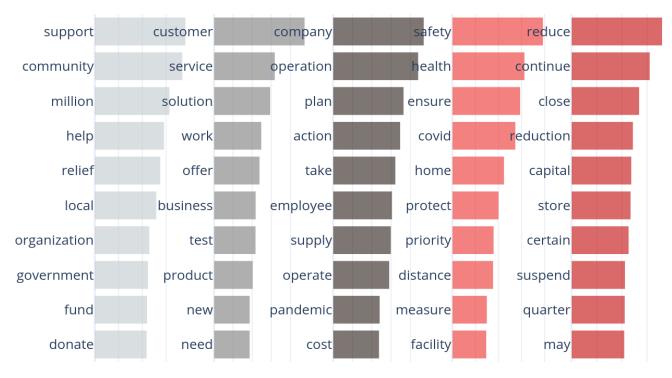# SPEED DIMENSION

Net Income YOY Comparison for Action Takers

ACTION DIMENSION DICTIONARY

Use dictionary-base method to tag sentences

① **Manually tag sentences**

- 💰 Donation
- 📈 Product Innovation
- ➕ Strategy Adjustment
- 🏛 Health Protection
- ✖ Negative Response

② **Normalize sentences**

③ **Tokenize words and give words tags**

④ **Use ML model to get a dictionary**

⑤ **Use the dictionary to predict tags of sentences**

Legend:
- Donation
- Product Innovation
- Strategy Adjustment
- Health Protection
- Negative Response

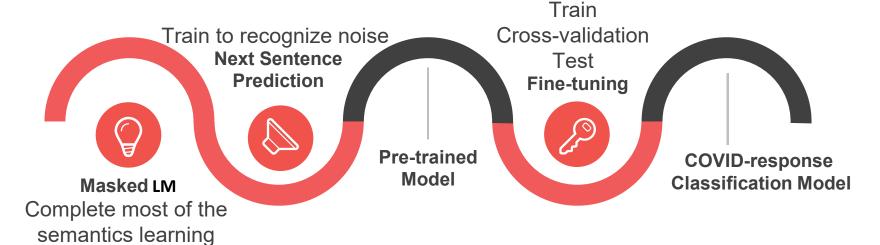| Donation	Product Innovation	Strategy Adjustment	Health Protection	Negative Response
support	customer	company	safety	reduce
community	service	operation	health	continue
million	solution	plan	ensure	close
help	work	action	covid	reduction
relief	offer	take	home	capital
local	business	employee	protect	store
organization	test	supply	priority	certain
government	product	operate	distance	suspend
fund	new	pandemic	measure	quarter
donate	need	cost	facility	may

Words Probability in 5 dictionaries

ACTION DIMENSION   BERT

Fine-tune pre-trained model to tag sentences

Model Building

Masked LM
Complete most of the semantics learning

Train to recognize noise
Next Sentence Prediction

Pre-trained Model

Train
Cross-validation
Test
Fine-tuning

COVID-response Classification Model

Data	Useful Information Proportion	Test Accuracy			
		Bert 1	Dictionary 1	Bert 2	Dictionary 2
Def 10-q Manual	63.55%	80.41%	79.59%	72.71%	65.28%
Earning call	19.63%	82.32%	70.68%	69.45%	56.17%
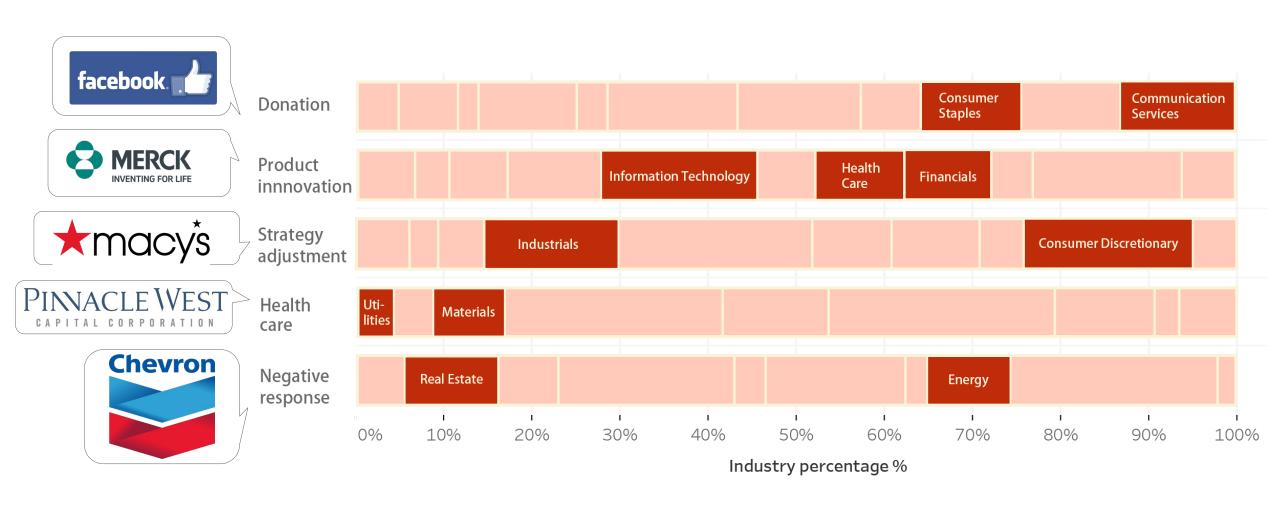
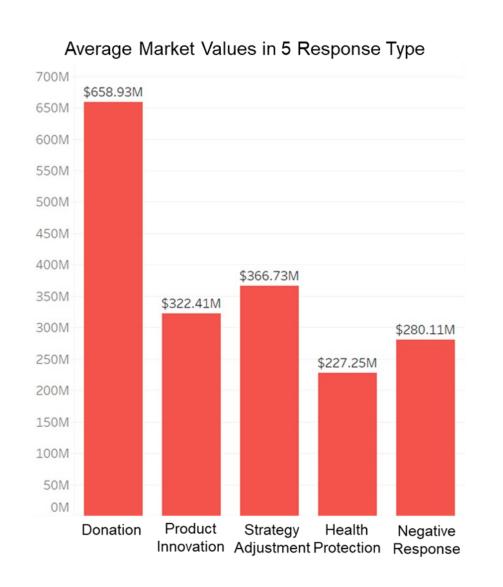· **Model 1: To delete useless information**   · **Model 2: To predict sentence classification**
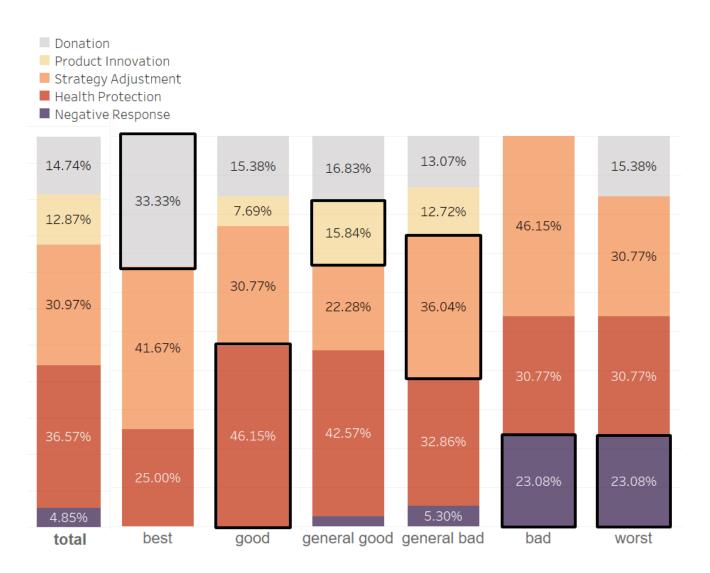
ACTION DIMENSION   COMPANY CLASSIFICATION

Set the maximum-column-tag as company's cluster

PCA
3 PC interpretation level:

85.3%

Donation   Product innovation   Strategy adjustment   Health care   Negative response

ACTION DIMENSION FINANCIAL ANALYSIS

Average Market Values in 5 Response Type

- Donation: $658.93M
- Product Innovation: $322.41M
- Strategy Adjustment: $366.73M
- Health Protection: $227.25M
- Negative Response: $280.11M

Legend:
- Donation
- Product Innovation
- Strategy Adjustment
- Health Protection
- Negative Response

	total	best	good	general good	general bad	bad	worst
Donation	14.74%	33.33%	15.38%	16.83%	13.07%		15.38%
Product Innovation	12.87%		7.69%	15.84%	12.72%		
Strategy Adjustment	30.97%	41.67%	30.77%	22.28%	36.04%	46.15%	30.77%
Health Protection	36.57%	25.00%	46.15%	42.57%	32.86%	30.77%	30.77%
Negative Response	4.85%			5.30%		23.08%	23.08%

CASE STUDY

NEGATIVE PERFORMANCE

Lbrands

an American fashion retailer

> Victoria's Secret to close about 250 stores in the U.S. and Canada, Bath & Body Works to close 50
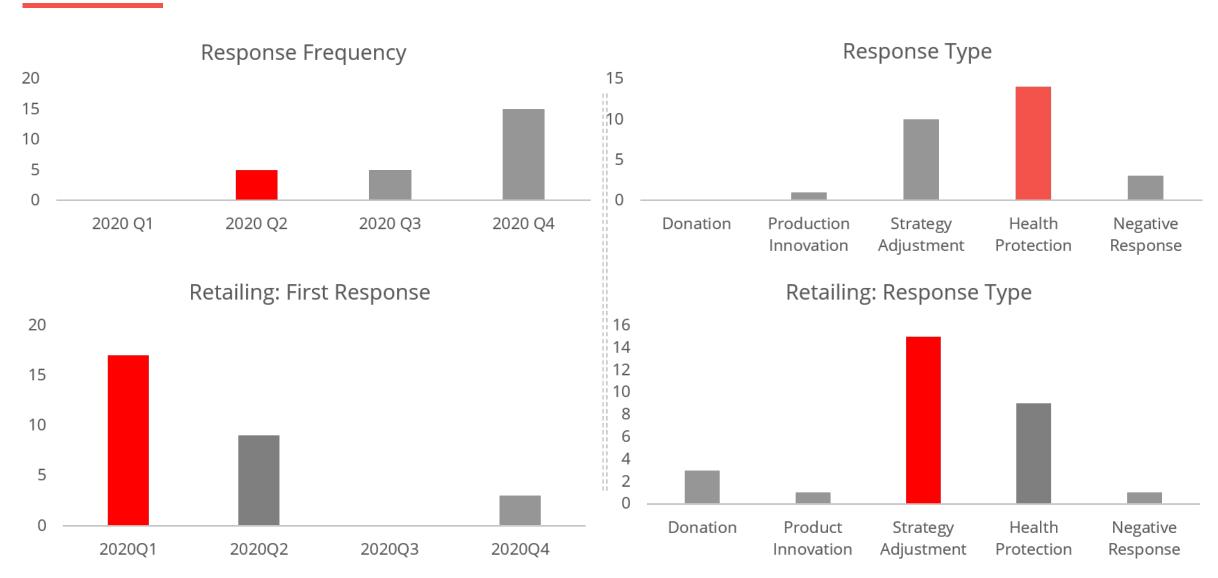>
> *-- USA TODAY, MAY 2020*
>
> Victoria's Secret is closing up to 50 more stores this year
>
> *-- CNN, FEB 2021*

How does this once-hot brand fall from grace during COVID-19?

L BRANDS

Respond speed and respond category

Response Frequency

Response Type

Retailing: First Response

Retailing: Response Type

L BRANDS

Response and suggestion

Action Lagger

-- follow the policy

Respond conservatively

-- strategy adjustment

Less focus on business continuity

-- switch focus to digital consumers experiences

POSITIVE PERFORMANCE

MERCK

	Date				
Action Type	2019-Q4	2020-Q1	2020-Q2	2020-Q3	2020-Q4
Establish an epidemic response team	●				
Donation	●	●			
Service		●			
Security Assurance		●			
Expand the scale		●	●		●
Cooperation		●	●	●	●
Research		●	●	●	●
Business strategy investment			●	●	●
Develop vaccine or drug			●	●	●

Develop vaccine or drug

"Our COVID-19 effort now shift, advance our two therapeutic candidate, Molnupiravir, often known as MK-4482 and MK-7110."

- Earnings call 2020 Q4

Cooperation

"As we announce yesterday, we have partner with scientist at the institute for system biology, Swedish hospital, and the providence health system all in Seattle, data derive from these analysis will be made available to researcher worldwide and will position us to decipher correlate of immunity to this coronavirus ."

- Earnings call 2020 Q1

MERCK

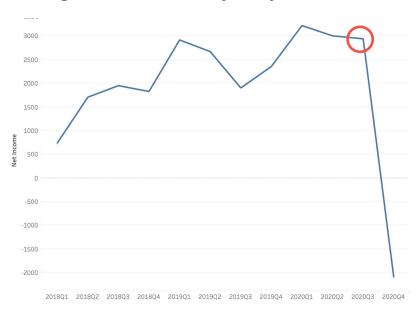**Merck signs $356 million deal with U.S. government for experimental COVID-19 therapy**

By Jaimy Lee

Change of Net Income by the year

Change of Investment in Research and Development by the year

CONCLUSION
&
FUTURE WORK

CONCLUSIONS

FUTURE WORK

Response Speed
Customer-oriented companies and medical companies are on the first place to respond

Data Timeliness
Incorporate more timely data sources like Twitter, Facebook

Data Cleaning
Try GloVe model or Topic Modeling, adjust rules to position COVID information more precisely

Response Volume
Industries with higher response volume tend to be severely impacted by COVID-19

Model Accuracy
Try to use k-fold cross validation to do the training and then use lightgbm to perform model fusion

Response Type
Most of the companies raise positive actions and the action types are in accordance with their industries and financial performance

Business Knowledge
Try quantifying firms' culture, location, scale to help understand the categorization results

THANK YOU