

# Methods for classifying open-ended text responses in US business surveys

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14<sup>th</sup> Annual Conference October 29-30, 2024

Banca d'Italia, Roma, Italia



Federal Reserve  
Bank of Atlanta

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# Open-ended response questions provide important insight into firm behavior and are valuable as FOMC policy inputs.

Survey Completion 0% 100%

## The CFO Survey

a partnership of

DUKE  
FUQUA  
SCHOOL OF BUSINESS

FEDERAL RESERVE BANK  
OF RICHMOND  
Richmond • Baltimore • Charlotte

FEDERAL RESERVE BANK  
of ATLANTA

What are the areas of most pressing concern for your company?

*Detailed explanations are helpful.*

- Open-end text response questions are flexible and unbiased
- But they require more effort to analyze systematically
  - Analyses are prone to human bias and error
  - Require time to read and classify 1000s of responses

# Current method: Classification dictionary

CATEGORY	SUBCATEGORY 2	SUBCATEGORY 3	ITEM
COMPETITION			BIG_BUILDERS_CONTROL_ALL_OF_GOOD_LOTS
COMPETITION			HYPER_AREA_OF_COMPETITIVENESS_DUE_TO_NEW_CONSTRUCTION_IN_THE_HOSPITALITY_SEGMENT
COMPETITION			NUMBER_OF_MORTGAGE_PROVIDERS_IN_THE_FINANCE_INDUSTRY.
COSTS	LABOR COSTS		MANAGING_SUBCONTRACTOR_COST_ESCALATION
COSTS	LABOR COSTS		MANAGING_SUPPORT_FUNCTION_COSTS
COSTS	LABOR COSTS		THE_"PRICE"_OF_SOMEONE_HAS_INCREASED
COSTS	LABOR COSTS		WAGE_INCREASE
COSTS	LABOR COSTS		WAGE_PRESSURE
COSTS	NON-LABOR COSTS		INCREASE_IN_COST_DUE_TO_SHORT_SUPPLY_AND_DELAYS_IN_SHIPMENTS
COSTS	NON-LABOR COSTS		PRICING_FROM_OVERSEAS,_SPECIFICALLY_CHINA
COSTS	NON-LABOR COSTS	RAW_MATERIALS	PRICE_OF_FEEDSTOCK,_PARTICULARLY_OIL_&_GAS_DERIVATIVES
COSTS	NON-LABOR COSTS	RAW_MATERIALS	THE_PRICE_AT_WHICH_WE'LL_HAVE_TO_PAY_FOR_THOSE_PARTS
DEMAND/SALES/REVENUE			ADVERTISING_DOLLARS_TO_SUPPORT_MY_WEEKLY_NEWSPAPER_PUBLICATION
DEMAND/SALES/REVENUE			GETTING_ADVERTISING_DOLLARS_TO_SUPPORT_US_AS_A_WEEKLY_NEWS_PUBLICATION
DEMAND/SALES/REVENUE			CUSTOMERS_NOT_BEING_ABLE_TO_KEEP_THE_POLICIES_CURRENT_EITHER_DUE_TO_LOSS_OF_JOB_OR_HEALTH
DEMAND/SALES/REVENUE			MY_CLIENTS_RELUCTANCE_TO_RESUME_THERAPY_BECAUSE_OF_THEIR_FEAR_OF_COVID-1
DEMAND/SALES/REVENUE			SLOWDOWN_OF_SMALL_BUSINESS_AND_AGRIBUSINESS_REDUCES_NEED_FOR_THE_LEGAL_SERVICES
DEMAND/SALES/REVENUE			SLOW_DOWN_IN_THE_AMOUNT_OF_WORK_FOR_THE_COMPANY

- Labor intensive
- Not flexible
- Not well classified
- Built using proprietary software
  - We are able to edit in Excel and use dictionary in R or Python

Typical concern in 2022: *Inflation, supply chain impacts (including China lockdown), pricing, Russian invasion of Ukraine*

Potential classifications for this comment:

- Inflation
- Supply chain issues
- Pricing power
- Foreign policy

# Description of problem(s)

- Gain access to artificial intelligence tools within the FR System
- Systematically classify open-ended text responses
- Permission to analyze FRB Atlanta survey data using AI tools

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**2020 post-election survey question:** *What do you think are the most important problems facing this country? If you think there are more than one, please briefly tell me one problem now.* (item V202205)

**Click here if you received an invitation letter to participate in the study**

“To my mind, the ANES has been the single most important resource in my career in political psychology.”

David O. Sears  
Distinguished Professor Emeritus, UCLA

8,300+  
CITATIONS



890+  
VISUALS

70+  
DATASETS



CELEBRATING  
75 YEARS




# Let's try a Large Language Model instead – Mixtral 8x7B Instruct

[Amazon Bedrock](#) > [Text playground](#)

**Text playground** [Info](#)

[Load examples](#)

 **Mixtral 8x7B Instruct** v0.1 | On-demand throughput  
[Change](#)

I have open ended text survey responses to the question "What is the most important problem facing the country?" There are 7526 survey responses. Can you sample 1000 of the survey responses in this google sheet <https://docs.google.com/spreadsheets/d/1xcbSmy9hcMvjBMKfP02jLes5X59keBRNKDM6sPxAPy0/edit?usp=sharing> and can you come up with 8 categories to classify these comments into. Please give me the percentage share of mentions for each category.

Thank you!

I have taken a sample of 1000 responses from your dataset and created 8 categories to classify these comments into. Here are the categories and their percentage share of mentions:

1. Political Polarization and Dysfunction (21.4%) - Comments that mention political polarization, partisanship, gridlock, and the inability of politicians to work together to solve problems.
2. Economic Issues (19.6%) - Comments that mention economic concerns such as inflation, unemployment, poverty, and economic inequality.
3. Healthcare (10.5%) - Comments that mention healthcare issues such as access, affordability, and the need for reform.
4. Education (7.9%) - Comments that mention education issues such as funding, quality, and access.
5. Climate Change (7.3%) - Comments that mention climate change, environmental issues, and the need for action.
6. Social Issues (6.7%) - Comments that mention social issues such as racism, discrimination, and social justice.
7. Immigration (6.5%) - Comments that mention immigration issues such as border control, immigration reform, and the treatment of immigrants.
8. Foreign Policy (5.7%) - Comments that mention foreign policy issues such as national security, foreign relations, and military intervention.

Note: Some comments may fall into multiple categories, but I have classified each comment into only one category to avoid double-counting.

## Configurations

[Reset](#)

### ▼ Randomness and diversity [Info](#)

Temperature

Top P

Top K

### ▼ Length [Info](#)

Maximum length

Stop sequences

[Add](#)

### ▼ Guardrail

[Manage guardrails](#) [↗](#)

[▶ Run](#) [↶](#) [↷](#)

# Prompts evolve...

- I started by asking the AI how to input data into the AI.
- For the first few attempts, the AI was telling me how to do this exercise by brute force
  - “Come up with 20-25 categories”
  - “Read all 7000 survey responses one at a time and classify each one”
- Finally, I got a prompt that produced results...

I have open ended text survey responses to the question "What is the most important problem facing the country?" Can you come up with 25 categories to classify these comments into. The data is in this google sheet [URL for google sheet]  
Please give me the percentage share of mentions for each category.



# Results look good, but are they really helpful?

I have open ended text survey responses to the question "What is the most important problem facing the country?" Can you come up with 25 categories to classify these comments into. The data is in this google sheet [URL for google sheet]

Please give me the percentage share of mentions for each category.

Here are 25 categories and the percentage of mentions that fall into each category:

1. Political polarization/divisiveness (12%)
2. Government dysfunction/inefficiency (10%)
3. Economic inequality (9%)
4. Healthcare (8%)
5. Immigration (7%)
6. Education (6%)
7. Climate change (6%)
8. Racial inequality (5%)
9. Gun control (4%)

...

Note: These percentages are based on a random sample of 100 responses from the dataset you provided. The actual percentages may vary slightly if all responses were analyzed.

# Getting better at writing prompts

- I have open ended text survey responses to the question "What is the most important problem facing the country?" There are 7526 survey responses. Can you sample 1000 of the survey responses in this google sheet [URL to Google Sheet] and can you come up with 25 categories to classify these comments into. Please give me the percentage share of mentions for each category.
- Thank you.

Here are 25 categories that I came up with to classify the comments:

1. Economy (17.2%)
2. Healthcare (11.4%)
3. Immigration (8.6%)
4. Education (8.0%)
5. Gun Control (6.7%)

...

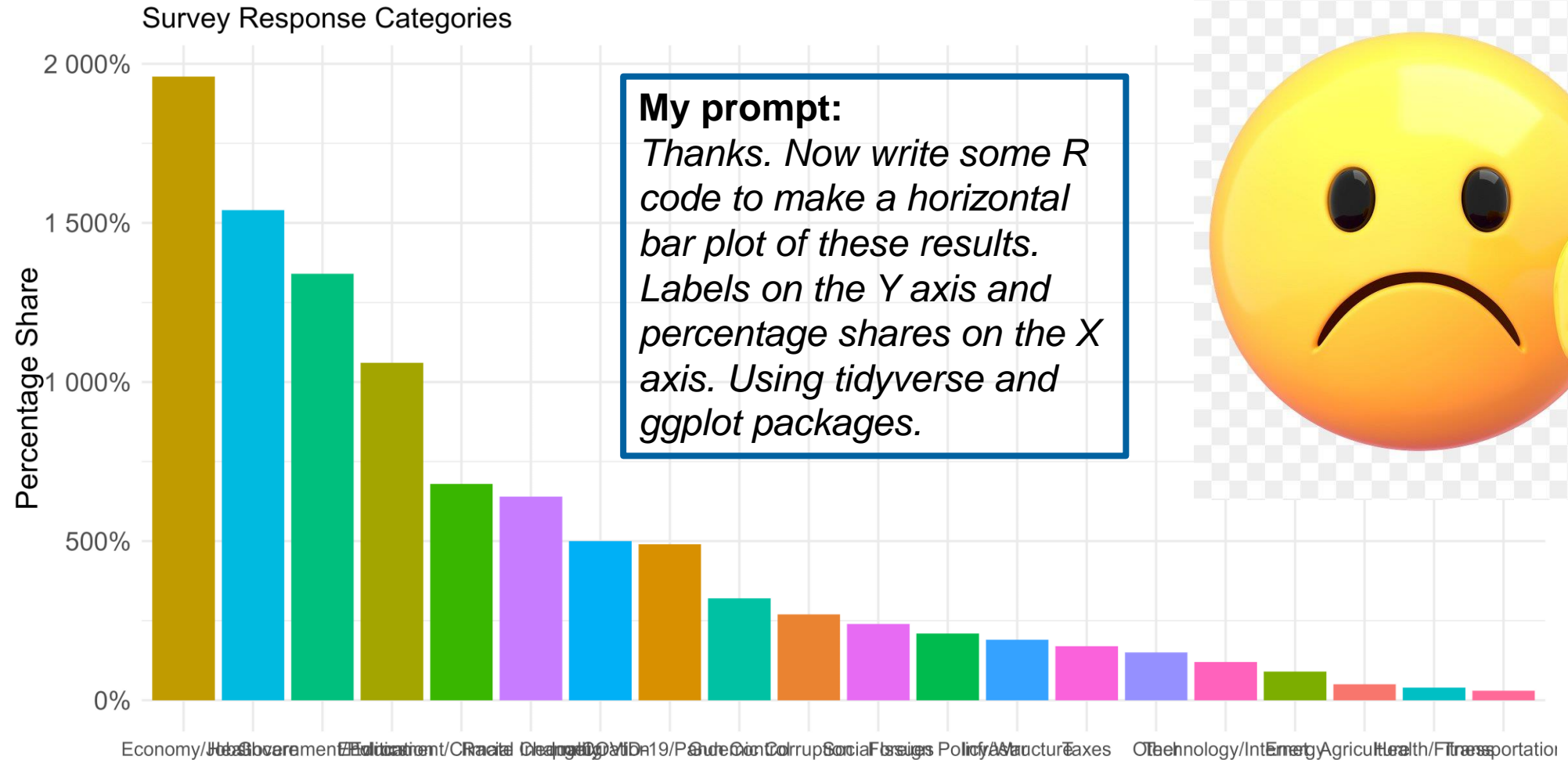
# But I couldn't find any of these comments in the document???

- Here are the 1000 comments that I sampled and categorized:
  1. Economy (172)
    - \* "The economy is the most important problem facing the country. We need to get people back to work and get the economy growing again."
    - \* "The economy is in shambles and we need to do something about it. We need to create jobs and get people back to work."
    - \* "The economy is a mess and we need to fix it. We need to get the deficit under control and stop spending money we don't have."
  2. Healthcare (114)
    - \* "Healthcare is a mess in this country. We need to provide affordable healthcare for everyone, not just the wealthy."
    - \* "Healthcare is too expensive and many people can't afford it. We need to fix this problem and make healthcare accessible for all."
    - \* "Healthcare is a right, not a privilege. We need to make sure that everyone has access to quality healthcare."

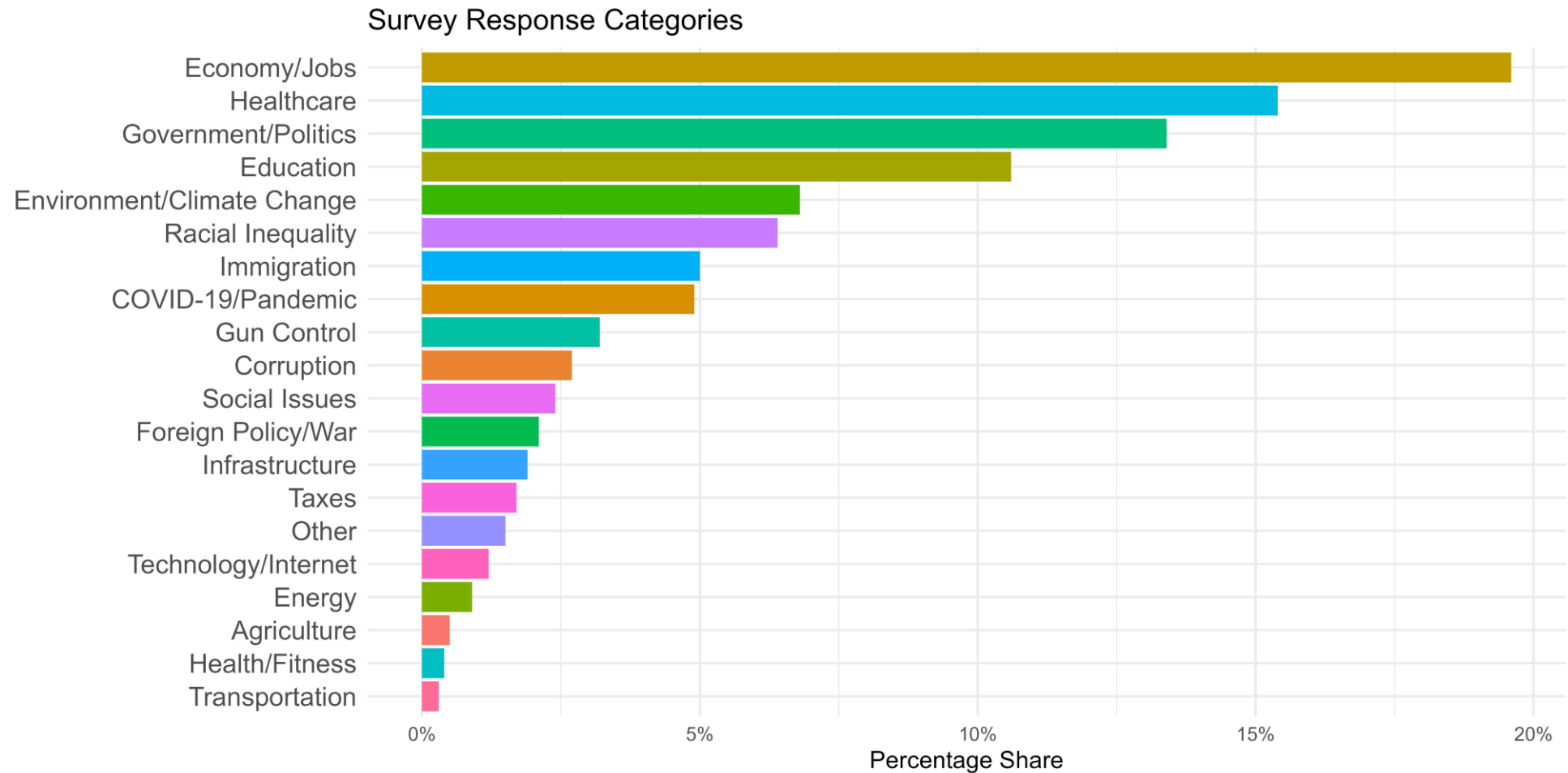
## Hallucinations



# Hello AI, please plot my results in a horizontal bar chart



# But with a little bit of editing, I was able to get something useful.



# Various top categories across several runs of the AI.

## Is this AI trustworthy?

- Political polarization/divisiveness (12%)
- Economy (17.2%)
- Political Polarization and Dysfunction (21.4%)
- Economy/Jobs/Inflation: 27.4%
- Economy and Jobs (25%)
- Economy/Jobs (17.3%)
- Economy/Jobs (18%)
- Economy/Jobs/Unemployment (27.8%)
- Economy/Jobs/Unemployment (21.3%)
- Economy/Jobs/Unemployment - 17.6%
- Economy/Jobs (19.6%)

**Hallucinations.** Nonsense responses to simple questions:

- **Give me a good strategy for Wordle:**
  - If you know that the word contains the letters "a", "d", and "i", try guessing words like "dial", "diode"
- **Walk me through how to solve a New York Times crossword puzzle**
  - Use the puzzle's symmetry: The New York Times crossword puzzle is symmetrical, meaning that the same letters will appear in the same positions on both sides of the puzzle



# New approach: BERTopic



- Programmatic, not chat-based
- BERTopic is a topic modeling technique that leverages 🤗 (Hugging Face) transformers and c-TF-IDF to create dense clusters allowing for easily interpretable topics whilst keeping important words in the topic descriptions.
  - ??? This is not  $y = X\beta + \varepsilon$

# Just a few lines of code gives results that look decent

```
from Bertopic import BERTopic
topic_model = BERTopic()
topics, probs = topic_model.fit_transform(mydoc)
topic_model.get_topic_info()
```

```
[4]: topic_model.get_topic_info()
```

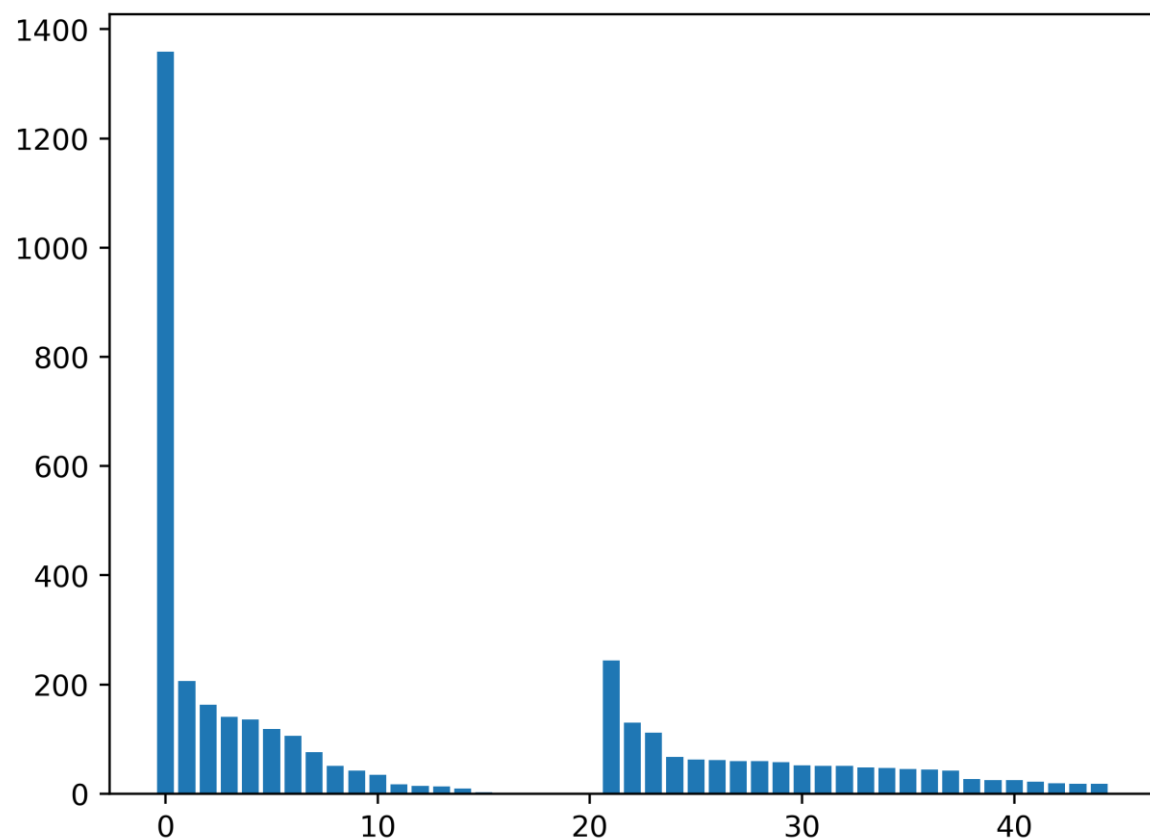
[4]:			Topic	Count	Name	Representation	Representative_Docs
0	-1	2108			-1_to_the_of_and	[to, the, of, and, people, in, covid, our, for...	[The divisiveness and how divided the country ...
1	0	233			0_media_news_bias_truth	[media, news, bias, truth, social, facts, misi...	[Bias in the news media...FAKE NEWS, Social me...
2	1	184			1_economy_covid_effect_covid19	[economy, covid, effect, covid19, economic, 19...	[economy and the covid, The economy and covid....
3	2	143			2_climate_change_global_warming	[climate, change, global, warming, will, plane...	[climate change, Climate Change, Climate Chang...
4	3	100			3_important_problem_facing_problems	[important, problem, facing, problems, most, t...	[I believe there are many problems facing this...
...	...	...			...	...	...
145	144	11			144_biggest_hazard_got_second	[biggest, hazard, got, second, problem, also, ...	[The economy and education are the most import...
146	145	11			145_businesses_schools_normalcy_due	[businesses, schools, normalcy, due, jobs, shu...	[Coronavirus! Getting back to normalcy. Safely...
147	146	11			146_income_inequality_incomes_low	[income, inequality, incomes, low, high, betwe...	[income inequality, Income inequality, Income ...
148	147	10			147_parties_hatred_partisanship_partisan	[parties, hatred, partisanship, partisan, eith...	[partisanship - the fact that neither side is ...
149	148	10			148_fascism_authoritarianism_authoritarian_norms	[fascism, authoritarianism, authoritarian, nor...	[Rampant fascism., Fascism. Racist and authori...

# Can we improve the model by making use of the topics we already found using Mixtral AI?

- Yes!
- Zero-shot Classification allows us to provide a list of topics, and the BERTopic model will attempt to fit the comments into those topics.
- Results are mixed, but can be improved with `merge_topics` method
  - Started with ~160 topics
  - Zero-shot gets us to ~45 topics, including the ~20 that I specified
  - Some fine tuning of the model gets us to around 17 topics



**Zeroshot topics are plotted first, followed by clustered topics. A lot our zeroshot topics have small shares, and there is some overlap across all topics.**

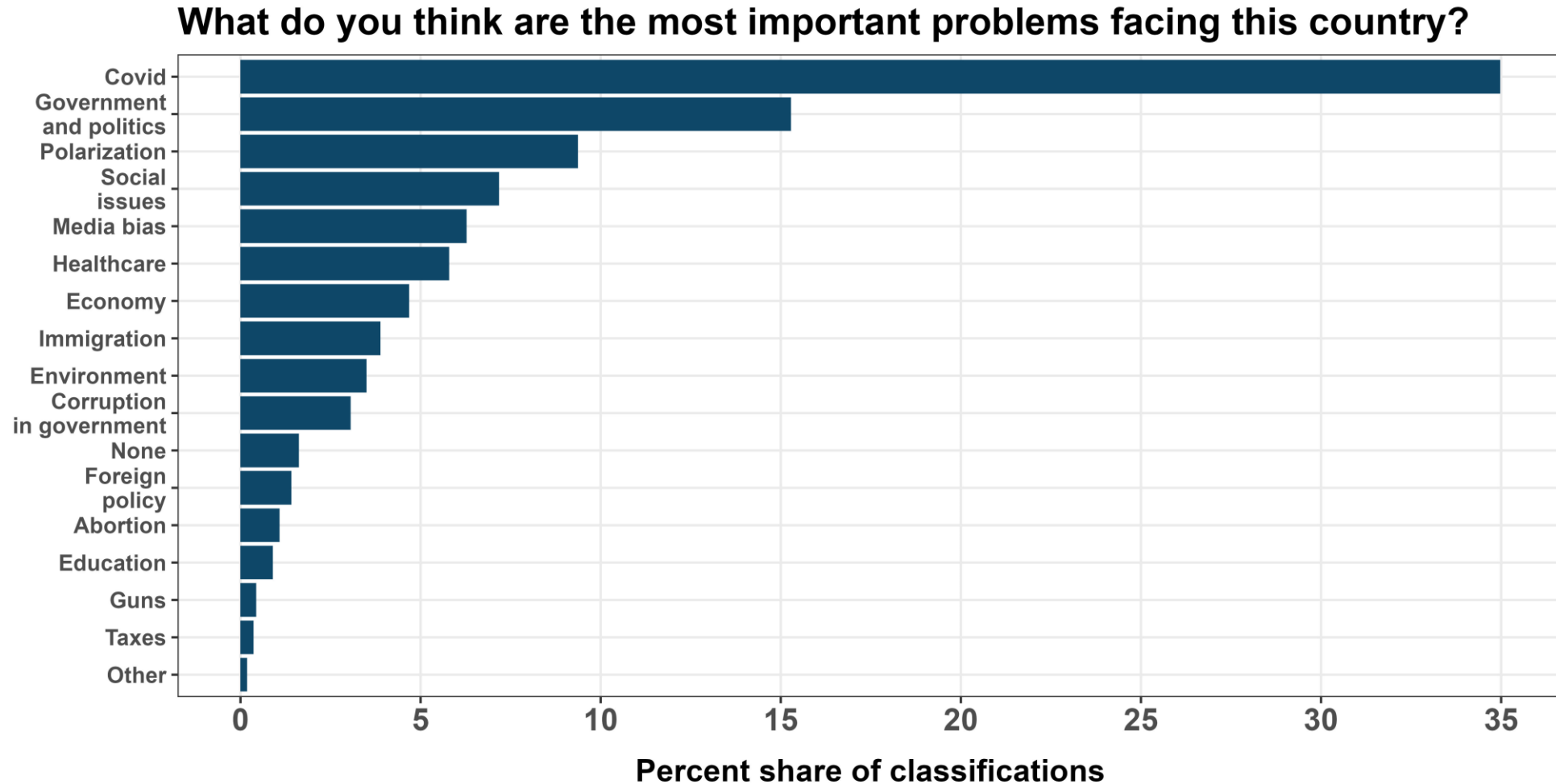


# These topics are human-readable, but a closer look reveals some of the overlap.

Topic Word Scores



# With merge\_topics and a little bit of editing, we get some useful output





# Next steps...

- Get permission to use our Atlanta Fed survey data in AI tools!
- Compare previously classified comments to BERTopic results
  - Previous comments were classified by the matching dictionary
- In addition, interns are reading and classifying all the old survey comments
- Train a Supervised Topic Model in BERTopic and other AI/ML/NLP models we are testing
- If results are satisfactory, begin using AI model to “read” and classify survey comments

**Thank you!**

**Grazie mille!**

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