Token Sentiment Analysis of COVID-19 Topic Tweets

Alice Chen   **Keenly Chuang**   **Emily Jiang**   **Filip Ryzner**
ayjchen@mit.edu kschuang@mit.edu   emji@mit.edu   ryznerf@mit.edu

1 Project Overview

As social media platforms assume an increasingly prevalent role in sociopolitical discourse, their unstructured data, text posts, and reactions offer insight into how current events are perceived within different groups of users. We'd like to explore COVID-19 related Twitter content for analyzing the impact of tweet language to sway sentiment. In the US, pandemic policies and public health guidelines have become politicized along party lines, resulting in certain concepts being perceived highly differently across sociopolitical groups (Stroebe et al., 2021).

To explore how this is reflected in language, we aim to develop a sentiment analysis model on COVID-19 tweet text and use it to identify the words or phrases with the most negative, positive, or polarizing (both very positive and very negative) sentiment scores. We anticipate that the most polarizing phrases, such as "mask mandate lifted," would be terms that different people have highly contrasting preconceptions about. The task of identifying extreme-sentiment terms is significant because important messages about public health are unlikely to reach a broad audience if they are delivered using unintentionally polarizing language.

Existing research in the COVID-19 sentiment analysis space establishes the precedent of using Twitter as a data source, but has primarily focused on different research topics. For example, the literature review of (Jalil et al., 2022) discusses research on optimizing the accuracy of a COVID-specific sentiment classifier; (Chandrasekaran et al., 2022) evaluates public sentiment over time toward a particular topic (vaccination); (Jang et al., 2021) identifies major pandemic-era public concerns and analyzes related sentiment. The last paper is of particular interest because their research methods involve topic modeling and aspect-based sentiment analysis, which we also propose in Section 2.2.

However, there is a general lack of research on identifying *controversial* terms or topics. We hope our research will expand upon these existing sentiment analysis models with emphasis on identifying polarizing topic phrases and their influence on sentiment trends. Recognizing sentiment as highly dependent on individual influences, we believe our approach adds nuance to the current state of pandemic-related NLP research.

2 Preliminary Ideas

2.1 Approach 1: Word Embeddings

A starting approach would be to scaffold a vanilla sentiment analysis model with Word2Vec embeddings trained with logistic regression over the COVID-19 tweet datasets, which would reveal the terms with most positive and negative sentiment. However, logistic regression does not provide sufficient information to identify "controversial" terms, which might be marked with a neutral sentiment score as a result of being associated with both positive and negative sentiment tweets. To identify polarizing terms, we can examine each of our tokens and calculate the maximum difference in sentiment scores between tweets that contain that token. We could add complexity to this model by experimenting with learning word embeddings using different word representation models such as GloVe, or transformer models such as BERT.

2.2 Approach 2: Aspect-Based Sentiment Analysis (ABSA)

A more complex approach would involve Aspect-Based Sentiment Analysis (ABSA) (Zhang et al., 2022), (Sun et al., 2019). In contrast to standard sentiment analysis, ABSA aims to identify aspect terms (Aspect Category Extraction) or categories (Aspect Category Detection) in the corpus and

can also extract an opinion term and sentiment for each, or Target-oriented opinion word extraction (TOWE). For example, we would determine the sentiment towards topics like mask mandates, vaccinations, and quarantines. This approach corresponds to one of potential approaches to conduct the Aspect-Opinion Pair Extraction (AOPE), wherein we identify pairs of words and topics, showing how each word relates to the sentiment of a particular topic.

Given our dataset, we would have to approach this problem in an unsupervised manner. The unsupervised case requires that we create the set of topics ourselves, which would require further topic modeling (e.g. Latent Dirichlet Allocation (Blei et al., 2003)). This approach would allow us to examine the most topical or extreme topics concerning COVID-19 on Twitter, and could also extend to analysis of how different groups perceive each topic in future work.

3 Evaluation Metrics

We plan to evaluate our standard sentiment analysis models with negative log likelihood (NLL) loss as our evaluation metric for sentiment classification. If we pursue ABSA, we will use exact-match evaluation with standard classification metrics (i.e. NLL, Precision, Recall, F1 score). This implies that an ABSA prediction is evaluated as correct if and only if all human-annotated sentiment scores align with the model-predicted sentiment scores for learned aspects.

4 Datasets

Many COVID-19 tweets have already been compiled into open-source databases for research. We plan to utilize one of the following COVID-19 topic-related tweet datasets with labeled sentiment scores:

1. COVID-19 Twitter Dataset with Latent Topics, Sentiments and Emotions Attributes (Gupta et al., 2020)

2. COV19Tweets Dataset (Lamsal, 2020)

5 Computational Resources

For computational resources, we will use the Google Colaboratory platform (potentially with the PRO subscription). If we run into resource concerns, we will additionally consider using the MIT Satori Cluster.

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