

APPENDIX

A. Regional Results

1) Country Results:

TABLE I

COUNTRY TWEET AND SENTIMENT STATISTICS. TOP: COVID, BOTTOM: LOCKDOWN

| | No. Tweets | Pos Ratio | Neg Ratio | Neu Ratio |
|------------------|------------|-----------|-----------|-----------|
| England | 228006 | 0.55 | 0.36 | 0.10 |
| Scotland | 50450 | 0.54 | 0.36 | 0.10 |
| Wales | 26542 | 0.51 | 0.37 | 0.09 |
| Northern Ireland | 4945 | 0.58 | 0.33 | 0.12 |
| | No. Tweets | Pos Ratio | Neg Ratio | Neu Ratio |
| England | 203551 | 0.55 | 0.35 | 0.10 |
| Scotland | 21354 | 0.55 | 0.35 | 0.10 |
| Wales | 14145 | 0.55 | 0.35 | 0.10 |
| Northern Ireland | 5402 | 0.54 | 0.36 | 0.10 |

2) County Results:

TABLE II

COUNTY TWEET AND SENTIMENT STATISTICS. **TOP:** COVID, **BOTTOM:** LOCKDOWN

| | County | No. Tweets | Ratio |
|-------------------|----------------|------------|-------|
| Highest Pos Ratio | Cumbria | 341 | 0.65 |
| Highest Neg Ratio | South Ayrshire | 802 | 0.4 |
| | County | No. Tweets | Ratio |
| Highest Pos Ratio | Leicestershire | 349 | 0.6 |
| Highest Neg Ratio | Fife | 120 | 0.4 |

3) County Tweet Count: :

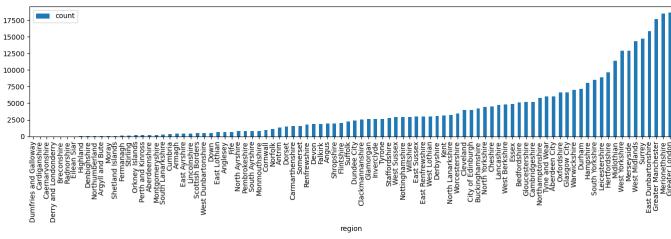


Fig. 1. Sorted Bar Chart of Number of Collected Tweets from Each Region Over Both Dataset

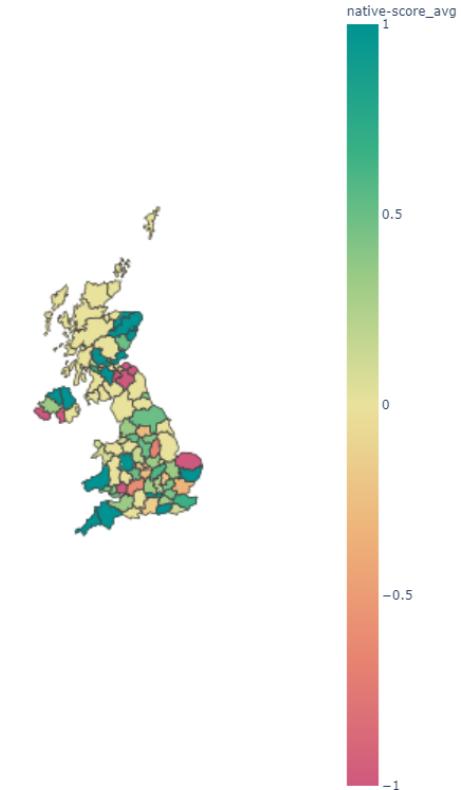


Fig. 2. Choropleth Map for the Covid Dataset and Naive Bayes sentiment on the date: 2020-12-27

C. Sentiment Analysis

1) Sentiment Technique Comparison: :



Fig. 3. Comparison of 7MA Sentiment Scores Between Techniques(COVID)



Fig. 4. Comparison of 7MA Sentiment Scores Between Techniques(Lockdown)

TABLE III
COMPARING THE OUTCOMES ACROSS NLP TECHNIQUES

| Model: | Total: | Agreement in % | | | % of Sentiment Labels |
|------------------------|--------|----------------|-------|-------|-----------------------|
| | | Pos | Neg | Neu | |
| Vader v Textblob | 56.47 | 55.31 | 29.70 | 14.99 | |
| Vader v LSTM | 56.95 | 54.29 | 45.71 | Nan | |
| Vader v Naive Bayes | 56.66 | 62.75 | 37.25 | Nan | |
| Textblob v LSTM | 47.54 | 67.45 | 32.55 | Nan | |
| Textblob v Naive Bayes | 49.80 | 75.76 | 24.24 | Nan | |
| LSTM v Naive Bayes | 68.70 | 66.21 | 33.79 | Nan | |
| All models Combined | 28.66 | 72.23 | 27.77 | Nan | |

TABLE IV
ACCURACY MEASURE OF MODELS

| Metrics: | Models: | | | |
|-----------|---------|----------|------|-------------|
| | Vader | TextBlob | LSTM | Naive Bayes |
| Accuracy | 0.78 | 0.56 | 0.78 | 0.67 |
| F-1 score | 0.78 | 0.59 | 0.74 | 0.61 |

TABLE V
MODEL ERROR AND PRECISION RATES

| Metrics: | Models: | | | |
|----------|---------|----------|------|-------------|
| | Vader | TextBlob | LSTM | Naive Bayes |
| TPR | 0 | 0.33 | 0.25 | 0 |
| TNR | 1.0 | 0.66 | 0.75 | 0.5 |
| FNR | 0 | 0 | 0 | 1.0 |
| FPR | 0.33 | 0.33 | 0.25 | 0.5 |

2) Country Sentiment Comparison: :

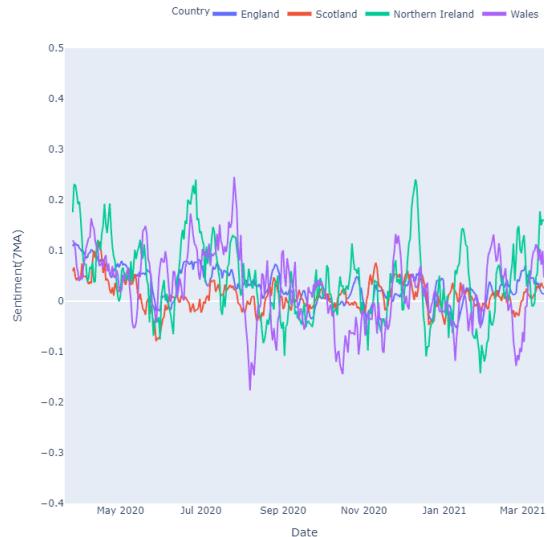


Fig. 5. Comparison of 7MA Sentiment Scores Between Countries(COVID)



Fig. 6. Comparison of 7MA Sentiment Scores Between Countries(Lockdown)

3) Sentiment and Tweet Volume in England vs COVID Rates: (Top: Covid, Bottom: Lockdown)

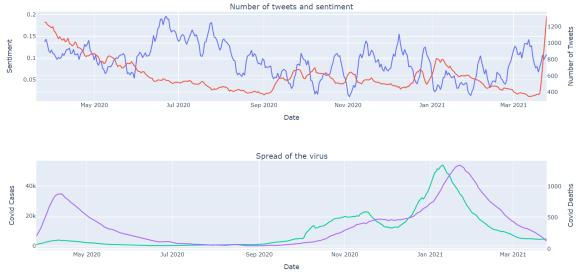


Fig. 7. Graphs of how Covid sentiment, tweet volume, COVID cases and COVID deaths changes over a year in England.



Fig. 8. Graphs of how Lockdown sentiment, tweet volume, COVID cases and COVID deaths changes over a year in England.

4) Sentiment and Tweet Volume in Scotland vs COVID Rates: (Top: Covid, Bottom: Lockdown)



Fig. 9. Graphs of how Covid sentiment, tweet volume, COVID cases and COVID deaths changes over a year in Scotland.



Fig. 10. Graphs of how Lockdown sentiment, tweet volume, COVID cases and COVID deaths changes over a year in Scotland.

5) Sentiment and Tweet Volume in Wales vs COVID Rates: (Top: Covid, Bottom: Lockdown)



Fig. 11. Graphs of how Covid sentiment, tweet volume, COVID cases and COVID deaths changes over a year in Wales.

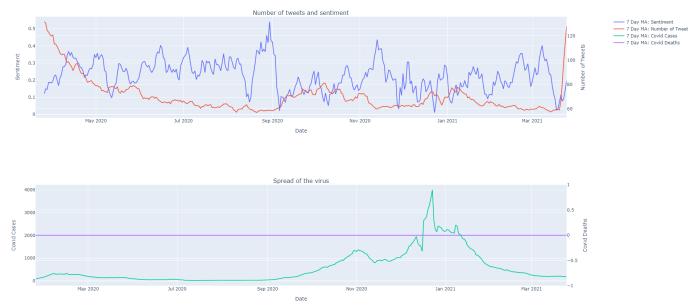


Fig. 12. Graphs of how Lockdown sentiment, tweet volume, COVID cases and COVID deaths changes over a year in Wales.

6) Sentiment and Tweet Volume in Northern Ireland vs COVID Rates: (Top: Covid, Bottom: Lockdown)

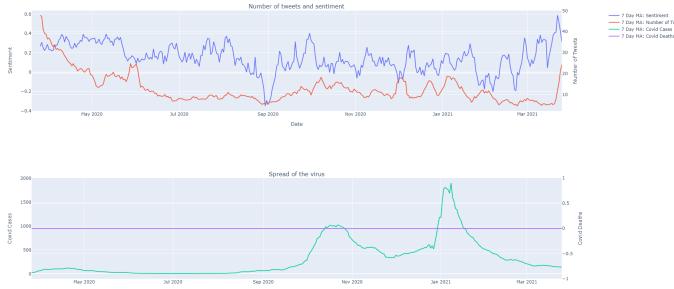


Fig. 13. Graphs of how Covid sentiment, tweet volume, COVID cases and COVID deaths changes over a year in Northern Ireland.

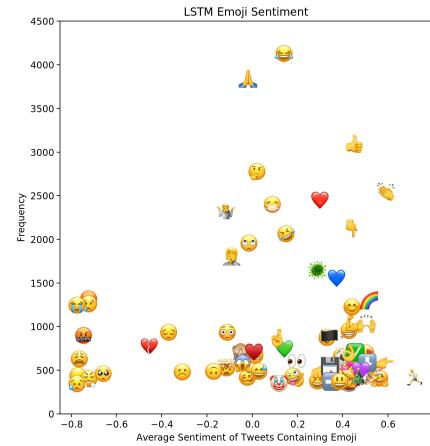


Fig. 16. Frequency and Sentiment of Emojis (LSTM)

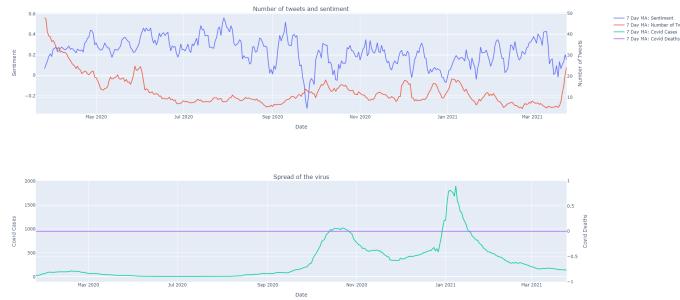


Fig. 14. Graphs of how Lockdown sentiment, tweet volume, COVID cases and COVID deaths changes over a year in Northern Ireland.

D. Emoji Trends

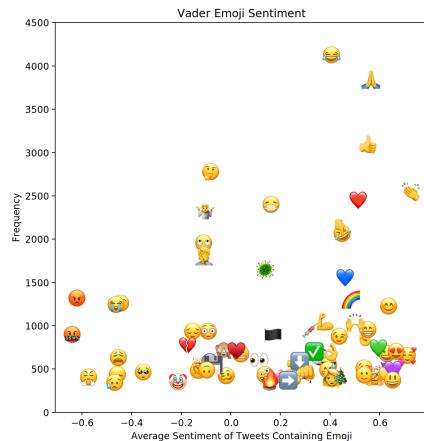


Fig. 15. Frequency and Sentiment of Emojis (Vader)

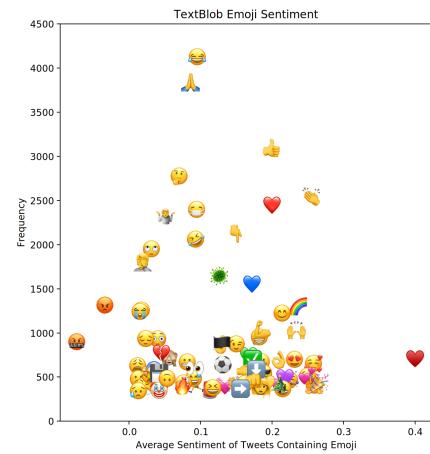


Fig. 17. Frequency and Sentiment of Emojis (TextBlob)

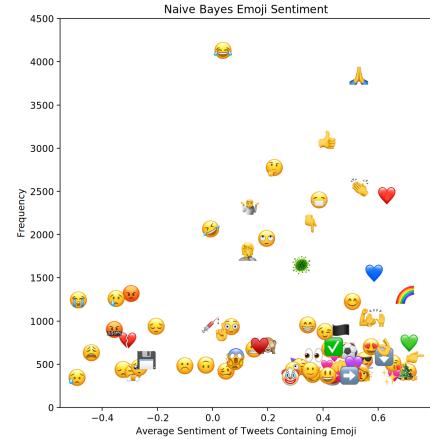


Fig. 18. Frequency and Sentiment of Emojis (Naive Bayes)

TABLE VI
FACE WITH TEARS OF JOY SENTIMENT

| | Vader | TextBlob | LSTM | Naive Bayes | Emoji Sentiment Ranking v1.0 |
|-----------|-------|----------|-------|-------------|------------------------------|
| Sentiment | 0.447 | 0.103 | 0.167 | -0.002 | 0.221 |
| IQR | 0.48 | 0.25 | 2.0 | 2.0 | n/a |

E. Notable Days

TABLE VII
NOTABLE DAYS. TOP: COVID, BOTTOM: LOCKDOWN

| | Date/Month | No. Tweets/Ratio |
|--|---------------|------------------|
| Highest Tweet Volume Day | 2021-03-25 | 2640 |
| Highest Tweet Volume Month | March 2020 | 1659 |
| Highest Positive Sentiment Ratio Day | 2020-03-21 | 0.65 |
| Highest Positive Sentiment Ratio Month | March 2020 | 0.53 |
| Highest Negative Sentiment Ratio Day | 2020-10-04 | 0.53 |
| Highest Negative Sentiment Ratio Month | January 2021 | 0.47 |
| | Date/Month | No. Tweets/Ratio |
| Highest Tweet Volume Day | 2021-01-04 | 1810 |
| Highest Tweet Volume Month | November 2020 | 1454 |
| Highest Positive Sentiment Ratio Day | 2020-06-29 | 0.79 |
| Highest Positive Sentiment Ratio Month | April 2020 | 0.63 |
| Highest Negative Sentiment Ratio Day | 2021-01-03 | 0.52 |
| Highest Negative Sentiment Ratio Month | October 2020 | 0.46 |

F. Popular Emojis

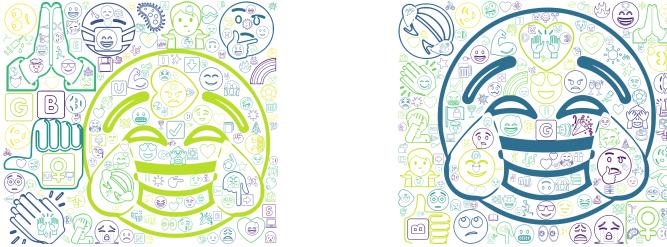


Fig. 19. Popular Emojis, Left: Covid, Right: Lockdown

G. Popular Words(Keywords Removed)

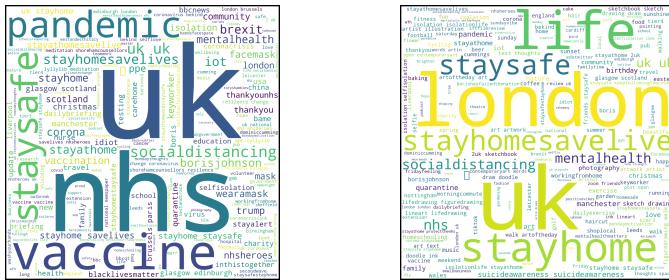


Fig. 20. Popular Words, Left: Covid, Right: Lockdown

H. Scaled Scatter Plots Between Features

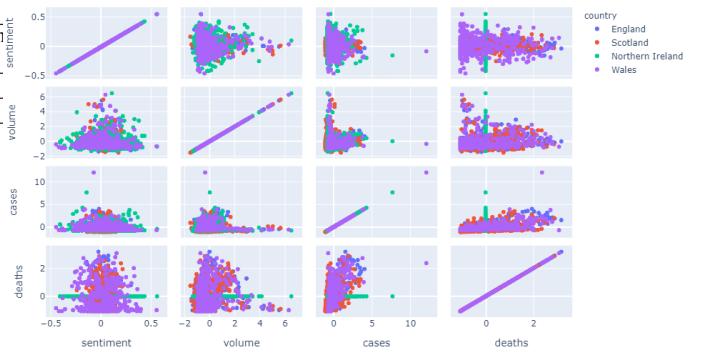


Fig. 21. Correlation Between Features for Each Country(Covid)

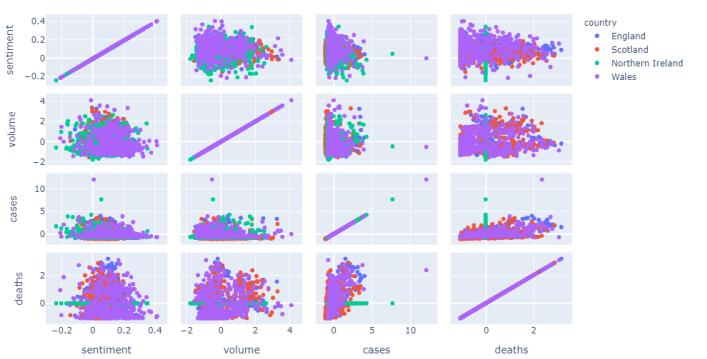


Fig. 22. Correlation Between Features for Each Country(Lockdown)