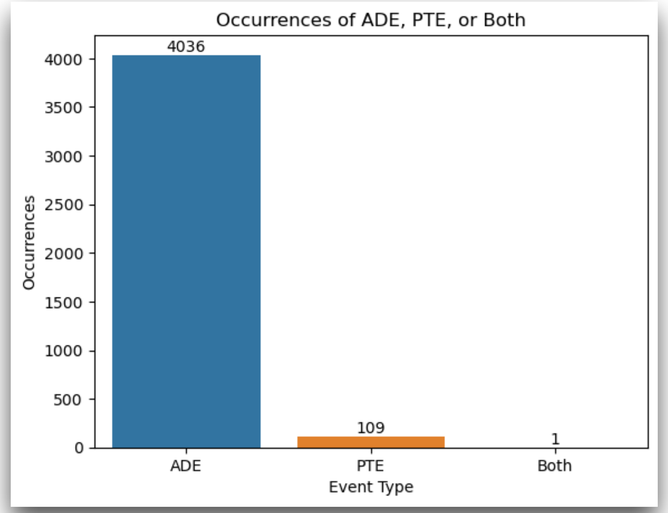
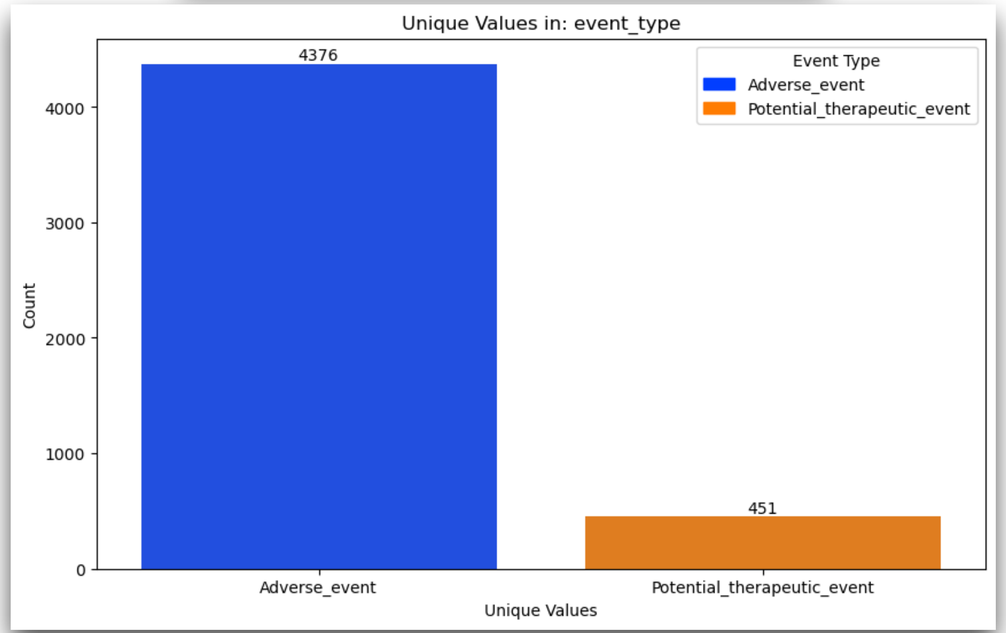
Pharmacovigilance NLP Sentiment Analysis

Exploring Sentiment Patterns in Adverse Drug Event Reports

Exploring Pharmacovigilance Data - Distribution Analysis

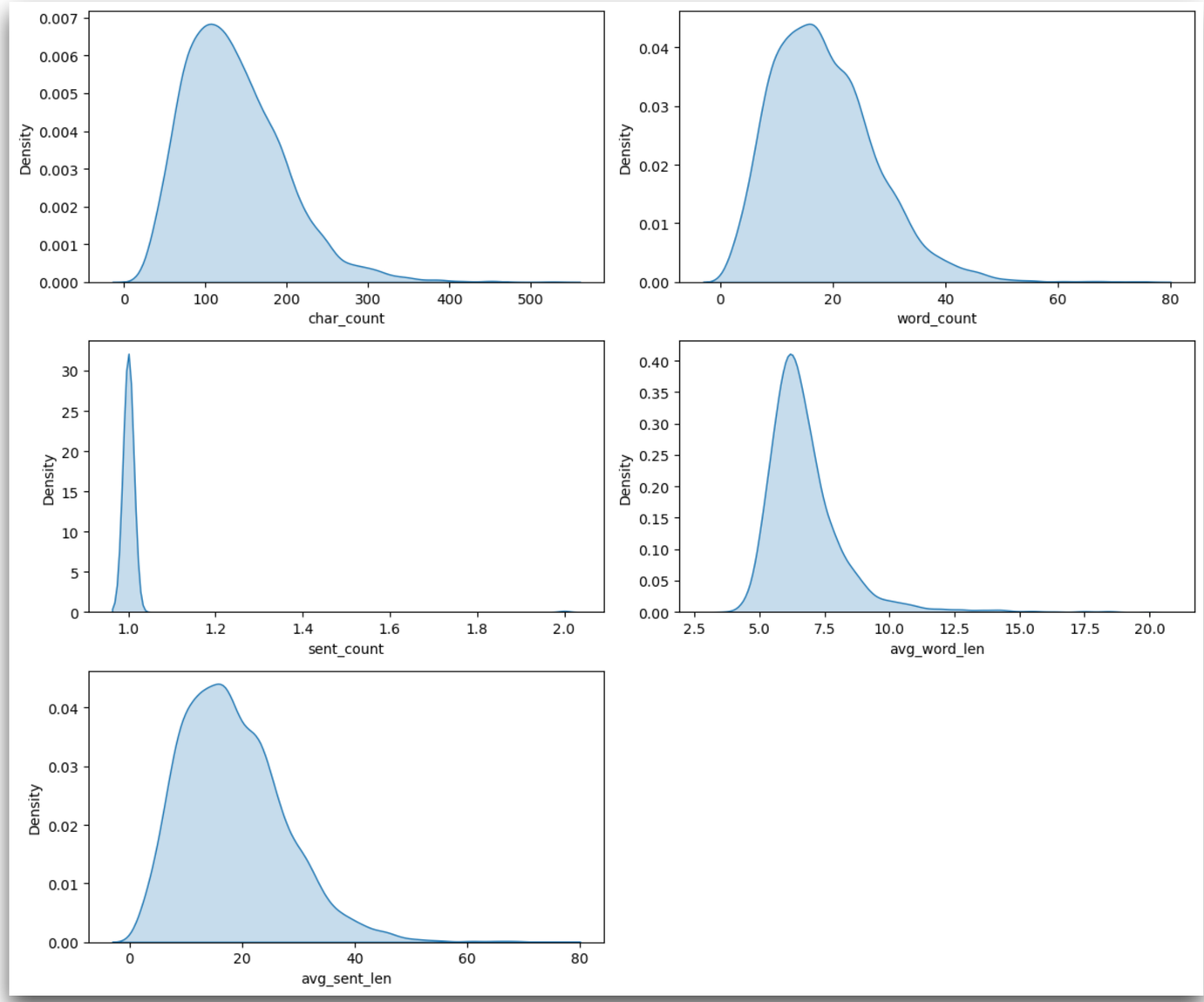
- **ADEs Prevalent**: With 4036 instances, Adverse Drug Events (ADEs) significantly outnumber Potential Therapeutic Events (PTEs), indicating potential safety concerns.
- **PTEs Scarce**: Only 109 instances of Potential Therapeutic Events were recorded, suggesting limited beneficial impacts of the drugs examined.
- **Dual Effects**: A single case showed both adverse and therapeutic effects simultaneously, pointing to complex drug interactions.
- **Need for Detailed Analysis**: The data calls for a comprehensive study, including considerations like event severity, medical conditions, dosage, and patient characteristics.
- **Class Imbalance**: The data exhibits a striking imbalance with 4376 ADEs against 451 PTEs, which could skew sentiment analysis towards ADEs.
- **Imbalance Impact**:The imbalance might lead to misleading conclusions about drug safety and efficacy, disproportionately classifying events as adverse.





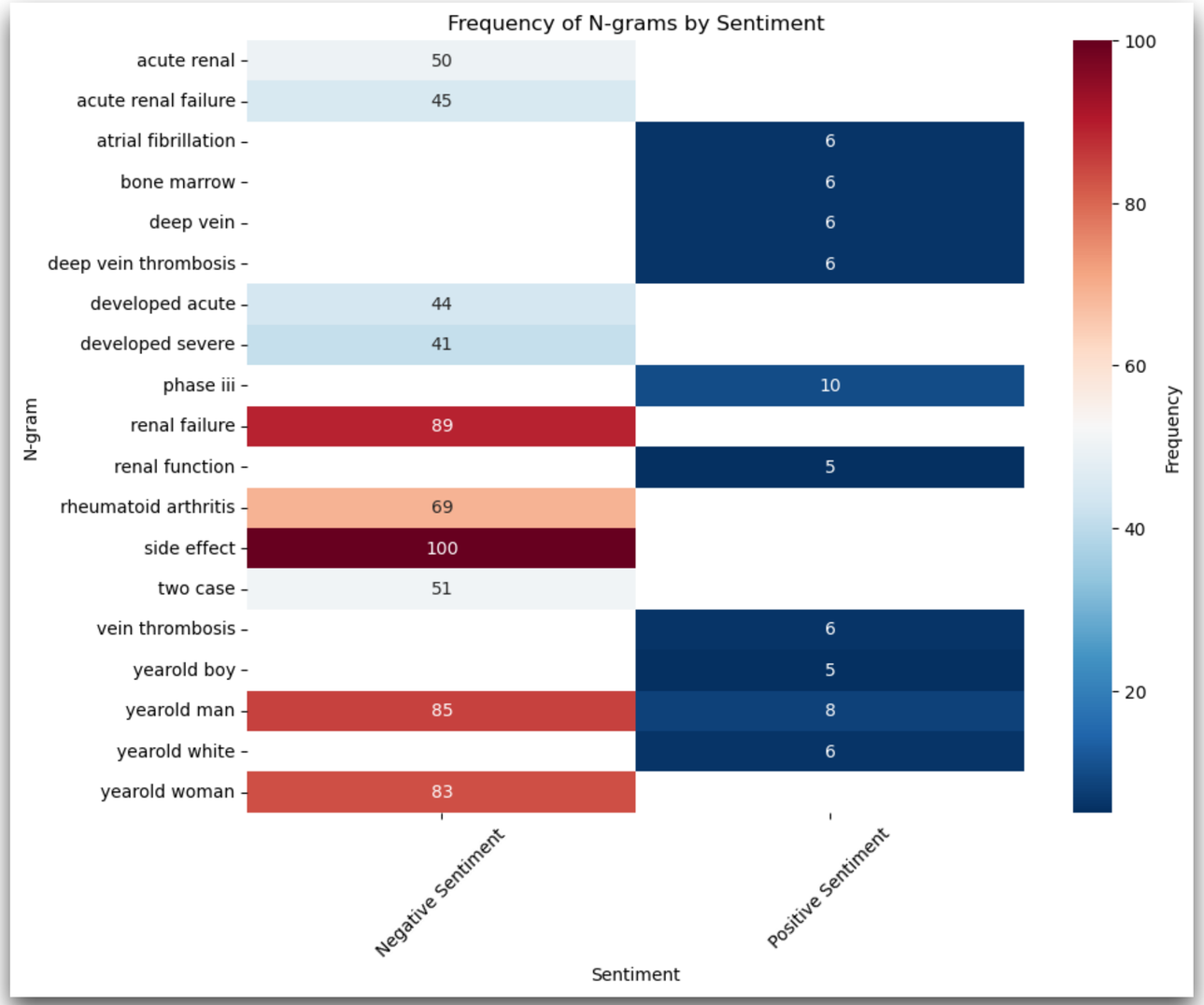
Insights from Sentiment Analysis and Linguistic Patterns

- **Sentiment:** Dataset is primarily negative with a smaller portion of positive sentiments.
- **Character Count:** Text length ranges from ~20 to 550 characters, showing variation.
- **Word Count:** Number of words ranges from 2 to 75, with moderate skewness.
- **Sentence Count:** Most texts have a single sentence, indicating consistent structure.
- **Avg. Word Length:** Average word length is ~6.75 characters, revealing linguistic patterns.
- **Avg. Sentence Length:** Average sentence length is ~18 words, with some longer sentences.



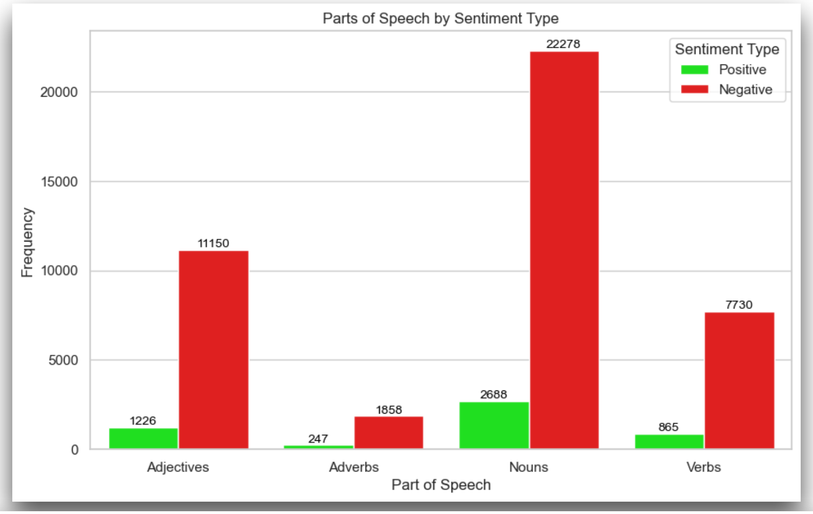
Insights from Sentiment Analysis and N-gram Patterns

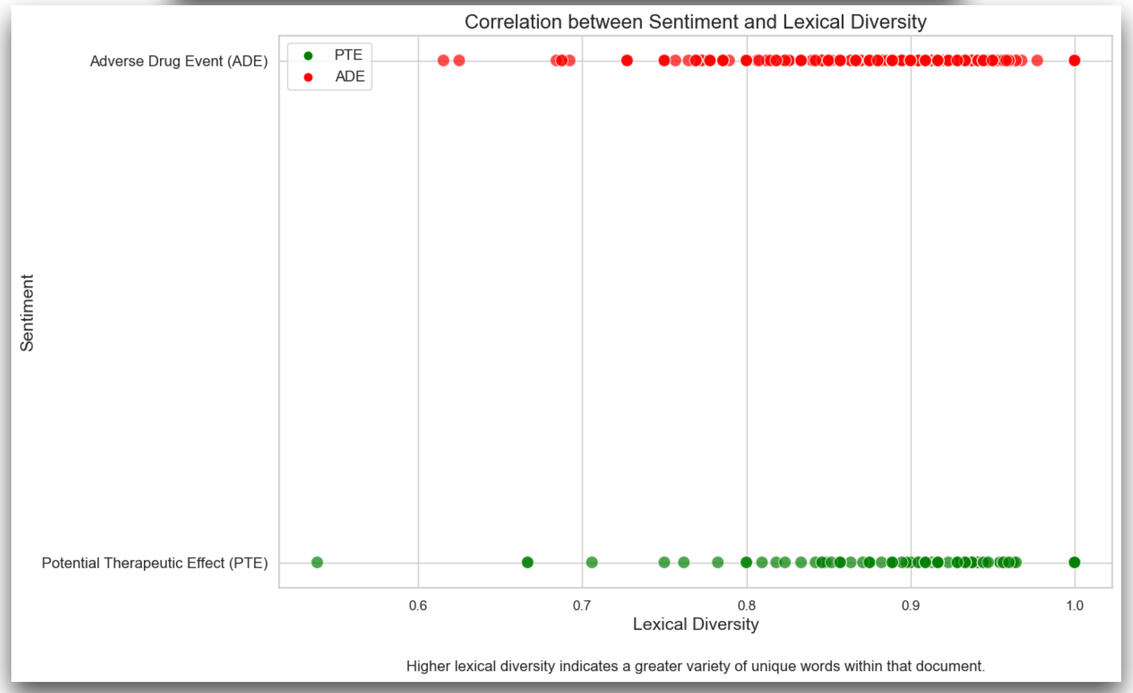
- **Top N-grams:** Negative - 'Side effect', 'Renal failure', 'Yearold man/woman', 'Rheumatoid arthritis'. Positive - 'Phase III', 'Yearold man', 'Yearold white', 'Vein thrombosis'.
- **High Frequency Negative N-grams:** 'Side effect' dominates negative sentiment, along with other N-grams indicating specific health conditions or demographics.
- **Low Frequency Positive N-grams:** 'Phase III' is the most frequent positive N-gram, but positive sentiments are less commonly discussed.
- **N-gram Overlap:** 'Yearold man' appears in both positive and negative sentiments, highlighting the importance of context analysis.
- **N-gram and Health Conditions:** N-grams like 'Renal failure' and 'Rheumatoid arthritis' are associated with negative sentiment, suggesting challenges in those areas.



Visual Patterns in Pharmacovigilance Reporting

- **Adjectives:** Low frequency in both positive and negative reports, indicating limited subjective descriptions.
- **Adverbs:** Slightly higher count in negative reports, emphasizing event intensity.
- **Nouns:** Higher frequencies overall, broader range in positive reports for adverse events.
- **Verbs:** Highest frequencies, especially in positive reports, highlighting active expression.
- **Lexical Diversity:** ADE sentiments show higher diversity, while PTE sentiments have even distribution.
- **Implication:** Accurate reporting of adverse events using specific nouns and verbs is crucial in pharmacovigilance.





Unveiling Patient Insights for Safer Healthcare

- **Modeling**:
  - ***MultinomialNB*** was chosen for its effectiveness in handling text data and limited labeled data.
  - Initial Evaluation: Unbalanced model achieved a mean CV score of approximately 91%.
- **Evaluation**:
  - Class Imbalance Challenge: Unbalanced model struggled to identify positive sentiments (PTE) while performing well in identifying negative sentiments (ADE).
  - Applied SMOTE technique to rebalance the dataset.
- **Modeling (Continued)**:
  - Rebalanced Model Evaluation:
    - Decreased overall accuracy, recall, F1 score, and slight decline in ROC AUC compared to the unbalanced model.
    - Improved sensitivity in capturing PTE sentiments.
- **Conclusion**:
  - Unbalanced Model: Showcased superior overall predictive performance with higher accuracy and F1 score.
  - Rebalanced Model: Provided better sensitivity in identifying adverse events (ADE) at the expense of decreased overall accuracy.
- **Recommendations**:
  - Use the *unbalanced model* for high overall accuracy in predicting sentiments.
  - Choose the *rebalanced model* when accurate identification of adverse events (ADE) is crucial.