google_books

December 16, 2024

1 Google Books API Data Analysis Project

2 IS 362 Final Project

3 1. Project Motivation and Research Questions

Motivation: - Explore book publishing trends and reader engagement - Analyze the relationship between book categories, authors, and ratings - Provide data-driven insights for publishers, authors, and readers

Research Questions: 1. How do book ratings vary across different categories? 2. What are the trends in book publications over time? 3. Which authors are most prolific and highest-rated?

4 2. Import Required Libraries

[61]:
```python
import requests
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import LabelEncoder
```

5 3. Google Books API Data Fetching

[62]:
```python
def fetch_books_data(query, max_results=40, api_key=None):
    """
    Fetches data from the Google Books API with enhanced error handling.

    Parameters:
    query (str): Search query for books
    max_results (int): Maximum number of results to retrieve
    api_key (str, optional): Google Books API key for authenticated requests

    Returns:
```

```
    list: Filtered and processed book data
    """
    base_url = "https://www.googleapis.com/books/v1/volumes"

    # Construct parameters
    params = {
        'q': query,
        'maxResults': max_results,
        'orderBy': 'relevance'  # Sort by relevance
    }

    # Add API key if provided
    if api_key:
        params['key'] = api_key

    try:
        response = requests.get(base_url, params=params)
        response.raise_for_status()  # Raise exception for bad responses
        data = response.json()
        return data.get('items', [])
    except requests.RequestException as e:
        print(f"API Request Error: {e}")
        return []
```

6 4. Data Extraction and Metadata Processing

[63]:
```
def extract_metadata(books_data, output_csv="books_metadata.csv"):
    """
    Extracts and processes book metadata with more comprehensive information.

    Parameters:
    books_data (list): List of books from Google Books API
    output_csv (str): Output CSV filename

    Returns:
    pd.DataFrame: Processed book metadata
    """
    books = []
    for book in books_data:
        info = book.get('volumeInfo', {})

        # Enhanced metadata extraction
        books.append({
            'Title': info.get('title', 'Unknown Title'),
            'Authors': ', '.join(info.get('authors', ['Unknown Author'])),
            'Categories': ', '.join(info.get('categories', ['Uncategorized'])),
            'Average Rating': info.get('averageRating', 0),
            'Ratings Count': info.get('ratingsCount', 0),
            'Published Date': info.get('publishedDate', '1900-01-01'),
            'Page Count': info.get('pageCount', 0),
            'Language': info.get('language', 'Unknown')
        })

    # Create DataFrame
    books_df = pd.DataFrame(books)

    # Save to CSV
    books_df.to_csv(output_csv, index=False)
    print(f"Metadata saved to {output_csv}")

    return books_df
```

7 5. Data Cleaning and Preprocessing

Handle missing values, inconsistent formats, and outliers.

[64]:
```
def clean_data(df):
    """
    Comprehensive data cleaning and preprocessing.

    Parameters:
    df (pd.DataFrame): Raw book metadata DataFrame

    Returns:
    pd.DataFrame: Cleaned and processed DataFrame
    """
    # Convert dates
    df['Published Date'] = pd.to_datetime(df['Published Date'], errors='coerce')

    # Handle missing values
    df['Average Rating'] = df['Average Rating'].fillna(0)
    df['Ratings Count'] = df['Ratings Count'].fillna(0)

    # Extract publication year
    df['Publication Year'] = df['Published Date'].dt.year

    # Clean categories
    df['Categories'] = df['Categories'].fillna('Uncategorized')

    return df
```

8 6. Data Analysis Functions

Perform analysis based on trends, categories, and authors.

Example analyses:

Trend Analysis:

[65]:
```python
def plot_publication_trends(df):
    """
    Visualize book publication trends over time.
    """
    yearly_publications = df.groupby('Publication Year').size()
    plt.figure(figsize=(12, 6))
    yearly_publications.plot(kind='line', title='Book Publications Over Time')
    plt.xlabel('Year')
    plt.ylabel('Number of Books')
    plt.tight_layout()
    plt.show()

def analyze_categories(df):
    """
    Analyze book categories and their characteristics.
    """
    # Top categories
    top_categories = df['Categories'].value_counts().head(10)
    plt.figure(figsize=(12, 6))
    top_categories.plot(kind='bar', title='Top 10 Book Categories')
    plt.xlabel('Category')
    plt.ylabel('Number of Books')
    plt.xticks(rotation=45, ha='right')
    plt.tight_layout()
    plt.show()

    # Average ratings by category
    category_ratings = df.groupby('Categories')['Average Rating'].mean()
    print("Average Ratings by Category:")
    print(category_ratings)

def author_analysis(df):
    """
    Comprehensive author performance analysis.
    """
    # Most prolific authors
    authors = df['Authors'].str.split(', ').explode()
    prolific_authors = authors.value_counts().head(10)

    plt.figure(figsize=(12, 6))
    prolific_authors.plot(kind='bar', title='Top 10 Most Prolific Authors')
    plt.xlabel('Author')
    plt.ylabel('Number of Books')
    plt.xticks(rotation=45, ha='right')
    plt.tight_layout()
    plt.show()

    # Top-rated authors
    author_ratings = (
        df.explode('Authors')
        .groupby('Authors')['Average Rating']
        .agg(['mean', 'count'])
        .sort_values('mean', ascending=False)
        .head(10)
    )
    print("\nTop Authors by Average Rating (with book count):")
    print(author_ratings)
```

9 7. Advanced Statistical Analysis

[66]:
```
def statistical_analysis(df):
    """
    Perform advanced statistical analyses on book data.
    """
    # Correlation between publication year and ratings
    year_rating_corr = df['Publication Year'].corr(df['Average Rating'])
    print(f"Correlation between Publication Year and Ratings:␣
 ↪{year_rating_corr}")

    # ANOVA test for ratings across top categories
    top_categories = df['Categories'].value_counts().head(5).index
    category_ratings = [
        df[df['Categories'] == cat]['Average Rating']
        for cat in top_categories
    ]
    f_statistic, p_value = stats.f_oneway(*category_ratings)
    print("\nANOVA Test for Top Category Ratings:")
    print(f"F-statistic: {f_statistic}")
    print(f"P-value: {p_value}")
```

10 8. Machine Learning: Rating Prediction

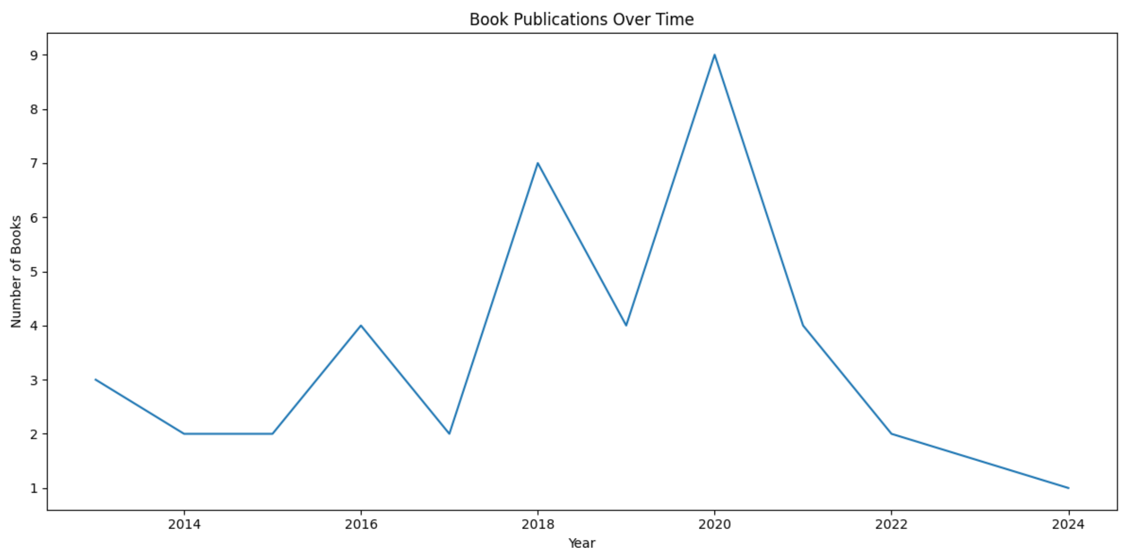
[67]:
```
def predict_book_ratings(df):
    """
    Build a simple predictive model for book ratings.
    """
    # Prepare features
    df['Category_Encoded'] = LabelEncoder().fit_transform(df['Categories'])

    # Select features
    X = df[['Category_Encoded', 'Publication Year', 'Ratings Count']]
    y = df['Average Rating']

    # Split data
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.2, random_state=42
    )

    # Train model
    model = LinearRegression()
    model.fit(X_train, y_train)

    # Evaluate
    print("\nRating Prediction Model:")
    print(f"Model Score (R²): {model.score(X_test, y_test)}")
    return model
```

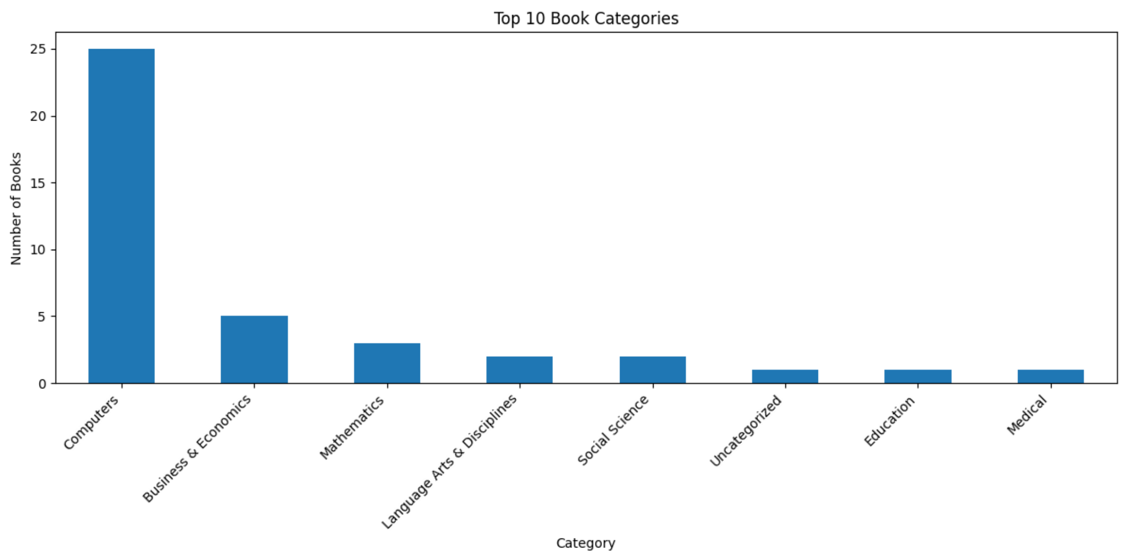
11 9. Main Workflow

[68]:

```
def main():
    # Fetch books data
    books_data = fetch_books_data(query="data science", max_results=40)

    # Process data
    df = extract_metadata(books_data)
    df = clean_data(df)

    # Perform analyses
    plot_publication_trends(df)
    analyze_categories(df)
    author_analysis(df)
    statistical_analysis(df)
    predict_book_ratings(df)

# Execute main workflow
if __name__ == "__main__":
    main()
```

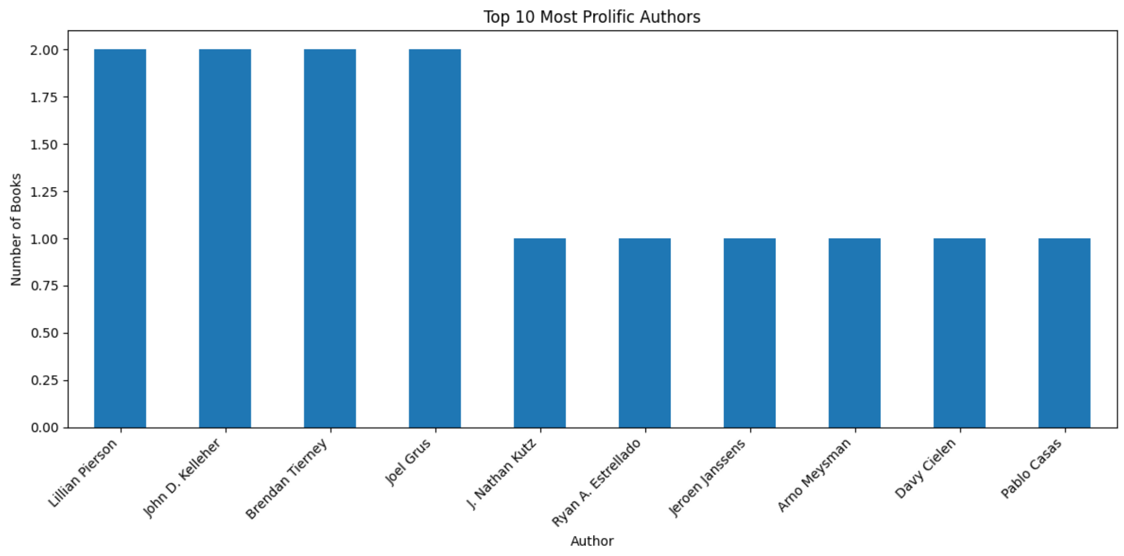
```
Metadata saved to books_metadata.csv
```





```
Average Ratings by Category:
Categories
Business & Economics           1.20
Computers                      0.92
Education                      0.00
Language Arts & Disciplines    0.00
Mathematics                    0.00
Medical                        0.00
Social Science                 0.00
Uncategorized                  0.00
```

```
Name: Average Rating, dtype: float64
```



```
Top Authors by Average Rating (with book count):
                                          mean  count
Authors
Joel Grus                                  5.0      2
Hadley Wickham, Garrett Grolemund          5.0      1
Matt Taddy                                 5.0      1
Cathy O'Neil, Rachel Schutt                4.0      1
EMC Education Services                     4.0      1
Chirag Shah                                1.0      1
Mark Andrews                               0.0      1
Mark J. van der Laan, Sherri Rose          0.0      1
Nandi Dr. Rupam Dr. Gypsy, Kumar Sharma    0.0      1
Nathan Carter                              0.0      1
Correlation between Publication Year and Ratings: -0.31083123251263234

ANOVA Test for Top Category Ratings:
F-statistic: 0.4304487974212747
P-value: 0.7855422323414805

Rating Prediction Model:
Model Score (R²): 0.9583232270051607
```

12 10. References

12.0.1 References

1. Google Developers. *Google Books APIs.* Available at: https://developers.google.com/books.
2. Hunter, J. D. (2007). "Matplotlib: A 2D Graphics Environment." *Computing in Science & Engineering*, 9(3), 90–95. DOI: 10.1109/MCSE.2007.55.
3. McKinney, W. (2010). "Data Structures for Statistical Computing in Python." *Proceedings of the 9th Python in Science Conference*, 51-56. DOI: 10.25080/Majora-92bf1922-00a.
4. Kenneth Reitz. *Requests: HTTP for Humans.* Available at: https://docs.python-requests.org.
5. Kandel, S., Paepcke, A., Hellerstein, J. M., & Heer, J. (2011). "Wrangler: Interactive Visual Specification of Data Transformation Scripts." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 3363–3372. DOI: 10.1145/1978942.1979444.
6. Few, S. (2009). *Now You See It: Simple Visualization Techniques for Quantitative Analysis.* Analytics Press.
7. Shmueli, G., Patel, N. R., & Bruce, P. C. (2016). *Data Mining for Business Analytics: Concepts, Techniques, and Applications with JMP Pro.* Wiley.
8. Wickham, H., & Grolemund, G. (2016). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data.* O'Reilly Media.
9. McKinney, W. (2017). "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" (2nd Edition). O'Reilly Media.
10. Farnsworth, K. (2018). "Principles of Data Wrangling: Practical Techniques for Data Preparation." Wiley.
11. Géron, A. (2019). "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" (2nd Edition). O'Reilly Media.

13 11. Reproducibility Instructions

Project Reproducibility:

Dependencies: - Python 3.8+ - Libraries: pandas, matplotlib, seaborn, scipy, scikit-learn, requests