Data Processing - Final Project

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Introduction

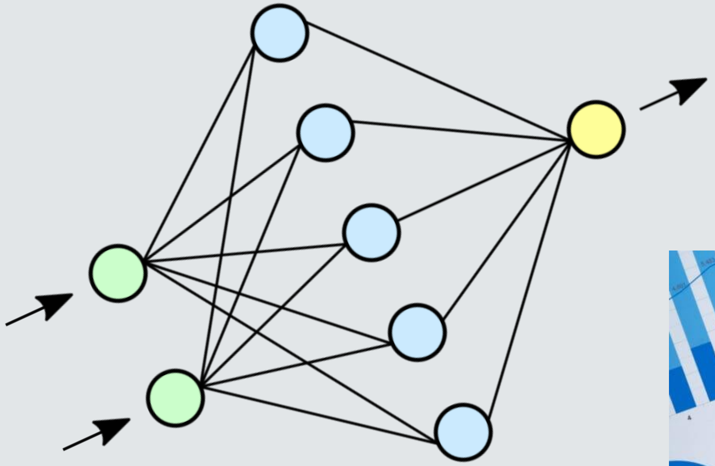
{.json}

1 output

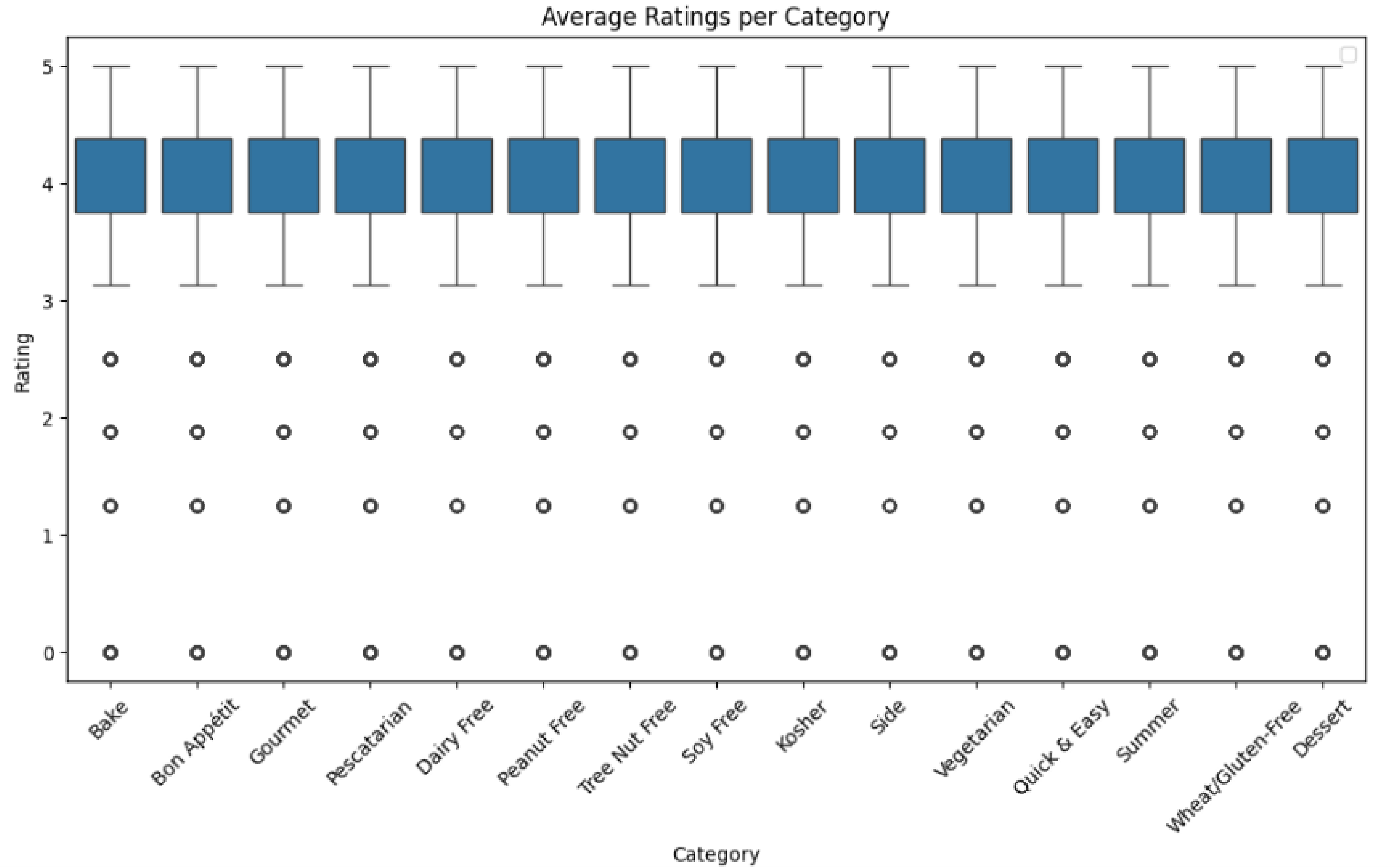
Integer variable “rating”

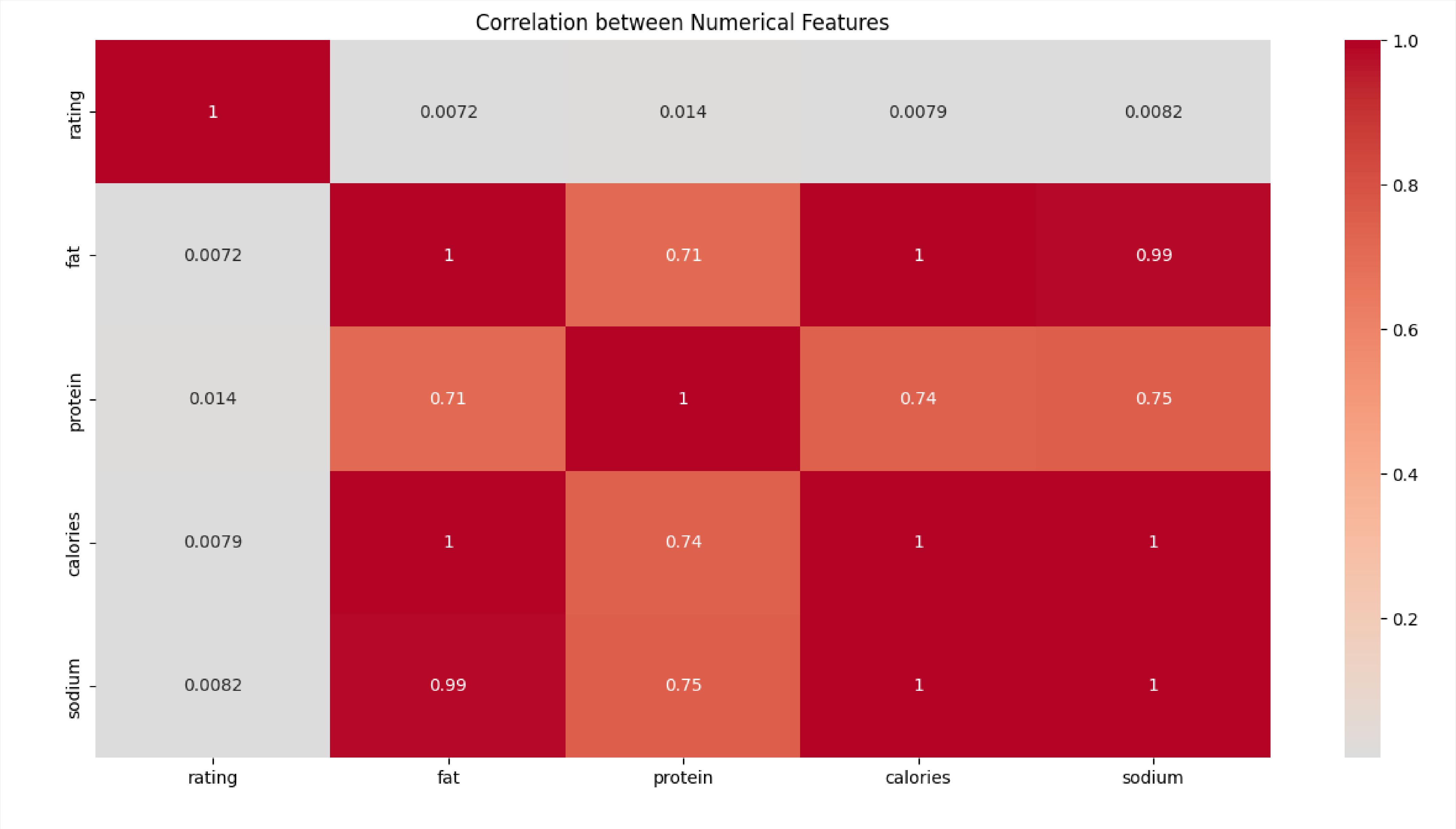
10 inputs

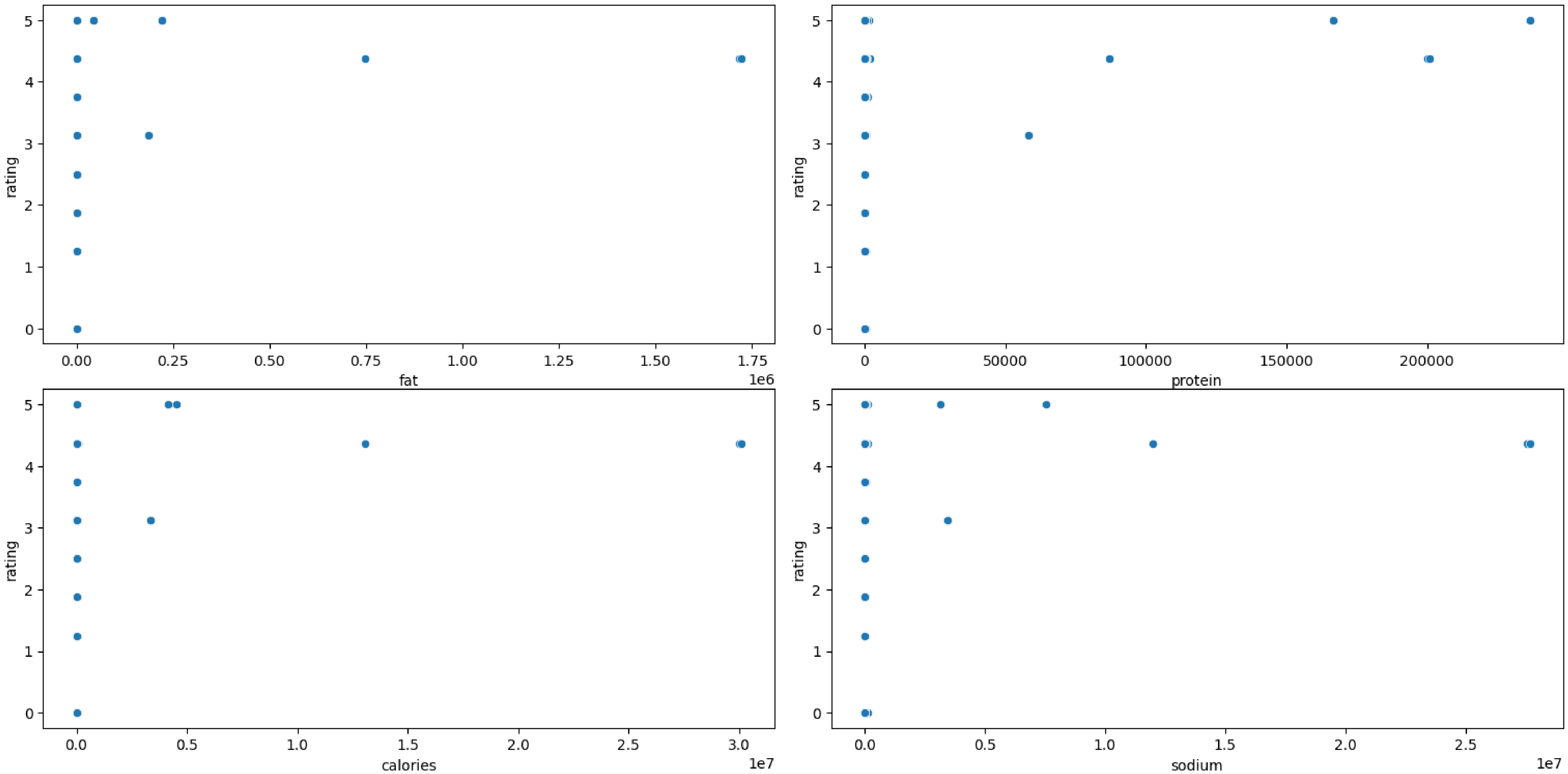
4 text variables
6 integers

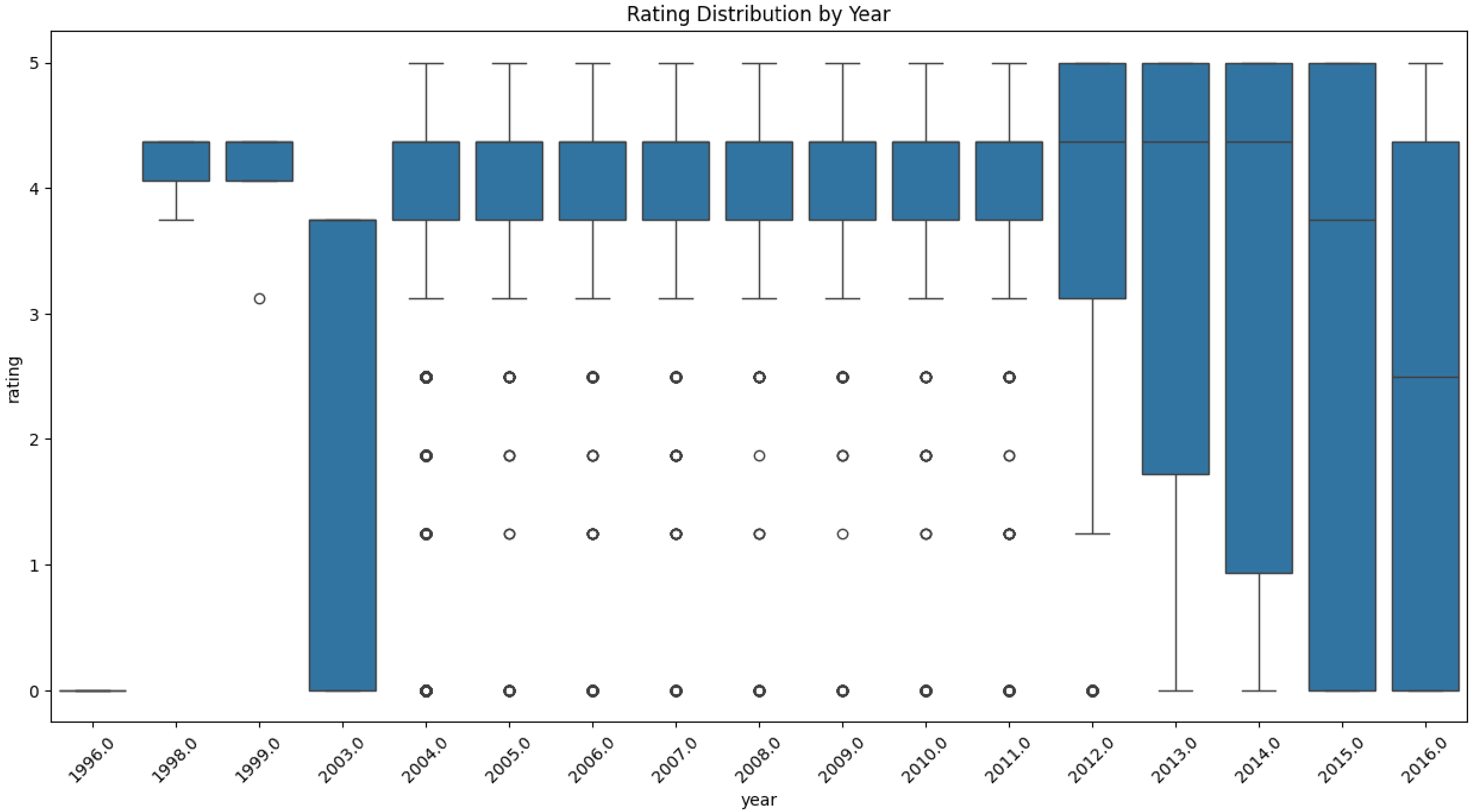


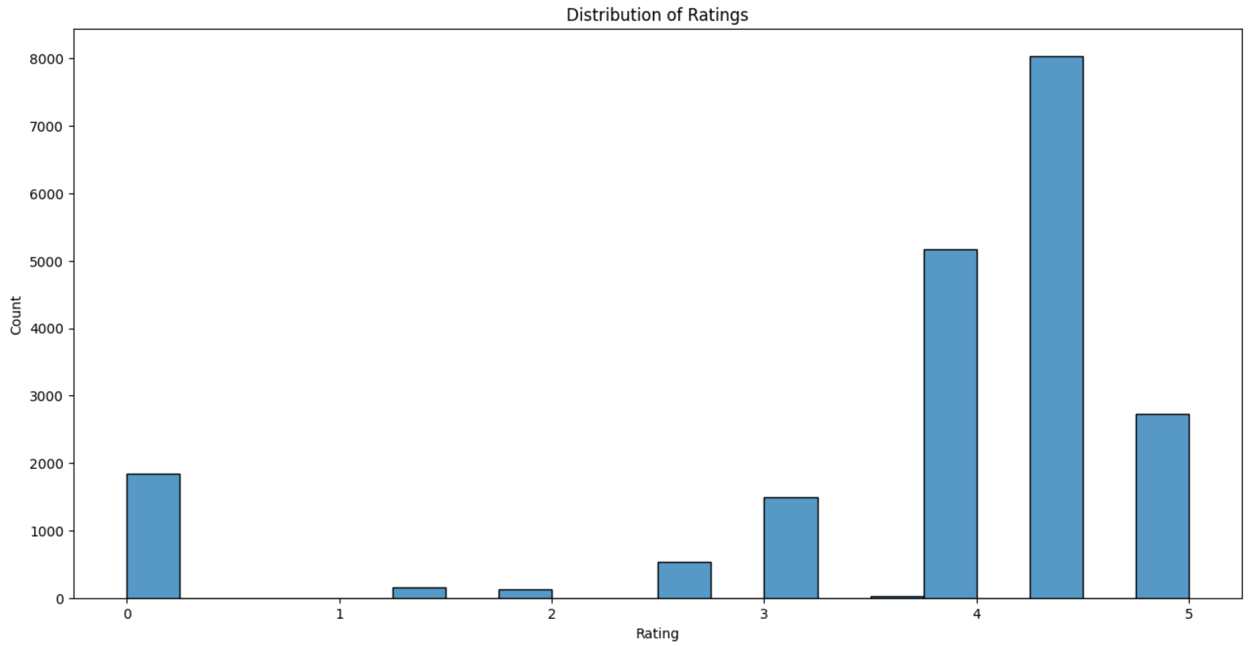
Input Variable Analysis

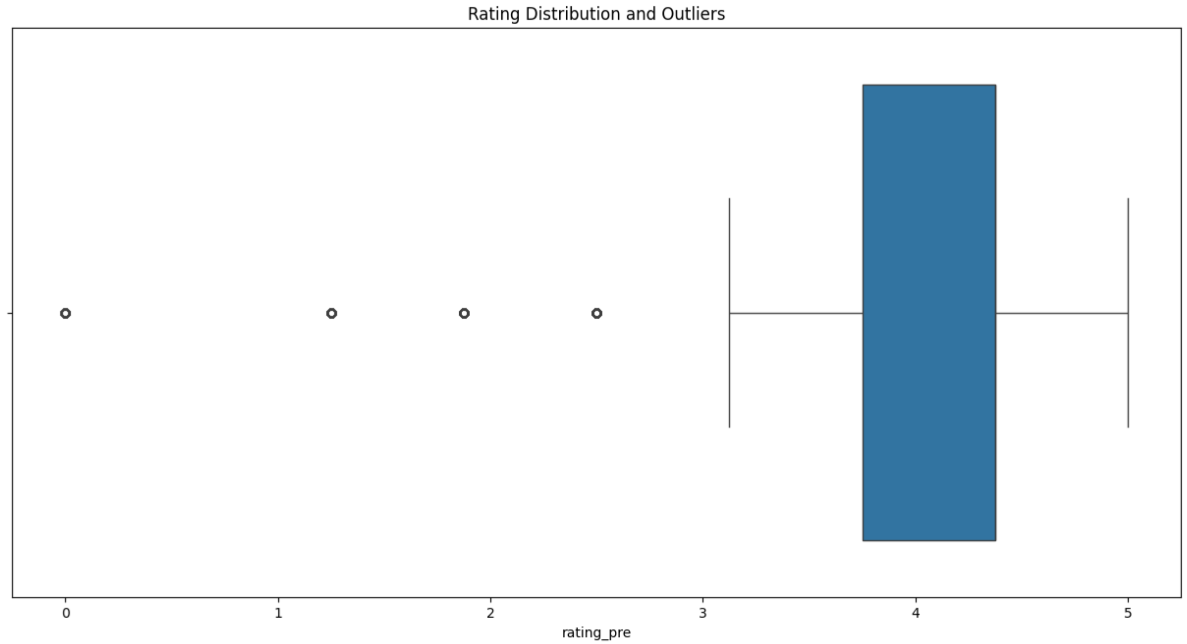

Average Ratings per Category
Rating
5
4
3
2
1
0
Category
Bake
Bon Appétit
Gourmet
Pescatarian
Dairy Free
Peanut Free
Tree Nut Free
Soy Free
Kosher
Side
Vegetarian
Quick & Easy
Summer
Wheat/Gluten-Free
Dessert


Correlation between Numerical Features
rating
fat
protein
calories
sodium
1
0.0072
0.014
0.0079
0.0082
0.0072
1
0.71
1
0.99
0.014
0.71
1
0.74
0.75
0.0079
1
0.74
1
1
0.0082
0.99
0.75
1
1
rating
fat
protein
calories
sodium
1.0
0.8
0.6
0.4
0.2

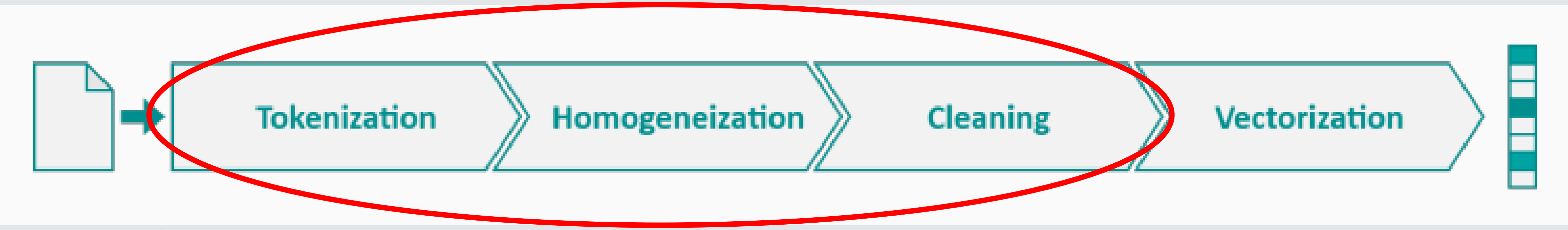

rating
0
1
2
3
4
5
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
1e6
fat
rating
0
1
2
3
4
5
0
50000
100000
150000
200000
protein
rating
0
1
2
3
4
5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1e7
calories
rating
0
1
2
3
4
5
0.0
0.5
1.0
1.5
2.0
2.5
1e7
sodium


Rating Distribution by Year
rating
5
4
3
2
1
0
year
1996.0
1998.0
1999.0
2003.0
2004.0
2005.0
2006.0
2007.0
2008.0
2009.0
2010.0
2011.0
2012.0
2013.0
2014.0
2015.0
2016.0


Distribution of Ratings
Count
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
Rating


Rating Distribution and Outliers
0
1
2
3
4
5
rating_pre

Text Preprocessing



Tokenization

- Divide phrases into words

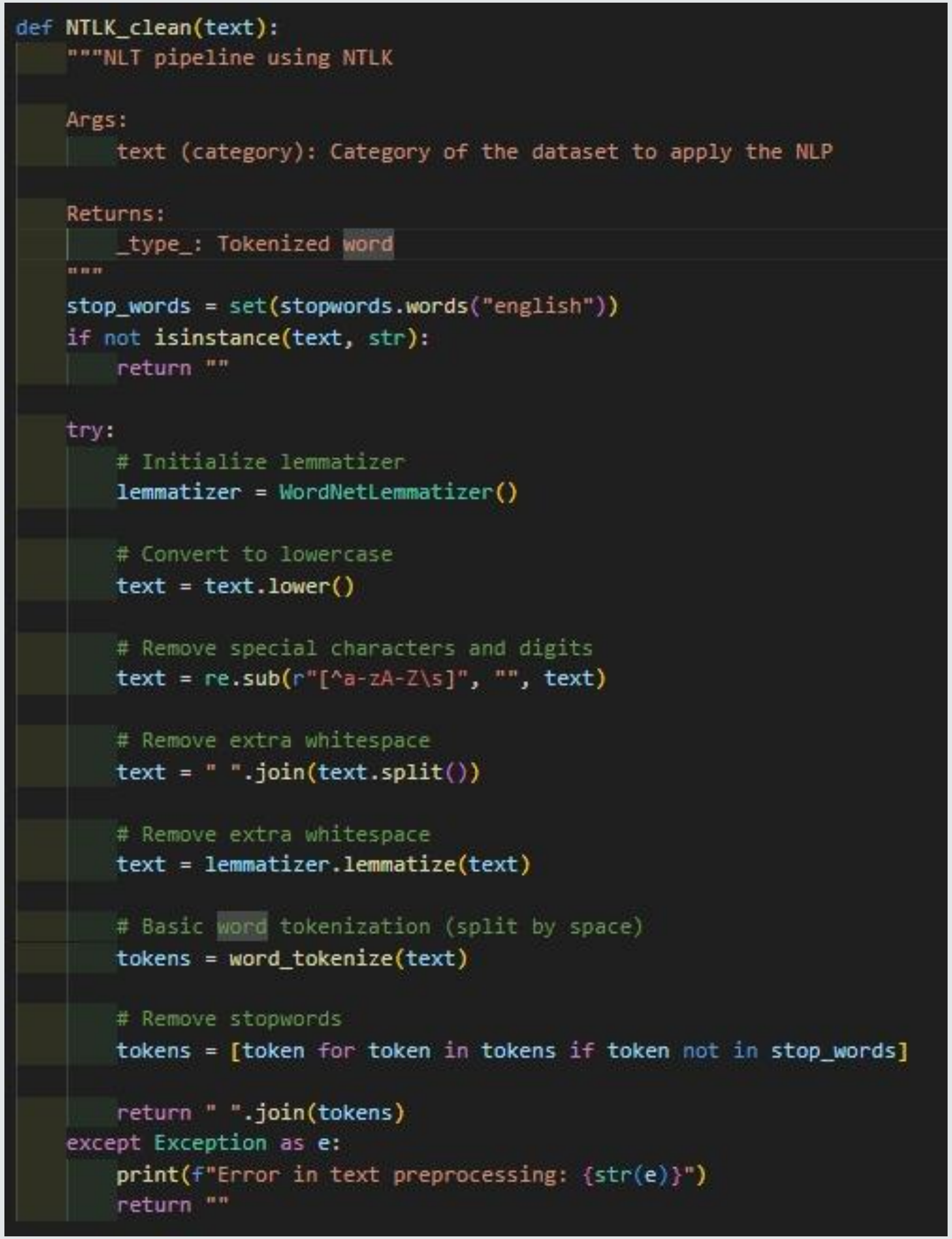
Homogeneization

- Lemmatization
- Convert to lowercase

Cleaning

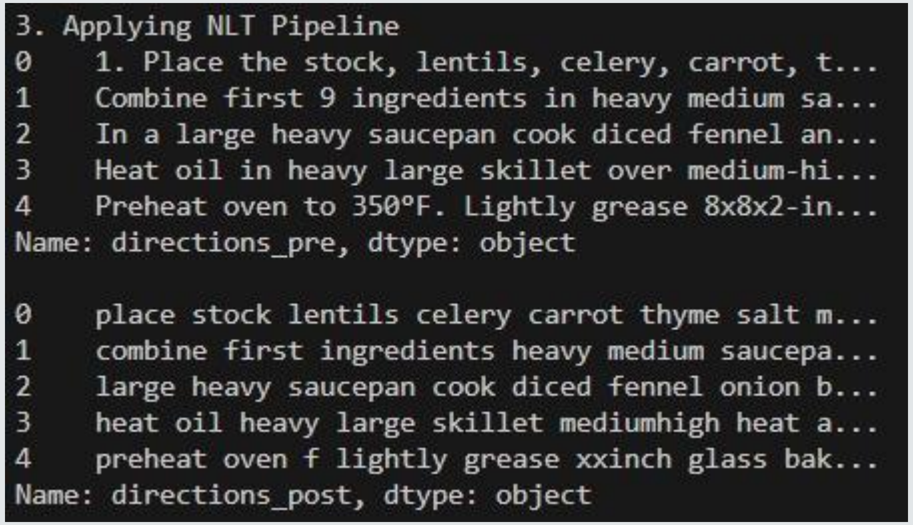
- Remove stop words, extra white spaces, special characters …

Code:



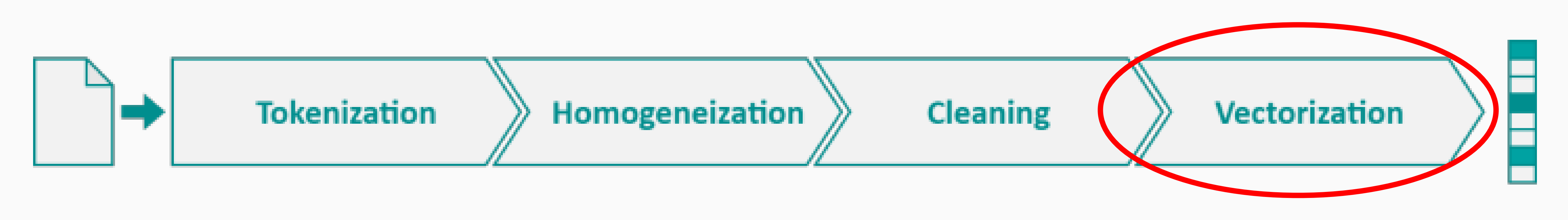
```python
def NTLK_clean(text):
    """NLT pipeline using NTLK

    Args:
        text (category): Category of the dataset to apply the NLP

    Returns:
        _type_: Tokenized word
    """
    stop_words = set(stopwords.words("english"))
    if not isinstance(text, str):
        return ""

    try:
        # Initialize lemmatizer
        lemmatizer = WordNetLemmatizer()

        # Convert to lowercase
        text = text.lower()

        # Remove special characters and digits
        text = re.sub(r"[^a-zA-Z\s]", "", text)

        # Remove extra whitespace
        text = " ".join(text.split())

        # Remove extra whitespace
        text = lemmatizer.lemmatize(text)

        # Basic word tokenization (split by space)
        tokens = word_tokenize(text)

        # Remove stopwords
        tokens = [token for token in tokens if token not in stop_words]

        return " ".join(tokens)
    except Exception as e:
        print(f"Error in text preprocessing: {str(e)}")
        return ""
```

Output:



```
3. Applying NLT Pipeline
0    1. Place the stock, lentils, celery, carrot, t...
1    Combine first 9 ingredients in heavy medium sa...
2    In a large heavy saucepan cook diced fennel an...
3    Heat oil in heavy large skillet over medium-hi...
4    Preheat oven to 350°F. Lightly grease 8x8x2-in...
Name: directions_pre, dtype: object

0    place stock lentils celery carrot thyme salt m...
1    combine first ingredients heavy medium saucepa...
2    large heavy saucepan cook diced fennel onion b...
3    heat oil heavy large skillet mediumhigh heat a...
4    preheat oven f lightly grease xxinch glass bak...
Name: directions_post, dtype: object
```

Vector Representation



Convert text data into **Word vectors** (numerical) to make inputs compatible to ML models.

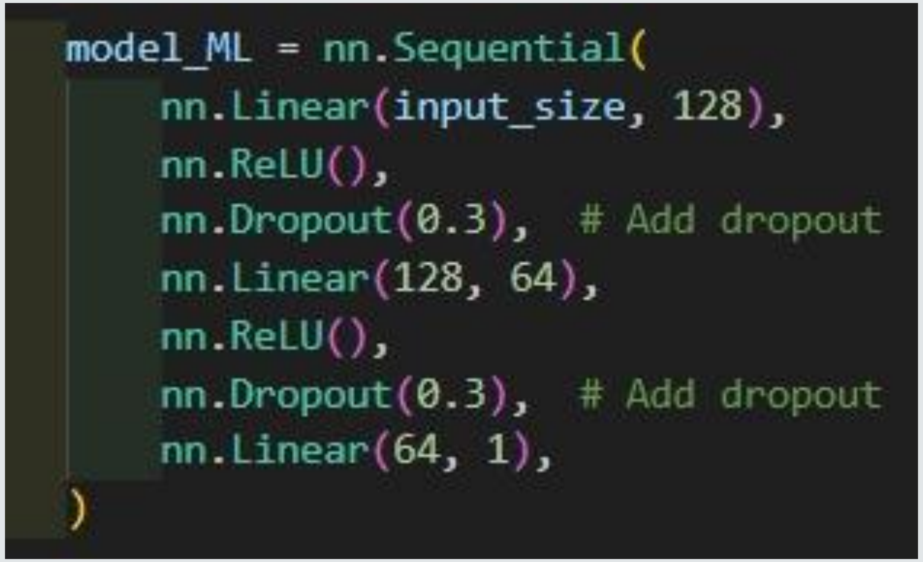
- TF-IDF: Context-agnostic and focuses on word importance (20130, 1000).
- Word2Vec: Captures shallow word relationships, lacks full contextual understanding: (20130, 100), vector size 100 and window 5. -> Mean vector
- BERT: Context-aware and provides deep contextual embeddings (20130, 768).

Regression Models

Neural Networks

Multi-Layer NN for regression

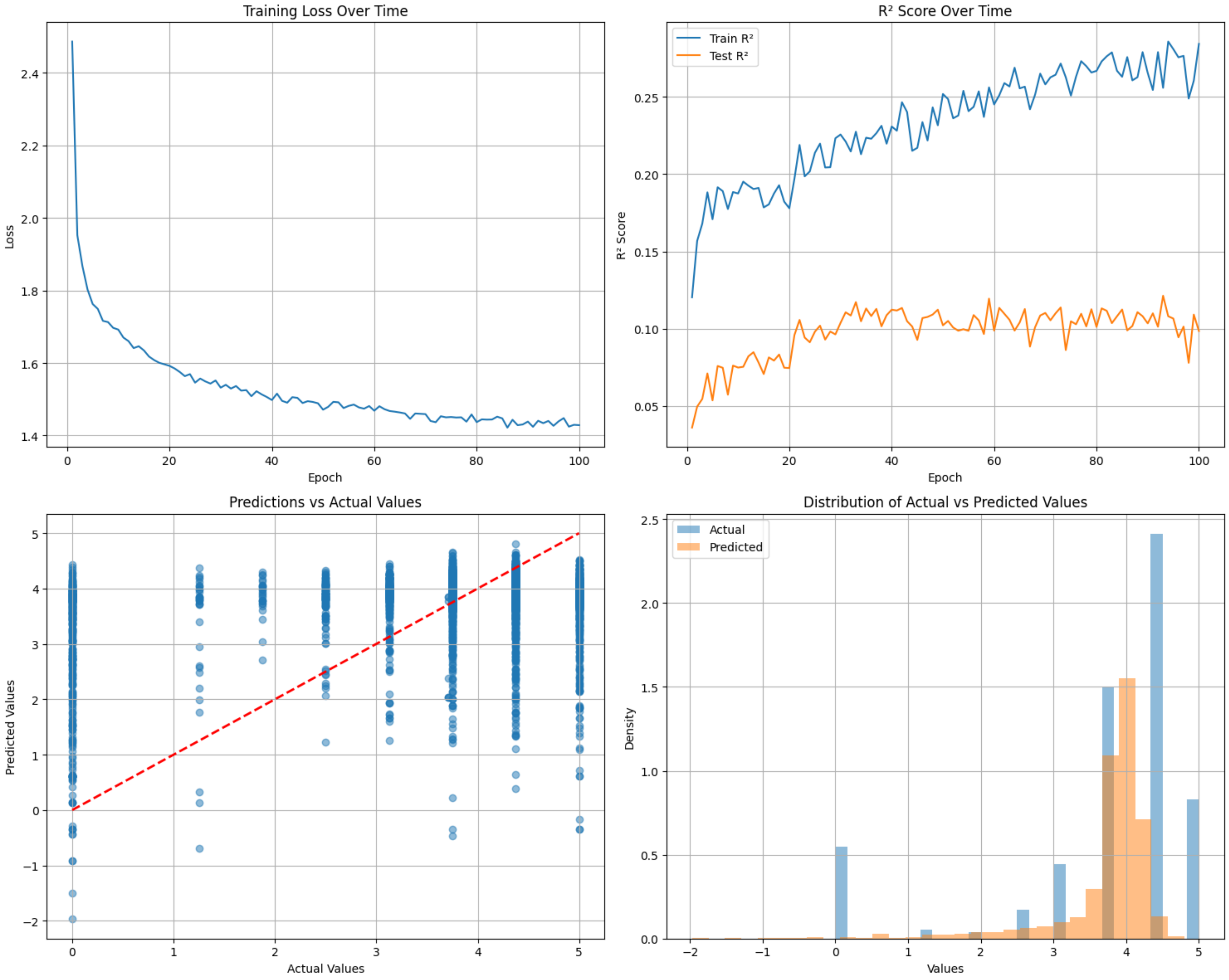
- 2 hidden layers (128 and 64 features).
- ReLu activation function.
- 30% dropout.



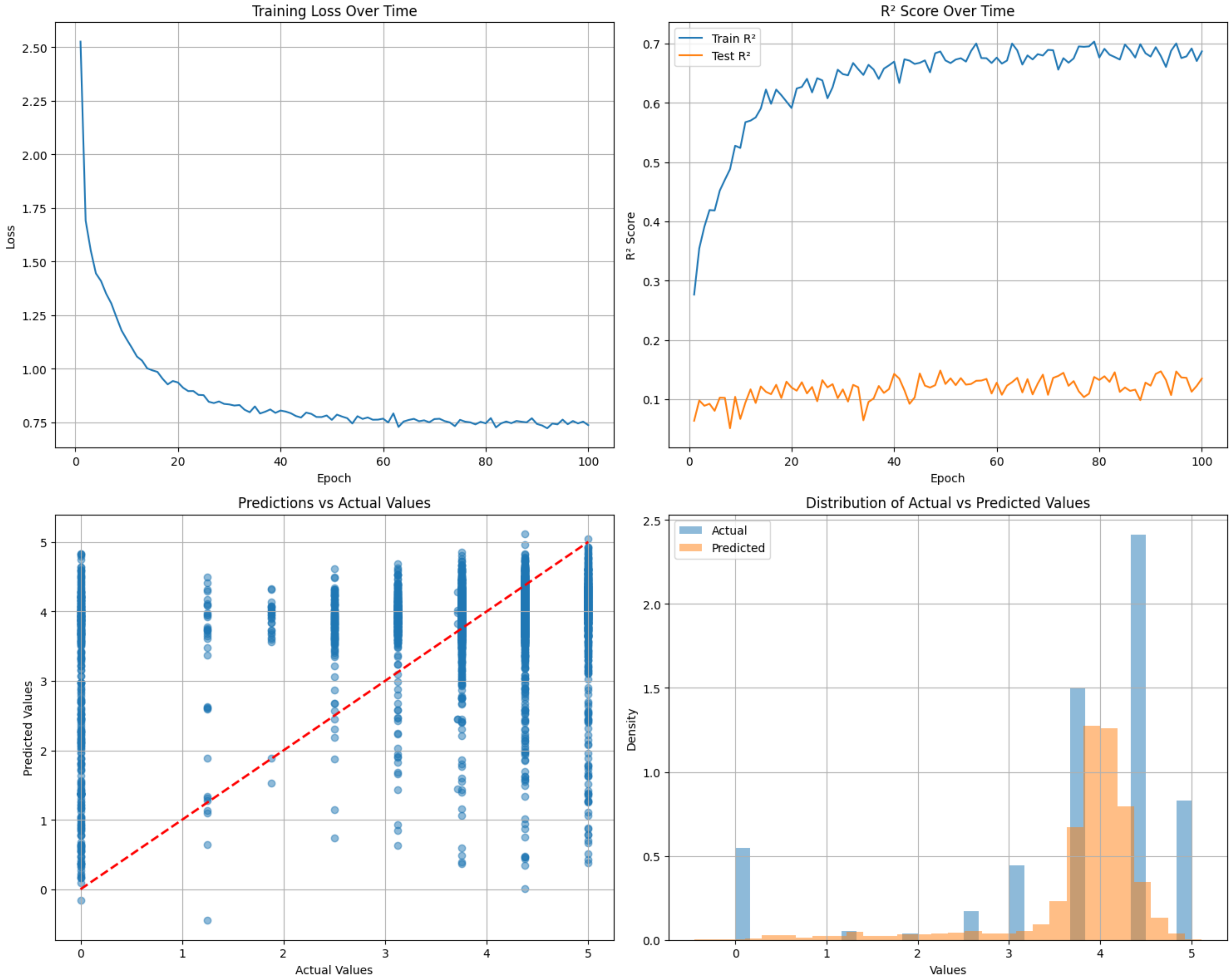
```
model_ML = nn.Sequential(
        nn.Linear(input_size, 128),
        nn.ReLU(),
        nn.Dropout(0.3),  # Add dropout
        nn.Linear(128, 64),
        nn.ReLU(),
        nn.Dropout(0.3),  # Add dropout
        nn.Linear(64, 1),
)
```

	Train R^2	**Test R^2**
TD-IDF	0,6869	0,1346
Word2Vec	0,206	0,1339
BERT	0,2843	0,0985

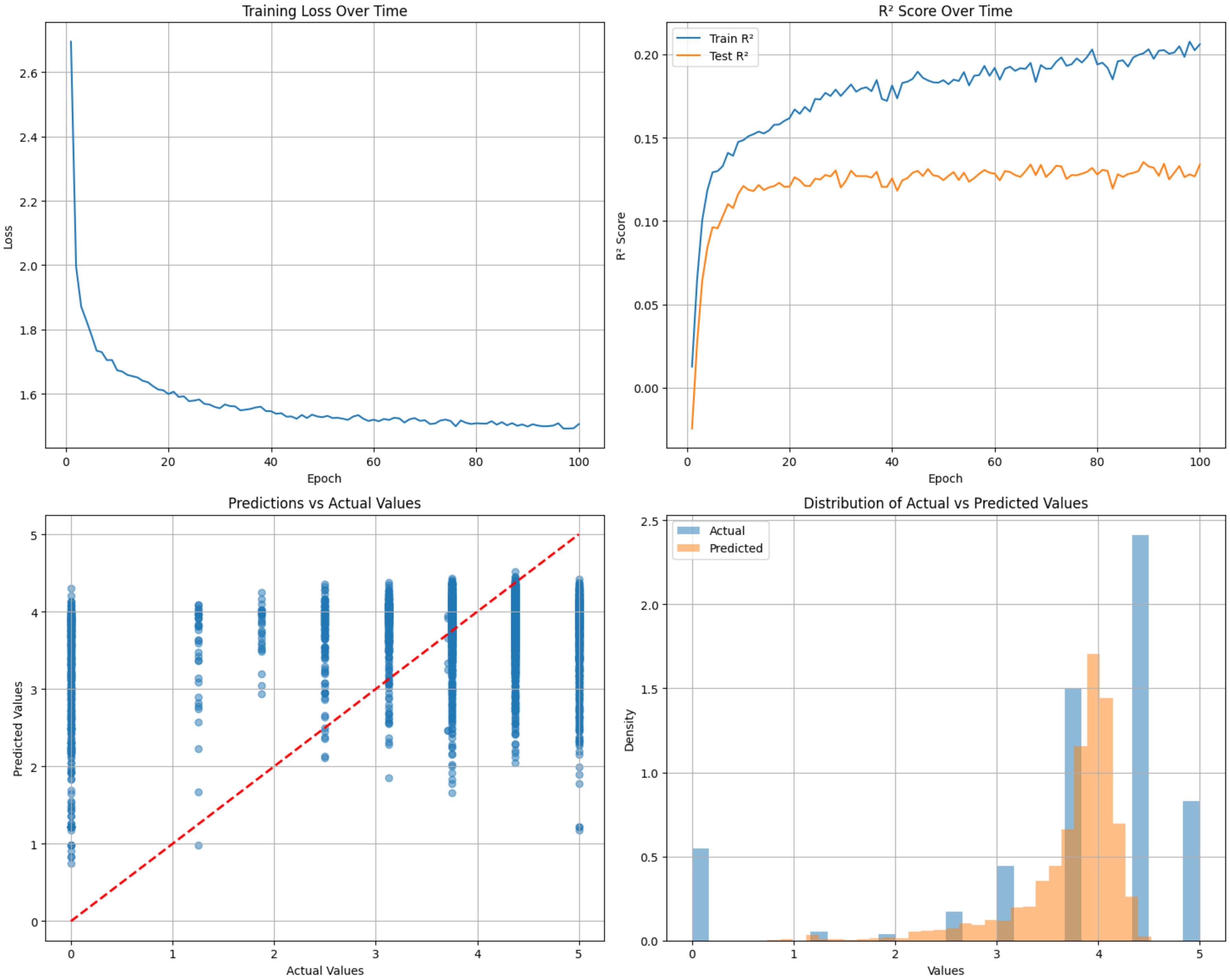
BERT


Training Loss Over Time
Loss
2.4
2.2
2.0
1.8
1.6
1.4
Epoch
0
20
40
60
80
100
R² Score Over Time
Train R²
Test R²
R² Score
0.25
0.20
0.15
0.10
0.05
Epoch
0
20
40
60
80
100
Predictions vs Actual Values
Predicted Values
5
4
3
2
1
0
−1
−2
Actual Values
0
1
2
3
4
5
Distribution of Actual vs Predicted Values
Actual
Predicted
Density
2.5
2.0
1.5
1.0
0.5
0.0
Values
−2
−1
0
1
2
3
4
5

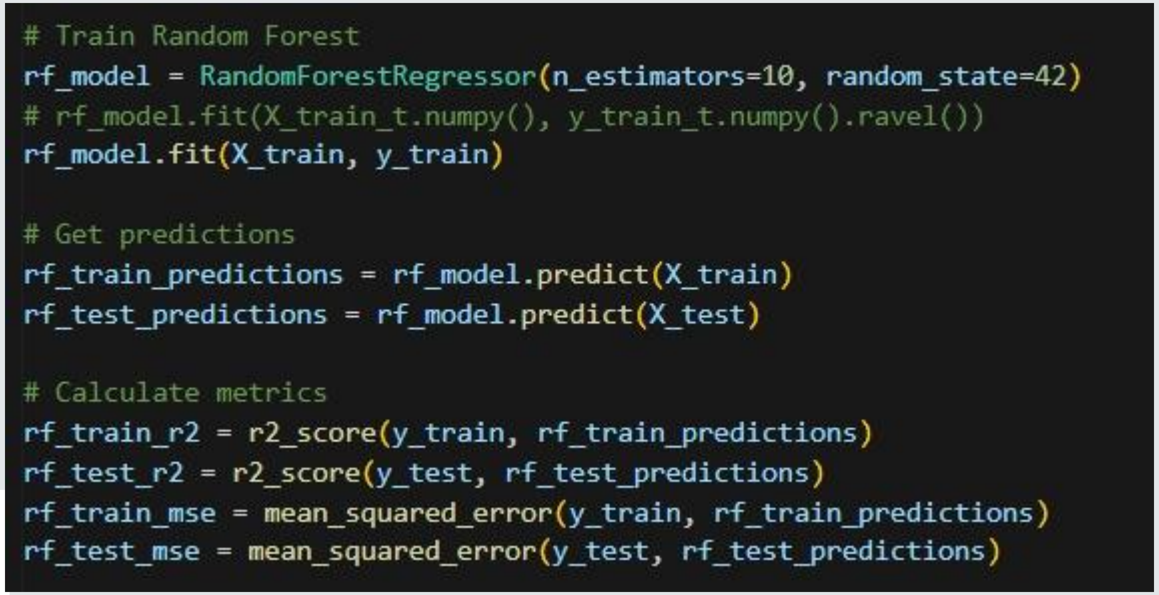
TF-IDF


Training Loss Over Time
Loss
Epoch
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0
20
40
60
80
100
R² Score Over Time
Train R²
Test R²
R² Score
Epoch
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Predictions vs Actual Values
Predicted Values
Actual Values
5
4
3
2
1
0
Distribution of Actual vs Predicted Values
Actual
Predicted
Density
Values
2.5
2.0
1.5
1.0
0.5
0.0

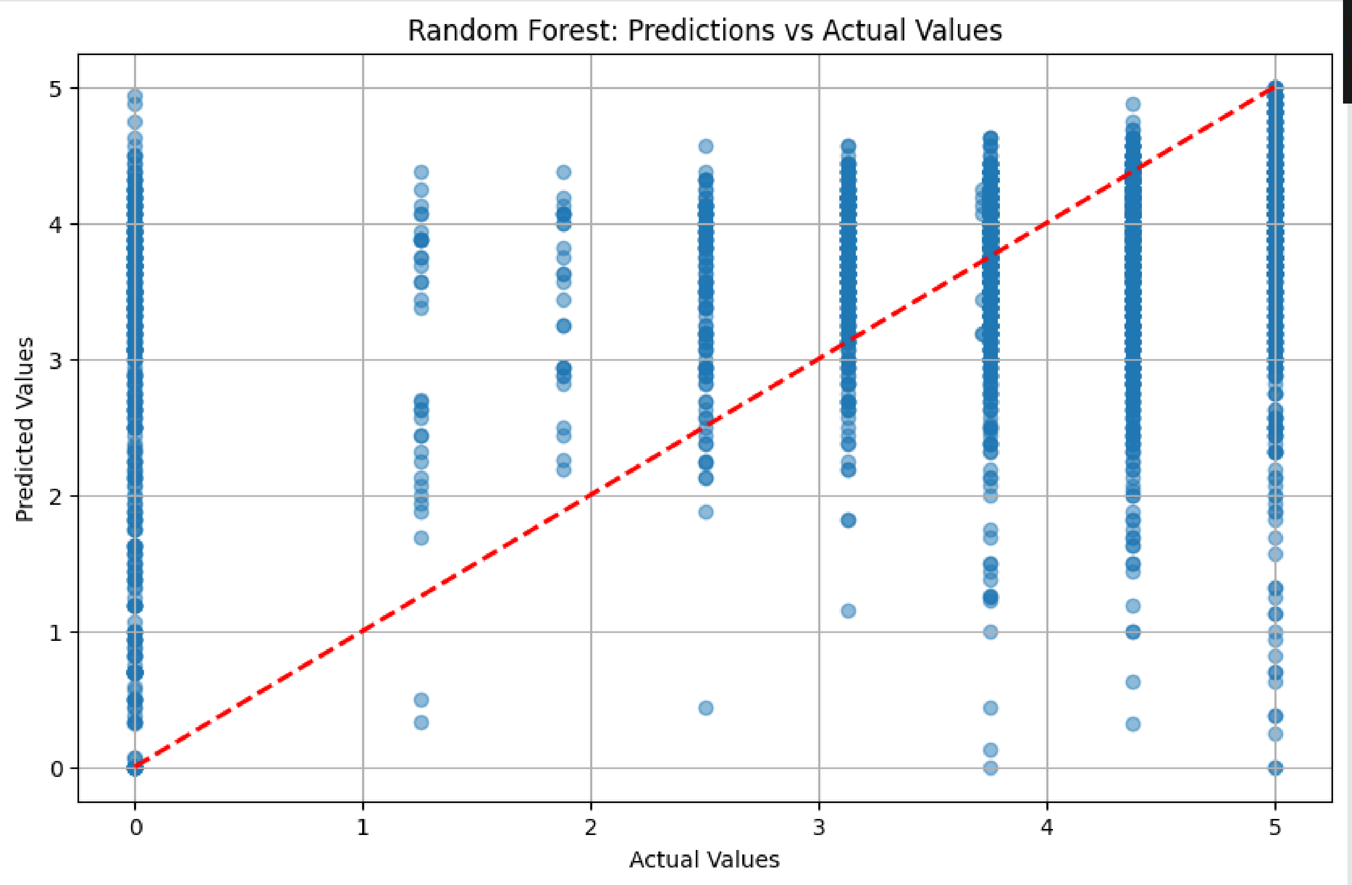
Word2Vec


Training Loss Over Time
Loss
2.6
2.4
2.2
2.0
1.8
1.6
Epoch
0
20
40
60
80
100
R² Score Over Time
Train R²
Test R²
R² Score
0.20
0.15
0.10
0.05
0.00
Epoch
0
20
40
60
80
100
Predictions vs Actual Values
Predicted Values
Actual Values
0
1
2
3
4
5
Distribution of Actual vs Predicted Values
Actual
Predicted
Density
2.5
2.0
1.5
1.0
0.5
0.0
Values
0
1
2
3
4
5

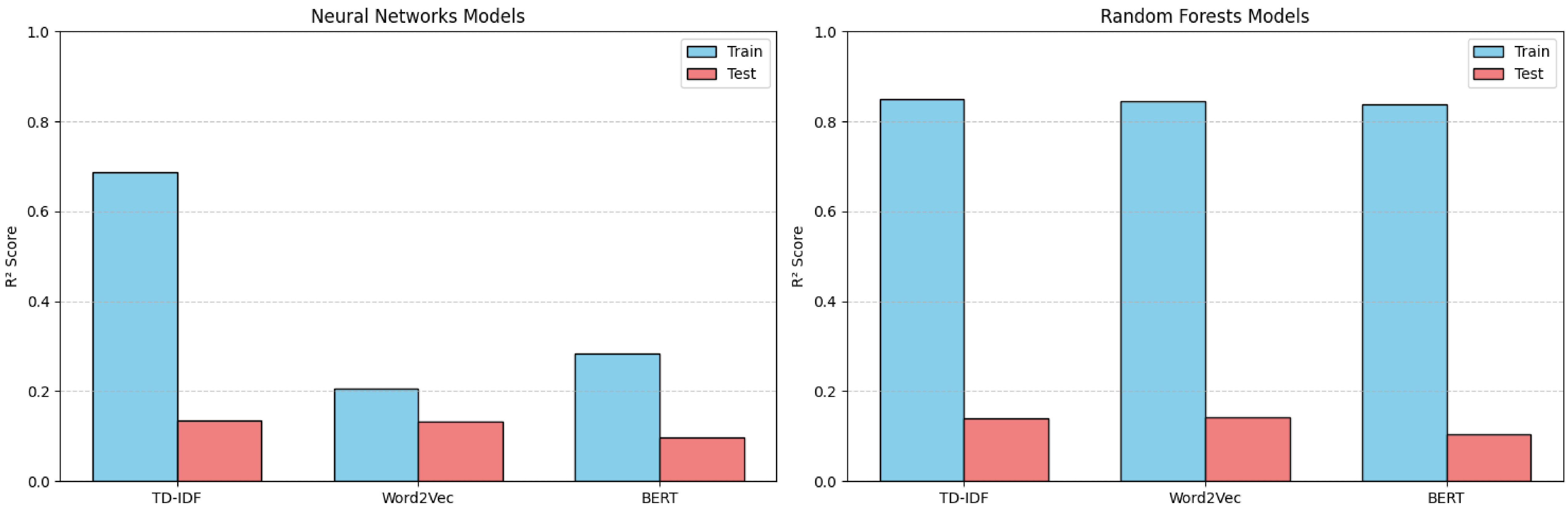
Random Forest



```
# Train Random Forest
rf_model = RandomForestRegressor(n_estimators=10, random_state=42)
# rf_model.fit(X_train_t.numpy(), y_train_t.numpy().ravel())
rf_model.fit(X_train, y_train)

# Get predictions
rf_train_predictions = rf_model.predict(X_train)
rf_test_predictions = rf_model.predict(X_test)

# Calculate metrics
rf_train_r2 = r2_score(y_train, rf_train_predictions)
rf_test_r2 = r2_score(y_test, rf_test_predictions)
rf_train_mse = mean_squared_error(y_train, rf_train_predictions)
rf_test_mse = mean_squared_error(y_test, rf_test_predictions)
```

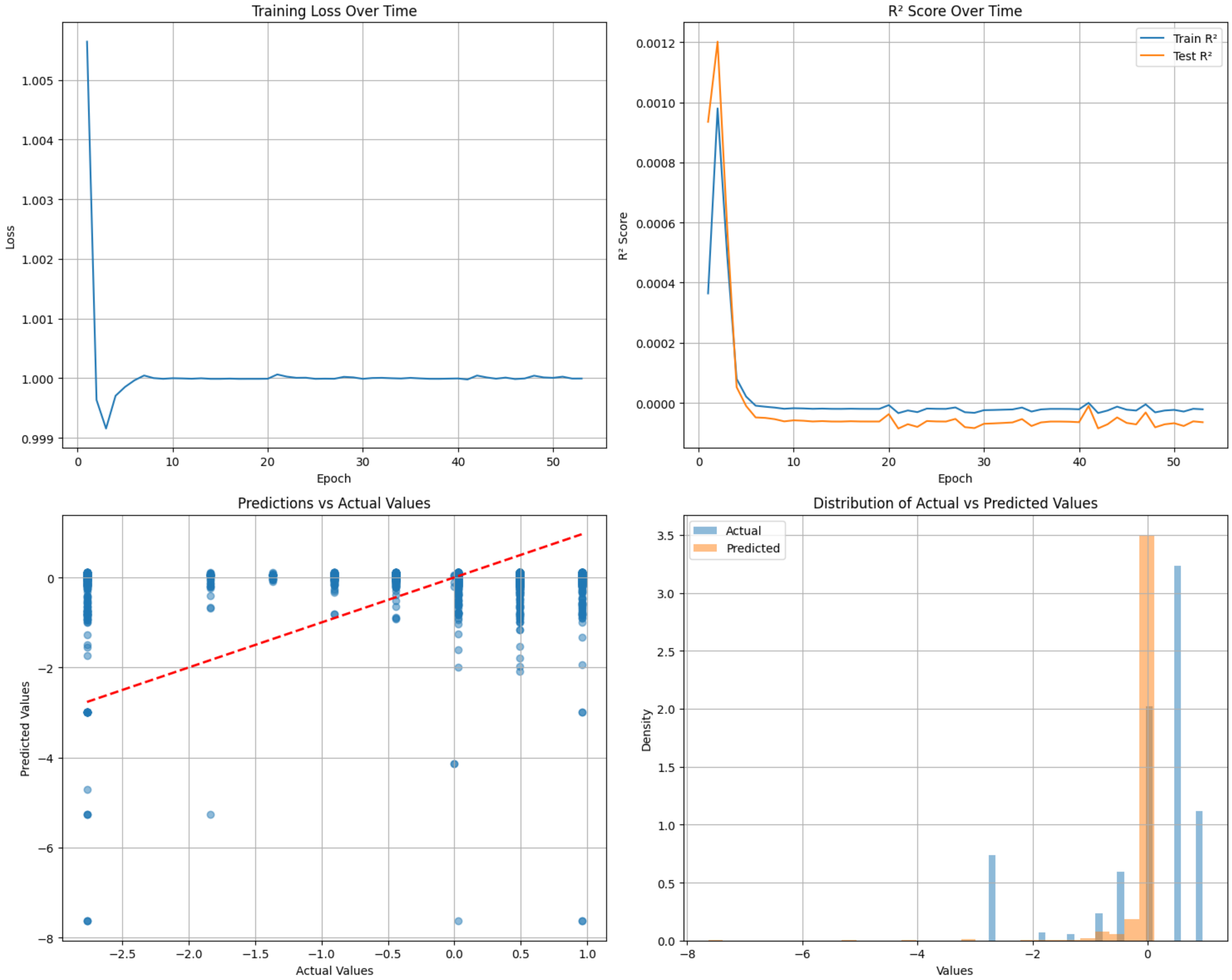


	Train R^2	Test R^2
TD-IDF	0,8489	0,1388
Word2Vec	0,844	0,1419
BERT	0,8378	0,1037


Neural Networks Models
Random Forests Models
R² Score
1.0
0.8
0.6
0.4
0.2
0.0
Train
Test
TD-IDF
Word2Vec
BERT

Hugging Face

We used RoBERTa as a model but the results were not better



Conclusion

Problems

- Bad regression model results.

Possible solutions

- Try different models.
- Find correlated inputs.

THANK YOU VERY MUCH

Iker Aldasoro

Jon Lejardi