6. Conclusion

6.1 Model Performance Summary:

Model	Best Alpha	Best L1 Ratio	MSE	MAE	R-squared
Multiple Linear Regression model	-	-	5.01	0.78	0.9123
Tuned Ridge Regression model	1	-	4.99	0.78	0.9126
Lasso Regression model	0.01	-	4.96	0.79	0.9131
Elastic Net Regression model	0.01	0.9	4.93	0.79	0.9136

6.2 Interpretation and Assessment:

- All models exhibit outstanding predictive performance with R-squared values around 91%, indicating strong explanatory power.
- Low MSE and MAE values signify accurate predictions with minimal errors.
- The Final Lasso and Elastic Net Regression models slightly outperform than Multiple Linear Regression and Tuned Ridge Regression.

6.3 Model Evaluation on Unseen Data:

- Elastic Net Regression on Unseen Data:
    - MSE: 0.426
    - MAE: 0.528
    - R-squared: 0.947

```
Model Evaluation on Unseen Data:
Mean Squared Error: 0.4262926426557641
Mean Absolute Error: 0.5281278549837918
R-squared: 0.9466440569420541
```

- The Final Elastic Net Regression model, with the best alpha of 0.01 and L1 ratio of 0.9, performs well on unseen data.
- The R-squared value of 0.947 indicates that approximately 95% of the variance in fire intensity is explained by the model.
- The MSE and MAE values are relatively low, suggesting accurate predictions on the unseen dataset.

6.4 Conclusion:

- The Elastic Net Regression model demonstrates robust performance on both the training and unseen datasets.
- The model's strengths are evident in its accurate prediction of fire intensity, showcasing its reliability across different datasets.
- Implementation of Outlier Detection and Handling proved successful: Future work involves refining outlier detection methods and assessing their sustained impact on model performance.
- Hyperparameter Tuning for ridge, lasso, and elastic net regularization significantly improved model performance: Continuous tuning of hyperparameters is encouraged to maximize predictive accuracy.
- While the model excels, there are opportunities for further feature engineering to explore additional variables that may enhance predictive capabilities.
- Recommendations for improvement include ongoing exploration of additional features and fine-tuning hyperparameters, contributing to the model's continuous refinement and adaptability to evolving datasets.

6.5 Next Steps for Improvement:

- Feature Engineering: Explore additional features that might enhance the models' predictive capabilities.
- Cross-Validation: Implement robust cross-validation techniques for more reliable model evaluation. Techniques such as k-fold cross-validation can provide a more comprehensive assessment of the model's performance across different subsets of the data.
- Ensemble Models: Consider ensemble techniques to combine predictions from multiple models for improved accuracy. Ensemble methods, such as bagging or boosting, can leverage the strengths of different models and mitigate individual model weaknesses, leading to enhanced overall performance.

Overall, the Elastic Net Regression model demonstrates consistent high-quality predictions across both training and unseen datasets, setting the stage for ongoing model enhancement and refinement.