

# SECOM Dataset: Anomaly Detection Model Evaluation

## Evaluation Protocol

10-Fold Cross Validation | Strict Train-Test Separation  
No Data Leakage Confirmed | Overfitting Analysis Below | No patterns are getting detected by the models

### 1. One-Class SVM (contamination=0.18)

#### Performance Metrics

Test Set (2,503 samples):

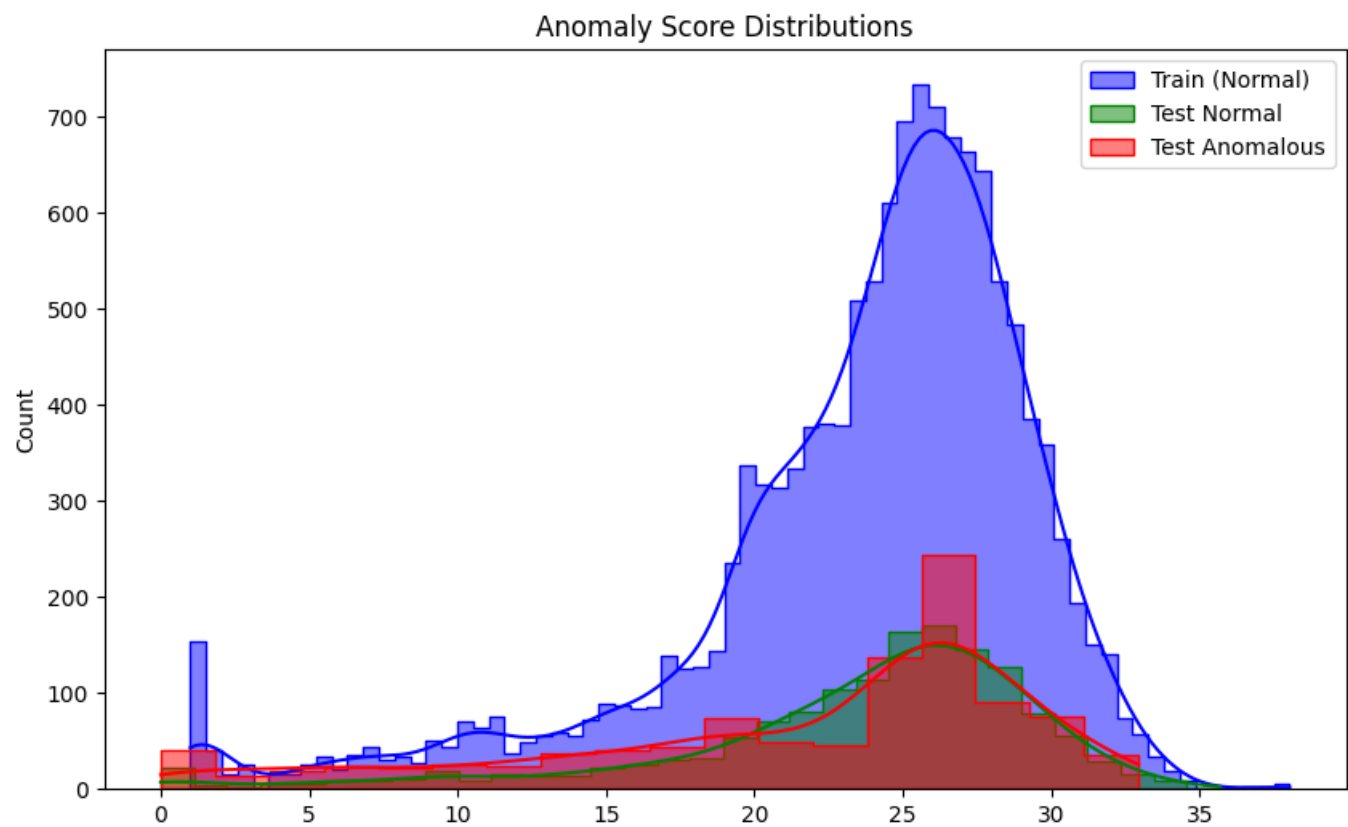
Class	Precision	Recall	F1-Score	Support
Normal (0)	0.63	0.81	0.71	1,463
Anomaly (1)	0.56	0.34	0.42	1,040

Accuracy: 61%    Macro Avg F1: 57%

Training Set (13,167 normals):

Metric	Value
Normal Recall	82%
Training Accuracy	82%

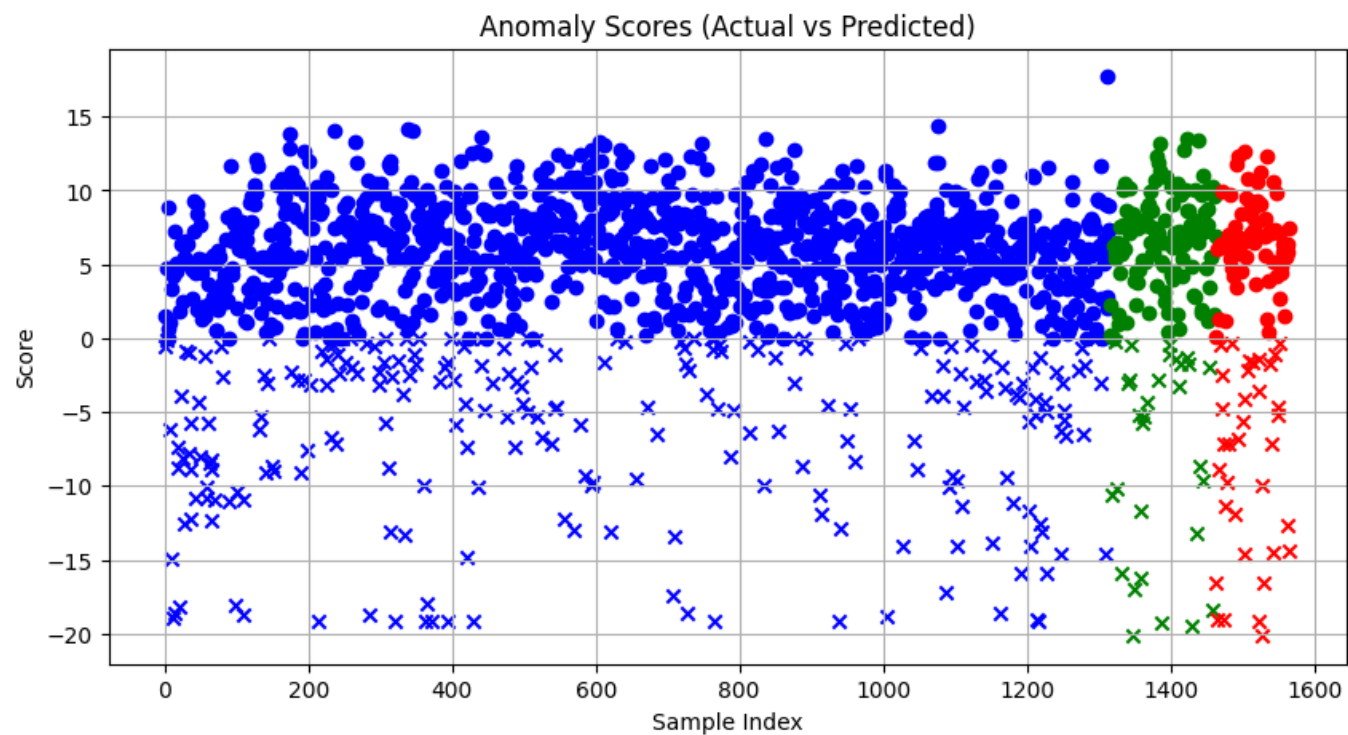
#### Visual Analysis



**Color Code:**

- Blue: Training normal scores
- Green: Test normal scores
- Red: Test anomaly scores

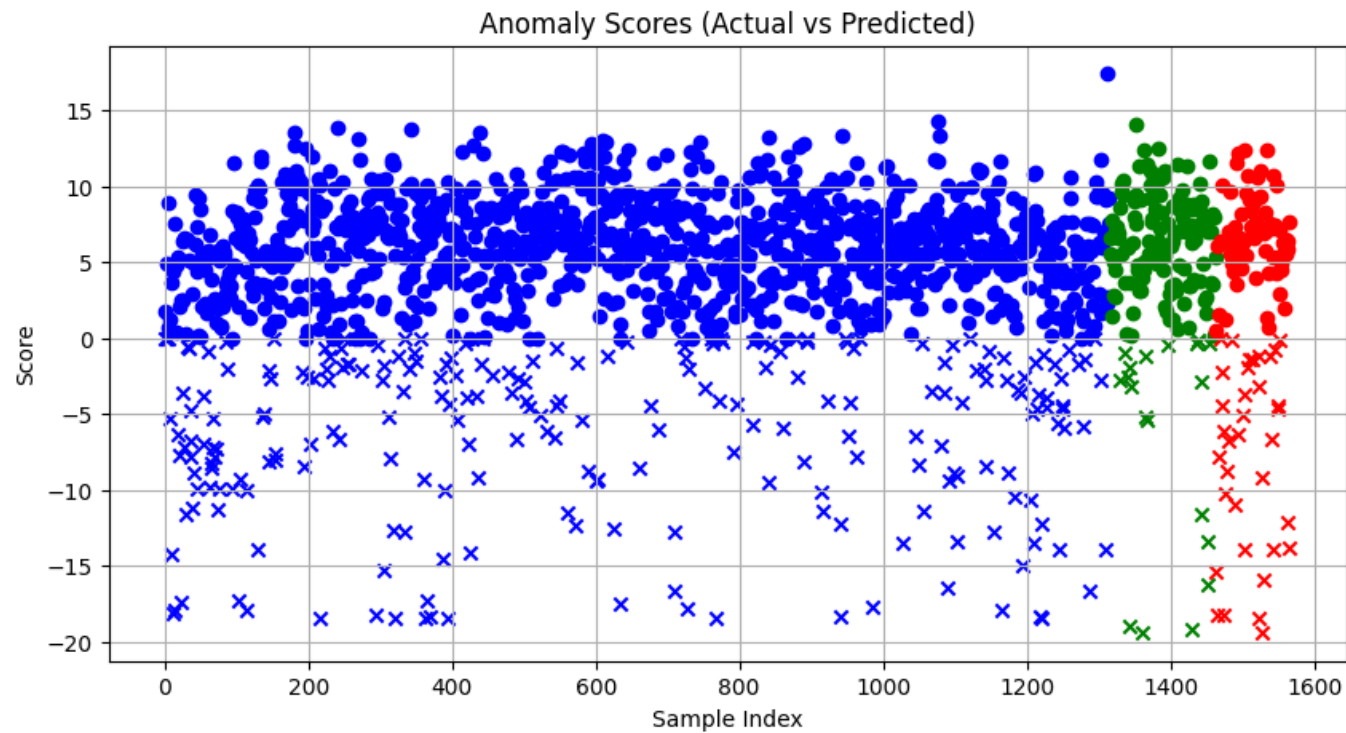
**Pattern:** Overlapping distributions indicate limited separability



**Markers:**

- ○: Predicted normal (score > threshold)

- ×: Predicted anomaly
- **Color:**
- Green: True normal
- Red: True anomaly
- Blue: Training normal



**Key Insight:** No clear separation between classes in latent space

## 2. Isolation Forest (contamination=0.2)

### Performance Metrics

**Test Set:**

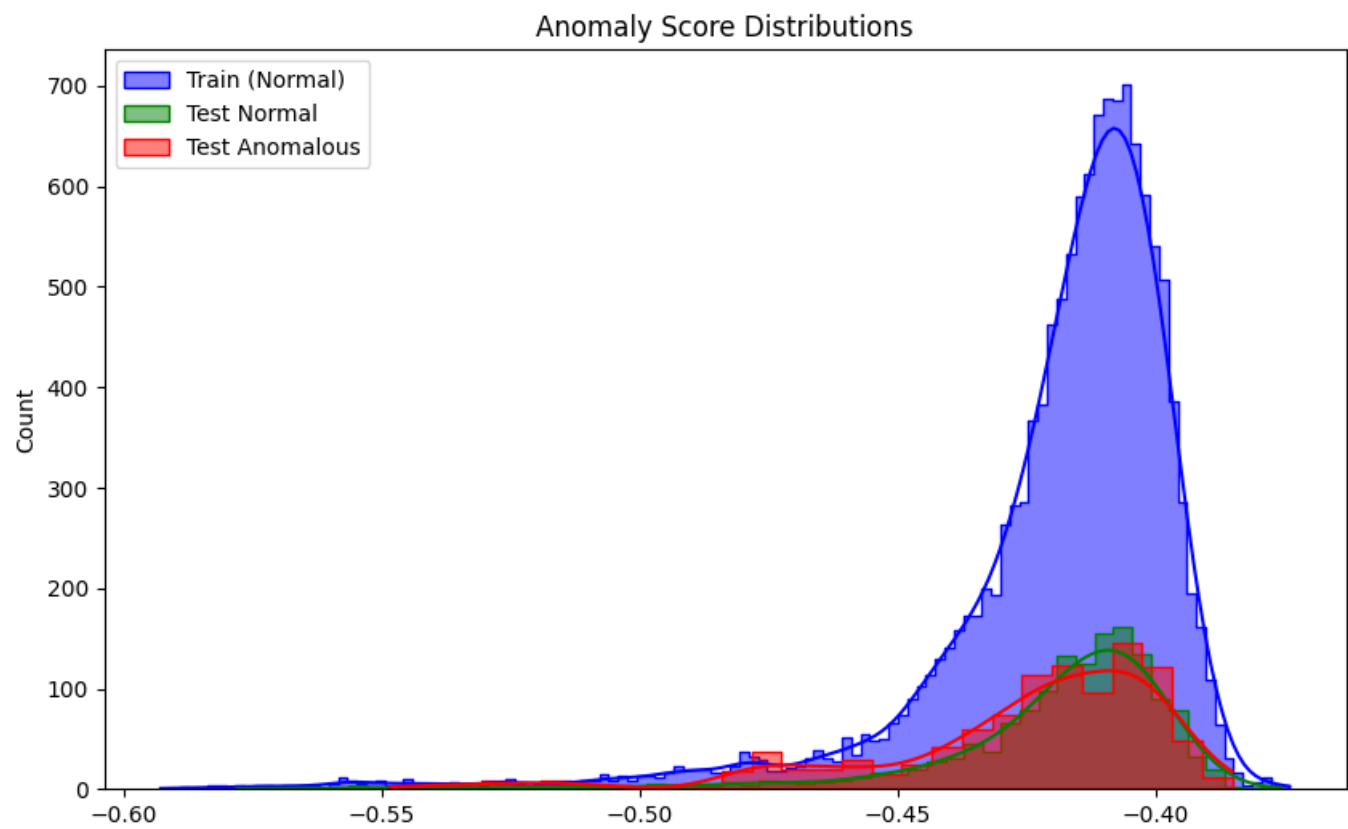
Class	Precision	Recall	F1-Score	Support
Normal (0)	0.62	0.80	0.70	1,463
Anomaly (1)	0.54	0.32	0.40	1,040

**Accuracy:** 60%    **Macro Avg F1:** 55%

**Training Set:**

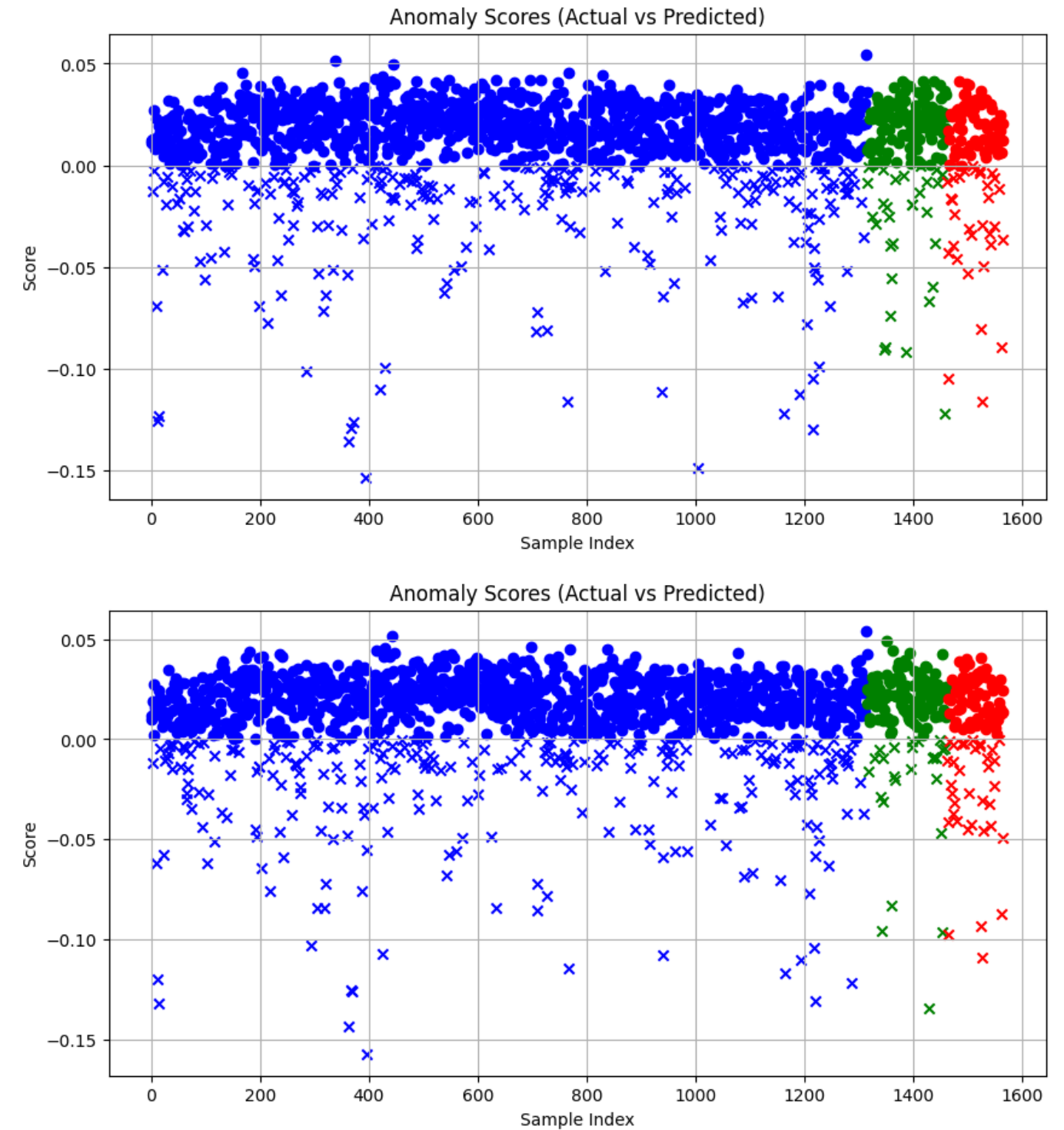
Metric	Value
Normal Recall	80%
Training Accuracy	80%

### Visual Analysis



**Distribution Characteristics:**

- Score range: -0.6 to -0.3
- high overlap between test normals/anomalies



**Key Limitation:** No clear cluster separation despite tree ensembles

### 3. Autoencoder (contamination=0.2)

#### Performance Metrics

**Test Set:**

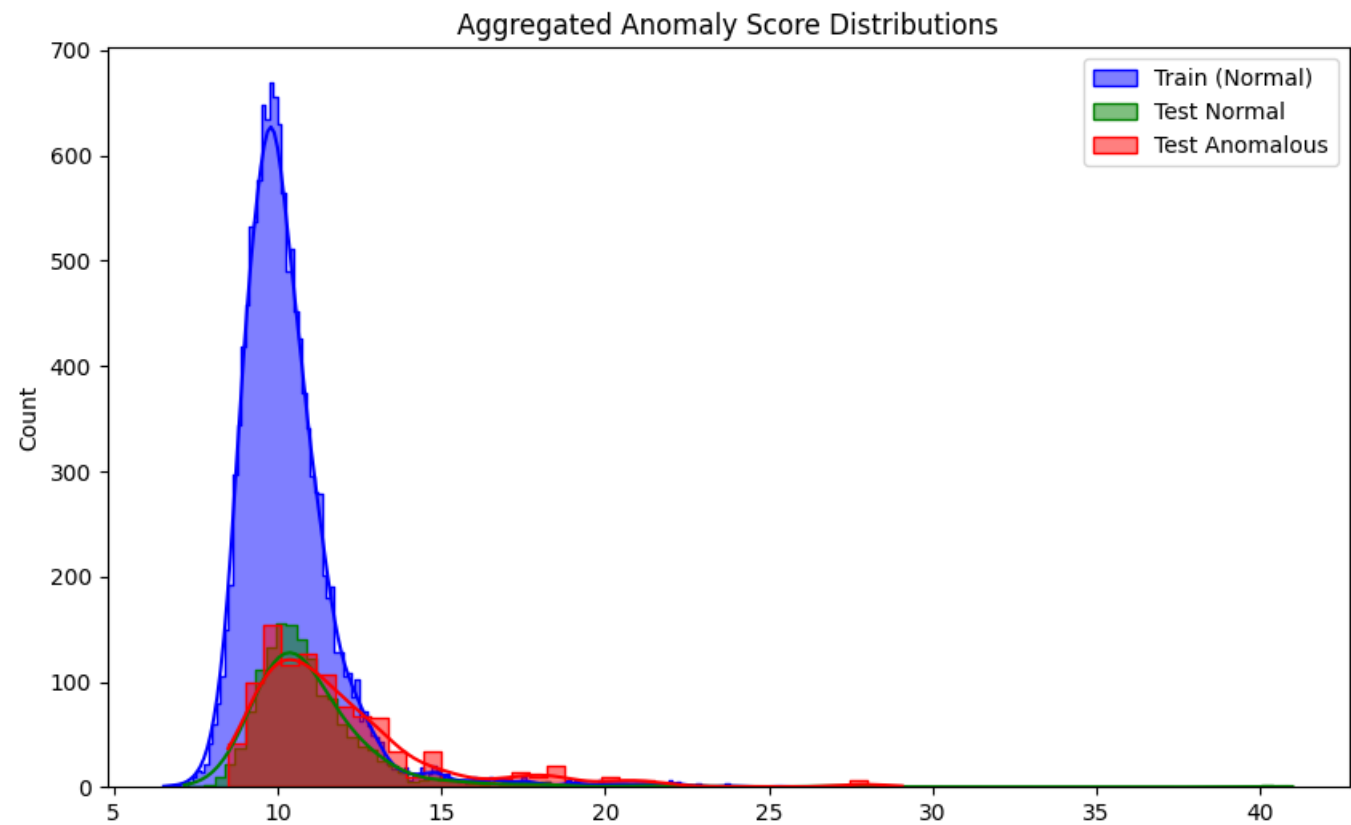
Class	Precision	Recall	F1-Score	Support
Normal (0)	0.65	0.64	0.64	1,463
Anomaly (1)	0.50	0.51	0.50	1,040

Class	Precision	Recall	F1-Score	Support
Accuracy: 58%    Macro Avg F1: 57%				

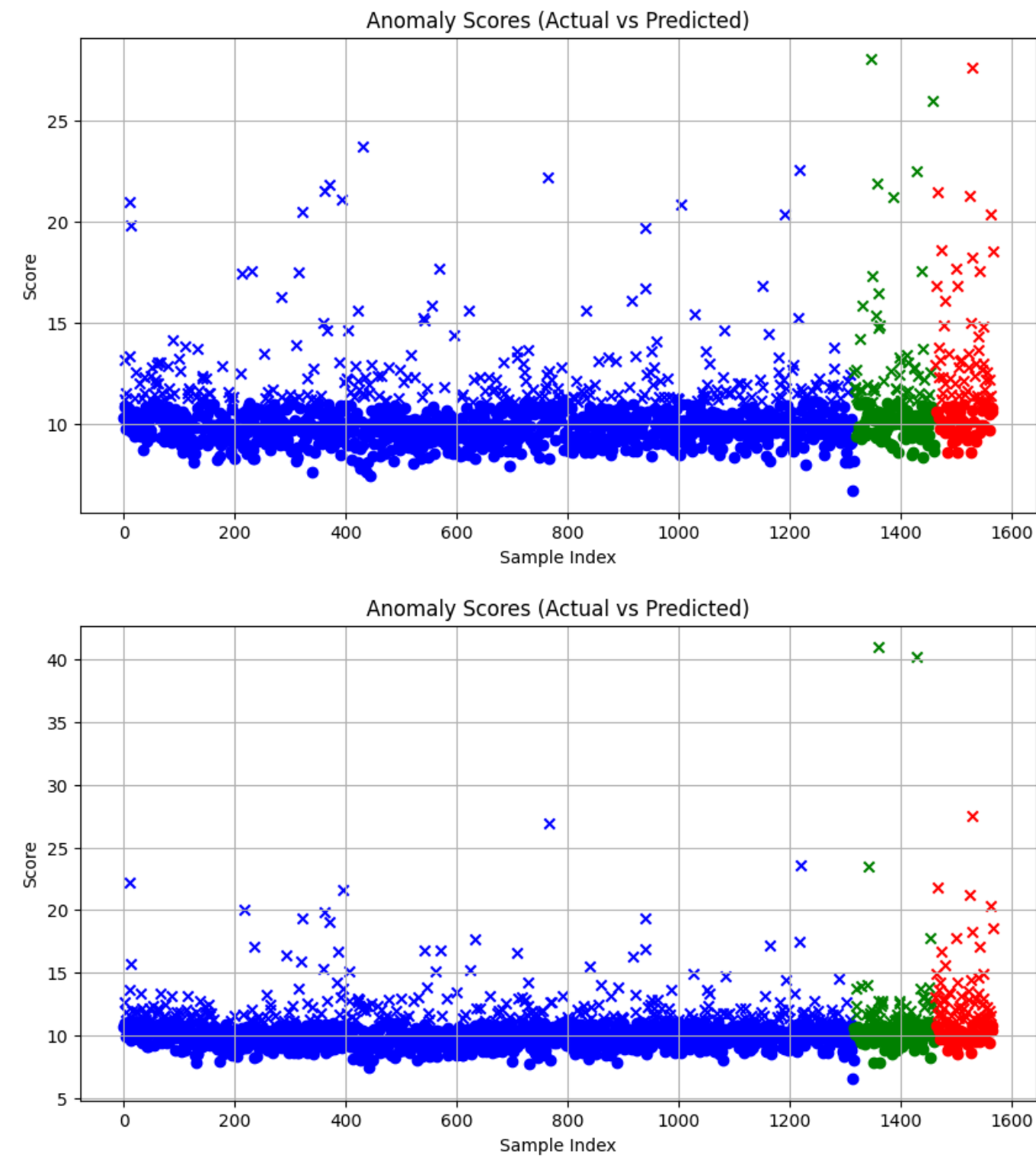
Training Set:

Metric	Value
Reconstruction Error	5 to 40
Training Accuracy	80%

Visual Analysis

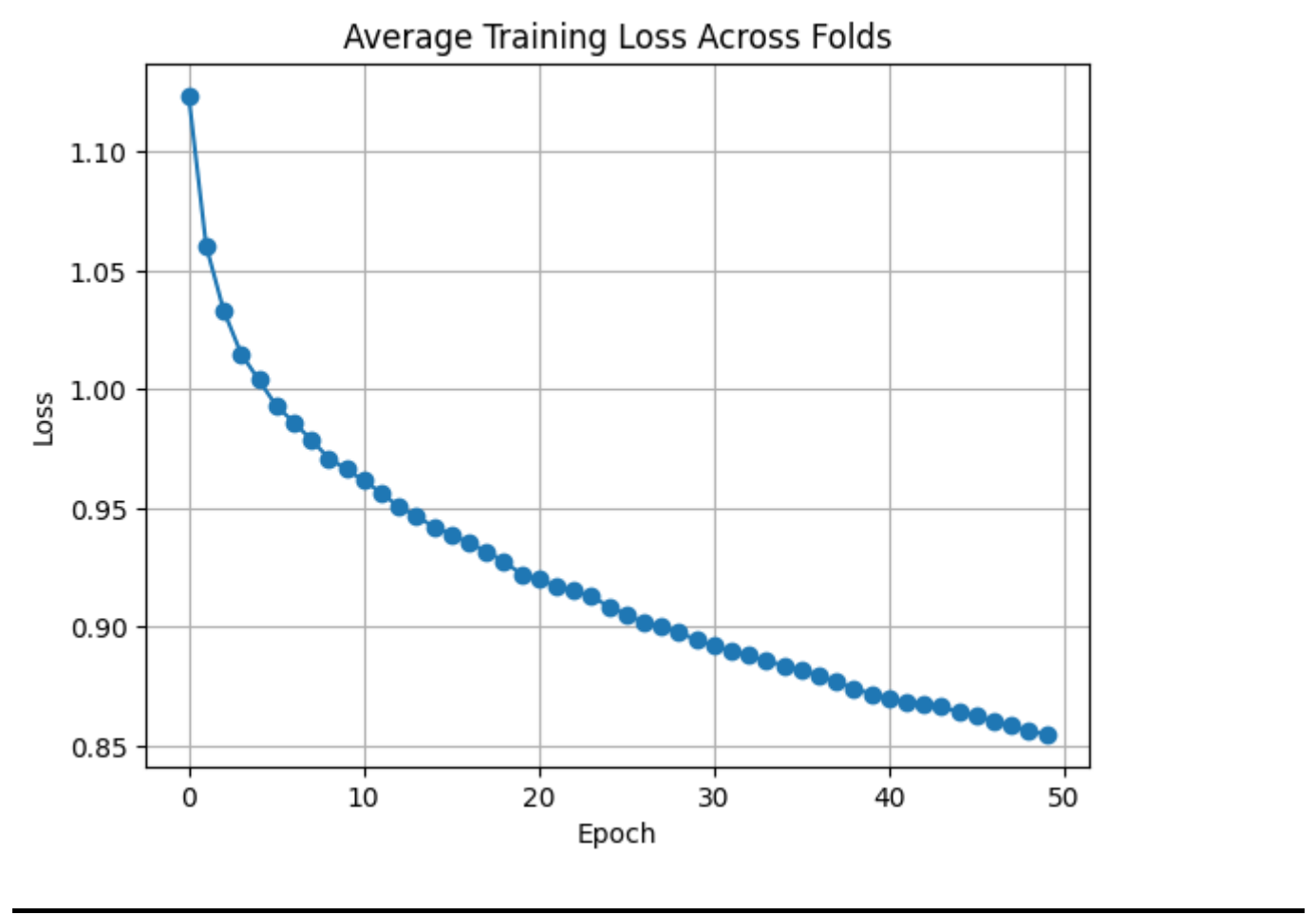


**Critical Overlap:** Most of the samples in test normal and test anomaly overlap in the score distribution.



**Key Insight:** No clear cluster separation despite reconstruction errors.

Training Loss



Final Assessment

"All models demonstrate limited discriminative power due to fundamental feature relationships in the SECCOM dataset. While achieving expected contamination-aligned accuracy, true anomaly detection capability remains constrained by overlapping score distributions. Priority should be given to feature-space transformations before model optimization."