04_length_of_stay_model

July 20, 2025

1 Stay Length Prediction Model

This notebook builds a regression model to predict the follow-up duration (`time`) of heart failure patients.

[1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score
import numpy as np
import joblib

sns.set(style='whitegrid')
```

1.1 Load Dataset and Prepare Features

[2]:
```
df = pd.read_csv('E:/hospital_analytics_project/data/raw/
 ↪heart_failure_clinical_records_dataset.csv')

# Feature engineering
df['is_elderly'] = (df['age'] > 65).astype(int)
df['low_ejection'] = (df['ejection_fraction'] < 30).astype(int)
df['high_creatinine'] = (df['serum_creatinine'] > 1.5).astype(int)
df['combined_risk_score'] = df['is_elderly'] + df['low_ejection'] +␣
 ↪df['high_creatinine']

# Define features and target for regression
y = df['time']
X = df.drop(columns=['time', 'DEATH_EVENT'])
```

1.2 Train-Test Split

[3]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

1.3 Train Gradient Boosting Regressor

[4]:
```
model = GradientBoostingRegressor(n_estimators=200, learning_rate=0.05,␣
↪random_state=42)
model.fit(X_train, y_train)

y_pred = model.predict(X_test)
```

1.4 Evaluation Metrics

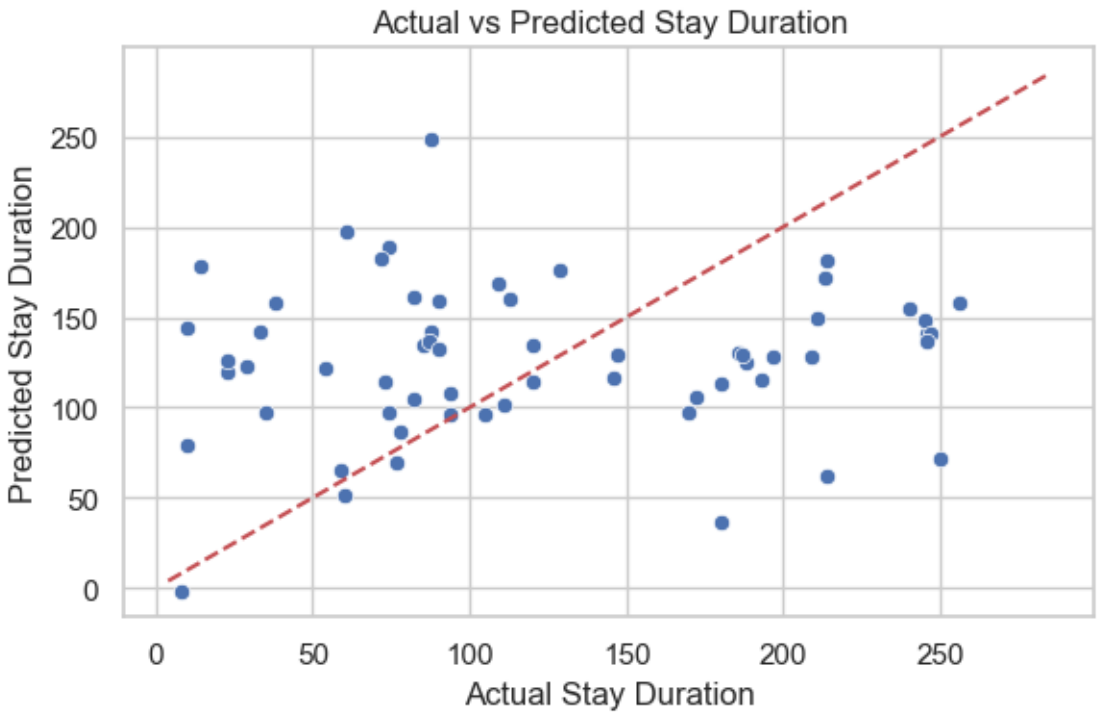
[5]:
```
mae = mean_absolute_error(y_test, y_pred)
rmse = np.sqrt(mean_squared_error(y_test, y_pred))
r2 = r2_score(y_test, y_pred)

print(f"MAE: {mae:.2f}")
print(f"RMSE: {rmse:.2f}")
print(f"R² Score: {r2:.2f}")
```

```
MAE: 68.14
RMSE: 81.72
R² Score: -0.22
```

1.5 Predicted vs Actual Plot

[6]:
```
plt.figure(figsize=(6, 4))
sns.scatterplot(x=y_test, y=y_pred)
plt.xlabel('Actual Stay Duration')
plt.ylabel('Predicted Stay Duration')
plt.title('Actual vs Predicted Stay Duration')
plt.plot([y.min(), y.max()], [y.min(), y.max()], '--r')
plt.grid(True)
plt.tight_layout()
plt.show()
```



1.6 Save the Model

[7]:
```
joblib.dump(model, 'E:/hospital_analytics_project/models/stay_length_model.pkl')
print("Model saved to E:/hospital_analytics_project/models/stay_length_model.
  ↪pkl")
```

```
Model saved to E:/hospital_analytics_project/models/stay_length_model.pkl
```