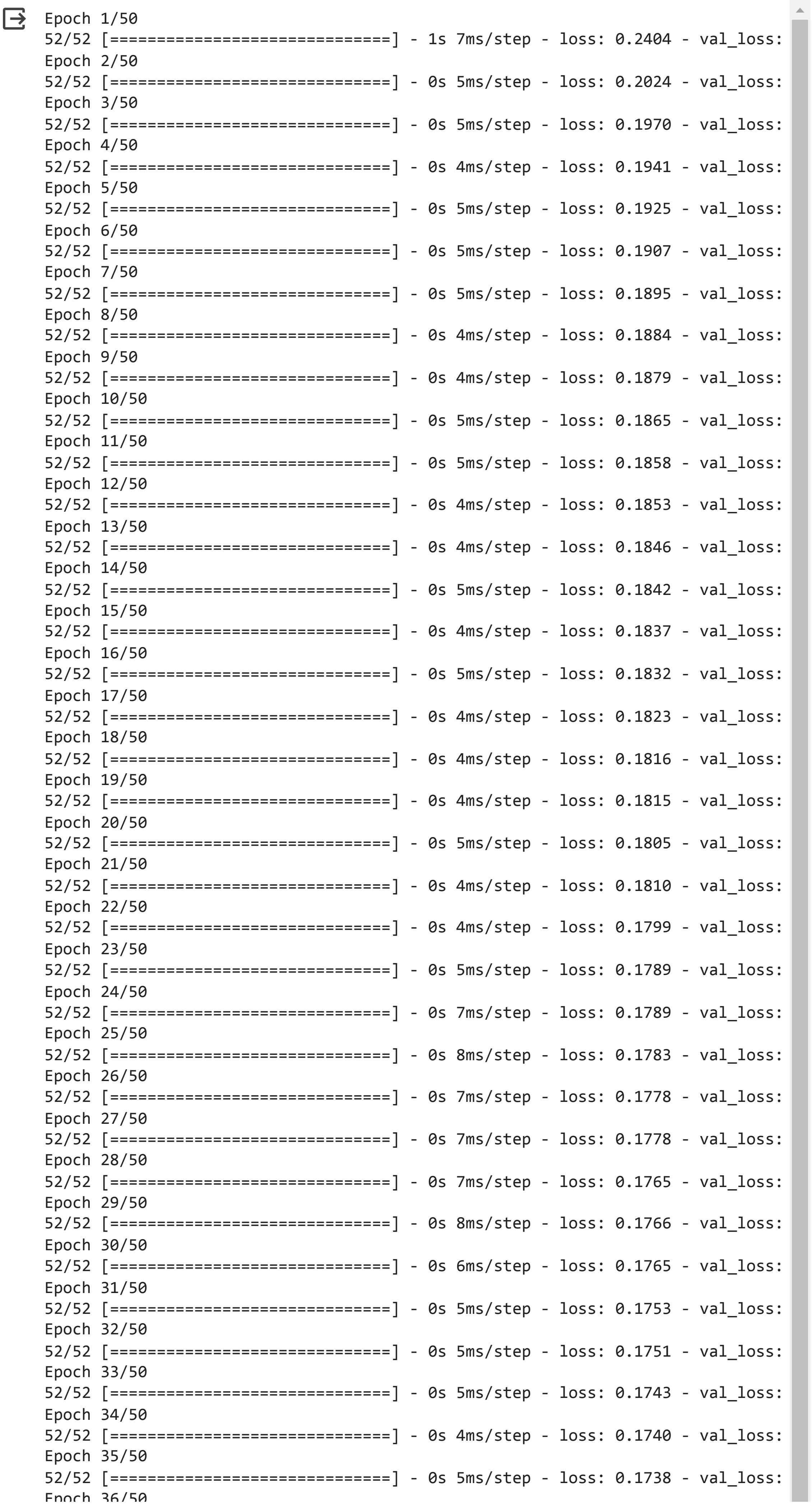
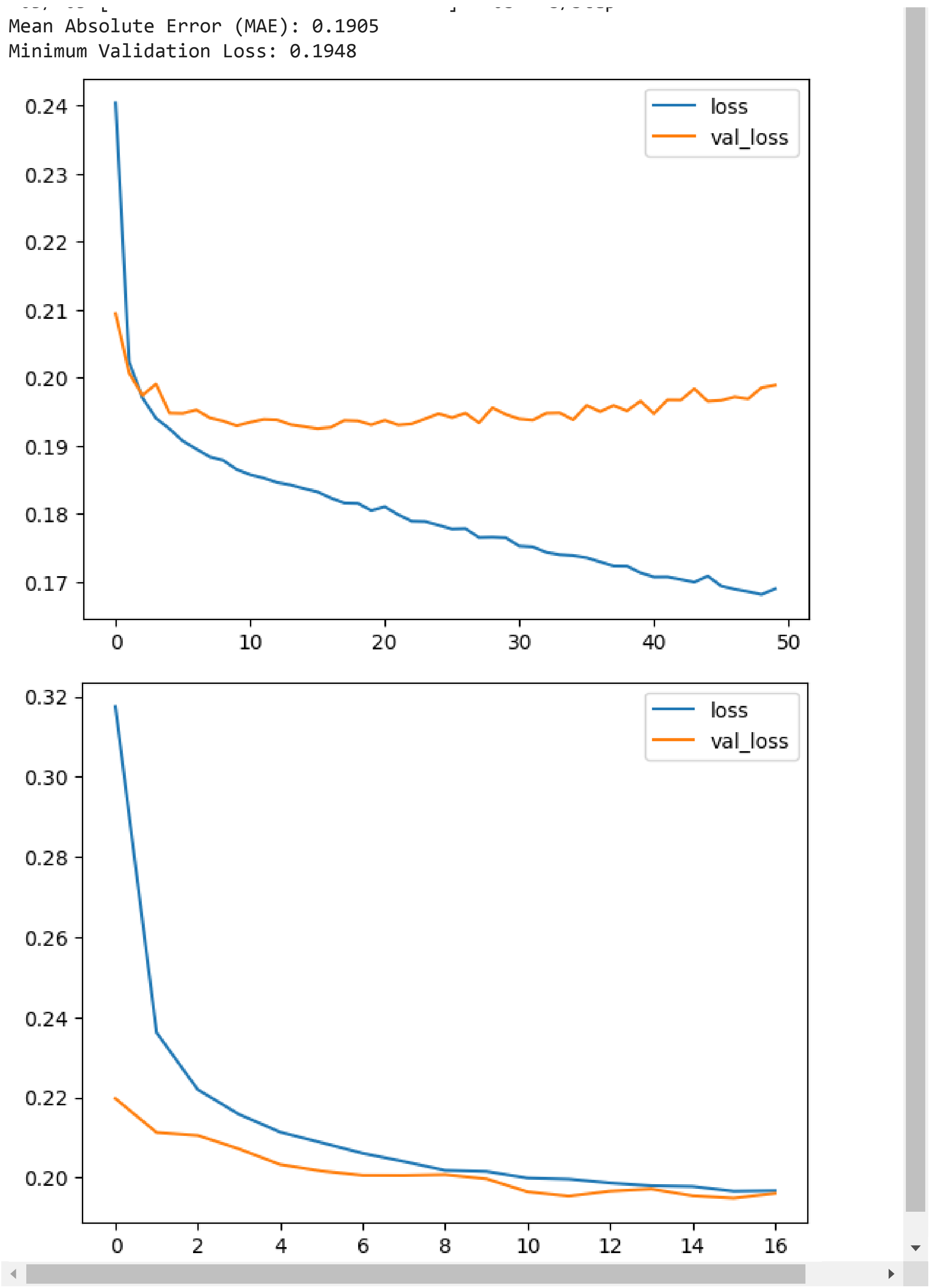
Experment-8 : Demonstrate working of dropout and earlystoping on Spotify dataset

```
import pandas as pd
from sklearn.preprocessing import StandardScaler, OneHotEncoder
from sklearn.compose import make_column_transformer
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_absolute_error
from tensorflow import keras
from tensorflow.keras import layers
from tensorflow.keras.callbacks import EarlyStopping

# Load dataset
spotify = pd.read_csv('/content/spotify.csv')

# Prepare features and target
X = spotify.dropna().copy()
y = X.pop('track_popularity') / 100
artists = X['track_artist']

# Define features
features_num = ['danceability', 'energy', 'key', 'loudness', 'mode',
                'speechiness', 'acousticness', 'instrumentalness',
                'liveness', 'valence', 'tempo', 'duration_ms']
features_cat = ['playlist_genre']

# Preprocess features
preprocessor = make_column_transformer(
    (StandardScaler(), features_num),
    (OneHotEncoder(), features_cat),
)
X = preprocessor.fit_transform(X)

# Split dataset
X_train, X_temp, y_train, y_temp = train_test_split(X, y, test_size=0.2, random_state=42)
X_valid, X_test, y_valid, y_test = train_test_split(X_temp, y_temp, test_size=0.5, random_state=42)

# Define model
model = keras.Sequential([
    layers.Dense(128, activation='relu', input_shape=[X_train.shape[1]]),
    # layers.Dropout(0.3),
    layers.Dense(64, activation='relu'),
    # layers.Dropout(0.3),
    layers.Dense(1)
])

model.compile(optimizer='adam', loss='mae')

history = model.fit(
    X_train, y_train,
    validation_data=(X_valid, y_valid),
    batch_size=512,
    epochs=50,
    verbose=1
)

# Evaluate model on test data
test_loss = model.evaluate(X_test, y_test)
print("Test Loss (MAE): {:.4f}".format(test_loss))
```

```
# Additional evaluation metrics
y_pred = model.predict(X_test)
mae = mean_absolute_error(y_test, y_pred)
print("Mean Absolute Error (MAE): {:.4f}".format(mae))

history_df = pd.DataFrame(history.history)
history_df.loc[:, ['loss', 'val_loss']].plot()
print("Minimum Validation Loss: {:0.4f}".format(history_df['val_loss'].min()))

# Define model
model_D_and_E = keras.Sequential([
    layers.Dense(128, activation='relu', input_shape=[X_train.shape[1]]),
    layers.Dropout(0.3),
    layers.Dense(64, activation='relu'),
    layers.Dropout(0.3),
    layers.Dense(1)
])

# Compile model
model_D_and_E.compile(optimizer='adam', loss='mae')

# Define early stopping
early_stopping = EarlyStopping(monitor='val_loss', min_delta=0.001, patience=5, restore_best_weights=True)

# Train model
history = model_D_and_E.fit(
    X_train, y_train,
    validation_data=(X_valid, y_valid),
    batch_size=512,
    epochs=50,
    callbacks=[early_stopping],
    verbose=1
)

# Evaluate model on test data
test_loss = model_D_and_E.evaluate(X_test, y_test)
print("Test Loss (MAE): {:.4f}".format(test_loss))

# Additional evaluation metrics
y_pred = model_D_and_E.predict(X_test)
mae = mean_absolute_error(y_test, y_pred)
print("Mean Absolute Error (MAE): {:.4f}".format(mae))

history_df = pd.DataFrame(history.history)
history_df.loc[:, ['loss', 'val_loss']].plot()
print("Minimum Validation Loss: {:0.4f}".format(history_df['val_loss'].min()))
```



```
Epoch 1/50
52/52 [==============================] - 1s 7ms/step - loss: 0.2404 - val_loss:
Epoch 2/50
52/52 [==============================] - 0s 5ms/step - loss: 0.2024 - val_loss:
Epoch 3/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1970 - val_loss:
Epoch 4/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1941 - val_loss:
Epoch 5/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1925 - val_loss:
Epoch 6/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1907 - val_loss:
Epoch 7/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1895 - val_loss:
Epoch 8/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1884 - val_loss:
Epoch 9/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1879 - val_loss:
Epoch 10/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1865 - val_loss:
Epoch 11/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1858 - val_loss:
Epoch 12/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1853 - val_loss:
Epoch 13/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1846 - val_loss:
Epoch 14/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1842 - val_loss:
Epoch 15/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1837 - val_loss:
Epoch 16/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1832 - val_loss:
Epoch 17/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1823 - val_loss:
Epoch 18/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1816 - val_loss:
Epoch 19/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1815 - val_loss:
Epoch 20/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1805 - val_loss:
Epoch 21/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1810 - val_loss:
Epoch 22/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1799 - val_loss:
Epoch 23/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1789 - val_loss:
Epoch 24/50
52/52 [==============================] - 0s 7ms/step - loss: 0.1789 - val_loss:
Epoch 25/50
52/52 [==============================] - 0s 8ms/step - loss: 0.1783 - val_loss:
Epoch 26/50
52/52 [==============================] - 0s 7ms/step - loss: 0.1778 - val_loss:
Epoch 27/50
52/52 [==============================] - 0s 7ms/step - loss: 0.1778 - val_loss:
Epoch 28/50
52/52 [==============================] - 0s 7ms/step - loss: 0.1765 - val_loss:
Epoch 29/50
52/52 [==============================] - 0s 8ms/step - loss: 0.1766 - val_loss:
Epoch 30/50
52/52 [==============================] - 0s 6ms/step - loss: 0.1765 - val_loss:
Epoch 31/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1753 - val_loss:
Epoch 32/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1751 - val_loss:
Epoch 33/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1743 - val_loss:
Epoch 34/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1740 - val_loss:
Epoch 35/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1738 - val_loss:
Epoch 36/50
Epoch 36/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1735 - val_loss:
Epoch 37/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1729 - val_loss:
Epoch 38/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1723 - val_loss:
Epoch 39/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1723 - val_loss:
Epoch 40/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1713 - val_loss:
Epoch 41/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1707 - val_loss:
Epoch 42/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1707 - val_loss:
Epoch 43/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1703 - val_loss:
Epoch 44/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1700 - val_loss:
Epoch 45/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1708 - val_loss:
Epoch 46/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1694 - val_loss:
Epoch 47/50
52/52 [==============================] - 0s 4ms/step - loss: 0.1689 - val_loss:
Epoch 48/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1685 - val_loss:
Epoch 49/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1681 - val_loss:
Epoch 50/50
52/52 [==============================] - 0s 5ms/step - loss: 0.1690 - val_loss:
103/103 [==============================] - 0s 1ms/step - loss: 0.1957
Test Loss (MAE): 0.1957
103/103 [==============================] - 0s 1ms/step
Mean Absolute Error (MAE): 0.1957
Minimum Validation Loss: 0.1925
Epoch 1/50
52/52 [==============================] - 1s 9ms/step - loss: 0.3175 - val_loss:
Epoch 2/50
52/52 [==============================] - 0s 7ms/step - loss: 0.2361 - val_loss:
Epoch 3/50
52/52 [==============================] - 0s 6ms/step - loss: 0.2219 - val_loss:
Epoch 4/50
52/52 [==============================] - 0s 7ms/step - loss: 0.2158 - val_loss:
Epoch 5/50
52/52 [==============================] - 0s 6ms/step - loss: 0.2113 - val_loss:
Epoch 6/50
52/52 [==============================] - 0s 7ms/step - loss: 0.2087 - val_loss:
Epoch 7/50
52/52 [==============================] - 0s 7ms/step - loss: 0.2060 - val_loss:
Epoch 8/50
52/52 [==============================] - 0s 7ms/step - loss: 0.2040 - val_loss:
Epoch 9/50
52/52 [==============================] - 0s 7ms/step - loss: 0.2018 - val_loss:
Epoch 10/50
52/52 [==============================] - 1s 10ms/step - loss: 0.2015 - val_loss:
Epoch 11/50
52/52 [==============================] - 1s 12ms/step - loss: 0.1999 - val_loss:
Epoch 12/50
52/52 [==============================] - 1s 10ms/step - loss: 0.1996 - val_loss:
Epoch 13/50
52/52 [==============================] - 1s 11ms/step - loss: 0.1987 - val_loss:
Epoch 14/50
52/52 [==============================] - 1s 10ms/step - loss: 0.1979 - val_loss:
Epoch 15/50
52/52 [==============================] - 0s 7ms/step - loss: 0.1978 - val_loss:
Epoch 16/50
52/52 [==============================] - 0s 7ms/step - loss: 0.1966 - val_loss:
Epoch 17/50
52/52 [==============================] - 0s 6ms/step - loss: 0.1967 - val_loss:
103/103 [==============================] - 0s 1ms/step - loss: 0.1905
Test Loss (MAE): 0.1905
103/103 [==============================] - 0s 1ms/step
```



```
Mean Absolute Error (MAE): 0.1905
Minimum Validation Loss: 0.1948
```