Advertising Sales Prediction – Multiple Linear Regression (MLR)

In [1]:
```
# Designed by : ALTAF HUSAIN DATA ANALYST
```

Step 1 : load modules

In [2]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_absolute_error,mean_squared_error,root_mean_squared_error
import warnings
warnings.filterwarnings('ignore')
print("All module s loaded succesfully")
```

```
All module s loaded succesfully
```

step 2 : load data

In [3]:
```
df = pd.read_csv(r"/content/drive/MyDrive/Colab Notebooks/data/advertising.csv")
```

In [4]:
```
# step 2.1 :
df.sample()
```

Out[4]:

	ID	TV	Radio	Newspaper	Sales
154	155	187.8	21.1	9.5	15.6

In [5]:
```
df.drop('ID',axis = 1,inplace =True)
```

In [6]:
```
df
```

Out[6]:

	TV	Radio	Newspaper	Sales
0	230.1	37.8	69.2	22.1
1	44.5	39.3	45.1	10.4
2	17.2	45.9	69.3	9.3
3	151.5	41.3	58.5	18.5
4	180.8	10.8	58.4	12.9
...	...	...	...	...
195	38.2	3.7	13.8	7.6
196	94.2	4.9	8.1	9.7
197	177.0	9.3	6.4	12.8
198	283.6	42.0	66.2	25.5
199	232.1	8.6	8.7	13.4

200 rows × 4 columns

In [7]:
```
# step 2.2 :
df.head()
```

Out[7]:

	TV	Radio	Newspaper	Sales
0	230.1	37.8	69.2	22.1
1	44.5	39.3	45.1	10.4
2	17.2	45.9	69.3	9.3
3	151.5	41.3	58.5	18.5
4	180.8	10.8	58.4	12.9

In [8]:
```
# step 2.3 :
df.tail()
```

Out[8]:

	TV	Radio	Newspaper	Sales
195	38.2	3.7	13.8	7.6
196	94.2	4.9	8.1	9.7
197	177.0	9.3	6.4	12.8
198	283.6	42.0	66.2	25.5
199	232.1	8.6	8.7	13.4

In [9]:
```
# step 2.4 :
df.info()
```

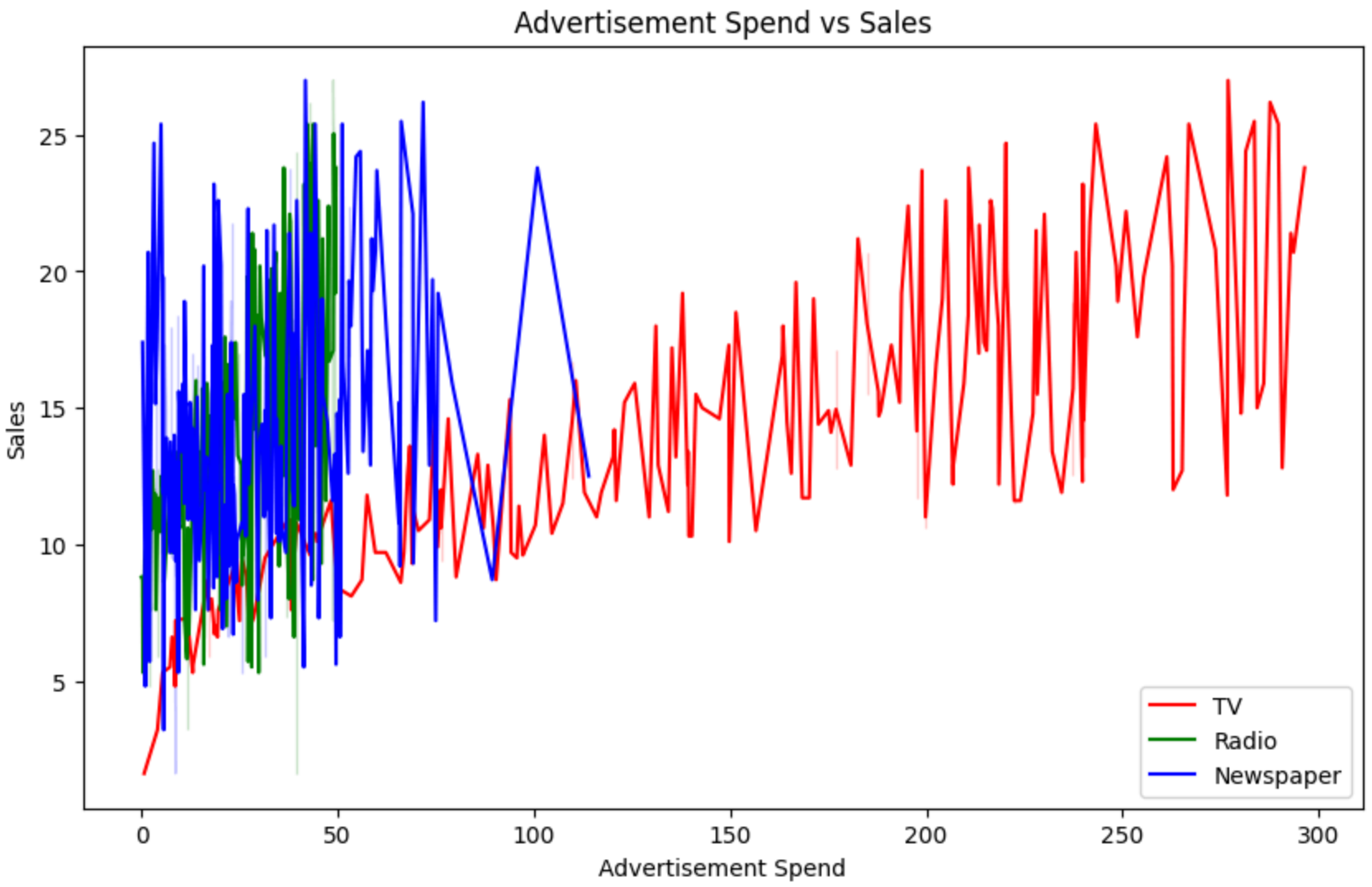
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   TV         200 non-null    float64
 1   Radio      200 non-null    float64
 2   Newspaper  200 non-null    float64
 3   Sales      200 non-null    float64
dtypes: float64(4)
memory usage: 6.4 KB
```

step 3 : EDA

In [10]:
```
# setp 3.1 :
plt.figure(figsize=(10,6))
sns.lineplot(data=df, x="TV", y="Sales", label="TV", color="r")
sns.lineplot(data=df, x="Radio", y="Sales", label="Radio", color="g")
sns.lineplot(data=df, x="Newspaper", y="Sales", label="Newspaper", color="b")

plt.title("Advertisement Spend vs Sales")
```

```
plt.xlabel("Advertisement Spend")
plt.ylabel("Sales")
plt.legend()
plt.show()
```



In [11]:
```
# step 3.2 :
df.describe()
```

Out[11]:

	TV	Radio	Newspaper	Sales
count	200.000000	200.000000	200.000000	200.000000
mean	147.042500	23.264000	30.554000	14.022500
std	85.854236	14.846809	21.778621	5.217457
min	0.700000	0.000000	0.300000	1.600000
25%	74.375000	9.975000	12.750000	10.375000
50%	149.750000	22.900000	25.750000	12.900000
75%	218.825000	36.525000	45.100000	17.400000
max	296.400000	49.600000	114.000000	27.000000

In [12]:
```
# step 3.3 :
df.corr()
```

Out[12]:

	TV	Radio	Newspaper	Sales
TV	1.000000	0.054809	0.056648	0.782224
Radio	0.054809	1.000000	0.354104	0.576223
Newspaper	0.056648	0.354104	1.000000	0.228299
Sales	0.782224	0.576223	0.228299	1.000000

step 4 : Divide data into X and y

In [13]:
```
X = df.iloc[: ,:-1]
X.shape
```

Out[13]:
```
(200, 3)
```

In [14]:
```
X.head()
```

Out[14]:

	TV	Radio	Newspaper
0	230.1	37.8	69.2
1	44.5	39.3	45.1
2	17.2	45.9	69.3
3	151.5	41.3	58.5
4	180.8	10.8	58.4

In [15]:
```
y = df['Sales']
y.shape
```

Out[15]: (200,)

In [16]:
```
y.head()
```

Out[16]:

	Sales
0	22.1
1	10.4
2	9.3
3	18.5
4	12.9

dtype: float64

step 5 : Model Biulding

In [17]:
```
# step 5.1 :
lr_model = LinearRegression()
```

In [18]:
```
#  step 5.2 :
lr_model.fit(X,y)
```

Out[18]:
```
LinearRegression()
```

In [19]:
```
# step 5.3 :
y_pred = lr_model.predict(X)
```

In [20]:
```
temp_df = df.copy()
temp_df['y_pred_sales'] = y_pred
```

In [21]:
```
temp_df
```

Out[21]:

	TV	Radio	Newspaper	Sales	y_pred_sales
0	230.1	37.8	69.2	22.1	20.523974
1	44.5	39.3	45.1	10.4	12.337855
2	17.2	45.9	69.3	9.3	12.307671
3	151.5	41.3	58.5	18.5	17.597830
4	180.8	10.8	58.4	12.9	13.188672
...	...	...	...	...	...
195	38.2	3.7	13.8	7.6	5.370342
196	94.2	4.9	8.1	9.7	8.165312
197	177.0	9.3	6.4	12.8	12.785921
198	283.6	42.0	66.2	25.5	23.767321
199	232.1	8.6	8.7	13.4	15.173196

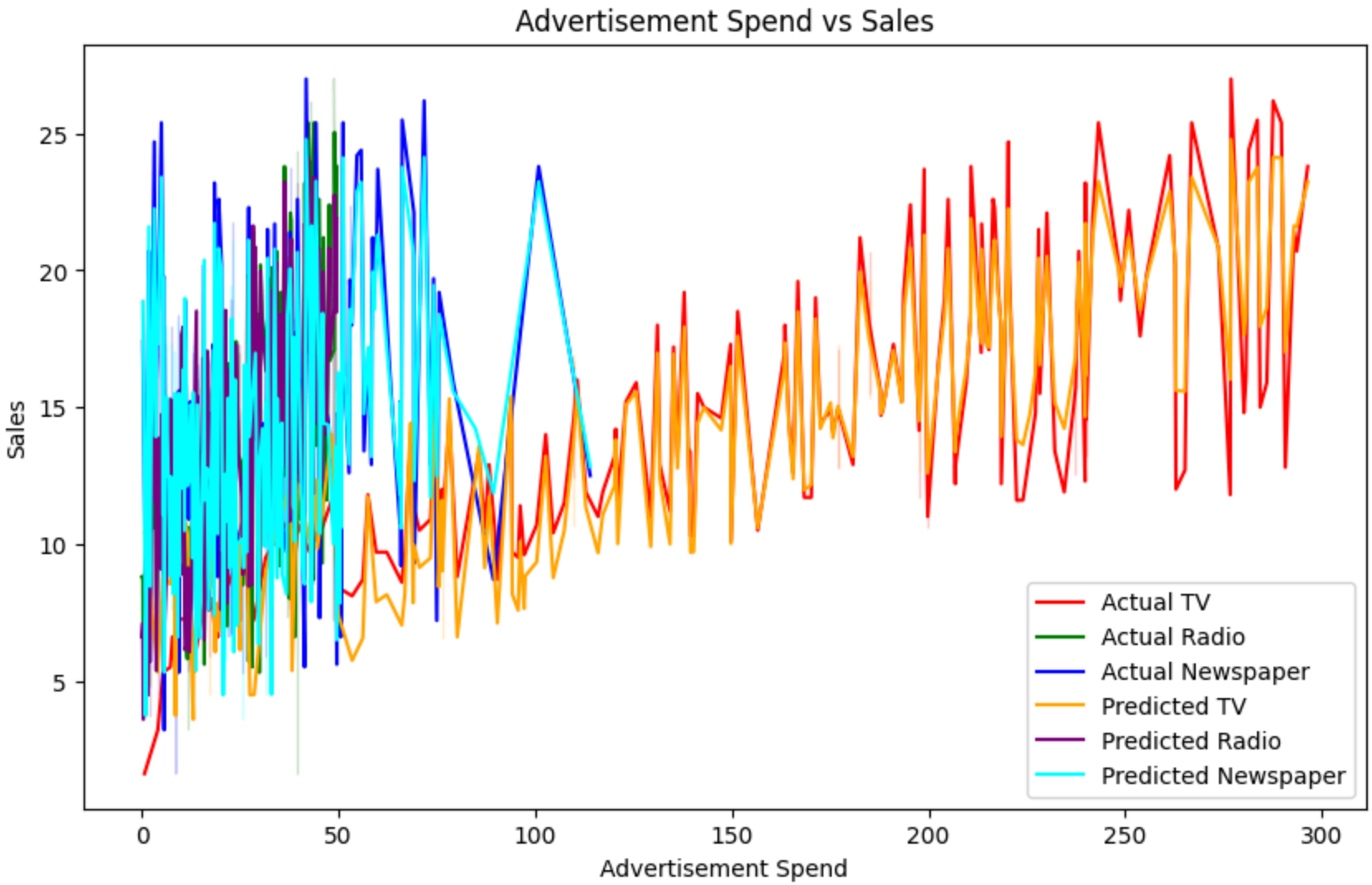
200 rows × 5 columns

step 6 : Visualize actual vs predict

In [22]:
```
# setp 3.1 :
plt.figure(figsize=(10,6))
# Actual Sales
sns.lineplot(data=df, x="TV", y="Sales", label="Actual TV", color="red")
sns.lineplot(data=df, x="Radio", y="Sales", label="Actual Radio", color="green")
sns.lineplot(data=df, x="Newspaper", y="Sales", label="Actual Newspaper", color="blue")

# Predicted Sales
sns.lineplot(data=temp_df, x="TV", y="y_pred_sales", label="Predicted TV", color="orange")
sns.lineplot(data=temp_df, x="Radio", y="y_pred_sales", label="Predicted Radio", color="purple")
sns.lineplot(data=temp_df, x="Newspaper", y="y_pred_sales", label="Predicted Newspaper", color="cyan")
```

```
plt.title("Advertisement Spend vs Sales")
plt.xlabel("Advertisement Spend")
plt.ylabel("Sales")
plt.legend()
plt.show()
```



step 7 : Checking MAE ,MSE and RMSE errors

In [23]:
```
# step 7.1 :
mae_sk = mean_absolute_error(y,y_pred)
print('Mean absolute error :',mae_sk)
```

```
Mean absolute error : 1.252011229687068
```

In [24]:
```
# step 7.2 :
mse = ((temp_df['Sales'] - temp_df['y_pred_sales'])** 2).mean()
print('Mean squared error :',mse)
```

```
Mean squared error : 2.784126314510936
```

In [25]:
```
# step 7.3 :
mse_sk = mean_squared_error(y,y_pred)
print('Mean squared error :',mse_sk)
```

```
Mean squared error : 2.784126314510936
```

In [26]:
```
# step 7.4 :
rmse = mse ** 0.5
print('root Mean squared error :',rmse)
```

```
root Mean squared error : 1.6685701407225697
```

In [27]:
```
# step 7.5 :
rmse_sk = root_mean_squared_error(y,y_pred)
print('Root Mean squared error :',rmse_sk)
```

```
Root Mean squared error : 1.6685701407225697
```

In [28]:
```
# Step 7.6 : model score
model_score = lr_model.score(X,y) # this is model learing score (almost 89 %)
model_score = round(model_score * 100,2)
print('Model has achieved learing score:',model_score)
```

```
Model has achieved learing score: 89.72
```

step 8 : Future predict for next 4 sales

In [29]:
```
future_tv = list(range(230, 270, 10))        # example future TV spends
future_radio = list(range(35, 55, 5))       # example future Radio spends
future_newspaper = list(range(20, 40, 5))   # example future Newspaper spends

future_X = pd.DataFrame({"TV": future_tv,"Radio": future_radio,"Newspaper": future_newspaper})
```

In [30]:
```
future_X["y_pred_sales"] = lr_model.predict(future_X[["TV", "Radio", "Newspaper"]])
```

step 9 : Visualize Past and future values

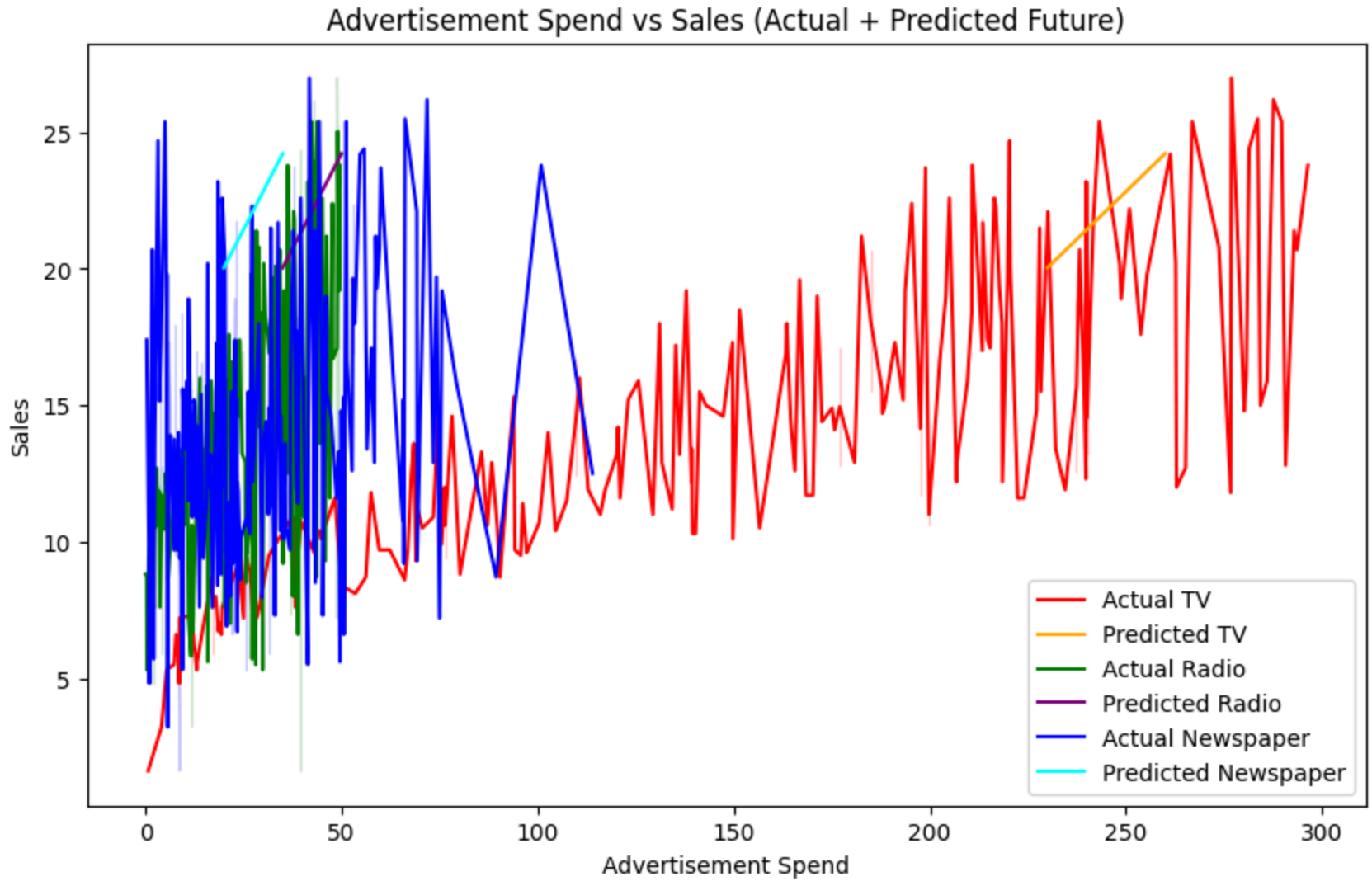
In [31]:
```
plt.figure(figsize=(10,6))

features = ["TV", "Radio", "Newspaper"]
actual_colors = ["red", "green", "blue"]
predicted_colors = ["orange", "purple", "cyan"]

for i, feature in enumerate(features):
    # Actual Sales
    sns.lineplot(data=df, x=feature, y="Sales", label=f"Actual {feature}", color=actual_colors[i])

    # Predicted Sales
    sns.lineplot(data=future_X, x=feature, y="y_pred_sales", label=f"Predicted {feature}", color=predicted_colors[i])

plt.title("Advertisement Spend vs Sales (Actual + Predicted Future)")
plt.xlabel("Advertisement Spend")
plt.ylabel("Sales")
plt.legend()
plt.show()
```



step 10 : Input from where user can ask and predict sales based on the features

In [32]:
```
tv = float(input("Enter TV ad spend: "))
radio = float(input("Enter Radio ad spend: "))
newspaper = float(input("Enter Newspaper ad spend: "))
```

```
user_input = [[tv, radio, newspaper]]
predicted_sales = lr_model.predict(user_input)
predicted_sales_value = round(predicted_sales[0], 2)

print(f"Predicted Sales: {predicted_sales_value}(US$)")
```

```
Enter TV ad spend: 200
Enter Radio ad spend: 300
Enter Newspaper ad spend: 250
Predicted Sales: 68.39(US$)
```

In [33]:
```
# Designed by : ALTAF HUSAIN DATA ANALYST
```