In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error, r2_score
```

In [3]:
```
df = pd.read_csv('Advertising (1).csv')
df
```

Out[3]:

	Unnamed: 0	TV	Radio	Newspaper	Sales
0	1	230.1	37.8	69.2	22.1
1	2	44.5	39.3	45.1	10.4
2	3	17.2	45.9	69.3	9.3
3	4	151.5	41.3	58.5	18.5
4	5	180.8	10.8	58.4	12.9
...	...	...	...	...	...
195	196	38.2	3.7	13.8	7.6
196	197	94.2	4.9	8.1	9.7
197	198	177.0	9.3	6.4	12.8
198	199	283.6	42.0	66.2	25.5
199	200	232.1	8.6	8.7	13.4

200 rows × 5 columns

In [4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   Unnamed: 0   200 non-null    int64  
 1   TV           200 non-null    float64
 2   Radio        200 non-null    float64
 3   Newspaper    200 non-null    float64
 4   Sales        200 non-null    float64
dtypes: float64(4), int64(1)
memory usage: 7.9 KB
```

In [7]:
```
df.isnull().sum()
```

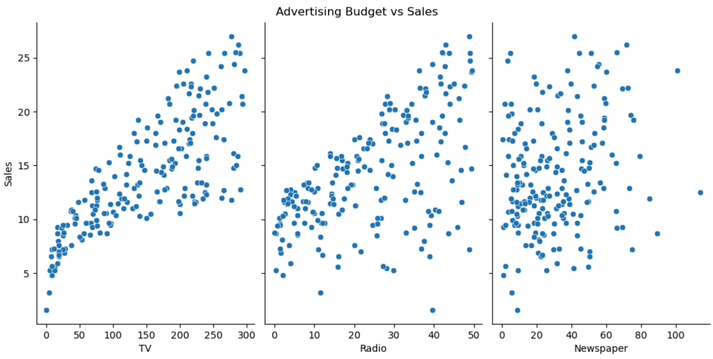
Out[7]:
```
TV           0
Radio        0
Newspaper    0
Sales        0
dtype: int64
```

In [8]:
```
df.describe()
```

Out[8]:

	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 [9]:
```
sns.pairplot(df, x_vars=['TV', 'Radio', 'Newspaper'], y_vars='Sales', height=5, aspect=0.7, kind='scatter')
plt.suptitle('Advertising Budget vs Sales', y=1.02)
plt.show()
```



In [10]:
```
X = df[['TV', 'Radio', 'Newspaper']]
y = df['Sales']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=42)
```

In [11]:
```
model = LinearRegression()
model.fit(X_train, y_train)
y_pred = model.predict(X_test)
mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)
r2 = r2_score(y_test, y_pred)
print(f"\nModel Evaluation Metrics:")
print(f"Mean Squared Error (MSE): {mse:.2f}")
print(f"Root Mean Squared Error (RMSE): {rmse:.2f}")
print(f"R-squared (R2 Score): {r2:.2f}")
```

```
Model Evaluation Metrics:
Mean Squared Error (MSE): 3.80
Root Mean Squared Error (RMSE): 1.95
R-squared (R2 Score): 0.86
```

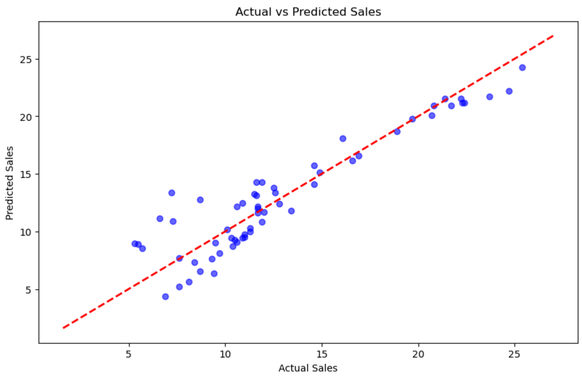
In [12]:
```
dt_model = DecisionTreeRegressor(random_state=42)
dt_model.fit(X_train, y_train)
y_pred_dt = dt_model.predict(X_test)
mse_dt = mean_squared_error(y_test, y_pred_dt)
rmse_dt = np.sqrt(mse_dt)
r2_dt = r2_score(y_test, y_pred_dt)
print("\nDecision Tree Regressor Evaluation Metrics:")
print(f"Mean Squared Error (MSE): {mse_dt:.2f}")
print(f"Root Mean Squared Error (RMSE): {rmse_dt:.2f}")
print(f"R-squared (R2 Score): {r2_dt:.2f}")
```

```
Decision Tree Regressor Evaluation Metrics:
Mean Squared Error (MSE): 1.55
Root Mean Squared Error (RMSE): 1.25
R-squared (R2 Score): 0.94
```

In [13]:
```
rf_model = RandomForestRegressor(random_state=42, n_estimators=100)
rf_model.fit(X_train, y_train)
y_pred_rf = rf_model.predict(X_test)
mse_rf = mean_squared_error(y_test, y_pred_rf)
rmse_rf = np.sqrt(mse_rf)
r2_rf = r2_score(y_test, y_pred_rf)
print("\nRandom Forest Regressor Evaluation Metrics:")
print(f"Mean Squared Error (MSE): {mse_rf:.2f}")
print(f"Root Mean Squared Error (RMSE): {rmse_rf:.2f}")
print(f"R-squared (R2 Score): {r2_rf:.2f}")
```

```
Random Forest Regressor Evaluation Metrics:
Mean Squared Error (MSE): 0.46
Root Mean Squared Error (RMSE): 0.68
R-squared (R2 Score): 0.98
```

In [14]:
```
plt.figure(figsize=(10, 6))
plt.scatter(y_test, y_pred, color='blue', alpha=0.6)
plt.plot([y.min(), y.max()], [y.min(), y.max()], 'r--', lw=2)
plt.xlabel('Actual Sales')
plt.ylabel('Predicted Sales')
plt.title('Actual vs Predicted Sales')
plt.show()
```


Actual vs Predicted Sales
Predicted Sales
Actual Sales
5
10
15
20
25

In [ ]: