In [1]:
```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import Ridge
import matplotlib.pyplot as plt
import kagglehub
import os
from sklearn.metrics import r2_score
```

In [2]:
```python
path = kagglehub.dataset_download("tylermorse/retail-business-sales-20172019")
print(os.listdir(path))
```

```
Downloading from https://www.kaggle.com/api/v1/datasets/download/tylermorse/ret
ail-business-sales-20172019?dataset_version_number=2...
100%|██████████| 10.7k/10.7k [00:00<00:00, 18.6MB/s]
Extracting files...
['business.retailsales.csv', 'business.retailsales2.csv']
```

In [3]:
```python
csv_path = os.path.join(path, 'business.retailsales.csv')
df = pd.read_csv(csv_path)
df.head()
```

Out[3]:

	Product Type	Net Quantity	Gross Sales	Discounts	Returns	Total Net Sales
0	Art & Sculpture	34	14935.0	-594.00	-1609.0	12732.00
1	Basket	13	3744.0	-316.80	0.0	3427.20
2	Basket	12	3825.0	-201.60	-288.0	3335.40
3	Basket	17	3035.0	-63.25	0.0	2971.75
4	Art & Sculpture	47	2696.8	-44.16	0.0	2652.64

In [4]:
```python
df.shape
```

Out[4]: (1775, 6)

In [5]:
```python
df.isnull().sum()
```

Out[5]:

	0
Product Type	8
Net Quantity	0
Gross Sales	0
Discounts	0
Returns	0
Total Net Sales	0

dtype: int64

In [6]:
```
df = df.drop('Product Type', axis=1)
```

In [7]:
```
x = df.iloc[:, :-1].values
y = df.iloc[:, -1].values
```

In [8]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3,random_state=
```

In [9]:
```
model=Ridge()
model.fit(x_train,y_train)
prediction=model.predict(x_test)
print(prediction)
print(y_test)
```

```
[8.64799943e+02 6.79999878e+01 7.55900468e+01 2.19999936e+02
 1.57500062e+02 7.19999963e+01 1.15999970e+02 2.36400036e+02
 1.74999948e+02 2.03999962e+02 5.99999958e+01 6.49999889e+01
 1.80000066e+01 2.80000028e+01 2.80000028e+01 2.88000223e+01
 5.57189916e+02 9.69100183e+01 7.59999898e+01 9.59999823e+01
 2.14199999e+02 1.40000081e+01 1.80000066e+01 4.80000003e+01
 2.12810052e+02 4.80000003e+01 6.12000323e+01 1.94990035e+02
 6.79999878e+01 5.85000013e+01 1.48500059e+02 1.09999972e+02
 1.34400017e+02 4.14000262e+01 2.95599954e+02 8.36000141e+01
 5.31000203e+02 3.79999991e+01 1.07200043e+02 1.18939989e+03
 3.38999926e+02 1.51800000e+02 1.87999958e+02 1.29200012e+02
 5.21900296e+01 1.67600054e+02 2.10000056e+02 1.44999959e+02
 5.79999915e+01 2.24599975e+02 4.86000284e+01 8.34399896e+02
 6.66000340e+01 2.71999926e+02 1.02600045e+02 4.28999935e+02
 4.91400022e+02 9.88000800e+01 2.29999932e+02 1.57500062e+02
 3.57500270e+01 1.31999974e+02 5.79999915e+01 7.79999890e+01
 1.44999959e+02 2.40000043e+01 1.34640007e+03 1.69400025e+02
 4.79999953e+01 5.40000030e+01 2.76000009e+02 4.79999953e+01
 3.06000278e+01 6.79999878e+01 5.49999827e+02 1.43999964e+02
 3.60000048e+01 1.17000055e+02 1.66500065e+02 1.51999966e+02
 4.18000162e+01 1.44999959e+02 3.32500001e+02 4.79999953e+01
 1.80000066e+01 1.84999944e+02 2.03580136e+02 6.96000120e+01
 1.80000066e+01 3.09999897e+02 7.49999852e+01 1.48000186e+02
 1.59999998e+02 1.84999944e+02 6.79999878e+01 3.41999925e+02
 1.64999951e+02 1.75999962e+02 2.50000039e+01 1.44999959e+02
 1.24999966e+02 6.79999928e+01 2.98590037e+02 3.48400009e+02
 1.48500059e+02 8.99999895e+01 9.79999765e+01 1.80000066e+01
 2.20000051e+01 8.75000009e+01 1.09999972e+02 1.74999948e+02
 1.74999948e+02 1.58400050e+02 1.49999972e+02 5.94000317e+01
 1.84999944e+02 3.69999879e+02 5.39999931e+01 3.08000043e+02
 2.34800324e+01 2.90255120e-05 1.74999948e+02 9.86000073e+01
 2.11200008e+02 2.43999927e+02 1.86210009e+02 2.80000028e+01
 3.14999925e+02 2.19999936e+02 9.89999667e+02 6.12000323e+01
 1.54999955e+02 3.00000021e+01 4.79999953e+01 4.40000018e+01
 4.79999953e+01 1.76380014e+02 1.60000073e+01 1.74999948e+02
 7.36999970e+02 1.11500003e+02 1.80000066e+01 7.82000075e+02
 8.51500187e+02 1.74999948e+02 1.59999963e+02 1.18200007e+02
 1.91999951e+02 1.97199991e+02 1.34999973e+02 1.27600003e+02
 2.40000043e+01 2.27999953e+02 4.39999968e+01 7.66519777e+02
 1.05000094e+01 3.97590100e+02 1.40000081e+01 5.44000768e+01
 5.59999973e+01 1.39999981e+02 3.59999998e+01 9.12000137e+01
 2.16000200e+01 1.35999962e+02 1.18319991e+03 6.46000150e+01
 6.75000030e+01 2.40000043e+01 1.80000066e+01 7.83999889e+01
 3.79999991e+01 6.04799965e+02 8.79999953e+01 1.84999944e+02
 7.20000013e+01 6.38000129e+01 6.59999985e+01 4.10399963e+02
 5.59999973e+01 1.97999979e+02 1.66500065e+02 1.29200012e+02
 1.80000066e+01 8.36000241e+01 1.19999973e+02 1.65999966e+02
 8.82000407e+01 1.10748992e+03 6.12000373e+01 1.21590012e+02
 5.22000148e+01 4.32000267e+01 9.20000087e+01 6.25000153e+01
 3.72609982e+02 8.99999845e+01 2.20000051e+01 8.99999995e+01
 1.02999964e+03 1.24999966e+02 5.79999915e+01 1.84999944e+02
 3.51999956e+02 6.79999878e+01 8.19999825e+01 8.99999845e+01
 8.90399936e+02 5.59999973e+01 1.48199996e+02 3.60000098e+01
 1.14010022e+02 6.39999893e+01 1.80000066e+01 5.59999973e+01
```

3.79999991e+01	3.20000063e+01	5.21999842e+02	2.91200088e+02
2.64000019e+02	1.14999970e+02	1.80000066e+01	2.03999947e+02
4.20000075e+01	2.80000028e+01	3.40000006e+01	1.21510051e+02
1.64999951e+02	4.39999968e+01	3.79999991e+01	3.79999991e+01
2.80000028e+01	5.79999915e+01	3.20000013e+01	3.20000013e+01
4.79999953e+01	8.10000484e+01	6.96000120e+01	3.40000006e+01
6.19999950e+01	9.80000065e+01	2.51690038e+02	8.57499819e+02
1.84999944e+02	2.03999947e+02	1.23200024e+02	5.20000110e+02
2.80000028e+01	3.48400124e+01	3.79999991e+01	2.80000028e+01
5.22000295e+01	2.51600060e+02	1.99999938e+02	7.19999863e+01
2.80000028e+01	6.59999985e+01	1.86190009e+02	1.95999945e+02
4.32000267e+01	3.96000256e+01	5.44000768e+01	3.89999987e+01
2.16000080e+02	1.15999970e+02	1.58000060e+02	2.34100205e+01
1.03500045e+02	2.84999941e+02	5.79999915e+01	3.07800003e+02
4.39999968e+01	1.44999959e+02	8.99999895e+01	1.10000002e+02
1.48199996e+02	5.59999973e+01	8.18400110e+02	1.40000081e+01
2.87999930e+02	9.57000044e+02	4.93500342e+01	3.04000790e+01
1.66500065e+02	5.59999973e+01	1.84999944e+02	2.80000028e+01
4.40000018e+01	1.84999944e+02	3.40000006e+01	1.43999964e+02
1.27400002e+02	8.79999803e+01	2.24999929e+02	7.92000379e+01
5.40000030e+01	4.72710010e+02	5.79999915e+01	1.44999959e+02
2.34000206e+01	1.73600035e+02	1.87200008e+02	3.40000006e+01
2.73679975e+02	3.72800049e+02	1.19999968e+02	3.05499987e+02
4.40000018e+01	1.98000195e+01	5.04000266e+01	1.15999970e+02
4.68000328e+01	5.80000485e+01	9.59999873e+01	4.80000003e+01
4.79999953e+01	2.95999907e+02	2.72000451e+01	3.65400247e+01
1.87199988e+02	7.98000143e+01	1.81999960e+02	6.63900427e+01
1.39200001e+02	1.44999959e+02	2.80000028e+01	1.31999989e+02
1.80000066e+01	2.88000223e+01	4.06800071e+02	1.74999948e+02
1.80000001e+02	1.01999985e+02	2.47999935e+02	2.20000051e+01
1.11590019e+02	4.79999953e+01	1.30500054e+02	1.53600015e+02
9.59999773e+01	6.38000129e+01	1.09999972e+02	1.66500065e+02
4.57166766e-05	8.79999803e+01	1.57510062e+02	3.96000151e+02
6.00000008e+01	1.64999951e+02	4.65352332e-05	7.92000379e+01
1.22400056e+02	1.86199987e+02	3.40000006e+01	7.28300386e+01
3.49999882e+02	1.51683002e+03	2.79800058e+02	1.09999972e+02
1.34000030e+02	4.39999968e+01	1.80000066e+01	6.79999878e+01
7.19999963e+01	3.40000006e+01	5.59999973e+01	3.49999887e+02
1.25999976e+02	3.60000048e+01	7.99999883e+01	1.36320062e+02
6.48000584e+01	3.20000013e+01	1.30600000e+02	6.48000334e+01
1.49600014e+02	1.80000066e+01	9.17900518e+01	2.39999943e+02
9.24999686e+02	8.79999853e+01	3.10000325e+01	1.05999984e+02
1.03249976e+03	6.03000021e+02	2.72400010e+02	5.40000030e+01
2.09999934e+02	5.84999901e+02	1.40000081e+01	5.64999816e+02
8.39999918e+01	1.35000083e+01	1.04400046e+02	1.24999966e+02
7.00000637e+01	3.59999998e+01	1.24999966e+02	2.88000223e+01
4.79999953e+01	5.07499941e+02	3.40000006e+01	1.84999944e+02
4.32000649e+01	8.91000410e+01	2.80000028e+01	1.73999958e+02
1.80000066e+01	9.00000442e+01	1.44999959e+02	1.84999944e+02
6.66000366e+01	1.80000066e+01	4.32000267e+01	5.59999973e+01
8.72000152e+01	9.52000295e+01	6.79999878e+01	1.88999988e+02
3.60000048e+01	3.60000048e+01	3.20000013e+01	1.48400027e+02
1.62000183e+01	4.40000318e+01	3.28500115e+02	3.18999971e+02
5.40000030e+01	3.40000006e+01	4.39999968e+01	4.21200063e+02

```
 5.79999915e+01 9.18000124e+01 2.78600063e+02 4.57800034e+02
 7.19999913e+01 1.03500045e+02 1.24000058e+02 1.27999965e+02
 4.04900259e+01 2.40000133e+02 3.56400129e+02 3.40000006e+01
 2.39999923e+02 1.15200054e+02 8.78999713e+02 8.79999803e+01
 9.12810156e-06 6.39999943e+01 5.79999915e+01 7.79999840e+01
 2.80000028e+01 9.88001405e+01 4.19999976e+01 1.72400030e+02
 7.39999955e+01 1.74999948e+02 1.15999970e+02 3.32800059e+02
 1.04400046e+02 2.64590017e+02 1.57500062e+02 3.79999991e+01
 1.48000186e+02 2.07600042e+02 1.44999959e+02 1.56599998e+02
 5.62000207e+01 2.60000036e+01 3.59999998e+01 4.32000267e+01
 3.06000228e+01 6.79999878e+01 1.24999966e+02 2.40000043e+01
 2.88800286e+01 1.24800159e+02 1.80000066e+01 1.80000066e+01
 9.90000440e+01 1.12500048e+02 1.36800061e+02 2.58999975e+02
 1.80000066e+01 2.40000043e+01 7.72000116e+01 3.40000006e+01
 3.00000071e+01 7.22000653e+01 1.10200013e+02 5.79999915e+01
 2.71199966e+02 4.19999976e+01 2.40000043e+01 2.09000008e+02
 8.39999918e+01 3.13200047e+02 8.12000101e+01 1.10000060e+02
 3.46000201e+01 1.80000066e+01 4.80000003e+01 5.51000143e+01
 4.79999953e+01 3.47599985e+02 6.84000395e+01 2.88000223e+01
 3.60000048e+01 1.73999958e+02 8.90999918e+02 3.42000239e+01
 3.81000157e+01 3.96000306e+01 2.03999962e+02 4.59999961e+01
 1.63999962e+02 8.16000765e+01 3.79999991e+01 6.79999878e+01
 1.44000301e+01 4.79999953e+01 5.27999971e+02 6.59999985e+01
 1.44999959e+02 1.66500065e+02 1.67999965e+02 7.34400020e+02
 1.49999957e+02 1.98000075e+02 3.40000006e+01 6.99999766e+02
 3.40000006e+01]
[ 864.8    68.     75.59  220.    157.5    72.    116.    236.4   175.
  204.     60.     65.     18.     28.     28.     28.8   557.19   96.91
   76.     96.    214.2    14.     18.     48.    212.81   48.     61.2
  194.99   68.     58.5   148.5   110.    134.4    41.4   295.6    83.6
  531.     38.    107.2  1189.4   339.    151.8   188.    129.2    52.19
  167.6   210.    145.     58.    224.6    48.6   834.4    66.6   272.
  102.6   429.    491.4    98.8   230.    157.5    35.75  132.     58.
   78.    145.     24.   1346.4   169.4    48.     54.    276.     48.
   30.6    68.    550.    144.     36.    117.    166.5   152.     41.8
  145.    332.5    48.     18.    185.    203.58   69.6    18.    310.
   75.    148.    160.    185.     68.    342.    165.    176.     25.
  145.    125.     68.    298.59  348.4   148.5    90.     98.     18.
   22.     87.5   110.    175.    175.    158.4   150.     59.4   185.
  370.     54.    308.     23.48    0.    175.     98.6   211.2   244.
  186.21   28.    315.    220.    990.     61.2   155.     30.     48.
   44.     48.    176.38   16.    175.    737.    111.5    18.    782.
  851.5   175.    160.    118.2   192.    197.2   135.    127.6    24.
  228.     44.    766.52   10.5   397.59   14.     54.4    56.    140.
   36.     91.2    21.6   136.   1183.2    64.6    67.5    24.     18.
   78.4    38.    604.8    88.    185.     72.     63.8    66.    410.4
   56.    198.    166.5   129.2    18.     83.6   120.    166.     88.2
 1107.49   61.2   121.59   52.2    43.2    92.     62.5   372.61   90.
   22.     90.   1030.    125.     58.    185.    352.     68.     82.
   90.    890.4    56.    148.2    36.    114.01   64.     18.     56.
   38.     32.    522.    291.2   264.    115.     18.    204.     42.
   28.     34.    121.51  165.     44.     38.     38.     28.     58.
   32.     32.     48.     81.     69.6    34.     62.     98.    251.69
  857.5   185.    204.    123.2   520.     28.     34.84   38.     28.
```

```
 52.2    251.6   200.     72.     28.     66.    186.19  196.     43.2
 39.6     54.4    39.    216.    116.    158.     23.41  103.5   285.
 58.     307.8    44.    145.     90.    110.    148.2    56.    818.4
 14.     288.    957.     49.35   30.4   166.5    56.    185.     28.
 44.     185.     34.    144.    127.4    88.    225.     79.2    54.
472.71    58.    145.     23.4   173.6   187.2    34.    273.68  372.8
120.     305.5    44.     19.8    50.4   116.     46.8    58.     96.
 48.      48.    296.     27.2    36.54  187.2    79.8   182.     66.39
139.2    145.     28.    132.     18.     28.8   406.8   175.    180.
102.     248.     22.    111.59   48.    130.5   153.6    96.     63.8
110.     166.5     0.     88.    157.51  396.     60.    165.      0.
 79.2    122.4   186.2    34.     72.83  350.   1516.83  279.8   110.
134.      44.     18.     68.     72.     34.     56.    350.    126.
 36.      80.    136.32   64.8    32.    130.6    64.8   149.6    18.
 91.79   240.    925.     88.     31.    106.   1032.5   603.    272.4
 54.     210.    585.     14.    565.     84.     13.5   104.4   125.
 70.      36.    125.     28.8    48.    507.5    34.    185.     43.2
 89.1     28.    174.     18.     90.    145.    185.     66.6    18.
 43.2     56.     87.2    95.2    68.    189.     36.     36.     32.
148.4     16.2    44.    328.5   319.     54.     34.     44.    421.2
 58.      91.8   278.6   457.8    72.    103.5   124.    128.     40.49
240.     356.4    34.    240.    115.2   879.     88.      0.     64.
 58.      78.     28.     98.8    42.    172.4    74.    175.    116.
332.8    104.4   264.59  157.5    38.    148.    207.6   145.    156.6
 56.2     26.     36.     43.2    30.6    68.    125.     24.     28.88
124.8     18.     18.     99.    112.5   136.8   259.     18.     24.
 77.2     34.     30.     72.2   110.2    58.    271.2    42.     24.
209.      84.    313.2    81.2   110.     34.6    18.     48.     55.1
 48.     347.6    68.4    28.8    36.    174.    891.     34.2    38.1
 39.6    204.     46.    164.     81.6    38.     68.     14.4    48.
528.      66.    145.    166.5   168.    734.4   150.    198.     34.
700.      34.  ]
```

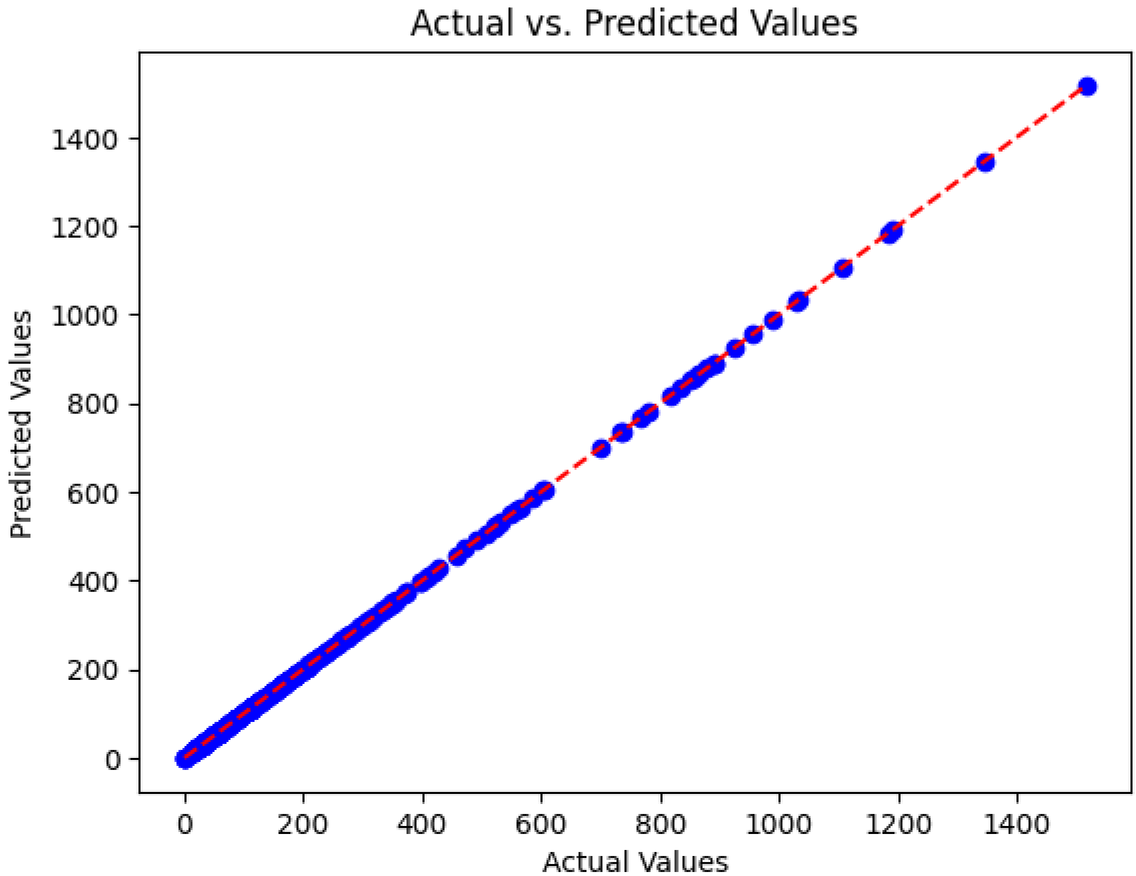
In [10]:

```python
r2 = r2_score(y_test, prediction)
print("R² Score:", r2)
```

```
R² Score: 0.9999999999999245
```

In [11]:

```python
plt.scatter(y_test, prediction, color='blue')
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], 'r--')
plt.xlabel('Actual Values')
plt.ylabel('Predicted Values')
plt.title('Actual vs. Predicted Values')
plt.show()
```


Actual vs. Predicted Values
Predicted Values
Actual Values
0
200
400
600
800
1000
1200
1400