In [28]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import sklearn
import seaborn as sns
```

In [29]:
```
df = pd.read_csv("Final.csv")
df.head()
```

Out[29]:

	Item_Identifier	Item_Weight	Item_Visibility	Item_Type	Item_MRP	Outlet_Identifier	Outlet_Establishment_Year	Item_Outlet_Sales	Outl
0	FDA15	9.30	0.922960	Dairy	249.8092	OUT049	1999	3735.1380	
1	DRC01	5.92	1.003057	Soft Drinks	48.2692	OUT018	2009	443.4228	
2	FDN15	17.50	0.831990	Meat	141.6180	OUT049	1999	2097.2700	
3	FDX07	19.20	0.750000	Fruits and Vegetables	182.0950	OUT010	1998	732.3800	
4	NCD19	8.93	0.666667	Household	53.8614	OUT013	1987	994.7052	

5 rows × 30 columns

In [30]:
```
df.shape
```

Out[30]:
```
(8519, 30)
```

In [31]:
```
df.describe()
```

Out[31]:

	Item_Weight	Item_Visibility	Item_MRP	Outlet_Establishment_Year	Item_Outlet_Sales	Outlet_Years
count	8519.000000	8519.000000	8519.000000	8519.000000	8519.000000	8519.000000
mean	12.875420	1.000000	141.010019	1997.837892	2181.188779	15.162108
std	4.646098	0.196805	62.283594	8.369105	1706.511093	8.369105
min	4.555000	0.636364	31.290000	1985.000000	33.290000	4.000000
25%	8.785000	0.888335	93.844900	1987.000000	834.247400	9.000000
50%	12.650000	0.943167	143.047000	1999.000000	1794.331000	14.000000
75%	16.850000	1.003298	185.676600	2004.000000	3100.630600	26.000000
max	21.350000	1.819614	266.888400	2009.000000	13086.964800	28.000000

In [32]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8519 entries, 0 to 8518
Data columns (total 30 columns):
 #   Column                     Non-Null Count  Dtype
---  ------                     --------------  -----
 0   Item_Identifier            8519 non-null   object
 1   Item_Weight                8519 non-null   float64
 2   Item_Visibility            8519 non-null   float64
 3   Item_Type                  8519 non-null   object
 4   Item_MRP                   8519 non-null   float64
 5   Outlet_Identifier          8519 non-null   object
 6   Outlet_Establishment_Year  8519 non-null   int64
 7   Item_Outlet_Sales          8519 non-null   float64
 8   Outlet_Years               8519 non-null   int64
 9   Item_Fat_Content_1         8519 non-null   bool
 10  Item_Fat_Content_2         8519 non-null   bool
 11  Outlet_Location_Type_1     8519 non-null   bool
 12  Outlet_Location_Type_2     8519 non-null   bool
 13  Outlet_Size_1              8519 non-null   bool
 14  Outlet_Size_2              8519 non-null   bool
 15  Outlet_Size_3              8519 non-null   bool
 16  Outlet_Type_1              8519 non-null   bool
 17  Outlet_Type_2              8519 non-null   bool
 18  Outlet_Type_3              8519 non-null   bool
 19  Item_Type_Combined_1       8519 non-null   bool
 20  Item_Type_Combined_2       8519 non-null   bool
 21  Outlet_1                   8519 non-null   bool
 22  Outlet_2                   8519 non-null   bool
 23  Outlet_3                   8519 non-null   bool
 24  Outlet_4                   8519 non-null   bool
 25  Outlet_5                   8519 non-null   bool
 26  Outlet_6                   8519 non-null   bool
 27  Outlet_7                   8519 non-null   bool
 28  Outlet_8                   8519 non-null   bool
 29  Outlet_9                   8519 non-null   bool
dtypes: bool(21), float64(4), int64(2), object(3)
memory usage: 773.8+ KB
```

In [33]:
```
remove_cols = [
    'Item_Identifier',
    'Item_Type',
```

```
    'Outlet_Identifier',
    'Outlet_Establishment_Year'
]
df = df.drop(remove_cols,axis =1)
df.head()
```

Out[33]:

	Item_Weight	Item_Visibility	Item_MRP	Item_Outlet_Sales	Outlet_Years	Item_Fat_Content_1	Item_Fat_Content_2	Outlet_Location_Type_
0	9.30	0.922960	249.8092	3735.1380	14	False	False	Fals
1	5.92	1.003057	48.2692	443.4228	4	False	True	Fals
2	17.50	0.831990	141.6180	2097.2700	14	False	False	Fals
3	19.20	0.750000	182.0950	732.3800	15	False	True	Fals
4	8.93	0.666667	53.8614	994.7052	26	True	False	Fals

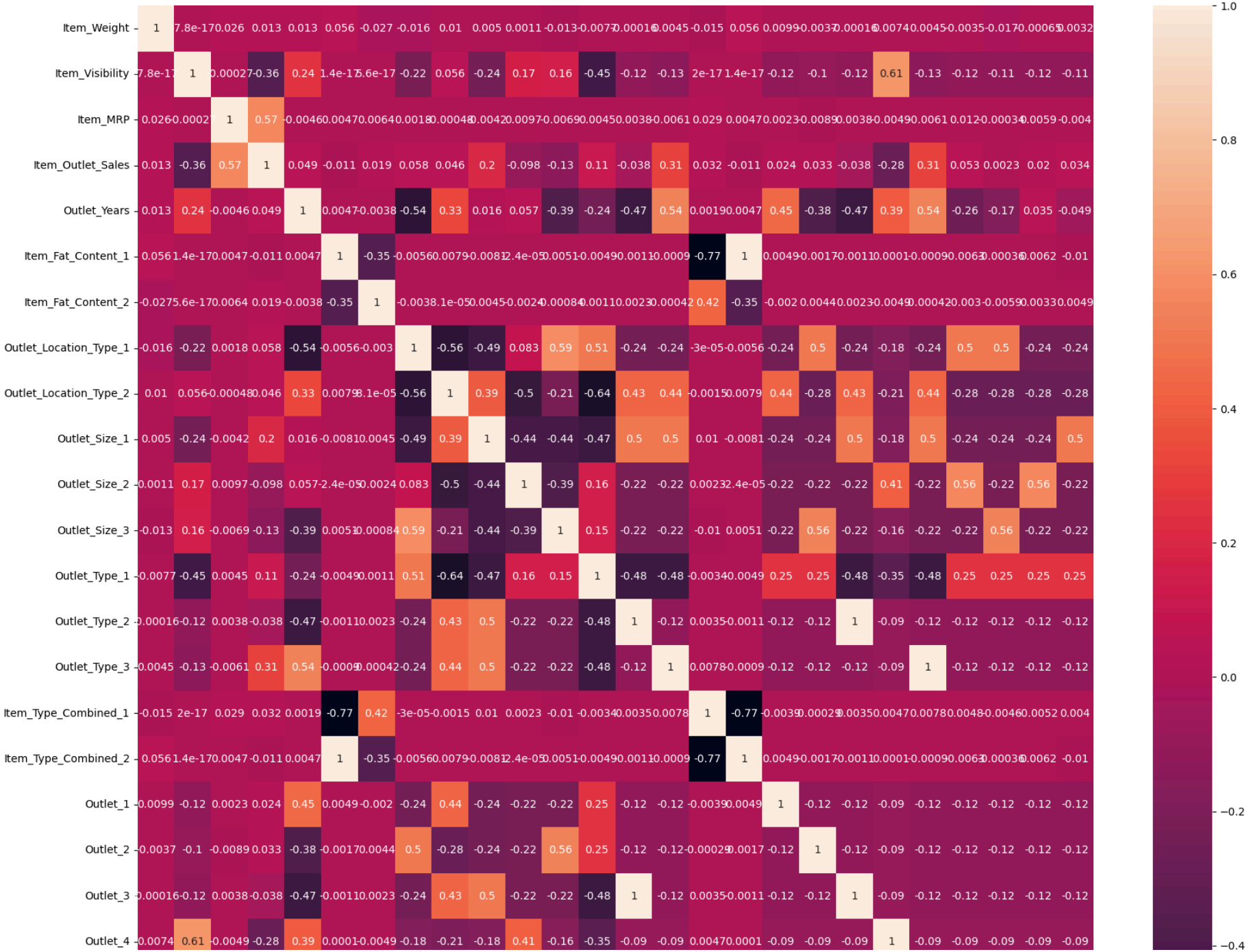
5 rows × 26 columns

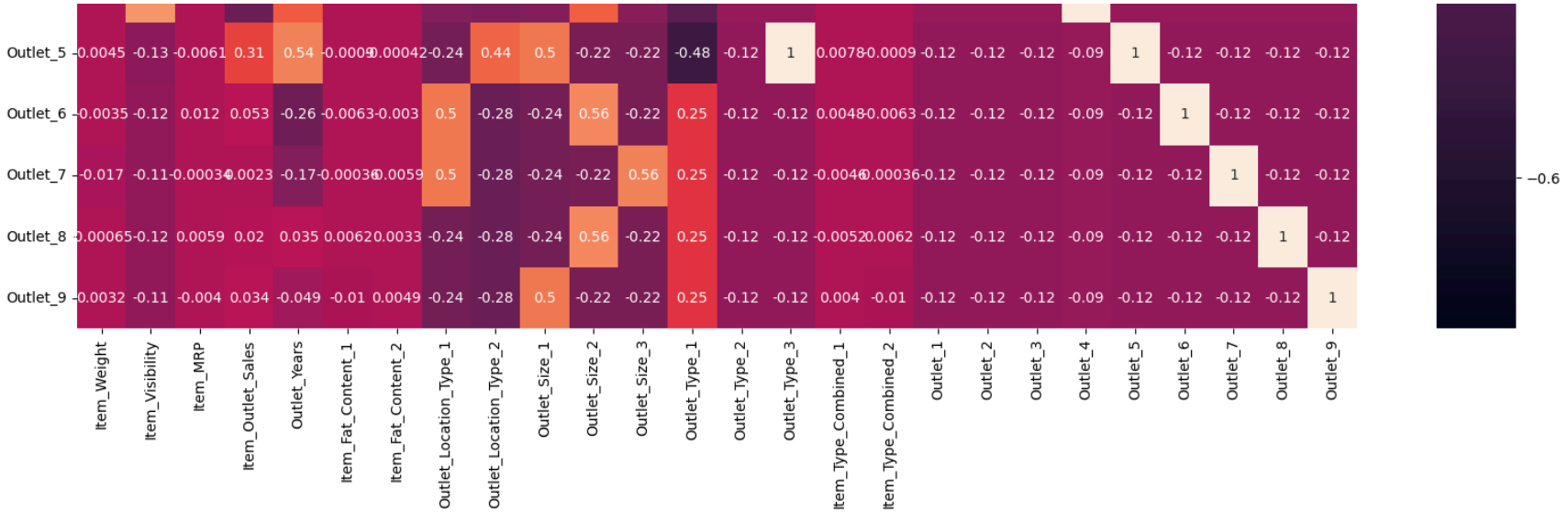
In [34]:
```
df.shape
```

Out[34]:
```
(8519, 26)
```

In [35]:
```
plt.figure(figsize = (20,20))
sns.heatmap(df.corr(),annot = True)
```

Out[35]:
```
<Axes: >
```


Item_Weight
Item_Visibility
Item_MRP
Item_Outlet_Sales
Outlet_Years
Item_Fat_Content_1
Item_Fat_Content_2
Outlet_Location_Type_1
Outlet_Location_Type_2
Outlet_Size_1
Outlet_Size_2
Outlet_Size_3
Outlet_Type_1
Outlet_Type_2
Outlet_Type_3
Item_Type_Combined_1
Item_Type_Combined_2
Outlet_1
Outlet_2
Outlet_3
Outlet_4
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4



In [36]:
```
y = df.Item_Outlet_Sales.values
X = df.drop('Item_Outlet_Sales',axis = 1)
```

In [37]:
```
print(X.shape,y.shape)
```

```
(8519, 25) (8519,)
```

In [38]:
```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
```

In [39]:
```
cols = [
    'Item_Weight',
    'Item_Visibility',
    'Item_MRP',
    'Outlet_Years'
]
X[cols]
```

Out[39]:

	Item_Weight	Item_Visibility	Item_MRP	Outlet_Years
0	9.300	0.922960	249.8092	14
1	5.920	1.003057	48.2692	4
2	17.500	0.831990	141.6180	14
3	19.200	0.750000	182.0950	15
4	8.930	0.666667	53.8614	26
...	...	...	...	...
8514	6.865	0.920247	214.5218	26
8515	8.380	1.000657	108.1570	11
8516	10.600	0.999512	85.1224	9
8517	7.210	1.031393	103.1332	4
8518	14.800	0.870321	75.4670	16

8519 rows × 4 columns

In [40]:
```
X[cols]  =  sc.fit_transform(X[cols])
```

In [41]:
```
X.head()
```

Out[41]:

	Item_Weight	Item_Visibility	Item_MRP	Outlet_Years	Item_Fat_Content_1	Item_Fat_Content_2	Outlet_Location_Type_1	Outlet_Location_
0	-0.769598	-0.391478	1.746938	-0.138865	False	False	False	
1	-1.497133	0.015532	-1.489096	-1.333806	False	True	False	
2	0.995427	-0.853739	0.009762	-0.138865	False	False	False	
3	1.361347	-1.270366	0.659682	-0.019371	False	True	False	
4	-0.849240	-1.693822	-1.399305	1.295064	True	False	False	

5 rows × 25 columns

In [42]:
```
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
model = LinearRegression()
model.fit(X_scaled, y)
```

Out[42]:
```
LinearRegression
LinearRegression()
```

In [43]:
```
model.fit(X,y)
```

Out[43]:
```
LinearRegression
LinearRegression()
```

In [44]:
```
y_pred = model.predict(X)
```

In [45]:
```
from sklearn.metrics import r2_score,mean_squared_error
score = r2_score(y,y_pred)
```

```
print("Score of Training:",score)
print("RMSE : %.4g" % np.sqrt(mean_squared_error(y,y_pred)))
```

```
Score of Training: 0.5632782566377577
RMSE : 1128
```

In [46]:
```
from sklearn.metrics import mean_squared_error,make_scorer,mean_absolute_error
from sklearn.model_selection import cross_val_score
cv_score = cross_val_score(model,X, y, cv=20, scoring = make_scorer(mean_squared_error))
cv_score = np.sqrt(np.abs(cv_score))
print("\nModel Report")
print("MAE : %.4g" % np.sqrt(mean_absolute_error(y,y_pred)))
print("RMSE : %.4g" % np.sqrt(mean_squared_error(y,y_pred)))
print("CV Score : Mean - %.4g | Std - %.4g | Min - %.4g | Max - %.4g" % (np.mean(cv_score),np.std(cv_score),np.min(cv_score),n
```

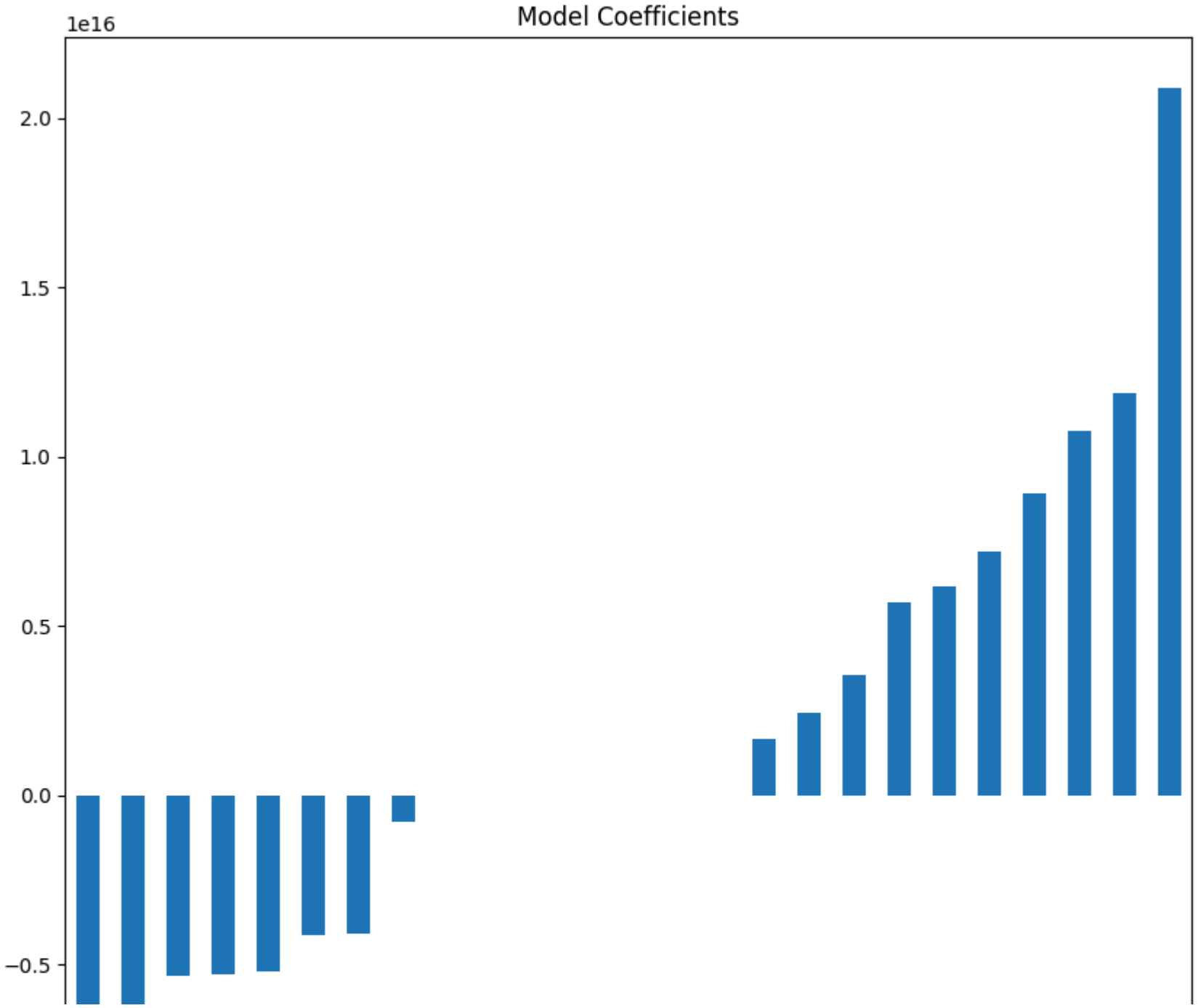
```
Model Report
MAE : 28.92
RMSE : 1128
CV Score : Mean - 1129 | Std - 42.82 | Min - 1074 | Max - 1211
```

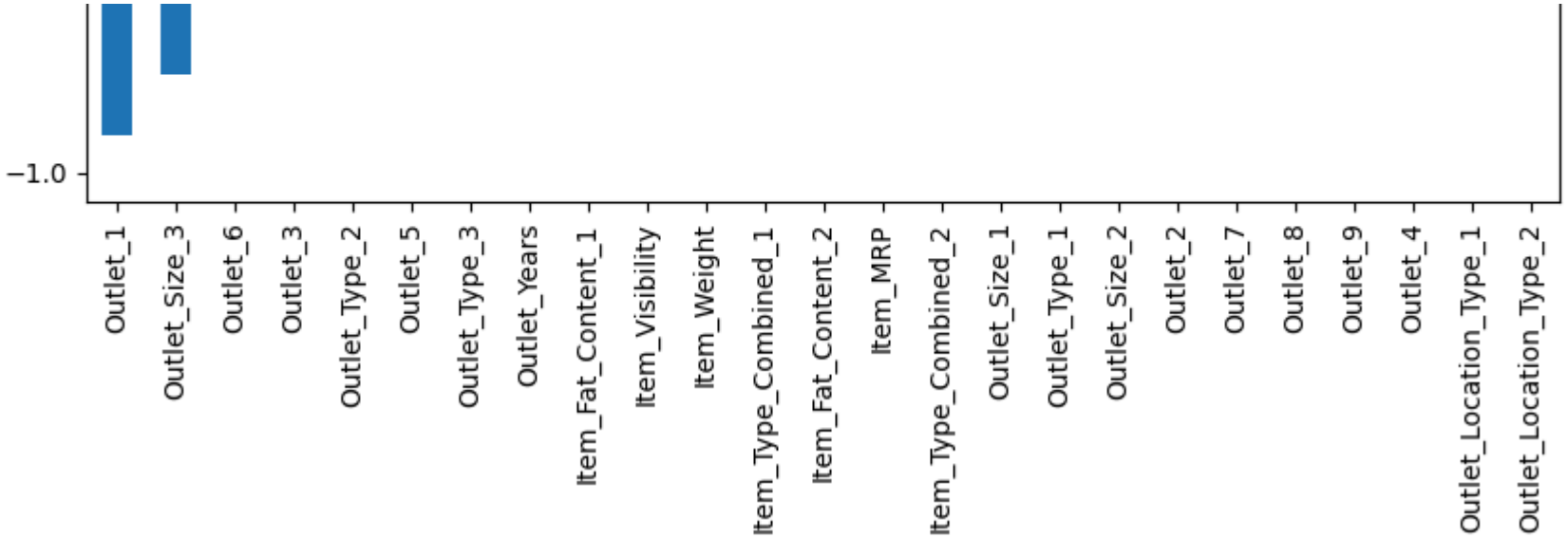
In [47]:
```
model.coef_
```

Out[47]:
```
array([ 3.98642503e-01, -2.48441207e+00,  9.68076285e+02, -7.85463912e+14,
       -4.60134601e+12,  4.19498958e+01,  1.18904905e+16,  2.08862709e+16,
        1.67130716e+15,  3.56071228e+15, -7.76847000e+15,  2.42995151e+15,
       -5.20324769e+15, -4.10115515e+15,  1.87666685e+01,  4.60134601e+12,
       -9.16598020e+15,  5.72110414e+15, -5.26897077e+15,  1.07772465e+16,
       -4.11846410e+15, -5.32650324e+15,  6.19039564e+15,  7.22099541e+15,
        8.92268393e+15])
```

In [48]:
```
coef2 = pd.Series(model.coef_ ,X.columns).sort_values()
plt.figure(figsize = (10,10))
coef2.plot(kind='bar', title='Model Coefficients')
```

Out[48]:
```
<Axes: title={'center': 'Model Coefficients'}>
```


Model Coefficients
1e16
2.0
1.5
1.0
0.5
0.0
−0.5



In [49]:
```
from sklearn.linear_model import Ridge
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
model_ridge = Ridge(alpha=0.05)
model_ridge.fit(X_scaled, y)
```

Out[49]:
```
Ridge
Ridge(alpha=0.05)
```

In [50]:
```
model_ridge.fit(X, y)
```

Out[50]:
```
Ridge
Ridge(alpha=0.05)
```

In [51]:
```
y_pred = model_ridge.predict(X)
```

In [52]:
```
score = r2_score(y,y_pred)
print("Score of Training:",score)
print("RMSE : %.4g" % np.sqrt(mean_squared_error(y,y_pred)))
```

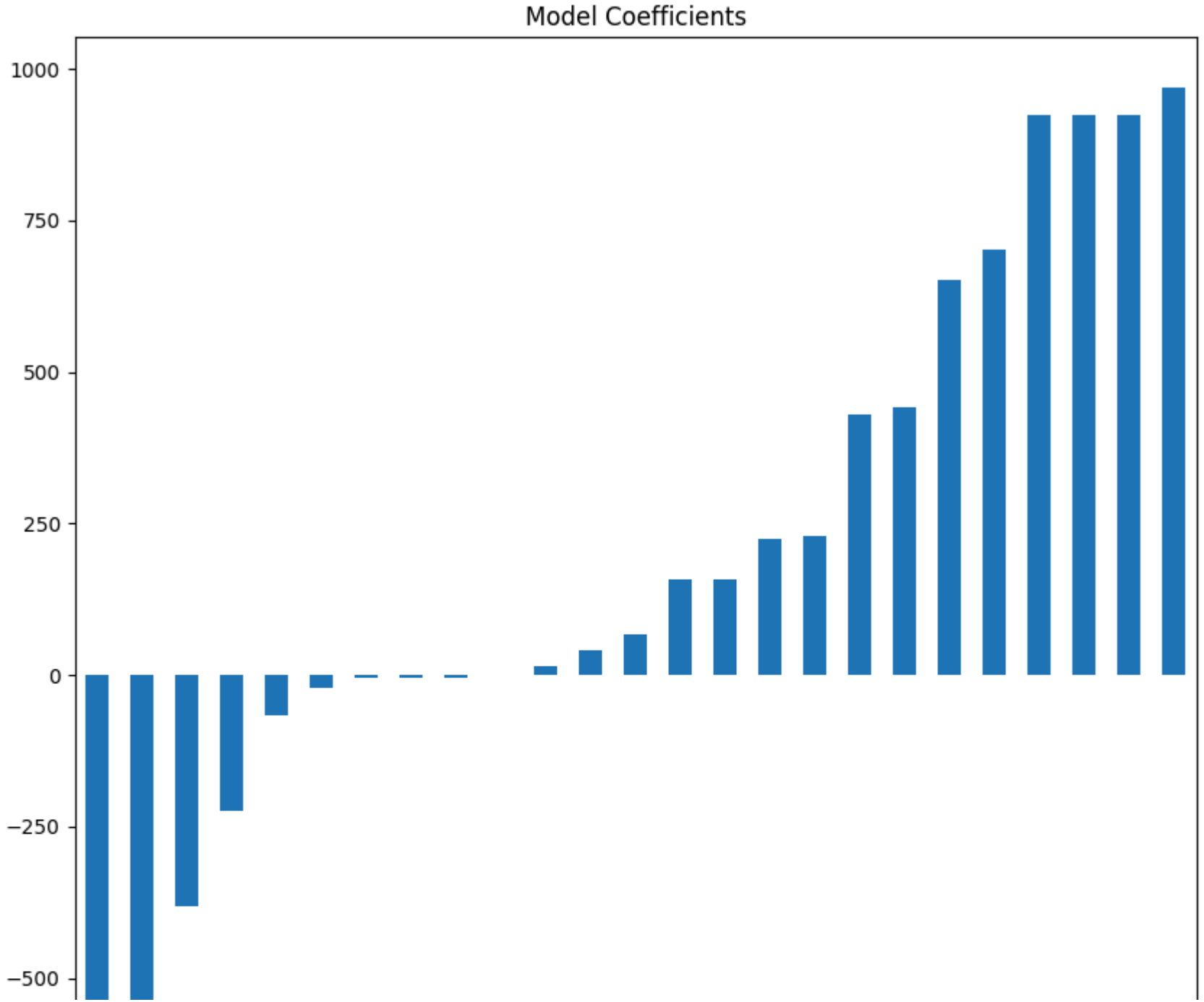
```
Score of Training: 0.5633685044075025
RMSE : 1128
```

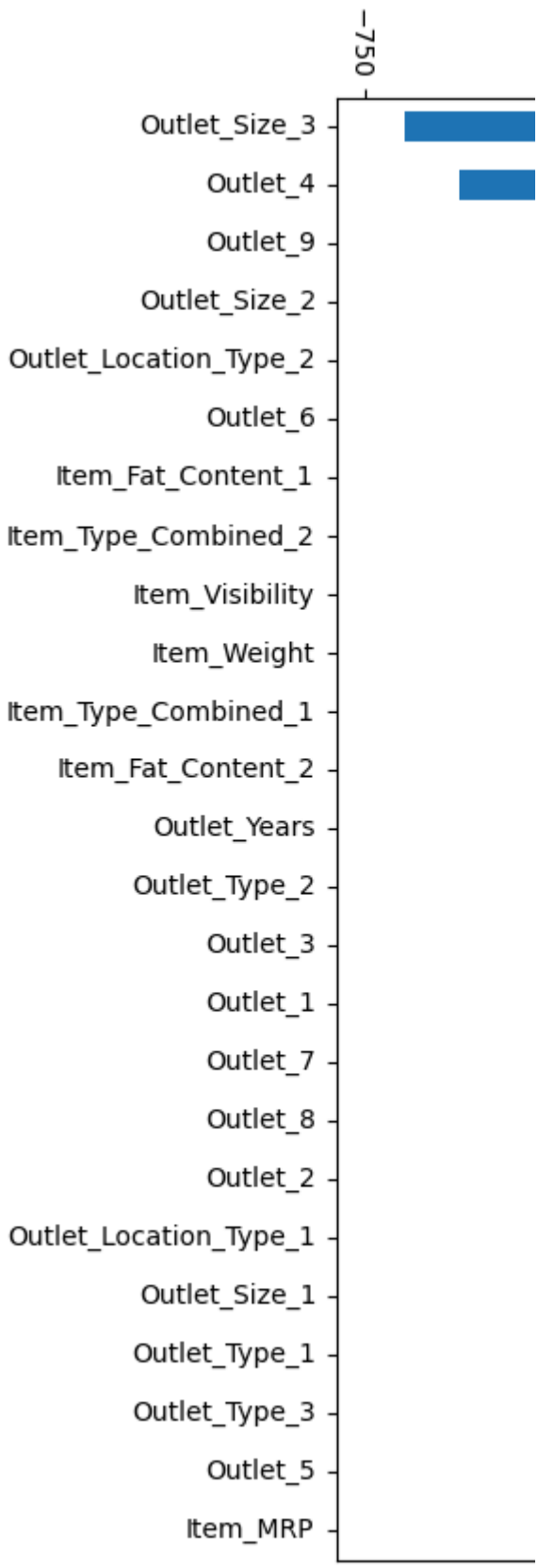
In [53]:
```
from sklearn.metrics import mean_squared_error,make_scorer,mean_absolute_error
from sklearn.model_selection import cross_val_score
cv_score = cross_val_score(model,X, y, cv=20, scoring = make_scorer(mean_squared_error))
cv_score = np.sqrt(np.abs(cv_score))
print("\nModel Report")
print("MAE : %.4g" % np.sqrt(mean_absolute_error(y,y_pred)))
print("RMSE : %.4g" % np.sqrt(mean_squared_error(y,y_pred)))
print("CV Score : Mean - %.4g | Std - %.4g | Min - %.4g | Max - %.4g" % (np.mean(cv_score),np.std(cv_score),np.min(cv_score),n
```

```
Model Report
MAE : 28.91
RMSE : 1128
CV Score : Mean - 1129 | Std - 42.82 | Min - 1074 | Max - 1211
```

In [54]:
```
coef2 = pd.Series(model_ridge.coef_ ,X.columns).sort_values()
plt.figure(figsize = (10,10))
coef2.plot(kind='bar', title='Model Coefficients')
```

Out[54]:
```
<Axes: title={'center': 'Model Coefficients'}>
```


Model Coefficients
1000
750
500
250
0
−250
−500


750
Outlet_Size_3
Outlet_4
Outlet_9
Outlet_Size_2
Outlet_Location_Type_2
Outlet_6
Item_Fat_Content_1
Item_Type_Combined_2
Item_Visibility
Item_Weight
Item_Type_Combined_1
Item_Fat_Content_2
Outlet_Years
Outlet_Type_2
Outlet_3
Outlet_1
Outlet_7
Outlet_8
Outlet_2
Outlet_Location_Type_1
Outlet_Size_1
Outlet_Type_1
Outlet_Type_3
Outlet_5
Item_MRP