In [ ]:

```
# Simple Regression Using "MachineHoursCurrentMeter" to Calculate "SalePrice"
```

In [1]:

```
import numpy as np
import pandas as pd
import statsmodels.api as sm
import matplotlib.pyplot as plt
```

In [ ]:

```
data = pd.read_csv('fast iron 100k data.csv')
```

In [3]:

```
data
```

Out[3]:

	SalesID	SalePrice	MachineID	ModelID	datasource	auctioneerID	YearMade	MachineHoursCur
0	1139283	36000	1052214	2232	121	3	1998	
1	1139299	9500	1002713	21442	121	3	2003	
2	1139356	53000	1004127	25458	121	3	2000	
3	1139369	14000	1050658	1918	121	3	1000	
4	1139390	8250	1011114	7110	121	3	1000	
...	...	...	...	...	...	...	...	
99995	1417929	93500	26366	3357	132	6	1990	
99996	1417930	47000	1412330	3357	132	9	1990	
99997	1417931	47000	1412330	3357	132	9	1990	
99998	1417934	48000	1412330	3357	132	9	1990	
99999	1417937	92500	1195271	3357	132	1	1990	

100000 rows × 53 columns

In [4]:

```
data['MachineHoursCurrentMeter'] = data['MachineHoursCurrentMeter'].replace(np.nan, 0)
```

In [5]:

```
data.describe()
```

Out[5]:

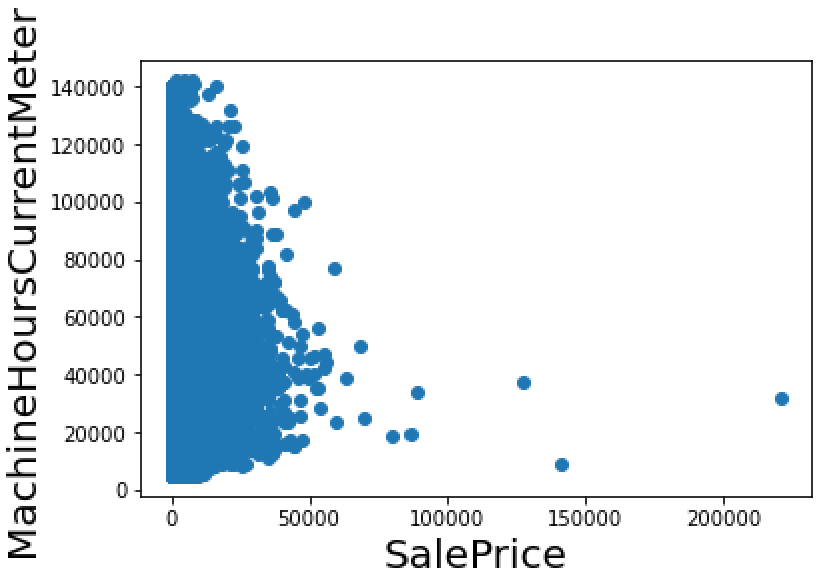
	SalesID	SalePrice	MachineID	ModelID	datasource	auctioneerID	Year
count	1.000000e+05	100000.00000	1.000000e+05	100000.000000	100000.000000	100000.000000	100000.0
mean	1.294013e+06	32361.55013	1.067671e+06	5485.211650	129.362860	6.502580	1931.4
std	7.910623e+04	23797.71391	3.947570e+05	5078.726263	4.696196	15.605157	237.2
min	1.139246e+06	4750.00000	1.300000e+01	28.000000	121.000000	1.000000	1000.0
25%	1.252166e+06	15500.00000	1.004246e+06	3171.000000	132.000000	1.000000	1984.0
50%	1.292648e+06	24500.00000	1.151534e+06	3819.000000	132.000000	3.000000	1993.0
75%	1.363022e+06	41000.00000	1.355657e+06	6797.000000	132.000000	4.000000	1999.0
max	1.417937e+06	142000.00000	1.558285e+06	37198.000000	132.000000	99.000000	2010.0

In [6]:

```
y = data['SalePrice']
x1 = data['MachineHoursCurrentMeter']
```

In [7]:

```
plt.scatter(x1, y)
plt.xlabel('SalePrice', fontsize = 20)
plt.ylabel('MachineHoursCurrentMeter', fontsize = 20)
plt.show()
```



In [8]:

```
x = sm.add_constant(x1)
results = sm.OLS(y, x).fit()
results.summary()
```

Out[8]:

OLS Regression Results

Dep. Variable:	SalePrice	**R-squared:**	0.012
Model:	OLS	**Adj. R-squared:**	0.012
Method:	Least Squares	**F-statistic:**	1221.

Date:	Thu, 21 Dec 2023	**Prob (F-statistic):**	7.90e-266
Time:	10:19:24	**Log-Likelihood:**	-1.1490e+06
No. Observations:	100000	**AIC:**	2.298e+06
Df Residuals:	99998	**BIC:**	2.298e+06
Df Model:	1		
Covariance Type:	nonrobust		

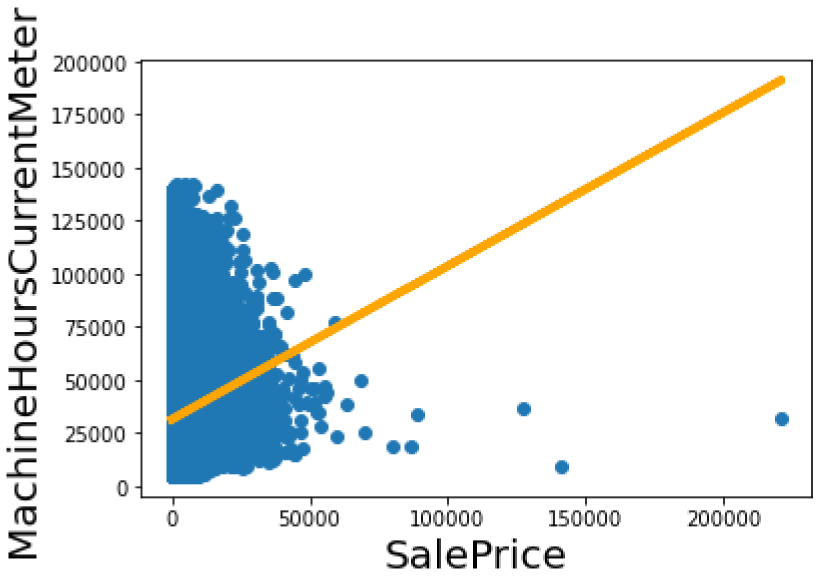
	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
const	3.15e+04	78.754	399.985	0.000	3.13e+04	3.17e+04
MachineHoursCurrentMeter	0.7231	0.021	34.938	0.000	0.683	0.764

Omnibus:	26748.274	**Durbin-Watson:**	0.815
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	60472.371
Skew:	1.539	**Prob(JB):**	0.00
Kurtosis:	5.245	**Cond. No.**	4.01e+03

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 4.01e+03. This might indicate that there are
strong multicollinearity or other numerical problems.

In [9]:

```
plt.scatter(x1, y)
yhat = 0.7231 * x1 + 31500 # Regression Equation
fig = plt.plot(x1, yhat, lw = 4, c = 'orange', label = 'regression line')
plt.xlabel('SalePrice', fontsize = 20)
plt.ylabel('MachineHoursCurrentMeter', fontsize = 20)
plt.show()
```



In [10]:

```
print(results.summary()) # Notice the really low R-squared
```

```
                            OLS Regression Results                            
==============================================================================
Dep. Variable:              SalePrice   R-squared:                       0.012
Model:                            OLS   Adj. R-squared:                  0.012
Method:                 Least Squares   F-statistic:                     1221.
Date:                Thu, 21 Dec 2023   Prob (F-statistic):          7.90e-266
Time:                        10:19:29   Log-Likelihood:            -1.1490e+06
No. Observations:              100000   AIC:                         2.298e+06
Df Residuals:                   99998   BIC:                         2.298e+06
Df Model:                           1                                         
Covariance Type:            nonrobust                                         
================================================================================
====
                               coef    std err          t      P>|t|      [0.025      0.
975]
--------------------------------------------------------------------------------
----
const                     3.15e+04     78.754    399.985      0.000    3.13e+04    3.17
e+04
MachineHoursCurrentMeter    0.7231      0.021     34.938      0.000       0.683       
0.764
==============================================================================
Omnibus:                    26748.274   Durbin-Watson:                   0.815
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            60472.371
Skew:                           1.539   Prob(JB):                         0.00
Kurtosis:                       5.245   Cond. No.                     4.01e+03
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specifi
ed.
[2] The condition number is large, 4.01e+03. This might indicate that there are
strong multicollinearity or other numerical problems.
```

In [ ]:

```
# Multiple Regression Using "MachineHoursCurrentMeter" and "YearMade" to Calculate "Sal
```

In [11]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import statsmodels.api as sm
```

In [ ]:

```
data = pd.read_csv('fast iron 100k data.csv')
```

In [13]:

```
data.head()
```

Out[13]:

	SalesID	SalePrice	MachineID	ModelID	datasource	auctioneerID	YearMade	MachineHoursCurrentM
0	1139283	36000	1052214	2232	121	3	1998	
1	1139299	9500	1002713	21442	121	3	2003	
2	1139356	53000	1004127	25458	121	3	2000	
3	1139369	14000	1050658	1918	121	3	1000	
4	1139390	8250	1011114	7110	121	3	1000	

5 rows × 53 columns

In [14]:

```
data.describe()
```

Out[14]:

	SalesID	SalePrice	MachineID	ModelID	datasource	auctioneerID	Year
count	1.000000e+05	100000.00000	1.000000e+05	100000.000000	100000.000000	100000.000000	100000.0
mean	1.294013e+06	32361.55013	1.067671e+06	5485.211650	129.362860	6.502580	1931.4
std	7.910623e+04	23797.71391	3.947570e+05	5078.726263	4.696196	15.605157	237.2
min	1.139246e+06	4750.00000	1.300000e+01	28.000000	121.000000	1.000000	1000.0
25%	1.252166e+06	15500.00000	1.004246e+06	3171.000000	132.000000	1.000000	1984.0
50%	1.292648e+06	24500.00000	1.151534e+06	3819.000000	132.000000	3.000000	1993.0
75%	1.363022e+06	41000.00000	1.355657e+06	6797.000000	132.000000	4.000000	1999.0
max	1.417937e+06	142000.00000	1.558285e+06	37198.000000	132.000000	99.000000	2010.0

In [15]:

```
data['MachineHoursCurrentMeter'] = data['MachineHoursCurrentMeter'].replace(np.nan, 0)
data = data[data['YearMade'] != 1000] # Excludes rows in which YearMade has a value of
```

In [16]:

```
data.describe() # Notice how there are now only 93,916 rows
```

Out[16]:

	SalesID	SalePrice	MachineID	ModelID	datasource	auctioneerID	YearMa
count	9.391600e+04	93916.000000	9.391600e+04	93916.000000	93916.000000	93916.000000	93916.0000
mean	1.299405e+06	32842.654372	1.068873e+06	5517.963989	129.695664	6.599664	1991.7818
std	7.780581e+04	24016.172084	4.013234e+05	5121.838352	4.476376	15.859059	9.7477
min	1.139246e+06	4750.000000	1.300000e+01	28.000000	121.000000	1.000000	1919.0000
25%	1.258933e+06	16000.000000	1.001703e+06	3171.000000	132.000000	1.000000	1986.0000
50%	1.298802e+06	25000.000000	1.164262e+06	3819.000000	132.000000	3.000000	1994.0000
75%	1.366180e+06	42000.000000	1.362241e+06	6805.000000	132.000000	4.000000	1999.0000
max	1.417937e+06	142000.000000	1.558285e+06	37198.000000	132.000000	99.000000	2010.0000

In [17]:

```python
y = data['SalePrice']
x1 = data[['MachineHoursCurrentMeter', 'YearMade']]
```

In [18]:

```python
x = sm.add_constant(x1)
results = sm.OLS(y, x).fit()
results.summary()
```

Out[18]:

OLS Regression Results

Dep. Variable:	SalePrice	**R-squared:**	0.054
Model:	OLS	**Adj. R-squared:**	0.054
Method:	Least Squares	**F-statistic:**	2673.
Date:	Thu, 21 Dec 2023	**Prob (F-statistic):**	0.00
Time:	10:19:54	**Log-Likelihood:**	-1.0779e+06
No. Observations:	93916	**AIC:**	2.156e+06
Df Residuals:	93913	**BIC:**	2.156e+06
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-9.593e+05	1.61e+04	-59.761	0.000	-9.91e+05	-9.28e+05
MachineHoursCurrentMeter	0.6337	0.028	22.951	0.000	0.580	0.688
YearMade	497.8320	8.062	61.747	0.000	482.030	513.634

Omnibus:	22790.243	**Durbin-Watson:**	0.786
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	47872.793
Skew:	1.435	**Prob(JB):**	0.00
Kurtosis:	5.000	**Cond. No.**	6.52e+05

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[2] The condition number is large, 6.52e+05. This might indicate that there are
strong multicollinearity or other numerical problems.

In [19]:

```
print(results.summary()) # R-squared increased from to what it was in simple regression
```

```
                            OLS Regression Results                            
==============================================================================
Dep. Variable:              SalePrice   R-squared:                       0.054
Model:                            OLS   Adj. R-squared:                  0.054
Method:                 Least Squares   F-statistic:                     2673.
Date:                Thu, 21 Dec 2023   Prob (F-statistic):               0.00
Time:                        10:19:56   Log-Likelihood:            -1.0779e+06
No. Observations:               93916   AIC:                         2.156e+06
Df Residuals:                   93913   BIC:                         2.156e+06
Df Model:                           2                                         
Covariance Type:            nonrobust                                         
========================================================================================
====
                               coef    std err          t      P>|t|      [0.025      0.
975]
----------------------------------------------------------------------------------------
----
const                    -9.593e+05   1.61e+04    -59.761      0.000   -9.91e+05   -9.28
e+05
MachineHoursCurrentMeter     0.6337      0.028     22.951      0.000       0.580        
0.688
YearMade                   497.8320      8.062     61.747      0.000     482.030     51
3.634
==============================================================================
Omnibus:                    22790.243   Durbin-Watson:                   0.786
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            47872.793
Skew:                           1.435   Prob(JB):                         0.00
Kurtosis:                       5.000   Cond. No.                     6.52e+05
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specifi
ed.
[2] The condition number is large, 6.52e+05. This might indicate that there are
strong multicollinearity or other numerical problems.
```

In [ ]:

```
# Regression Equation: SalePrice = 0.6337 * MachineHoursCurrentMeter + 497.8320 * YearM
```