Logistic regression with Admittance dataset

Import the relevant libraries

In [1]:
```
import numpy as np
import pandas as pd
import statsmodels.api as sm
import matplotlib.pyplot as plt
import seaborn as sns
#sns.set()

#Apply a fix to the statsmodels library
from scipy import stats
stats.chisqprob = lambda chisq, df: stats.chi2.sf(chisq, df)
```

Load the data

In [2]:
```
raw_data = pd.read_csv('Admittance.csv')
data = raw_data.copy()
data['Admitted'] = raw_data['Admitted'].map({'Yes': 1, 'No': 0})
data
```

Out[2]:

	SAT	Admitted
0	1363	0
1	1792	1
2	1954	1
3	1653	0
4	1593	0
...	...	...
163	1722	1
164	1750	1
165	1555	0
166	1524	0
167	1461	0

168 rows × 2 columns

Declare the dependent and the independent variables

In [3]:
```
y = data['Admitted']
x1 = data['SAT']
```

Regression

In [4]:
```
x = sm.add_constant(x1)
reg_log = sm.Logit(y,x)
results_log = reg_log.fit()
```

```
Optimization terminated successfully.
         Current function value: 0.137766
         Iterations 10
```

Summary

In [5]:
```
# Get the regression summary
results_log.summary()
```

Out[5]:

Logit Regression Results

Dep. Variable:	Admitted	**No. Observations:**	168
Model:	Logit	**Df Residuals:**	166
Method:	MLE	**Df Model:**	1
Date:	Tue, 25 Oct 2022	**Pseudo R-squ.:**	0.7992
Time:	11:30:49	**Log-Likelihood:**	-23.145
converged:	True	**LL-Null:**	-115.26
Covariance Type:	nonrobust	**LLR p-value:**	5.805e-42

	coef	std err	z	P>|z|	[0.025	0.975]
const	-69.9128	15.737	-4.443	0.000	-100.756	-39.070
SAT	0.0420	0.009	4.454	0.000	0.024	0.060

Possibly complete quasi-separation: A fraction 0.27 of observations can be perfectly predicted. This might indicate that there is complete quasi-separation. In this case some parameters will not be identified.

Looking into LL-null

In [6]:
```
# Create a variable only of 1s
const = np.ones(168)
const
```

Out[6]:
```
array([1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.])
```

In [7]:
```
reg_null = sm.Logit(y,const)
results_null = reg_null.fit()
results_null.summary()
```

```
Optimization terminated successfully.
         Current function value: 0.686044
         Iterations 4
```

Out[7]:

Logit Regression Results

Dep. Variable:	Admitted	**No. Observations:**	168
Model:	Logit	**Df Residuals:**	167
Method:	MLE	**Df Model:**	0
Date:	Tue, 25 Oct 2022	**Pseudo R-squ.:**	7.410e-11
Time:	11:30:49	**Log-Likelihood:**	-115.26
converged:	True	**LL-Null:**	-115.26
Covariance Type:	nonrobust	**LLR p-value:**	nan

	coef	std err	z	P>|z|	[0.025	0.975]
const	0.2392	0.155	1.539	0.124	-0.065	0.544

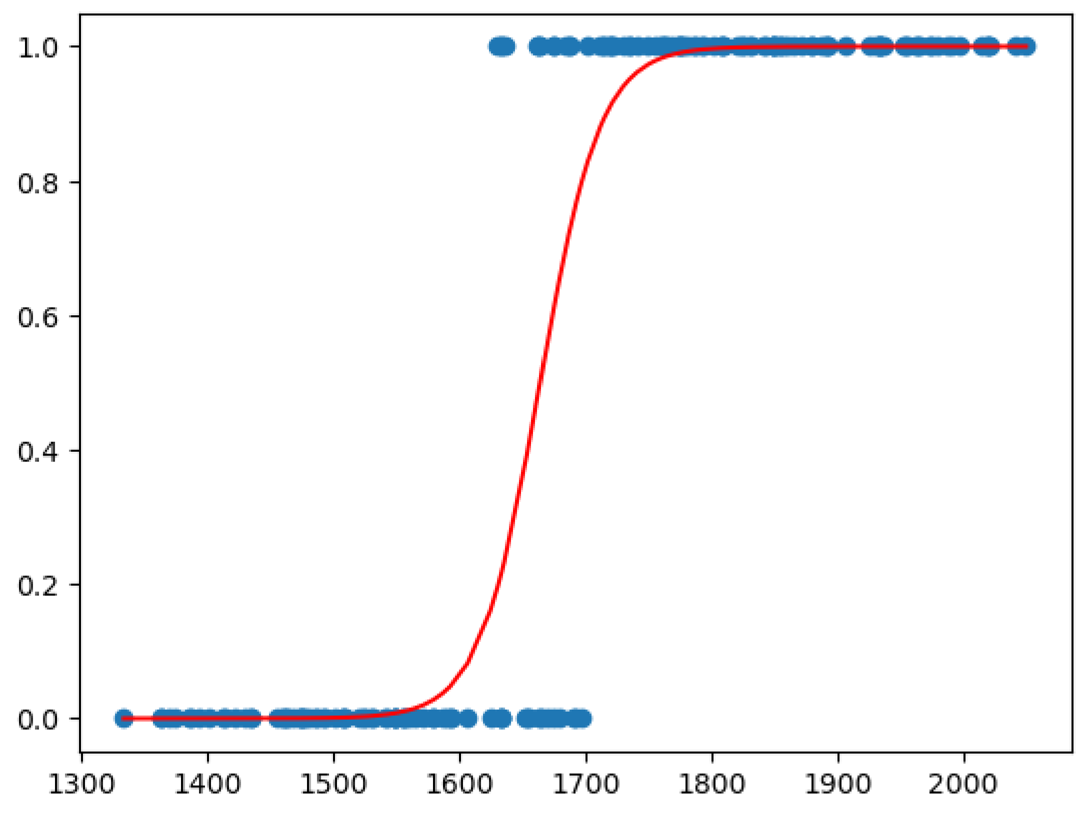
Plot a logistic regression curve

In [8]:
```
# Creating a logit regression (we will discuss this in another notebook)
reg_log = sm.Logit(y,x)
# Fitting the regression
results_log = reg_log.fit()

# Creating a logit function, depending on the input and coefficients
def f(x,b0,b1):
    return np.array(np.exp(b0+x*b1) / (1 + np.exp(b0+x*b1)))

# Sorting the y and x, so we can plot the curve
f_sorted = np.sort(f(x1,results_log.params[0],results_log.params[1]))
x_sorted = np.sort(np.array(x1))
ax = plt.scatter(x1,y,color='C0')
#plt.xlabel('SAT', fontsize = 20)
#plt.ylabel('Admitted', fontsize = 20)
# Plotting the curve
ax2 = plt.plot(x_sorted,f_sorted,color='red')
plt.figure(figsize=(20,20))
plt.show()
```

```
Optimization terminated successfully.
         Current function value: 0.137766
         Iterations 10
```




```
<Figure size 2000x2000 with 0 Axes>
```

In [9]:
```
np.exp(4.20)
```

Out[9]:
```
66.68633104092515
```