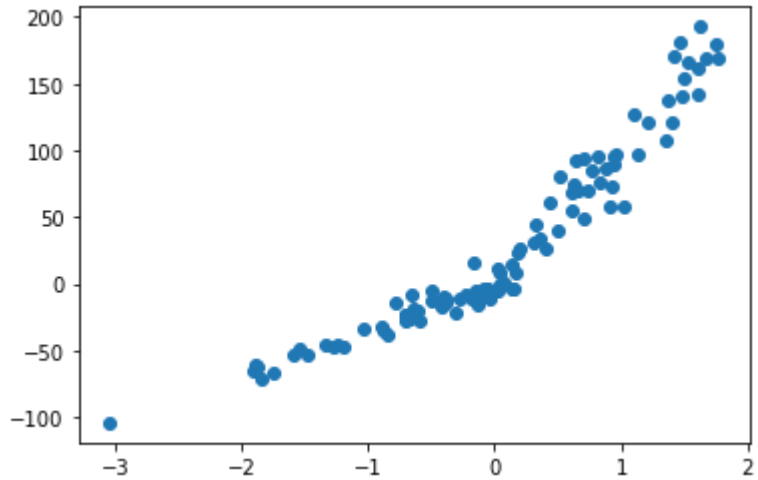
In [3]:
```
import numpy as np
from sklearn.datasets import make_regression
import matplotlib.pyplot as plt
```

In [68]:
```
x, y = make_regression (n_samples=100, n_features=1, noise=10)
y = y + abs(y/2)
plt.scatter(x,y)
```

Out[68]:
```
<matplotlib.collections.PathCollection at 0x7f9e0b4f7130>
```



In [69]:
```
y=y.reshape(y.shape[0], 1)
```

In [70]:
```
print(x.shape, y.shape)
```

```
(100, 1) (100, 1)
```

In [72]:
```
X=np.hstack((x, np.ones (x.shape)))
X=np.hstack((x**2,X))
print(X.shape)
X
```

Out[72]:

```
(100, 3)
array([[ 2.34314828e+00,  1.53073456e+00,  1.00000000e+00],
       [ 4.05076055e-02,  2.01265013e-01,  1.00000000e+00],
       [ 3.63550392e-01,  6.02951401e-01,  1.00000000e+00],
       [ 2.59413017e+00,  1.61063036e+00,  1.00000000e+00],
       [ 1.60905614e+00, -1.26848576e+00,  1.00000000e+00],
       [ 2.32201695e-03,  4.81873110e-02,  1.00000000e+00],
       [ 2.63466034e-02, -1.62316368e-01,  1.00000000e+00],
       [ 3.67266029e-01, -6.06024776e-01,  1.00000000e+00],
       [ 7.30595516e-03, -8.54748803e-02,  1.00000000e+00],
       [ 1.06212576e+00, -1.03059486e+00,  1.00000000e+00],
       [ 2.54692883e+00, -1.59591003e+00,  1.00000000e+00],
       [ 1.98499375e+00,  1.40889806e+00,  1.00000000e+00],
       [ 5.06811758e-01,  7.11907128e-01,  1.00000000e+00],
       [ 4.31860827e-01,  6.57161188e-01,  1.00000000e+00],
       [ 2.21293127e-03, -4.70418034e-02,  1.00000000e+00],
       [ 8.91732775e-01,  9.44316035e-01,  1.00000000e+00],
       [ 8.44363935e-01,  9.18892777e-01,  1.00000000e+00],
       [ 1.69324090e-01,  4.11490085e-01,  1.00000000e+00],
       [ 1.46876305e+00,  1.21192535e+00,  1.00000000e+00],
       [ 4.93648039e-01, -7.02600910e-01,  1.00000000e+00],
       [ 3.13809125e+00,  1.77146585e+00,  1.00000000e+00],
       [ 3.18131860e-02, -1.78362513e-01,  1.00000000e+00],
       [ 4.36673581e-03, -6.60812819e-02,  1.00000000e+00],
       [ 2.22966574e-02, -1.49320653e-01,  1.00000000e+00],
       [ 3.06639443e+00, -1.75111234e+00,  1.00000000e+00],
       [ 9.22866181e-02, -3.03787126e-01,  1.00000000e+00],
       [ 8.59216258e-01,  9.26939188e-01,  1.00000000e+00],
       [ 2.24494295e+00,  1.49831337e+00,  1.00000000e+00],
       [ 9.29788884e+00, -3.04924398e+00,  1.00000000e+00],
       [ 7.67536535e-03, -8.76091625e-02,  1.00000000e+00],
       [ 6.01445181e-01, -7.75528968e-01,  1.00000000e+00],
       [ 4.29206991e-01, -6.55138909e-01,  1.00000000e+00],
       [ 2.66453862e+00,  1.63234145e+00,  1.00000000e+00],
       [ 1.04635174e+00,  1.02291336e+00,  1.00000000e+00],
       [ 1.41596887e+00, -1.18994490e+00,  1.00000000e+00],
       [ 8.04668472e-01, -8.97033150e-01,  1.00000000e+00],
       [ 1.99723810e+00,  1.41323675e+00,  1.00000000e+00],
       [ 1.82939119e+00,  1.35254988e+00,  1.00000000e+00],
       [ 2.14598170e+00,  1.46491696e+00,  1.00000000e+00],
       [ 9.80297828e-02,  3.13097082e-01,  1.00000000e+00],
       [ 4.89648603e-02, -2.21280049e-01,  1.00000000e+00],
```

```
[ 1.46027053e-01, -3.82134862e-01,  1.00000000e+00],
[ 3.95260104e-01,  6.28697148e-01,  1.00000000e+00],
[ 1.78707222e-02, -1.33681421e-01,  1.00000000e+00],
[ 4.95816402e-01, -7.04142316e-01,  1.00000000e+00],
[ 2.36367415e+00, -1.53742452e+00,  1.00000000e+00],
[ 7.68429446e-01, -8.76601076e-01,  1.00000000e+00],
[ 3.07455961e+00,  1.75344222e+00,  1.00000000e+00],
[ 1.26873986e-03, -3.56193747e-02,  1.00000000e+00],
[ 3.48981424e+00, -1.86810445e+00,  1.00000000e+00],
[ 4.58586481e-01, -6.77190136e-01,  1.00000000e+00],
[ 1.30116107e+00,  1.14068447e+00,  1.00000000e+00],
[ 3.47965477e-04,  1.86538328e-02,  1.00000000e+00],
[ 2.50130785e-02,  1.58155235e-01,  1.00000000e+00],
[ 2.60031895e+00,  1.61255045e+00,  1.00000000e+00],
[ 9.08648514e-01,  9.53230567e-01,  1.00000000e+00],
[ 7.86493643e-01,  8.86844768e-01,  1.00000000e+00],
[ 1.90107071e+00,  1.37879321e+00,  1.00000000e+00],
[ 2.73075420e-02,  1.65249938e-01,  1.00000000e+00],
[ 3.62497739e+00, -1.90393734e+00,  1.00000000e+00],
[ 6.55034504e-01,  8.09342019e-01,  1.00000000e+00],
[ 1.78302538e-01, -4.22258852e-01,  1.00000000e+00],
[ 9.01470844e-01,  9.49458184e-01,  1.00000000e+00],
[ 1.19903823e+00,  1.09500604e+00,  1.00000000e+00],
[ 1.30357387e-01,  3.61050395e-01,  1.00000000e+00],
[ 3.08329787e-02,  1.75593219e-01,  1.00000000e+00],
[ 6.91324584e-01,  8.31459310e-01,  1.00000000e+00],
[ 7.70155757e-02, -2.77516802e-01,  1.00000000e+00],
[ 1.61595403e-01, -4.01989307e-01,  1.00000000e+00],
[ 3.52842297e-01, -5.94005301e-01,  1.00000000e+00],
[ 1.54392184e+00, -1.24254651e+00,  1.00000000e+00],
[ 4.01862146e-01, -6.33925979e-01,  1.00000000e+00],
[ 2.65387830e-01,  5.15158063e-01,  1.00000000e+00],
[ 5.06599612e-01,  7.11758114e-01,  1.00000000e+00],
[ 2.51400248e-01,  5.01398293e-01,  1.00000000e+00],
[ 4.38795291e-03,  6.62416252e-02,  1.00000000e+00],
[ 2.77602744e+00,  1.66614148e+00,  1.00000000e+00],
[ 2.40140549e-01, -4.90041375e-01,  1.00000000e+00],
[ 2.16836109e+00, -1.47253560e+00,  1.00000000e+00],
[ 1.05629858e-01,  3.25007474e-01,  1.00000000e+00],
[ 1.69689184e-02,  1.30264801e-01,  1.00000000e+00],
[ 2.49792352e-01, -4.99792308e-01,  1.00000000e+00],
[ 7.37502008e-04,  2.71569882e-02,  1.00000000e+00],
```

```
       [ 4.10780506e-01,  6.40921607e-01,  1.00000000e+00],
       [ 2.17542101e+00,  1.47493085e+00,  1.00000000e+00],
       [ 1.68940143e-01, -4.11023288e-01,  1.00000000e+00],
       [ 1.12325022e-03,  3.35149253e-02,  1.00000000e+00],
       [ 1.53946784e-01, -3.92360528e-01,  1.00000000e+00],
       [ 1.89437069e-01,  4.35243690e-01,  1.00000000e+00],
       [ 4.91386078e-01, -7.00989356e-01,  1.00000000e+00],
       [ 3.70877919e-01,  6.08997471e-01,  1.00000000e+00],
       [ 1.79028226e+00, -1.33801430e+00,  1.00000000e+00],
       [ 4.13096934e-03, -6.42726173e-02,  1.00000000e+00],
       [ 1.74644768e-02,  1.32153232e-01,  1.00000000e+00],
       [ 3.40801214e+00, -1.84608021e+00,  1.00000000e+00],
       [ 3.59384882e+00, -1.89574492e+00,  1.00000000e+00],
       [ 2.89754938e-03,  5.38288898e-02,  1.00000000e+00],
       [ 5.93966466e-01,  7.70692199e-01,  1.00000000e+00],
```

In [74]:

```
theta=np.random.randn(3,1)
theta
```

Out[74]:

```
array([[1.87596324],
       [0.3482715 ],
       [0.50503204]])
```

In [75]:

```
def model (X, theta):
    return X.dot(theta)
```

In [76]:

```
model(X, theta)
```

Out[76]:

```
array([[ 5.4338033 ],
       [ 0.65111769],
       [ 1.39703   ],
       [ 5.93246152],
       [ 3.08178475],
       [ 0.52617032],
       [ 0.49792713],
       [ 0.98294845],
       [ 0.48896928],
       [ 2.13861409],
       [ 4.7271669 ],
       [ 4.71948638],
```

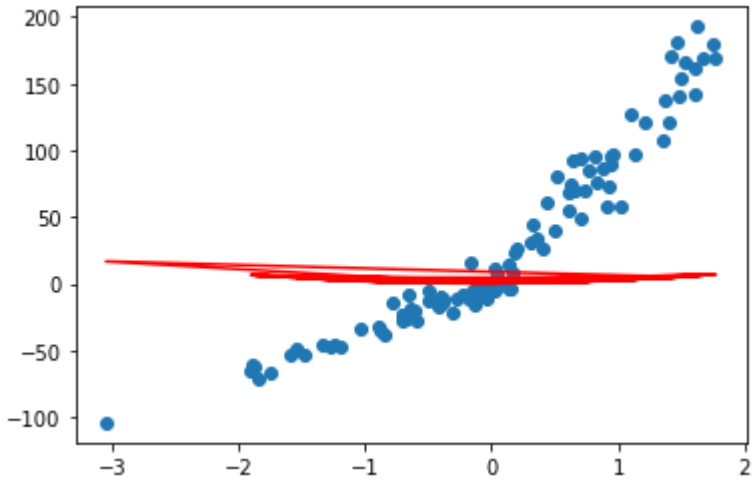
```
[ 1.70372923],
[ 1.54405759],
[ 0.4928001 ],
[ 2.50676831],
[ 2.40905191],
[ 0.96598808],
[ 3.68245658],
[ 1.18640174],
[ 7.00892693],
[ 0.50259383],
[ 0.49020965],
[ 0.49485562],
[ 5.64761273],
[ 0.57235794],
[ 2.43971666],
[ 5.23828233],
[16.88556488],
[ 0.48891897],
[ 1.36322645],
[ 1.08204236],
[ 6.07210655],
[ 2.824201  ],
[ 2.74691368],
[ 1.70214942],
[ 4.74396738],
[ 4.40795723],
[ 5.04100365],
[ 0.7979751 ],
[ 0.51982278],
[ 0.64588674],
[ 1.46548276],
[ 0.49199943],
[ 1.18993268],
[ 4.40375669],
[ 1.64128225],
[ 6.8834668 ],
[ 0.49500693],
[ 6.40118771],
[ 1.12947739],
[ 3.34323026],
[ 0.51218141],
[ 0.60703662],
```

```
[ 5.94474015],
[ 2.54160629],
[ 2.28932796],
[ 4.55156518],
[ 0.61381183],
[ 6.64226924],
[ 2.01572345],
[ 0.69246032],
[ 2.52682743],
[ 3.13574308],
[ 0.87532127],
[ 0.62402769],
[ 2.09150513],
[ 0.55285923],
[ 0.66817765],
[ 0.9600761 ],
[ 2.9686291 ],
[ 1.0381323 ],
[ 1.18230472],
[ 1.70327935],
[ 1.1512724 ],
[ 0.53633375],
[ 6.29302706],
[ 0.78485943],
[ 4.05995554],
[ 0.81638061],
[ 0.58223262],
[ 0.79956989],
[ 0.51587357],
[ 1.4988559 ],
[ 5.09971826],
[ 0.67880984],
[ 0.51881151],
[ 0.65718255],
[ 1.01199199],
[ 1.18271964],
[ 1.41288184],
[ 3.39754349],
[ 0.49039726],
[ 0.58381996],
[ 6.25540038],
[ 6.58672636],
```

```
       [ 0.5292148 ],
       [ 1.88770142]
```

In [77]:
```
plt.scatter(x,y)
plt.plot(x, model(X,theta), c='r')
```

Out[77]:
```
[<matplotlib.lines.Line2D at 0x7f9e0b519e50>]
```



In [78]:
```
def cout(X,y,theta):
    m=len(y)
    return 1/(2*m)*np.sum((model(X,theta)-y)**2)
```

In [79]:
```
cout(X,y,theta)
```

Out[79]:
```
2810.79400538242
```

In [80]:
```
def grad(X, y, theta):
    m=len(y)
    return (1/m)*X.T.dot(model(X,theta)-y)
```

In [81]:
```
grad(X,y,theta)
```

Out[81]:
```
array([[-32.41998742],
       [-67.61500423],
       [-28.11826762]])
```

In [82]:
```
def DG (X,y, theta, learning_rate, n_iterations):
    histCout=np.zeros(n_iterations)
    for i in range(0, n_iterations):
        theta=theta-learning_rate*grad(X,y, theta)
        histCout[i]=cout(X,y,theta)

    return theta, histCout
```

In [83]:
```
thetaF, histCout = DG(X,y,theta, learning_rate=0.01, n_iterations=1000)
```

In [84]:
```
thetaF
```

Out[84]:
```
array([[14.43111003],
       [69.83583399],
       [11.34419655]])
```

In [85]:
```
histCout
```

Out[85]:
```
array([2747.13381558, 2685.33409998, 2625.32125996, 2567.02544568,
       2510.380338  , 2455.32294382, 2401.79340391, 2349.73481251,
       2299.09304796, 2249.81661359, 2201.85648842, 2155.1659868 ,
       2109.70062672, 2065.41800597, 2022.27768584, 1980.24108193,
       1939.27136138, 1899.33334645, 1860.39342376, 1822.41945907,
       1785.3807171 , 1749.24778613, 1713.99250715, 1679.58790716,
       1646.00813642, 1613.22840947, 1581.22494955, 1549.97493634,
       1519.45645676, 1489.64845858, 1460.53070682, 1432.08374263,
       1404.28884456, 1377.12799208, 1350.58383111, 1324.63964168,
       1299.27930729, 1274.48728605, 1250.2485835 , 1226.54872689,
       1203.37374096, 1180.710125  , 1158.54483128, 1136.86524454,
       1115.65916278, 1094.91477889, 1074.62066348, 1054.7657485 ,
       1035.33931178, 1016.33096241,  997.7306269 ,  979.52853601,
        961.71521237,  944.28145863,  927.21834632,  910.51720518,
        894.16961318,  878.16738686,  862.50257229,  847.16743646,
        832.15445901,  817.45632447,  803.0659148 ,  788.97630234,
        775.18074306,  761.67267014,  748.44568784,  735.49356566,
```

```
722.81023281,  710.38977284,  698.22641857,  686.31454726,
674.64867593,  663.22345697,  652.03367384,  641.07423701,
630.34018009,  619.82665607,  609.52893376,  599.44239429,
589.5625279 ,  579.8849307 ,  570.40530167,  561.11943968,
552.02324074,  543.11269526,  534.38388543,  525.83298271,
517.45624545,  509.2500165 ,  501.21072102,  493.33486426,
485.61902947,  478.05987591,  470.65413687,  463.39861778,
456.29019439,  449.325811  ,  442.50247875,  435.81727396,
429.26733653,  422.8498684 ,  416.56213202,  410.4014489 ,
404.36519819,  398.45081534,  392.65579072,  386.97766833,
381.41404459,  375.96256707,  370.62093332,  365.38688972,
360.25823037,  355.23279597,  350.30847279,  345.48319161,
340.75492674,  336.12169502,  331.58155491,  327.1326055 ,
322.77298565,  318.5008731 ,  314.31448361,  310.21207012,
306.19192195,  302.25236399,  298.39175591,  294.60849145,
290.90099764,  287.2677341 ,  283.7071923 ,  280.21789496,
276.79839527,  273.44727633,  270.16315045,  266.94465855,
263.79046957,  260.69927983,  257.66981247,  254.70081691,
251.79106825,  248.93936675,  246.14453729,  243.40542888,
240.72091411,  238.08988869,  235.51127093,  232.98400132,
230.507042  ,  228.07937638,  225.70000862,  223.36796327,
221.08228479,  218.84203716,  216.64630348,  214.49418557,
212.38480355,  210.31729552,  208.29081713,  206.30454126,
204.35765763,  202.44937247,  200.5789082 ,  198.74550304,
196.94841073,  195.1869002 ,  193.46025526,  191.76777426,
190.10876986,  188.48256865,  186.88851095,  185.32595045,
183.79425399,  182.29280128,  180.82098459,  179.37820858,
177.96388995,  176.57745727,  175.2183507 ,  173.88602173,
172.57993303,  171.29955811,  170.0443812 ,  168.81389696,
167.60761031,  166.42503618,  165.26569937,  164.12913426,
163.0148847 ,  161.92250376,  160.85155355,  159.80160507,
158.772238  ,  157.7630405 ,  156.7736091 ,  155.80354847,
154.8524713 ,  153.91999808,  153.005757  ,  152.10938377,
151.23052145,  150.36882033,  149.52393776,  148.69553802,
147.88329216,  147.08687788,  146.30597942,  145.54028735,
144.78949851,  144.05331588,  143.3314484 ,  142.6236109 ,
141.92952398,  141.24891386,  140.58151228,  139.9270564 ,
139.28528868,  138.65595678,  138.03881343,  137.43361637,
136.84012818,  136.25811628,  135.68735274,  135.12761422,
134.5786819 ,  134.04034135,  133.51238246,  132.99459937,
132.48679033,  131.98875767,  131.5003077 ,  131.02125062,
130.55140045,  130.09057495,  129.63859555,  129.19528725,
```

```
128.7604786 ,  128.33400157,  127.91569152,  127.50538711,
127.10293025,  126.70816601,  126.32094258,  125.9411112 ,
125.5685261 ,  125.20304442,  124.84452618,  124.4928342 ,
124.14783407,  123.80939404,  123.47738503,  123.15168055,
122.83215662,  122.51869177,  122.21116694,  121.90946547,
121.61347305,  121.32307762,  121.03816939,  120.75864077,
120.48438631,  120.21530267,  119.95128859,  119.69224482,
119.43807409,  119.1886811 ,  118.94397243,  118.70385653,
118.46824369,  118.23704597,  118.01017722,  117.78755297,
117.56909047,  117.35470859,  117.14432784,  116.9378703 ,
116.73525963,  116.53642097,  116.34128098,  116.14976779,
115.96181093,  115.77734135,  115.59629137,  115.41859467,
115.24418623,  115.07300234,  114.90498054,  114.74005963,
114.5781796 ,  114.41928166,  114.26330818,  114.11020266,
113.95990973,  113.81237512,  113.66754565,  113.52536917,
113.38579457,  113.24877176,  113.11425165,  112.98218611,
112.85252795,  112.72523094,  112.60024975,  112.47753996,
112.35705801,  112.23876121,  112.12260772,  112.00855651,
111.89656738,  111.78660091,  111.67861847,  111.57258216,
111.46845488,  111.36620021,  111.26578249,  111.16716672,
111.07031864,  110.97520461,  110.8817917 ,  110.79004759,
110.69994062,  110.61143974,  110.52451452,  110.43913511,
110.35527227,  110.27289732,  110.19198214,  110.11249917,
110.03442138,  109.95772228,  109.88237589,  109.80835675,
109.73563989,  109.66420082,  109.59401555,  109.52506054,
109.45731271,  109.39074946,  109.32534858,  109.26108835,
109.19794743,  109.13590491,  109.0749403 ,  109.01503349,
108.95616477,  108.89831481,  108.84146467,  108.78559575,
108.73068985,  108.67672908,  108.62369592,  108.57157321,
108.52034408,  108.46999202,  108.42050082,  108.37185459,
108.32403776,  108.27703505,  108.23083146,  108.18541231,
108.14076318,  108.09686995,  108.05371874,  108.01129598,
107.96958832,  107.92858268,  107.88826626,  107.84862647,
107.80965097,  107.77132768,  107.73364471,  107.69659044,
107.66015345,  107.62432254,  107.58908673,  107.55443526,
107.52035755,  107.48684324,  107.45388216,  107.42146435,
107.38958002,  107.35821958,  107.32737361,  107.29703289,
107.26718835,  107.23783111,  107.20895246,  107.18054384,
107.15259687,  107.12510332,  107.09805511,  107.07144433,
107.0452632 ,  107.01950409,  106.99415954,  106.96922221,
106.94468488,  106.92054051,  106.89678215,  106.87340301,
106.85039641,  106.82775582,  106.8054748 ,  106.78354705,
```

```
106.76196638,  106.74072673,  106.71982215,  106.69924678,
106.67899489,  106.65906086,  106.63943915,  106.62012436,
106.60111116,  106.58239434,  106.56396877,  106.54582942,
106.52797136,  106.51038974,  106.49307982,  106.47603693,
106.45925649,  106.44273401,  106.42646507,  106.41044535,
106.3946706 ,  106.37913665,  106.3638394 ,  106.34877484,
106.33393901,  106.31932804,  106.30493815,  106.29076558,
106.27680668,  106.26305785,  106.24951556,  106.23617635,
106.2230368 ,  106.21009359,  106.19734342,  106.18478307,
106.17240939,  106.16021927,  106.14820966,  106.13637757,
106.12472005,  106.11323422,  106.10191725,  106.09076635,
106.07977878,  106.06895188,  106.05828299,  106.04776953,
106.03740896,  106.02719878,  106.01713654,  106.00721983,
105.99744629,  105.9878136 ,  105.97831946,  105.96896165,
105.95973795,  105.95064621,  105.94168431,  105.93285015,
105.92414169,  105.91555692,  105.90709385,  105.89875054,
105.89052509,  105.88241563,  105.8744203 ,  105.86653729,
105.85876484,  105.85110119,  105.84354463,  105.83609347,
105.82874605,  105.82150074,  105.81435595,  105.8073101 ,
105.80036165,  105.79350908,  105.78675089,  105.78008562,
105.77351183,  105.7670281 ,  105.76063304,  105.75432529,
105.74810349,  105.74196633,  105.7359125 ,  105.72994074,
105.72404978,  105.7182384 ,  105.71250537,  105.70684952,
105.70126965,  105.69576463,  105.69033333,  105.68497462,
105.67968741,  105.67447063,  105.66932322,  105.66424413,
105.65923235,  105.65428688,  105.64940671,  105.64459088,
105.63983843,  105.63514843,  105.63051994,  105.62595206,
105.62144389,  105.61699456,  105.61260319,  105.60826895,
105.60399098,  105.59976847,  105.59560061,  105.5914866 ,
105.58742567,  105.58341703,  105.57945993,  105.57555363,
105.57169738,  105.56789048,  105.56413221,  105.56042188,
105.55675878,  105.55314226,  105.54957164,  105.54604627,
105.54256551,  105.53912871,  105.53573527,  105.53238456,
105.52907599,  105.52580895,  105.52258286,  105.51939715,
105.51625125,  105.51314461,  105.51007667,  105.50704689,
105.50405475,  105.50109972,  105.49818129,  105.49529894,
105.49245218,  105.48964053,  105.48686348,  105.48412058,
105.48141135,  105.47873533,  105.47609206,  105.4734811 ,
105.470902  ,  105.46835434,  105.46583769,  105.46335163,
105.46089574,  105.45846961,  105.45607285,  105.45370505,
105.45136584,  105.44905482,  105.44677162,  105.44451586,
105.44228719,  105.44008523,  105.43790964,  105.43576006,
```

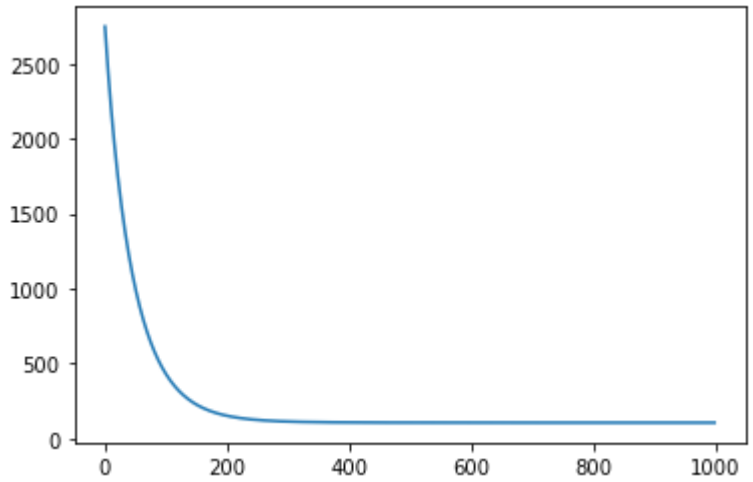
```
105.43363616,  105.43153758,  105.429464  ,  105.42741508,
105.4253905 ,  105.42338995,  105.4214131 ,  105.41945965,
105.41752928,  105.41562171,  105.41373662,  105.41187374,
105.41003276,  105.40821341,  105.40641541,  105.40463848,
105.40288235,  105.40114674,  105.39943141,  105.39773608,
105.3960605 ,  105.39440442,  105.39276759,  105.39114976,
105.3895507 ,  105.38797015,  105.38640789,  105.38486369,
105.38333732,  105.38182854,  105.38033715,  105.37886292,
105.37740563,  105.37596507,  105.37454104,  105.37313332,
105.37174172,  105.37036603,  105.36900604,  105.36766158,
105.36633244,  105.36501843,  105.36371938,  105.36243508,
105.36116536,  105.35991004,  105.35866895,  105.3574419 ,
105.35622873,  105.35502926,  105.35384333,  105.35267078,
105.35151143,  105.35036513,  105.34923171,  105.34811103,
105.34700293,  105.34590726,  105.34482385,  105.34375258,
105.34269328,  105.34164582,  105.34061005,  105.33958584,
105.33857304,  105.33757152,  105.33658114,  105.33560176,
105.33463327,  105.33367552,  105.33272839,  105.33179176,
105.33086549,  105.32994947,  105.32904357,  105.32814768,
105.32726168,  105.32638544,  105.32551886,  105.32466181,
105.3238142 ,  105.3229759 ,  105.32214681,  105.32132683,
105.32051583,  105.31971372,  105.3189204 ,  105.31813576,
105.31735971,  105.31659213,  105.31583293,  105.31508202,
105.3143393 ,  105.31360468,  105.31287805,  105.31215934,
105.31144844,  105.31074527,  105.31004973,  105.30936174,
105.30868122,  105.30800808,  105.30734223,  105.30668358,
105.30603207,  105.3053876 ,  105.30475009,  105.30411947,
105.30349566,  105.30287857,  105.30226814,  105.30166428,
105.30106693,  105.30047601,  105.29989144,  105.29931315,
105.29874108,  105.29817515,  105.2976153 ,  105.29706145,
105.29651354,  105.29597149,  105.29543525,  105.29490475,
105.29437993,  105.29386072,  105.29334705,  105.29283887,
105.29233612,  105.29183873,  105.29134664,  105.2908598 ,
105.29037815,  105.28990162,  105.28943017,  105.28896373,
105.28850225,  105.28804568,  105.28759395,  105.28714703,
105.28670484,  105.28626735,  105.2858345 ,  105.28540623,
105.28498251,  105.28456327,  105.28414846,  105.28373805,
105.28333198,  105.2829302 ,  105.28253266,  105.28213933,
105.28175015,  105.28136507,  105.28098406,  105.28060707,
105.28023405,  105.27986496,  105.27949976,  105.2791384 ,
105.27878085,  105.27842706,  105.27807699,  105.2777306 ,
105.27738786,  105.27704871,  105.27671313,  105.27638106,
```

```
105.27605249,  105.27572736,  105.27540564,  105.27508729,
105.27477228,  105.27446057,  105.27415213,  105.27384691,
105.27354489,  105.27324603,  105.27295029,  105.27265765,
105.27236807,  105.27208151,  105.27179794,  105.27151734,
105.27123967,  105.27096489,  105.27069299,  105.27042391,
105.27015765,  105.26989416,  105.26963341,  105.26937539,
105.26912005,  105.26886736,  105.26861731,  105.26836987,
105.26812499,  105.26788267,  105.26764286,  105.26740555,
105.2671707 ,  105.26693829,  105.2667083 ,  105.2664807 ,
105.26625545,  105.26603255,  105.26581196,  105.26559366,
105.26537763,  105.26516383,  105.26495225,  105.26474286,
105.26453565,  105.26433058,  105.26412763,  105.26392679,
105.26372803,  105.26353132,  105.26333665,  105.26314399,
105.26295333,  105.26276464,  105.2625779 ,  105.26239309,
105.26221019,  105.26202918,  105.26185004,  105.26167275,
105.26149729,  105.26132364,  105.26115179,  105.26098171,
105.26081339,  105.2606468 ,  105.26048193,  105.26031876,
105.26015727,  105.25999745,  105.25983928,  105.25968273,
105.2595278 ,  105.25937447,  105.25922271,  105.25907252,
105.25892388,  105.25877676,  105.25863116,  105.25848706,
105.25834444,  105.25820329,  105.25806359,  105.25792533,
105.25778849,  105.25765305,  105.25751901,  105.25738635,
105.25725505,  105.2571251 ,  105.25699648,  105.25686919,
105.2567432 ,  105.25661851,  105.2564951 ,  105.25637295,
105.25625206,  105.25613241,  105.25601399,  105.25589678,
105.25578078,  105.25566597,  105.25555233,  105.25543986,
105.25532854,  105.25521837,  105.25510932,  105.25500139,
105.25489457,  105.25478884,  105.2546842 ,  105.25458063,
105.25447812,  105.25437666,  105.25427624,  105.25417685,
105.25407847,  105.2539811 ,  105.25388473,  105.25378935,
105.25369494,  105.2536015 ,  105.25350902,  105.25341748,
105.25332688,  105.2532372 ,  105.25314844,  105.25306059,
105.25297364,  105.25288758,  105.2528024 ,  105.25271809,
105.25263464,  105.25255204,  105.25247029,  105.25238937,
105.25230928,  105.25223001,  105.25215155,  105.25207389,
105.25199703,  105.25192095,  105.25184564,  105.25177111,
105.25169734,  105.25162432,  105.25155204,  105.25148051,
105.2514097 ,  105.25133962,  105.25127025,  105.25120159,
105.25113363,  105.25106636,  105.25099978,  105.25093388,
105.25086866,  105.25080409,  105.25074019,  105.25067694,
105.25061433,  105.25055237,  105.25049103,  105.25043032,
105.25037023,  105.25031075,  105.25025188,  105.2501936 ,
```

```
105.25013593,  105.25007884,  105.25002233,  105.2499664 ,
105.24991103,  105.24985624,  105.249802  ,  105.24974831,
105.24969517,  105.24964257,  105.24959051,  105.24953898,
105.24948797,  105.24943748,  105.24938751,  105.24933804,
105.24928908,  105.24924062,  105.24919265,  105.24914517,
105.24909817,  105.24905166,  105.24900561,  105.24896003,
105.24891492,  105.24887027,  105.24882607,  105.24878232,
105.24873902,  105.24869616,  105.24865373,  105.24861174,
105.24857017,  105.24852903,  105.2484883 ,  105.24844799,
105.24840809,  105.24836859,  105.2483295 ,  105.2482908 ,
105.2482525 ,  105.24821459,  105.24817706,  105.24813992,
105.24810315,  105.24806675,  105.24803073,  105.24799507,
105.24795978,  105.24792484,  105.24789026,  105.24785603,
105.24782215,  105.24778862,  105.24775542,  105.24772256,
105.24769004,  105.24765785,  105.24762598,  105.24759444,
105.24756322,  105.24753231,  105.24750172,  105.24747144,
105.24744147,  105.2474118 ,  105.24738244,  105.24735337,
105.2473246 ,  105.24729612,  105.24726793,  105.24724003,
```

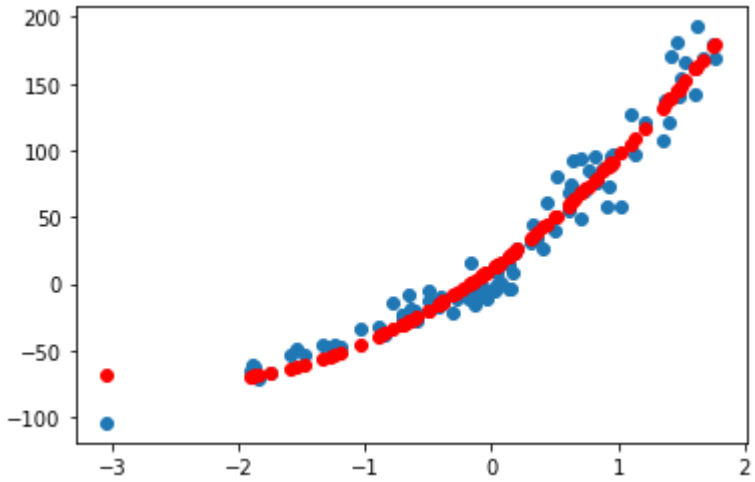
In [87]:
```
plt.plot(range(1000),histCout)
```

Out[87]:
```
[<matplotlib.lines.Line2D at 0x7f9de82000d0>]
```



In [90]:
```
prediction=model(X, thetaF)
plt.scatter(x[:,0],y)
plt.scatter(x[:,0], prediction, c='r')
```

Out[90]:
```
<matplotlib.collections.PathCollection at 0x7f9e1873e940>
```



In [91]:
```
def coefDet(y, prediction):
        u=((y-prediction)**2).sum()
        v=((y-y.mean())**2).sum()
        return 1-u/v
```

In [92]:
```
coefDet(y, prediction)
```

Out[92]:
```
0.9570357881334713
```

In [ ]: