Problem-01

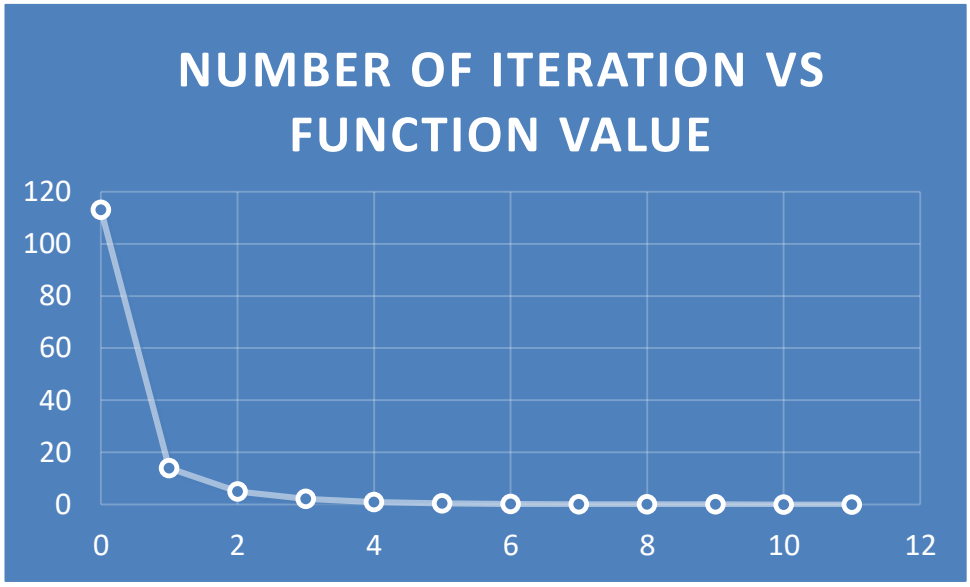
Sum squares function

$$\sum_{i=1}^{d} i * (x_i)^2$$

The Initial values for the variables are :
[-4.25126165 2.25045999 3.86836256 -2.85891749 -1.20439751]

The no. of iteration are :
11
The Finals values for the variables are :
[0.03392 0. 0. 0. 0.00705]
The Final Value of Objective Function is:
0.0014

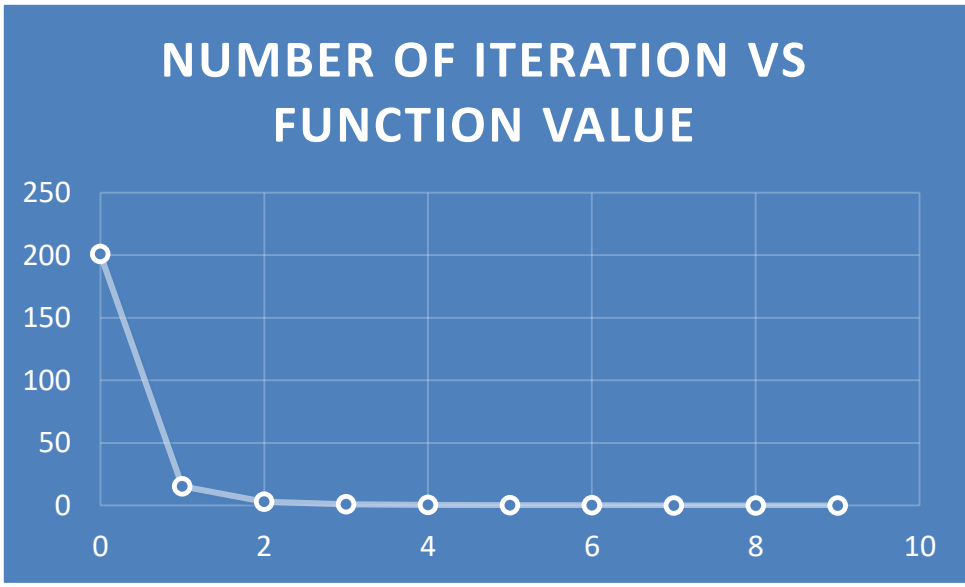
iteration	fuction value
0	113.0415562
1	13.95963306
2	4.988840647
3	2.115518144
4	0.928585512
5	0.411150973
6	0.182454488
7	0.081011081
8	0.035974507
9	0.015975702
10	0.007094615
11	0.003150638



The Initial values for the variables are :
[3.08081444 -4.48183759 4.12724124 5.00279459 0.06913181]

The no. of iteration are :
9
The Finals values for the variables are :
[0.03184 0. 0. 0.00092 0.00712]
The Final Value of Objective Function is:
0.00127

iteration	fuction value
0	200.9032258
1	15.29643481
2	2.905216227
3	0.902044631
4	0.313460863
5	0.112721019
6	0.041864188
7	0.016181778
8	0.006734849
9	0.002893556



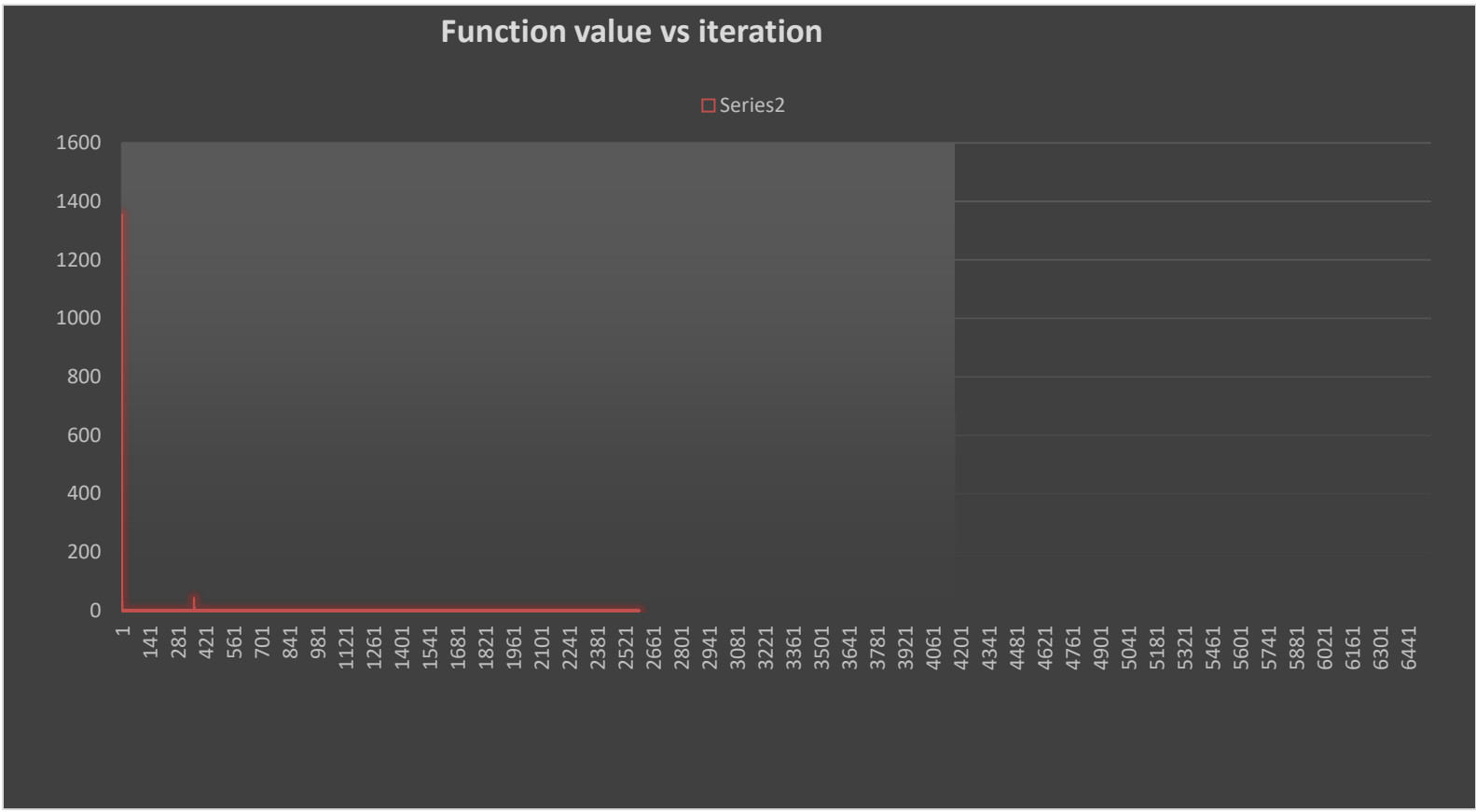
Problem-02

Rosenbrock function

$$\sum_{i=1}^{d-1} [100 * (x_{i+1} - xi^2)^2 + (x_i - 1)^2]$$

The Initial values for the variables are :
[-1.95596993 1.39318078 -0.80398019]

The no. of iteration are :
6554
The Finals values for the variables are :
[0.9998 0.9996 0.99919]
The Final Value of Objective Function is:
0.0
****



Problem-03

Dixon Price function

$$f(x\quad) = (x_1 - 1)^2 + \sum_{i=2}^{d} i * \left(2 * x_i^2 - x_{i-1}\right)^2$$

The Initial values for the variables are :

****

[8.04073328 -2.25229416 3.32688472 1.89912193]

The no. of iteration are :

****

70

The Finals values for the variables are :

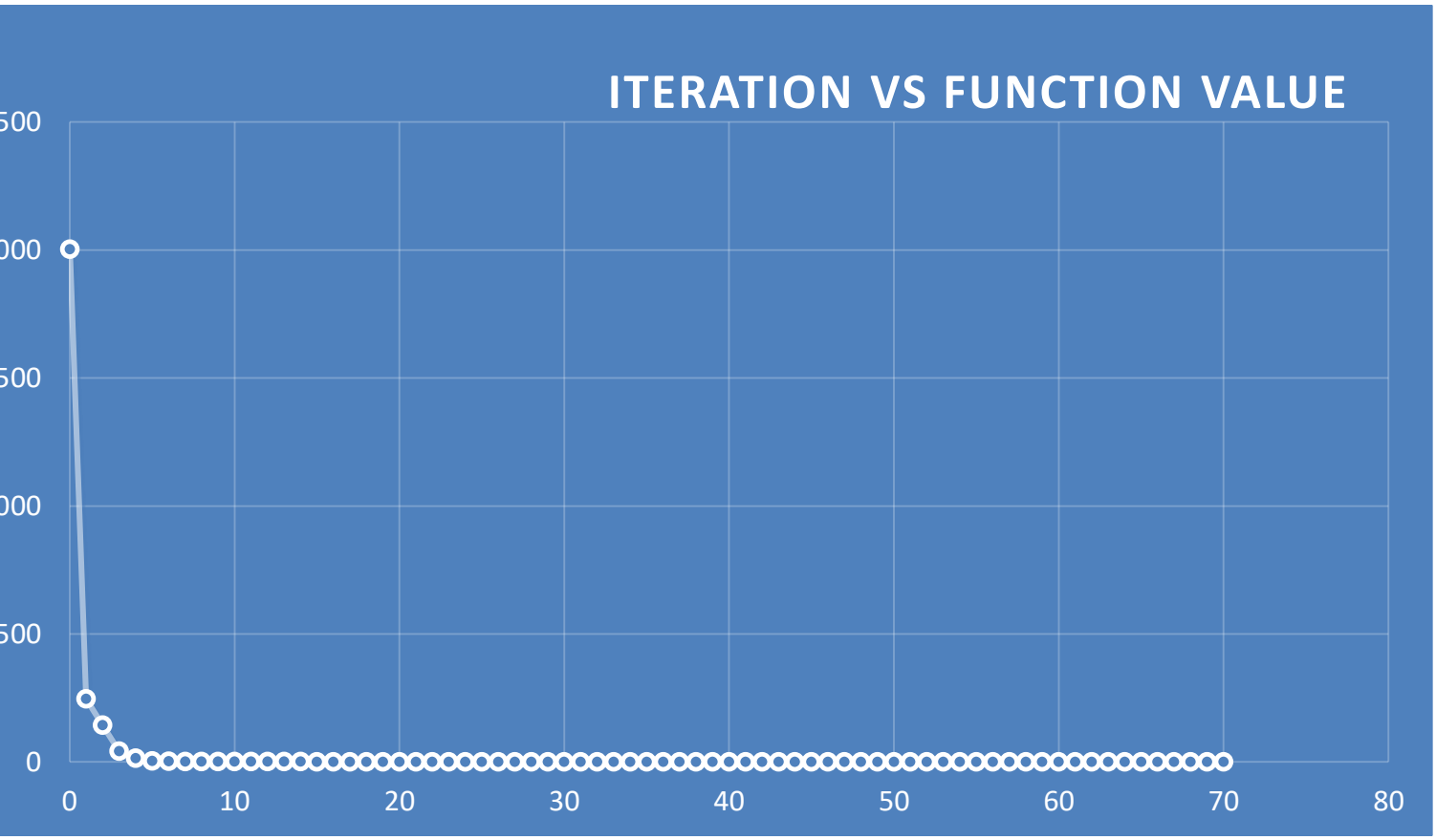
****

[0.99998 0.7071 0.5946 0.54525]

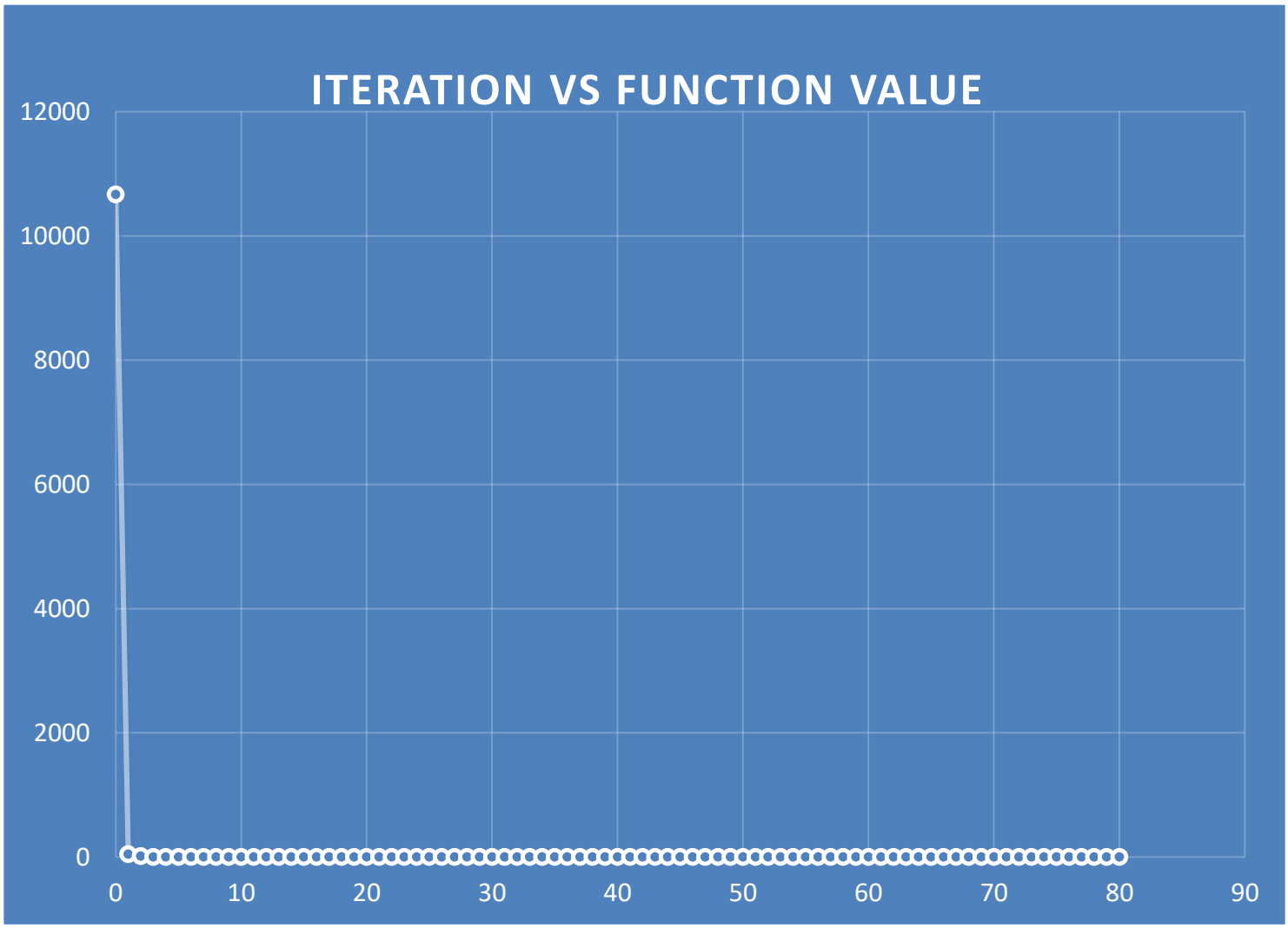
The Final Value of Objective Function is:

0.0

****



0	2002.409034
1	246.5211285
2	143.6295152
3	41.833116
4	13.78611687
5	3.850053609
6	2.667652331
7	1.04724322
8	1.032079862
9	1.029707016
10	1.025313527
11	1.016053127
12	0.995074016
13	0.947130612
14	0.762271938
15	0.463299116
16	0.247178136
17	0.144539476
18	0.089207745
19	0.059167889
20	0.039426415
21	0.026763332
22	0.018450269
23	0.012819008
24	0.008895265
25	0.006191987
26	0.004351466
27	0.003068794
28	0.002147031
29	0.001507084
30	0.00106544
31	0.000752763
32	0.000530766
33	0.000372798
34	0.000264961
35	0.000187702
36	0.000132551
37	9.37E-05


ITERATION VS FUNCTION VALUE
12000
10000
8000
6000
4000
2000
0
0
10
20
30
40
50
60
70
80
90

0	10665.59767
1	46.27368977
2	17.01800177
3	1.070257179
4	1.034884804
5	1.03158794
6	1.031299235
7	1.03127012
8	1.031268111
9	1.031266811
10	1.031265922
11	1.031265274
12	1.031264755
13	1.031264257
14	1.031263786
15	1.031263339
16	1.031262915
17	1.031262507
18	1.031262119
19	1.031261749
20	1.031261396
21	1.031261058
22	1.031260735
23	1.031260425

Problem-04

Trid function

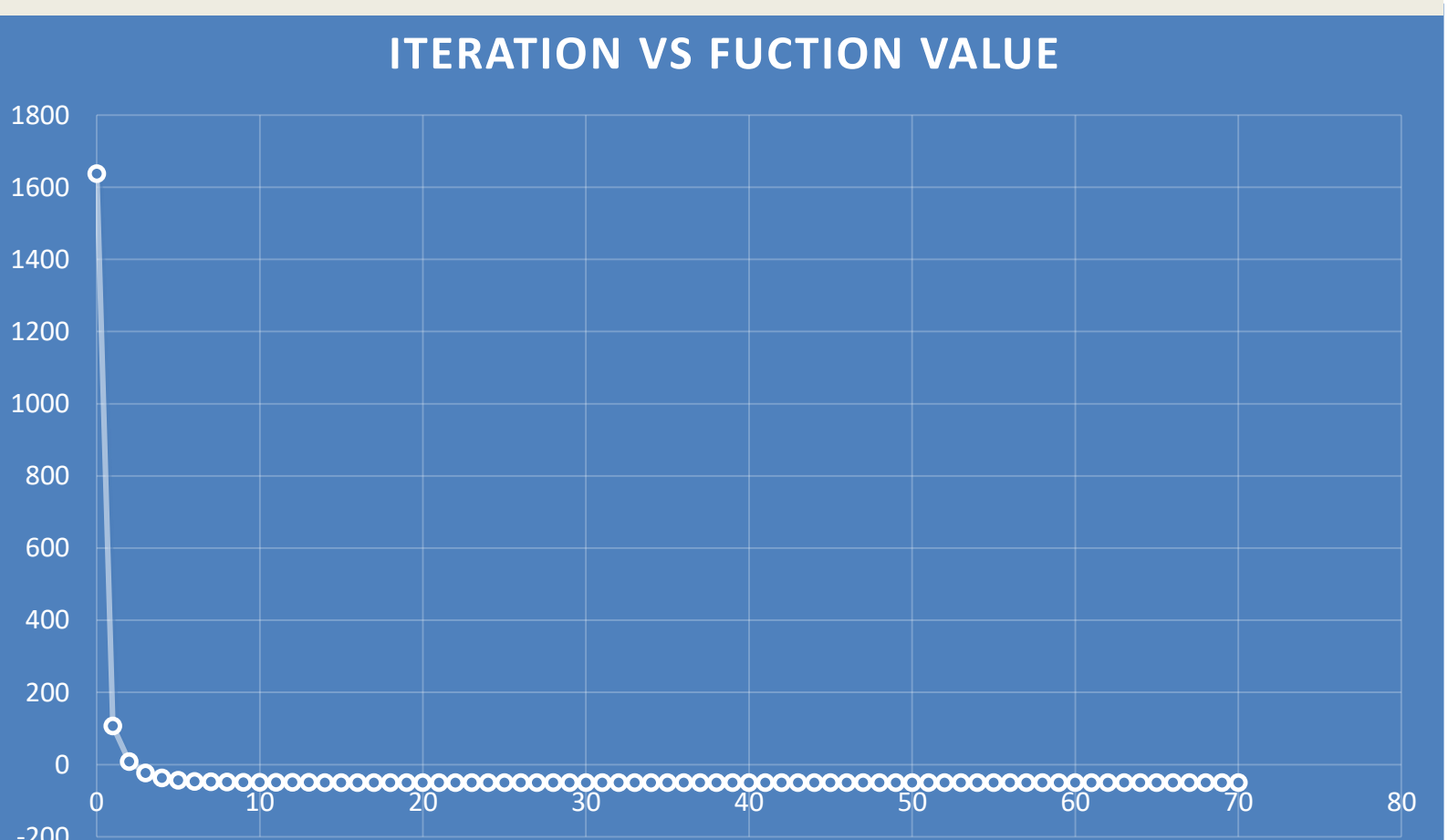
$$f(x) = \sum_{i=1}^{d} (x_i - 1)^2 - \sum_{i=2}^{d} x_i * x_{i-1}$$

The Initial values for the variables are :
[-0.16402285 15.4655353 -12.7774776 27.19680957 34.62702787
6.13501611]

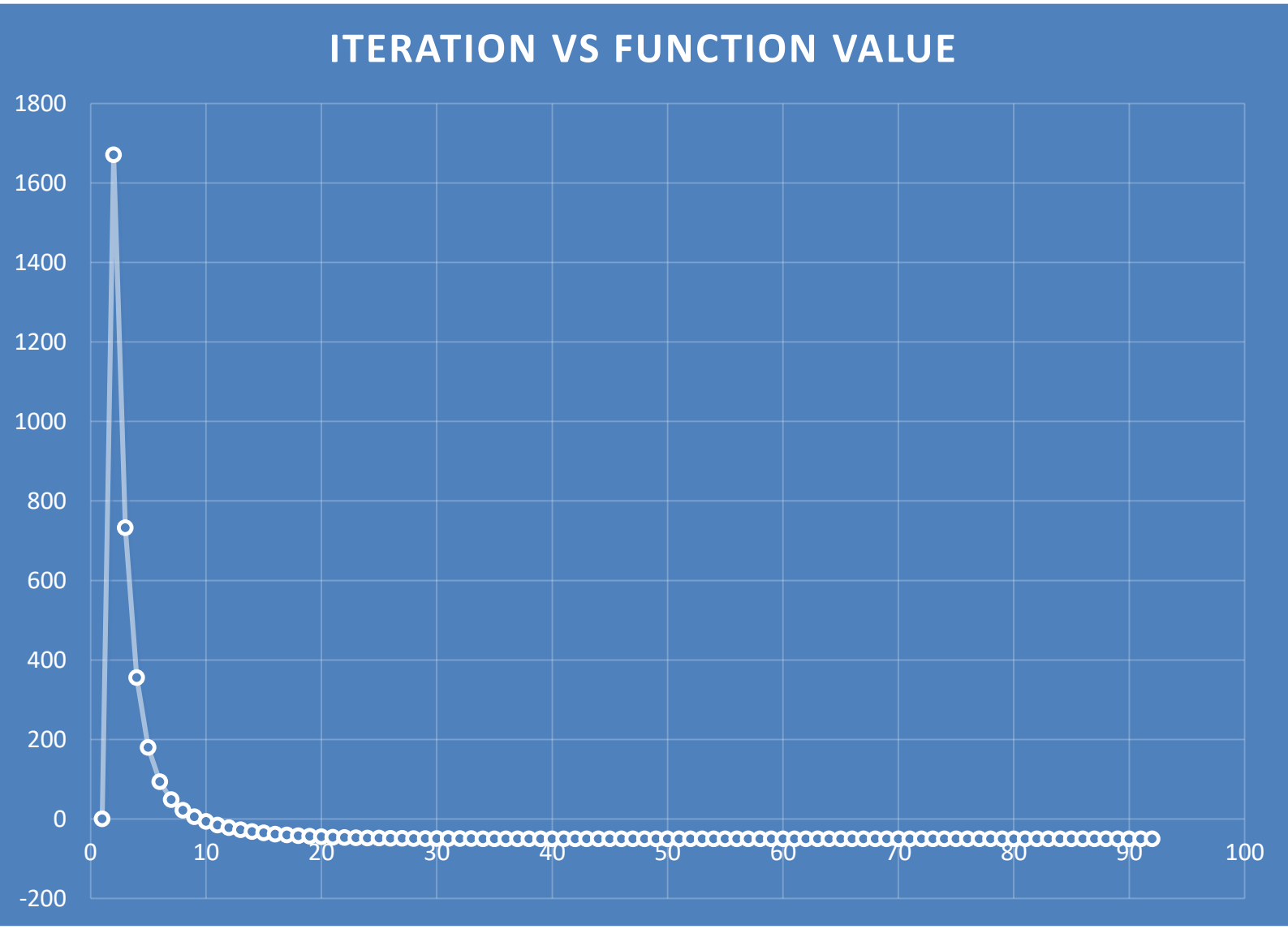
The no. of iteration are :
****

70
The Finals values for the variables are :
****

[6.00104 10.0017 12.00234 12.00212 10.00188 6.00094]
The Final Value of Objective Function is:
-50.0
****



iteration	fuction value
0	1637.315575
1	106.8201019
2	7.80161689
3	-23.6493788
4	-37.37602991
5	-43.62227469
6	-46.53677845
7	-47.94228756
8	-48.65859309
9	-49.05158836
10	-49.28950209
11	-49.44742726
12	-49.56138604
13	-49.64789756
14	-49.71581699
15	-49.76998863
16	-49.81359612
17	-49.84883512
18	-49.87737946
19	-49.90052018
20	-49.9192857
21	-49.93450773
22	-49.94685807
23	-49.95688016
24	-49.96501331
25	-49.97161159
26	-49.97696587
27	-49.98131012
28	-49.98483503
29	-49.98769526
30	-49.99001584
31	-49.991899
32	-49.99342673
33	-49.99466622
34	-49.995672
35	-49.99648818
36	-49.99715034

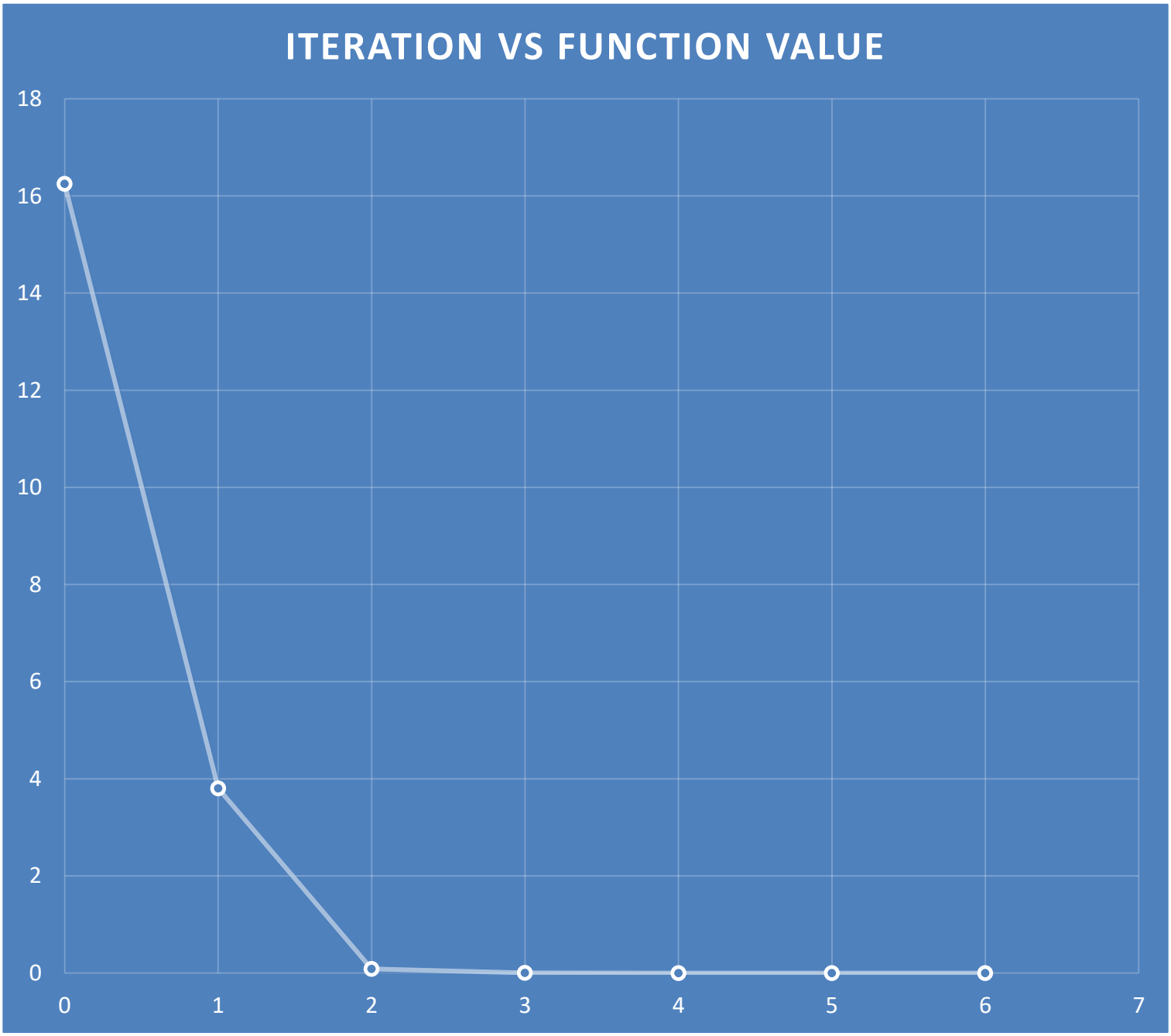

ITERATION VS FUNCTION VALUE
1800
1600
1400
1200
1000
800
600
400
200
0
-200
0
10
20
30
40
50
60
70
80
90
100

iteration	fuction value
0	1670.650118
1	732.5436833
2	355.6488885
3	180.1087944
4	93.67410918
5	48.37405882
6	22.03296586
7	5.296652913
8	-6.489169573
9	-15.25783733
10	-22.07778344
11	-27.47747559
12	-31.8063066
13	-35.2904857
14	-38.1040233
15	-40.37810267
16	-42.21628953
17	-43.70253272
18	-44.90478828
19	-45.87729094
20	-46.66456407
21	-47.30143421
22	-47.81653437
23	-48.23331279
24	-48.57064253
25	-48.84358894
26	-49.06430257
27	-49.24292426
28	-49.38746598
29	-49.50444487
30	-49.59912992
31	-49.67574009
32	-49.73772752
33	-49.78786236
34	-49.82840608
35	-49.86119055
36	-49.88770112
37	-49.90915599

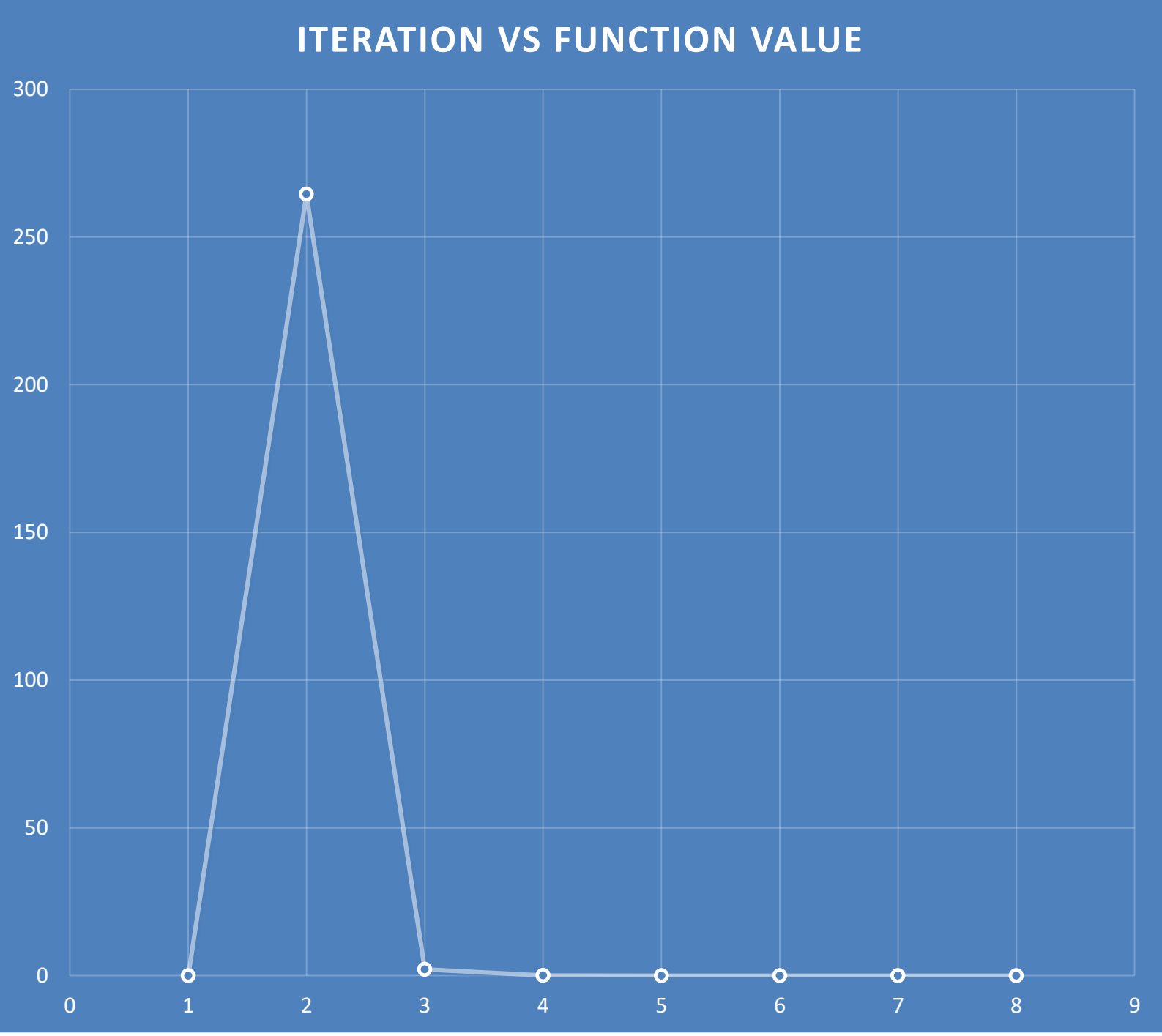
Problem-05

Zakharov function

$$f(\mathbf{x}) = \sum_{i=1}^{d} x_i^2 + \left(\sum_{i=1}^{d} 0.5ix_i\right)^2 + \left(\sum_{i=1}^{d} 0.5ix_i\right)^4$$



iteration	fuction value	
0	16.24702675	
1	3.799854227	
2	0.086777739	
3	0.002062447	
4	3.86E-05	
5	6.84E-07	
6	1.23E-08	



The Initial values for the variables are :
[2.89845325 2.46471161]

The no. of iteration are :
****
*
6
The Finals values for the variables are :
****
*
[1.e-05 0.e+00]
The Final Value of Objective Function is:
0.0
****

iteration	fuction value
0	264.4638264
1	2.133574467
2	0.037744666
3	0.000650491
4	1.14E-05
5	1.92E-07
6	3.62E-09

Conclusions

- Rosenbrock required more no. of iteration to achieve minima.
- If epsilon value is small then accuracy will better but the number of iteration will be increase and vice versa.
- The initial guess as much closer to the minima of the function it will converges very fast and iterations required will be less.
- In the starting convergence will be fast but later it will slow.