Numerical solutions for Lorenz equations

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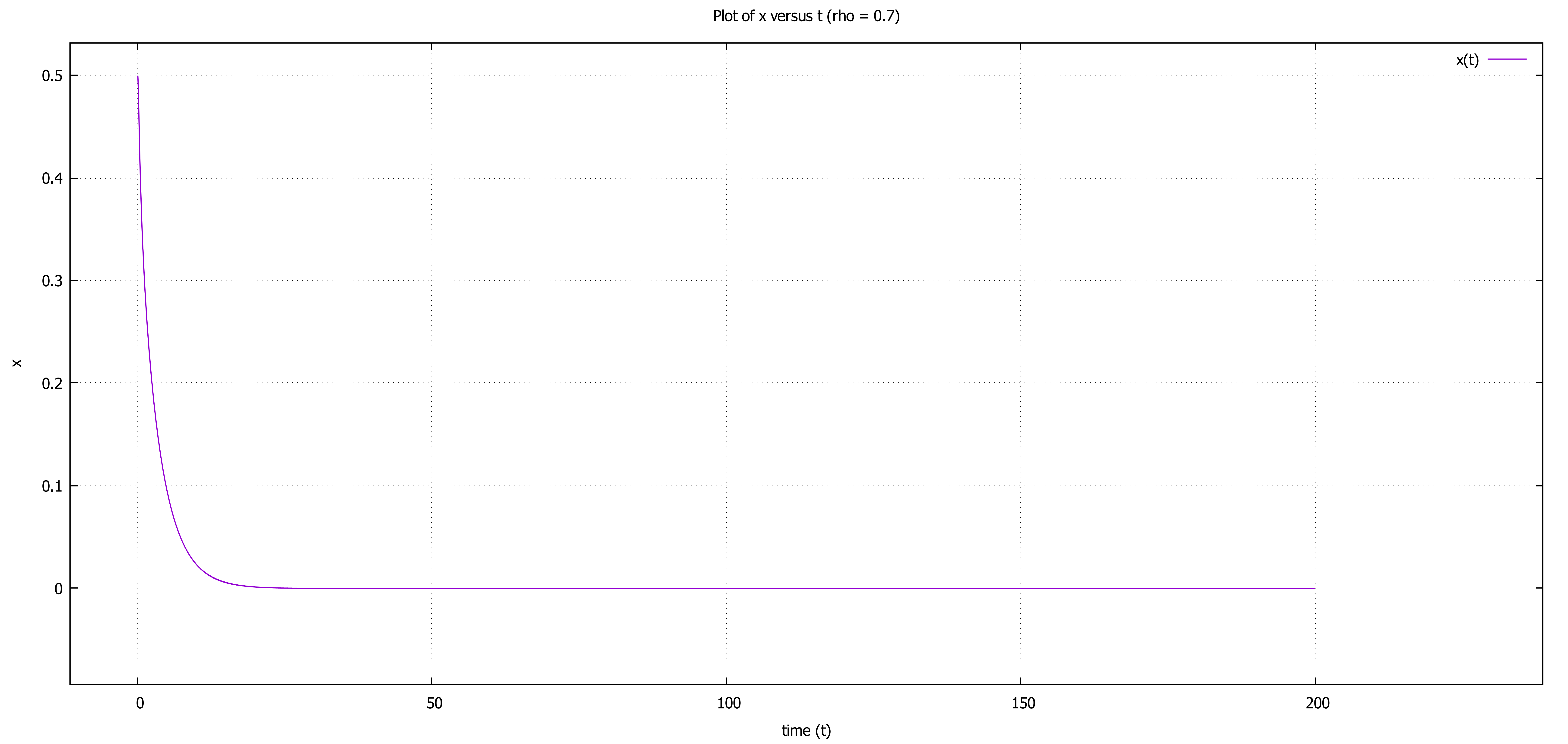
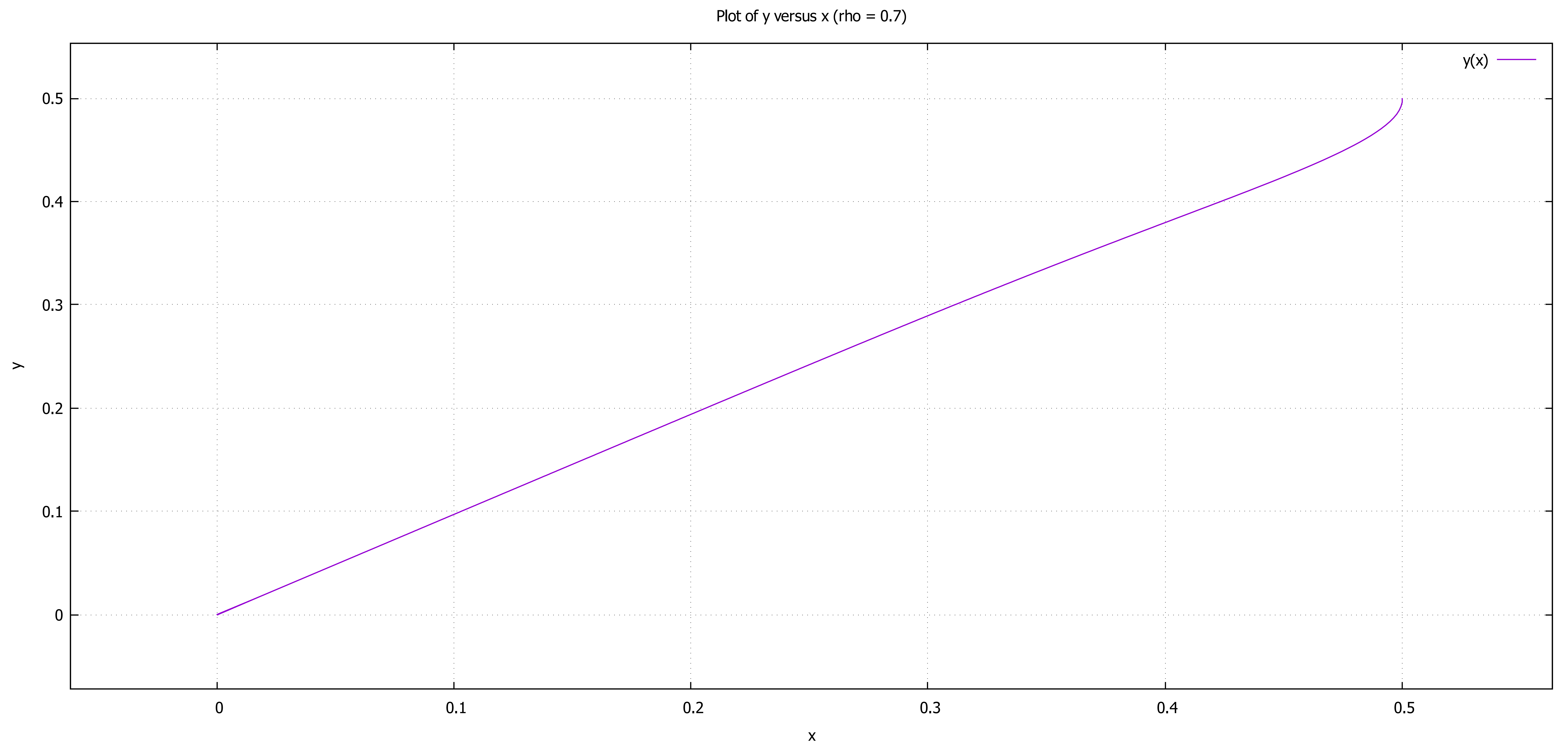
For a point near P_1

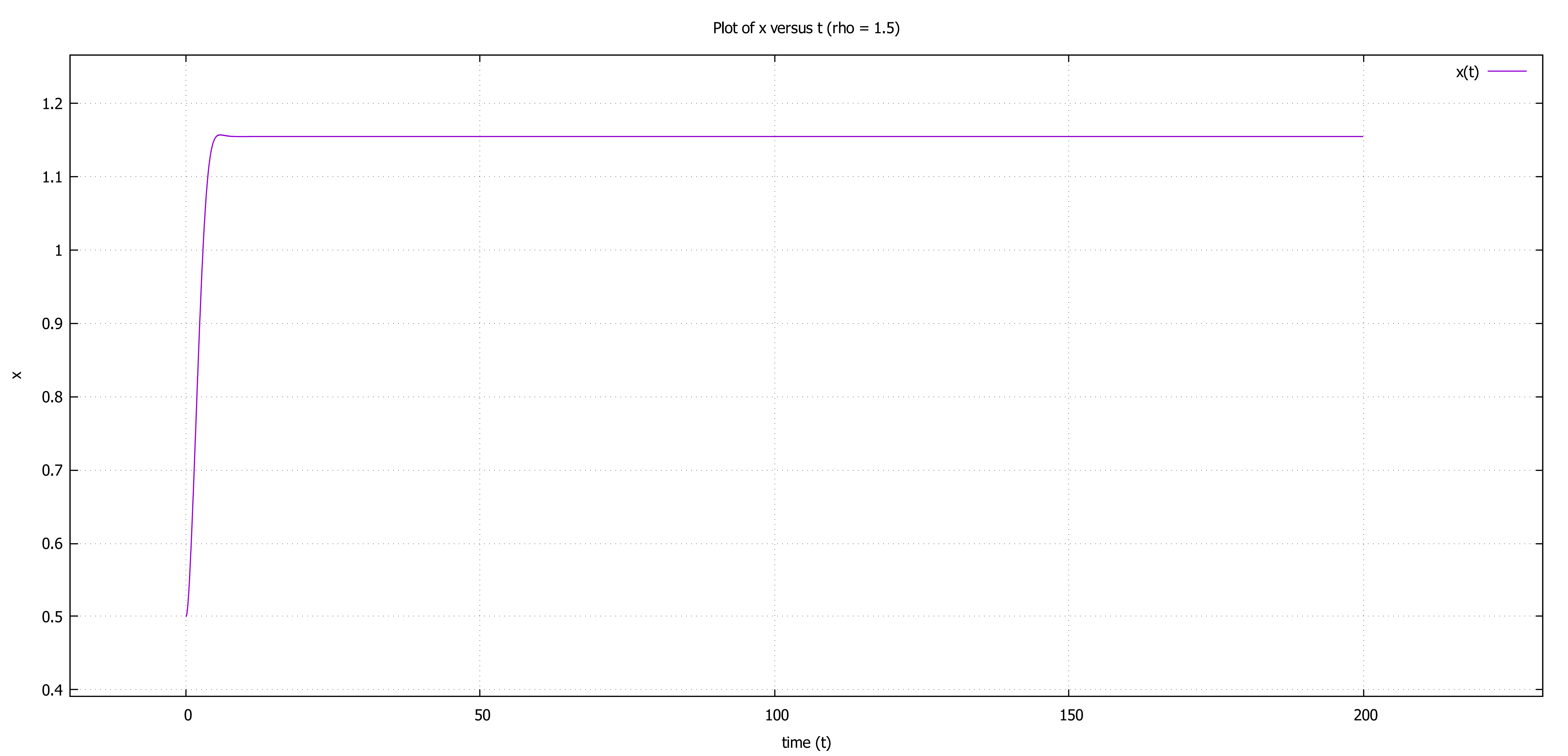
Following are the plots when initial point is $I_0 \equiv (0.5, 0.5, 0.5)$ and $\sigma = 10, \beta = 2.667$. Here, $P_1 \equiv (0, 0, 0)$ And,

- $\rho = 0.7 < 1$
- $\rho = 1.5 > 1$
- $\rho = 1$

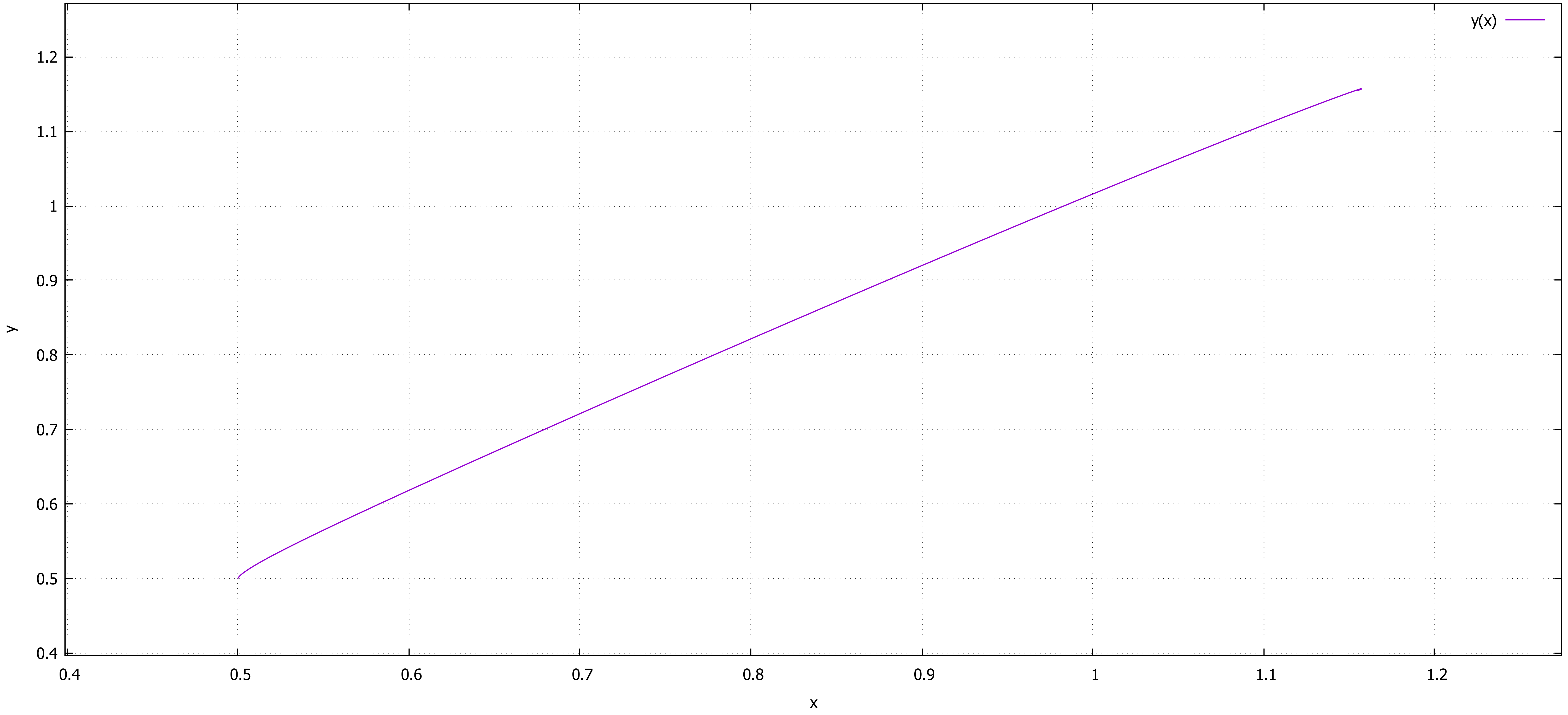

Plot of x versus t (rho = 0.7)
x(t)
x
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
time (t)

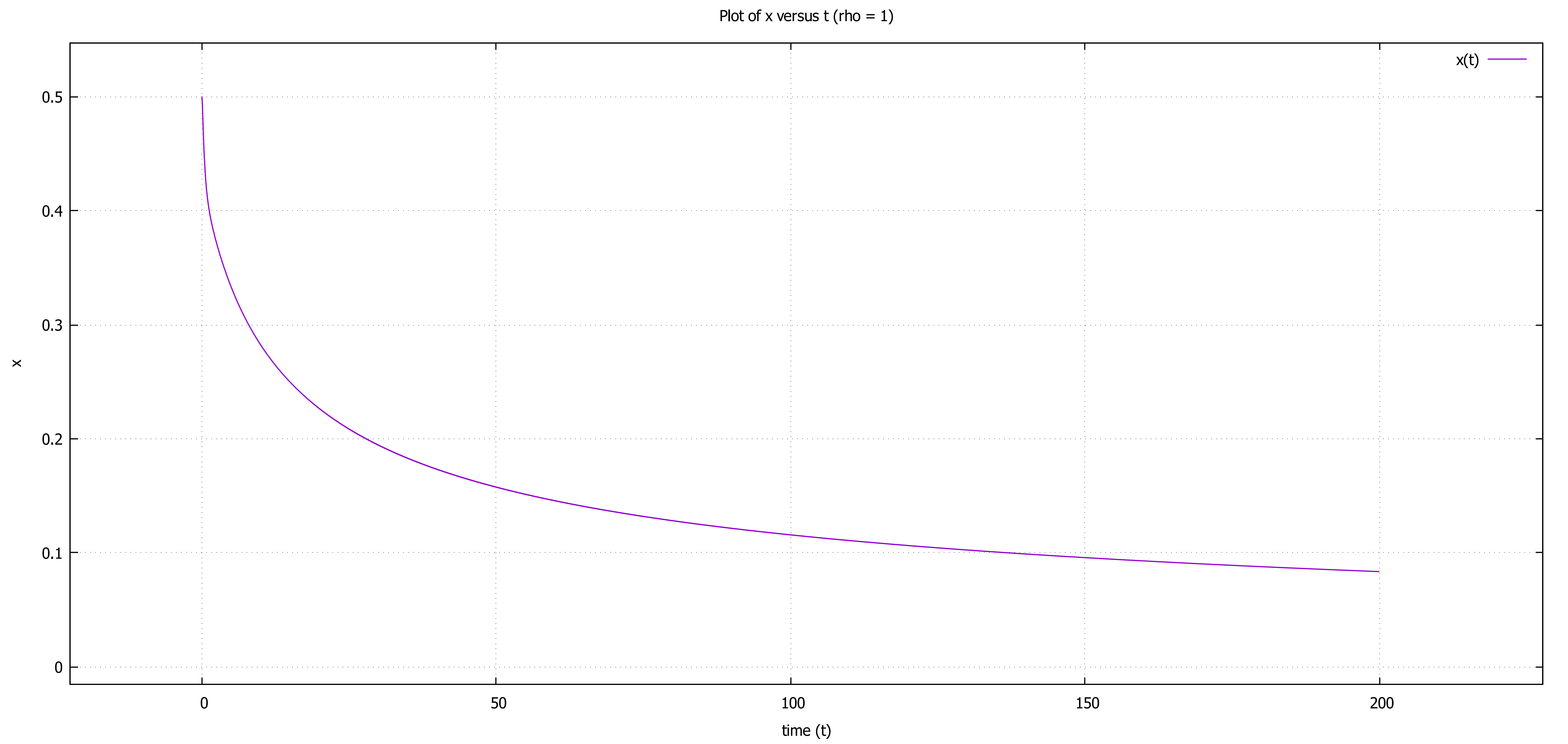


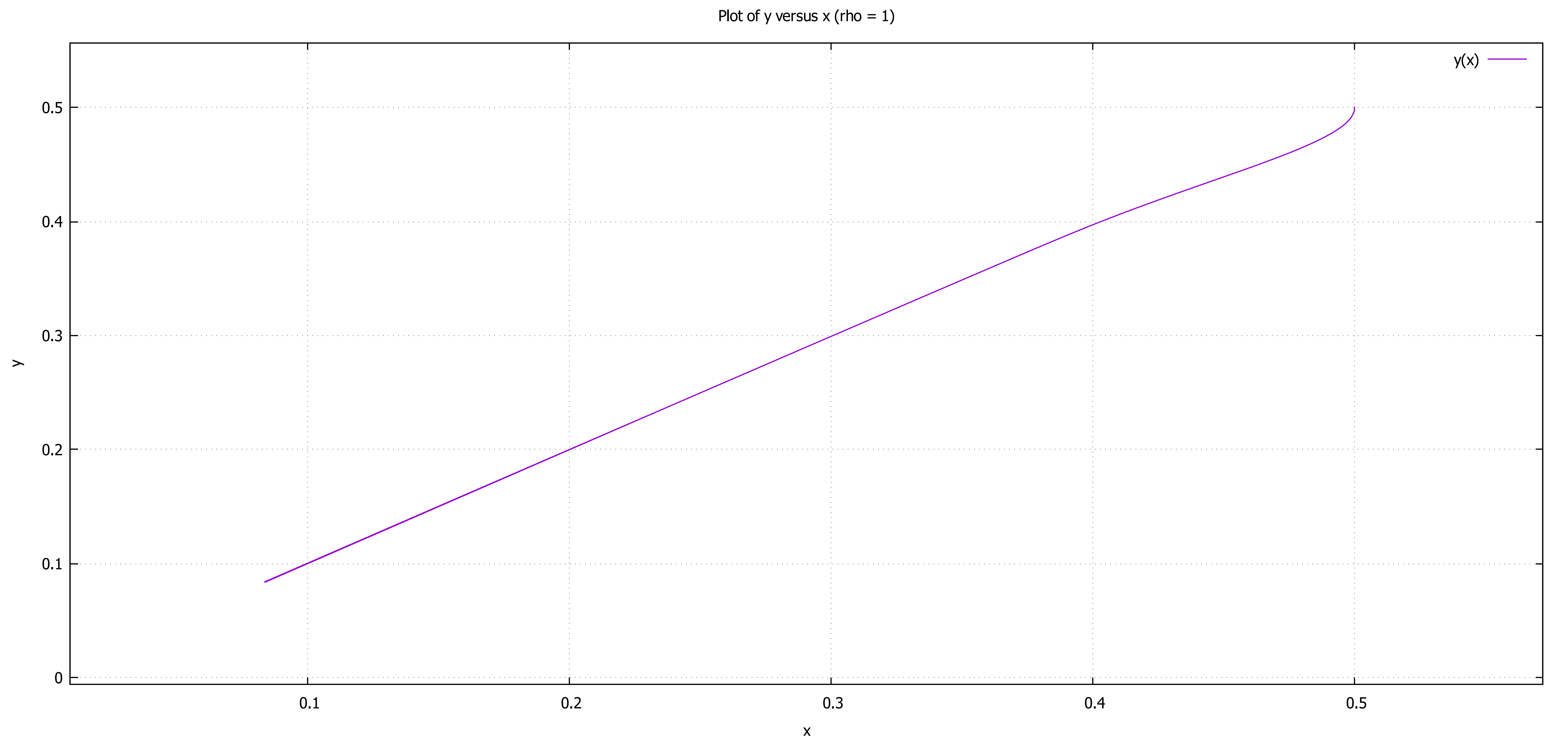
Plot of y versus x (rho = 0.7)
y(x)
y
x
0
0.1
0.2
0.3
0.4
0.5


Plot of x versus t (rho = 1.5)
x(t)
x
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0
50
100
150
200
time (t)

Plot of y versus x (rho = 1.5)



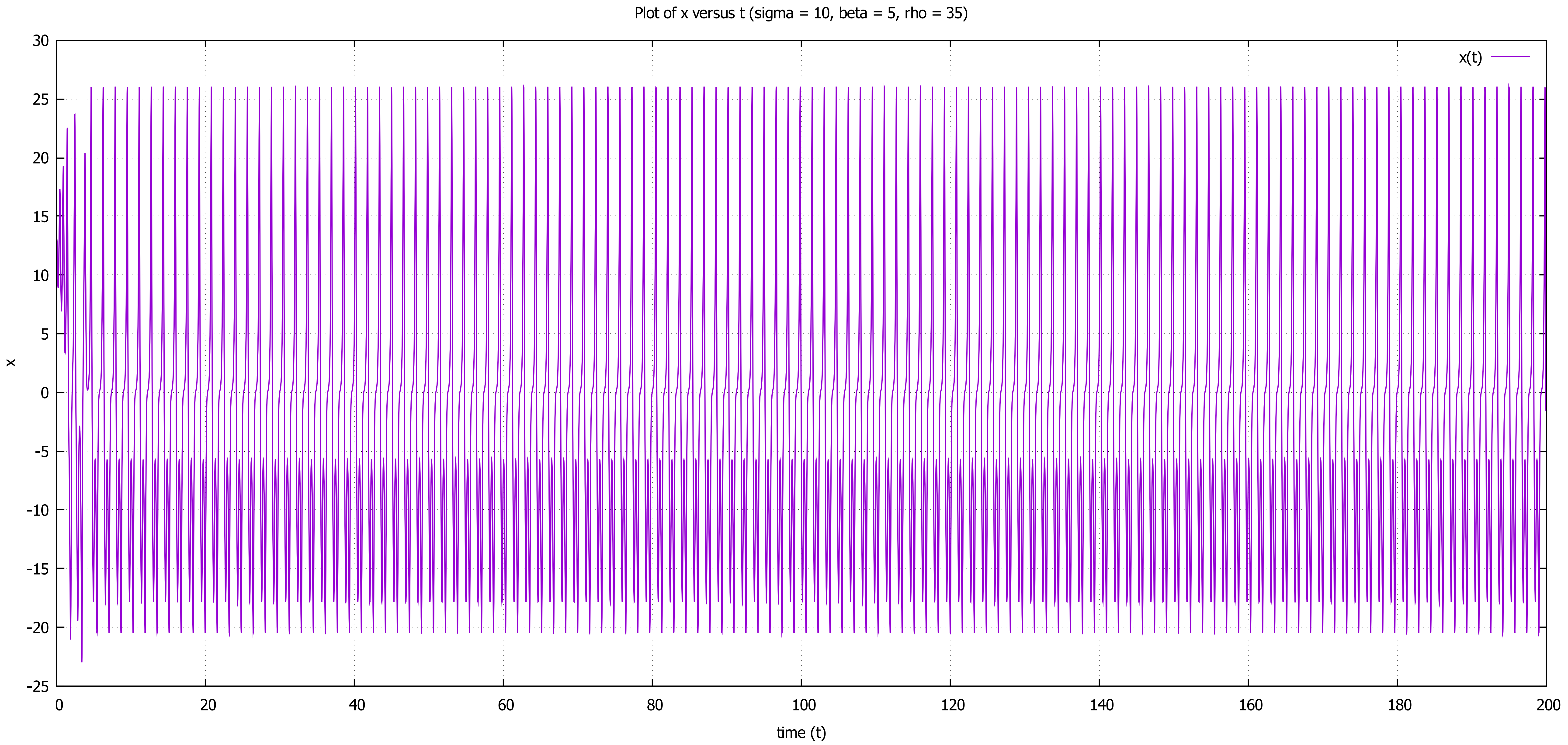

Plot of x versus t (rho = 1)
x(t)
x
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
time (t)

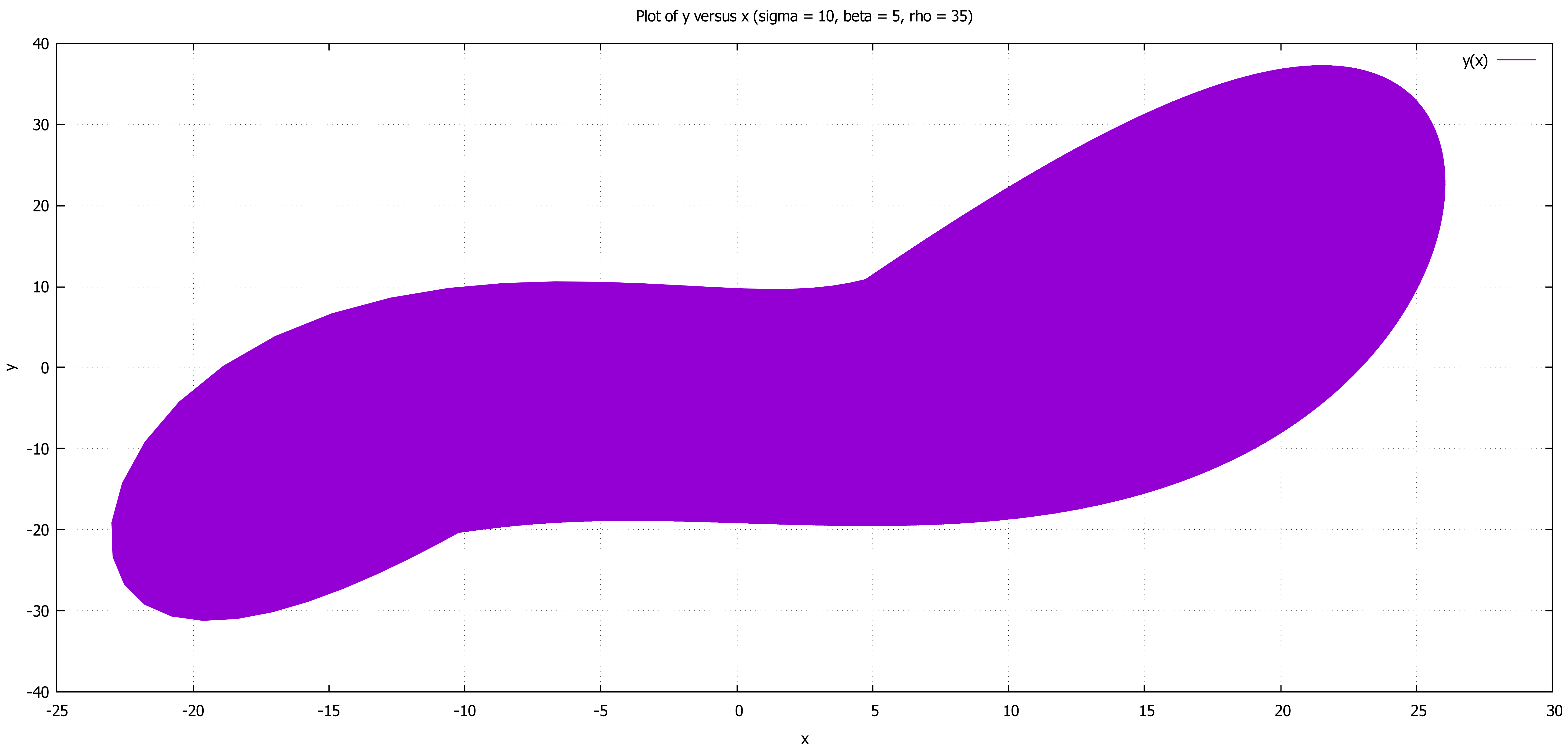

Plot of y versus x (rho = 1)
y(x)
0.5
0.4
0.3
0.2
0.1
0
y
0.1
0.2
0.3
0.4
0.5
x

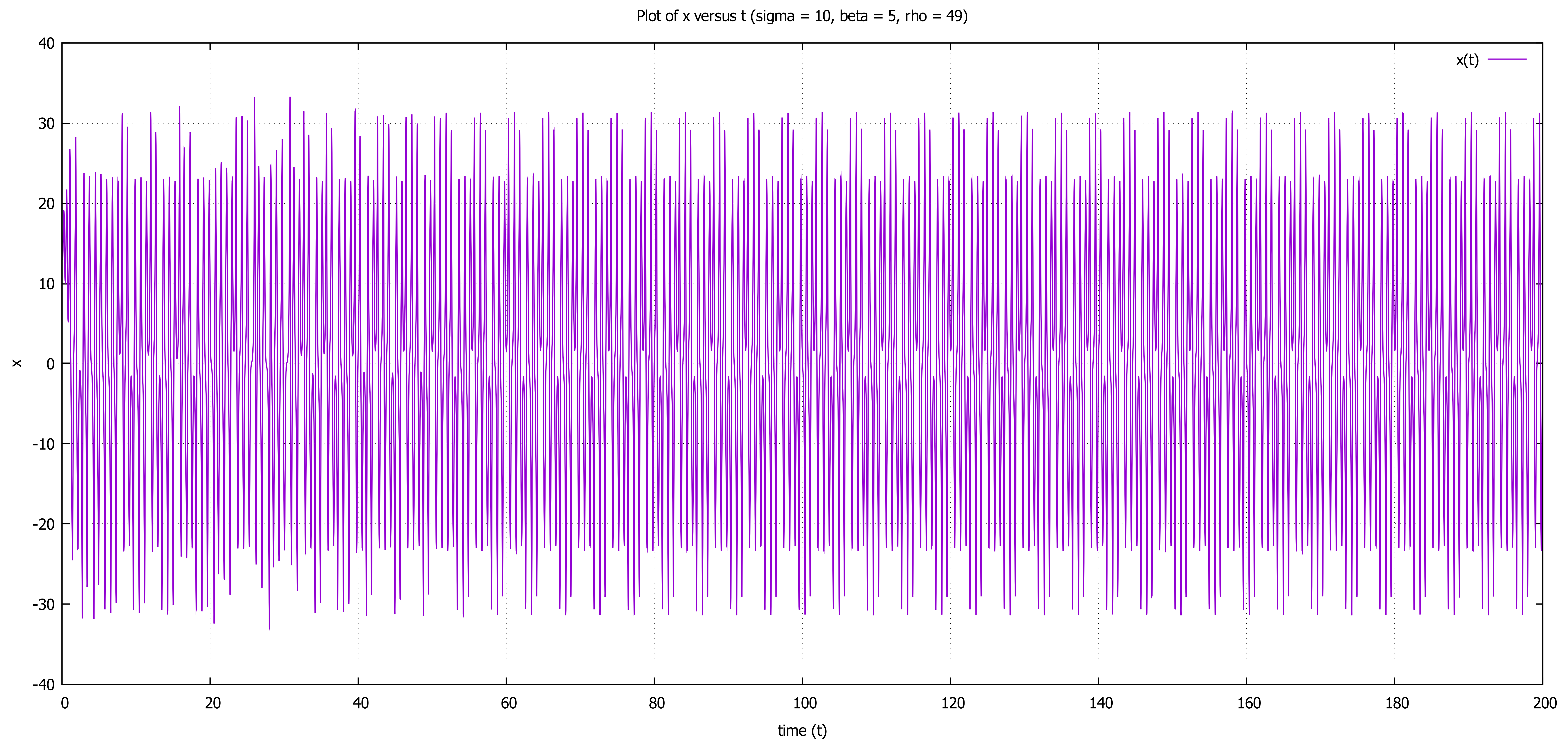
For a point near P_2

Following are the plots when initial point is $I_0 \equiv (13, 13, 42)$ and $\sigma = 10, \beta = 5$. Here $P_2 \equiv (14.83, 14.83, 44)$ and $\rho_0 = 45$ And,

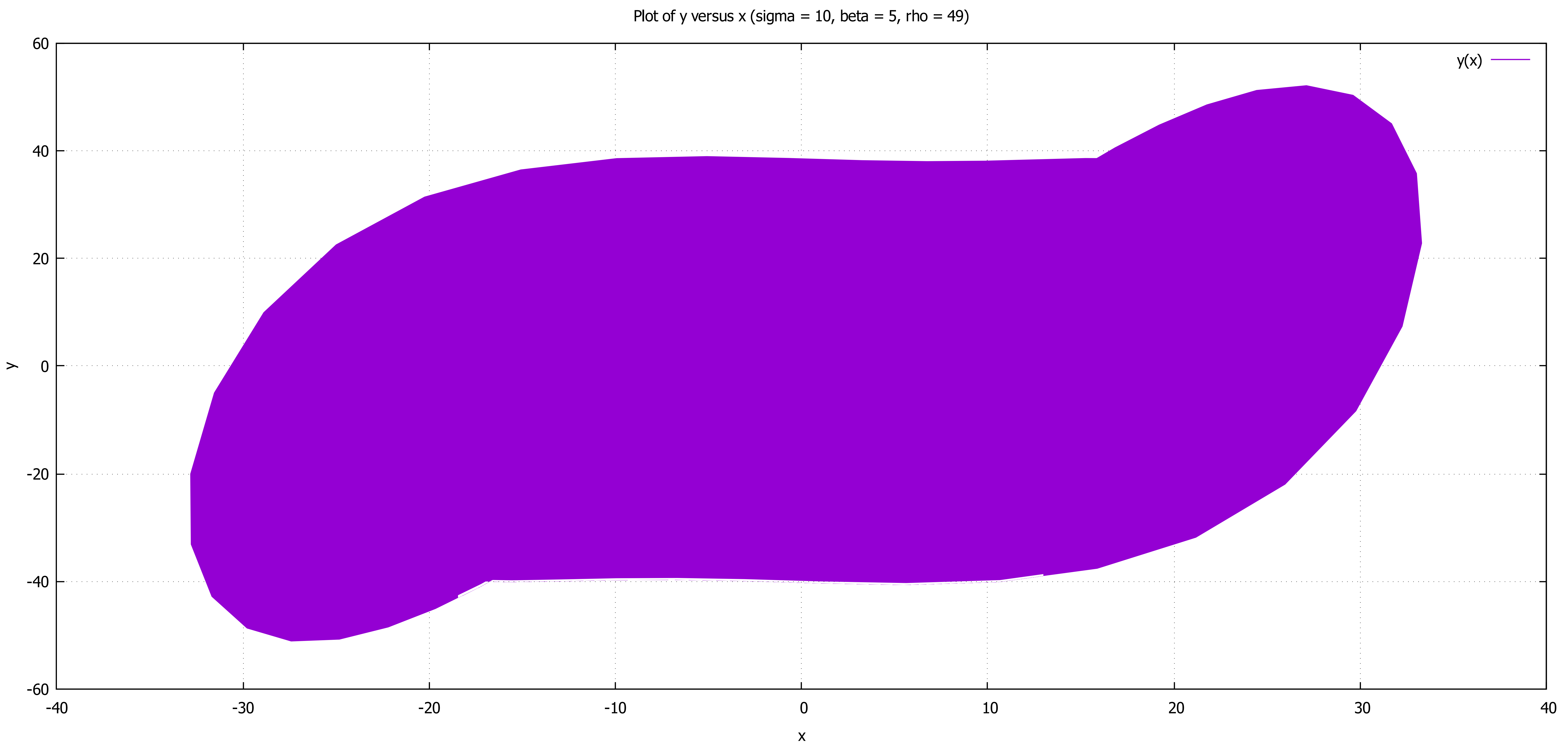
- $\rho = 35 < \rho_0$
- $\rho = 49 > \rho_0$
- $\rho = 45 = \rho_0$

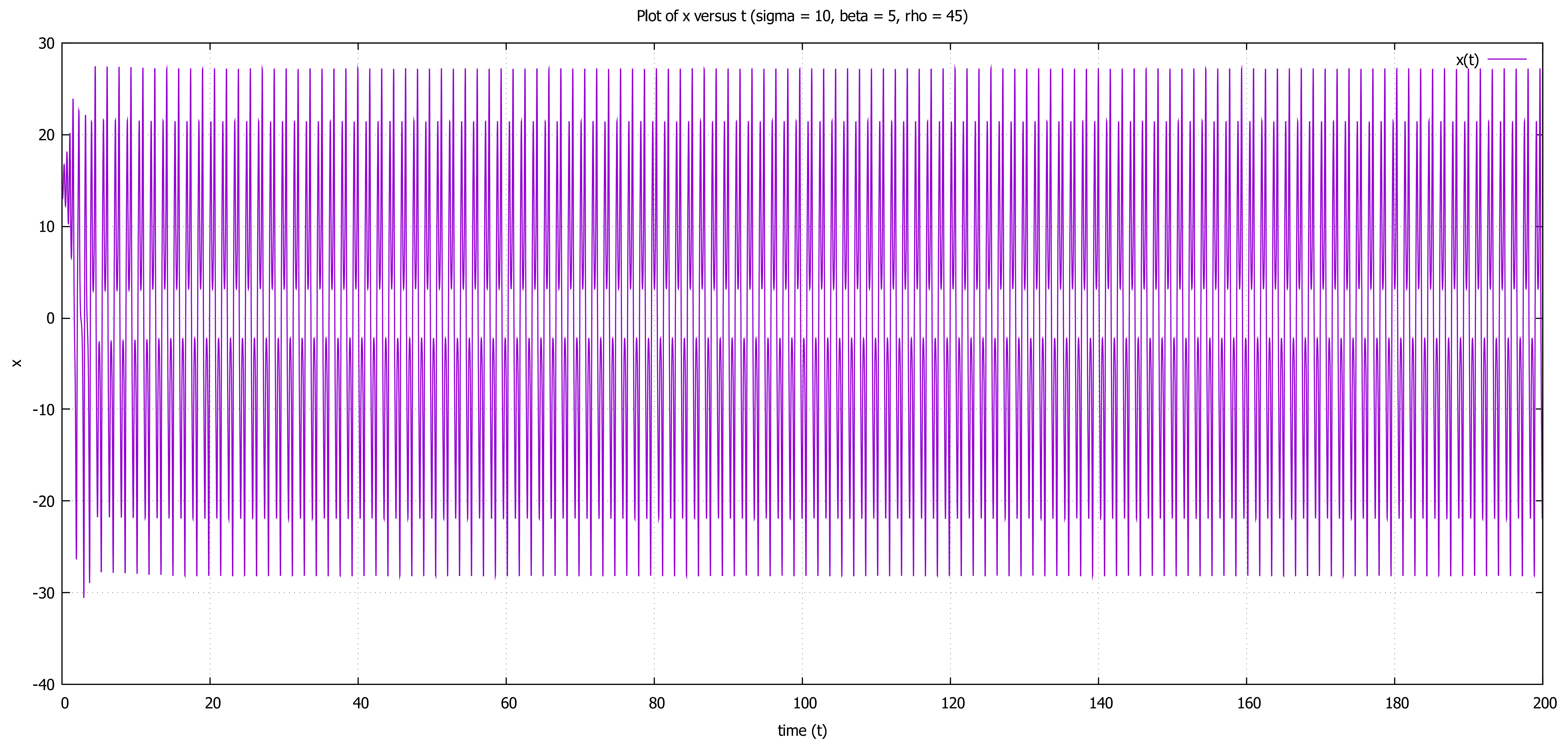

Plot of x versus t (sigma = 10, beta = 5, rho = 35)
x(t)
x
time (t)
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
0
20
40
60
80
100
120
140
160
180
200

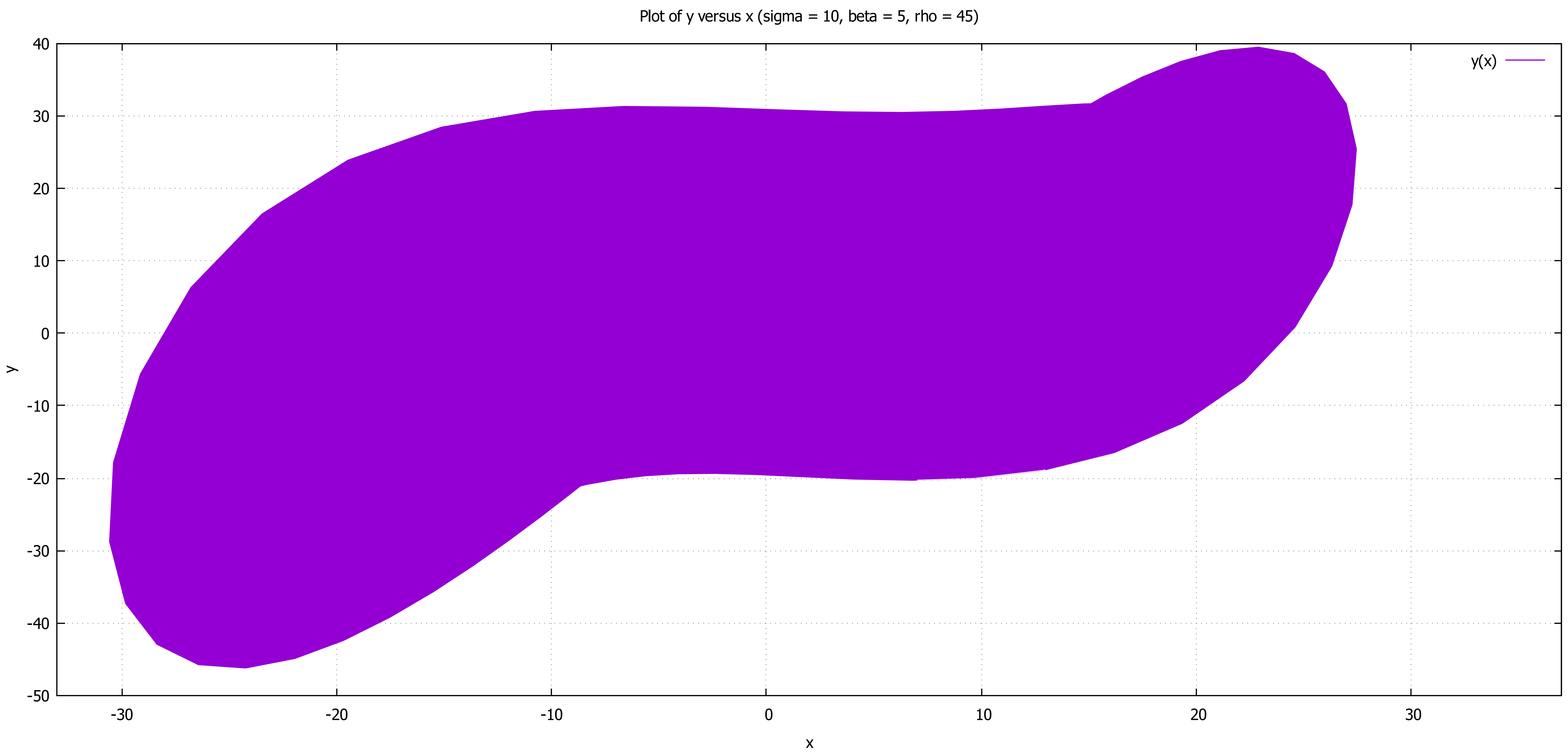

Plot of y versus x (sigma = 10, beta = 5, rho = 35)
y(x)
y
x
40
30
20
10
0
-10
-20
-30
-40
-25
-20
-15
-10
-5
0
5
10
15
20
25
30



Plot of x versus t (sigma = 10, beta = 5, rho = 49)
x(t)
x
time (t)
40
30
20
10
0
-10
-20
-30
-40
0
20
40
60
80
100
120
140
160
180
200


Plot of y versus x (sigma = 10, beta = 5, rho = 49)
y(x)
y
x
60
40
20
0
-20
-40
-60
-40
-30
-20
-10
0
10
20
30
40

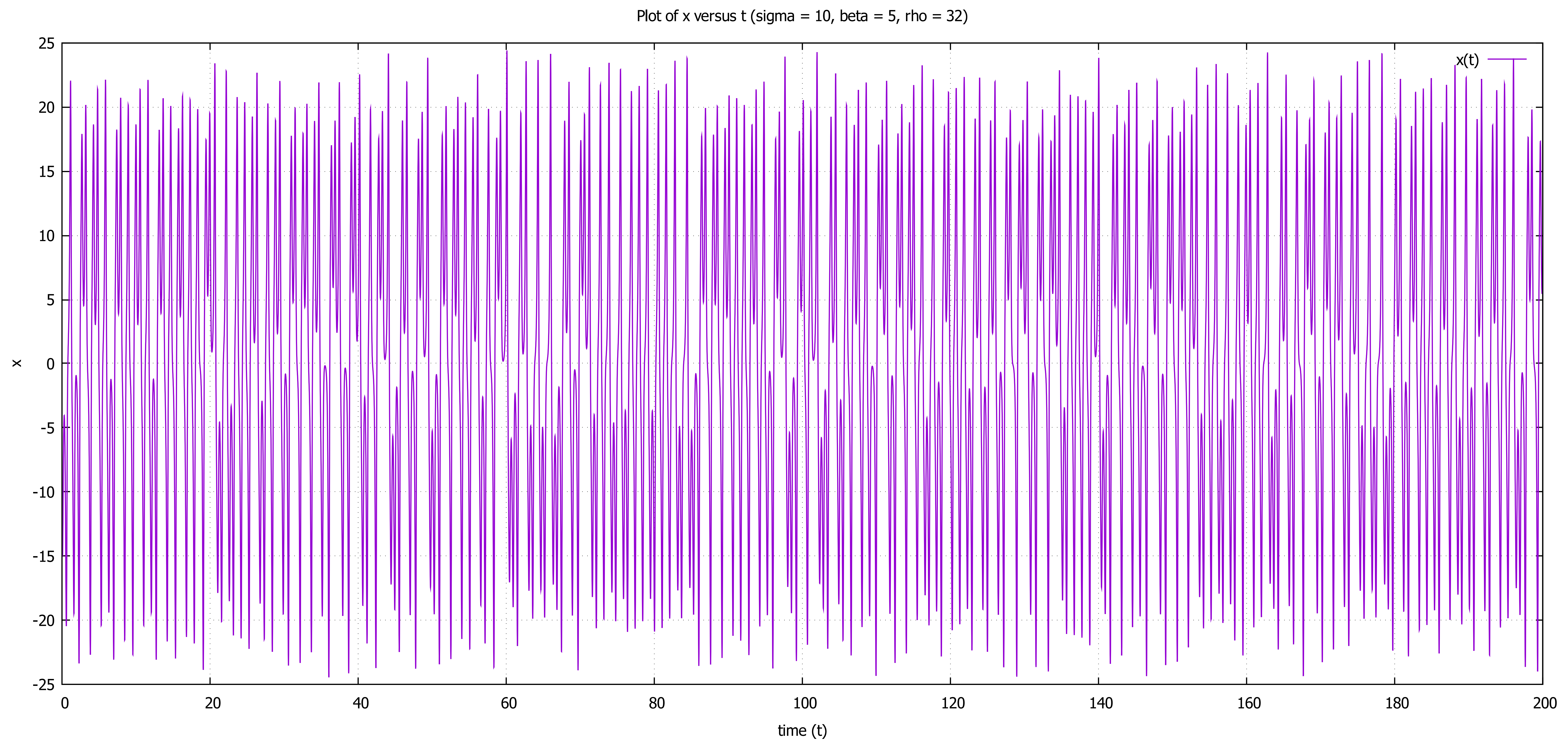

Plot of x versus t (sigma = 10, beta = 5, rho = 45)
x(t)
x
30
20
10
0
-10
-20
-30
-40
0
20
40
60
80
100
120
140
160
180
200
time (t)


Plot of y versus x (sigma = 10, beta = 5, rho = 45)
y(x)
40
30
20
10
0
-10
-20
-30
-40
-50
y
-30
-20
-10
0
10
20
30
x

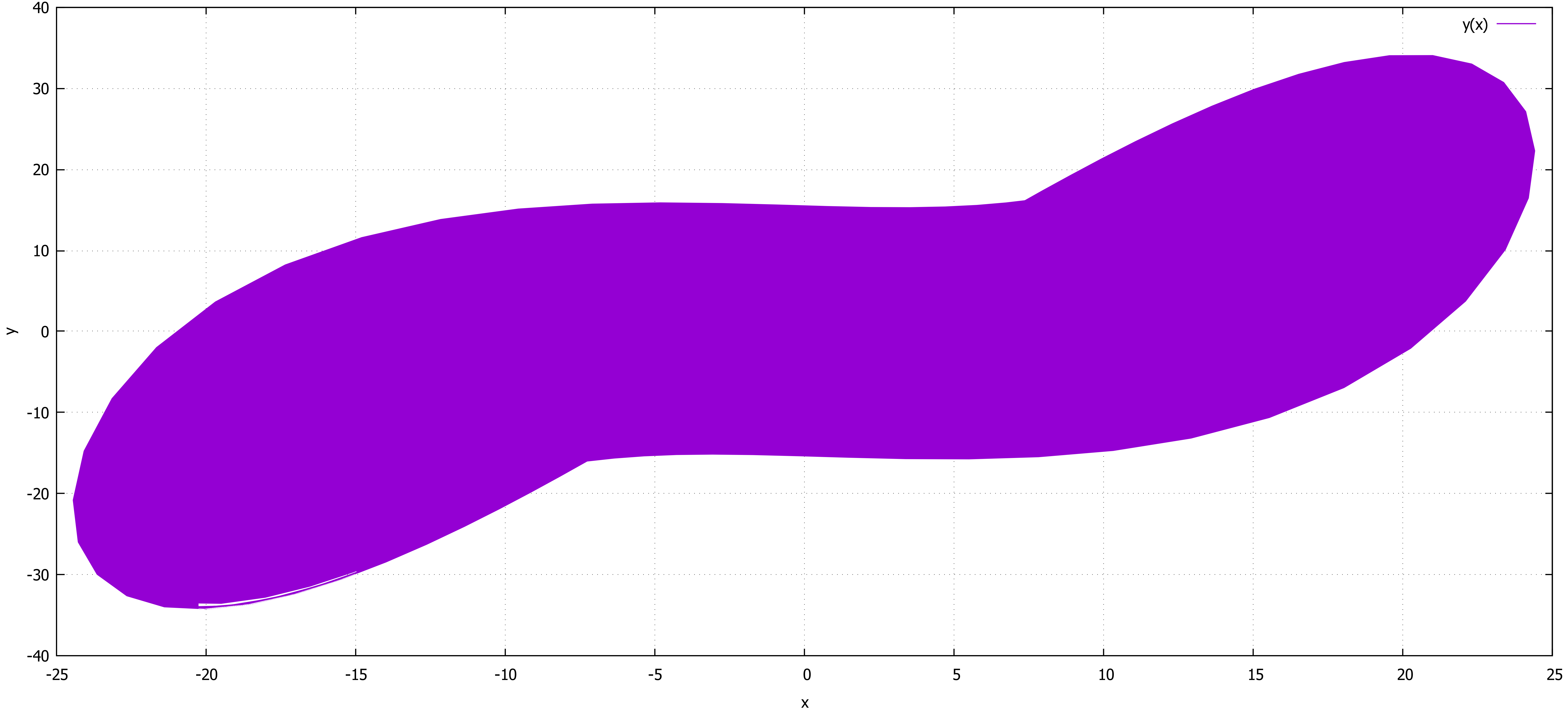
For a point near P_3

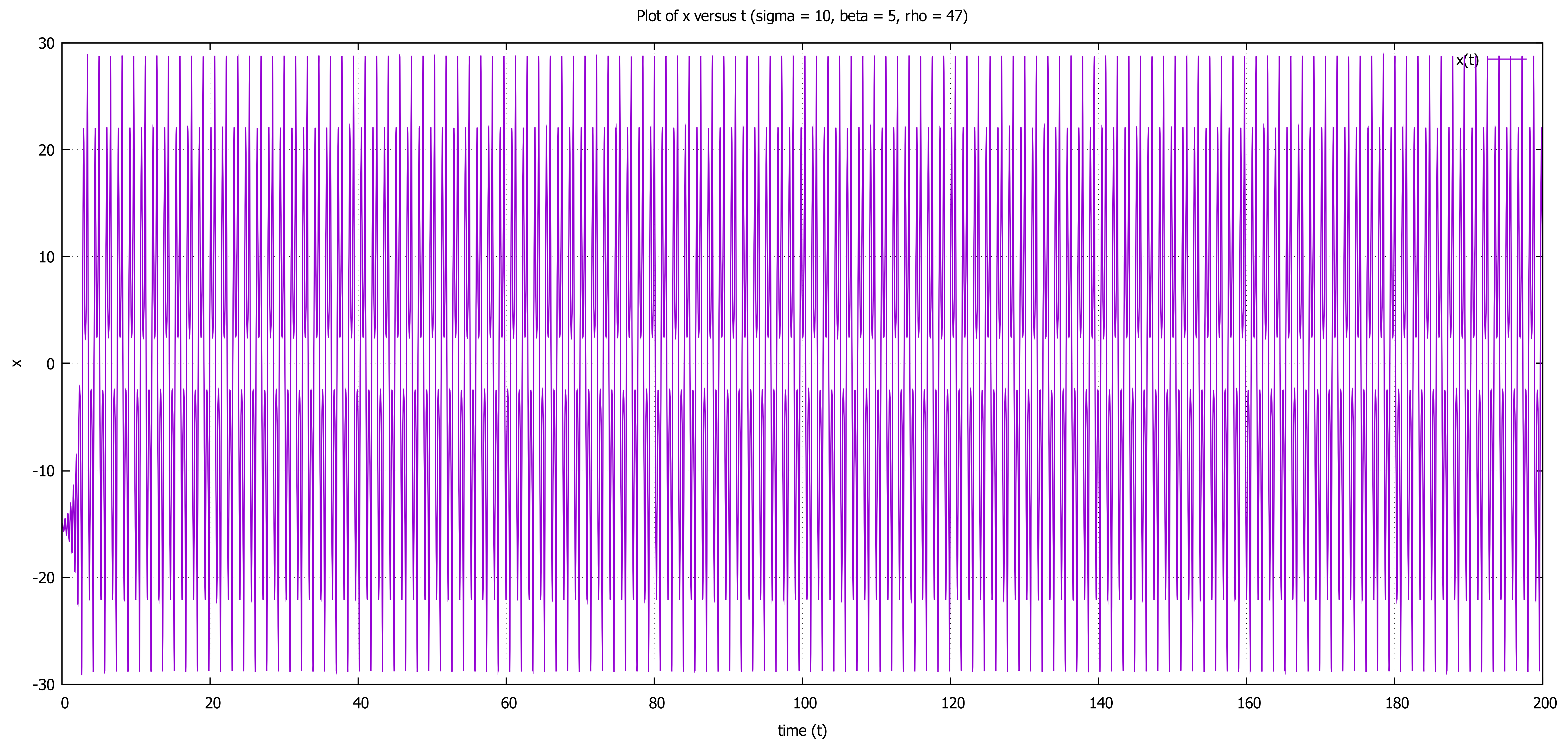
Following are the plots when initial point is $I_0 \equiv (-15, -15, 45)$ and $\sigma = 10, \beta = 5$. Here $P_2 \equiv (-14.83, -14.83, 44)$ and $\rho_0 = 45$ And,

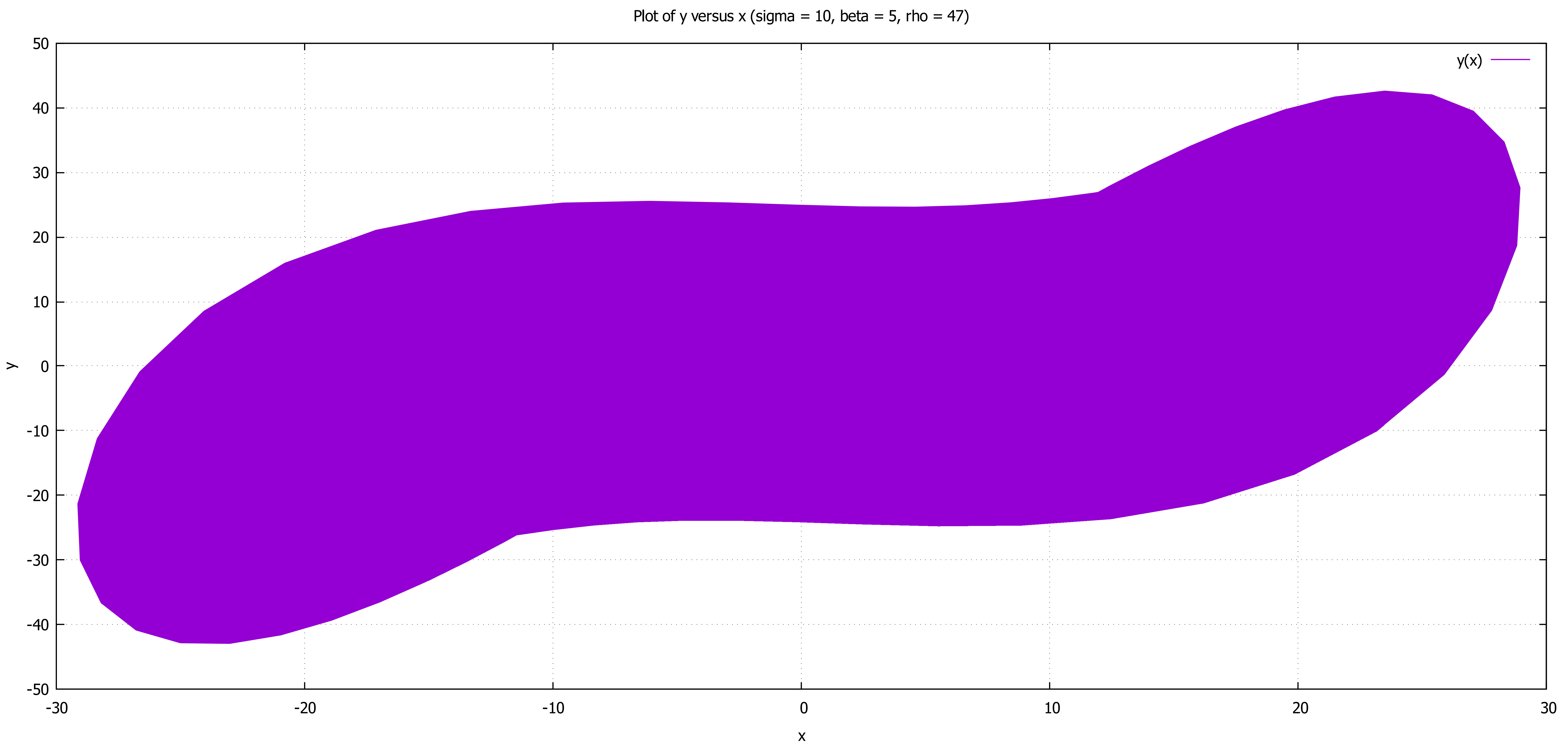
- $\rho = 32 < \rho_0$
- $\rho = 47 > \rho_0$
- $\rho = 45 = \rho_0$


Plot of x versus t (sigma = 10, beta = 5, rho = 32)
x(t)
x
time (t)
25
20
15
10
5
0
-5
-10
-15
-20
-25
0
20
40
60
80
100
120
140
160
180
200

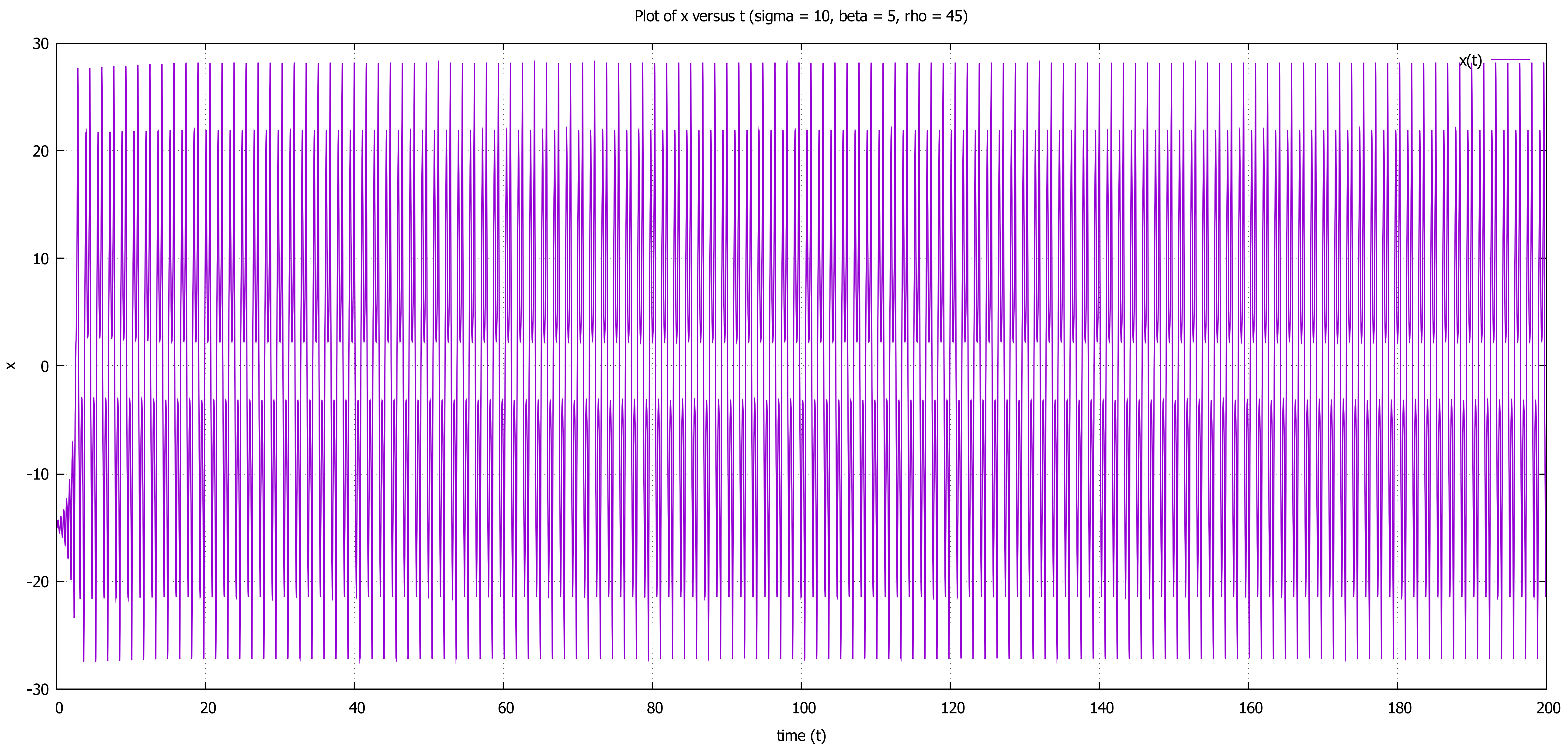
Plot of y versus x (sigma = 10, beta = 5, rho = 32)

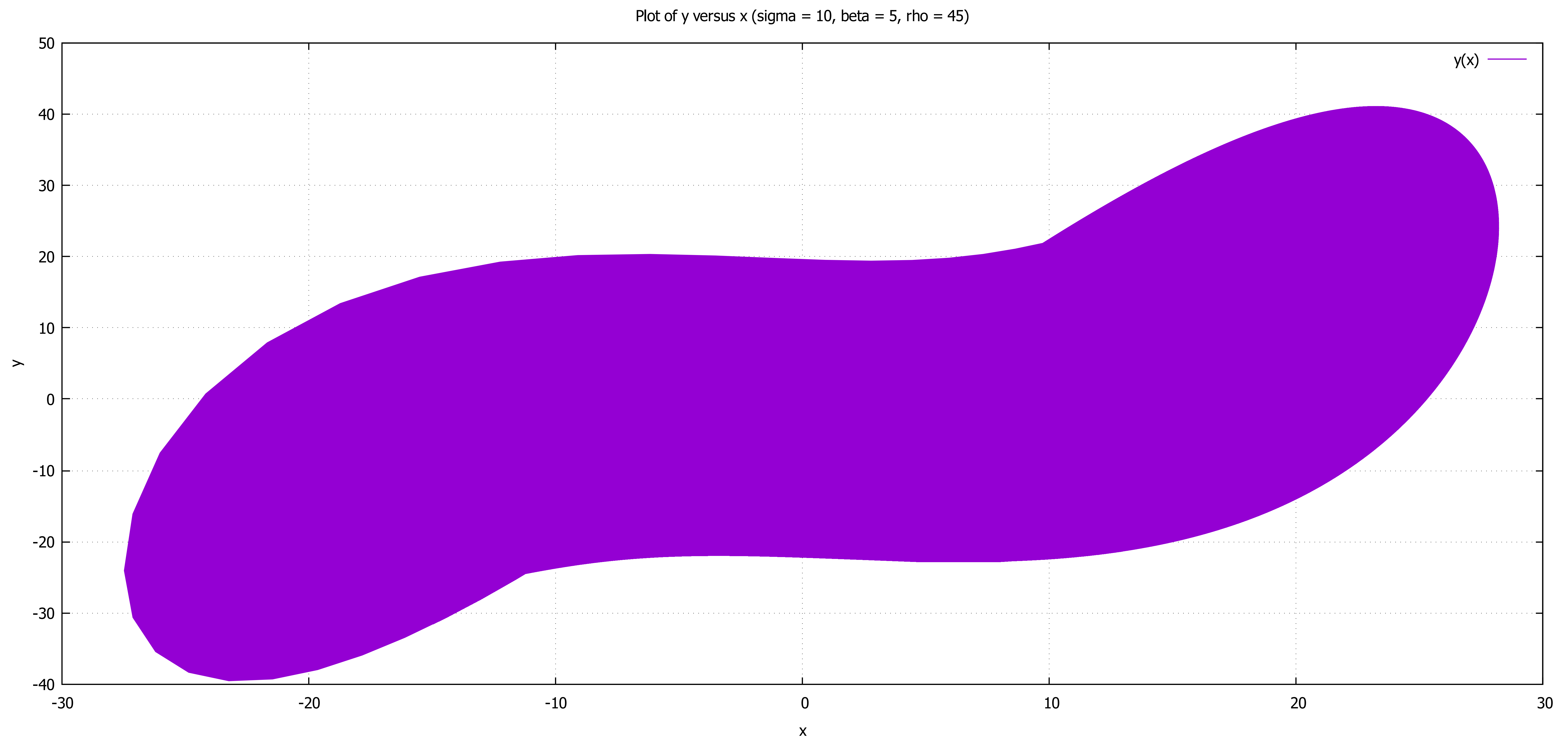



Plot of x versus t (sigma = 10, beta = 5, rho = 47)
x(t)
30
20
10
0
-10
-20
-30
x
0
20
40
60
80
100
120
140
160
180
200
time (t)



Plot of y versus x (sigma = 10, beta = 5, rho = 47)
y(x)
y
50
40
30
20
10
0
-10
-20
-30
-40
-50
x
-30
-20
-10
0
10
20
30

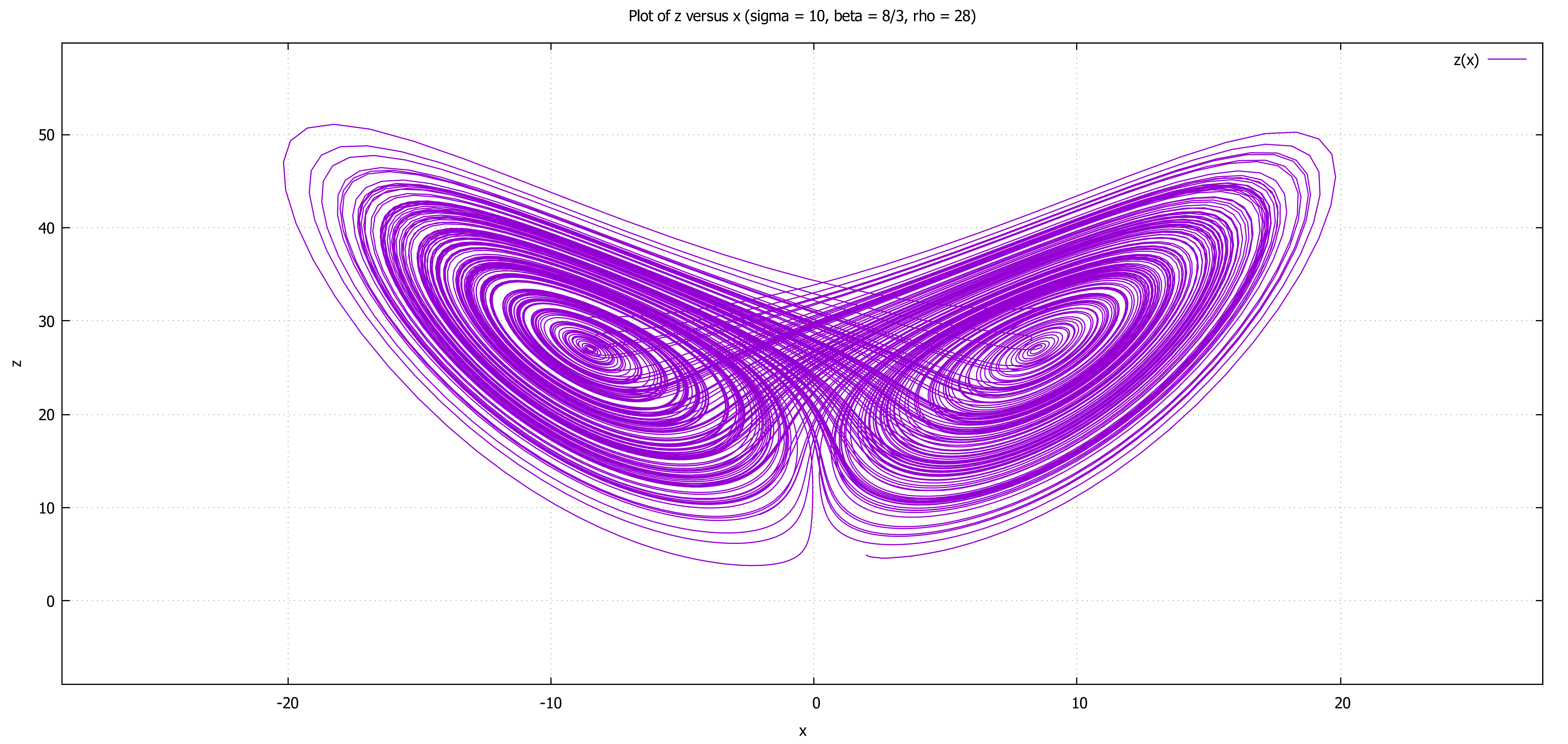

Plot of x versus t (sigma = 10, beta = 5, rho = 45)
x(t)
30
20
10
0
-10
-20
-30
x
0
20
40
60
80
100
120
140
160
180
200
time (t)



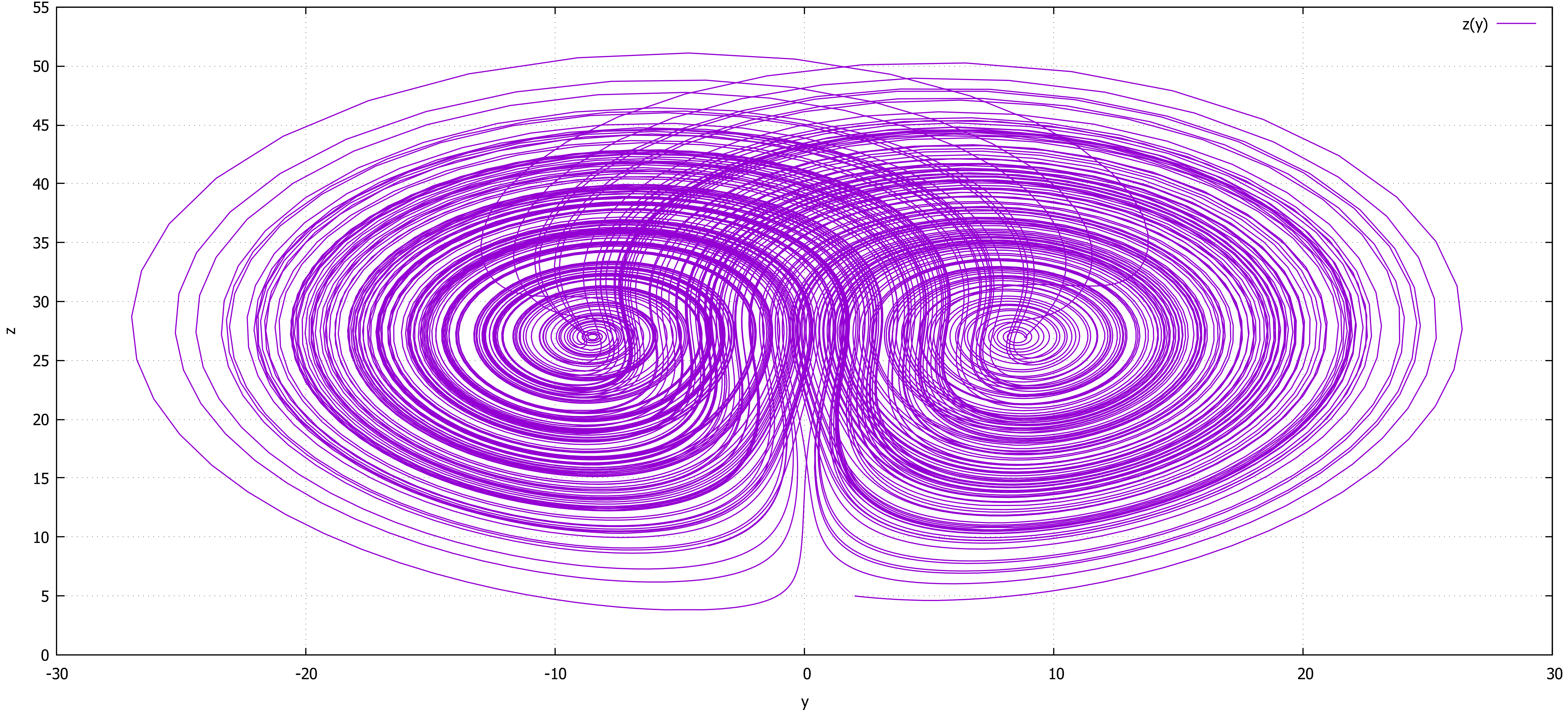
Plot of y versus x (sigma = 10, beta = 5, rho = 45)
y(x)
y
x
50
40
30
20
10
0
-10
-20
-30
-40
-30
-20
-10
0
10
20
30

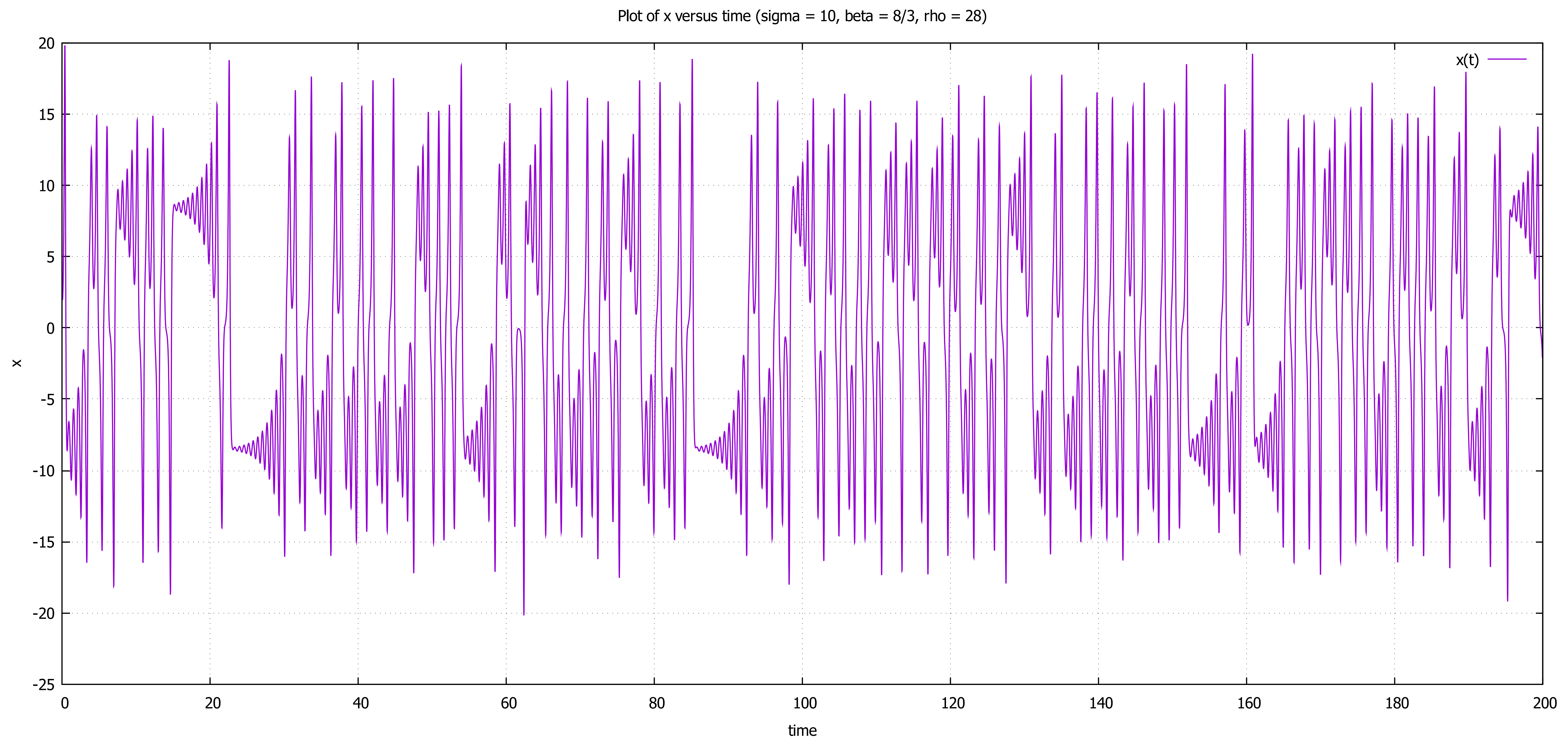
For $\sigma = 10, \beta = 8/3, \rho = 28$

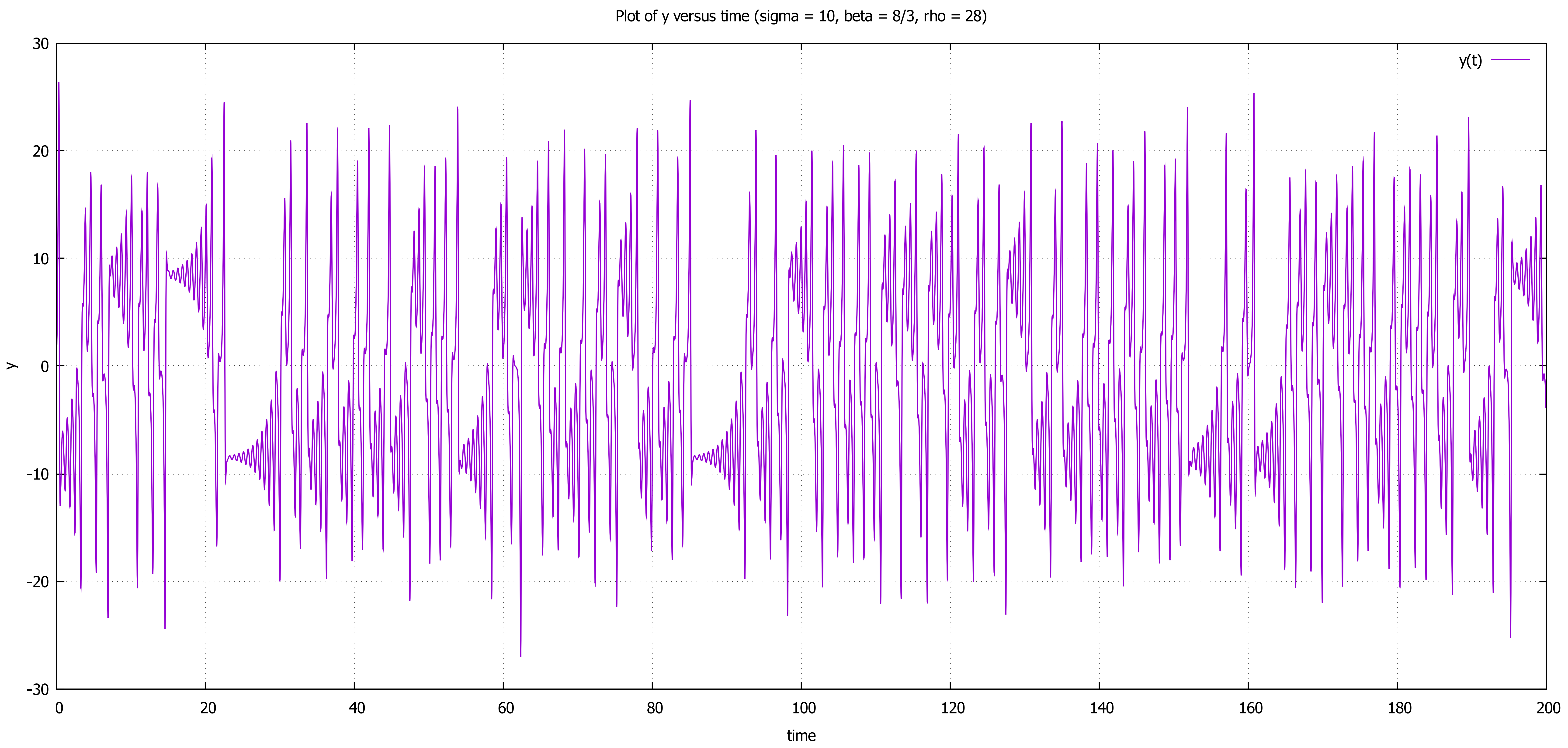
Following are the plots when initial point is $I_0 \equiv (2, 2, 5)$ and $\sigma = 10, \beta = 8/3, \rho = 28$.


Plot of z versus x (sigma = 10, beta = 8/3, rho = 28)
z(x)
50
40
30
20
10
0
z
-20
-10
0
10
20
x

Plot of z versus y (sigma = 10, beta = 8/3, rho = 28)




Plot of x versus time (sigma = 10, beta = 8/3, rho = 28)
x(t)
x
time
20
15
10
5
0
-5
-10
-15
-20
-25
0
20
40
60
80
100
120
140
160
180
200


Plot of y versus time (sigma = 10, beta = 8/3, rho = 28)
y(t)
y
time
30
20
10
0
-10
-20
-30
0
20
40
60
80
100
120
140
160
180
200