Exercise Solution

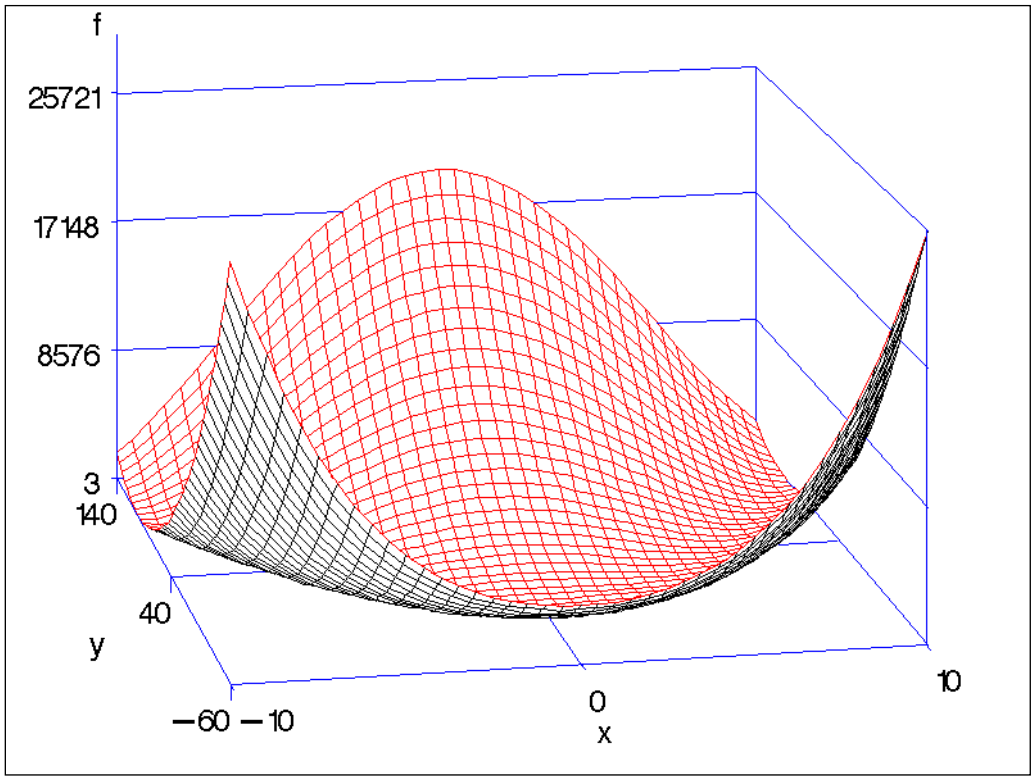
Using the OPTMODEL Procedure

Use PROC OPTMODEL to minimize the Rosenbrock banana function.

$$f = (y - x^2)^2 + (1 - x)^2$$

(This is a standard example to show that methods that use only the gradient can fail by repeatedly crossing back and forth over the "valley," whereas methods that use information about curvature can converge in a few iterations.)

Why do you think that the objective function is called a *banana function*?



This graph can be produced by the SAS program **banana_graph.sas** located in the course files folder: **D:\workshop\OPCON**

```
proc optmodel;
   var x, y;

   min f = (y-x**2)**2 + (1-x)**2;

   solve;

   print x y;
```

```
quit;
```

The objective function can also be entered using the caret symbol (^) for exponentiation, but this symbol is also a logical NOT operator in Base SAS.

PROC OPTMODEL Output

The OPTMODEL Procedure

Problem Summary

Objective Sense	Minimization
Objective Function	f
Objective Type	Nonlinear
Number of Variables	2
Bounded Above	0
Bounded Below	0
Bounded Below and Above	0
Free	2
Fixed	0
Number of Constraints	0

Solution Summary

Solver	NLP
Algorithm	Interior Point
Objective Function	f
Solution Status	Optimal
Objective Value	2.962209E-15
Optimality Error	8.9089584E-8
Infeasibility	0
Iterations	5
Presolve Time	0.00
Solution Time	0.03

x	y
1	1

PROC OPTMODEL selected a different algorithm than in the demonstration. In this example, five iterations were required.

The solution x = y = 1 has objective value zero, but the reported value is positive. The default number of significant digits for the PRINT command (PDIGITS=5) is less than the number for the objective value (BEST12.), so the actual values of x and y found by the solver are not both exactly 1.

The objective function is called a banana function because the level sets {[x,y]: f(x,y) = z} for z > 0

have a banana shape. (See the contour plot below.)