Mathematical Modeling

Math 396 Fall 2008 Fowler 110 Thu 1:30- 2:55pm
 http://faculty.oxy.edu/ron/math/396/08/

Class 5: **Thursday September 25**

TITLE Multivariable Optimization
CURRENT READING Meerschaert, Chapter 2

SUMMARY
This week we will go over various techniques useful for optimizing multivariable functions.

Example 2.1, page 21 of *Meerschaert*
A manufacturer of color TV sets is planning the introduction of two new products: a 19-inch stereo color set wiith a manufacturer's suggested retail price (MSRP) of $339 and a 21-inch stereo color set with an MSRP of $399. The cost to the company is $195 per 19-inch set and $225 per 21-inch set, plus an additional $400,000 in fixed costs. In the competitive market in which these sets will be sold, the number of sales per year will affect the average selling price. It is estimated that for each type of set, the average selling price drops by one cent for each additional unit sold. Furthermore, sales of the the 19-inch set will affect sales of the 21-inch set and vice versa. It is estimated that the average selling price for 19-inch sets will be reduced by an additional 0.3 cents for each 21-inch set sold, and the price for 21-inch sets will decrease by 0.4 cents for each 19-inch set sold. How many units of each type of set should be manufactured?

The Five Step Method

Step 1: Ask the question.

Step 2: Select the modeling approach.

Step 3: Formulate the model.

Step 4: Solve the model.

Step 5: Answer the question.

Mathematica Code for Example 2.1

Look at the file in `Start--> My Computer-->S ('stuserver')--> Math Courses--> Math 396-->Mathematica`.

To execute commands in Mathematica one uses `Shift-Enter` after selecting (on the right) the particular command or commands one is trying to execute. The following Mathematica Notebook was written by Mark. M. Meerschaert to help illustrate the solution to the Color TV problem. You shoudl try to understand exactly what each line is doing.

Example 2.1 (p.21) Color TV problem

```
y = (339 - .01*x1 - .003*x2)*x1 + (399 - .004*x1 - .01*x2)*
      x2 - (400000 + 195*x1 + 225*x2)

Plot3D[y, {x1, 0, 10000}, {x2, 0, 10000}]

dydx1 = D[y, x1]
 dydx2 = D[y, x2]

s = Solve[{dydx1 == 0, dydx2 == 0}, {x1, x2}]

y /. s
```

Sensitivity Analysis

```
y = (339 - a*x1 - .003*x2)*x1 + (399 - .004*x1 - .01*x2)*
      x2 - (400000 + 195*x1 + 225*x2)

dydx1 = D[y, x1]
dydx2 = D[y, x2]

s = Solve[{dydx1 == 0, dydx2 == 0}, {x1, x2}]

x1opt = x1 /. s
x2opt = x2 /. s

Plot[x1opt, {a, 0.005, 0.015}]

dx1optda = D[x1opt, a]

a = .01
S = dx1optda*(a/x1opt)
```