

Optimization Homework 1
Due January 23, 2017 by 5:00 pm

The Hawley Lighting Company manufactures four families of household lighting at its factory. The product families are table lamps, floor lamps, ceiling fixtures, and pendant lamps. The table below shows the average material costs for each of the products.

Product	Table	Floor	Ceiling	Pendant
Material cost	\$66	\$85	\$50	\$80

Each product is made in one of two production processes by purchasing components, assembling and testing the product, and, finally, packaging it for shipping. Table lamps and floor lamps go through the assembly and finishing process in Department 1, while ceiling fixtures and chandeliers go through the process in Department 2.

Variable production costs and capacities (measured in units of product) are shown in the table below. The capacities are measured in units of product. Note that there are regular and overtime possibilities for each department.

Process	<u>Regular Time</u>		<u>Overtime</u>	
	Unit Cost	Capacity	Unit Cost	Capacity
Department 1	\$16	100,000	\$18	25,000
Department 2	\$12	90,000	\$15	24,000

Average selling prices for the four products are known, and estimates have been made of the market demand for each product at these prices. These figures are shown in the following table:

Product	Table	Floor	Ceiling	Pendant
Selling price	\$120	\$150	\$100	\$160
Potential sales (000)	60	20	100	35
Advertising effect	12%	10%	8%	15%

Sales levels can also be affected by advertising expenditures. Starting with the demand levels in the table, an increase of up to \$10,000 in advertising raises the demand by the percent shown in the last row. An expenditure of less than \$10,000 in advertising will lead to a proportional effect on demand. For example, an increase in advertising of \$5,000 for table lamps would raise demand by 6 percent, or 3,600 units. However, there is a budget limit of \$18,000 on the total amount to be spent on advertising among all four products.

Write a report that answers the following questions

- What is an optimal output plan for the company?
- For each department, what is the marginal value of additional overtime capacity? (i.e. if we are able to increase the overtime capacity by one unit, how much impact would this have on the objective function)

- c. What is the marginal value of additional advertising dollars?
- d. What is the marginal value of additional sales for each product?