Exam 2 Practice Problems

1. A retail store in Des Moines, Iowa receives shipments of a particular product from Kansas City and Minneapolis. Let *x* be the number of units of product received from Kansas City, and let *y* be the number of units of product received from Minneapolis. Shipments from Kansas City cost $0.20 per unit and shipments from Minneapolis cost $0.25 per unit. Monthly demand at the retail store is 5,000 units. No more than 4,000 units can be shipped from Kansas City, and no more than 3,000 units can be shipped from Minneapolis in a month.
    a. Construct an optimization model for this problem and use it to find an optimal solution.
    b. Provide some relevant sensitivity analysis of the optimal solution.

2. Kelson Sporting Equipment, Inc. makes two different types of baseball gloves: regular and catcher. The firm has 900 hours of production time available in its cutting and sewing department, 300 hours available in its finishing department, and 100 hours available in its packaging and shipping department. The production time requirements and the profit per glove are given in the following table.

Glove	Production Time per Glove			Profit per Glove
	Cut/Sew	Finishing	Pack/Ship	
Regular	1.000	0.500	0.125	$5.00
Catcher	1.500	0.333	0.250	$8.00

    a. Construct an optimization model for this problem and use it to find an optimal solution.
    b. What is the dual value for each constraint in the model and which constraints are binding?
    c. If 20 additional hours of production time can be added in the packaging and shipping department, how will the optimal value change?
    d. If overtime can be scheduled in only one of the departments which one would you recommend and why?

3. Quality Air Conditioning manufactures three types of home air conditioners: economy, standard, and deluxe. The profits per unit are $63, $95, and $135, respectively. For the next production period, the company has 200 fan motors, 320 cooling coils, and 2,400 hours of production time available. The production requirements per unit for each type are provided in the table below.

Model	Fans	Coils	Time (hours)
Economy	1	1	8
Standard	1	2	12
Deluxe	1	4	14

   a. Construct an optimization model for this problem and use it to find an optimal solution.
   b. What are the slack and dual values for each constraint in the model? Which constraints are binding?
   c. If the profit for the deluxe model increases to $150 per unit, would the optimal solution change? If so, how?

4. Esiason Oil makes two blends of fuel by mixing oil from three wells, one each in Texas, Oklahoma, and California. The costs and daily availability of the oils are provided in the following table.

Well	Cost per gallon	Gallons Available
Texas	$0.30	12,000
Oklahoma	$0.40	20,000
California	$0.48	24,000

   Because these three wells yield oils with different chemical compositions, Esiason's two blends of fuel are composed of different proportions of oil from its three wells. Blend A must be composed of at least 35% of oil from the Texas well, no more than 50% of oil from the Oklahoma well, and at least 15% of oil from the California well. Blend B must be composed of at least 20% of oil from the Texas well at least 30% of oil from the Oklahoma well, and no more than 40% of oil from the California well. Each gallon of Blend A can be sold for $3.10 and each gallon of Blend B can be sold for $3.20. Long term contracts require at least 20,000 gallons of each blend to be produced.
   a. What are the decision variables in this problem? How many are there?
   b. What are the constraints in this problem? How many?
   c. What should be the objective function for this problem?
   d. Construct an optimization model for this problem and use it to find an optimal solution.
   e. Generate some appropriate sensitivity analysis of the optimal solution.

Answers to Selected Problems:

1. Optimal solution: 4,000 units from KC and 1,000 units from Minneapolis with an optimal cost = $1,050. Total demand and KC supply constraints are binding and have non-zero marginal cost ($0.25) and marginal value (-$0.05).

2. Optimal solution: 500 regulars and 150 catchers; optimal value = $3,700.
   Binding constraints are cut/sew, finishing, and packaging with marginal values of $0, $3, and $28 respectively.
   20 additional hours in packaging increases profit by $560.
   Additional hours are most valuable in packaging.

3. Optimal solution: 80 economy, 120 standard, and 0 deluxe with optimal profit = $16,440
   Fan motor and cooling coil constraints are binding.
   Increase of $150 in deluxe profit would not change the optimal solution or value.

4. Optimal Profit = $124,160