Quantitative Method
Assignment 6
Due November 28, 2006

1. Interstate Bakeries, Inc., is an Atlanta-based manufacturer and distributor of branded bread products. Two leading products, Low Calorie, Q_A, and High Fiber, Q_B, bread, are produced using the same baking facility and staff. Low Calorie bread requires 0.3 hours of worker time per case, whereas High Fiber bread requires 0.4 hours of worker time per case. During any given week, a maximum of 15,000 worker hours are available for these two products. To meet grocery retailer demands for a full product line of branded bread products, Interstate must produce a minimum of 25,000 cases of Low Calorie bread and 7,500 cases of High Fiber bread per week. Given the popularity of low-calorie products in general, Interstate must also ensure that weekly production of Low Calorie bread is at least twice that of High Fiber bread.

    Low Calorie bread is sold to groceries at a price of $42 per case; the price of High Fiber bread is $40 per case. Despite its lower price, the markup on High Fiber bread substantially exceeds that on Low Calorie bread. Variable costs are $30.50 per case for Low Calorie bread, but only $17 per case for High Fiber bread.

    (a) Set up the linear programming problem that the firm would use to determine the profit-maximizing output levels for Low Calorie and High Fiber bread.

    (b) Completely solve the linear programming problem.

    (c) Interpret the solution values for the linear programming problem.

    (d) Holding all else equal, how much would variable costs per unit on High Fiber bread have to fall before the production level indicated in Part (b) would change?

2. The James Bond Fund is a mutual fund (open-end investment company) with an objective of maximizing income from a widely diversified corporate bond portfolio. The fund has a policy of remaining invested largely in a diversified portfolio of investment-grade bonds. Investment-grade bonds have high investment quality and receive a rating of Baa or better by Moody's, a bond rating service. The fund's investment policy states that investment-grade bonds are to be emphasized, representing at least three times the amount of junk bond holdings. Junk bonds pay high nominal returns but have low investment quality, and they receive a rating of less than Baa from Moody's. To maintain the potential for high investor income, at least 20% of the fund's total portfolio must be invested in junk bonds. Like many funds, the James Bond Fund cannot use leverage (or borrowing) to enhance investor returns. As a result, total bond investments cannot total more than 100% of the portfolio. Finally, the current expected return for investment-grade (I) bonds in 9%, and it is 12% for junk (J) bonds.

    (a) Set up and interpret the linear programming problem that the James Bond Fund would use to determine the optimal portfolio percentage holdings of investment-grade (I) and junk (J)

bonds.

(b) Use a graph to determine the optimal solution, and check your solution algebraically. Fully interpret solution values.

(c) Holding all else equal, how much would the expected return on junk bonds have to fall to alter the optimal investment policy determined in Part (b)? Alternatively, how much would the return on investment-grade bonds have to rise before a change in investment policy would be warranted?

(d) In anticipation of a rapid increase in interest rates and a subsequent economic downturn, the investment committee has decided to minimize the fund's exposure to bond price fluctuations. In adopting a defensive position, what is the maximum share of the portfolio that can be held in cash, given the investment policies stated in the problem?

3. Creative Accountants, Ltd, is a small San Francisco-based accounting partnership specializing in the preparation of individual (I) and corporate (C) income tax returns. Prevailing prices in the local market are $125 for individual tax return preparation and $250 for corporate tax return preparation.

Five accountants run the firm and are assisted by four bookkeepers and four secretaries, all of whom work a typical 40-hour workweek. The firm must decide how to target its promotional efforts to best use its resources during the coming tax preparation season. Based on previous experience, the firm expects that an average of one hour of accountant time will be required for each individual return prepared. Corporate return preparation will require an average of two accountant hours and two bookkeeper hours. One hour of secretarial time will also be required for typing each individual or corporate return. In addition, variable computer and other processing costs are expected to average $25 per individual return and $100 per corporate return.

(a) Set up the linear programming problem the firm would use to determine the profit-maximizing output levels for preparing individual and corporate returns.

(b) Completely solve and interpret the solution values for the linear programming problem.

(c) Calculate maximum possible net profits per week for the firm, assuming that the accountants earn $1,500 per week, bookkeepers earn $500 per week, secretaries earn $10 per hour, and fixed overhead (including promotion and other expenses) averages $5,000 per week.

(d) After considering the preceding data, one senior accountant recommended letting two bookkeepers go while retaining the rest of the current staff. Another accountant suggested that if any bookkeepers were let go, an increase in secretarial staff would be warranted. Which is the more profitable suggestion? Why?

(e) Set up, solve, and interpret solution values for the dual linear programming problem.

(f) Does the dual solution provide information useful for planning purposes? Explain.