Business Analytics

BUSM3021, Spring 2021

Instructor: Thomas Vossen

Practice Final Exam

Score:_____ Max: 100 points

Name:_____

Instructions:

Make sure to sign the honor code pledge! I cannot accept exams without your signature.

For full credit, complete solutions must be provided to all problems. An answer without motivation or explanation is not acceptable. I expect that you clearly organize and format the answers to the solutions.

Note: Carefully read the questions before you start working on the solutions. Clearly state your assumptions (if any) and try to keep your solutions as simple as possible.

Honor Code Pledge

"On my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this work."

Signature:_____

Question 1 (30pts)

Broker Steve Johnson is currently trying to maximize his profit in the bond market. Four bonds are available for purchase and sale, with the bid and ask price of each bond as shown in the following table.

Bond	Bid Price	Ask Price
1	980	990
2	970	985
3	960	972
4	940	954

Steve can buy up to 1,000 units of each bond at the ask price or sell up to 1,000 units of each bond at the bid price. During each of the next 3 years, the person who sells a bond will pay the owner of the bond the cash payments shown in the following table.

Year	Bond 1	Bond 2	Bond 3	Bond 4
1	100	80	70	60
2	110	90	80	50
3	1,100	1,120	1,090	1,110

Steve's goal is to maximize his revenue from selling bonds less his payment for buying bonds, subject to the constraint that after each year's payments are received, his current cash position is non-negative.

Formulate an LP formulation to maximize net profit from buying and selling bonds.

a) Decision Variables (12pts)

b) Objective function (6pts)

c) Constraints (12pts)

Question 2(30 pts)

A furnace repair company estimates that number of hours of skilled repair time that it requires during the next four months is as follows:

Month 1: 6,000 hours
Month 2: 7,000 hours
Month 3: 9,500 hours
Month 4: 12,000 hours

At the beginning of the first month, 50 skilled repair technicians work for the company. Each skilled repair technician can work up to 160 hours a month.

To meet future demands, new repair technicians must be trained. It takes one month to train a new technician. During the month of training, a trainee must be supervised for 50 hours by an experienced technician; experienced technicians cannot perform other work when supervising trainees. Each experienced repair technician is paid $3,000 a month (even if he or she does not work the full 160 hours). During the month of training, a trainee is paid $1,500 a month.

Formulate a Linear Programming Model that will enable the company to minimize the labor cost incurred in meeting the labor requirements for the next four months.

a. Define the decision variables (10 pts)

b. Specify the objective function (5 pts)

c. Define the constraints. (10 pts)

d. Suppose now that at the end of each month, 3% of the company's experienced repair technicians quit their job. In addition, 5% of the trainees leave after their initial month of training. Show how you can incorporate these factors into your LP formulation. (5pts)

Question 3 (25pts)

A nuclear power company is deciding whether to build a nuclear power plant at Diablo Canyon or at Roy Rogers City. The cost building a power plant is $10 million at Diablo Canyon and $20 million at Roy Rogers City.

If the company builds at Diablo, however, and an earthquake occurs at Diablo during the next 5 years, construction will be terminated and the company will lose $10 million (and will still have to build a power plant at Roy Rogers city). A priori, the company believes there is a 20% chance that an earthquake will at Diablo during the next 5 years. For $1 million, a geologist can be hired to analyze the fault structure at Diablo Canyon. He will either predict that an earthquake will occur or that an earthquake will not occur. The geologist past record indicates that he will predict an earthquake on 95% of the occasions for which an earthquake will occur and no earthquake on 90% of the occasions for which an earthquake will not occur.

a) Identify the alternatives, states of nature, and payoff table if the geologist is not hired;

b) Determine the optimal investment using an expected value criterion;

c) Find the expected value of perfect information.

d) Find the posterior probabilities of the respective states of nature for each of the geologist's predictions.

e) Should the power company hire the geologist?

Question 4 (15pts)

In August, Walton Bookstore must decide how many of next year's nature calendars should be ordered. Each calendar costs the bookstore $2 and is sold for $4.50. After January 1, any unsold calendars are returned to the publisher for a refund of 75¢ per calendar. Walton believes that the number of calendars sold by January 1 follows the probability distribution shown in the table below. Walton wants to maximize the expected net profit from calendar sales. How many calendars should the bookstore order in August?

Calendars sold	Probability
100	0.25
150	0.20
200	0.30
250	0.15
300	0.10

a) How many calendars should the Walton Bookstore order? (8pts)

b) What is the expected profit from this policy? (7pts)