King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics

Math 131 (Term 143)

Final Exam – CODE 002

(Duration: 150 minutes. Number of Exercises: 25)

Student Name_____ **Student ID:** _____

Exercise 1
The demand function for an electronics company's laptop computer line is p = 2400 - 6q, where p is the price (in dollars) per unit when q units are demanded (per week) by consumers. The level of production that will maximize the manufacturer's total revenue is

(a) 4000 (b) 2400 (c) 2000 (d) 400 (e) 200

Exercise 2
Suppose the cost to produce 10 units of a product is $40 and the cost of 20 units is $70. Assuming cost is linearly related to output, the cost to produce 30 units is

(a) $100 (b) $105 (c) $110 (d) $115 (e) $120

Exercise 3
Painters are often paid either by the hour or on a per-job basis. The rate they receive can affect their working speed. For example, suppose they can work either for $9.00 per hour or for $320 plus $3 for each hour less than 40 if they complete the job in less than 40 hours. Suppose the job will take t hours. If $t \geq 40$, clearly the hourly rate is better. If $t < 40$, then the hourly rate will be better for the painter if t is equal or greater than:

(a) 36 (b) 37 (c) 38 (d) 39 (e) 40

Exercise 4
A company is designing a package for its product. One part of the package is to be an open box made from a square piece of aluminum by cutting out a 2-cm square from each corner and folding up the sides. The box is to contain 50 cm^3. The length of the square piece of aluminum is:

(a) $4 + 5\sqrt{2}$ cm (b) 9 cm (c) 29 cm (d) 4 cm (e) 5 cm

Exercise 5

A diet is to contain at least 16 units of carbohydrates and at most 20 units of protein. Food A contains 2 units of carbohydrates and 4 units of protein; food B contains 2 units of carbohydrates and 1 unit of protein. Food A costs \$1.20 per unit and food B costs \$0.80 per unit. Let x = Number of units of food A and y = Number of units of food B. The linear programming problem to minimize cost Z is:

(a) Minimize $Z = 1.2x + 0.8y$ subject to $2x + 2y \geq 16$; $4x + y \geq 20$.
(b) Minimize $Z = 16x + 20y$ subject to $2x + 2y \geq 1.20$; $4x + y \geq 0.8$.
(c) Minimize $Z = 1.2x + 0.8y$ subject to $2x + 4y \geq 16$; $2x + y \leq 20$.
(d) Minimize $Z = 1.2x + 0.8y$ subject to $x + y \geq 8$; $4x + y \leq 20$.
(e) Minimize $Z = 0.8x + 1.2y$ subject to $2x + 2y \geq 16$; $4x + y \leq 20$.

Exercise 6

Consider the function $Z = y - x$ subject to $x \geq 3$, $x + 3y \geq 6, x - 3y \geq -6, y \geq 0$. Then Z has:

(a) no minimum value
(b) a maximum value at (0, 2)
(c) a minimum value at (3, 3)
(d) a maximum value at (3, 1)
(e) a minimum value at (6, 0)

Exercise 7

The market equilibrium point for a product occurs when 13,500 units are produced at a price of \$4.50 per unit. The producer will supply no units at \$1, and the consumers will demand no units at \$20. Assuming the supply equation is linear, it is given by:

(a) 7q + 27,000p – 27,000 = 0
(b) $31q$ + 27,000p – 540,000 = 0
(c) 7q – 540,000p + 27,000 = 0
(d) 7q – 27,000p + 27,000 = 0
(e) $31q$ – 27,000p + 540,000 = 0

Exercise 8

The system $\begin{cases} y = \frac{x^2}{x-1} + 1 \\ y = \frac{1}{x-1} \end{cases}$ has

(a) no solution
(b) one solution
(c) two solutions
(d) one-parameter family of solutions
(e) two-parameter family of solutions

Exercise 9

A owes B the sum of \$5,000 and agrees to pay B the sum of \$1,000 at the end of each year for five years and a final payment at the end of the sixth year. Assume that money is worth 8% compounded annually and let x denote the final payment. Then:

(a) $x = 5{,}000 - 1{,}000s_{5|0.08}$
(b) $x = 5{,}000 - 1{,}000a_{5|0.08}$
(c) $x = (1.08)^6\left(5{,}000 - 1{,}000a_{5|0.08}\right)$
(d) $x = (1.08)\left(5{,}000 - 1{,}000s_{5|0.08}\right)$
(e) $x = (1.08)^{-6}\left(5{,}000 - 1{,}000a_{5|0.08}\right)$

Exercise 10

Ahmed wishes to lease a car for a period of 6 months. The fee is 1,000 SR per month payable at the beginning of each month. Suppose that he wants to make a payment at the beginning of the lease period to cover all fees for the six-month period. If money is worth 9% compounded monthly, this payment will be:

(a) 5,845.598 SR (b) 5,889.440 SR (c) 6,159.484 SR (d) 6,845.598 SR (e) 7,159.484 SR

[From Appendix A: $a_{4|0.0075} = 3.926110$; $a_{5|0.0075} = 4.889440$; $a_{6|0.0075} = 5.845598$
$s_{5|0.0075} = 5.075565$; $s_{6|0.0075} = 6.113631$; $s_{7|0.0075} = 7.159484$]

Exercise 11

A debt of \$7,000 due in five years is to be repaid by a payment of \$3,000 now and a second payment at the end of five years. If the interest rate is 8% compounded monthly, the second payment will be:

(a) \$2,460.30 (b) \$2,530.46 (c) \$3,460.30 (d) \$3,530.46 (e) \$4,000

Exercise 12

At a nominal rate of interest R, compounded semiannually, money will double in 4 years. Then $R =$

(a) $\sqrt[8]{2} - 2$ (b) $\sqrt[8]{2} - 1$ (c) $2^{\frac{5}{4}} - 2$ (d) $\sqrt[4]{2} - 1$ (e) $2^{\frac{9}{8}} - 2$

Exercise 13

We use the simplex method to solve the following linear programming problem:

Maximize $Z = -3x_1 + 5x_2 + 4x_3 - x_4$ subject to $\begin{cases} x_1 + x_3 - x_4 \le 2 \\ x_2 + x_3 + x_4 \le 5 \\ -x_1 + x_2 + x_3 + x_4 \le 3 \\ x_1, x_2, x_3, x_4 \ge 0 \end{cases}$

The maximum is

(a) 15 (b) 16 (c) 17 (d) 18 (e) 19

Exercise 14
A subcommittee of 4 members is to be selected from a committee of 4 males and 4 females. If at least 2 females are to serve on this subcommittee, the number of ways this can be done is:

(a) 12 (b) 36 (c) 37 (d) 52 (e) 53

Exercise 15
On a history exam, each of 6 items in one column is to be matched with exactly one of 8 items in another column. No item in the second column can be selected more than once. The number of ways the matching can be done is:

(a) 6^8 (b) ${}_8P_6$ (c) ${}_8C_6$ (d) 8^6 (e) 48

Exercise 16
Suppose that $S = \{1,2,3,4,5,6,7,8,9,10\}$ is the sample space for an experiment with events:
$E = \{1,3,5\}$; $F = \{3,5,7,9\}$; $G = \{2,4,6,8\}$. Then $(E \cup G) \cap F' =$

(a) {1,2,3,4,5,6,7,8,9} (b) {1,2,3,4,5,6,8,10} (c) Empty Set (d) {3,5} (e) {1,2,4,6,8}

Exercise 17
Urn I contains 2 Red and 2 Blue marbles and Urn II contains 1 Pink and 1 Blue marbles. An urn is selected at random. Then a marble is randomly drawn from it and placed in the other urn from which we randomly draw a marble. The probability that the second draw yields a Pink marble is

(a) $\frac{13}{60}$ (b) $\frac{11}{60}$ (c) $\frac{1}{4}$ (d) $\frac{1}{12}$ (e) $\frac{1}{20}$

Exercise 18
On an 8-question, multiple-choice examination, there are 4 choices for each question, only one of which is correct. If a student answers each question in a random fashion, the probability that exactly 3 questions are correct is:

(a) $(4^{-8})({}_8C_3)(3^5)$ (b) $(4^{-8})(3^8)$ (c) $(4^{-8})({}_8C_4)(3^4)$ (d) $(4^{-8})(3)$ (e) $(4^{-8})({}_8C_3)$

Exercise 19
Bill Gates lives in a town of 1,000 people. He is worth $10 billion and each one of the other 999 people is worth 0 $. In this town:

(a) the median personal wealth is not representative
(b) the mean for the personal wealth is equal to 1,000,000
(c) the mode for the personal wealth is representative and is equal to 1,000
(d) the mode for the personal wealth is equal to 0 and is not representative
(e) the median personal wealth is equal to 0

Exercise 20

Six hundred investors were surveyed to determine whether a person who uses a full-service stockbroker has better performance in his or her investment portfolio than one who uses a discount broker. In general, discount brokers usually offer no investment advice to their clients, whereas full-service brokers usually offer help in selecting stocks but charge larger fees. The data, based on the last 12 months, are given in the below table. Let E denote the event of having a full-service broker and let F denote the event of having an increase in portfolio value. Then:

	Increase	Decrease	Total
Full Service	320	80	400
Discount	160	40	200
Total	480	120	600

(a) E and F are dependent
(b) E and F are independent
(c) E and F are mutually exclusive
(d) P(E) = P(F | E)
(e) P(F) = P(E | F)

Exercise 21

In an article comparing national mathematics examinations in the U.S. and some European countries, a researcher found the results, shown in the below table, for the number of minutes allowed for each open-ended question.

France	10
Germany	15
Netherlands	11
Portugal	12
Scotland	5
US	6

The number of data values within one standard deviations of the mean is:

(a) 2 (b) 3 (c) 4 (d) 5 (e) 6

Exercise 22

A basket contains 10 balls, each of which shows a number. Five balls show 3, two balls show 2, and three balls show 1. A ball is selected at random. If X is the number that shows, then E(X) =

(a) $\frac{3}{5}$ (b) 1 (c) $\frac{7}{5}$ (d) $\frac{9}{5}$ (e) $\frac{11}{5}$

Exercise 23

A fast-food chain estimates that if it opens a restaurant in a shopping center, the probability that the restaurant is successful is 0.65. A successful restaurant earns an annual profit of $75,000; a restaurant that is not successful loses $20,000. The expected gain to the chain if it opens a restaurant in a shopping center is:

(a) $41,000 (b) $41,750 (c) $48,000 (d) $48,750 (e) $55,000

Exercise 24

Suppose X is a binomially distributed random variable with $\mu = 2$ and $\sigma^2 = \frac{3}{2}$. Then $P(X = 2) =$

(a) $1 - P(X \leq 1)$ (b) $\frac{(3^2)(7)}{4^7}$ (c) $\frac{(3^2)(14)}{4^7}$ (d) $\frac{(3^6)(7)}{4^7}$ (e) $\frac{(3^6)(14)}{4^7}$

Exercise 25

A biased coin is tossed three times in succession. The probability of tails on any toss is $\frac{4}{5}$. The probability that two or three heads occur is:

(a) 0.008 (b) 0.096 (c) 0.104 (d) 0.896 (e) 0.904

---------- *Good Luck* ----------