Homework #9 – *due Friday, April 9, 2021*

1. Andy Mendoza makes handcrafted dolls, which he sells at craft fairs. He is considering massproducing the dolls to sell in stores. He estimates that the initial investment for plant and equipment will be \$25,000, while labor, materials, packaging, and shipping will be about \$10 per doll. He has determined that sales volume is related to price, according to the following linear equation:

$$v = 4000 - 80p$$

   (a) Develop a nonlinear profit function for Andy and determine the price that will maximize profit, the optimal volume, and the maximum profit per month.

   (b) Graphically illustrate the profit curve developed in part (a). Indicate the optimal price/volume combination and the maximum profit per month.

2. The Riverwood Paneling Company makes two kinds of wood paneling: Colonial and Western. The company has developed the following nonlinear programming model to determine the optimal number of sheets of Colonial paneling (x_1) and Western paneling (x_2) to produce to maximize profit, subject to a labor constraint:

$$\begin{aligned} \text{maximize} \quad & Z = \$25x_1 - 0.8x_1^2 + 30x_2 - 1.2x_2^2 \\ \text{subject to} \quad & x_1 + 2x_2 = 40 \text{ hr.} \end{aligned}$$

   (a) Determine the optimal solution to this nonlinear programming model.

   (b) Interpret the meaning of the Lagrange multiplier.

3. The Burger Doodle restaurant chain purchases ingredients from four different food suppliers. The company wants to construct a new central distribution center to process and package the ingredients it uses in its menu items before shipping them to their various restaurants. The suppliers transport the food items in 40-foot tractor-trailer trucks. The coordinates of the four suppliers and the annual number of truckloads that will be transported to the distribution center are as follows:

	Coordinates		
Supplier	x	y	**Annual Truckloads**
A	200	200	65
B	100	500	120
C	250	600	90
D	500	300	75

   Determine the set of coordinates for the new distribution center that will minimize the total miles traveled from the suppliers.

4. Mark Decker has identified four stocks for his portfolio, and he wants to determine the percentage of his total available funds he should invest in each stock. The alternative stocks include an Internet company, a computer software company, a computer manufacturer, and an entertainment conglomerate. He wants a total annual return of .12. From historical data, he has determined the average annual return and variance for each of the funds, as follows:

Stock	Annual Return	Variance
1. Internet	.18	.112
2. Software	.12	.061
3. Computer	.10	.045
4. Entertainment	.15	.088

He has also estimated the correlation coefficients between stocks, as follows:

Stock Combination (i, j)	Correlation coefficients
1, 2	.9
1, 3	.7
1, 4	.3
2, 3	.8
2, 4	.4
3, 4	.2

Determine the percentage of Mark's total funds that he should invest in each stock to minimize his overall risk.