Operations Research
Chapter 6

Problem 1: 5

The price of a share of a particular stock listed on the New York Stock Exchange is currently $39. The following probability distribution shows how the price per share is expected to change over a three-month period:

Stock Price Change ($)	Probability
−2	0.05
−1	0.10
0	0.25
+1	0.20
+2	0.20
+3	0.10
+4	0.10

a. Set up intervals of random numbers that can be used to generate the change in stock price over a three-month period.
b. With the current price of $39 per share and the random numbers 0.1091, 0.9407, 0.1941, and 0.8083, simulate the price per share for the next four 3-month periods. What is the ending simulated price per share?

Problem 2:

The management of Brinkley Corporation is interested in using simulation to estimate the profit per unit for a new product. Probability distributions for the purchase cost, the labor cost, and the transportation cost are as follows:

Purchase Cost ($)	Probability	Labor Cost ($)	Probability	Transportation Cost ($)	Probability
10	0.25	20	0.10	3	0.75
11	0.45	22	0.25	5	0.25
12	0.30	24	0.35		
		25	0.30		

Assume that these are the only costs and that the selling price for the product will be $45 per unit.
a. Provide the base-case, worst-case, and best-case calculations for the profit per unit.
b. Set up intervals of random numbers that can be used to randomly generate the three cost components.
c. Using the random numbers 0.3726, 0.5839, and 0.8275, calculate the profit per unit.
d. Using the random numbers 0.1862, 0.7466, and 0.6171, calculate the profit per unit.
e. Management believes the project may not be profitable if the profit per unit is less than $5. Explain how simulation can be used to estimate the probability the profit per unit will be less than $5.

Problem 3:

The time between arrivals of oil tankers at a loading dock at Prudhoe Bay is given by the following probability distribution:

Time Between Ship Arrivals (days)	Probability
1	.05
2	.10
3	.20
4	.30
5	.20
6	.10
7	.05

The time required to fill a tanker with oil and prepare it for sea is given by the following probability distribution:

Time to Fill and Prepare (days)	Probability
3	.10
4	.20
5	.40
6	.30

Simulate the movement of tankers to and from the single loading dock for the first 10 arrivals. Compute the average time between arrivals, average waiting time to load, average service time per ship and average time that a ship spends in the repair shop.
Use the following sets of random numbers:
{.70, .32, .89, .18, .43, .96, .56, .73, .02, .32}, {.68, .98, .27, .44, .04, .57, .82, .11, .68, .30}.

Problem 1

a.

Stock Price Change	Probability	Interval
-2	.05	.00 but less than .05
-1	.10	.05 but less than .15
0	.25	.15 but less than .40
+1	.20	.40 but less than .60
+2	.20	.60 but less than .80
+3	.10	.80 but less than .90
+4	.10	.90 but less than 1.00

b.

Random Number	Price Change	Ending Price Per Share
0.1091	-1	$38
0.9407	+4	$42
0.1941	0	$42
0.8083	+3	$45

Ending price per share = $45

Problem 2

a. Profit = Selling Price - Purchase Cost - Labor Cost - Transportation Cost

Base Case using most likely costs

Profit = 45 - 11 - 24 - 3 = $7/unit

Worst Case

Profit = 45 - 12 - 25 - 5 = $3/unit

Best Case

Profit = 45 - 10 - 20 - 3 = $12/unit

b.

Purchase Cost	Interval	Labor Cost	Interval	Transportation Cost	Interval
$10	.00 but less than .25	$20	.00 but less than .10	$3	.00 but less than .75
11	.25 but less than .70	22	.10 but less than .35	5	.75 but less than 1.00
12	.70 but less than 1.00	24	.35 but less than .70		
		25	.70 but less than 1.00		

c. Profit = 45 - 11 - 24 - 5 = $5/unit

d. Profit = 45 - 10 - 25 - 3 = $7/unit

e. Simulation will provide a distribution of the profit per unit values. Calculating the percentage of simulation trials providing a profit less than $5 per unit would provide an estimate of the probability the profit per unit will be unacceptably low.

Problem 3

Time Between Ship Arrivals (days)	Probability	Cumulative probability	Ranges
1	.05	0.5	00-04
2	.10	0.15	05-14
3	.20	0.35	15-34
4	.30	0.65	35-64
5	.20	0.85	65-84
6	.10	0.95	85-94
7	.05	1	95-99

Time to fill and prepare (days)	Probability	Cumulative probability	Ranges
3	.10	0.10	00-09
4	.20	0.30	10-29
5	.40	0.70	30-69
6	.30	1	70-99

Ship #	RN1	Time between ships	Arriving time	RN2	Service time	Beg. time	End time	Waiting time	Time in the system
1	.70		0	.68	5	0	5	0	5
2	.32	3	3	.98	6	5	11	2	7
3	.89	6	9	.27	4	11	15	2	6
4	.18	2	11	.44	5	15	16	4	9
5	.43	4	15	.04	3	16	19	1	4
6	.96	7	22	.57	5	22	27	0	5
7	.56	4	26	.82	6	27	33	1	7
8	.73	5	31	.11	4	33	37	2	6
9	.02	2	33	.68	5	37	42	4	9
10	.32	3	35	.30	5	42	47	7	12
Total		36			48		23	71	
Average		3.6 days			4.8 days		2.3 days	7.1 days	