

Homework 2 solution – due 9/22
Chapter 2, page 60 – problem 21:

Estimate by simulation the average number of lost sales per week for an inventory system that functions as follows:

- (a) When ever the inventory level falls to or below 10 units, an order is placed. Only one order can be outstanding at a time
- (b) The size of each order is $20-I$ where I is the inventory level when the order is placed.
- (c) If a demand occurs during a period when the inventory level is zero, the sale is lost.
- (d) Daily demand is normally distributed with a mean of 5 and a standard deviation of 1.5 units. (Round off demand to the closest integer during the simulation and if a negative value results, give it a demand of zero).
- (e) Lead time is distributed uniformly between zero and 5 days, integers only
- (f) The simulation starts with 18 units in inventory
- (g) For simplicity, assume that all demands occur at 12 noon and that all orders are placed at the same time. Assume further that orders are received at 5:00 pm, or after demand has occurred for that day.
- (h) Let the simulation run for 5 weeks.

In the simulation table below, the cells are calculated as follows:

- (a) Day – increments from 1 to 35 (5 weeks)
- (b) Starting inventory – previous day inventory minus day's satisfied demand plus any delivery
- (c) Demand – Gaussian distributed with mean of 5, standard deviation of 1.5. This demand is generated by generating a uniform distributed number between 0 and 1 and looking up the value in the table of cumulative distribution on the right side.
- (d) End of day inventory – starting inventory minus satisfied demand
- (e) Order – if the inventory drops below 10, 20 -current level.
- (f) Remaining order lead time – when an order is generated, a random number between 0 and 5 is generated, indicating the time to delivery. This value counts down each day until it is equal to 0, at which time an order is delivered. If the lead time generated is 0, the order is placed the same day.
- (g) Open order tracks the (single) open order until it is delivered
- (h) Delivery – indicates the order delivered each day.
- (i) Lost sale – if demand exceeds inventory, the difference is a lost sale
- (j) Average number of lost sales per week is the total number of lost sales divided by the number of weeks.
- (k) Random number – cumulative distribution of a gaussian distribution with mean 5 and standard deviation 1.5. A uniformly distributed random number is used to lookup the cumulative distribution value to determine the gaussian distributed random variable
- (l) Normal – the resulting gaussian R.V.

day	starting inventory	demand	end day inventory	remaining		open order	delivery	lost sale	random#	normal
				order	lead time					
1	18	8	10	0	0	0	0	0	0.000429	0
2	10	4	6	14	2	14	0	0	0.00383	1
3	6	5	1	0	1	14	0	0	0.02275	2
4	1	5	0	0	0	0	14	4	0.091211	3
5	14	5	9	11	3	11	0	0	0.252492	4
6	9	3	6	0	2	11	0	0	0.5	5
7	6	7	0	0	1	11	0	1	0.747508	6
8	0	7	0	0	0	0	11	7	0.908789	7
9	11	3	8	12	3	12	0	0	0.97725	8
10	8	5	3	0	2	12	0	0	0.99617	9
11	3	4	0	0	1	12	0	1	0.999571	10
12	0	5	0	0	0	0	12	5	0.999968	11
13	12	4	8	12	1	12	0	0	0.999998	12
14	8	3	5	0	0	0	12	0	1	13
15	17	9	8	12	1	12	0	0		
16	8	4	4	0	0	0	12	0		
17	16	5	11	0	0	0	0	0		
18	11	5	6	14	3	14	0	0		
19	6	7	0	0	2	14	0	1		
20	0	3	0	0	1	14	0	3		
21	0	5	0	0	0	0	14	5		
22	14	5	9	11	4	11	0	0		
23	9	5	4	0	3	11	0	0		
24	4	3	1	0	2	11	0	0		
25	1	3	0	0	1	11	0	2		
26	0	6	0	0	0	0	11	6		
27	11	7	4	16	3	16	0	0		
28	4	5	0	0	2	16	0	1		
29	0	5	0	0	1	16	0	5		
30	0	4	0	0	0	0	16	4		
31	16	7	9	11	4	11	0	0		
32	9	4	5	0	3	11	0	0		
33	5	5	0	0	2	11	0	0		
34	0	6	0	0	1	11	0	6		
35	0	6	0	0	0	0	11	6		
								average number of lost sales per week	11	

It is a good idea to verify that the generated information matches the desired distribution. This is a bar chart of the demand. It looks somewhat gaussian, as desired. More data should more closely resemble the standard “Bell shaped curve.”

