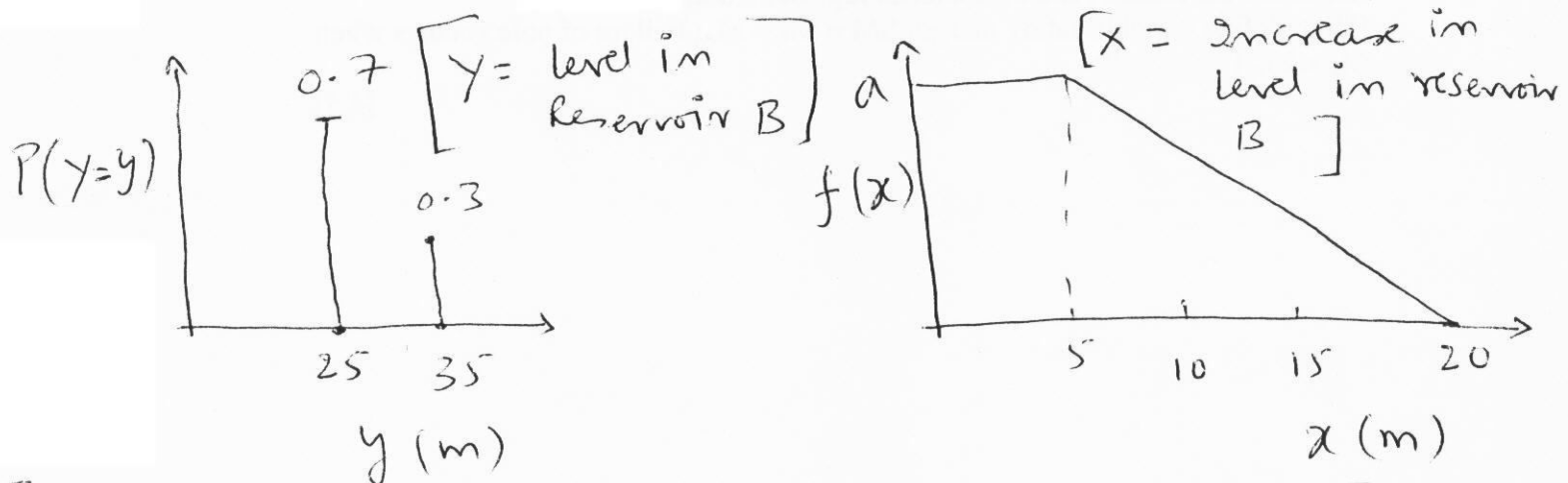
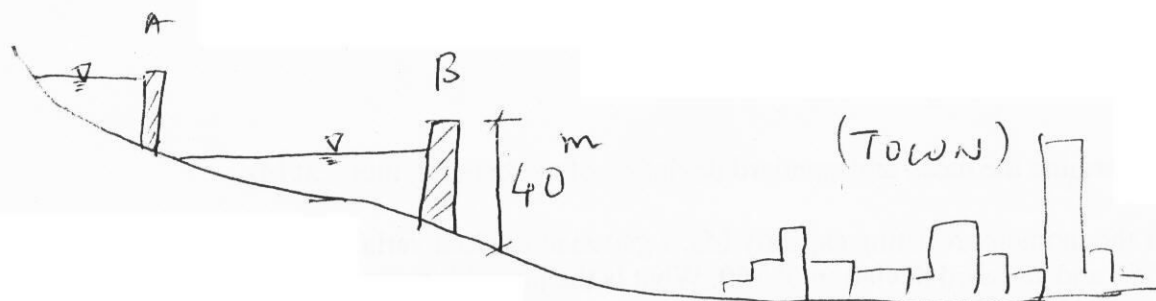


University of Colorado
Department of Civil, Environmental and Architectural Engineering
Statistical Methods for Water and Environmental Engineers
CVEN-5454
Spring 2005
Midterm
Date: 03/17/2005
75 minutes
40 points

Please write the steps clearly so that points can be awarded even when the numerical answer is incorrect. Answer either one of Problem 4 or 5. However, answering both of them will fetch bonus points.

1. Two reservoirs are located upstream of a town; the water is held back by two dams A and B. Dam B is 40m high (see Figure below). During a strong-motion earthquake, dam A will suffer damage and water will flow downstream into the lower reservoir. Depending on the amount of water in the upper reservoir when such an earthquake occurs, the lower reservoir water may or may not overflow dam B. Suppose that the water level at reservoir B, during an earthquake, is either 25m or 35m (as shown in Figure below); and the increase in elevation of water level in B caused by the additional water from reservoir A is a continuous random variable with the probability density function (also shown in the Figure below).

- Determine the value of a
- What is the probability of overflow at B during a strong-motion earthquake?
- If there were no overflow at B during an earthquake, what is the probability that the original water level in reservoir B is 25 m?
- What is the expected value of the random variable X [3, 5, 4, 3]



[Hint: O = overflow at B, happens when $x+y > 40$]

2. The sewers in a city are designed for a rainfall having a return period of 10 years.

- (a) What is the probability that the sewers will be flooded for the first time in the third year after completion of construction?
- (b) What is the probability of flooding within the first 3 years?
- (c) What is the probability of flooding in 3 of the first 5 years?
- (d) What is the flood risk over a 25-year period? [i.e., atleast one occurrence]

[2, 3, 3, 2]

3. What are the key differences between parametric and nonparametric approaches to PDF fitting/estimation? (list at least two)

(b) Suppose you are given the histogram (i.e., #of bin and the data points that fall within each bin). Could you devise a Monte-Carlo simulation algorithm?

(c) What are some utilities of Monte-Carlo

[2,2,2]

4. Two damaging hurricanes occurred during a 50-year record at a location. A tower is to be built at this location to last for 20 years.

(a) What is the probability that the tower will be subjected to less than 3 damaging hurricanes?

(b) The probability of failure of the tower depends on the number of damaging hurricanes occurring during its lifetime, which is given as

#of damaging hurricanes	0	1	2	3	4	5
Probability of Failure	0	0.2	0.8	1.0	1.0	1.0

What is the probability that the tower will not be destroyed during its useful life

[3,6]

5. A vertical steel structure is acted upon by two loads P_1 and P_2 so that the resulting bending moment created is

$$M_A = 30P_1 - 20P_2$$

P_1 and P_2 are independent Gaussian random variables with the following parameters

	Mean	Std.deviation
P_1	50	5
P_2	20	3

(a) Determine the mean and standard deviation of the bending moment M_A .

(b) If the moment resisting capacity M_R , a gaussian random variable with mean of 1750 and standard deviation of 150. What is the probability that the pole will fail under the loads P_1 and P_2 . Pictorial representation will suffice.

[Hint: define variable safety margin $SM = M_R - M_A$; Failure of pole occurs when $M_R < M_A$]

[4,5]