Assignment – Module 6

1. The streamflows at a site for the two seasons within a year are considered to be normally distributed with the following parameters:

Season	I	II
Mean	46	30
Std. Dev	27	18

   The site is proposed for a reservoir and is required to serve demands of 25, and 40 units in the two seasons respectively. Using a LDR of the form, $R_t = S_t - b_t$, formulate a chance constrained linear programming problem to determine the minimum capacity of the reservoir. Also write down the deterministic equivalent of the minimum release constraints for the two seasons. The minimum reliability with which the demands must be met in the two periods are 0.92, and 0.89, respectively.

2. At a site propsed for reservoir, monthly flows are known to be log-normally distributed with the following parameters:

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Mean	2.8	3.5	3.6	3.2	3.1	2.7	2.3	2	1.7	1.6	1.7	2.3
Stdev	2.7	3.3	3.1	2.8	2.7	2.4	2	1.9	1.5	1.6	1.7	2.1

   Formulate and solve a chance constrained LP problem to determine the minimum reservoir capacity required to satisfy a constant demand of 0.95A, A and 1.05A (where A is the average of the mean flows). Solve the problem for a reliability of 90% of meeting the demand.

3. The inflow in Mm^3 at a site for two seasons (t=1 and t=2) are given below for 10 years:

t = 1	1342	3945	913	7309	10512	5018	5886	982	2863	3069
t= 2	895	704	913	2720	697	607	812	1968	1512	1091

Average evaporation during the two seasons is 3.0 and 1.0 Mm3 respectively. It is known that the inflows in season t=1 and in season t=2 are normally distributed. With usual notations used in Chance Constrained LP for reservoir design, write down the complete deterministic equivalents of the following chance constraints. Use the LDR, $S_t = R_t + b_t$.

$$P[\ R_t \geq 3000] \geq 0.72 \qquad t=1, 2$$

$$P[\ R_t \leq 7000] \geq 0.82 \qquad t=1,2$$

4. Solve the two state, two period SDP reservoir operation problem with the following data to obtain steady state release policy.

Transition probabilities:

t = 1	t = 2	
	j	
i	1	2
1	0.5	0.5
2	0.3	0.7

t = 2	t = 1	
	j	
i	1	2
1	0.4	0.6
2	0.8	0.2

Period t=1

I	Q_i^t	*k*	S_k^t
1	15	1	30
2	25	2	40

Period t= 2

I	Q_i^t	*k*	S_k^t
1	35	1	20
2	45	2	30

Reservoir capacity = 60 units

$B_{kilt} = | R_{kilt} - T_R | + |S_k^t - T_s|$

with $T_R = 55$; $T_s = 30$

5. The steady state release probabilities obtained from a SDP solution are given below, with notations followed in the text.

k	*i*	PR_{kit}	
		t = 1	t = 2
1	1	0.112	0.320
1	2	0.053	0.115
2	1	0.144	0.166
2	2	0.532	0.200
3	1	0.080	0.090
3	2	0.079	0.109

Obtain the steady state probabilities of inflows and storages.

6. The following inflow transition probabilities are given for a two state, two period SDP reservoir operation problem.

	$t = 2$			$t = 1$	
$t = 1$	0.9	0.1	$t = 2$	0.4	0.6
	0.5	0.5		0.2	0.8

The steady state policy obtained from the SDP solution is as given below:

$t = 1$			$t = 2$		
k	*i*	*l**	*k*	*i*	*l**
1	1	1	1	1	2
1	2	1	1	2	2
2	1	2	2	1	2
2	2	1	2	2	1

Obtain the steady state probabilities for release, storage and inflows from this solution.