Homework 6

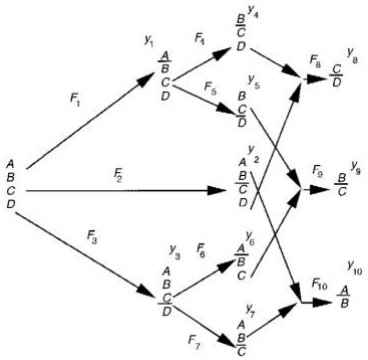
NO HANDWRITTEN SOLUTIONS WILL BE ACCEPTED

Problem 1: consider the following problem

$$Z_1(x) = x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2$$
$$\min Z_2(x) = 3x_1 + 2x_2 - \frac{x_3}{3} + 0.01(x_4 - x_5)^3$$
$$x_1 + 2x_2 - x_3 - 0.5x_4 + x_5 = 2$$
$$s.t. 4x_1 - 2x_2 + 0.8x_3 + 0.6x_4 + 0.5x_5^2 = 0$$
$$x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 \leq 10$$

a. Use the epsilon-constraint method to solve the following NLP problem in GAMS, upload your code
b. Create a plot with the Pareto front.

Problem 2: Consider the same problem that we explored in the previous homework.



In which the the total cost of a distillation column was calculated as follows:

$$cost_k = \alpha_k + \beta_k F_k + \gamma^{Hot} Q_k^{Hot} + \gamma^{Cold} Q_k^{Cold}$$

α_k represents a fixed capital cost, β_k represents the variable investment cost, $\gamma^{Hot/cold}$ is the cost of hot/cold utilities, and $Q_k^{Hot/cold}$ is the total demand of hot and cold utilities (you can assume that they are equal). Considering an initial fed of 1000 Kmol/h, and a composition of the feed stream (mol fraction) of A=0.15, B=0.3, C=0.35 and D=0.2. And considering the following data:

k	Separator	Investment cost α_k, fixed (10^3\$/yr)	Investment cost β_k, variable (10^3\$hr/kmol yr)	Heat duty coefficients, K_k, (10^6kJ /kgmol)
1	*A/BCD*	145	0.42	0.028
2	*AB/CD*	52	0.12	0.042
3	*ABC/D*	76	0.25	0.054
6	*A/BC*	125	0.78	0.024
7	*AB/C*	44	0.11	0.039
4	*B/CD*	38	0.14	0.040
5	*BC/D*	66	0.21	0.047
10	*A/B*	112	0.39	0.022
9	*B/C*	37	0.08	0.036
8	*C/D*	58	0.19	0.044

Cost of utilities:

Cooling water $C_C = 1.3$ (10^3\$/10^6kJyr)
Steam $C_H = 34$ (10^3\$/10^6kJyr)

Unlike the previous case, assume that the parameters γ^{Hot} and γ^{Cold} are known with uncertainty. And the probability of occurrence in different scenarios is as follows

	Probability	γ^{Hot} (10^3\$$10^6$KJ-y)	γ^{Cold} (10^3\$$10^6$KJ-y)
Scenario 1	0.025	0.1	3
Scenario 2	0.05	0.1	10
Scenario 3	0.1	0.1	34
Scenario 4	0.15	1.3	3
Scenario 5	0.35	1.3	10
Scenario 6	0.15	1.3	34
Scenario 7	0.1	3	3
Scenario 8	0.05	3	10
Scenario 9	0.025	3	34

Formulate a stochastic optimization problem in GAMS and solve the problem.