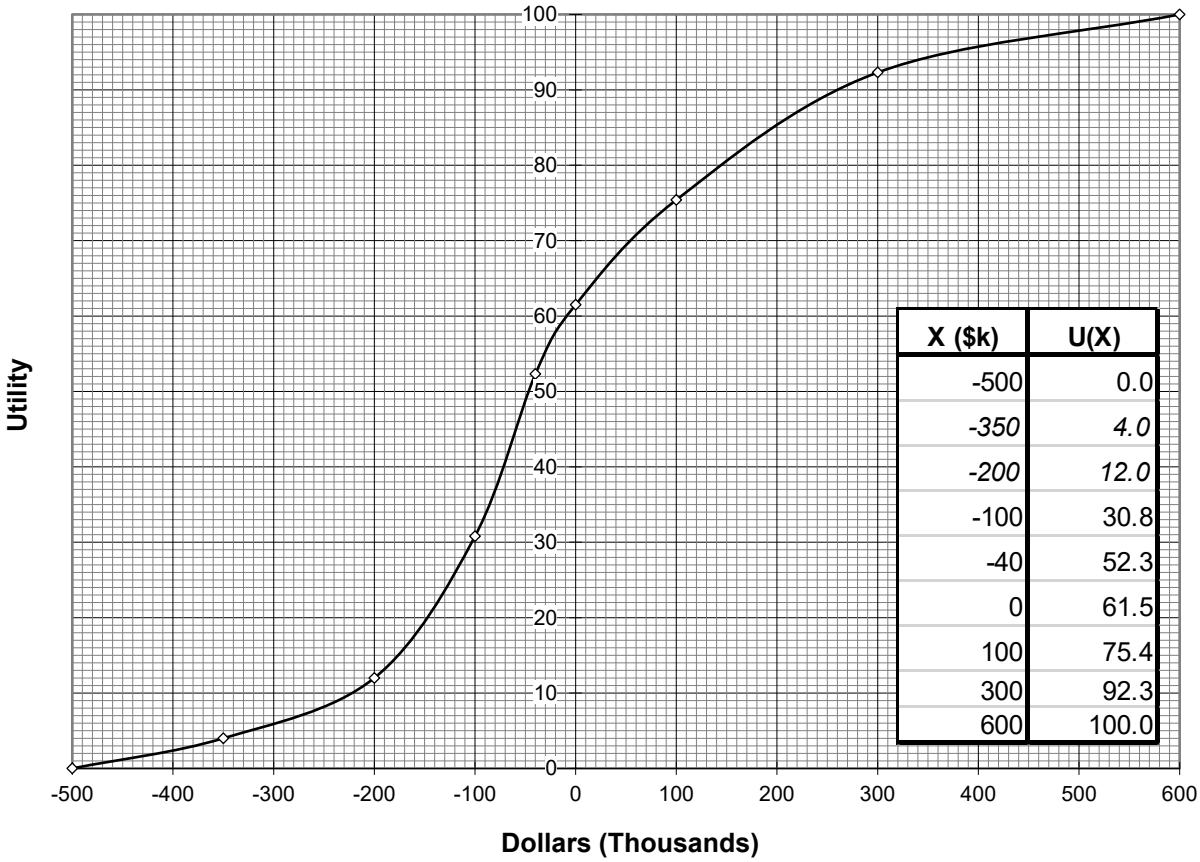
Homework 8 – Assigned: March 11, 2026, Due: March 18, 2026

Decision Problems using Utility Curves.

1. Solve Problem 13 (a,b,c) using the DPL model from HW 6 and the utility curve below. The dollar units for the utility curve table that you enter in the DPL program ($ or $k) should match the dollar units ($ or $k) that you used in the DPL model (decision tree). Notice that questions (b,c) require trial and error. Produce two solutions that show (i) EUV and (ii) CE.



X ($k)	U(X)
-500	0.0
-350	*4.0*
-200	*12.0*
-100	30.8
-40	52.3
0	61.5
100	75.4
300	92.3
600	100.0

2. Rework Problem 13 (a,b,c) in DPL, but now use the exponential utility curve below:

$$u(x) = s - t^{*}\exp(-x/\rho)$$

Risk tolerance ρ=$200k; s= 102.154726; t=43.27882905

Enter the value of the Risk Tolerance ρ in DPL directly. Notice that all nodes in the DPL Policy Tree will show CE (certain equivalents) and not EUV, and that DPL does not need the values for s and t for the exponential utility curve. (The values for s and t would have been needed if you had entered the exponential utility curve as an "objective function" in DPL to get EUV values at the nodes.) Again, make sure that the dollar units for the Risk Tolerance ρ that you enter in DPL ($ or $k) match the dollar units ($ or $k) that you used in the DPL model (decision tree).

Because of the "delta property" of the exponential utility curve, questions (b, c) do not require trial and error. Show clearly how you have obtained the answers (b, c) directly.

Diversion Tunnel for an Earthfill Dam

3. You are the contractor for an earthfill dam. You are required to construct a diversion tunnel to divert excess stream flow around the dam during the rainy season. The table below shows the choices for the capacity of the diversion tunnel and their estimated cost: (*Note*: A-ft = acre-foot = 1,233m^3; kA-ft =1,000 A-ft = 1,233,000 m^3)

Diversion Tunnel Alternative	Diversion Capacity (kA-ft)	Estimated Cost ($k)
T_1	80	100
T_2	100	130
T_3	120	160

You are not sure what available capacity the dam will have when the peak flow occurs, but you assess the probabilities of available capacity as:

	Avail. Dam Capacity (kA-ft)	P(C)
C_1	60	0.6
C_2	80	0.3
C_3	100	0.1

You assess the maximum possible demand upon the total (dam + diversion) capacity during the year to be:

	Demand (kA-ft)	P(D)
D_1	140	0.50
D_2	160	0.30
D_3	180	0.15
D_4	200	0.05

The dam will overflow if demand (D) exceeds diversion capacity (T) plus dam capacity (C). The amount of overflow is $X = \max\{D\text{-}T\text{-}C, 0\}$. The cost of overflow is given below:

	Overflow (kA-ft)	Cost of overflow ($k)
X_1	0	0
X_2	20	200
X_3	40	250
X_4	60	300

a. Based on expected monetary value, what size diversion tunnel should you construct?

b. Suppose that your utility curve is exponential (shown below) with risk tolerance ρ = \$150k. What size diversion tunnel should you construct?

$$u(x) = \frac{1-\exp(-(x-L)/\rho)}{1-\exp(-(H-L)/\rho)}, \text{ where } H = \$0,\ L = -\$400\text{k},\ \rho = \$150\text{k}$$

c. You have constructed an 80 kA-ft diversion tunnel (T_1) and the rainy season is approaching. You can tell by now that the available dam capacity will be at the 80 kA-ft level (C_2). You can set up a rainfall gauge network at a cost of \$10,000 (including recording and reporting costs). You estimate that if the stream flow (i.e., demand) will be greater than 160 kA-ft (which would lead to an overflow), the network will predict same with probability 0.8. You also estimate that if demand will be up to 160 kA-ft (which would not lead to an overflow), the network will predict same with probability 0.9. Early warning will allow you to excavate an emergency trench at a cost of \$20,000 which would reduce the cost of overflow to \$40,000[**]. If the dam overflows and there is no emergency trench, your latest estimate for the overflow cost is \$250k.

   Should you install the early warning network if you are risk-neutral?

   Note: Make sure that the end-node monetary values for your decision tree include the cost of \$100k for the construction of the 80 kA-ft diversion tunnel.[***]

d. Repeat part (c) using your exponential utility curve.

[**] You do not have the alternative of excavating the trench without the early warning network because this would delay work throughout the season (since the timing of this emergency would not be known).

[***] In general, all end-node monetary values for the decision tree in (c) and (d) must include the \$100k for the cost of constructing the 80 kA-ft diversion tunnel because the utility curve given in (b) measures costs (reductions in wealth) relative to your asset position before the construction of the 80 kA-ft diversion tunnel.
Because the given utility curve for this problem is exponential, however, one could argue that the "delta property" makes it unnecessary to add the constant cost of \$100k to all the end-node monetary values. Nevertheless, for this problem you should include the cost of \$100k in your calculations of the monetary values of all end-node values (so that your modeling approach would be general and valid even for a non-exponential utility curve).