ME 615: Design under Uncertainty

Prof Hoyle, Spring 2020

HW 4

Assigned: 5/7/2020

Due: 5/27/2020 (on CANVAS)

1. You are indifferent between receiving *A* for sure and a lottery that gives you *B* with a probability of 0.9 and *C* with a probability of 0.1. You are also indifferent between receiving *A* for sure and a lottery that gives you *B* with a probability of 0.7 and *D* with a probability of 0.3. Your preferences satisfy the von N-M axioms:
    - If the utility of B = 1 and your utility for C is 0, then what are your utilities for A and D?

2. For the Motor Design problem, use the **Monte Carlo** method to compare the **expected utility** of **two** different motor designs. Use the following uncertain parameters:
    - D ~ N(7.5, 0.5)
    - L ~ N(9.5, 0.5)
    - dcu ~ N(8.94e3, 100)
    - dfe ~ N(7.98e3, 100)

    Use the exponential forms in the slides and assume a risk aversion coefficient of 10, a "high" value of 40 and a "low" value of 2. In this problem, assume you prefer *less weight.*

    A new **MotorDesignHW4** .m file is provided: In the file the two designs can be accessed by changing setting nargout=1 (the original motor design) and nargout=2 (a new motor design). The new motor design will have some probability that the weight is less than 0, which doesn't have any physical meaning, so treat this design as a mathematical exercise.

    *Which design has higher **expected utility**?*

3. Repeat problem 2 but use the **FFNI** (i.e. Gaussian quadrature) method using **3 nodes**:
    - D ~ N(6.5, 0.5)
    - L ~ N(11.5, 0.5)
    - dcu ~ N(8.94e3, 100)
    - dfe ~ N(7.98e3, 100)

    *Which design has higher **expected utility**? If you were to compare motor designs 1 and 2 as a risk neutral decision maker, which one would be preferred (use your above FTNI solution)?*

4. Redo problem 3 but use the Robust Design formulation in which CE = $\mu + \sigma^2/2\rho$ and the FTNI method (**use 5 nodes**):
    - D ~ N(6.5, 0.5)
    - L ~ N(11.5, 0.5)
    - dcu ~ N(8.94e3, 100)
    - dfe ~ N(7.98e3, 100)

    Compare the CE equivalents from both problems 3 and 4—how do they differ?