STAT535: Statistical Computing **Fall 2020**

Lab 2: Company Valuation

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Objective This problem set will introduce you to probabilistic valuation of a company. The goal is to put a valuation on the company based on a sequence of uncertain future events.

Collaboration You will work on this lab in class and you may extend it for your final project.

1. **Net Present Value**

   The standard evaluation of net present value of a company is

   $$NPV = B_0 - C_0 + \sum_{k=1}^{K} \frac{B_k - C_k}{(1+\delta_k)^k}$$

   where B_k is the dollar benefit in the kth period, C_k is the dollar cost in the kth period, and δ_k is the discount rate in period k.

   (a) What kind of data structure might you use to store B, C and δ?

   (b) Write a function using your data structures that returns the net present value.

2. **Expected Net Present Value** When there is uncertainty as to the future cash flows, we need some way of computing an expected net present value. If we take the expectation of the net present value formula, we get

   $$\begin{aligned} E[NPV] &= E\left[B_0 - C_0 + \sum_{k=1}^{K} \frac{B_k - C_k}{(1+\delta_k)^k}\right] \\ &= B_0 - C_0 + \sum_{k=1}^{K} \frac{E[B_k] - E[C_k]}{(1+\delta_k)^k} \end{aligned}$$

   (a) When computing expected net present value, we only need to know the expected value of C_k and B_k. What is the (numerical) difference between the standard net present value and the expected net present value?

   (b) There is a hidden assumption about the independence (or lack thereof) between B_k and C_k. What is it?

   (c) Assume that B_k and C_k are independent random variables. What is the expression for the variance of the net present value?

3. **Probabilistic Net Present Value**

   (a) Suppose that B_k is always a Bernoulli random variable. How might you represent the parameters of the random variable? Note, you need to store both the benefit amounts and the probability of the benefits.

(b) Using the data structure you selected, write function to compute the expected net present value.

4. **Probabilistic Net Present Value**

The actual net present value after K periods may be very different than the expected value and we would like some way of capturing our uncertainty in the outcome.

(a) Write function that chooses one of the two possible outcomes of the Bernoulli benefit at each period and returns the net present value.

(b) Run this function N (perhaps 100) times and record the net present value.

(c) Plot a histogram of the net present values.

(d) As extra credit think about what the expected net present value might be if δ_k is random. How might you compute the expected net present value with a random δ_k?