

Business Decision Analytics under Uncertainty

Spring 2017, Professor Eckstein

Homework 3

Due Wednesday, February 15

Show your work for each problem.

Q1: Baking Cookies

Problem 1(a) on pages 177-178 of the textbook. Do not answer parts (b)-(c).

Q2: Supplying a Remote Outpost

Your firm operates a remote mining outpost in coastal Alaska. The outpost is supplied once per year by ship and more frequently by aircraft. Over the 20 years the outpost has been in operation, the number of canisters of de-icing fluid the outpost uses per year has followed the distribution below:

Canisters	Probability
0	5%
1	5%
2	10%
3	20%
4	25%
5	20%
6	10%
7	5%

The canisters cost \$40 each to purchase from the manufacturer. There are two ways to send the canisters to the outpost: first, they may be put on the annual supply ship at a transportation cost of \$15 each. If the outpost runs out of canisters before the next supply ship arrives, more may be sent in by air at a transportation cost of \$50 each. At the end of the year, all canisters at the outpost must be shipped back, whether they have been used or not, because they only have a limited shelf life. The return transportation is by the return voyage of the annual supply ship and costs \$5 per canister, whether the canister has been used or not. Unused canisters, even if they are at the end of their shelf life, are accepted back by the manufacturer for a \$20 credit each.

To minimize your average cost per year, how many canisters should you send on the annual supply ship?

Q3: Health Flexible Spending Accounts

Some proposals for replacing the Affordable Care Act (“Obamacare”) rely on an existing mechanism called health flexible spending accounts (FSA’s). At the beginning of the year, you decide how much money to put in an FSA. This money is deducted from your wages before taxes, thus reducing your tax payments. However, if you do not use all the money in the FSA by the end of the year, it reverts to your employer. A person who earns between \$37,950 and

\$91,900 per year after deductions is in the 40.5% federal tax bracket (15.5% for Social Security and Medicare, plus 25% for income taxes). Suppose such a person believes that their health care expenses are equally like to be \$1000, \$1500, \$2000, \$2500, \$3000, \$3500, \$4000, or \$4500 in the coming year. To maximize the expected benefit from their FSA, how much should they contribute to it?

Hint: to calculate G and L , focus on the net effect on the person's bank account at the end of the year if (for G) they contribute one extra dollar to their FSA and are able to spend it, and (for L) they contribute one extra dollar to their FSA and it reverts to their employer.

Q4: Medication Stocks

Tucson General Hospital sometimes has to treat people bitten by rattlesnakes. In the past 15 years, they have observed the following numbers of rattlesnake-bite cases:

Year	Number of Cases
2001	4
2002	8
2003	9
2004	2
2005	3
2006	4
2007	12
2008	8
2009	4
2010	3
2011	5
2012	10
2013	11
2014	6
2015	7

At the beginning of each year, the hospital has the opportunity to pre-order anti-venom kits at cost of \$350 each. Treating each snake-bite case requires one anti-venom kit. The kits expire after one year, after which any unused kits must be disposed of at a cost of \$10 each. If the hospital runs out of pre-ordered anti-venom kits before the end of the year, it may immediately obtain a functionally equivalent packet of medications from a local pharmacy, but the cost is \$500 per case treated.

Assuming the past data presented above are representative of the number of snake-bite cases that may be expected in the future, how many anti-venom kits should the hospital pre-order each year?