Operations Analytics MOOC: Practice Problems for Week 4

1. Power Cycle

Power Cycle makes meters that gauge the speed and power with which cyclists ride their bikes. An electronic sensor, connected to the bicycle's pedal, communicates via Bluetooth to the rider's iPhone or Android phone.

Power Cycle buys the device's Bluetooth interface from an outside vendor that has offered the following terms. 1) The vendor will deliver 50,000 interfaces to *Power Cycle* 60 days from now. 2) *Power Cycle* has the option to buy another 50,000 interfaces for delivery 120 days from now. 3) If it wants to buy the 2nd set of 50,000 interfaces, *Power Cycle* must let the supplier know at least 30 days before delivery; that is, by 90 days from now. 4) *Power Cycle* will pay £5 per unit for the interfaces.

The supplier incurs a fixed cost of £125,000 for each production run, plus a per-unit cost – for materials, labor and energy – of £2 for each interface produced. The manufacturer believes that there is a 60% chance that *Power Cycle* will request the 2nd set of 50,000 interfaces, and it wants to decide which of the following options it should choose: 1) Enter into the contract, produce 50,000 units now, and produce a 2nd set of 50,000 units only if *Power Cycle* requests them. 2) Enter into the contract, produce 100,000 units now, and bear the risk that *Power Cycle* does not reorder. If the supplier chooses option 2 and *Power Cycle* orders only 50,000 units in total, the leftover 50,000 units will have no salvage value for the supplier.

a) Structure the supplier's choices using a decision tree. Make sure you explicitly define all of the elements of the tree: decisions, events, cash flows and probabilities associated with decisions and events, and payouts associated with the final outcomes.

b) What are the maxi-min, maxi-max, and expected value maximizing decisions for the supplier? What are the monetary values associated with those choices?

2. Cygnet Health Care

Cygnet Corporation offers health insurance policies that reimburse policy holders for their medical expenses. The amount the policy pays a policy holder depends on the total dollar value of the medical claims s/he files in a given year.

Consider how reimbursement of annual medical claims works for the following example policy.

- If annual claims fall below a fixed *deductible* limit of $1,000, the policy holder receives nothing. For example, a policy holder with $800 of annual claims would receive nothing from Cygnet and would have to pay the entire $800.

- Annual claims beyond the $1,000 deductible limit are reimbursed at 100%. For example, a policy holder with $2,500 of annual claims would pay only the first $1,000 of claims, and Cygnet would pay the remaining $1,500 in claims that exceed the $1,000 deductible.

Cygnet sells the example policy, above, for $2,000.

Noah must decide whether or not to buy Cygnet's insurance policy. If he buys the policy he will be responsible for paying at most $1,000 in medical expenses over the coming year. If he does not buy the insurance, however, he will have to pay 100% of his medical expenses for the coming year.

Suppose that Noah believes his annual medical expenses will have the following distribution for the coming year

- With probability 0.3 he will have medical expenses that are less than $1,000. In this case, he expects his expenses to average $500 for the year.
- With probability 0.7 he will have medical expenses that are more than $1,000. In this case, he expects his expenses to average $4,000 for the year.

a) Structure Noah's choices using a decision tree. Make sure you explicitly define all of the elements of the tree: decisions, events, cash flows and probabilities associated with decisions and events, and payouts associated with the final outcomes.

b) What are Noah's maxi-min, maxi-max, and expected value maximizing decisions? What are the dollar values associated with those choices?