MGT 239 I SOLUTION

Shortcuts

1(a). In 2.13 (see p74, HW2, HW3, `2-13.xls`), replace the number of claims by the number of manufacturers who place orders, and change the distributions correspondingly.

1. (b), (c): newsvendor model (see lecture III, and `mgt239_3nw.xls` on iLearn).

2: Exercise 4 (see `MGT239_EXE4_LongGao.xls` on iLearn, replace the production cost term by a fixed cost term.

Formulation

1. (a) Let N be the number of manufacturers who place orders in a period. Then N follows Binomial distribution, $N \sim Binormial(n = 10, p = 0.7)$. The total daily demand D is then given by

$$D = \sum_{i=1}^{N} D_i, \tag{1}$$

where $N \sim Binomial(10, 0.7)$, and $D_i \sim U[1, 10]$. The Excel implementation is similar to `2-13.xls` of 2.13(p74).

(b) and (c): Use newsvendor model. Let overage cost $C_o = 10$, underage cost $C_u = 2$, base stock level $Q = 50$. Then the daily total cost is given by

$$TC(Q, D) = C_o \max(0, Q - D) + C_u \max(0, D - Q),$$

where D is defined by Eq (1). The Excel implementation then follows `mgt239_3nw.xls`.

2. Consider a period t. Let x_t be the initial inventory, y_t the inventory level *after production*, $p = 20$ fixed production cost, and $C_o = 4$ and $C_u = 12$ be the overage and shortage cost, respectively. According to (s, S) policy, the system initiates production and incurs fixed production cost only if $x_t \le s$, i.e., $\mathbb{I}(x_t \le s)$. The system state is defined by (x_t, y_t). Then system dynamics (recursion) are

$$x_t = \max(0, y_{t-1} - D_{t-1}), \tag{2}$$

$$y_t = S \cdot \mathbb{I}(x_t \le s) + x_t \cdot \mathbb{I}(x_t > s). \tag{3}$$

Total cost of period t under (s, S) policy is

$$TC_t(y_t, D_t, x_t; s, S) = p \cdot \mathbb{I}(x_t \le s) + C_o \cdot \max(0, y_t - D_t) + C_u \cdot \max(0, D_t - y_t). \tag{4}$$

Total cost over T periods demand path $D = \{D_t : t = 1, \ldots, T\}$ under (s, S) policy is

$$TC(D, x_1; s, S) = \sum_{t=1}^{T} TC_t(y_t, D_t, x_t; s, S) \tag{5}$$

The objective for a given S is to find optimal stock level s such that the expected total cost is minimized:

$$\min_{0 \le s \le S} \quad \mathbb{E}[TC(D, x_1; s, S)] \tag{6}$$

The Excel implementation then follows `MGT239_EXE4_LongGao.xls`.