1 ...

\[ q^* = \sqrt{\frac{2KD}{n}} = \sqrt{\frac{2(80)(5000)}{3}} = 516.4 \text{ gal} \]

1 month shelf life \( \Rightarrow \frac{5000}{12} = 416.66 \text{ gal demanded over shelf life.} \Rightarrow q^* \Rightarrow 416.66 \)

let \( q_d^* \) = EOQ with better facility and \( h = 6 \) (doubled)

\[ = \sqrt{\frac{2(80)(5000)}{6}} = 365.15 < 833.3 \text{ gal demand over 2 month shelf life.} \]

Old storage facility:

\[ \text{TC}(416.66) = (12)(80) + (3)(1/2)(416.66) = 1585 \]

Better storage facility:

\[ \text{TC}(365.15) = \sqrt{2KDh} = \sqrt{(2)(80)(5000)(6)} = 2191 \]

Therefore, order 1 month supply = 416.66, and store in old facility.

2 ...

let \( q \) = amount planned for monthly expenses (i.e., not invested)

\[ 100,000 - q = \text{amount invested} \]

monthly interest = \( (24/12)\% = 2\% \)

\( d \sim \text{Normal: } \mu=6000/\text{mo. } \sigma=2000/\text{mo.} \)
\[ d \leq q: \text{ expenses met from amount planned} \]
\[
\text{cost } (d, q) = -0.02 (100,000 - q) \\
= 0.02q - 2000 \\
\therefore c_0 = 0.02
\]

\[ d > q: \text{ } d - q \text{ must be withdrawn from investment to cover expenses.} \]
\[
\text{cost } (d, q) = 0.04 (d - q) - 0.02 (100,000 - d) \\
= -0.04q + 0.06d - 2000 \\
\therefore c_u = 0.04
\]

\[
P\left(\frac{q^* - 6000}{2000}\right) = \frac{c_u}{c_0 + c_u} = \frac{0.04}{0.06} = 0.667 \rightarrow z^* = 0.43
\]

\[ \therefore q^* = 6000 + (0.43)(2000) = 6860 \rightarrow \text{invest 93140/mo.} \]

\[ 3... \]

(a) \[
P(z) = 1 - \frac{Rh}{c_B} = 1 - \frac{\left(\frac{1}{12}\right)(10)}{100} = 0.9917 \rightarrow z = 2.395
\]
\[
S = D(R + L) + z\sigma_{R+L} \\
= (600)\left(\frac{1}{6}\right) + (2.395)\sqrt{\frac{(400)^2}{6}} = 491.1
\]
\[ \rightarrow \text{safety stock = 391.1} \]

(b) \[ \bar{L} = 1 \text{ mo. } \var(L) = 0.8 \quad \sigma^2_R = \frac{(400)^2}{12} = 13,333 \]
\[
\sigma^2_L = \bar{L} \var(D) + E(D)^2 \var(L) = \frac{1}{12}(400)^2 + (600)^2(0.8) = 301,333 \\
\sigma_L = 549
\]
\[
\sigma^2_{R+L} = \sigma^2_L + \sigma^2_R = 301,333 + 13,333 = 314,666 \\
\sigma_{R+L} = 561
\]
\[
S = 100 + (2.395)(561) = 1443.5
\]

SScost(part a) = (391.1)(10) 
SScost(part b) = (1343.5)(10)
ΔSScost = (1343.5 – 391.1)(10) = $9523.78/yr.

\[ (c) \quad NL(z) = \frac{\overline{DR}(1 - SLM)}{\sigma_{R+L}} = \frac{600 \left( \frac{1}{12} \right) \cdot 0.01}{163.3} = 0.003063 \rightarrow z = 2.36 \]

Note: safety stock = \( z \sigma_{R+L} \).

\therefore \text{since } z \text{ is lower here, not as much protection is offered.}