4.2.4

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(a)

$$E[X] = E[I] * E[B] = 500$$
$$Var(X) = E[I] * Var(B) + E[B]^2 * Var(I) = 2.25 \times 10^6$$

(b)

$$VaR_{0.5}(X) = VaR_{\frac{0.5-(1-q)}{q}}(B) = 0$$
$$TVaR_{0.5}(X) = \frac{E[X]}{1-0.5} = 1000$$

(c)

$$VaR_{0.99}(X) = VaR_{\frac{0.95-(1-q)}{q}}(B) = 7489.3306839 \text{Voir annexe qour la VaR de B.}$$
$$\begin{aligned} TVaR_{0.99}(X) &= \frac{q * TVaR_0.99(B)}{1-0.99} \\ &= q * \frac{e^{-\beta * VaR_{0.99}(X)} * (E[B] + VaR_{0.99}(X))}{1-k} \\ &= \frac{\bar{F_X}(VaR_0.99(K))}{1-k} * (E[B] + VaR_{0.99}(X)) \\ &= \frac{1-k}{1-k}(E[B] + VaR_{0.99}(X)) \\ &= E[B] + VaR_{\frac{0.99-(1-q)}{q}}(B), \text{ pour } k > q \\ &= 9989.3306839 \end{aligned}$$

```
VaR <- function(k) ifelse((1-q) > k, 0 , qexp((k-(1-q))/q,b))
TVaR <- function(k) VaR(k)+1/b
```

(d)

$$S_{TOT} \sim BinComp(n = 3, q, F_B)$$
$$\begin{aligned} TVaR_{0.99}(S_{TOT}) &= \frac{1}{1-k} \sum_{i=1}^{3} P(M = i) * \frac{i}{\beta} * \bar{H}(VaR_{0.99}(S_{TOT}), i+1, \beta) \\ &= 1.451071 \times 10^4 \end{aligned}$$

```
TVaR_S <-
    function(k)
    sum(sapply(seq(3), function(i)
    dbinom(i, 3, q) * i / b * (1 - pgamma(11658.566, i + 1, b)))) / (1 - k)
```