3.4.9
(a) $m_X(s) = E(e^{sX}) = \int_0^{10} e^{sx}(1/10)dx = (1/10)(e^{10s} - 1)/s$ for $s \neq 0$, with (of course) $m_X(0) = 1$.
(b) For $s \neq 0$, $m'_X(s) = (1/10)(s(10e^{10s}) - (e^{10s} - 1))/s^2$. We then compute using L'Hôpital's Rule (twice) that $m'_X(0) = \lim_{s\to\infty} m'_X(s) = 5 = E(X)$.

3.4.21 The mgf of the Poisson(λ_i) equals $m_i(s) = \exp\{\lambda_i(e^s - 1)\}$. Then the mgf of $Y = X_1 + \cdots + X_n$ is given by (Theorem 3.4.5)

$$m_Y(s) = \prod_{i=1}^{n} m_i(s) = \prod_{i=1}^{n} \exp\{\lambda_i(e^s - 1)\} = \exp\left\{\sum_{i=1}^{n} \lambda_i(e^s - 1)\right\}$$

and we recognize this as the mgf of the Poisson($\sum_{i=1}^{n} \lambda_i$). Therefore, the uniqueness theorem implies that this is the distribution of Y.

3.6.2 Since $X \geq 0$, $P(X \geq 3) \leq E(X)/3 = (1/5)/3 = 1/15$.

3.6.10
(a) $E(W) = \int_{R^1} wf(w)dw = \int_0^1 w(3w^2)dw = 3w^4/4\big|_{w=0}^{w=1} = 3/4$.
(b) $E(W^2) = \int_0^1 w^2(3w^2) = 3w^5/5\big|_{w=0}^{w=1} = 3/5$. Thus, $\text{Var}(W) = 3/5 - (3/4)^2 = 3/80$. Hence, the Chebyshev's inequality bound is $3/5$ because $P(|W - E(W)| \geq 1/4) \leq \text{Var}(W)/(1/4)^2 = (3/80)/(1/16) = 3/5$.

3.6.18
(a) We have that $\int_1^\infty (2/x^3)\, dx = -x^{-2}\big|_1^\infty = 1$, so f_X is a density.
(b) $E(X) = \int_1^\infty x\,(2/x^3)\, dx = \int_1^\infty (2/x^2)\, dx = -2x^{-1}\big|_1^\infty = 2$.
(c) Markov's inequality says that $P(X \geq k) \leq E(X)/k = 2/k$, while the precise value is $P(X \geq k) = \int_k^\infty (2/x^3)\, dx = -x^{-2}\big|_k^\infty = 1/k^2$, and we see that the tail probability declines quadratically, while Markov's inequality only declines linearly.
(d) We have that $E(X^2) = \int_1^\infty x^2\,(2/x^3)\, dx = \int_1^\infty (2/x)\, dx = -2\ln x\big|_1^\infty = \infty$. Therefore, $\text{Var}(X) = \infty$ and Chebyshev's inequality does not provide a useful bound in this case.