3.7.44 $F_X(x) = \int_0^x \frac{t}{2} dt = \frac{x^2}{4}$. $F_Y(y) = \int_0^y 2t\, dt = y^2$

$$F_{X,Y}(x, y) = F_X(x)F_Y(y) = \frac{x^2 y^2}{4}, 0 \le x \le 2, 0 \le y \le 1$$

3.8.2 $f_{X+Y}(w) = \int_{-\infty}^{\infty} f_X(x) f_Y(w-x)dx = \int_0^w (xe^{-x})(e^{-(w-x)})dx = e^{-w}\int_0^w x\,dx = \frac{w^2}{2}e^{-w},\ w \geq 0$

3.9.14 From Question 3.9.3, we have $E(X + Y) = E(X) + E(Y) = 5/9 + 11/18 = 21/18 = 7/6$

$$E[(X+Y)^2] = \int_0^1\int_0^1 (x+y)^2 \frac{2}{3}(x+2y)dxdy$$

$$= \frac{2}{3}\int_0^1\int_0^1 (x^2+2xy+y^2)(x+2y)dxdy = \frac{2}{3}\int_0^1\int_0^1 (x^3+2x^2y+xy^2+2x^2y+4xy^2+2y^3)dxdy$$

$$= \frac{2}{3}\int_0^1\int_0^1 (x^3+4x^2y+5xy^2+2y^3)dxdy = \frac{2}{3}\int_0^1 \left(\frac{1}{4}x^4+\frac{4}{3}x^3y+\frac{5}{2}x^2y^2+2xy^3\right)\Bigg|_0^1 dy$$

$$= \frac{2}{3}\int_0^1 \left(\frac{1}{4}+\frac{4}{3}y+\frac{5}{2}y^2+2y^3\right)dy = \frac{2}{3}\left(\frac{1}{4}+\frac{4}{6}+\frac{5}{6}+\frac{2}{4}\right) = \frac{3}{2}$$

Then $\text{Var}(X+Y) = E[(X+Y)^2] - E(X+Y)^2 = \frac{3}{2} - \left(\frac{7}{6}\right)^2 = \frac{5}{36}$

3.9.8 Let X_1 = number showing on face 1; X_2 = number showing on face 2. Since X_1 and X_2 are independent, $E(X_1X_2) = E(X_1)E(X_2) = (3.5)(3.5) = 12.25$.