D

$$Ex_1x_3 = \int_0^1\int_0^1 x_1x_3(9x_1^2x_3^2)\,dx_1dx_3$$

$$Ex_1x_3 = \int_0^1\int_0^1 9x_1^3x_3^3\,dx_1dx_3$$

$$Ex_1x_3 = 9\int_0^1 \frac{1}{4}x_3^3\,dx_3$$

$$Ex_1x_3 = 9\cdot\frac{1}{4}\int_0^1 x_3^3\,dx_3$$

$$Ex_1x_3 = \frac{9}{4}\cdot\frac{1}{4}$$

$$\boxed{Ex_1x_3 = \frac{9}{16} = 0.5625}$$

E

$$\frac{\text{joint}}{\text{marginal}} = \frac{A}{C}$$

$$\frac{81x_1^2x_2^2x_3^2x_4^2}{9x_1^2x_3^2} = 9x_2^2x_4^2$$

$$P\left(x_2 > \frac{3}{4},\ x_4 < \frac{1}{2} \,\middle|\, x_1 = \frac{1}{3},\ x_3 = \frac{2}{3}\right)$$

$$\int_0^{1/2}\int_{3/4}^{1} 9x_2^2x_4^2\,dx_2dx_4$$

$$9x_4^2\int_0^{1/2}\left[\frac{1}{3}x^3\right]_{3/4}^{1} \longrightarrow \frac{1}{3} - \frac{1}{3}\cdot\left(\frac{3}{4}\right)^3 = .192$$

$$9(.192)\int_0^{1/2} x_4^2\,dx_4$$

$$9(.192)\left[\frac{1}{3}x^3\right]_0^{1/2} \rightarrow \frac{1}{3}\cdot\frac{1}{8} = .042$$

$$9(.192)(.042) = 0.072$$

$$\boxed{P\left(x_2 > \frac{3}{4},\ x_4 < \frac{1}{2} \,\middle|\, x_1 = \frac{1}{3},\ x_3 = \frac{2}{3}\right) = 0.072}$$