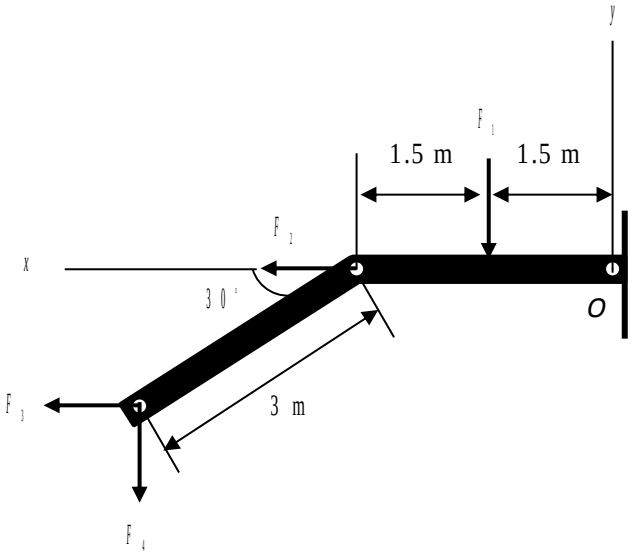
14. Four forces act on the rod, and they are independently distributed with normal distributions $F_1 \sim N(40, 2^2)$ N , $F_2 \sim N(50, 3^2)$ N , $F_3 \sim N(25, 3^2)$ N , and $F_4 \sim N(60, 5^2)$ N . Determine the distribution of the resultant moment about point *O*.



Solution

$$M_o = \Sigma Fd = F_1 d_1 + F_2 d_2 + F_3 d_3 + F_4 d_4$$

$$\mu_{M_o} = \mu_{F1} d_1 + \mu_{F_2} d_2 + \mu_{F_3} d_3 + \mu_{F_4} d_4$$
$$= 40(1.5) + 50(0) - 25(3\sin 30^\circ) + 60(3 + 3\cos 30^\circ) = 358.38 \text{ N.m}$$

$$\sigma_{M_o} = \sqrt{\left(\sigma_{F1} d_1\right)^2 + \left(\sigma_{F_2} d_2\right)^2 + \left(\sigma_{F_3} d_3\right)^2 + \left(\sigma_{F_4} d_4\right)^2}$$
$$= \sqrt{2^2(1.5)^2 + 3^2(3\sin 30^\circ)^2 + 5^2(3 + 3\cos 30^\circ)^2} = 28.51$$

Thus, the distribution of the resultant moment about point *O* is $M_O \sim N(358.38, 28.51^2)$ N.m.