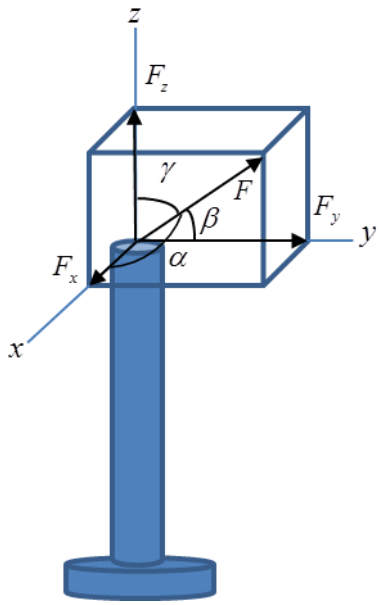
5. The force F applied to a pole has components acting along the x, y, z axes. If the distribution of the magnitude of F follows a normal distribution $N(5, 0.2^2)$ kN, and $\beta = 40^\circ$ and $\gamma = 65^\circ$. Determine the distributions of the magnitudes of its three components.



Solution

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

For $\beta = 40^\circ$ and $\gamma = 65^\circ$, the above equation is

$$\cos^2\alpha + \cos^2 40^\circ + \cos^2 65^\circ = 1$$

We get $\alpha = 61.03^\circ$

$$F_x = F\cos\alpha$$

$$F_y = F\cos\beta$$

$$F_z = F\cos\gamma$$

For $F \sim N(5, 0.2^2)$ kN, we have

$$\mu_{F_x} = \mu_F \cos\alpha = 5\cos 61.03^\circ = 2.42 \text{ kN}$$
$$\sigma_{F_x} = \sigma_F \cos\alpha = 0.2\cos 61.03^\circ = 0.1 \text{ kN}$$
$$\mu_{F_y} = \mu_F \cos\beta = 5\cos 40^\circ = 3.83 \text{ kN}$$

$$\sigma_{F_y} = \sigma_F \cos\beta = 0.2\cos 40^\circ = 0.15 \text{ kN}$$

$$\mu_{F_z} = \mu_F \cos\gamma = 5\cos 65^\circ = 2.11 \text{ kN}$$

$$\sigma_{F_z} = \sigma_F \cos\gamma = 0.2\cos 65^\circ = 0.08 \text{ kN}$$

Thus, we can conclude

$$F_x \sim N(2.42, 0.1^2) \text{ kN}$$ **Ans.**

$$F_y \sim N(3.83, 0.15^2) \text{ kN}$$ **Ans.**

$$F_z \sim N(2.11, 0.08^2) \text{ kN}$$ **Ans.**