48. A torsion $T \sim N(8, 0.8^2)$ kN·m is applied to a bar having a hollow round cross section with an inner diameter of $d_i = 2$ cm. The allowable stress of the bar is $\tau_a \sim N(20, 2^2)$ MPa. If the maximum probability of failure is designed to be $p_f = 10^{-5}$, determine the minimum outer diameter of the bar using the First Order Second Moment Method. Note that T and τ_a are independent.

Answer: $d_{min} = 157.7$ mm, $d_{preferred} = 160$ mm