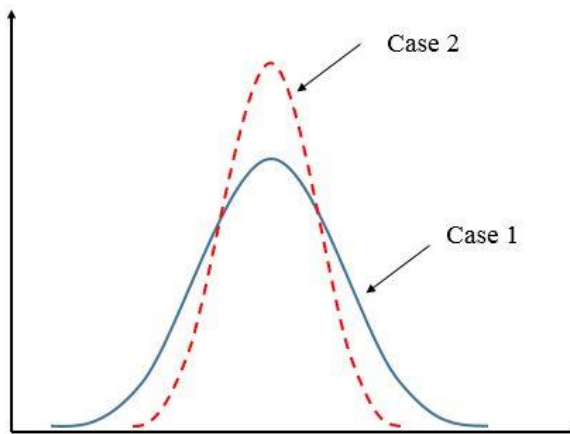


Exam 1

Please put your answers in the following table.

1	2	3	4	5	6	7	8	9	10

1. The standard deviation is always non-negative. (true or false)
2. Six components failed out of 1000 manufactured components, determine the reliability of the components.
 - A. 0.006
 - B. 0
 - C. 1
 - D. 0.994
3. The factor of safety is defined by $n_s = \mu_{S_y} / \mu_S$, where μ_{S_y} and μ_S are the means of yield strength S_y and stress S , respectively. Denote σ_{S_y} and σ_S as the standard deviations of S_y and S , respectively. The reliability is defined by $R = P\{S_y > S\}$. Which of the following statements is not true to improve reliability?
 - A. Keep n_s constant, and increase σ_{S_y} and σ_S .
 - B. Keep σ_{S_y} and σ_S constant, and increase n_s .
 - C. Keep n_s constant, and decrease σ_{S_y} and σ_S .
 - D. Keep n_s constant, and decrease σ_{S_y} .
4. Two cases are shown for the normally distributed stress of a component. Which case has probability of failure?



- A. Case 1
- B. Case 2
- C. Equal probability
- D. Cannot determine

5. A hollow tube has an inside diameter of $d_i \sim N(20, 0.3^2)$ mm and an outside diameter of $d_o \sim N(25, 0.4^2)$ mm. What is the distribution of the thickness t of the tube?
- A. $t \sim N(45, 0.5^2)$ mm
 B. $t \sim N(5, 0.5^2)$ mm
 C. $t \sim N(5, 0.7^2)$ mm
 D. $t \sim N(5, 0.25^2)$ mm
6. The length of a shaft is $L \sim N(5, 0.01^2)$ in. What is the $\Pr\{5 - 0.02 < L < 5 + 0.02\}$?
- A. 0.9545
 B. 0.9973
 C. 0.6827
 D. 0.9999
7. A circular rod with a diameter of $d \sim N(\mu_d, \sigma_d^2)$ is subjected to a tensile force $P \sim N(\mu_P, \sigma_P^2)$. The yield strength of the rod is S_y . If the reliability of the rod is defined by the probability $R = P\{S_y > \frac{4P}{\pi d^2}\}$, which of the following actions cannot improve the reliability?
- A. Do not change d and decrease μ_P
 B. Do not change P and increase μ_d
 C. Do not change P and increase σ_d
 D. Do not change P and decrease σ_d
8. For the above problem, if the limit-state function is defined by $g = S_y - \frac{4P}{\pi d^2}$, and denote μ_g and σ_g as the mean and standard deviation of g , respectively. Which of the following statements is true?
- A. The larger is μ_P , the larger is μ_g
 B. The larger is S_y , the larger is σ_g
 C. The smaller is S_y , the larger is σ_g
 D. The larger is S_y , the larger is μ_g
9. A cylindrical part is loaded by an axial force P , causing a stress of $S \sim N(20, 2^2)$ MPa. The modulus of elasticity is $E = 200$ GPa. What is the mean and standard deviation of the normal strain ϵ ?
- A. $\mu_\epsilon = 0.1, \sigma_\epsilon = 0.01$
 B. $\mu_\epsilon = 0.1, \sigma_\epsilon = 0.1$
 C. $\mu_\epsilon = 0.1, \sigma_\epsilon = 0.001$
 D. $\mu_\epsilon = 0.1, \sigma_\epsilon = 0.0001$
10. For problem 9, if the allowable strain is $\epsilon_a = 0.12$, what is the probability of failure?
- A. $\Phi(20)$
 B. $\Phi(-2)$
 C. $\Phi(2)$
 D. $\Phi(-20)$