Quiz 2

Please put your answers in the following table.

1	2	3	4	5	6	7	8	9	10

1. If X follows a normal distribution with mean μ_X and standard deviation σ_X, which transformation changes X to a standard normal random variable?

A) $Z = \dfrac{X}{\sigma_X}$

B) $Z = \dfrac{X - \mu_X}{\sigma_X}$

C) $Z = \dfrac{X + \mu_X}{\sigma_X}$

D) $Z = \dfrac{X - \mu_X}{2\sigma_X}$

2. If X and Y are independent and c is a positive constant, which of the following statement about the standard deviation is not true?

A) $\sigma(X+Y) = \sigma(X) + \sigma(Y)$
B) $\sigma(c) = 0$
C) $\sigma(X+c) = \sigma(X) + c$
D) $\sigma(cX) = c\sigma(X)$

3. A bar is measured 10 times, and the measured lengths are given below.

99.8
85.0
106.5
108.5
91.2
119.3
119.3
104.5
108.9
107.1

The average of the length is

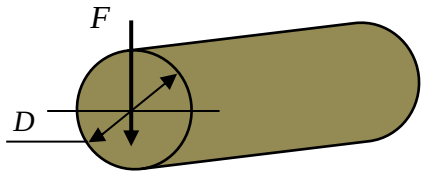
A) 90.2 mm B) 105 mm C) 95 mm C) 110.1 mm

4. For problem 3, the standard deviation of the length is

A) 10.9 mm
B) 20.1 mm
C) 5.6 mm
D) 0.8 mm

5. A rod has a diameter D = 2.4 in. It is subjected to a shear force of $F \sim N(5, 0.5^2)$ kip. If the allowable shear stress is $\tau_a \sim N(2.5, 0.2^2)$ ksi, which statement is not true? Assume that τ_a and F are independent.

(**Hint:** The first moment of the cross section area at the neutral axis: $Q = \overline{y}'A'$, in which $\overline{y}' = \frac{2D}{3\pi}$, and $A' = \frac{\pi r^2}{2}$)

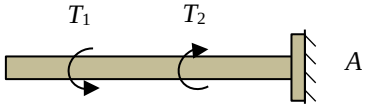


A) The shear stress follows a normal distribution.
B) The mean value of the shear stress is a linear function of that of *F*.
C) The standard deviation of the shear stress is a linear function of that of *F*.
D) The shear stress depends on τ_a.

6. For problem 5, what is the probability of failure of the rod?

A) 0
B) $\Phi(-4.131)$
C) $\Phi(-3.517)$
D) $\Phi(-2)$

7. A shaft has an outer diameter of 32 mm and an inner diameter of 20 mm. Two torques T_1 and T_2 are applied to the shaft. If $T_1 \sim N(80, 5^2)$ Nm and $T_2 \sim N(40, 4^2)$ Nm, which statement about the maximum shear stress developed in the shaft is true? Assume that T_1 and T_2 are independent.



A) τ_{max} follows a normal distribution.
B) τ_{max} is a linear function of T_1.

C) $\tau_{\max}$ is a linear function of T_2.

D) The mean of $\tau_{\max}$ is 25 MPa.

8. For problem 7, if the allowable shear stress is $\tau_a \sim N(15, 2^2)$ MPa , τ_a , T_1 , and T_2 are independent, what is the probability of failure of the shaft?

A) $\Phi(0)$

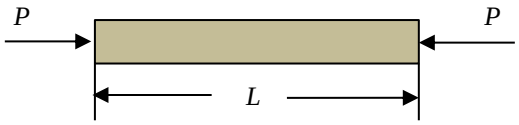
B) $\Phi(-3.304)$

C) $\Phi(-4.512)$

D) $\Phi(-1.057)$

9. A rod is subject to two forces as shown below. The rod is 16 in. long and its diameter is $d = 0.5\,\text{in}$. The yield strength of the rod is $S_y = 50\,\text{ksi}$. The modulus of elasticity follows a normal distribution $E \sim N\left(29\times10^3, (3\times10^3)^2\right)\text{ksi}$. The forces also follow a normal distribution $P \sim N(2, 0.2^2)\,\text{kip}$. Which statement about the critical buckling force P_{cr} is not true? Assume that S_y and are P are independent.

(**Hint:** the critical buckling force : $P_{cr} = \dfrac{\pi^2 EI}{(KL)^2}$, in which $I = \dfrac{\pi d^4}{64}, K = 1$)



A) P_{cr} follows a normal distribution.

B) P_{cr} and E are dependent.

C) The mean of P_{cr} is 3.42 kip.

D) The standard deviation of P_{cr} is 0.41kip.

10. For problem 9, find the probability of failure of the rod caused by buckling.

A) 0.5

B) $\Phi(-2.58)$

C) $\Phi(-3.46)$

D) $\Phi(-4.72)$