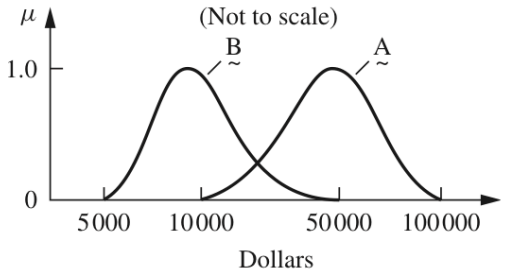
Q1. In determining corporate profitability, many construction companies must make decisions based upon the particular client's spending habits, such as the amount the client spends and their capacity for spending. Many of these attributes are fuzzy. A client which spends a "large amount" is considered to be "profitable" to the construction company. A "large" amount of spending is a fuzzy variable, as is a "profitable" return. These two fuzzy sets should have some overlap, but they should not be defined on an identical range.

$$\underset{\sim}{A} = \{\text{"large" spenders}\}.$$

$$\underset{\sim}{B} = \{\text{"profitable" clients}\}.$$

For the two fuzzy sets shown in Figure , find the following properties graphically:

(a) $\underset{\sim}{A} \cup \underset{\sim}{B}$: all clients deemed profitable or who are large spenders.
(b) $\underset{\sim}{A} \cap \underset{\sim}{B}$: all clients deemed profitable and large spenders.
(c) $\overline{\underset{\sim}{A}}$ and $\overline{\underset{\sim}{B}}$: those clients (i) deemed not profitable and (ii) deemed not large spenders (separately).
(d) $\underset{\sim}{A} | \overline{\underset{\sim}{B}}$: entities deemed profitable clients, but not large spenders.
(e) $\overline{\underset{\sim}{A} \cup \underset{\sim}{B}} = \overline{\underset{\sim}{A}} \cap \overline{\underset{\sim}{B}}$ (De Morgan's principle).



Q2. Consider a local area network (LAN) of interconnected workstations that communicate using Ethernet protocols at a maximum rate of 10 Mbit s^{-1}. Traffic rates on the network can be expressed as the peak value of the total bandwidth (BW) used, and the two fuzzy variables, "Quiet" and "Congested," can be used to describe the perceived loading of the LAN. If the discrete universal set $X = \{0, 1, 2, 5, 7, 9, 10\}$ represents BW usage, in megabits per second, then the membership functions of the fuzzy sets Quiet $\underset{\sim}{Q}$ and Congested $\underset{\sim}{C}$ are as shown in Figure P2.12.

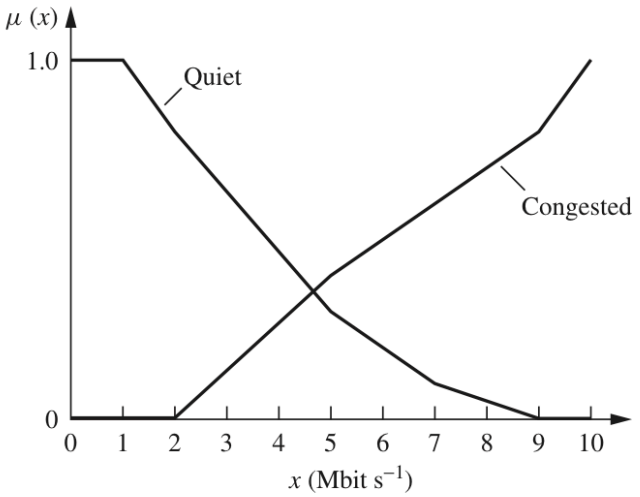


FIGURE P2.12

For these two fuzzy sets, graphically determine the union, intersection, complement of each, difference $\underset{\sim}{Q} | \underset{\sim}{C}$, and both De Morgan's principles.

Q3. Typical membership functions for laminar and turbulent flow for a flat plate with a sharp leading edge in a typical air stream are shown in Figure P2.1. Transition between laminar and turbulent flow usually takes place between Reynolds numbers of 2×10^5 and 3×10^6. An $Re = 5 \times 10^5$ is usually considered the point of turbulent flow for this situation. Find the intersection, union, and the difference for the two flows. And, find the complement of laminar flow.

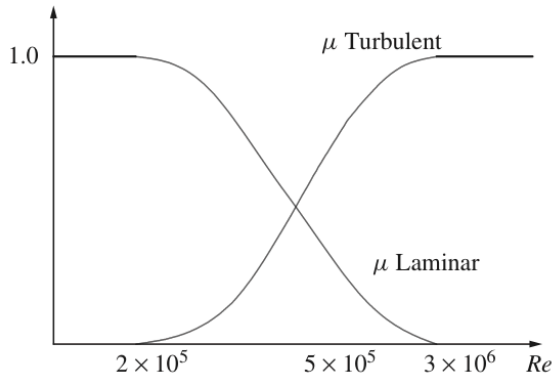


FIGURE P2.1