Problem-Solving 3

1. You are faced with the problem of controlling a motor that is subjected to a variable load. The motor must maintain a constant speed, regardless of the load placed on it; therefore, the voltage applied to the motor must change to compensate for changes in load. Define fuzzy sets for motor speed (rpm) and motor voltage (volts) as follows:

    A = "motor speed OK" = 0.3/20 + 0.6/30 + 0.8/40 + 1/50 + 0.7/60 +0.4/70

    B = "motor voltage nominal" = 0.1/1 + 0.3/2 + 0.8/3 + 1/4 + 0.7/5 +0.4/6 + 0.2/7

    A fuzzy inference rule is as follows:

    IF motor speed is OK, THEN motor voltage is nominal.

    Now consider the actual fact is A' = "motor speed a little slow", where
    A' = 0.4/20 + 0.7/30 + 1/40 + 0.6/50 + 0.3/60 +0.1/70 . Find the conclusion B'.

2. Consider the two triangular-shape fuzzy numbers A and B

    $$A(x) = \begin{cases} 0 & \text{for } x \leq -1 \text{ and } x > 3 \\ \dfrac{x+1}{2} & \text{for } -1 < x \leq 1 \\ \dfrac{3-x}{2} & \text{for } 1 < x \leq 3 \end{cases} \qquad B(x) = \begin{cases} 0 & \text{for } x \leq 1 \text{ and } x > 5 \\ \dfrac{x-1}{2} & \text{for } 1 < x \leq 3 \\ \dfrac{5-x}{2} & \text{for } 3 < x \leq 5 \end{cases}$$

    Determine the arithmetic operations of $(A/B)(x)$.

3. Consider the fuzzy rule: if X is P then Y is Q

    The fuzzy sets P and Q are given by

    $P = 0.2/x_1 + 0.6/x_2 + 1/x_3 + 0.6/x_4 + 0.2/x_5$
    $Q = 0.5/y_1 + 0.7/y_2 + 1/y_3$

    For a fuzzy input of A = $1/x_1$ + $0.7/x_2$ + $0.5/x_3$ + $0.3/x_4$ + $0.1/x_5$, apply the rule of fuzzy inference to find the output fuzzy set of the system.

4.   A FKBC system contains the following two rules:

if x is A_1 and y is B_1 then z is C_1
if x is A_2 or y is B_2 then z is C_2

the fuzzy sets A_1, A_2, B_1, B_2, C_1 and C_2 are defined by

$A_1 = 1/x_1 + 0.9/x_2 + 0.1/x_3$
$B_1 = 1/y_1 + 0.4/y_2 + 0.2/y_3$
$C_1 = 0.5/z_1 + 1/z_2 + 0.2/z_3$
$A_2 = 0.4/x_1 + 1/x_2 + 0.3/x_3$
$B_2 = 0.2/y_1 + 0.9/y_2 + 1/y_3$
$C_2 = 1/z_1 + 0.5/z_2 + 0.1/z_3$

Given the input fuzzy set $A' = 0.3/x_1 + 0.6/x_2 + 1/x_3$ and $B' = 0.2/y_1 + 1/y_2 + 0.4/y_3$, determine the output fuzzy set F of the system.