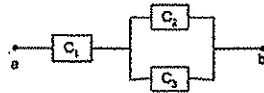


### Hands-On Problem

- For the RBD called RBD-Ex1, use the following four methods to calculate the system reliability
  - I/E based on minimal cut-sets
  - SDP based on minimal cut-sets
  - I/E based on minimal path-sets
  - SDP based on minimal path-sets



- Assume that the probability of occurrence for each of the basic events (the failure of the component  $C_i$ ) is:  
 $\Pr\{C_1\} = 0.1, \Pr\{C_2\} = 0.2, \Pr\{C_3\} = 0.3$

minimal cut-sets:

$$K_1 = \{1\}$$

$$K_2 = \{2, 3\}$$

minimal path-sets:

$$P_1 = \{C_1, C_2\} = \{1, 2\}$$

$$P_2 = \{1, 3\}$$

① I/E based on minimal cut-sets

$$\begin{aligned} U_{sys} &= \Pr\{K_1 \cup K_2\} \\ &= \Pr\{K_1\} + \Pr\{K_2\} - \Pr\{K_1 \cap K_2\} \\ &= \Pr\{C_1\} + \Pr\{C_2\} \cdot \Pr\{C_3\} - \Pr\{C_1 \cap C_2 \cap C_3\} \\ &= 0.1 + 0.2 \times 0.3 - 0.1 \times 0.2 \times 0.3 \\ &= 0.1 + 0.06 - 0.006 = 0.154 \end{aligned}$$

② SDP based on minimal cut-sets.

$$\begin{aligned} U_{sys} &= \Pr\{K_1 \cup K_2\} \\ &= \Pr\{K_1\} + \Pr\{\bar{K}_1 \cap K_2\} \\ &= \Pr\{C_1\} + \Pr\{\bar{C}_1 \cap C_2 \cap C_3\} \\ &= 0.1 + (1-0.1) \times 0.2 \times 0.3 \\ &= 0.1 + 0.054 = 0.154 \end{aligned}$$

\*  $C_i$  in cut-sets denotes the failure of component  $C_i$

③ I/E based on minimal path-sets

$$\begin{aligned} R_{sys} &= \Pr\{P_1 \cup P_2\} \\ &= \Pr\{P_1\} + \Pr\{P_2\} - \Pr\{P_1 \cap P_2\} \\ &= \Pr\{C_1 \cap C_2\} + \Pr\{C_1 \cap C_3\} - \Pr\{C_1 \cap C_2 \cap C_3\} \\ &= (1-0.1) \times (1-0.2) + 0.9 \times 0.7 - 0.9 \times 0.8 \times 0.3 \\ &= 0.9 \times 0.8 + 0.63 - 0.504 \\ &= 0.846 \end{aligned}$$

④ SDP based on path-sets

$$\begin{aligned} R_{sys} &= \Pr\{P_1 \cup P_2\} \\ &= \Pr\{P_1\} + \Pr\{\bar{P}_1 \cap P_2\} \\ &= \Pr\{C_1 \cap C_2\} + \Pr\{\bar{C}_1 \cap C_2 \cap C_3\} \\ &= \Pr\{C_1\} \times \Pr\{C_2\} + \Pr\{\bar{C}_1 \cap C_2 \cap C_3\} \\ &= 0.9 \times 0.8 + 0.2 \times 0.9 \times 0.7 \\ &= 0.72 + 0.126 \\ &= 0.846 \end{aligned}$$

\*  $C_i$  in path-sets denotes the success / function of component  $C_i$