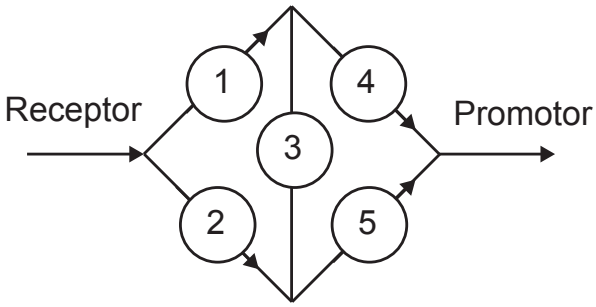
A. Two fair dice are rolled, one after the other.

i. Let E_6 be the event that the sum of the dice is 6. Let F_4 be the event that the first die is 4. Are these two events independent?

ii. Let E_7 be the event that the sum of the dice is 7. Let F_4 be the event that the first die is 4. Are these two events independent?

iii. Let E_i be the event that the sum of the dice is i. Let F_j be the event that the first die is j. For what values of i and j are these two events independent?

B. Consider a simple protein-protein interaction network with a receptor, five proteins numbers 1 to 5, and a gene promotor. You have determined that the proteins interact according to the figure below. In a population of cells, you find that each protein has a probability p_i of being functionally active in a given cell, where $i = 1, 2, 3, 4, 5$. A functional signal transduction requires at least one complete path



from the membrane receptor (R) to the transcription factor (TF). Protein P3 can interact bidirectionally with both P2 and P4 (acting as a scaffold protein). Assume that the proteins are active independently of each other. Calculate the probability that signal transduction occurs successfully in this network.