Assignment1: Probability

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Exercise 1.4 (Chained Production Elements)

An apparatus consists of six elements A, B, C, D, E, F. Assume the probabilities $P(b_X)$, that element X breaks down, are all stochastically independent, with $P(b_A) = 5\%, P(b_B) = 10\%, P(b_C) = 15\%, P(b_D) = 20\%, P(b_E) = 25\%$ and $P(b_F) = 30\%$.

1. Assume the apparatus works if and only if at least A and B are operational, C and D are operational, or E and F are operational. What is the probability the apparatus works?

   $work = \neg((b_A \vee b_B) \wedge (b_C \vee b_D) \wedge (b_E \vee b_F)) \Rightarrow$
   $P(work) = 1 - (P(b_A) + P(b_B)) \cdot (P(b_C) + P(b_D)) \cdot (P(b_E) + P(b_F)) = 0.971125$

2. Consider a different scenario, in which the elements A and C, D and F and B and E are pairwise linked; such that if either of them breaks down, then the linked element is not operational either. What is the probability that the apparatus works now?

   $work = \neg(((b_A \vee b_C) \vee (b_B \vee b_E)) \wedge ((b_C \vee b_A) \vee (b_D \vee b_F)) \wedge ((b_E \vee b_B) \vee (b_F \vee b_D))) \Rightarrow$

   $$\begin{aligned} P(work) = 1 - &(P(b_A) + P(b_C) + P(b_B) + P(b_E)) \cdot (P(b_C) + P(b_A) + P(b_D) + P(b_F)) \cdot \\ &(P(b_E) + P(b_B) + P(b_F) + P(b_D)) = 0.67275 \end{aligned}$$