Probability

Reliability Analysis| Conditional Probability

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Reliability analysis

- **Reliability analysis** is the branch of engineering concerned with **estimating the failure rates of systems**.
- While some problems in reliability analysis require advanced mathematical methods, there are many problems that can be solved with the methods we have learned so far.
- We begin with an example illustrating the computation of the reliability of a system consisting of **two components connected in series**

Example - 01

- A system contains **two components, A and B, connected in series** as shown in the following diagram. The system will **function only if both** components function. The probability that **A functions** is given by $\boldsymbol{P(A) = 0.98}$, and the probability that **B functions** is given by $\boldsymbol{P(B) = 0.95}$. Assume that **A and B function independently**.

Find the probability that the system functions.

Example - 01

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Find the probability that the system functions.

$\mathrm{P(system\ functions)} = P(A \cap B)$

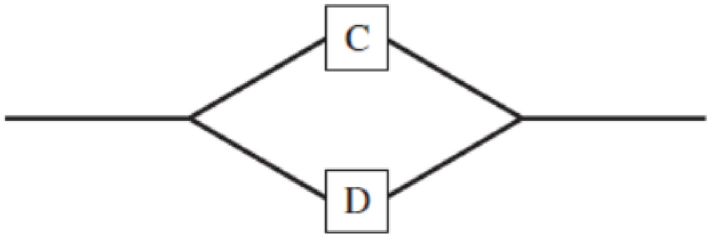
$= P(A)P(B)$ by the assumption of independence

$= (0.98)(0.95)$

$= 0.931$

Example - 02

- A system contains **two components, C and D**, connected in **parallel** as shown in the following diagram.
- The system will **function if either C or D functions**. The probability that **C functions is 0.90**, and the probability that **D functions is 0.85**. **Assume C and D function independently**.



Find the probability that the system functions.

Example - 02

- P(system functions) = $P(C \cup D)$

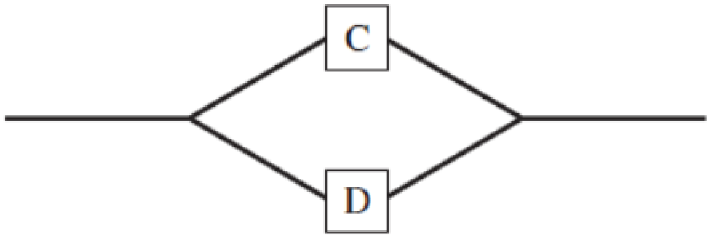
$= P(C) + P(D) - P(C \cap D)$

$= P(C) + P(D) - P(C)P(D)$

by the assumption of independence

= 0.90 + 0.85 – (0.90)(0.85)

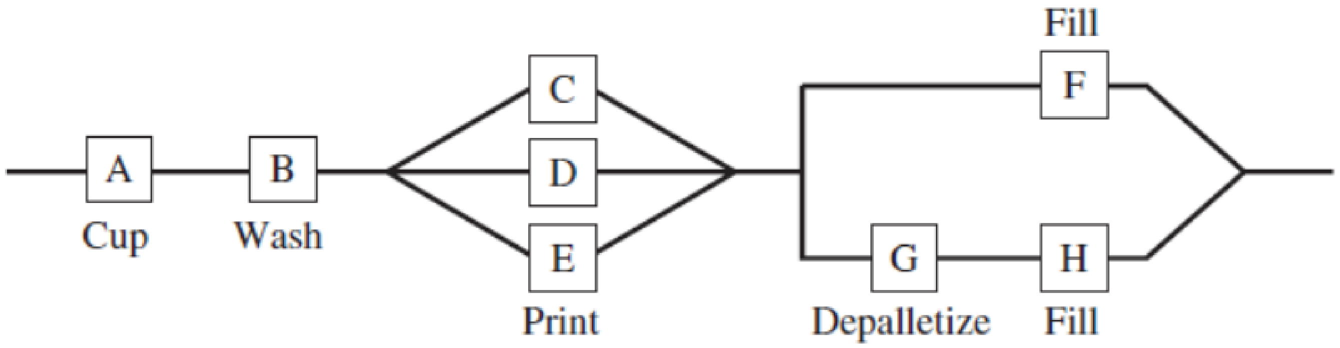
= 0.985



Note

- The reliability of more complex systems can often be determined by **decomposing** the system into a **series of subsystems**, each of which contains components connected either **in series or in parallel**

Example 03



- A production method used in the manufacture of aluminum cans. The following schematic diagram, slightly simplified, depicts the process
- Since this component is denoted by "A" in the diagram, we will express this probability as $\boldsymbol{P(A) = 0.995}$. Assume that the other process components have the following probabilities of functioning successfully during a one-day period: $P(B) = 0.99$, $P(C) = P(D) = P(E) = 0.95$, $P(F) = 0.90$, $P(G) = 0.90$, $P(H) = 0.98$. Assume the components **function independently**.

Find the probability that the process functions successfully for one day

References

- Statistics for Engineers and Scientists, Fourth Edition, William Navidi Colorado School of Mines
- Khan Academy