Assignment 1
AI1110: Probability and Random Variables

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12.13.6.15 : Question. An electronic assembley consists of two subsystems,say A and B.From previous testing procedures, the following probabilities are assumed to be known:
$\Pr(A\ fails)$=0.20
$\Pr(B\ alone\ fails)$=0.15
$\Pr(A\ and\ B\ fails)$=0.15
Evaluate the following probabilities
(i) $\Pr(A\ fails\ given\ B\ has\ failed)$
(ii) $\Pr(A\ fails\ alone)$
ans:
$\Pr(A\ fails\ given\ B\ has\ failed)$= 0.50
$\Pr(A\ fails\ alone)$=0.05
Solution:
let:
A represent when subsystem A works
Similary **B** represent when subsystem B works
Given in question,
Probability that **A** fails $\Pr(\mathbf{A}') = 0.20$
Probability that **B** fails alone $\Pr(\mathbf{AB}')$=0.15
Probability that both **A** and **B** fail $\Pr(\mathbf{A}'\mathbf{B}')$=0.15
Now to find,
Probability that both **A** fails given **B** has failed $\Pr(\mathbf{A}'|\mathbf{B}')$ and Probability that **A** fails alone $\Pr(\mathbf{BA}')$
To obtain $\Pr(\mathbf{A}'|\mathbf{B}')$
we know that,

$$\Pr(\mathbf{A}'|\mathbf{B}') = \Pr(\mathbf{A}'\mathbf{B}') / \Pr(\mathbf{B}') \tag{1}$$

to obtain $\Pr(\mathbf{B}')$
let us use $\Pr(\mathbf{AB}')$ and $\Pr(\mathbf{A}'\mathbf{B}')$
we know that,

$$\Pr(\mathbf{B}') = \Pr(\mathbf{AB}') + \Pr(\mathbf{A}'\mathbf{B}') \tag{2}$$
$$= 0.15 + 0.15 \tag{3}$$
$$\Pr(\mathbf{B}') = 0.30 \tag{4}$$

now we have $\Pr(\mathbf{B}')$ we can find $\Pr(\mathbf{A}'|\mathbf{B}')$

$$\Pr(\mathbf{A}'|\mathbf{B}') = 0.15/0.30 \tag{5}$$
$$\Pr(\mathbf{A}'|\mathbf{B}') = 0.50 \tag{6}$$

similiarly,
To obtain $\Pr(\mathbf{BA}')$ we have to use $\Pr(\mathbf{A}'\mathbf{B}')$ and $\Pr(\mathbf{A}')$
we know that,

$$\Pr(\mathbf{BA}') = \Pr(\mathbf{A}') - \Pr(\mathbf{A}'\mathbf{B}') \tag{7}$$
$$= 0.20 - 0.15 \tag{8}$$
$$\Pr(\mathbf{BA}') = 0.05 \tag{9}$$