Total Probability Rule

state of nature in mechanical shop:

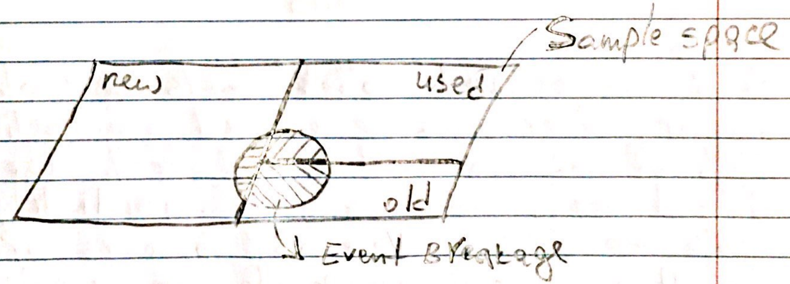
$Pr(\text{new tool}) = 0.5$
$Pr(\text{used tool}) = 0.3$
$Pr(\text{old tool}) = 0.2$

Prior probabilities

Then, we observed breakage in the shop and found out that 5% of brakage accounts for new tools, 15% of breakage accounts for used tools and 40% of breakage accounts for old tools.

$Pr(\text{Break}/\text{new}) = 0.05$
$Pr(\text{Break}/\text{used}) = 0.15$
$Pr(\text{Break}/\text{old}) = 0.4$

Likelyhood



$$Pr(\text{Breakage}) = Pr(\text{new} \cap \text{Break}) + Pr(\text{used} \cap \text{Break}) + Pr(\text{old} \cap \text{Break}) =$$

$$= Pr(\text{Break}/\text{new}) \times Pr(\text{new}) + Pr(\text{Break}/\text{used}) \times Pr(\text{used}) + Pr(\text{Break}/\text{old}) \times Pr(\text{old}) =$$

$$= (0.05 \times 0.5) + (0.15 \times 0.3) + (0.4 \times 0.2) = 0.15$$

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Bayes' Theorm

Pr(Breakage) → we call it an evidence.
or
Preposterior

In Bayesian Probability we try to find Posterior probability. When additional information becomes available (in this case the tool Breakage), we can update our Prior beliefs.

$$Pr(old/Breakage) = \frac{Pr(Breakage/old) \times Pr(old)}{Pr(Breakage)} =$$

$$= \frac{0.4 \times 0.2}{0.15} = 0.53$$

Prior we believed 20% of tools were old. However, after breakage occured we believe that 53% of the time it is old tool. The proportion of old tools have changed immediately from 20% to 53%. Now 53% becomes prior probability. Thus, we can incorporate another evidence and update our prior believe each time we get new information.

Pr(Breakage | old) – Likelyhood
Pr(old) – Prior
Pr(Breakage) – Evidence or new information

Pr(old/Breakage) – Posterior probability.

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