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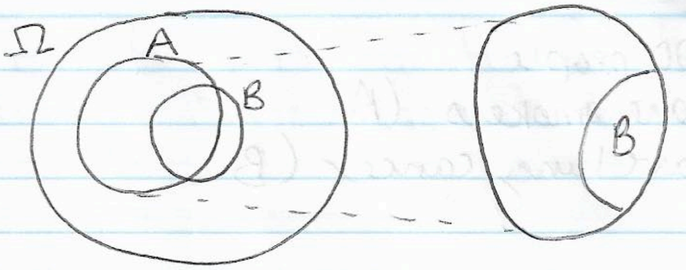
Smoking : $P(A) = .2$

lung cancer : $P(B) = .06$

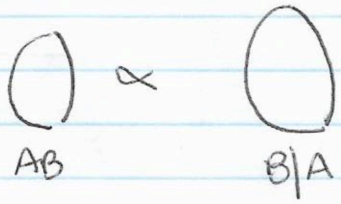
$P(AB) = .036$



$A = \Omega \subset \Omega$

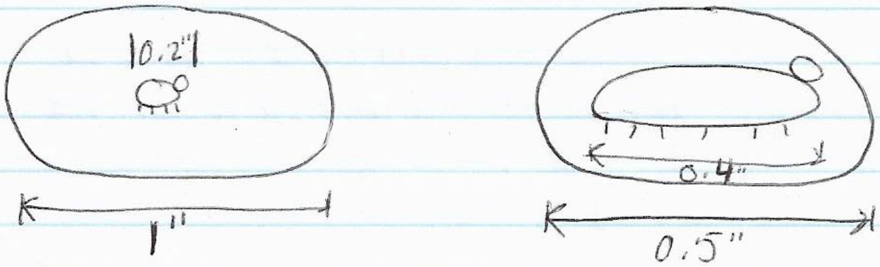
$P(\text{l.c. among smokers})$

$= P(B|A) \propto P(AB)$



$= \underline{\qquad\qquad} \; P(AB)$

zoom factor



zoom $= \dfrac{\text{original scope size}}{\text{new scope size}} = \dfrac{1''}{0.5''} = 2$

zoom factor : $\dfrac{P(\Omega)^{=1}}{P(A)} P(AB) = P(B|A)$

$$P(B|A) = \frac{P(AB)}{P(A)} = \frac{0.036}{0.2} = 0.18$$

Def. of Cond. Prob.

$\forall A$ s.t. $P(A) > 0$

$$\boxed{P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}}$$ Bayes Rule 1763

$$P(A|B) = \frac{(0.18)(0.2)}{0.06} = 0.6$$

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P(l.c. among non-smokers)

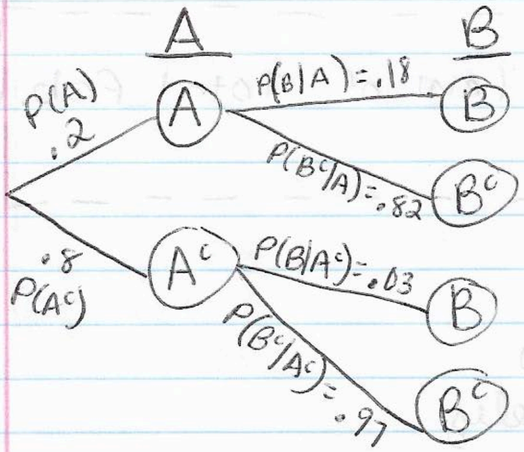
$$= P(B|A^c) = \frac{P(BA^c)}{\underbrace{P(A^c)}_{\substack{1-P(A) \\ 1-0.2=0.8}}} = \frac{0.024}{0.8} = 0.03$$

$$P(B) = P(AB \cup A^cB)$$
$$= P(AB) + P(A^cB)$$
$$\Rightarrow P(A^cB) = P(B) - P(AB)$$
$$= 0.06 - 0.036$$
$$= 0.024$$

Risk Ratio : $\dfrac{P(B|A)}{P(B|A^c)} = \dfrac{0.18}{0.03} = 6$ People who smoke are 6 times more likely to get lung cancer.

trivial questions: $P(A|A)$ $P(A|A^c)$

Probability Tree:

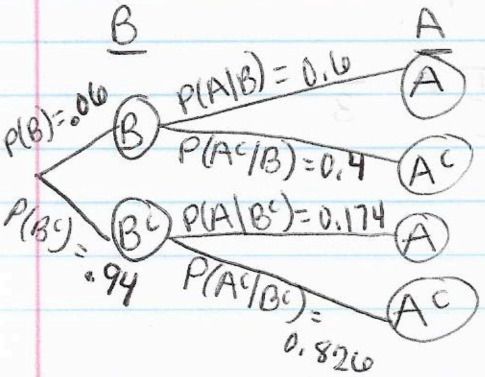


Joint Events

$P(AB) = 0.036$
$P(AB^c) = 0.164$
$P(A^cB) = 0.24$
$+\ P(A^cB^c) = 0.776$

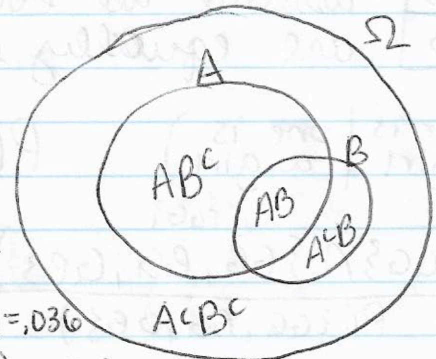
1

Tree Inversion:



Joint Events

$P(AB) = .036$
$P(A^cB) = .24$
$P(AB^c) = .164$
$P(A^cB^c) = .776$



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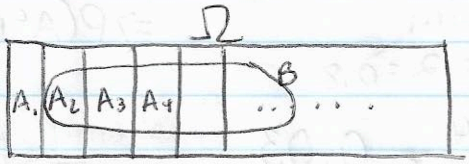
Thm. 7: If $A_1, A_2, A_3, \dots$ are mutually exc. and collectively exh. and $\exists$ event B



$P(B) = P(B \cap \Omega)$

$= P(B \cap (A_1 \cup A_2 \cup A_3 \cup \dots))$

$= P((B \cap A_1) \cup (B \cap A_2) \cup (B \cap A_3) \cup \dots)$

$(B \cap A_i) \cap (B \cap A_j)$

$= B \cap B \cap \underbrace{A_i \cap A_j}_{\emptyset}$ $\emptyset$ because mutually exclusive

$\Rightarrow P(B \cap A_1) + P(B \cap A_2) + \dots$

$$\boxed{P(B) = \sum_{i=1}^{\infty} P(BA_i) \quad \text{Law of Total Prob.}}$$

Two kids:

Ω

GG	GB
BG	BB

assume all events are equally likely

$P\left(\begin{matrix}\text{other is}\\ \text{a girl}\end{matrix} \middle| \begin{matrix}\text{one is}\\ \text{a girl}\end{matrix}\right)$ $\quad P(\{GG\} \mid \{GG, GB, BG\})$

$$P = \frac{(\overbrace{\{GG\} \cap \{GG, BG, GB\}}^{=\{GG\}})}{P(\{GG, BG, GB\})} = \frac{\frac{1}{4}}{\frac{3}{4}} = \frac{1}{3}$$

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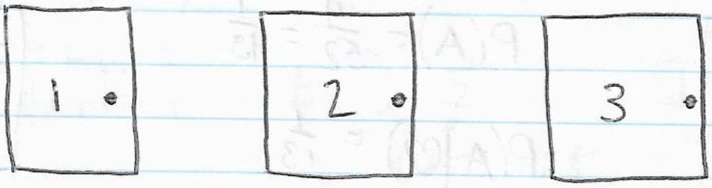
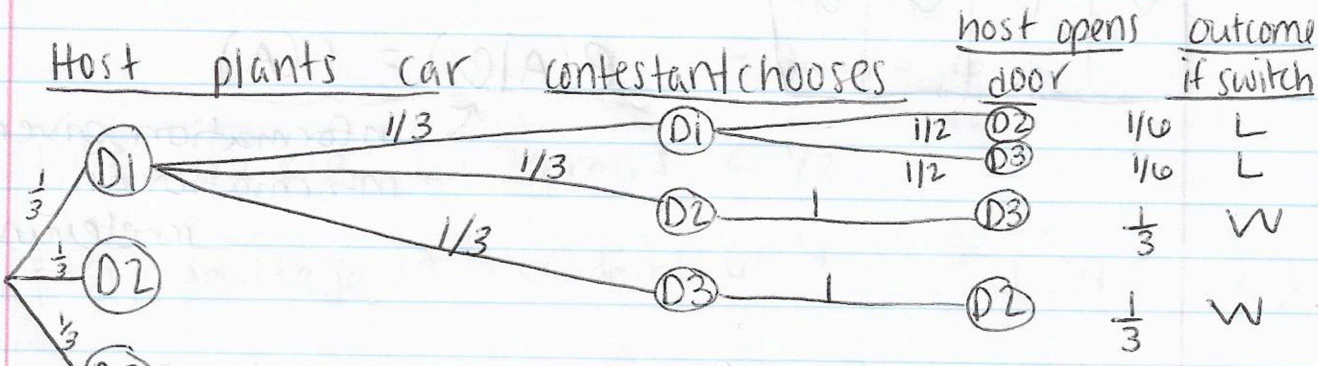

1
2
3


Host plants car
contestant chooses
host opens door
outcome if switch
D1
D2
D3
1/3
1/3
1/3
D1
D2
D3
1/3
1/3
1/3
1/2
1/2
1
1
D2
D3
D3
D2
1/6 L
1/6 L
1/3 W
1/3 W

$P(W) = 2/3$