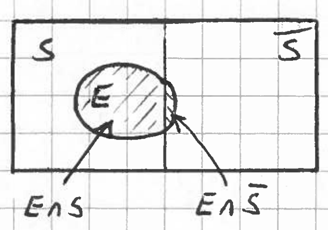
SMP

GA2: Ebola Outbreak



Events: E : Patient has ebola
S : Patient has symptoms

$Pr(S) = Pr(\bar{S}) = 0.5$

$Pr(E \cap S) = 0.2$; $Pr(E \cap \bar{S}) = 0.01$

1. $\underline{\underline{Pr(E)}} = Pr(E \cap S) + Pr(E \cap \bar{S}) = 0.2 + 0.01 = \underline{\underline{0.21}}$

2. $\underline{\underline{Pr(\bar{S}|E)}} = \dfrac{Pr(E \cap \bar{S})}{Pr(E)} = \dfrac{0.01}{0.21} = \underline{\underline{0.0476}}$

3. 10 patients: $5 \times S + 5 \times \bar{S}$

$Pr(\geq 1 \times E) = 1 - Pr(0 \times E) = 1 - Pr(10 \times \bar{E}) = 1 - Pr(5 \times \bar{E}|S) \cdot Pr(5 \times \bar{E}|\bar{S}) = 1 - Pr(\bar{E}|S)^5 \cdot Pr(\bar{E}|\bar{S})^5$

(uafh. handelser)

$Pr(\bar{E}|S) = 1 - Pr(E|S) = 1 - \dfrac{Pr(E \cap S)}{Pr(S)} = 1 - \dfrac{0.2}{0.5} = 0.6$

$Pr(\bar{E}|\bar{S}) = 1 - Pr(E|\bar{S}) = 1 - \dfrac{Pr(E \cap \bar{S})}{Pr(\bar{S})} = 1 - \dfrac{Pr(E \cap \bar{S})}{Pr(\bar{S})} = 1 - \dfrac{0.01}{0.5} = 0.98$

$Pr(5 \times \bar{E}|S) = Pr(\bar{E}|S)^5 = 0.6^5 = 0.07776$

$Pr(5 \times \bar{E}|\bar{S}) = Pr(\bar{E}|\bar{S})^5 = 0.98^5 = 0.90392$

$Pr(10 \times \bar{E}) = Pr(5 \times \bar{E}|S) \cdot Pr(5 \times \bar{E}|\bar{S}) = 0.07776 \cdot 0.90392 = 0.0703$

$\underline{\underline{Pr(\geq 1 \times E)}} = 1 - Pr(10 \times \bar{E}) = 1 - 0.0703 = \underline{\underline{0.9297}} \approx 93\%$

5. 1 has E: $\underset{(1)}{(1000000000)}, \underset{(2)}{(0100000000)}, \underset{(3)}{(0010000000)}, \underset{\dots}{\dots}, \underset{(10)}{(0000000001)}$ with equal probability

Average number of tests: $\underline{\underline{\bar{N}}} = 1 \cdot Pr(1) + 2 \cdot Pr(2) + 3 \cdot Pr(3) + \dots + 10\,Pr(10) = \sum_{k=1}^{10} k \cdot Pr(k)$

$= \sum_{k=1}^{10} k \cdot \frac{1}{10} = \frac{1}{10} \cdot \frac{10 \cdot 11}{2} = \frac{11}{2} = \underline{\underline{5.5}}$

7. 2 out of 10: $\underline{\underline{N_2^{10}}} = \binom{10}{2} = \dfrac{10!}{2!\,8!} = \dfrac{10 \cdot 9}{2} = \underline{\underline{45 \text{ combinations}}}$ (non-ordered)

8. $\underline{\underline{Pr(\text{select the } 2 \times E)}} = \dfrac{N_{succes}}{N_{all}} = \underline{\underline{\dfrac{1}{45} = 0.022}}$

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10. Number of new infected pr. day pr. infected : $p = 0.5$

Number of infected on day d : $N(d)$ $\quad (N(1) = 10 \cdot Pr(E) = 2.1)$

Number of infected on day $d+1$: $N(d+1) = p \cdot N(d) + N(d) = (p+1) \cdot N(d)$

Number of infected after x days : $N(1+x) = (p+1)^x \cdot N(1)$

Days to 100 infected : $N(1+x) = 1.5^x \cdot 2.1 = 100$

$$\Downarrow \underline{\underline{x}} = \frac{\ln(100/2.1)}{\ln(1.5)} = \underline{\underline{9.53 \text{ days}}}$$

Number of infected after 10 days : $N(1+10) = 1.5^{10} \cdot 2.1 = 121$ persons

11. $Pr(\geq 100 \text{ persons infected after } 10 \text{ days}) = \frac{N_{\geq 100}}{N_{sim.}}$

Matlab : N_{sim} = Total number of simulations

$N_{\geq 100}$ = Number of simulations giving 100 or more infected after 10 days.