#2.2. Sensitivity = specificity = 0.8

	Pos	Neg
True	0.8	0.2
False	0.2	0.8

$\therefore$ Odds ratio $= \dfrac{0.8\times 0.8}{0.2\times 0.2} = \dfrac{64}{4} = 16$ $\boxed{}$

#2.5

	Gun-Death	O-W
U.S	14.24	
Can	4.31	
Aus	2.65	
Ger	1.24	
Eng	0.41	

$RR_{Can/USA} = \dfrac{4.31}{14.24}$

$RR_{Aus/USA} = \dfrac{2.65}{14.24}$

$RR_{Ger/USA} = \dfrac{1.24}{14.24}$

$RR_{Eng/USA} = \dfrac{0.41}{14.24}$

$\rightsquigarrow$ Interp : All countries, have low RR for gun-Death compare to USA.

#2.8. (a) Odd ratio $= 11.4 \neq RR$

Such interpretation is for RR. ($\pi_1 = 11.4\pi_2$)

Correct interpretation is just female has 11.4 times "odds" for survival.

(b) Odds of survival for female $= 2.9$

$= \pi_{surv} / 1-\pi_{surv}$

$\therefore \pi_{surv} = \dfrac{2.9}{3.9} = 0.74$ (female)

$\dfrac{1}{11.4} = \underset{\text{ratio}}{\text{Odds}} = \dfrac{2.9}{\pi_{surv}} \Big/ \dfrac{3.9}{1-\pi_{surv}} = \dfrac{2.9\pi_{surv}}{2.9-2.9\pi_{surv}}$

$\boxed{}$

No.
year . month . day ( )

#2.11.

	Smokers	Non-smokers
Lung Cancer	0.0014	0.0010
Coronary	0.00669	0.00413

(a)

Condition →	L	C
S	$\frac{140}{809}$	$\frac{669}{809}$
N-S	$\frac{100}{513}$	$\frac{413}{513}$

$\Rightarrow$ Difference of prop $= \frac{140}{809} - \frac{100}{513}$

RR $= (140/809) / (100/513)$

Odds ratio $= \frac{[illegible]}{140 \times 413}$

(b) Odds ratio가 큰 것

(RR은 S가 N-S 대비 많이 L로 죽었는데 C는 관계 안기 어렵다

#2.14.

		Victim	D. W.
(a) Male	White	0.0049	$1-\pi_1$
	Non-white	0.0263	$1-\pi_2$
Female	White	0.0023	$1-\pi_3$
	Non-white	0.0072	$1-\pi_4$

$Odd_1 = 0.0138$

$Odd_2 = 0.3179$

Homogeneous X.

(b) (Same #)

White $\frac{(49+23)}{10000}$

Non-white $\frac{(263+72)}{10000}$

Odd = 38.

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#2.17.

		Yes	No
$s<20$	S	π_1	$1-\pi_1$
	N-S	π_2	$1-\pi_2$
$S>20$	S	π_3	$1-\pi_3$
	N-S	π_2	$1-\pi_2$

Odds ratio = 11.7

〃 = 26.1

$\frac{26.1}{11.7} \doteq 2.2$

$\boxed{\begin{array}{l} N-S = x\text{명} \\ S<20 = y\text{명} \\ S\geq 20 = z\text{명} \end{array}}$

$\frac{y\pi_1+z\pi_3}{y+z}$ $\quad 1-\left(\frac{\quad}{y+z}\right)$

$\pi_2 \quad 1-\pi_2$

$$= \frac{\left(\frac{y\pi_1+z\pi_3}{y+z}\right)\cdot(1-\pi_2)}{\pi_2 \cdot \frac{y+z-y\pi_1-z\pi_3}{y+z}} = \frac{(1-\pi_2)}{\pi_2}\cdot\frac{(y\pi_1+z\pi_3)}{(y+z)-y\pi_1-z\pi_3}$$

$$= \frac{1-\pi_2}{\pi_2}\cdot\frac{y\pi_1+z\pi_3}{y(1-\pi_1)+z(1-}$$

#2.20.

Victim	D	Y	N		
W	W	19	132	0.68.	< 1
	B	11	52		
B	W	0	9	0	< 1
	B	6	97		
Total	W.	19	141	1.18.	> 1
	B	17	149		

Simpson's parad[ox] occurs.

#2 23.

D : Having certain disease

E : " exposure to ~ factor

AR : proportion of disease attributable to that exposure

(a) Show $P(\bar{E}) = 1 - P(E)$

$AR = 1 - \frac{P(D|\bar{E})}{P(D)}$

$P(D)$ 중에 E 인데 걸린 자랑

(b)

	D	N-D
E		
N-E		

$\frac{P(D|E)}{P(E)}$

$\frac{P(D|\bar{E})}{P(\bar{E})}$

$\therefore RR = \frac{P(D|E)}{P(E)} \cdot \frac{P(\bar{E})}{P(D|\bar{E})}$

Given $AR + P(E)(RR-1) \cdot AR = P(E) \cdot (RR-1)$

$\Leftrightarrow P(E)(RR-1)(1-AR) = AR$

$\Leftrightarrow RR - 1 = \frac{AR}{1-AR} \cdot \frac{1}{P(E)}$

$\Leftrightarrow RR = 1 + \left(1 - \frac{P(D|\bar{E})}{P(D)}\right) \cdot \frac{1}{P(E)} \cdot \frac{P(D)}{P(D|\bar{E})}$

$= 1 + (P(D) - P(D|\bar{E})) \cdot \frac{1}{P(E) \cdot P(D|\bar{E})}$

$= \frac{(P(D|\bar{E})) \cdot (P(E) - 1) + P(D)}{P(E) \cdot P(D|\bar{E})}$

$= \frac{P(D) - P(\bar{E})P(D|\bar{E})}{}$

$= \frac{P(D) - P(D, \bar{E})}{}$

$= \frac{P(D) \cdot (1 - P(\bar{E}|D))}{}$

$RR = \frac{P(D|E)}{P(D|\bar{E})} \Leftarrow P(D)$

$P(E)(RR-1) = \frac{P(D|E)}{P(D|\bar{E})} - 1$

$= \frac{P(D|E) - P(D|\bar{E})}{P(D|\bar{E})} \cdot P(E)$

$\therefore RHS = \frac{\frac{P(D|E) - P(D|\bar{E})}{P(D|\bar{E})}}{1 + \frac{}{P(D|\bar{E})} \cdot P(E)}$

$= \frac{P(D|E) - P(D|\bar{E})}{P(D|E) + P(D|\bar{E})\cancel{P(E)} - }$

$P(E)($ $)$

#2.26.

		E_1	$\bar{E}_1$
E_3	E_2		
	$\bar{E}_2$		
$\bar{E}_3$	E_2		
	$\bar{E}_2$		

Think conditional RR.

& marginal RR

$\rightarrow$ Simpson's paradox.

$\boxed{///}$

#2.29

$n_1 \quad n_2 \quad \cdots \quad n_k \qquad \pi_1 \cdots \pi_k$

$m_1 \quad m_2 \quad \cdots \quad m_k \qquad p_1 \cdots p_k$

$\pi_1 > p_1$

$\vdots$

$\pi_k > p_k$,

$$\Rightarrow \frac{n_1\pi_1 + \cdots + n_k\pi_k}{n_1 + \cdots + n_k} \qquad \frac{m_1 p_1 + \cdots + m_k p_k}{m_1 + \cdots + m_k}$$

$$< \frac{m_1\pi_1 + \cdots + m_k\pi_k}{m_1 + \cdots + m_k}$$

		Hit	Not
year$_1$	S	1	99
	J	0	2
year$_2$	S	1	2
	J	49	51
$\vdots$			
year$_k$	S		
	J		

Simpson's paradox

S	2	101	$\Rightarrow$	$\frac{2}{101}$
J	49	53	$\Rightarrow$	$\frac{49}{102}$

$\boxed{///}$

#2.32. $$\frac{\pi_{ij}\,\pi_{IJ}}{\pi_{Ij}\,\pi_{iJ}} = \alpha_{ij}$$

① indep $\Rightarrow$ $\pi_{ij} = \pi_{i+} \cdot \pi_{j+}$

$$\Rightarrow \alpha_{ij} = \frac{\pi_{i+} \cdot \pi_{j+} \quad \pi_{I+}\pi_{J+}}{\pi_{I+}\pi_{j+} \quad \pi_{i+}\pi_{J+}} = 1$$

②

$$1 = \frac{\pi_{j|i} \quad \pi_{J|I}}{\pi_{J|i} \quad \pi_{j|I}}$$

#2.35. Pois ⇒ multi $(n = \sum n_i)$ 일때 생각하면 됨.

#2.38. $V(Y) = \sum \pi_{+j}(1-\pi_{+j}) = 1 - \sum \pi_{+j}^2$

(a)

	N_1	⋯	N_k
Y_1	π_{11}	⋯	π_{1k}
	⋮		⋮
Y_m	π_{m1}	⋯	π_{mk}
	π_{+1}		π_{+j} = 1

$\pi_{+j} = 1$ for some j ⇒

$\Rightarrow$ other $\pi_{+j} = 0$

$(\because \sum_j \pi_{+j} = 1)$ $\therefore V(Y) = 0$

Cauchy 최소값

$\Rightarrow \pi_{+j} = \frac{1}{J}$ 같은 값일때 Max

$\Rightarrow J \cdot \frac{1}{J} \cdot (1 - \frac{1}{J}) = \frac{J-1}{J} = V(Y)$ ▨

★ (b) $E(V(Y|X)) = \sum_i \pi_{i+} V(Y|i)$

$= \sum_i \left(\pi_{i+} \sum_j \pi_{ij}(1-\pi_{ij})\right)$

$= \sum_i \pi_{i+} \left(\sum_j \pi_{ij} - \pi_{ij}^2\right)$

$= \sum_i \pi_{i+} \left(\pi_{i+} - \sum_j \pi_{ij}^2\right)$

$= \sum_i \pi_{i+}^2 - \pi_{i+} \cdot \sum_j \pi_{ij}^2$

$= \sum_i \pi_{i+} (\pi_{i+} - \sum_j \pi_{ij}$

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