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DATE:

LEON MARCO A. DEVELA — ADVANCED MACHINE LEARNING

COM232 — EXERCISE 5

Dataset:

PERSON	HEIGHT (cm)	WEIGHT (kg)	r_{women}	r_{men}
A	158	52	0.98	0.02
B	162	56	0.95	0.05
C	166	60	0.99	0.00
D	175	72	0.10	0.90
E	180	78	0.05	0.95
F	185	84	0.02	0.98

PARAMETER	WOMEN	MEN
mean (M)	$\begin{bmatrix}160\\55\end{bmatrix}$	$\begin{bmatrix}180\\78\end{bmatrix}$
mixing coefficient (π)	0.5	0.5
covariance (Σ)	$\begin{bmatrix}9&0\\0&16\end{bmatrix}$	$\begin{bmatrix}16&0\\0&25\end{bmatrix}$

⑬ Compute the responsibility for sample C

$$|\Sigma_{women}| = \begin{bmatrix}9&0\\0&16\end{bmatrix} = 144$$

$$144^{1/2} = \sqrt{144} = 12$$

$$2(3.14)^{2/2} * 12 = \boxed{75.36}$$

$$\Sigma_{women}^{-1} = \frac{1}{144}\begin{bmatrix}9&0\\0&16\end{bmatrix} = \begin{bmatrix}0.0625&0\\0&0.1111\end{bmatrix}$$

$$(C - M_{women})^T \Sigma_{women}^{-1} (C - M_{women}) = \frac{(166-160)^2}{9} + \frac{(60-55)^2}{16} = 5.56$$

$$N(C \mid \mu_{women}, \Sigma_{women}) = \frac{1}{75.36}\exp\left(-\frac{1}{2} \times 5.56\right)$$

$$= \frac{1}{75.36}\exp(-2.78)$$

$$= \frac{1}{75.36}(0.062) = \boxed{0.000823}$$

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$$|\Sigma_{men}| = \begin{bmatrix} 16 & 0 \\ 0 & 25 \end{bmatrix} = 400$$

$$400^{1/2} = \sqrt{400} = 20$$

$$2(3.14)^{2/2} * 20 = 125.6$$

$$\sum_{men}^{-1} = \frac{1}{400}\begin{bmatrix} 16 & 0 \\ 0 & 25 \end{bmatrix} = \begin{bmatrix} 0.04 & 0 \\ 0 & 0.0625 \end{bmatrix}$$

$$(C - M_{men})^T \sum_{men}^{-1} (C - M_{men}) = \frac{(166-180)^2}{16} + \frac{(60-78)^2}{25} = 25.21$$

$$N(C|\mu_{men}, \Sigma_{men}) = \frac{1}{125.6} \exp\left(-\frac{1}{2} \times 25.21\right)$$

$$= \frac{1}{125.6} \exp(-12.605)$$

$$= \frac{1}{125.6}(0.000003355) = \boxed{0.00000002671}$$

$$r_{women} = \frac{0.5 \times 0.000823}{0.5 \times 0.000823 + 0.5 \times 0.00000002671} = \boxed{0.999}$$

$$r_{men} = \frac{}{0.5 \times 0.000823 + 0.5 \times 0.00000002671} = \boxed{0.0000325}$$

(2.) Compute the data points for each cluster

Women = 1 + 1 + 1 + 0 + 0 + 0 = $\boxed{3}$ Men = 0 + 0 + 0 + 1 + 1 + 1 = $\boxed{3}$

(3.) Compute the updated mixing coefficient for each cluster

$\pi_{women} = \frac{3}{6} = \frac{1}{2} = \boxed{0.5}$ $\pi_{men} = \frac{3}{6} = \frac{1}{2} = \boxed{0.5}$

(4.) Compute the updated means of each cluster

WOMEN

$\mu_{height} = \frac{158 + 162 + 166}{3} = \boxed{162}$

$\mu_{weight} = \frac{52 + 56 + 60}{3} = \boxed{56}$

MEN

$\mu_{height} = \frac{175 + 180 + 185}{3} = \boxed{180}$

$\mu_{weight} = \frac{72 + 78 + 84}{3} = \boxed{78}$

$\mu_{women} = \begin{bmatrix} 162 \\ 56 \end{bmatrix}$ $\mu_{men} = \begin{bmatrix} 180 \\ 78 \end{bmatrix}$

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(5.) Compute the updated covariance of each cluster

$A_w = \left(\begin{bmatrix}158\\52\end{bmatrix} - \begin{bmatrix}162\\56\end{bmatrix}\right) = \begin{bmatrix}-4\\-4\end{bmatrix}$ $A_w^T = [-4 \quad -4]$

$B_w = \left(\begin{bmatrix}162\\56\end{bmatrix} - \begin{bmatrix}162\\56\end{bmatrix}\right) = \begin{bmatrix}0\\0\end{bmatrix}$ $B_w^T = [0 \quad 0] =$

$C_w = \left(\begin{bmatrix}166\\60\end{bmatrix} - \begin{bmatrix}162\\56\end{bmatrix}\right) = \begin{bmatrix}4\\4\end{bmatrix}$ $C_w^T = [4 \quad 4] =$

$D_M = \left(\begin{bmatrix}175\\72\end{bmatrix} - \begin{bmatrix}180\\78\end{bmatrix}\right) = \begin{bmatrix}-5\\-6\end{bmatrix}$ $D_M^T = [-5 \quad -6] =$

$E_M = \left(\begin{bmatrix}180\\78\end{bmatrix} - \begin{bmatrix}180\\78\end{bmatrix}\right) = \begin{bmatrix}0\\0\end{bmatrix}$ $E_M^T = [0 \quad 0] =$

$F_M = \left(\begin{bmatrix}185\\84\end{bmatrix} - \begin{bmatrix}180\\78\end{bmatrix}\right) = \begin{bmatrix}5\\6\end{bmatrix}$ $F_M^T = [5 \quad 6] =$

$A_w = \begin{bmatrix}-4\\-4\end{bmatrix}[-4 \quad -4] = \begin{bmatrix}16 & 16\\16 & 16\end{bmatrix}$

$B_w = [0]$

$C_w = \begin{bmatrix}4\\4\end{bmatrix}[4 \quad 4] = \begin{bmatrix}16 & 16\\16 & 16\end{bmatrix}$

$D_M = \begin{bmatrix}-5\\-6\end{bmatrix}[-5 \quad -6] = \begin{bmatrix}25 & 30\\30 & 36\end{bmatrix}$

$E_M = [0]$

$F = \begin{bmatrix}5\\6\end{bmatrix}[5 \quad 6] = \begin{bmatrix}25 & 30\\30 & 36\end{bmatrix}$

$\sum_{women} = \frac{1}{3}\begin{bmatrix}16 & 16\\16 & 16\end{bmatrix} + [0] + \begin{bmatrix}16 & 16\\16 & 16\end{bmatrix}$

$= \frac{1}{3}\begin{bmatrix}32 & 32\\32 & 32\end{bmatrix}$

$= \begin{bmatrix}10.67 & 10.67\\10.67 & 10.67\end{bmatrix}$

$\sum_{men} = \frac{1}{3}\begin{bmatrix}25 & 30\\30 & 36\end{bmatrix} + [0] + \begin{bmatrix}25 & 30\\30 & 36\end{bmatrix}$

$= \frac{1}{3}\begin{bmatrix}50 & 60\\60 & 72\end{bmatrix}$

$= \begin{bmatrix}16.67 & 20\\20 & 24\end{bmatrix}$