Ans 1

Multinomial $(20, 0.3, 0.4, 0.1)$

$0.3 + 0.4 + 0.1 = 0.8 \neq 1$

So there are 4 components in
Multinomial $(20, 0.3, 0.4, 0.1)$

With $p_1 = 0.3$, $p_2 = 0.4$, $p_3 = 0.1$, $p_4 = 0.2$

Ans 2

Let $f_i(x)$ $i = 1, 2, 3, 4$ be four.
bivariate gaussian distributions with mean
M_1, M_2, M_3, M_4 & covariance matrix corresponding
to them is $\Sigma_1, \Sigma_2, \Sigma_3, \Sigma_4$

Define hidden variable

$$z_i = \begin{cases} i & \text{if } X_i \sim f_i \\ 0 & 0.w \end{cases}$$

$$P[x_i < X_i < x_i + \Delta x_i, \; z_i | \theta]$$

$$P[x_i < X_i < x_i + \Delta x_i | z_i, \theta] \, P[z_i = z_i]$$

$$\begin{cases} P_1 f_1(x_i) & x_i \sim f_1 \\ P_2 f_2(x_i) & x_i \sim f_2 \\ P_3 f_3(x_i) & x_i \sim f_3 \\ P_4 f_4(x_i) & x_i \sim f_4 \end{cases} \qquad P_1 + P_2 + P_3 + P_4 = 1$$

Now

$$L(\theta) = P_1 f_1(x_i) \, I(z_i = 1) + P_2 f_2(x_i) \, I(z_i = 2) + P_3 f_3(x_i) \, I(z_i = 3)$$
$$+ P_4 f_4(x_i) \, I(z_i = 4)$$

$$L(\theta) = [P_1 f_1(x_i)]^{I(z_i = 1)} [P_2 f_2(x_i)]^{I(z_i = 2)} [P_3 f_3(x_i)]^{I(z_i = 3)} \times [P_4 f_4(x_i)]^{I(z_i = 4)}$$