$$= \int_y^\infty \int\int_I$$

$\boxed{\mathbb{E}[Q]}$

$$\int_c^\infty \int\int_I$$

$P_1, P_2, \ldots, P_n$

$$\mathbb{E}\left[\mathbb{E}Q \mid H\right) = \mathbb{E}\left[\sum_{i=1}^{m_0} \sum_{k=1}^{m} \frac{1}{k} \mathbb{P}\left(\overbrace{\{P_i \le q_k \cap C_k^{(i)}}^{\boxed{X_{ik}}}\right) \Big| \mathbb{H}_0, \mathbb{H}_0, m, m_0\right]$$

$$= \mathbb{E}[m_0]\, \mathbb{E}\left[\sum_{k=1}^{m} \frac{1}{k} \mathbb{P}\left(\qquad \mid m, m_0\right)\right]$$

$$\mathbb{E}\left[\sum^{m_0} X_i \mid m_0\right]$$

make k random here, then you get:

$$\frac{1}{k}\mathbb{P}\left(\{P_i \le q_k \cap C_k^{(i)}\right)$$

iid but the sum don't change.