①

$$D(P\|Q) = \sum_i P_i \log \frac{P_i}{Q_i} = \frac{n!}{k_{1i}! \cdots k_{Ki}!} P_1^{k_{1i}} \cdots P_K^{k_{Ki}} \log \left(\frac{\frac{n!}{k_{1i}! \cdots k_{Ki}!} P_1^{k_{1i}} \cdots P_K^{k_{Ki}}}{\frac{n!}{k_{1i}! \cdots k_{Ki}!} Q_1^{k_{1i}} \cdots Q_K^{k_{Ki}}} \right)$$

$$= \sum_i \frac{n!}{k_{1i}! \cdots k_{Ki}!} P_1^{k_{1i}} \cdots P_K^{k_{Ki}} \log \left(\left(\frac{P_1}{Q_1}\right)^{k_1} \cdots \left(\frac{P_K}{Q_K}\right)^{k} \right)$$

$$= \frac{n!}{k_{1i}! \cdots k_{Ki}!} P_1^{k_{1i}} P_2^{k_{2i}} P_K^{k_{Ki}} \left(k_{1i} \log \frac{P_1}{Q_1} + \cdots + k_{Ki} \log \frac{P_K}{Q_K} \right)$$