Derivation of Differential Expression Confidence Score

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Given Bayes Theorem:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

First, define A as the sample class (e.g. normal, cancer) and B as a mixture component(s). Therefore, re-write Bayes Theorem as:

$$P(\omega|k) = \frac{P(k|\omega)P(\omega)}{P(k)}$$

The probability of sample type ω being part of mixture component k is given as:

$$P(k|\omega) = \sum_{j}^{\omega} \tau_{jk} \Big/ N_{\omega}$$

where τ_{jk} is the posterior probability that observation j arose from component k and N_{ω} is the number of libraries of type ω.

The probability that a sample is of type ω is simply:

$$P(\omega) = N_{\omega} \Big/ N$$

where N is the total number of libraries.

The probability that a sample arose from mixture component k is given as:

$$P(k) = \sum_{j} \tau_{jk} \Big/ N$$

Substituting terms, we arrive at:

$$P(\omega|k) = \frac{\sum_{j}^{\omega} \tau_{jk}}{N_{\omega}} \frac{N_{\omega}}{N} \Big/ \frac{\sum_{j} \tau_{jk}}{N}$$

Finally, by canceling like terms, we have the expression:

$$P(\omega|k) = \sum_{j}^{\omega} \tau_{jk} \Big/ \sum_{j} \tau_{jk}$$