S1: Derivation of equation (6)

The transformation in equation (6) is followed by the marginal covariance-based standardization of the multivariate mixture model proposed in [Guo M, 2014]. As discussed in Section 2.1, $x$ is a one-dimensional vector generated from a GMM of $N$ components and $s_j = \mathbb{1}_{x = j}$. Then for $s \sim \text{Multinominal}(1; c_1, \ldots, c_N)$, $x|s \sim \mathcal{N}(\sum_{j=1}^{N} s_j \mu_j, \sum_{j=1}^{N} s_j \sigma_j)$. The authors of [Guo M, 2014] show that the marginal mean and variance of $x$ take the following forms

$$E[x] = E[E[x|s]] = \sum_{j=1}^{N} \hat{s}_j \mu_j \tag{S1.1}$$

$$Var[x] = E_s(Var[x|s]) + Var_s(E[x|s]) = \sum_{j=1}^{N} \hat{s}_j \sigma_j + (\mu_j - \sum_{j=1}^{k} \hat{s}_j \mu_j)^2 \tag{S1.2}$$

The corresponding standardized score $T_3$ is

$$T_3 = [Var(x)]^{-1/2}(x - E[x]) \tag{S1.3}$$

Therefore, we get equation (6) by plugging in equations (S1.1) and (S1.2) into equation (S1.3).

References

[Guo M, 2014] Guo M, Yap JT, V. d. A. A. L. N. S. A. (2014). Voxelwise single-subject analysis of imaging metabolic response to therapy in neuro-oncology. Stat, 3:1.