Cluster Analysis

-- Simultaneous inferences

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For each voxel, $\alpha = 0.01$, and $P (\text{no Type I error}) = P (\text{true negative}) = 1 - \alpha = 0.99$

For all four voxels together,

$P (\text{no Type I error}) = P (\text{true negative}) = 0.99^4 = 0.96$

$\alpha = 1 - P (\text{no Type I error}) = 1 - 0.96 = 0.04$ (the corrected $P$ value)

If there are ~ 4000 voxels in the brain,

$P (\text{no Type I error}) = P (\text{true negative}) = (1-\alpha)^{4000} = 0.99^{4000} = 3.47 \times 10^{-18}$

$\alpha = 1 - P (\text{no Type I error}) = 1 - 3.47 \times 10^{-18} = 1$ (the corrected $P$ value)
Bonferroni Correction: Assuming independent voxels.

\[ \alpha_{\text{bon}} = \frac{\alpha}{n} \]
(A) $t = 2.10, P < 0.05$ (uncorrected)

(B) $t = 3.60, P < 0.001$ (uncorrected)

(C) $t = 7.15, P < 0.05$ (Bonferroni corrected)
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Monte Carlo Simulation