FMRI Pre-Statistics

Brief introduction to Task FMRI experiments and analysis
**FMRI Experiments**

- Simple paradigm design:
  - stimulus vs baseline
  - constant stimulus “intensity”
  - constant block lengths
  - many repetitions: ABABA

- Need baseline (rest) condition to measure *change*
The Haemodynamic Response

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- BOLD-tuned MRI ($T_2^*$-weighted) is sensitive to this effect
The process can be modelled by **convolving** the activity curve with a "haemodynamic response function" or HRF.
FMRI Experiments: Analysis

• Each voxel contains a time-varying signal (BOLD signal)
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• Each voxel contains a time-varying signal (BOLD signal)

• Model the stimulus-induced change in BOLD signal (predicted response)

• Find which voxels have signals that match the model

• Good match implies activation related to stimulus
Standard GLM Analysis

- Correlate model at each voxel separately
- Measure residual noise variance
- $t$-statistic = model fit / noise amplitude
Residual Noise
Standard GLM Analysis

- Correlate model at each voxel separately
- Measure residual noise variance
- \( t \)-statistic = model fit / noise amplitude
- Threshold \( t \)-stats and display map

Signals of no interest (e.g. artifacts) can affect both activation strength and residual noise variance

Use pre-processing to reduce/eliminate some of these effects
Summary:

- Task experiment involves stimuli that is:
  - repeated many times
  - includes two or more conditions
- FMRI is based on BOLD effect
- HRF models the delay and spread of blood response
- GLM matches predicted response with data at each voxel to get amplitude
- Ratio with residual error gives statistic
- Thresholded values give map of significant voxels