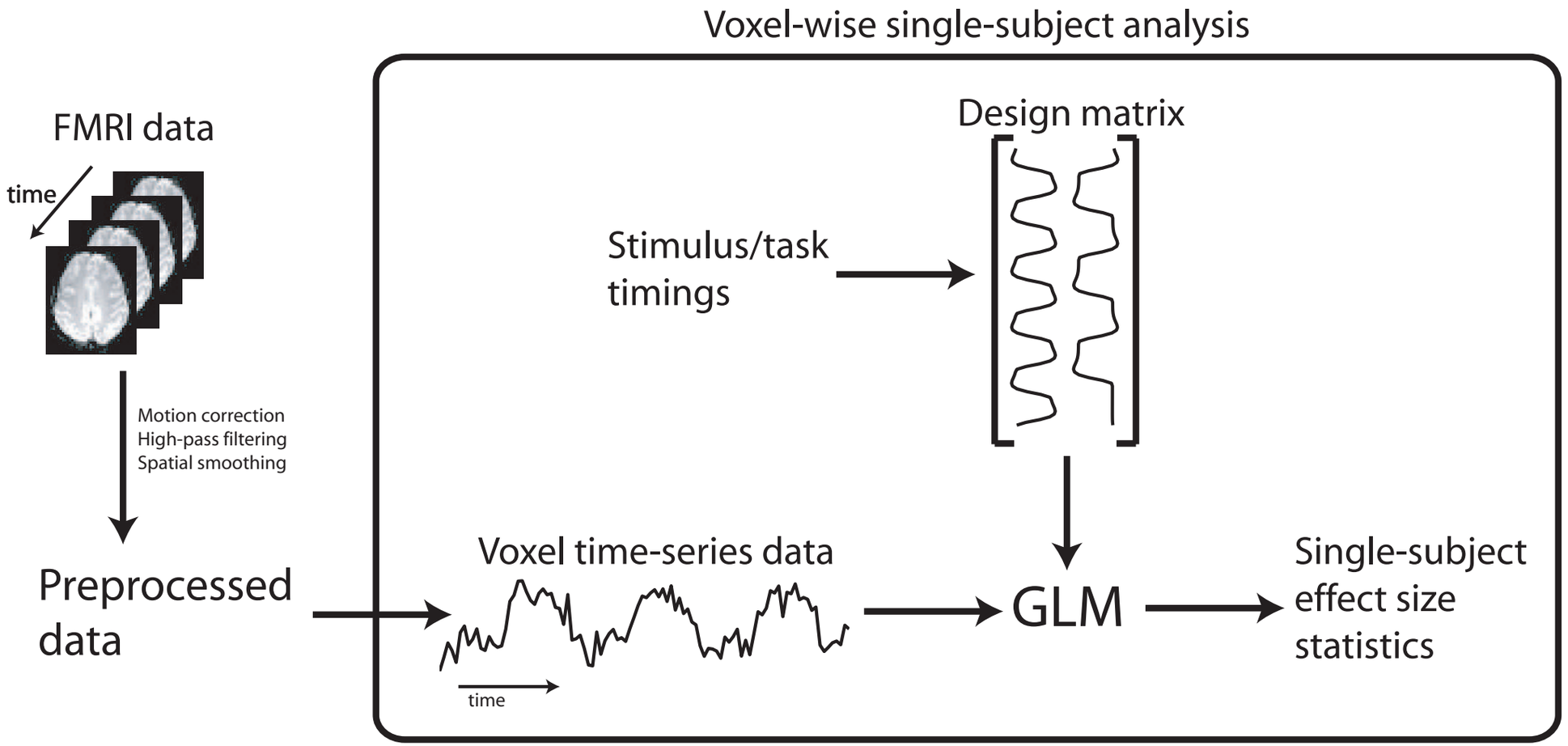
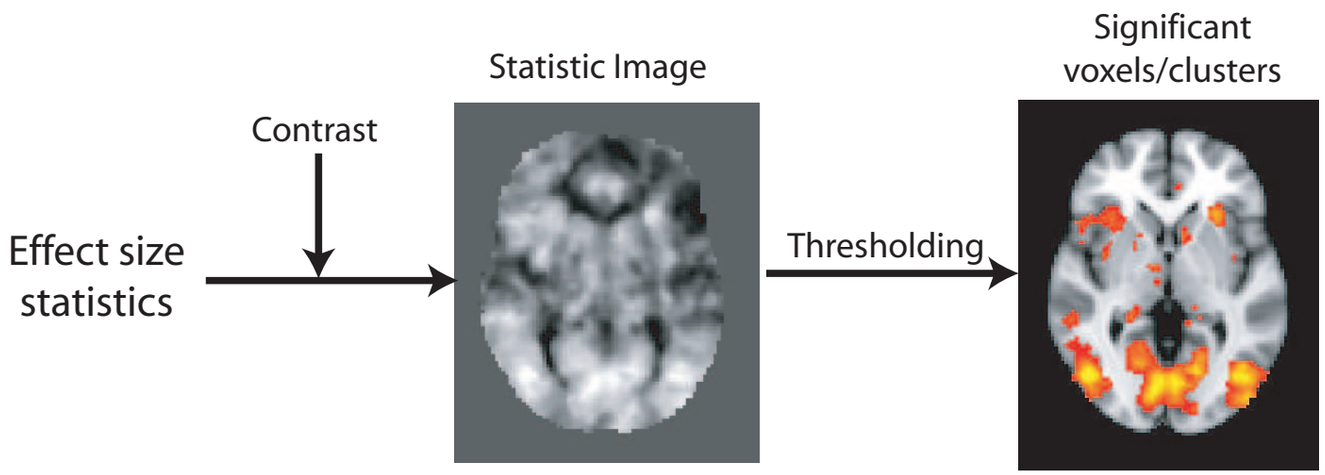
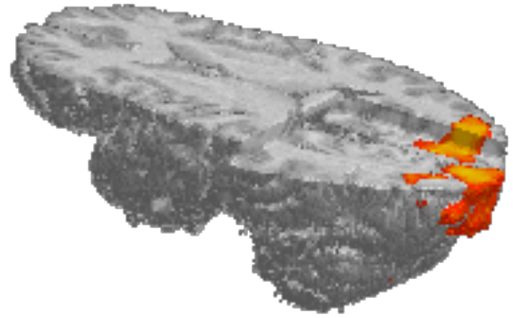
Single-Session Analysis





FMRI Modelling and Statistics

- An example experiment
- Multiple regression (GLM)
- T and F Contrasts
- Null hypothesis testing
- The residuals
- Thresholding: multiple comparison correction

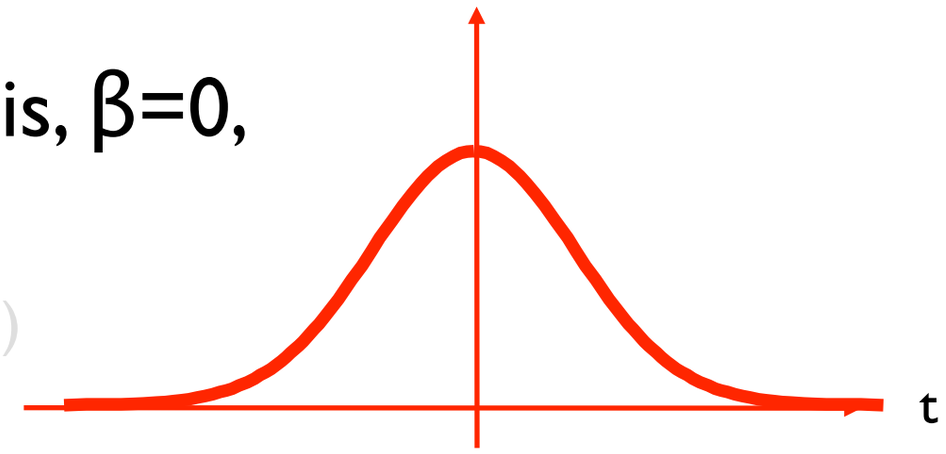


Null Hypothesis Testing

t-statistic: $$t = \frac{\hat{\beta}}{\widehat{std(\beta)}}$$

Under null hypothesis, β=0,
t is t-distributed

(what are the chances of that?)



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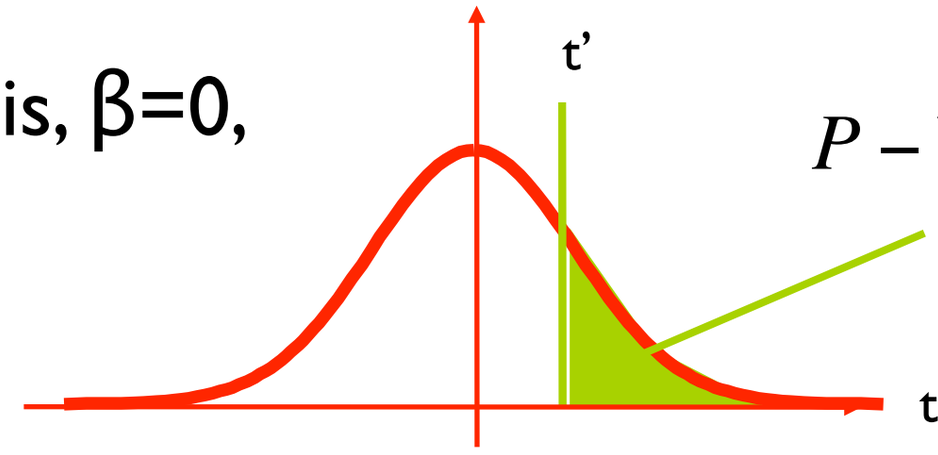
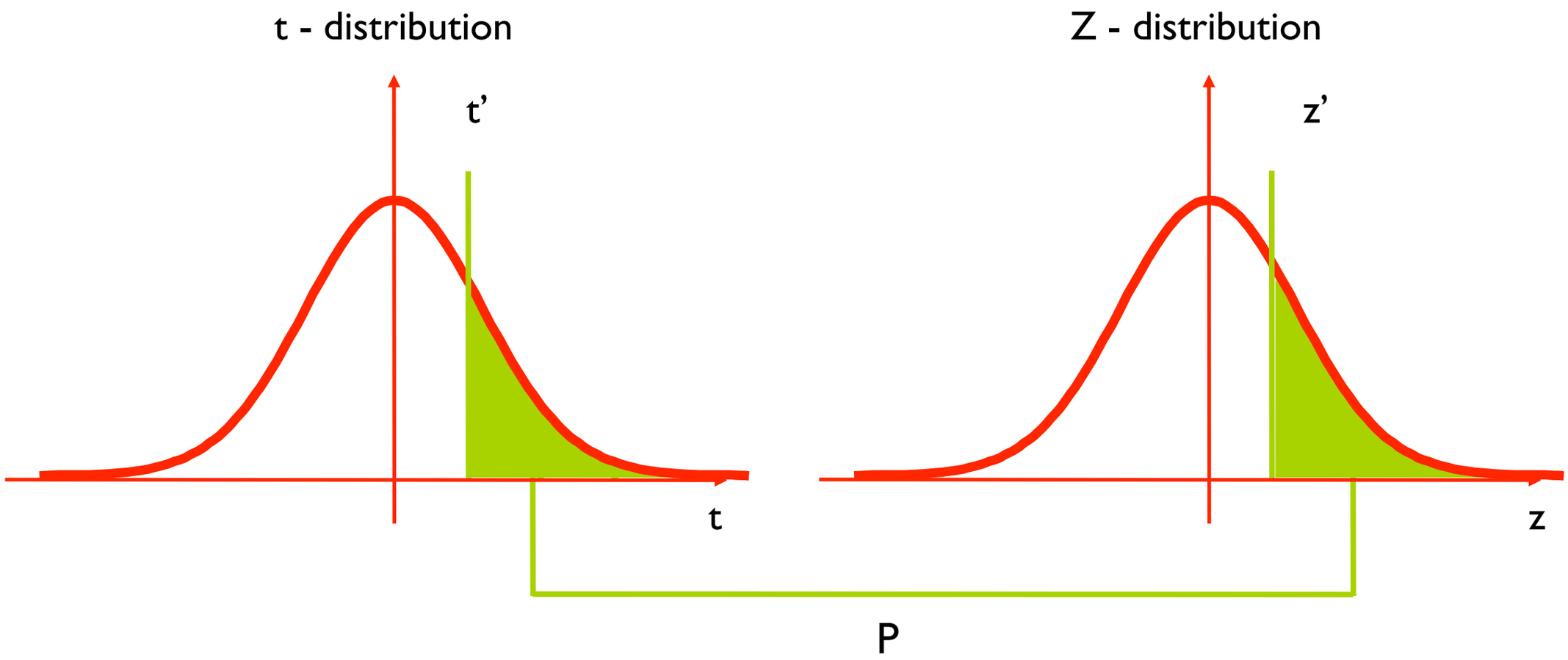


$$P - Value = p(t > t' | \beta = 0)$$

Small P-Value = null hypothesis unlikely
If P-Value < P-threshold then voxel is "active"
P-threshold corresponds to False Positive Rate (FPR)

T to P to Z



- FEAT performs spatial inference on z statistic maps
- Therefore, we convert t statistics to z statistics by equating probabilities under the tails of the distributions (t'-> p->z')

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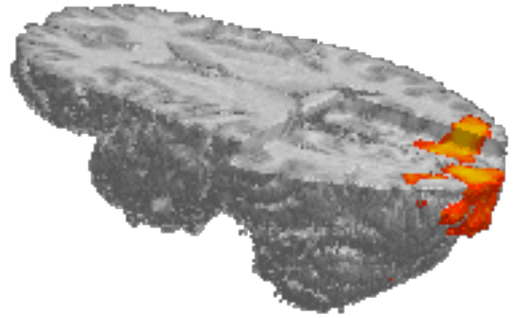
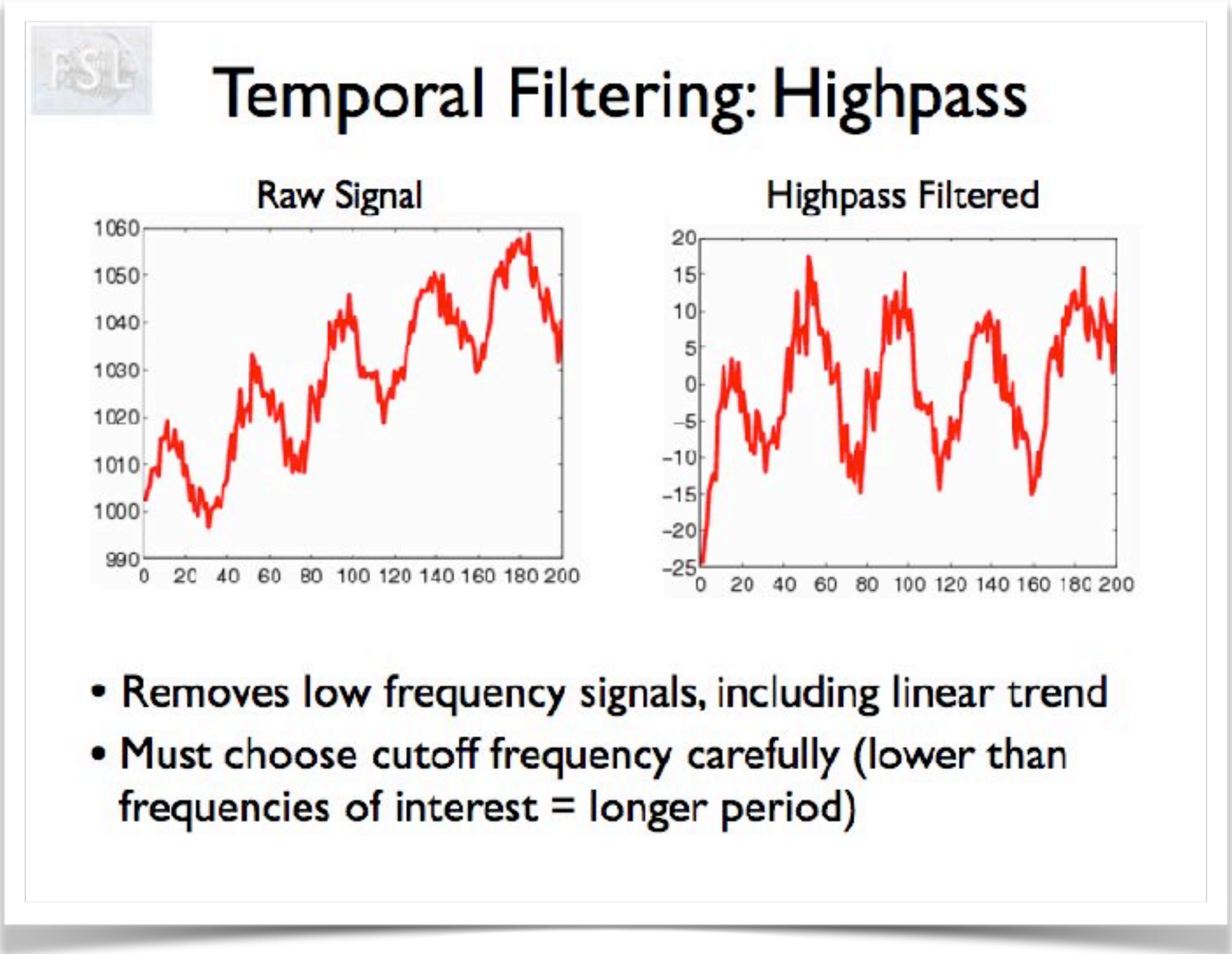


Choosing High-Pass Filter Cut-off

- Can use the tool *cutoffcalc* to determine a good cut-off value

Remember that MJ mentioned highpass filtering?



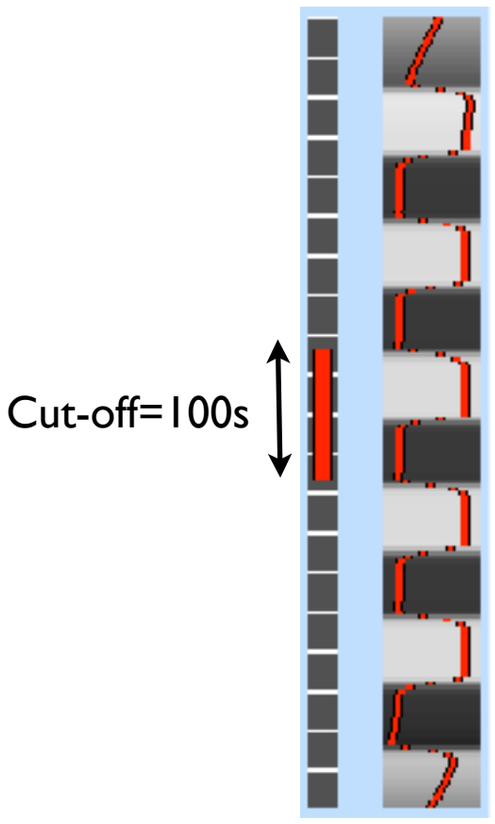
Choosing High-Pass Filter Cut-off

- Can use the tool *cutoffcalc* to determine a good cut-off value

OR

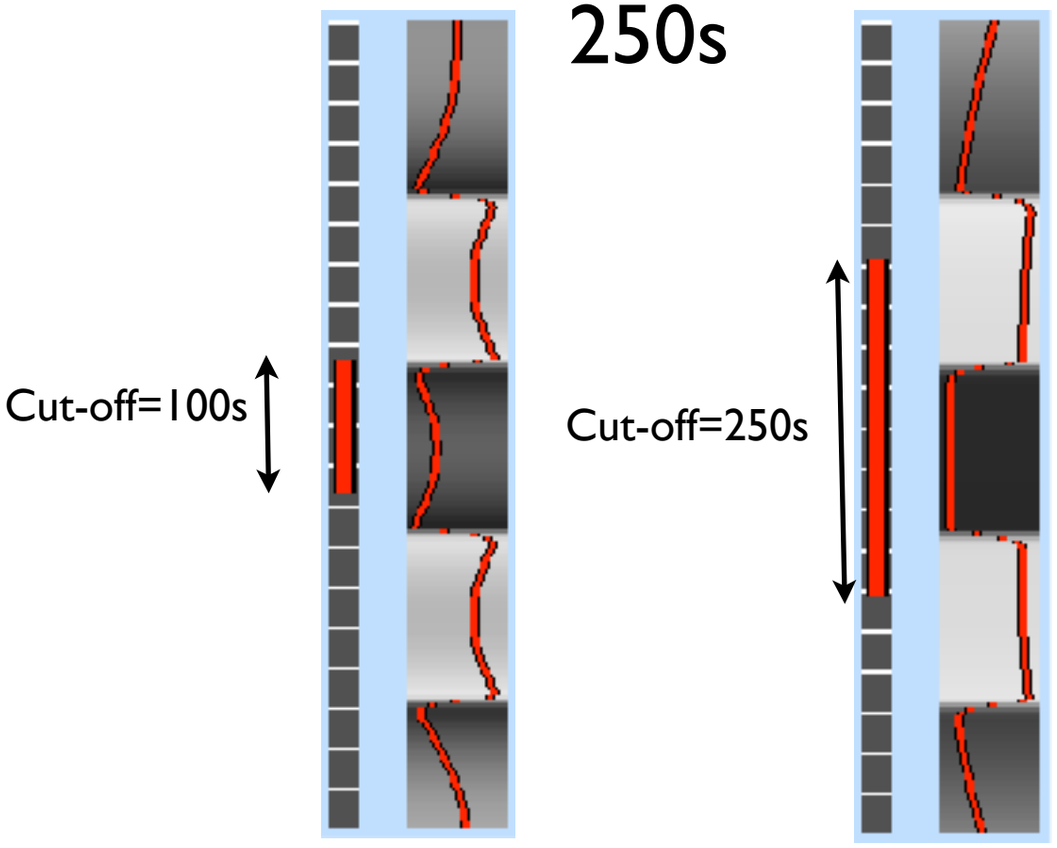
- Set by hand, but make sure model is not badly affected

Example: Boxcar EV with period 100s



Negligible effect on EV, so use cut-off of 100s

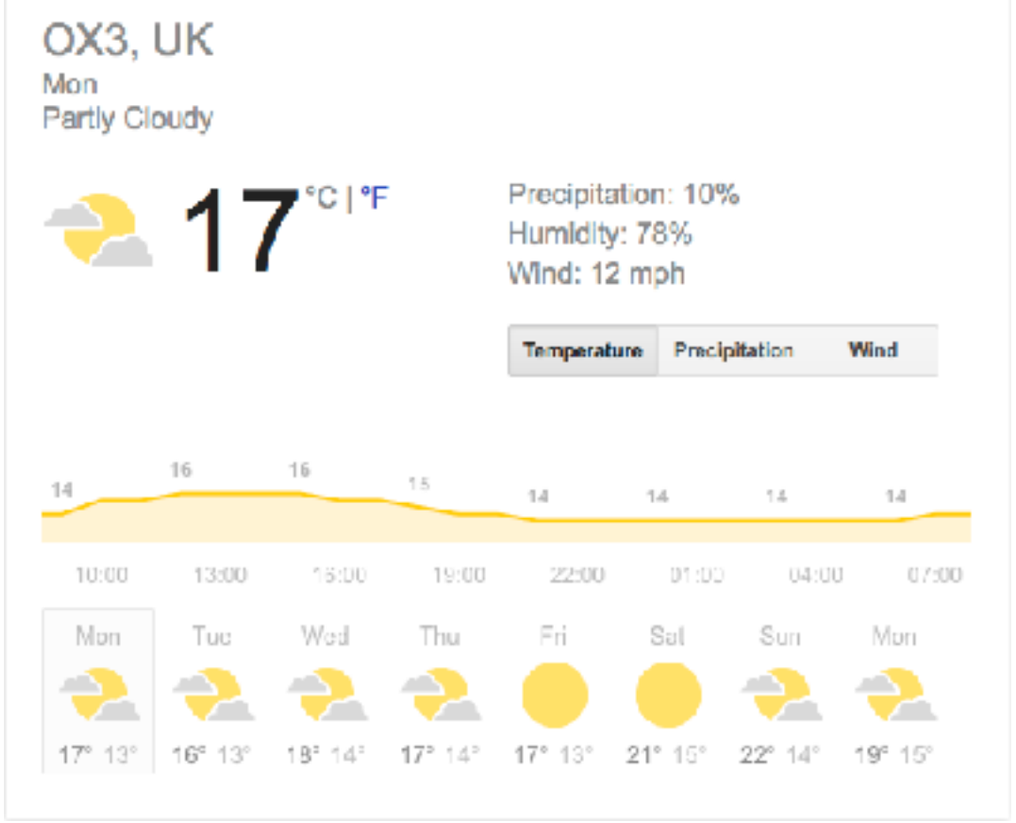
Example: Boxcar with period 250s



Substantial effect on EV, so need longer cut-off

Negligible effect on EV, so use cut-off of 250s

Non-independent/Autocorrelation/ Coloured FMRI noise



Uncorrected, this causes:

- biased stats (increased false positives)
- decreased sensitivity

FSL fixes it for you in FEAT!

Cannot use randomise (see later) because of autocorrelation

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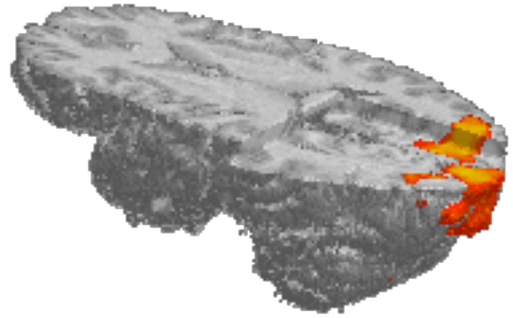
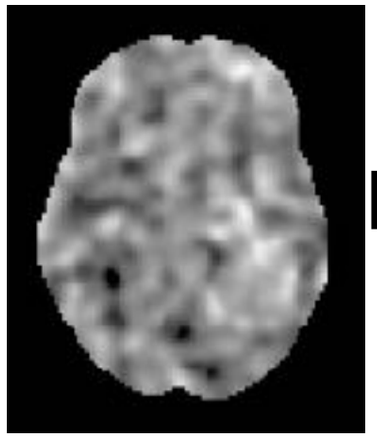
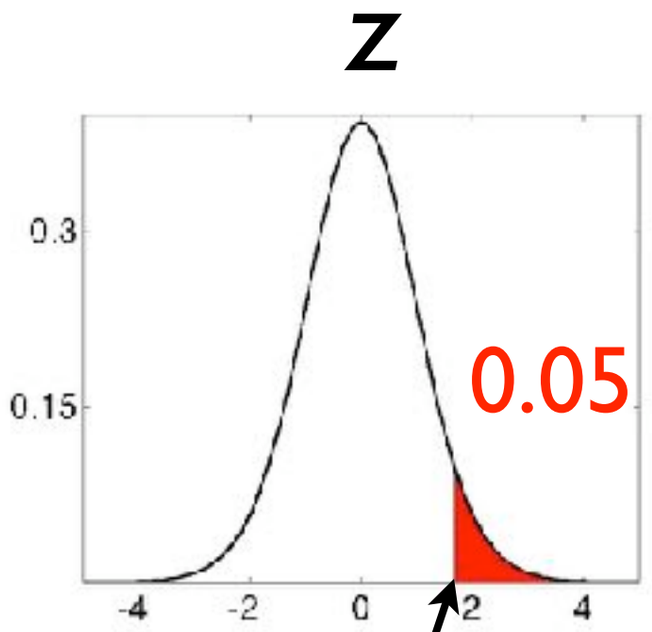


What happens when we apply "standard" statistical testing to imaging data?



z-map where each voxel ~*N*.
Null-hypothesis true everywhere, i.e.
NO ACTIVATIONS



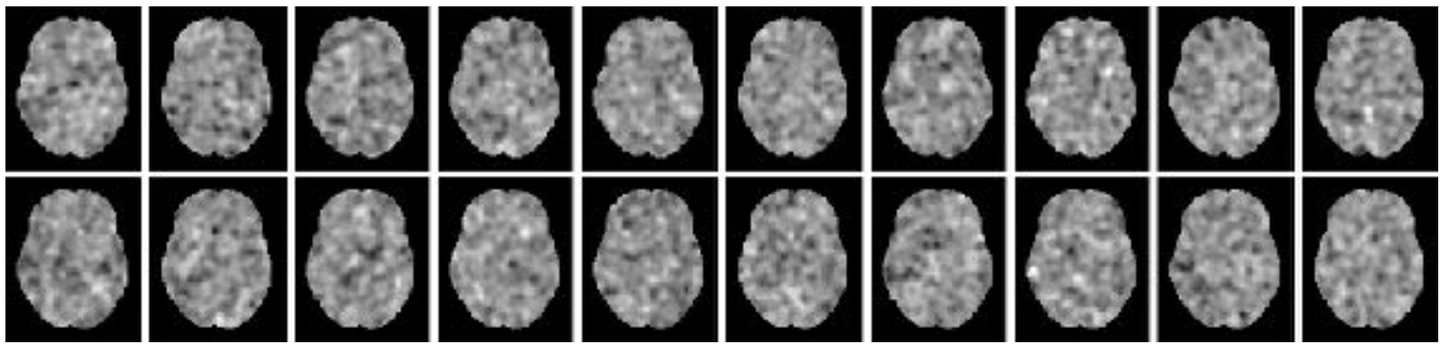
z-map thresholded at 1.64

16 clusters
288 voxels
~5.5% of the voxels

That's a LOT of false positives

What we really want

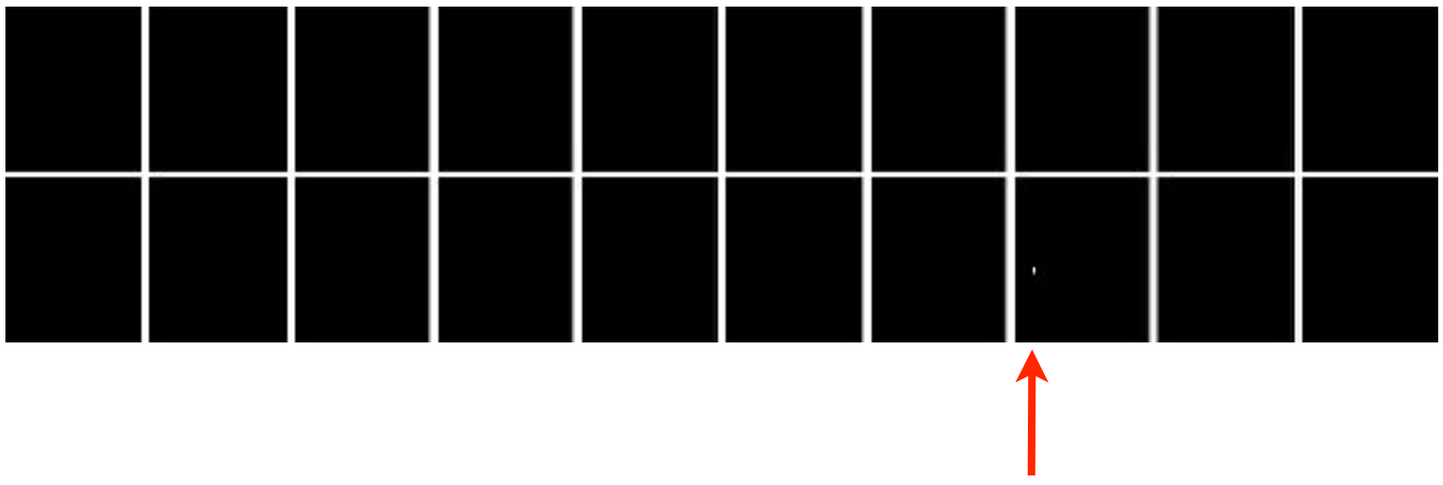
Let's say we perform a series of identical studies



Each *z*-map is the end result of a study

Let us further say that the null-hypothesis is true

We want to threshold the data so that only once in 20 studies do we find a voxel above this threshold



There will be a whole talk on how to find such a threshold

Summary

- We test for an effect through a null-hypothesis, that we might reject.
- The null-hypothesis is rejected if the observed statistic is "too unlikely".
- When thresholding the number of false positives needs to be controlled across the entire brain

That's all folks