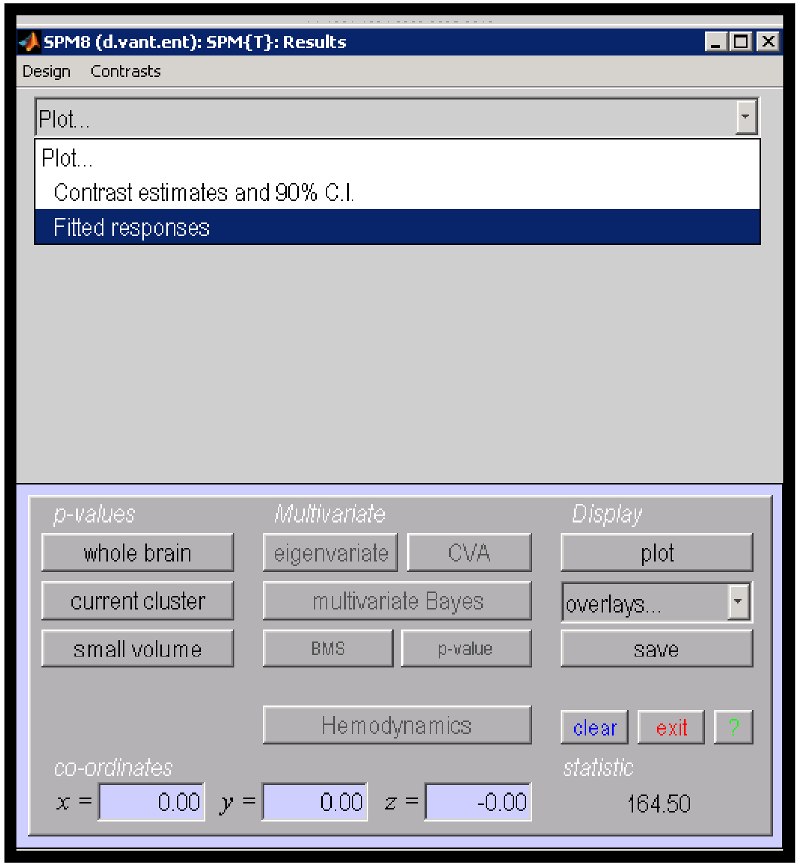
In this document I try to explain in a simple way what it means if you choose to plot predicted or adjusted data for a selected voxel.



I use a 2nd level model as an example, but the same holds true for 1st level models.

The Data

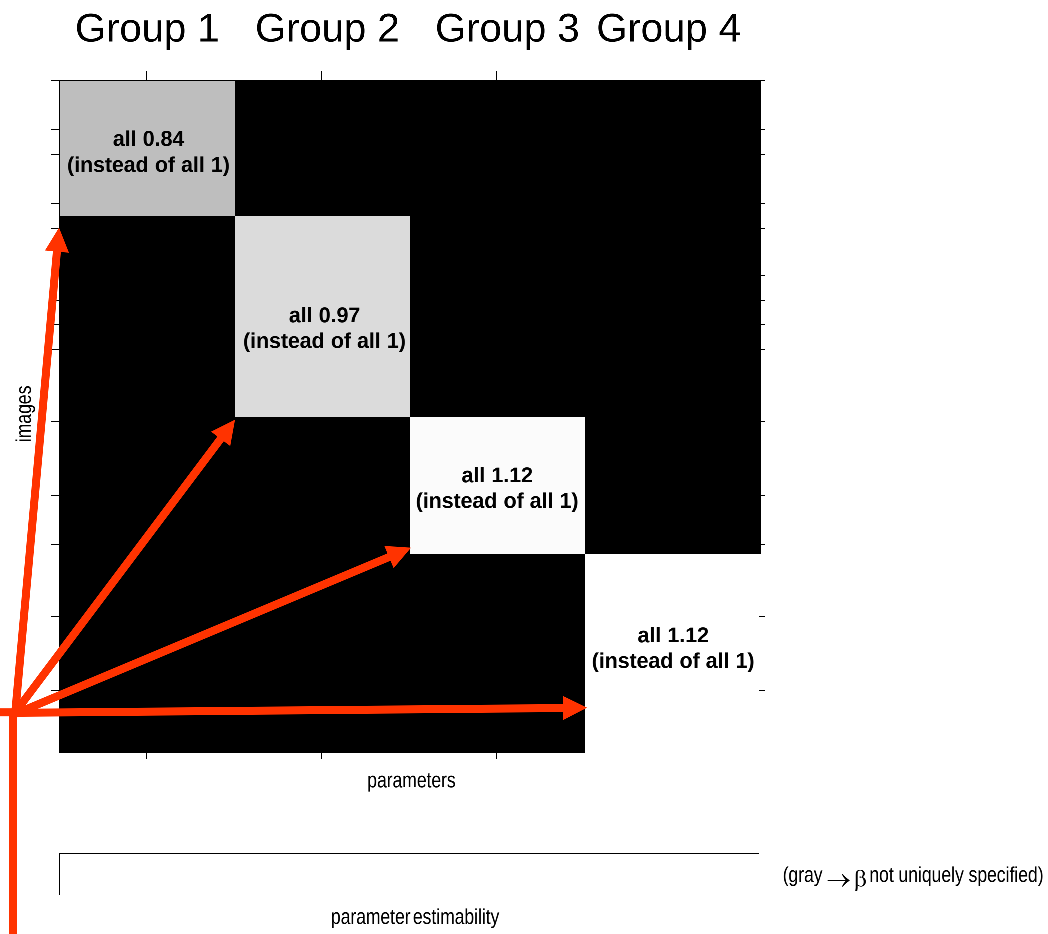
2nd level analysis: full factorial with 4 groups

Group 1: 28 scans

Group 2: 41 scans

Group 3: 28 scans

Group 4: 41 scans



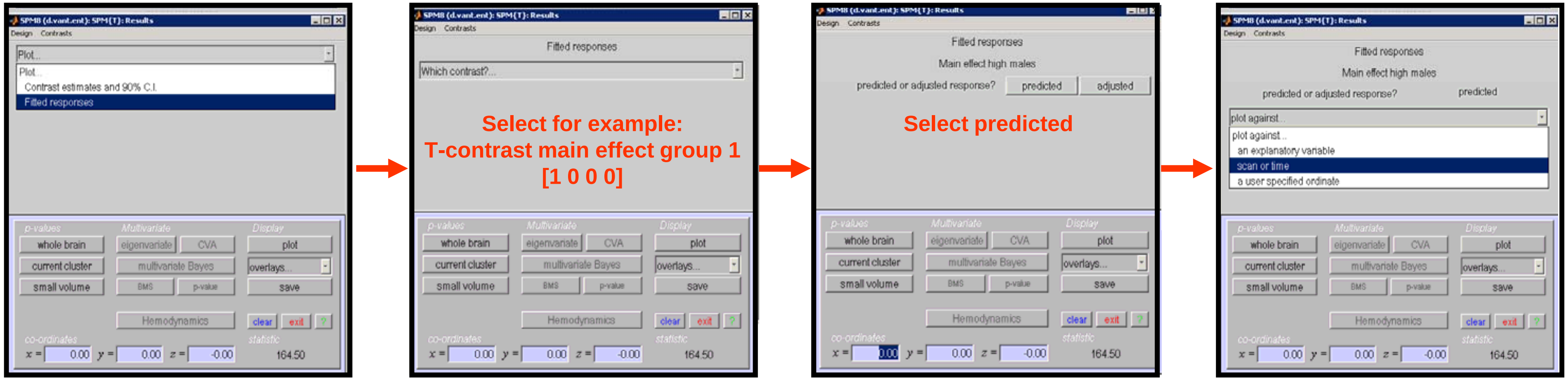
Between group variances were set to unequal in our model therefore hyperparameter estimation was done during model estimation and the loadings of the scans in each group have been modified by SPM, initially they were all 1's:
Group 1: from 1 to 0.84
Group 2: from 1 to 0.97
Group 3: from 1 to 1.12
Group 4: from 1 to 1.12

For plot:predicted the 1's are used and for plot: adjusted the modified values are used: see next slides)

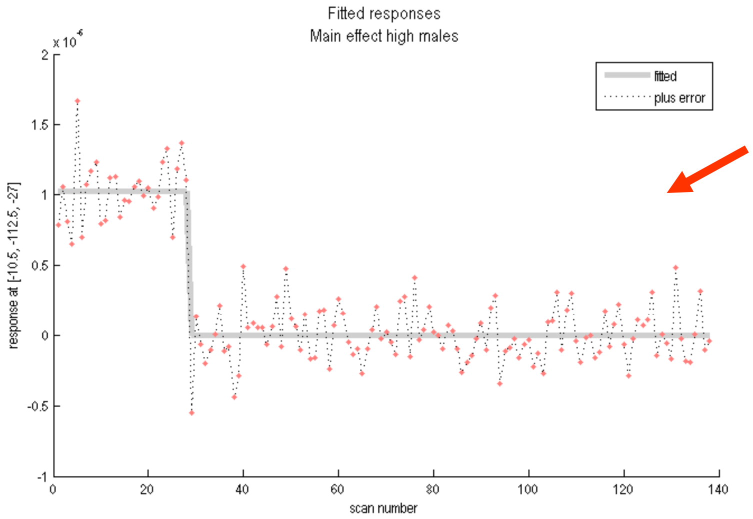
Design description...

Design : Full factorial
Global calculation : omit
Grand mean scaling : <no grand Mean scaling>
Global normalisation : <no global normalisation>
Parameters : 4 condition, +0 covariate, +0 block, +0 nuisance
4 total, having 4 degrees of freedom
leaving 134 degrees of freedom from 138 images

Plot predicted (for a selected voxel)



Output:



What does this mean:

In this example we have 4 groups therefore 4 beta's are estimated:

Y(data) = Model + [Error vector]

= Beta1*[11..11 00..00 00..00 00..00]+
Beta2*[00..00 11..11 00..00 00..00]+
Beta3*[00..00 00..00 11..11 00..00]+
Beta4*[00..00 00..00 00..00 11..11]+ [Error vector]

- fitted (gray line) = how does your selected contrast fits the unadjusted (raw) data.

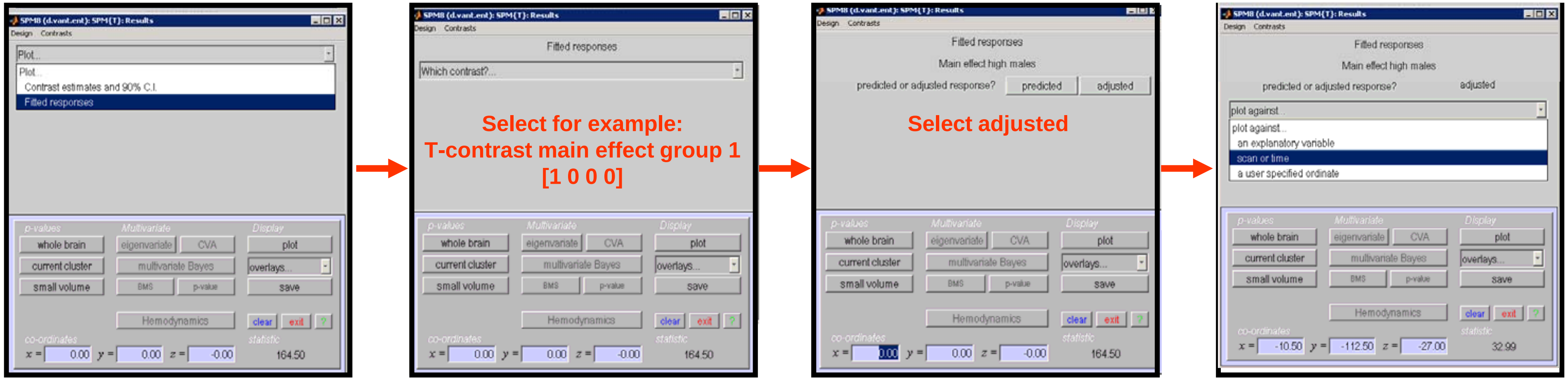
For contrast [1 0 0 0]: fitted= Beta1*[11…11 00..00 00..00 00..00]
For contrast [0 1 0 0]: fitted= Beta2*[00…00 11..11 00..00 00..00]
For contrast [1 1 1 1]: fitted= 0.25*Beta1*[11…11 00..00 00..00 00..00]+
0.25*Beta2*[00…00 11..11 00..00 00..00]+
0.25*Beta3*[00…00 00..00 11..11 00..00]+
0.25*Beta4*[00…00 00..00 00..00 11..11]
Etc.

- plus error (red dots) = [fit of your selected contrast] + [Error vector]

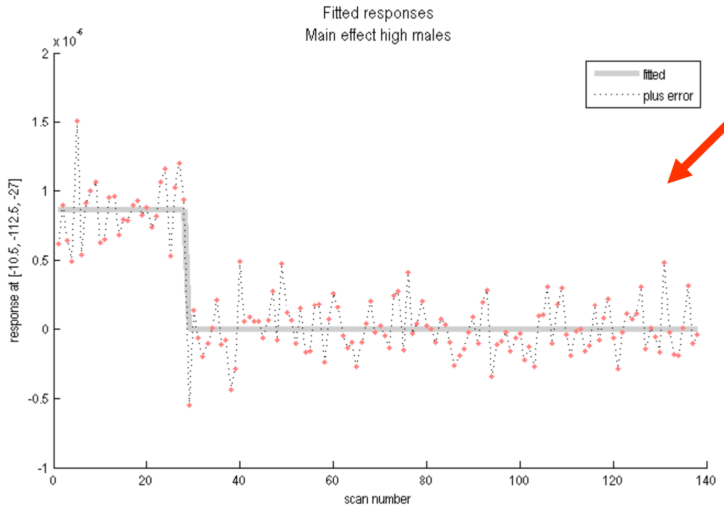
NB 1: The beta's are stored in a variable named "beta". You can see the values if you enter beta in the matlab command window (after you issued the plot commands). For this example:
Beta1=1.026.10^{-6}; Beta2=0.854.10^{-6}; Beta3=0.409.10^{-6};Beta4=0.430.10^{-6}

NB 2: data for the fitted (gray line) is in variable "Y", and fitted plus error in variable "y" (after you issued the plot commands)

Plot adjusted (for the same voxel)



Output:



What does this mean:

Now the modified loadings of the scans are used; for this example:

Y(adjusted) = Beta1*[0.84 0.84..0.84 0.84 00..00 00..00 00..00]+
Beta2*[00..00 0.970.97..0.97 0.97 00..00 00..00]+
Beta3*[00..00 00..00 1.12 1.12..1.12 1.12 00..00]+
Beta4*[00..00 00..00 00..00 1.12 1.12..1.12 1.12]+ [Error vector]

- fitted (gray line) = how does your selected contrast fits the adjusted data.

For contrast [1 0 0 0]: fitted= Beta1*[0.84 0.84…0.84 0.84 00..00 00..00 00..00]
For contrast [0 1 0 0]: fitted= Beta2*[00…00 0.97 0.97..0.97 0.97 00..00 00..00]
For contrast [1 1 1 1]: fitted= 0.25*Beta1*[0.840.84…0.840.84 00..00 00..00 00..00]+
0.25*Beta2*[00…00 0.97 0.97..0.97 0.97 00..00 00..00]+
0.25*Beta3*[00…00 00..00 1.12 1.12 ..1.12 1.12 00..00]+
0.25*Beta4*[00…00 00..00 00..00 1.12 1.12 ..1.12 1.12]

Etc.

- plus error (red dots) = [fit of your selected contrast to adjusted data] + [Error vector]

NB 1: data for the fitted (gray line) is in variable “Y”, and fitted plus error in variable “y” (after you issued the plot commands)

Additional notes

1: For clarity: the vector abbreviations in the previous slides, such as for example [11..11 00..00 00..00 00..00] should be read as [N (group 1)*1 + N (group 2)*0 + N (group 1)*0 + N (group 1)*0] = [11..(28 in total) 00..(41 in total) 00..(28 in total) 00..(41 in total)] for this example study

2: The [Error vector] for a given voxel (= data-model), is the same regardless of which contrast you select for plotting, and also regardless of whether you choose “predicted” or “adjusted” for plotting.

3: In general, neither “predicted” or “adjusted” plotting gives you the complete raw or adjusted data for the selected voxel, unadjusted for contrasts)

To get the complete raw data:
a: Get the beta’s (by entering the command beta in matlab)
b: Get the [Error vector] (by typing y-Y in matlab)
c: Compute (in matlab or excell, etc); Y(data) = model+ [Error vector], e.g. In this example we had 4 beta’s:

Y(data) = Beta1*[11..11 00..00 00..00 00..00]+
Beta2*[00..00 11..11 00..00 00..00]+
Beta3*[00..00 00..00 11..11 00..00]+
Beta4*[00..00 00..00 00..00 11..11]+ [Error vector]

To get the complete adjusted data:
a: Get the beta’s (by entering the command beta in matlab)
b: Get the [Error vector] (by typing y-Y in matlab)
c: Compute (in matlab or excell, etc); Y(adjusted) = model+ [Error vector], but now using the modified loadings of your scans, e.g. In this example:

Y(adjusted) =Beta1*[0.84 0.84..0.84 0.84 00..00 00..00 00..00]+
Beta2*[00..00 0.970.97..0.97 0.97 00..00 00..00]+
Beta3*[00..00 00..00 1.12 1.12..1.12 1.12 00..00]+
Beta4*[00..00 00..00 00..00 1.12 1.12..1.12 1.12]+[Error vector]

Maybe there are other smarter tricks….

4:This example is on a 2nd level model, but the same holds true for 1st level models.

Disclaimer

I think that this is how it works….., but any interpretations pertaining to your own data are of course on your own behalf…

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