PSGY4009

Q+A about assessment, the GLM in more detail

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Attendance

Today

Assessment

- A bit more detail on the written assessment
- General advice on writing, structure

The General Linear Model (GLM)

- intuition / non-mathematical explanation
- some of the nitty-gritty (in `matlab`)
- demo in `fsl`

Kinds of designs

- task, resting state, connectivity, ...

Learning objectives

By the end of the lecture you should:

- know what's expected in coursework
- have all the information to get started on assessment
- understand the GLM in principle
- appreciate some of the technical details of GLM analysis
- have some knowledge of different kinds of "designs" / approaches to fMRI for neuroscience

Figure 1: qr code

Assessment

- Written assignment (max 3000 words) including a 250 word abstract.
- Details on moodle (2023/24).

The written assignment for this module is an essay about how functional magnetic resonance imaging and/or brain stimulation can be used to study different neuroscience questions. It should cover two topics and/or methods from the course.

Not just a literature review

One aim of the assignment is to make you think about the methodological choices the experimenters have to make. After a brief summary of the state of the literature in your area, there should be therefore be a component that talks about how you might extend some previous findings.

On moodle

Guided submission

There are very specific suggestions for how you can tackle each section in turn

overall word limit, 3000w - stick to this limit)

- Title of project (suggested ~10 words)
- Lay Summary (max 250 words, one paragraph)
- Scientific Summary (max 250 words, one paragraph)
- Background of the project (suggested 600 words)
- Questions to be answered (suggested 200 words)
- Plan of investigation (suggested 500 words)
- Details of data analysis (suggested 500 words)
- Expected outcomes (suggested 200 words & 1-2 figures)
- Theoretical & practical implications (suggested 500 words)
- References

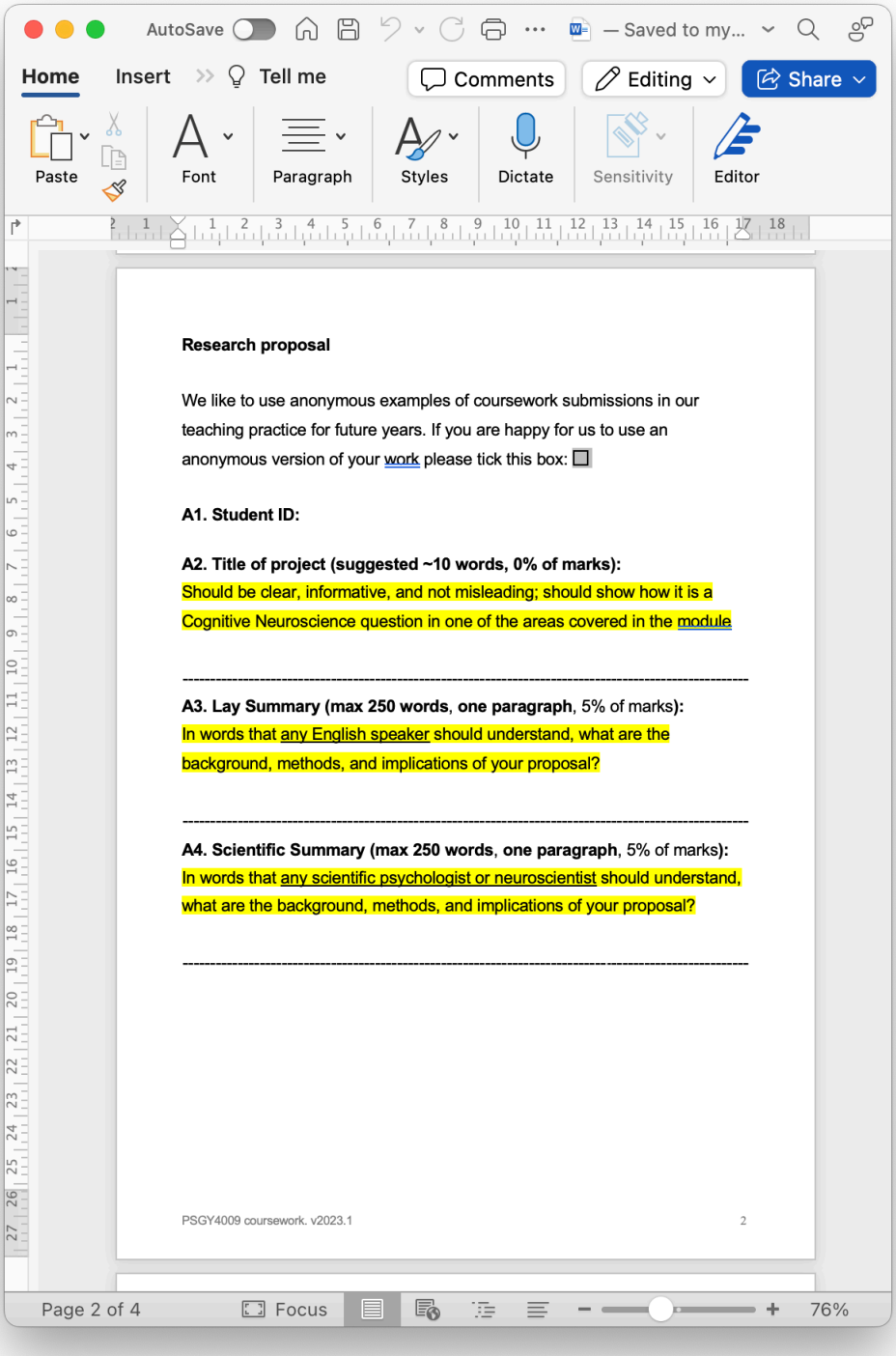


Figure 2: word doc template

Things that you might wonder about:

- Plan of investigation (suggested 500 words)
- Details of data analysis (suggested 500 words)
- Expected outcomes (suggested 200 words & 1-2 figures)

  But I don't have any data (yet?). How to square that circle??

What do we look for?

Content

The **content** of your coursework is (obviously) important - topic choice - methodological details included - facts correct?

... but writing!

- clear, concise, economic
- line of argument?
- structure easy to follow
- ...

Strunk & White - *Elements of Style*

If you haven't read this little book (26 pages), take the time!

free online PDF of the book

The GLM - a quick walk-through

Some notes for my demo

```
cd ~/projects/hands-on-brain-data
julia
# using Pluto
# Pluto.run()
# "what_is_linearReg.jl"
```

in `matlab`

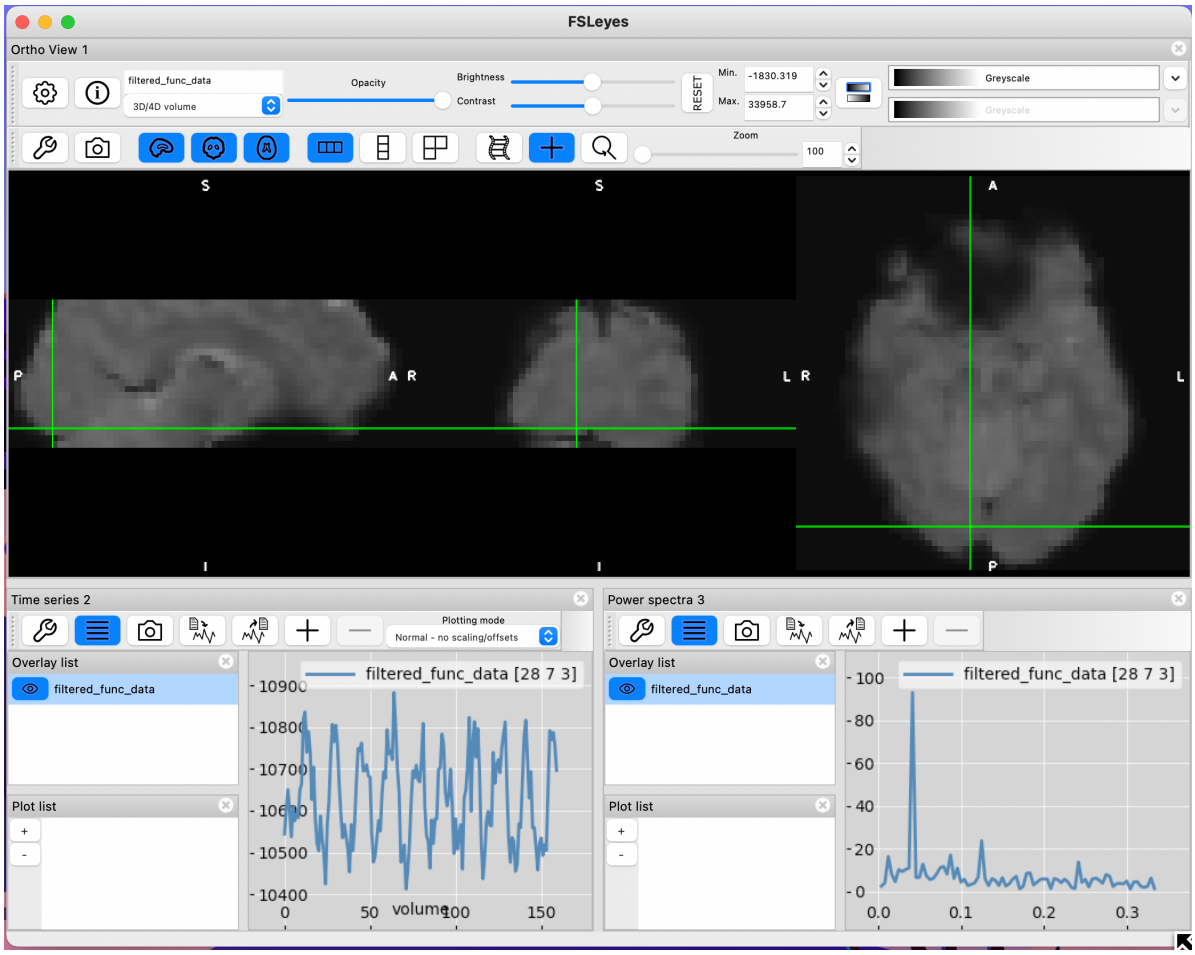
Some notes for my demo

```
cd ~/projects/hands-on-brain-data
cd data
X = load('design-3.txt')
y = load('timecourse.txt')
X\y
% regress(), pinv()
```

in `fsl`

```
cd ~/projects/hands-on-brain-data
cd data
fsleyes filtered_func_data
fsl &
# simple block design ... stats: 6, (12, 12, 12)
```

in `fsl/fsleyes`



Kinds of designs / approaches

Two directions, in which people elaborate experiments:

1. **tasks, stimuli** have become more sophisticated
2. **data analysis methods** are changing all the time

Tasks

You can find lots of versions of these across all domains of cognitive neuroscience...

- task-based experiments

  - block designs, event-related designs, mixed, ...
  - "continuous" (eg watching movies)
- resting state fMRI (rsFMRI)

Analysis methods

- GLM, linear regression (the "workhorse" of fMRI analysis)
- data-driven methods (search for patterns in the data)
  - *independent component analysis*, ICA (dimensionality reduction techniques)
  - seed-based correlation methods
  - network analysis, ...
- machine learning, *decoding*

GLM

We have just seen a bit more of this in action

Resting state fMRI

Smith et al, 2012, PNAS

Decoding, multivariate analysis

Variously: *classification*, SVM (support vector machines), decoding, even "mind reading", ...

Aim: try to use **data** - the pattern of activity across many voxels (and trials) - to figure out which stimulus was being displayed.

First use, classic reference

Kamitani & Tong, 2005

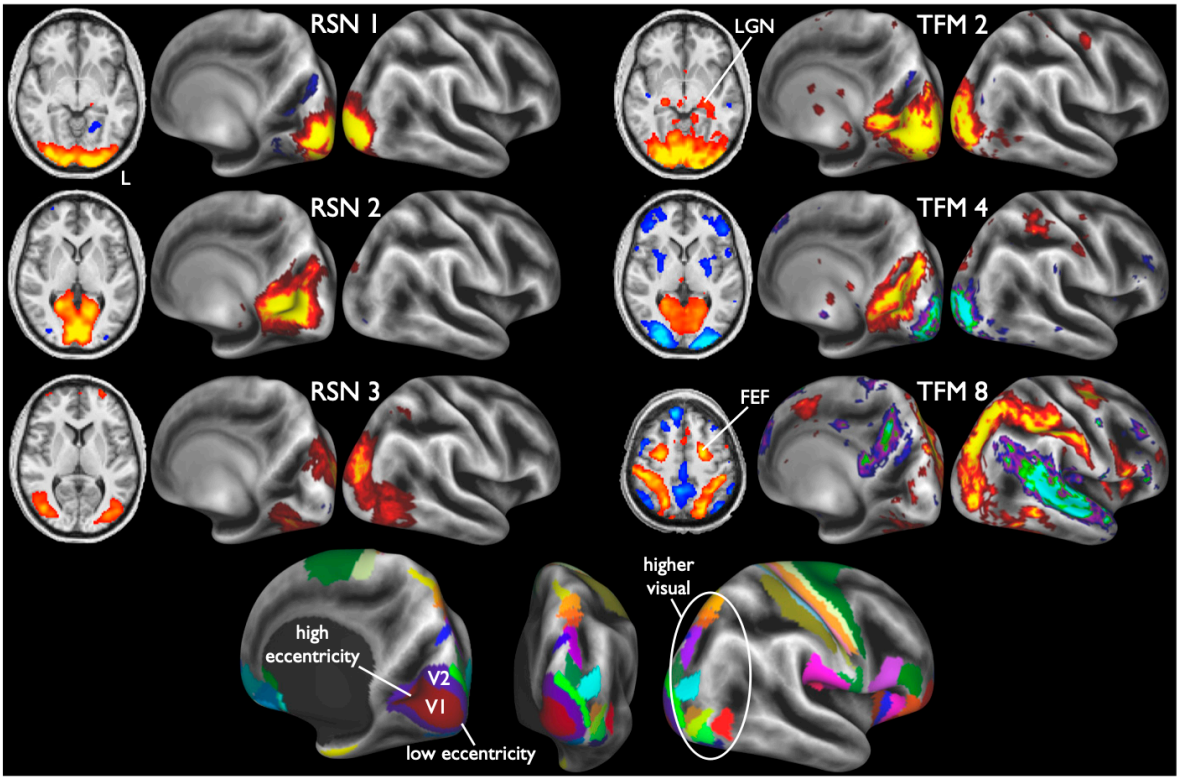


Fig. 1. Three visual components from a 21-dimensional spatial ICA decomposition of the complete dataset, as well as three components from the 21-dimensional TFM analysis. To help localize the maps structurally, they are shown on the partially inflated cortical surface, with sulci indicated by darker background intensity. To help localize the maps functionally, the bottom row shows several cytoarchitecturally based (V1 and V2) and retinotopically based (higher visual) areas from the "FS_LR" atlas (11). LGN, lateral geniculate nucleus. FEF, frontal eye fields.

Figure 3: example rs analysis

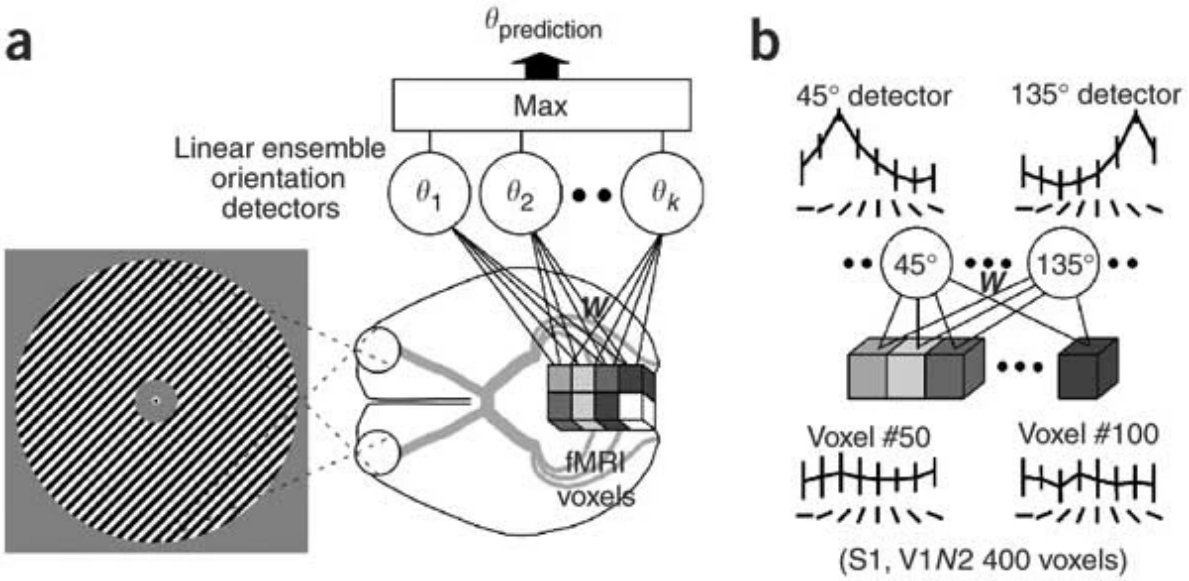


Figure 4: Kamitani and Tong, 2005

Thanks

Hope you found this helpful.

See you soon!

Colophon

- This presentation was made with `quarto` and `revealjs`.
- Uses a font called `Atkinson Hyperlegible`, which was designed to work better for people with low vision: available via google fonts.