Worksheet: Group-Level Inference in fMRI (Stroop Task): Session 4

Goal: Understand group-level statistical inference.

E1: Validate ROI Locations Using the Literature

Instructions:

1. Open the article by **Verstynen et al. (2014)** (*The Organization and Dynamics of Corticostriatal Pathways…*) or any other fMRI study on the Stroop task.
2. Open matlab scripts: scripts 4a, b

Questions:

- According to the Stroop fMRI literature, which cortical and subcortical regions are most commonly activated?
- What functional role does the ACC and DLPFC play in Stroop-related cognitive control?
- Do the simulated coordinates align with these known anatomical targets? And if not what are the correct ones?

E2: Group-Level t-Test

Each subject's synthetic map is included in a 4D matrix. A voxel-wise **one-sample t-test** is computed to assess consistent activation across subjects.

Questions:

1. What is the **null hypothesis** of this t-test?
2. What does a **positive t-value** at a voxel mean?

E3: Thresholding the t-map

You apply statistical thresholds to the t-map to control for false positives:

- **Uncorrected threshold**: $p<0.01$
- **FDR correction** (False Discovery Rate)

Questions:

4. What changes when applying **FDR correction**?
5. Why might FDR be preferred over **Bonferroni correction** in neuroimaging?

E4: Interpretation on forward/reversed inference

1. What does the figure show about how Task A and Task B activate Region R?

- Describe the pattern of bars.

- Which task tends to produce higher activation?
- What does this suggest about the region's response?

2. If you observe an activation level above the threshold (e.g., >1.2), how confident can you be that the subject was doing Task A?

- Does Task B ever show activation above this threshold?
- What does this tell you about using Region R to infer cognitive state?

3. Imagine a third task is added that also activates Region R.

- Would it become easier or harder to tell which task caused the activation?
- How would this affect your confidence in reverse inference?