CISC 3250
Systems Neuroscience

Matlab, part 4: Projection/Correlation Analyses

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JMH 332

Matrix math

$$\begin{bmatrix} | & | & | \\ v_1 & v_2 & v_3 \\ | & | & | \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = xv_1 + yv_2 + zv_3$$

Assuming right matrix is a single column

In general, # of left matrix columns must equal
# of right matrix rows

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Matrices in matlab

```
A= [1 2; 3 4];
b= [4; 5];
```

What is `A*b`?

Transpose: `[4; 5]  ==  [4 5]'`

`a'` flips rows and columns

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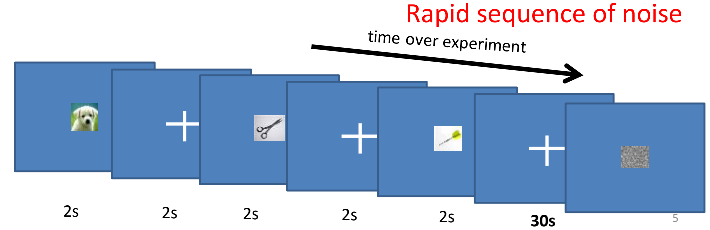
LOC localizer: experimental design

Localize part of brain selective for object pictures

Each second:
- new object OR
- new noise OR
- "blank screen" (fixation)

Our data: "block design"
Rapid sequence of objects
Pause
Rapid sequence of noise



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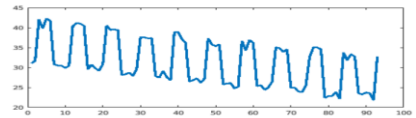
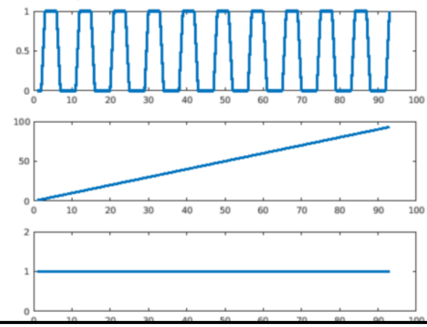
Building the voxel response

Voxel response
`neuroData`



at each second neural response to stimuli



`timesObjs`,
at each second:

- 0 for no-object, 1 for yes-object
- Drift and offset

Building the voxel response
General Linear Model

Design matrix M

- On/off information O
- Constant offset C
- Linear drift L

Measured voxel output v $[\ v_{t=1}\ \ v_{t=2} \ldots v_{t=93}]^T$

$$M = \begin{bmatrix} | & | & | \\ O & C & L \\ | & | & | \end{bmatrix} \qquad M \begin{bmatrix} \beta_O \\ \beta_C \\ \beta_L \end{bmatrix} = v \qquad B = M^{-1} v$$

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Comparing vectors

Can compare 2 vectors

- by correlating `corr(a,b)`
  - between -1 and 1
  - high |correlation| = high connection between vectors
  - +1 significant mutual rise/mutual fall
  - -1 significant complementary rise-vs-fall
  - In bio-signal recording, |r|>0.2 can be considered big!
- by multiplying `a*b'`
  - high product = high similarity

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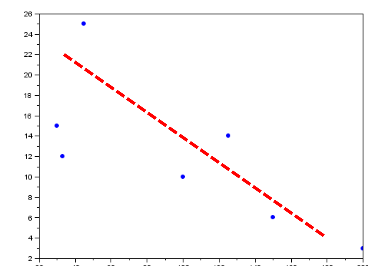
Scatter-plots

Visualizing how two variables vary together

Reaction time	Cortical response
100	10
45	25
150	6
30	15
125	14
33	12
200	3



```
plot(var1,var2,'.')
scatter(var1,var2)
```

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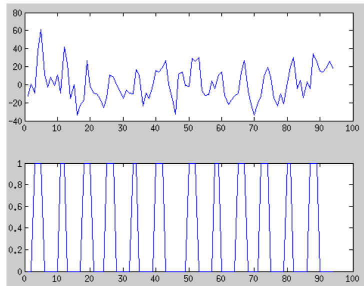
Visual comparison

`timesObjs2`, at each second:

- 0 for no-object
- 1 for yes-object

Voxel response
`neuroData2`
at each second neural response to stimuli



Numeric comparison

Single voxel response:

```
voxResp1=squeeze(neuroData2(24,26,4,:));
```

Compare with picture appearance times:

```
corr(voxResp1, timesAnyStim');
```

Consider correlations at multiple locations :

```
???
```

Numeric comparison

Single voxel response:

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Compare with picture appearance times:

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corr(voxResp1, timesAnyStim');
```

Consider correlations at multiple locations :

```
for x=1:32,
 for y=1:32
  for z=1:16,
   voxVec=squeeze(neuroData2(x,y,z));
   corrMat(x,y,z)=corr(voxVec,timesAnyStim');
 end
end
```

Numeric comparison

Single voxel response:

```
voxResp1=squeeze(neuroData2(24,26,4,:));
```

Compare with object appearance times, not noise:

```
objNotNoise=timesObjs2-timesNonsense2;
corr(voxResp1, objNotNoise');
```

Consider correlations at multiple locations :

```
???
```

Numeric comparison

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```

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