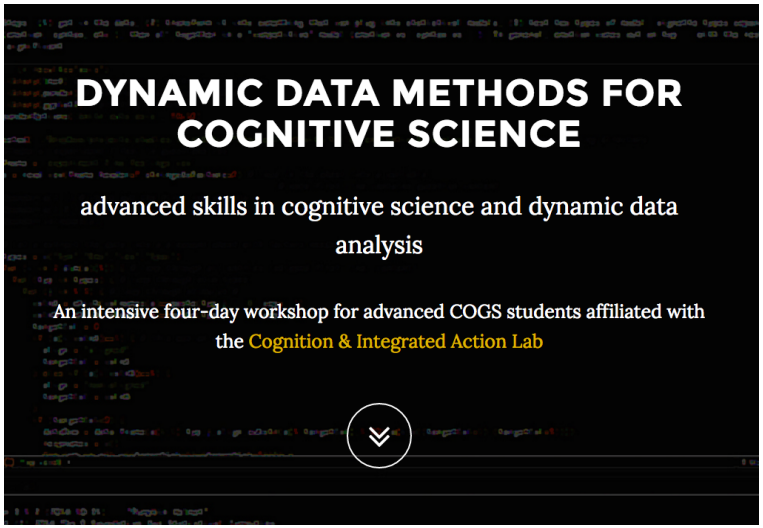


Why?

- Not always lots of **RA opportunities** in our laboratory from semester to semester.
- Provide opportunity for **awesome students** who applied or from recent classes to gain some experiences.
- To **translate some cognitive science into day-to-day practice**, hone training materials, disseminate resources, etc.

Caveats

- This workshop will be a **rough draft**.
- Material may **not** always be super clear, however I will be here to collaborate on RStudio.

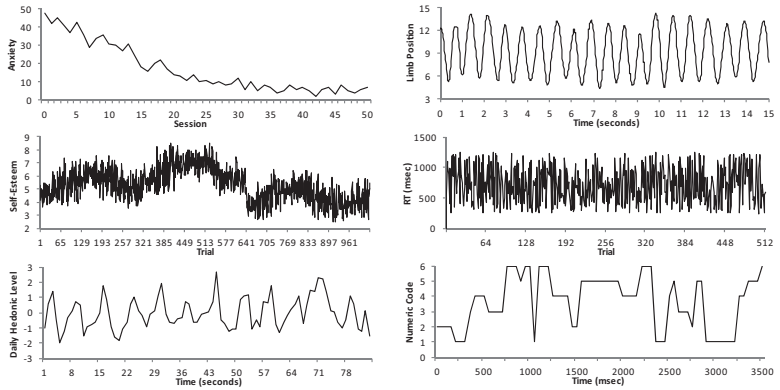
Goals

- **Learn some solid RStudio**.
- Learn how to **plot and describe** data that is organized in time.
- **Apply** this knowledge to real-world case studies.
- **Today**: we start slow and simple just to get everyone on the same page.

Time Series Types

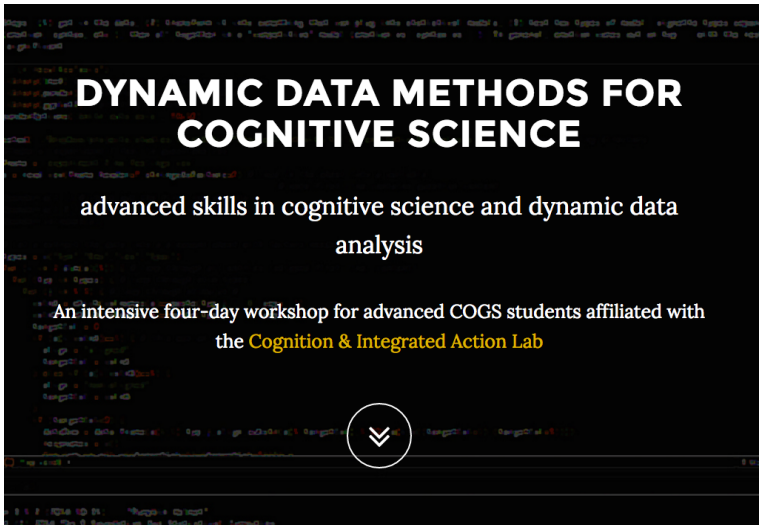
measurement sampling

measurement type	**regular**	**irregular**
categorical	second-by-second emotion **type**	**word sequence** in a conversation
continuous	brain waves or **motion tracking**	**reaction time**, or keystrokes (*trial series*)



arm while walking (Harrison & Richardson, 2009). In other cases the patterns of change over time are highly complex and appear to be nondeterministic or stochastic (i.e., random): an individual's self-esteem over the course of 1.5 years (see Delignières et al., 2004) and the trial-by-trial RT and an individual completing a 512 trial lexical decision task (see Holden, 2005). Others seem to fall somewhere in between, containing

Figure 11.8. Hypothetical examples of several types of behavioral time series. (top left) Change in anxiety level for an individual over 50 therapy sessions. (middle left) An individual's self-esteem recorded on a 9-point Likert-scale twice a day for 512 days. (bottom left) An individual's daily hedonic (mood) level recorded over 12 weeks. (top right) Motion sensor recording of a individuals right arm movements while walking. (middle right) Reaction times of a participant completing a 512 trial lexical decision task. (bottom right) A time series representing categorical data obtained from eye movement behav-



Recap Day 1

- Setting up RStudio
- Navigating your computer to get to your working directory (setwd)
- Loading in a table (read.table) for inspection and plotting (plot)
- Time series concepts.

Time Series Types

measurement sampling

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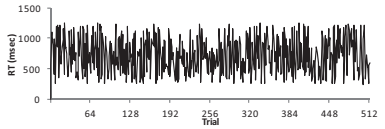
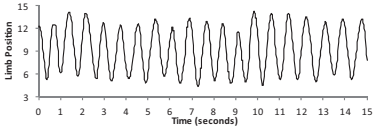
continuous trial series

reaction time!



continuous regular

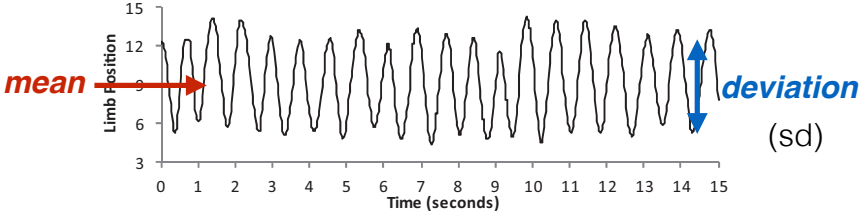
motion tracking!



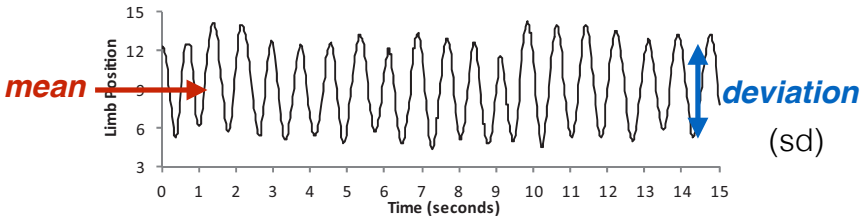
Goals Day 2

- Taking the mean and standard deviation (sd) of your time series.
- The concept of entropy as a measure of "disorder"
- Taking the difference (diff) of your time series to explore how "stable" a process it.
  - E.g., mental processing during typing
  - E.g., stock prices

quantities for continuous time series



quantities for continuous time series



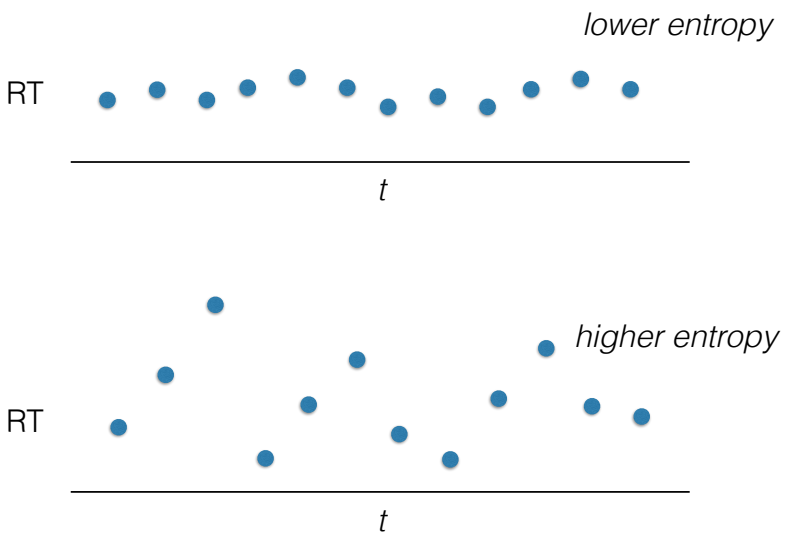
*+ a new measure of **disorder***

entropy

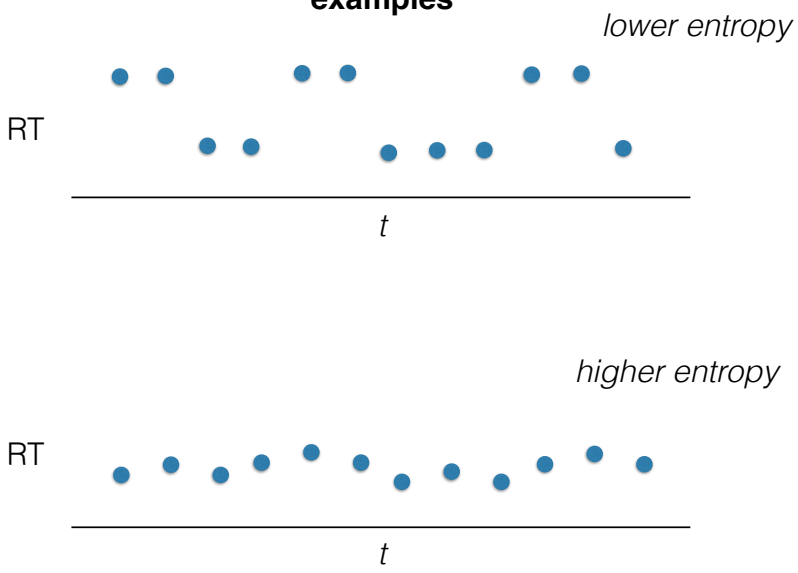
how (in)consistent is the time series in its values?

the higher the entropy, the more general "disorder" in the time series

examples

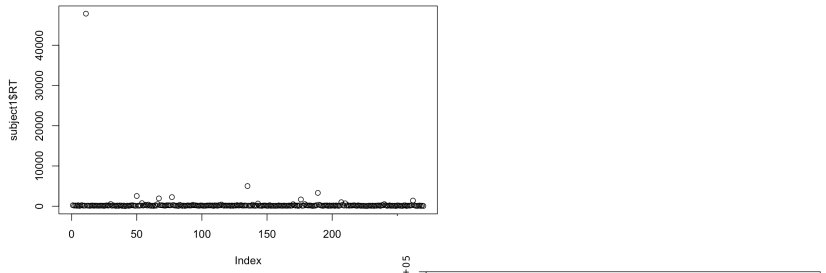


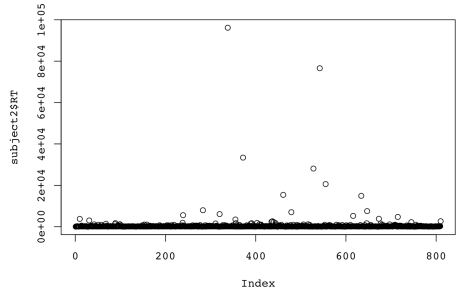
examples



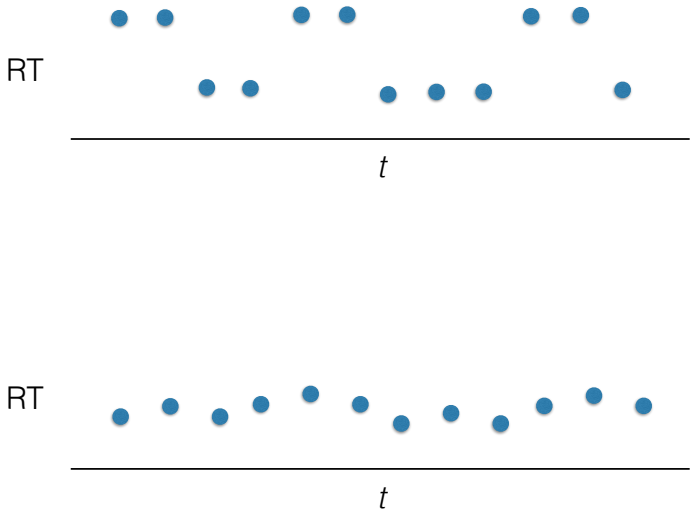
Exercise 4

entropy of differences

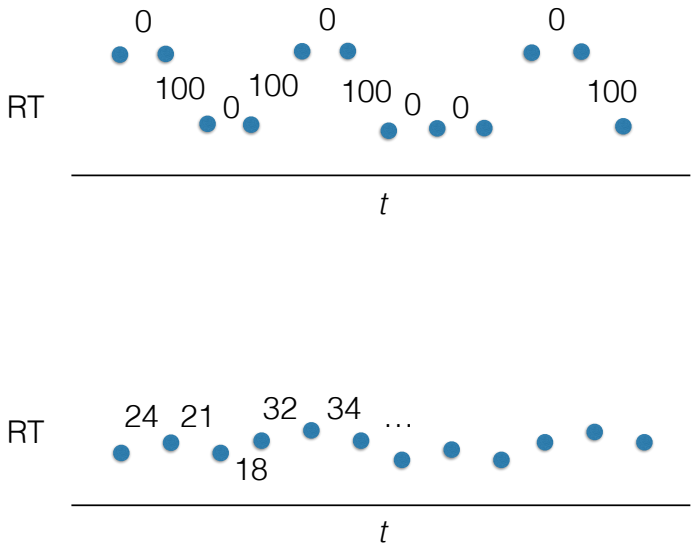




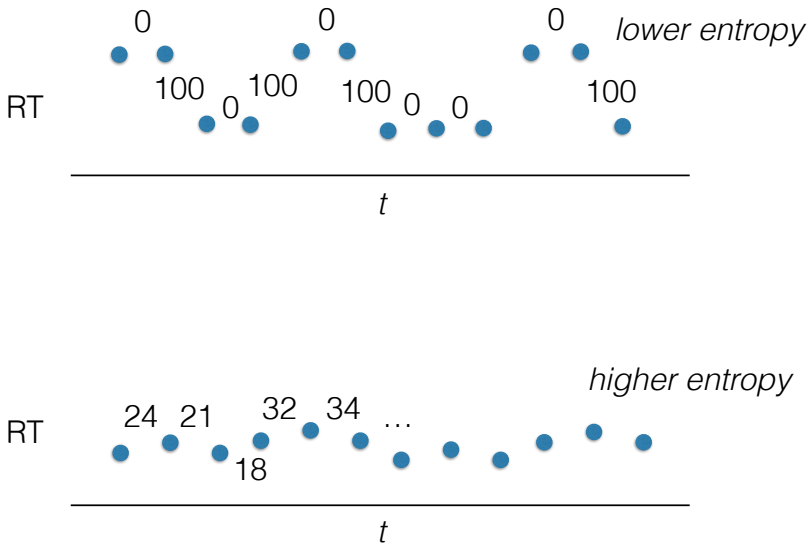
example of taking the difference



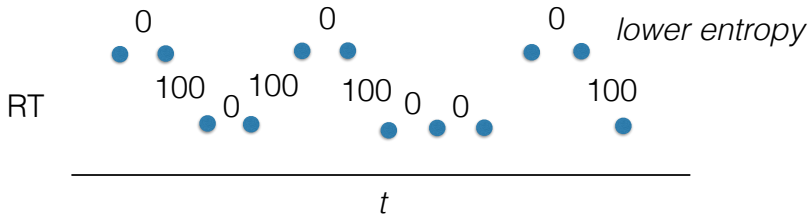
example of taking the difference



example of taking the difference



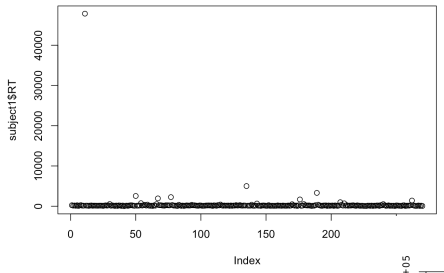
how do we get the difference, like this?

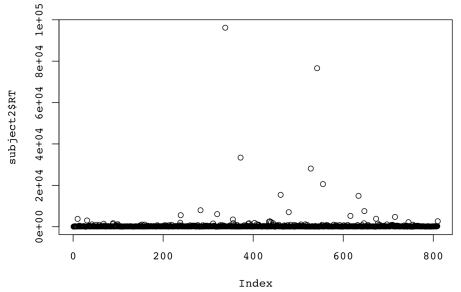



```
differenced_time_series = diff(subject1$RT)
plot(differenced_time_series)
```

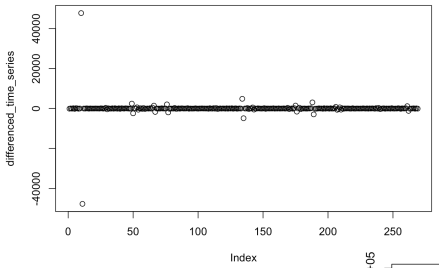
(0, 100, 0, 100, 0, 100, 0, 0, …)

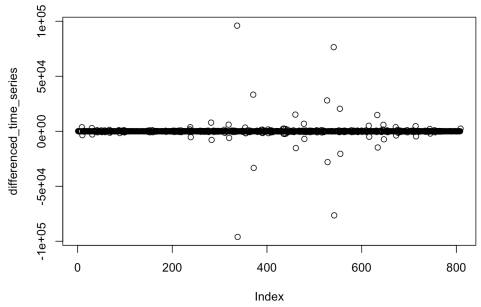
entropy of differences



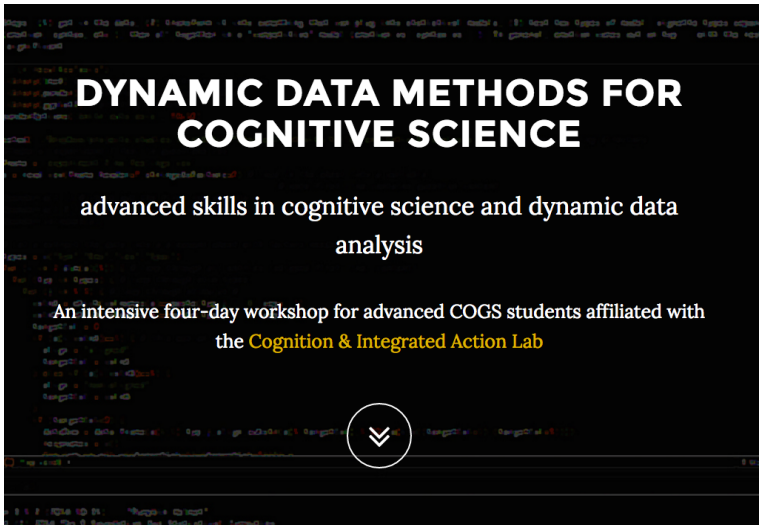


entropy of differences





Exercise 5



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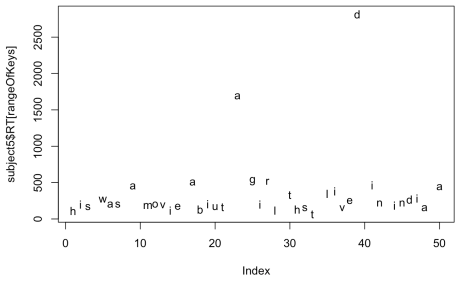
Goals Day 3

- How to **subset** data.
  - E.g.: Deleting outliers from your data (like a 47-second keystroke!?)
  - "*Devilish details.*"
- Analyzing typing **speed for individuals characters** (e.g., 'e' vs. 'p').
  - Which do you think would be faster?
- Experience **collecting dynamic data** with eye tracking.



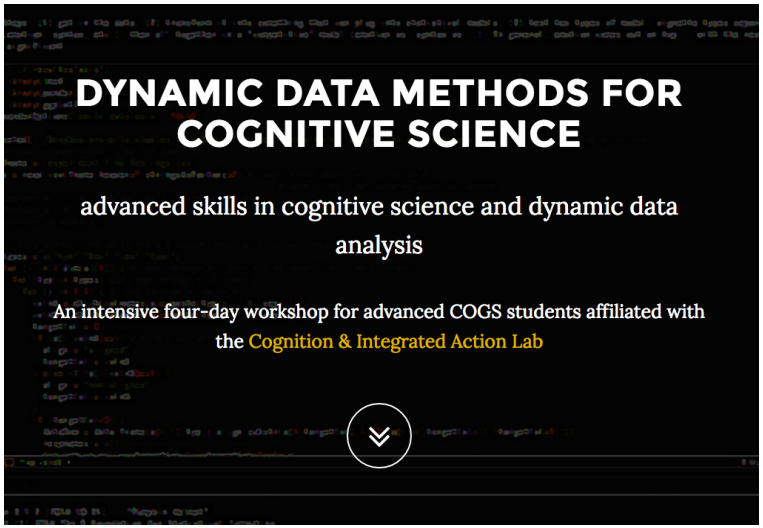
more fun with dynamic data

```
## [1] "his was a movie abiut a girl thst lived in india and a guy whi lived in america  the girl worked in a ban
k and she came across the guys file whos card was being charged for things he did not buy  the girl had alws want
ed to go to san frs  she had told the guy she lived in san fra because her job gad given her a fake name and and
city  the guy yold her he wss going to he in san fra and they could meet if she wanted  sje meet with him wito hi
m and left her parents a note  the girl was supposes to get married but she stared ro fslwith the other guy  the
story contined where her parents caugr her snd bring her back to india  but soon enough the guy realzes that her
relly like her sk he follws her and they fall in love and the girl gets a parent approval  "
```

Plan for Eye Tracking

- Used a **“relay” method** for training
  - I will get things prepped at the back of the room.
  - Kevin will join me, and act as my subject as I show him the tracker.
  - Kevin will then act as me, and train Mario on the eye tracker.
  - Mario will then act as Kevin, and train Mitzy on the eye tracker, etc.
  - …

Exercise 6



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- How to **subset** data.
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  - “*Devilish details.*”
- Analyzing typing **speed for individuals characters** (e.g., ‘e’ vs. ‘p’).
  - Which do you think would be faster?
- Experience **collecting dynamic data** with eye tracking.

Goals Last Day!

- More hands-on training on dynamic data collection (**eye tracking glasses**).
  - Mario VR demo!?
- Case study in a cultural domain: **word frequencies over historical time**.
- Case study **challenge**: I give you some data, some basic code, and you **hack at it**.

Promise of Data

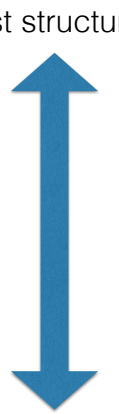
- It is our era… for example, today…

Strategies for Next Steps

What kind of learner are you?

3 Strategies

- 1. Find a structured course online.
  - E.g.: Coursera.
- 2. Find videos and other structured resources.
  - https://www.youtube.com/channel/UC5ktyacv_aPSBmKB7uX5Piw
- 3. Hack, hack away using Google and manuals



Skill Concepts

- Program planning (“logic in pseudo-code”)
  - *Not even actually programming*
- Debugging process
  - When starting out, any time you are writing a script, *run each line as you write it*.
- Learn how to maximize use of online resources
  - Become familiar with *help(function)* or an RStudio reference site that can help (e.g.: r-dir.com).