TIMESERIES

10.31.2018

HOMEWORK 3

* due friday!!!

RECAP

* correlation
  * tells you about the (linear) relationship between two samples
* similar to covariance (but scaled)
* significance can be tested by various methods (bootstrap, permutation, exact test)

TIMESERIES

* lots of experimental data (especially neural recordings) are **timeseries**

* this happens when data is recorded at fixed intervals in time

* e.g. in fMRI we usually get one data point every 2 seconds

* electrophysiological recordings (HW 3 data!) get up to 25,000 data points per second

TIMESERIES

* timeseries are not like other data

* timeseries are *special*

* timeseries have specific properties that should & must be accounted for in analyses

TIMESERIES

* what is it that makes timeseries special?

TIMESERIES

* it’s that data from nearby times are *related*

* i.e. each data point is not independent of the others

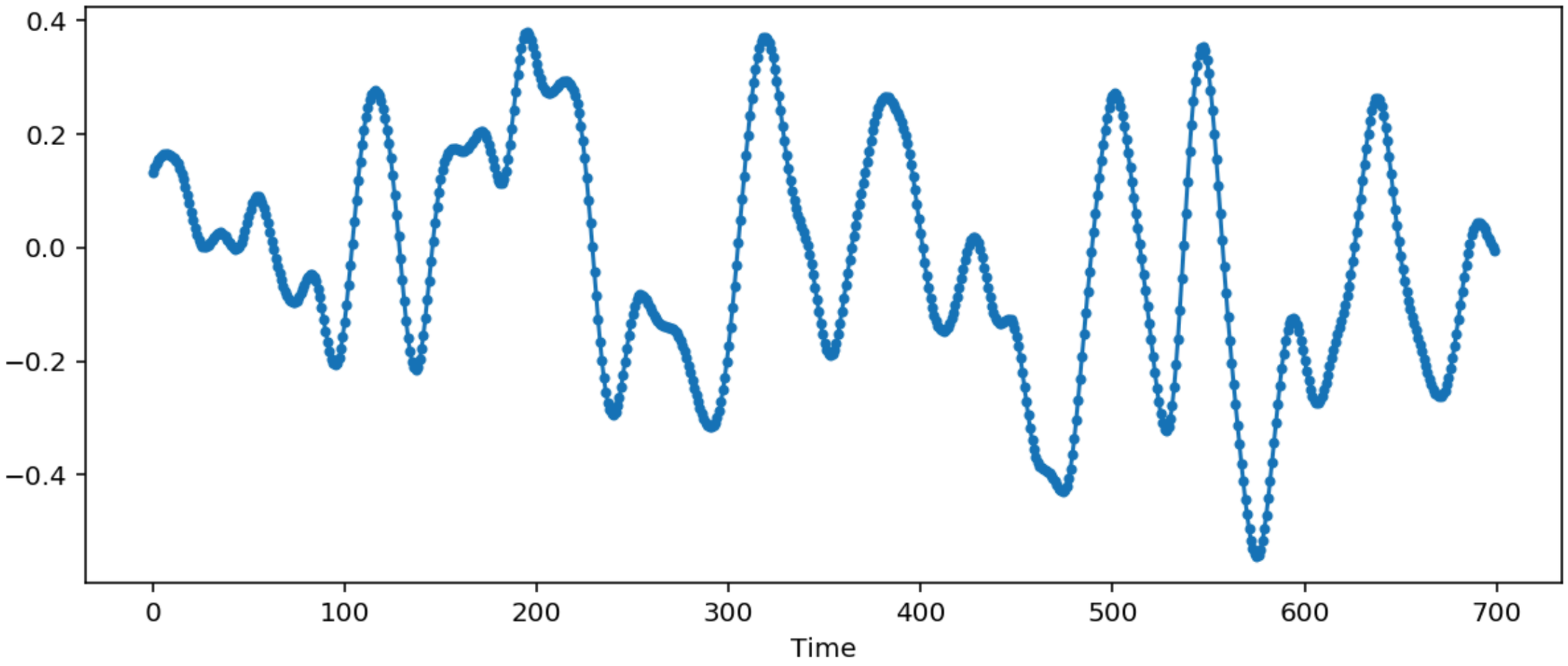
TIMESERIES

* the degree of relatedness often depends on *how* close two data points are to each other in time

* points that are very nearby are often very related

* points that are far away are usually not too related

AUTOCORRELATION



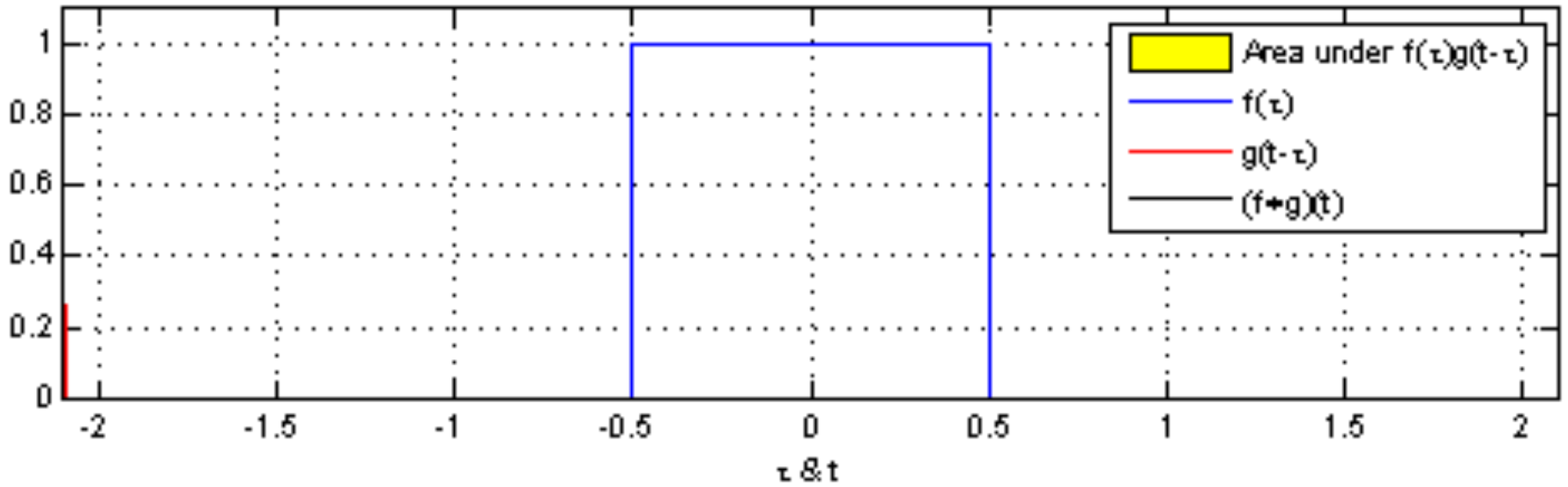
CONVOLUTION

* **convolution** is the most basic & important operation in timeseries analysis

* the convolution between f and g is defined as:

$$(f * g)[n] = \sum_{m=-\infty}^{\infty} f[m]g[n-m]$$

CONVOLUTION



from https://en.wikipedia.org/wiki/Convolution

CONVOLUTION

* another term for convolution that you will often hear is **filtering**

* filtering means convolving your data with a **filter** (often aka a **kernel**)

* a filter/kernel is typically a small array with some specific properties

CONVOLUTION

* for example, we could filter a signal with a kernel that looks like this:

* kernel = [0.25, 0.25, 0.25, 0.25]

CONVOLUTION

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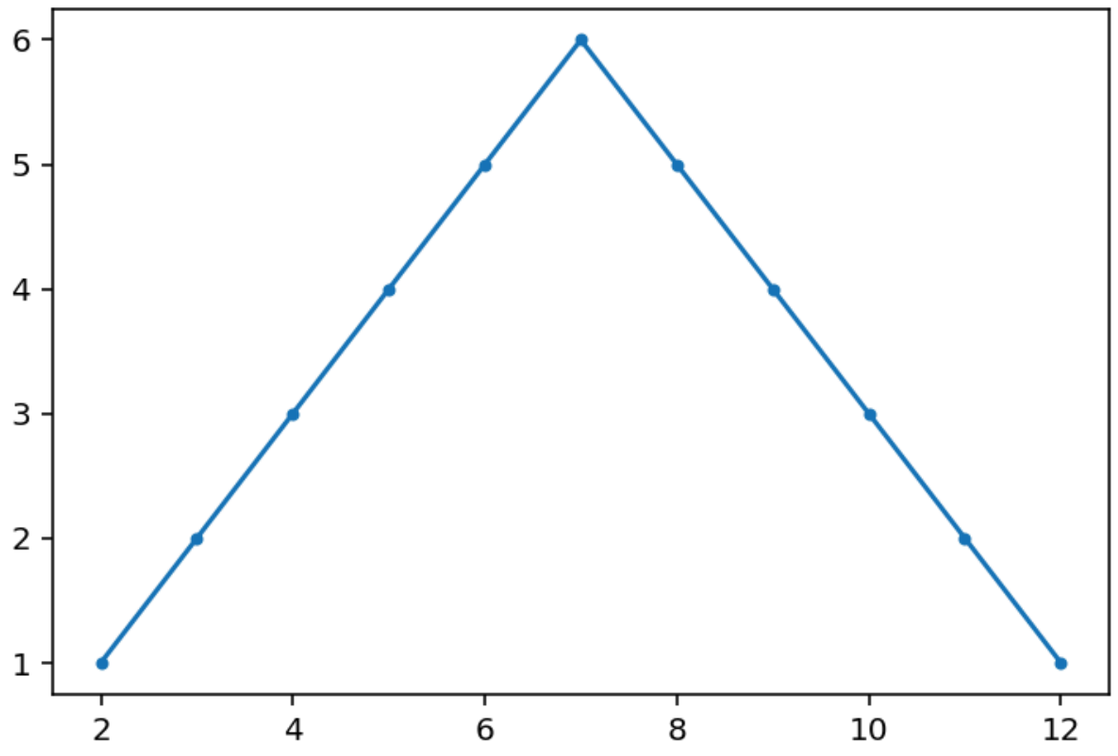
* ^ this will take a running average of every 4 timepoints in the signal!

CONVOLUTION & STATS

* convolution is also important in statistics!
  * suppose X ~ U{1,6}, a random number in the range 1..6 (like throwing dice)
  * suppose also Y ~ U{1,6}
* what is the distribution of X + Y?

CONVOLUTION & STATS

* X + Y ~ U{1,6} ✶ U{1,6}, the convolution of the two probability distributions



CONVOLUTION & STATS

* generally, for the sum of any two random numbers, the distribution is the convolution of their two distributions

CONVOLUTION & STATS

* where else have we talked about adding together random numbers, and what happens to their distributions…?

CONVOLUTION & STATS

* by the central limit theorem, if you convolve *anything* with itself enough times, the result will be a gaussian distribution

NEXT TIME

* Fourier!


END