# CLASS #1

0. Introduce myself and ask students to do the same
1. Hand out revised Course Outline and briefly discuss it
2. Computer exercises : Numerical Recipes OK

   IMSL OK

   "Need to see CODE"

Def. : Time Series a collection or sequence of numbers that represent the state of any system as a function of time (or space or any other "ordering" independent variable).

ex. 1: Can be complex, i.e., $c = a + j\,b$ $\quad j = \sqrt{-1}$

real complex parts

Can be scalars like temperature or sealevel

Can be vectors like ocean current $\vec{u} = (u_{east}, v_{north}, w_{up})$

Can be ~~vectors~~ matrices like spatial patterns $u_{east} = \begin{Bmatrix} u_{east}(x_1, y_1, t) \\ u_{east}(x_2, y_2, t) \\ u_{east}(x_3, y_3, t) \end{Bmatrix}$

ex. 2: discrete series $x(t_i)$ $\quad i = 1, 2, 3, \ldots$

continuous $x(t)$

ex. 3: deterministic, i.e., can in principle be predicted into the future

random (stochastic), i.e., cannot be predicted into the future without stating probabilities (weather)

A

class #1/99

Ensemble, auto-correlation, stationarity, ergodicity

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Begin class #2/99

1. RANDOM
   - STATIONARY
   - NON-STATIONARY

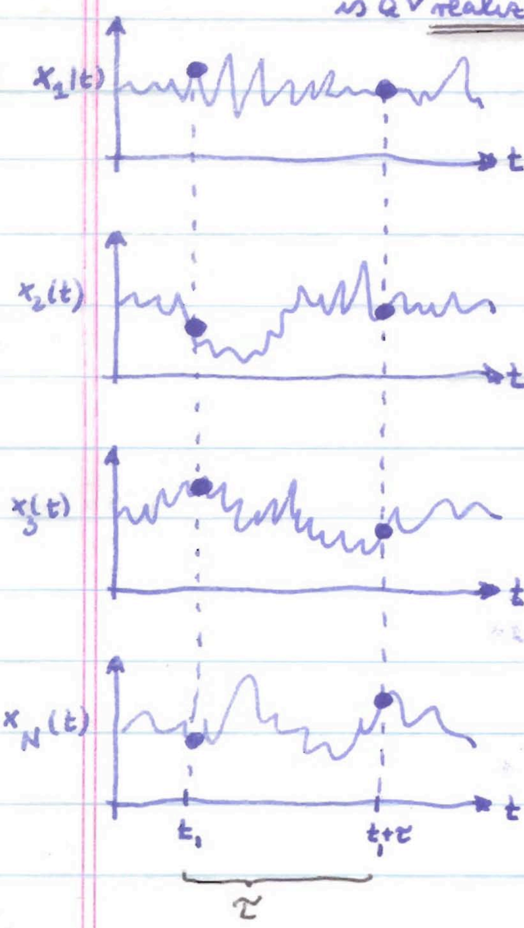
2. DETERMINISTIC
   - PERIODIC
     - (a) Sinusoidal
     - (b) complex periodic
   - NON-PERIODIC
     - (c) almost periodic
     - (d) transient

## 1. RANDOM data

climate change
numerical modeling

Ensemble : Needs to be clearly defined ; "replica" ; repetitions

is a set of realizations of a random process $\{x(t)\} \equiv \{x_1(t), x_2(t), x_3(t), \ldots\}$




experiment #1 : Lab culture 1 - Drifter #1

- " - #2 :

- " - #3 :

- " - #N :

definitions

Mean over ensembles : ~~$\mu_x$~~ $\mu_x(t_1) \equiv \lim_{N\to\infty} \frac{1}{N} \sum_{k=1}^{N} x_k(t_1)$

auto-correlation : $R_{xx}(t_1, t_1+\tau) \equiv \lim_{N\to\infty} \frac{1}{N} \sum_{k=1}^{N} x_k(t_1) \cdot x_k(t_1+\tau)$

If

$\mu_x(t) = \text{const.}$ , i.e., universal mean holds at all times

and

$R_{xx}(t, t+\tau) = R_{xx}(\tau)$ , i.e., auto-correlation does not depend on the start times

then

the process $\{x(t)\}$ is said to be stationary.

→ Now, who can affort to ~~sample~~ redo exactly the same experiment every so often?

If it is at possible to repeat the experiment it is usually prohibitive expensive.

#1 Sept. 5

Many naturally occuring systems (~~also~~ weather, oceans) are not necessarily "repeatable". Try to repeat hurricane "Hugo"

→ events

#2 Sept. 8

→ ALSO : Most observations contain both signals that are deterministic and random, i.e.,

MEASUREMENT = SIGNAL + NOISE

try to separate the two (it ain't easy)

⇒ Assume that the observed process $\{x(t)\}$ is ERGODIC