**Principles of Complex Systems, Vols. 1, 2, & 3D**
**CSYS/MATH 6701, 6713, & a pretend number**
**University of Vermont, Fall 2024**
**Assignment 01**

**"I don't understand the question and I won't respond to it"**
Lucille Bluth, Arrested Development, Public Relations, S1E09.
Episode links: Wikipedia, IMDB, Fandom, TV Tropes.

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**Due:** Monday, September 2, by 5:00 pm
https://pdodds.w3.uvm.edu/teaching/courses/2024-2025pocsverse/assignments/01/
*Some useful reminders:*
**Deliverator:** Prof. Peter Sheridan Dodds (contact through Teams)
**Office:** The Ether and/or Innovation, fourth floor
**Office hours:** See Teams calendar
**Course website:** https://pdodds.w3.uvm.edu/teaching/courses/2024-2025pocsverse
**Overleaf:** LaTeX templates and settings for all assignments are available at
https://www.overleaf.com/read/tsxfwwmwdgxj.

Some guidelines:

1. Each student should submit their own assignment.
2. All parts are worth 3 points unless marked otherwise.
3. Please show all your work/workings/workingses clearly and list the names of others with whom you ~~conspired~~ collaborated.
4. We recommend that you write up your assignments in LaTeX (using the Overleaf template). However, if you are new to LaTeX or it is all proving too much, you may submit handwritten versions. Whatever you do, please only submit single PDFs.
5. For coding, we recommend you improve your skills with Python, R, and/or Julia. The (evil) Deliverator uses (evil) Matlab.
6. There is no need to include your code but you can if you are feeling especially proud.

**Assignment submission:**

Via Brightspace (which is not to be confused with the death vortex of the same name).

Again: One PDF document per assignment only.

1. An amuse-bouche for scaling, to signal the flavors ahead:

   Examine current weightlifting world records for the snatch, clean and jerk, and the total for scaling with body mass (three regressions).

   Do so separately for both women and men's current world records.

   This makes for six regressions.

   For weight classes, take the upper limit for the mass of the lifter.[1]

   For the open category (for women and for men), take the mass of the lifter with the world record. If unknown, omit this one data point.

   Wikipedia is an excellent source.

   (a) Plot each set of data with the best fit regression line along with a adjacent line indicating the 2/3 fit.
   You can do this with just two plots, one for women and one for men, by plotting the three competitions on each axis.
   You can offset the 2/3 line vertically for clarity.

   (b) How well does 2/3 scaling hold up?
   Is 2/3 scaling over, under, or thereabouts?
   Optional: support your observation by making mention of the errors reported by the linear regression method you used.

   (c) Normalized by the scaling you determine, who holds the overall, rescaled world record?
   Again, there are six of world records.
   Normalization here means relative:

   $$100 \times \left( \frac{M_{\text{world record}}}{cM^{\beta}_{\text{weight class}}.} - 1 \right),$$

   where $c$ and $\beta$ are the parameters determined from a linear fit.

2. Some kitchen table preparation for for power-law size distributions:

   Consider a random variable $X$ with a probability distribution given by

   $$P(x) = cx^{-\gamma}$$

   where $c$ is a normalization constant, and $0 < a \leq x \leq b$. ($a$ and $b$ are the lower and upper cutoffs respectively.) A Perishing Monk tells you to assume that $\gamma > 1$, that $a > 0$ always, and allow for the possibility that $b \to \infty$. And then the Monk disappears.

[1] In general, and beyond weightlifting, athletes will try to be at the upper weight limit of their sport.

(a) Determine $c$.

(b) Why did the Perishing Monk tell us to assume $\gamma > 1$?
Think about what happens as $b \to \infty$.