Principles of Complex Systems, CSYS/MATH 300
University of Vermont, Fall 2019
Assignment 01 – Code Name: "Conspiracy Theories and Interior Design"

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November 7, 2019

These are solutions I've written to assignment 01 of UVM's course "Principles of Complex Systems", CSYS/MATH 300, from Fall 2019. I am independently studying topics in complex systems, and am currently doing the assignments from UVM's PoCS (principles of complex systems) and CoCoNuTs (complex networks) courses.

This assignment focuses on scaling.

Problem 01

Use a back-of-an-envelope scaling argument to show that maximal rowing speed V increases as the number of oarspeople N as $V \propto N^{1/9}$.

Via assumptions (a)–(g), we have the following scaling proportions:

1. $P \propto D_f \times V$
2. $D_f \propto V^2 \times \ell^2$
3. $\delta_\omega \propto N$
4. $\delta_d \propto \ell$
5. $P \propto N$

and, via isometric scaling of ℓ, we have

$$\delta_\omega \propto \delta_d^3 \equiv \delta_d \propto \delta_\omega^{1/3}$$

and so we can determine

1. $V \propto \frac{P}{D_f}$
2. $V \propto \frac{N}{V^2 \times \ell^2}$
3. $\ell^2 \times V^3 \propto N$
4. $\delta_d^2 \times V^3 \propto N$
5. $\delta_\omega^{2/3} \times V^3 \propto N$
6. $N^{2/3} \times V^3 \propto N$
7. $V^3 \propto N^{1-2/3} \implies V^3 \propto N^{1/3}$
8. $V \propto N^{\frac{1/3}{3}}$
9. $V \propto N^{1/9}$

■ Problem 02