

Stat 471: Homework 02

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Due Date: October 10, 1:20pm. No late assignments will be accepted or graded. There will be 10% bonus points for exceptional solutions. Do not use any built in random number generators other than your own random number generators.

1. (Computational) The data in <http://www.stat.wisc.edu/~mchung/teaching/data/strength.data> is from Blakely *et al* (1995, Journal Personnel Psychology). There are two measurements **arm** and **grip** that measure the strength of construction workers. Check if two measurements follow a bivariate normal distribution.
2. Based on standard normal random number generator you built in homework 1, write a function that generate 4D random vector $X = (x_1, x_2, x_3, x_4)'$ whose components are normally distributed with the following covariance matrix

$$\mathbf{Cov}(\mathbf{vec}(X)) = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix} \otimes \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}.$$

3. If the singular value decomposition of X is $X = UDV'$ (see Lecture 8), show that $VD^{-1}U'$ is the Moore-Penrose generalized inverse of X .
4. Using data in problem 1, fit the data with the following model

$$\mathbf{grip} = \alpha_0\phi_0(\mathbf{arm}) + \alpha_1\phi_1(\mathbf{arm}) + \epsilon,$$

where ϕ_1 and ϕ_2 are the first two Hermite polynomials. What is the expected grip strength when the person has the arm strength of 200 pounds? Compare your model with the linear model $\mathbf{grip} = \beta_0 + \beta_1\mathbf{arm} + \epsilon$ studied in Lecture 9.

5. Compute the digits of the constant e upto 3 decimal places only using the exponential random number generator studied in Lecture 2 and the concept of Monte-Carlo integration.