

# PhD - Introduction to Computing I

Afrasiab Mirza

January 13, 2011

## Basic Problems

1. Create a matrix with 10 rows and 4 columns. The numbers in the matrix should be random integers within 10 to 100.
  - (a) Find the maximal values in each column.
  - (b) Find the maximal values in each row.
  - (c) Find the maximal entry in the matrix.
  - (d) Find the index of this entry (row and column).
  - (e) Create a matrix with the same dimensions in which all entries equal the maximal value that you found in d).
  - (f) Calculate the difference between the matrix from e) and the original matrix.
  - (g) Find all the entries that are less than 40 and more than 20. Can you do it in one line?
2. Random Quantities.
  - (a) Create a vector  $x$  with 100 random entries between 0 to 1.
  - (b) Create a vector  $y$  with 100 random entries between 0.1 to 1.1.
  - (c) Calculate the mean, range and standard deviation for each vector.
  - (d) Check the null hypothesis that the two vectors are from the same distribution (use `ttest2` or `ttest`).
  - (e) Find how many members of  $x$  are greater than their corresponding members in  $y$ .
  - (f) Find the greatest difference between  $x$  and  $y$ .

### More Difficult

1. How good is the default random number generator? Draw a vectors random numbers,  $X$ , of size  $10, 10^3, 10^6$ . Then compute the correlation between  $X_t$  and  $X_{t-l}$  for  $l = 1, 2, 3, 4$ .
2. Compute the mean and variance of the following random variables using a sample of size  $10, 10^3$ :
  - (a)  $U(0, 1)$
  - (b)  $N(0, 1)$
  - (c)  $\chi^2(1)$
3. Illustrate the CLT for the uniform random variables.
4. The data for this question is in testdata.dat.
  - (a) regress precipitation on month and lagged-month
  - (b) run a t-test to test if each of the coefficients is significant
  - (c) run an f-test to test if both coefficient are jointly significant
5. Solve the following problems:

(a)

$$\max_{x,y} \sqrt{xy} - x - y$$

(b)

$$\begin{aligned} \max_{x,y} & -x_1x_2x_3 \\ \text{s.t.} & 0 \leq x_1 + 2x_2 + 2x_3 \leq 72 \end{aligned}$$