Yerevan State University
Applied Statistics with R
Midterm 1 Exam Test

30 October, 2018

Exam Time: 19:00 - 21:00

Last Name: _____ **First Name:** _____

READ THESE INSTRUCTIONS CAREFULLY

- This test consists of 6 Show-Work Problems. The test booklet has 16 pages, including this cover page and empty pages for draft calculations.
- Each Show-Work Problem has its own grade. The overall test grade is 100.
- This is a closed-book test, and no notes, assignments, practice problems, books, formula sheets or other materials are allowed.
- The use of mobile phones or any other electronic devices are strongly prohibited. Please turn off your cell phones and place them out of reach. You can use only simple calculators.
- Sharing of stationery (pens, pencils, erasers, etc.) or calculators is not permitted.
- Talking to another student, looking at another student's paper, or communicating with other students in any way is strictly forbidden.
- Use the scratch pages of the test booklet to do your draft calculations. Please ask the instructor for extra scratch papers if necessary.
- If you run out of the space on the test pages, please use a scratch page to finish your work. Indicate in the test page that you will continue on the scratch page, and mark with the rectangle the portion on the scratch page that contains the solution. Any other work on the scratch page will not be graded.
- Good luck!

DO NOT OPEN THIS BOOKLET
UNTIL YOU HAVE BEEN TOLD TO DO SO

Scratch Paper

Show-Your-Work Problems

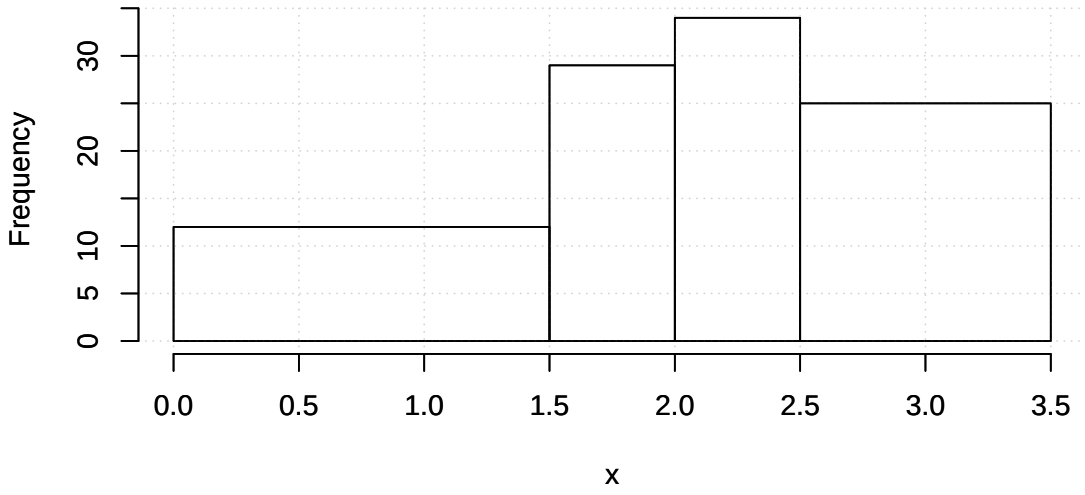
1. (10 Points) Below is the Frequency Histogram for some dataset x (left-endpoint convention is used).

   a. Find the number of data points (observations) in x;

   b. Find the approximate median of x. Explain your reasoning;

   c. Construct the Density Histogram of x with the same bins.

   Show and explain all your steps.



Scratch Paper

2. (10 Points) Assume

$$x: \ -5,\ 3,\ -3,\ 2,\ 4,\ -11,\ 10 \qquad \text{and} \qquad y = -x + 10$$

   a. Draw the BoxPlots for x and y, separately;
   b. Calculate the Mean Absolute Deviation from the Mean $MAD(x)$, and $MAD(y)$;
   c. Calculate $cor(x, y)$;
   d. Give the scatter plot of (x, y).

   Show and explain all your steps.

Scratch Paper

3. (20 Points) Consider the following dataset:

$$x: \quad -1, 0, 3, 0, 4, -1, 2, 1, 0, \alpha.$$

   a. Find all α-s, for which $range(x) = 5$;
   b. Only for this part assume $\alpha \geq 4$. Find all α-s, for which α will be an outlier for x.
   c. (Supplementary, will not be graded) Find all α-s, for which $median(x) = 0$.

   Show and explain all your steps.

Scratch Paper

4. (20 Points) Let

$$x: \ \ 2,\ 1,\ 0,\ 1,\ -1,\ 0,\ -2,\ 3,\ 3,\ 1$$

and

$$\mathcal{U} = Unif[-1,2]$$

be the Uniform Distribution in $[-1,2]$.

   a. Construct the Q-Q Plot of x versus $\mathcal{U}$, by plotting the 25%, 40% and 80% quantiles.
   b. Is it possible that x is generated form $\mathcal{U}$? Explain your reasoning.

   Show and explain all your steps.

   Note: The PDF of the $Unif[a,b]$ distribution is given by $f(x) = \dfrac{1}{b-a}$, if $x \in [a,b]$, and $f(x) = 0$ otherwise.

Scratch Paper

5. (20 Points) Consider the following dataset given in the form of the Frequency Table:

Unique Values	Frequencies	Relative Frequencies
-2	10	$\frac{2}{13}$
0		$\frac{1}{13}$
1	30	
2		

a. Calculate Missing Values in the table;
b. Calculate the Sample Mean and Median of this dataset;
c. Plot the ECDF of this dataset.

Show and explain all your steps.

Scratch Paper

6. (20 Points) Assume we have a dataset of observations

$$(x, y): \quad (x_1, y_1),\ (x_2, y_2),\ ...,\ (x_n, y_n),$$

where x_i is the height of the i-th person in Meters, and y_i is that person's weight in Kilograms. How the covariance of x and y will be changed, if we will calculate x in Centimeters and y in Grams? Express the relationship in exact mathematical terms and prove your assertion.

Show and explain all your steps.

Scratch Paper

Scratch Paper

Scratch Paper