

# Computer Assignment 2

Use SPSS to do the computations. Print the SPSS output and submit it. Use the SPSS output to answer the questions neatly on a separate and clean piece of paper.

## 1 Purpose

By using SPSS, we will generate sets of random numbers. This is a process which forms the basis of randomly selecting elements of a sample or of assigning treatments to subjects in a design of experiment or of applying Monte Carlo techniques to obtain numerical answers to very difficult computational problems.

We will first generate 30 random numbers which follow a discrete Uniform probability distribution and then another set of 30 random variables which follow a Normal distribution. Based on these two sets of random numbers, you will draw their histograms, and you will draw histograms of their z-scores.

According to theory, the more observations which are taken, the better the histograms approach the shape of the probability distributions. If we were to generate 100 numbers instead of 30 random numbers, the histograms would look even nicer.

For both sets of random numbers, you will calculate descriptive statistics.

## 2 Generate Random Numbers Using SPSS

1. Invoke SPSS
2. Under the `Data` menu select `Insert Variable`. Call it `v1`.
3. Select `Insert Case` from the `Data` menu. A missing value symbol “.” should appear in the first cell under variable `v1`. Highlight that cell, copy, and paste it in 29 highlighted cells under `v1` so that 30 empty cells will exist under `v1`.
4. Under the `Transform` menu, select `Compute Variable`. In the resulting screen, put `v1` in the box labeled `Target Variable`. In the list of functions, scroll down and select `RV.UNIFORM`. (Press the arrow boxes in the window with your cursor). We will generate 30 random numbers from a  $U(2, 8)$  by means of this SPSS function.
5. After you clicked `OK`, acknowledge the `change existing variable` warning, so that 30 numbers will appear under `v1`. You will notice that they are decimal numbers. The uniform distribution which SPSS provides is the one for a continuous random variable. Let us generate random numbers for a discrete random variable instead as if we are tossing a fair die.

6. Go back to `Compute` in the `Transform` menu. Put your cursor in the box where `RV . UNIFORM` is shown and type in the box the following command:  
`RND (RV . UNIFORM (2 , 8 ) )`. The function `RND` will round the uniform random numbers to produce integers. However, we need to compensate for round-off error on the end points; so type again so that you will see:  
`RND (RV . UNIFORM (2 - .4999 , 8 + .4999 ) )`. Click `OK`, acknowledge that you will overwrite the values for `v1` to produce 30 random numbers from a  $U(2,8)$  discrete distribution.
7. Generate a second column of random numbers like before but call the `Target Variable` `v2`.
8. Go back to `Compute` in the `Transform` menu. Put your cursor in the box where `RV . UNIFORM` is shown and type in the box the following command: `RV . NORMAL ( 5 , 2 )`. This command will generate 30 random numbers from a  $N(5, 4)$  distribution.

Answer the following questions.

- Question 1 : *What are the expected value and variance of the discrete Uniform random variable starting at 2 and ending at 8? Hint:  $E[V] = \frac{a+b}{2}$  and  $var(V) = \frac{(b-a)(b-a+2)}{12}$*
- Question 2 : *What are the sample mean and sample variance of v1?*
- Question 3 : *What are the expected value and variance of the Normal random variable  $X \sim N(5, 4)$ ?*
- Question 4 : *What are the sample mean and sample variance of v2?*

### 3 Construct z-scores

1. Go back to `Compute` in the `Transform` menu. Enter `v3` for the `Target Variable`. Put your cursor in the box where `RV . NORMAL` is shown and type in the box the following command: `(v1-muhat) / s` where `muhat` is the sample mean of `v1` and `s` is the sample standard deviation which you calculated in Question 2. Click `OK` to produce 30 sample z-scores of `v1` which came from a discrete Uniform distribution.
2. Go back to `Compute` in the `Transform` menu. Enter `v4` for the `Target Variable`. Put your cursor in the box where `(v1-muhat) / s` is shown and type in the box the following command: `(v2-muhat) / s` where `muhat` is the sample mean of `v2` and `s` is the sample standard deviation which you calculated in Question 4. Click `OK` to produce 30 sample z-scores of `v2` which came from a Normal distribution.

- Question 5 : *What are the sample mean and sample variance of v3?*
- Question 6 : *What are the sample mean and sample variance of v4?*
- Question 7 : *Make four histograms, one each for v1, v2, v3, and v4?*
- Question 8 : *If the number of random numbers were to become very large like a billion of them, to what number should the sample mean of v3, the z-scores of a discrete Uniform, converge and to what number should the sample variance of v3 converge?*

Question 9 : *If the number of random numbers were to become very large like ten billion of them, to what number should the sample mean of  $v_4$ , the z-scores of a Normal, converge and to what number should the sample variance of  $v_4$  converge?*

Question 10 : *Why should the answers of Question 8 be the same as the answers in Question 9 even when the two original distributions are completely different?*