15.075 Statistical Thinking and Data Analysis

Computer Exercises 1
Due October 13, 2011

Instructions: Please solve the following exercises using Matlab. One simple way to present your solutions is to copy all of your code and results (plots, numerical answers, etc.) into a Word document, which you should submit in class. There is no online submission.

Exercise 1

Write a Matlab script that calculates the mean and median of a sample of 100 uniform random numbers between 0 and 2 and the percentage of points in the sample that are greater than 1.

Solution

Here is the script and the results for my iterations:

```
clear all;
clc;

n = 100;

% Generate 100 uniform random numbers between 0 and 2
x = 2*rand(n,1);

% Calculate the mean
mu = mean(x);

% Calculate the median
med = median(x);

% Find the percentage of points greater than 1
per = sum(x>1)/n;
```

```
mu =

    1.0089


med =

    0.9841


per =

    0.4900
```

Exercise 2

a. Generate a vector of 1000 normal random numbers with mean 8 and variance 25.
b. Calculate how many elements in the vector are greater than or equal to 9.
c. What is the sample mean and standard deviation for this sample of 1000 numbers?
d. What are the 25^{th} and 75^{th} percentiles of the normal distribution with mean 8 and variance 25?
e. What are the 25^{th} and 75^{th} percentiles of the sample of the 1000 normal random numbers generated in part (a)?
f. Find Φ(0.789) and Φ(-0.543). (Remember Φ is the cumulative density function for the standard normal distribution.)

Solution

Here is the script and the results for my iterations:

```
clear all;
clc;

n = 1000;
mu = 8;
sigma = 5;

% a.    Generate a vector of 1000 normal random numbers with mean 8 and
variance 25.
x = sigma*randn(n,1)+mu;

% b.    Calculate how many elements in the vector are greater than or equal
to 9.
num = sum(x>=9)

% c.    What is the sample mean and standard deviation for this sample of
1000 numbers?
sample_mean = mean(x)
sample_std = std(x)

% d.    What are the 25th and 75th percentiles of the normal distribution
with mean 8 and variance 25?
q1 = norminv(.25,8,5) % or q1 = 5*norminv(0.25)+8
q3 = norminv(.75,8,5) % or q1 = 5*norminv(0.75)+8

% e.    What are the 25th and 75th percentiles of the sample of the 1000
normal random numbers generated in part (a)?
s_q1 = quantile(x,0.25)
s_q3 = quantile(x,0.75)

% f.    Find ?(0.789) and ?(-0.543).
normcdf(0.789)
normcdf(-0.543)

num =

   428


sample_mean =
```

```
    8.0511

sample_std =

    4.9974

q1 =

    4.6276

q3 =

   11.3724

s_q1 =

    4.7150

s_q3 =

   11.2380

ans =

    0.7849

ans =

    0.2936
```

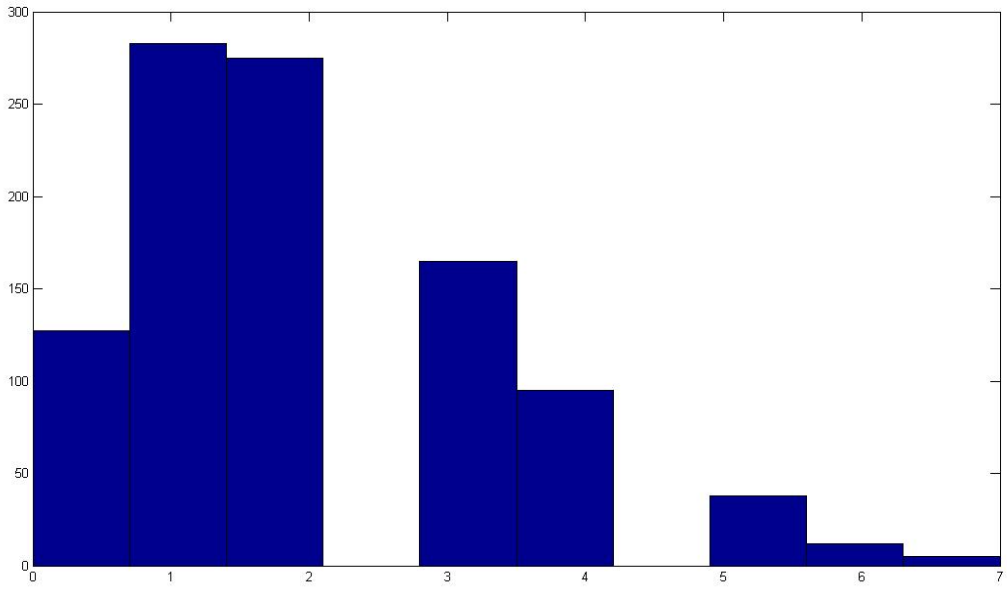
Exercise 3

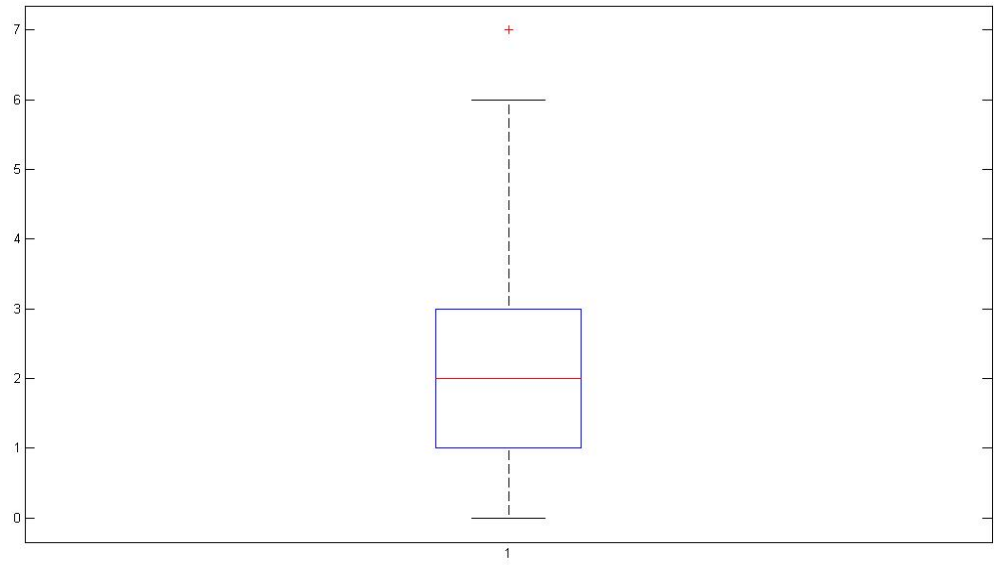
a. Generate a vector of 1000 Poisson random numbers with $\lambda = 2$.
b. Make a histogram and a boxplot of the 1000 numbers from part (a).

Solution

Here is the script and the plots for my iterations:

```
clear all;
clc;
close all;

n = 1000;
lambda = 2;

% a.    Generate a vector of 1000 Poisson random numbers with ? = 2.
x = poissrnd(lambda,n,1);

% b.    Make a histogram and a boxplot of the 1000 numbers from part (a).
figure;
hist(x);

figure;
boxplot(x);
```




7
6
5
4
3
2
1
0
1

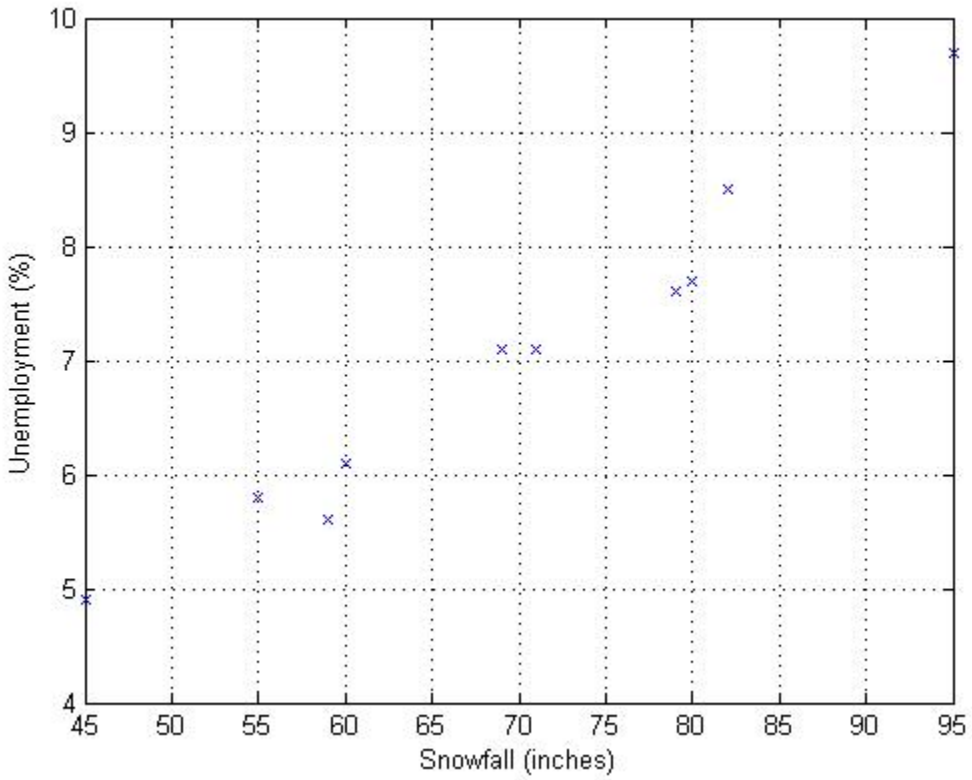
Exercise 4

Answer questions (a) – (c) from 4.36 in your textbook.

Solution

Here is the script and a scatterplot:

```
clear all;
close all;
clc;

snowfall = [45 59 82 80 71 60 55 69 79 95];
unemployment = [4.9 5.6 8.5 7.7 7.1 6.1 5.8 7.1 7.6 9.7];

% Scatterplot
plot(snowfall, unemployment, 'x');
grid;
xlabel('Snowfall (inches)');
ylabel('Unemployment (%)');

% Calculates the correlation coefficient
rho = corr(snowfall',unemployment');
```



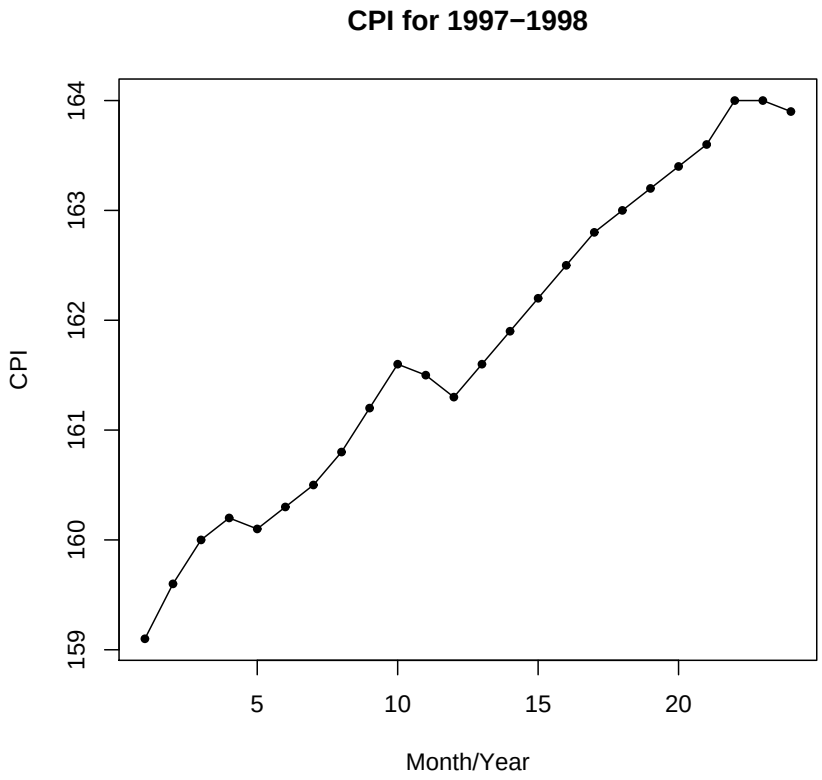
rho =

0.9835

A strong linear positive relationship is indicated by both the scatter plot and the correlation coefficient. This relationship does not mean that the snowfall influences the national unemployment rates or vice versa. It means that there is an association between them.

4.44

a. Below is a time-series plot of the data. There is an increasing trend, so no, the time-series does not appear to be stationary.



b,c. The moving averages and exponentially weighted moving averages are listed below. The MAPE is 0.2655% and 0.5679% for MA and EWMA respectively.

MA	EWMA
159.1000	159.1000
159.3500	159.2000
159.5667	159.3600
159.9333	159.5280
160.1000	159.6424
160.2000	159.7739
160.3000	159.9191
160.5333	160.0953
160.8333	160.3162

```
161.2000  160.5730
161.4333  160.7584
161.4667  160.8667
161.4667  161.0134
161.6000  161.1907
161.9000  161.3926
162.2000  161.6140
162.5000  161.8512
162.7667  162.0810
163.0000  162.3048
163.2000  162.5238
163.4000  162.7391
163.6667  162.9913
163.8667  163.1930
163.9667  163.3344
```

d. We have $r_1 = 0.8694$, $r_2 = 0.7380$, and $r_3 = 0.6149$. So CPI in successive months have a rather strong positive correlation, but the correlation grows weaker with CPI's removed farther apart.

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