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University Examinations 2012/2013

THIRD YEAR, FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE AND BACHELOR OF SCIENCE IN STATISTICS

SMA 2311: STATISTICAL PROGRAMMING II

DATE: AUGUST 2013 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

a) The R function $rep\ (m, n)$ is used to compute a vector of number where m and n are natural numbers. The following program was written using $rep(m, n)$

>id<-rep(1:4, each = 8)

i. What is the program supposed to do? (3 Marks)

ii. Determine the output of the program clearly showing each of the steps followed. (3 Marks)

b) A researcher wrote the following R programme.

```
>v1<-seq(1:11)
>v2<-seq(-5,5by=1)
>in.product<-t(v1)%*%v2
>in.product
```

i. Explain each line of the code. (4 Marks)

ii. Determine the output from the line two above. (3 Marks)

iii. Determine the output from line four above. (3 Marks)

c) The data below represents the profits (in million Kenya shillings) made by certain financial firm in Kenya from the year 2000 to 2009.

Years (Y)	200	2001	2002	2003	2004	2005	2006	2007	2008	2009
Profits (x)	15	12.5	20	18.6	19	25	30	15	13	40

i. Write a well commented programme in R that fits the least squares estimates of β_0 and β_1 using the R function. (6 Marks)

ii. Using the results of (i) above write a program that predicts the sales for the years 2010. (2 Marks)

d) Consider the following integral equation

$$\int_0^\infty \frac{1}{(x+1)\sqrt{x}}\,dx$$

Carefully, write a well commented program in R that solves the above equation and give the value of your integral. (6 Marks)

QUESTION TWO (20 MARKS)

a) Write short notes on the following R syntax. (6 Marks)

i. $Y\sim -1+A$

ii. $Y\sim A+B$

iii. $Y\sim A$

b) Consider the following R code

```
>value <- c (1,3,4, rep(3,40, seq (from=1, to=6,by=2))
>value
```

Write the output of the above program. (3 Marks)

c) The following output was generated using the command dim(value), assuming the 6 values were generated using a random command, write a well commented program in R that generated this output. (4 Marks)

	[, 1]	[, 2]	[, 3]
[1,]	0.7093460	-0.864345	-0.1093764
[2,]	-0.3461981	-1.7348805	1.8176161

QUESTION THREE (20 MARKS)

The following data represents alcohol concentration in the blood sample of 10 drivers along a certain road as well as their driving speeds.

Alcohol concentration	1.71	1.39	1.15	1.33	1.00	1.03	1.68	1.76	1.34	1.55
Speed km/hr	60	100	93	78	80	99	120	125	83	61

a) If you wish to analyze the above data using regression, write the basic syntax for regression analysis in R. (2 Marks)

b) Write a well commented program in R that does the following

i. Reads in the data. (3 Marks)

ii. Fits a linear modes to the data but provides no further statistical information to the model. (3 Marks)

iii. Provides a complete statistical summary of the model. (3 Marks)

iv. Gives the residual errors in Y. (3 Marks)
v. Gives the predicted values for Y. (3 Marks)
vi. Visually examines the model using plots. (3 Marks)

QUESTION FOUR (20 MARKS)

a) Define the description of the following logical expressions as used in R
   i. !x
   ii. xly (4 Marks)

b) The following product was written using inner.product in R.

```
>data1<-seq(1,10)
>data1seq(11,20)
>in.prod<-t(data1)%*%data2
>in.prod
```

Determine the output of the above code clearly showing your workings. (4 Marks)

c) Consider the following program that was written correctly by a student in statistical programming.

```
>Xij<-matrix(seq(1:40),ncol = 4)
>rownames(Xij)<-paste("S",seq(1, dim(Xij([1]), sep="")
>colnames(Xij)<-paste("V",seq(1,dim(Xij)[2]),sep="")
>Xij
```

   i. Explain each line of the above code. (4 Marks)
   ii. Determine the output from the line four above. (8 Marks)

QUESTION FIVE (20 MARKS)

a) Consider the following system of linear equation

$x_1 + 2x_2 + 3x_3 + 4x_4 + 5x_5 = 7$
$2x_1 + x_2 + 2x_3 + 3x_4 + 4x_5 = -1$
$3x_1 + 2x_2 + x_3 + 2x_4 + 3x_5 = -3$
$4x_1 + 3x_2 + 2x_3 + x_4 + 2x = 5$
$5x_1 + 4x_2 + 3x_3 + 2x_4 + 5x_5 = 17$

   i. Write a well commented program in R that creates a matrix of the coefficient. (5 Marks)
   ii. Creates a column vector of the known values. (3 Marks)
   iii. Displays the column vector. (2 Marks)
   iv. Solves the equation. (3 Marks)

b) Suppose that we want to minimize the function $f(x1; x2) = \cos h\,(x1x2 + 2) + \cos h\,(x1 + 3x2 - 5) - 2$ starting with the guess x~(5; 9)

Write a well commented R code that performs the algorithm. (4 Marks)

c) Give the definition of the following arguments as used in R for optimization. (3 Marks)

i. Fn
ii. Par
iii. gr