2104529 Computational Method for IE
Workshop 1: Basic in R Programming

Question 1

Consider a dice experiment that a player roller three dices. The outcome of the experiment is the summation of dices.

(a) If dices are fair, what is the descriptive statistic of the outcomes as well as its visualization

(b) If dices are fair, what it the distribution of the outcome? Does the outcome normally distributed?

(c) what happen if If dices are bias.

Question 2

Consider *multiplication table* 20×20, particularly

	1	2	3	$\cdots$	20
1	1	2	3	$\cdots$	20
2	2	4	6	$\cdots$	40
$\vdots$				$\ddots$	$\vdots$
20	20	40	60	$\cdots$	400

(a) create the table using R/RStudio (**hint:** There are two ways to complete this assignment: for$(\cdot)$ loop, outer$(\cdot)$)

(b) [0 points (bonus)] use outer$(\cdot)$ to create additive, subtraction, and power tables

(c) [0 points (bonus)] access diagonal/ upper triangle/ reverse diagonal of the matrix

(d) [0 points (bonus)] compute det$(\cdot)$ explain the mathematical implication of result

Question 3

Consider of the following cash flow of project if an annual investment interest rate is 8%.

Year	0	1	2	3	4	5	6
Cash flow	-1350	363	551	681	761	821	1467

(a) determine *Net Present Value*, *Payback Period*, and *Internal Rate of Return*

(b) [0 points (bonus)] implement combined variation of interpolation and BiSection Search and compare the result with polyroot$(\cdot)$ when compute IRR

Question 4

A 10-year, 12 % semiannual coupon bond, with a par value of \$1000 may be called in 4 years at a call price of \$1060. The bond sells for \$1100 (Assume that the bond has just been issued.)

(a) What is the bond's yield to maturity?

(b) What is the bond's yield to call?

(c) [0 points (bonus)] plot the yield curves (both maturity and call) if the bond is traded between 900 to 1200 THB

Question 5

Consider a 12-Years 7.980000% of annual coupon bond of BANPU plc issued on 01-Apr-11 with a par value of THB1000. Answer the following questions

(a) If such bond trades at THB1020 on 01-Apr-11, should we buy it?

(b) What is the **spread** of this bond comparing to Thai bonds (Yield Curve: `thYeild-20130401.csv`)?

- import Thai risk free bonds data on 02-Apr-13: `thYeild-20130401.csv`
- generate cash flow of bond of BANPU plc from 02-Apr-12 onward
- solve for yield spread x from the following equation:

$$\sum_{t=0}^{n} \frac{\text{cash flow}_t}{(1 + \text{risk free yield} + x)^t} = 0$$

(c) [0 points (bonus)] repeat the question with current Current Thai Bond , assuming the other factors remains unchanged.

Question 6

Determine the *first-* and *second-order functional derivative* of the following functions at a specific point

(a) $f(x_1) = sin(x_1)\, e^{-x_1^2}$, at $x = 1$

(b) $g(x_1, x_2) = x_1\, e^{-x_2} + x_2 + 1$, $(x_1, x_2) = (1, 0)$

(c) $h(x_1, x_2, x_3, x_4) = 100(x_1 - x_2)^2 + 10(x_2 - x_3)^4 + (x_3 - x_4)^6$, at $(x_1, x_2, x_3, x_4) = (1, 2, -1, 0)$.

(d) [0 points (bonus)] graph values of function, first-derivative, and second-derivative across their ranges

Question 7

If a company charges a price p USD for a product, then it can sell $3000e^{-p}$ units of the product.

(a) plot revenue function

(b) use Newton method to find the optimal p, denoted by p^*, using $p = 0$ as initial point for 10 iterations

(c) use R function 'optimize()' to solve for p^* and compare results with other methods

(d) [0 points (bonus)] implement Stochastic Search and to find p^*

Question 8

Let $f(x) = 3\,x\,e^{-x^2} - 3\frac{1}{x}\ln(x), x \geq 0$.

(a) plot $f(x)$ versus x over the interval $[0, 20]$

(b) use the *Newton's Method* 10 iterations to locate x_*