# My grades for **Assignment for Credit**

## A.I.S

0 / 0

Academic Integrity statement:
Complete the following statement and upload as a pdf or screen shot/picture.
"I am attesting to the fact that I, [name] (write your full name here), [stnum] (write your student number here), have abided fully to the Code of Behaviour on Academic Matters. I have not committed academic misconduct, and am aware of the penalties that may be imposed if I have committed an academic offence."

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I am attesting to the fact that I, Wei-Han Wang, 1005804346, have abided fully to the Code of Behaviour on Academic Matters. I have not committed academic misconduct, and am aware of the penalties that may be imposed if I have committed academic offence.

## Q1

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Upload your answer to Question 1 here.

# Question 1

### Q1 (Question 3 Version 2 on Midterm)

```
count_C1 = 0 #count of getting coin 1
count_H = 0 #count of getting head two times
count_HC1 = 0 #count of getting coin 1 and 2 heads
count_heads = 0
for(i in 1:10000){
  draw_from_bag = sample(c("1", "2"), size = 1, prob = c(0.5,0.5), replace = TRUE)
  #we want draw with replacement because every time we take a dice out of the bag
  if (draw_from_bag == "1"){ #if we chose coin 1 from the bag
    draw_c = sample(c("H", "T"), size = 3, prob = c(0.6, 0.4), replace = TRUE)
    #draw with replacement; we have three results every round
    count_heads = sum(draw_c == "H") #we want to count the number of heads when
    if (count_heads==2){
      count_H = count_H + 1} #if the count of head is equal to 2 we add one to
  }else{ #if we didn't choose coin 1 from the bag (ie we chose coin 2)
    draw_c = sample(c("H", "T"), size = 3, prob = c(0.5, 0.5), replace = TRUE)
    count_heads = sum(draw_c == "H") #again we want to count the number of heads
    if (count_heads == 2){count_H = count_H + 1}} #if count of the head is equal
  if (draw_from_bag == "1" & count_heads == 2){
    count_HC1 = count_HC1 + 1}} #we calculate the number of times we get coin 1

#probability of getting 2 heads from biased coin
count_HC1/count_H
```

```
## [1] 0.5360524
```

### Part B

```
head_count = 0
for(i in 1:100000){
  draw1 = sample(c("1", "2"), size = 1, prob = c(0.5, 0.5), replace = TRUE)
  if (draw1 == "1"){
    draw2 = sample(c("H", "T"), size = 3, prob = c(0.6, 0.4), replace = TRUE)
    count_heads_2 = sum(draw2 == "H")
    if (count_heads_2 == 3){head_count = head_count + 1}
  }else{
    draw2 = sample(c("H", "T"), size = 3, prob = c(0.5, 0.5), replace = TRUE)
    count_heads_2 = sum(draw2 == "H")
    if (count_heads_2 == 3){head_count = head_count + 1}
  }
}
```

1

```
#probs of getting less than 3 H
prob_3 = 1 - head_count/100000
prob_3
```

```
## [1] 0.82863
```

Great work!
3

## Q2

3 / 3

Upload your answer to Question 2 here.

# Question2

### Part A

```
my_function = function(u){
  u = runif(1, min = 0, max = 1)
  accident = sample(c("Major", "Minor", "None"), size = 1, prob = c(0.02, 0.05, 0.93), replace = TRUE)
  if (accident == "Major"){
    Y = -25000*log(1-u)
    if (Y > 1500){
      return(Y-1500)
    }else{
      return(Y)
    }
  }else if (accident == "Minor"){
    X = -5000*log(1-u)
    if (X > 1500){
      return(X-1500)
    }else{return(X)}
  }else{return(0)}
}
```

### Part B

```
total <- replicate(1000000, my_function(u))
average_of_total <- sum(total)/1000000
average_of_total
```

```
## [1] 669.5559
```

### Part C

I would not suggest using E[Z] to calculate the yearly premiums. Since the chance of getting into an accident (regardless of the type) is slim, it is possible that in one of the accidents, TD will have to pay money higher than normal. Also, counts of car accidents fluctuate over the seasons. Logically speaking, in winter there will be higher possibility of getting into accidents because of the snow and/or the rain. I would propose another summary such as quarterly premiums. TD can adjust the quarterly premium in quarters to better ensure they can cover the unexpected costs.

Excellent work!
3

## Q3

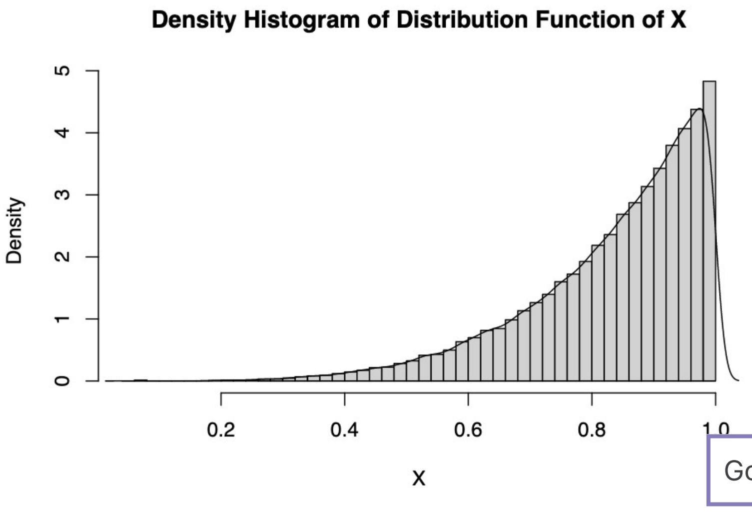
2.25 / 3

Upload your answer to Question 3 here.

# Question3

### Part A

```
u = runif(100000, min = 0, max = 1)
X = u^(1/5) #distribution function of X
hist(X, freq = FALSE, breaks = 50, main = "Density Histogram of Distribution Function of X")
lines(density(X))
```




Good work!

The density histogram of the X values does look like the given pdf graph.

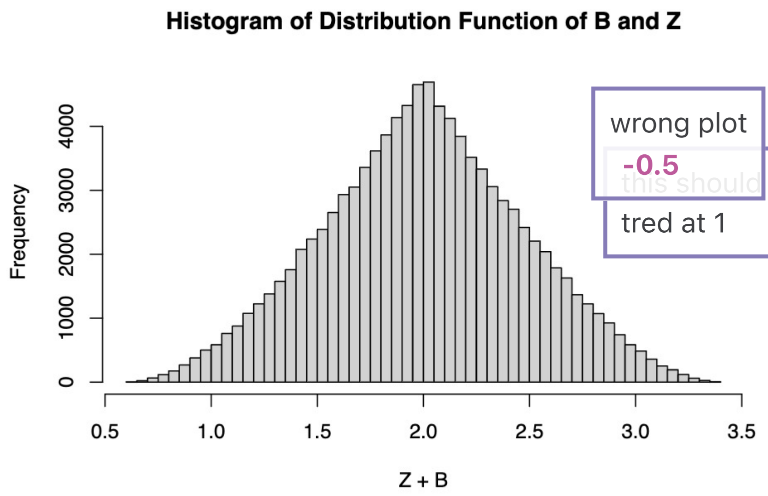
### Part B

```
X = runif(100000, min = 0, max = 1)
Z = sqrt(2*X)
X = runif(100000, min = 0, max = 1)
```

1

```r
B = 2-sqrt(2-2*X)
hist(Z+B, main = "Histogram of Distribution Function of B and Z", breaks = 50)
```

Missing distribution function
-0.25




wrong plot
-0.5

this should be centred at 1

## Q4

3 / 3

Upload your answer to Question 4 here.

---

# Question4

**Part (a)**

```
library(readr)
norwegian <- read_csv("Desktop/Fall 2020/sta237/assignment for credit/norwegian.csv")
```

```
##
## -- Column specification --------------------------------------------------------
## cols(
##   No2Con = col_double(),
##   NumCar = col_double()
## )
```

```
X= norwegian$NumCar
Y= norwegian$No2Con

#E[X]
ex = mean(X)
ex
```

```
## [1] 6.971903
```

```
#E[Y]
ey = mean(Y)
ey
```

```
## [1] 3.698328
```

```
#V[X]
vx = mean((ex-X)^2)
vx
```

```
## [1] 1.180896
```

```
#V[Y]
vy = mean((ey-Y)^2)
vy
```

```
## [1] 0.5633945
```

1

```
#E[XY]
exy = mean(X*Y)
exy
```

```
## [1] 26.2022
```

```
#cov[X,Y]
covxy = exy-ex*ey
covxy
```

Great job!

```
## [1] 0.4178162
```

```
#p(X,Y)
pxy = covxy/sqrt(vx*vy)
pxy
```

```
## [1] 0.5122396
```

### Part (b)

The value of E[Z] and e^E[X] will not be the same. We cannot use change of unit formula since e is not a linear function (change of unit formula only works on linear functions). However, we can use Jensen's inequality to determine which value is going to be greater. The Euler's number is the convex function in this scenario. The Jensen's Inequality states that g(E[X] ≤ E(g(X)]. Since the convex function g in this case is e, e^E[X] ≤ E[e^X]. We can conclude that e^E[X] will be smaller than E[Z].

```
u = exp(mean(X)) #this is e to the power of expectation of X
u
```

```
## [1] 1066.25
```

```
z = exp(X)
w = mean(z) #this is expectation of e to the power of X
w
```

```
## [1] 1624.697
```

Excellent work!
3

## Q5

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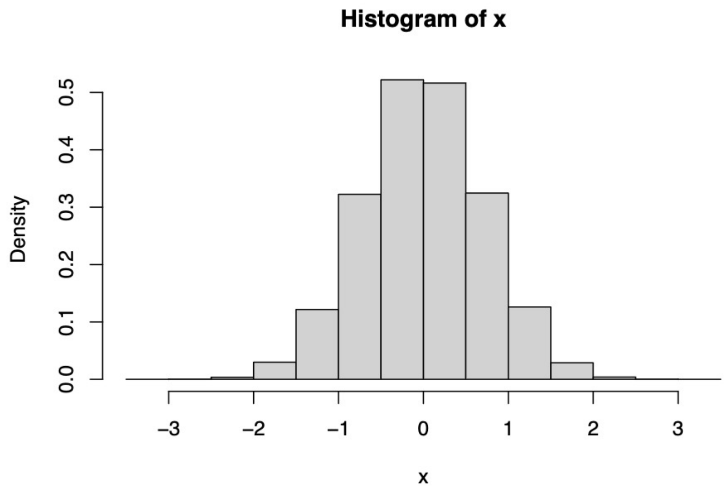
Upload your answer to Question 5 here.

### Question 5

**Part A**

```
x = c(1:100000)
for (i in 1:100000) {
  t<- rnorm(2)
  p<-mean(t)
  x[i]=p
}
hist(x, freq = FALSE)
```




The distribution looks like a normal distribution density plot. The parameters are mean and standard deviation. Mean is 0 and standard deviation is 1 in this graph.

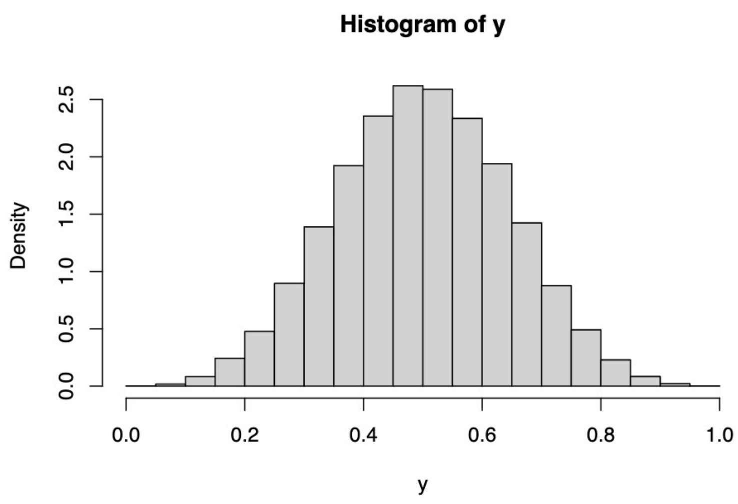
should be N(0,0.5)

**Part B**

1

```r
y = c(1:100000)
for (i in 1:100000){
  xy <- runif(4, min = 0, max = 1)
  q <- mean(xy)
  y[i] = q
}

hist(y, freq = FALSE)
```

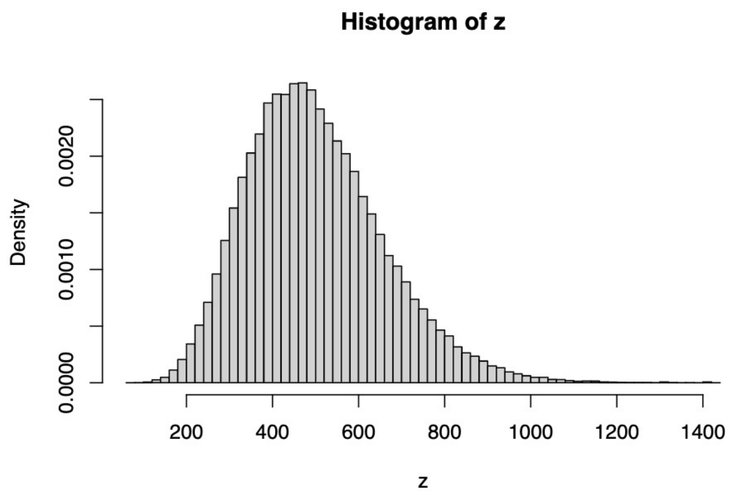



When n = 4, we can start to notice the shape of normal distribution begins to appear. When n = 2, the shape of the histogram is leaning towards triangle. As value of n increases, the sides of the shape begins to curve in, showing the shape of a normal distribution.

**Part C**

```r
z = c()
for(i in 1:100000){
  u <- rexp(10, rate = 1/500)
  r <- mean(u)
  z[i] = r
}

hist(z, freq=FALSE, breaks = 50)
```




When n = 10, we can clearly see the full shape of a normal distribution we saw in Part (a). Before n = 10, we can only see the right curve of the entire shape. As n goes above 10, the shape of a normal distribution becomes full and gets clearer.

Excellent work!
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