STA511 Homework #1

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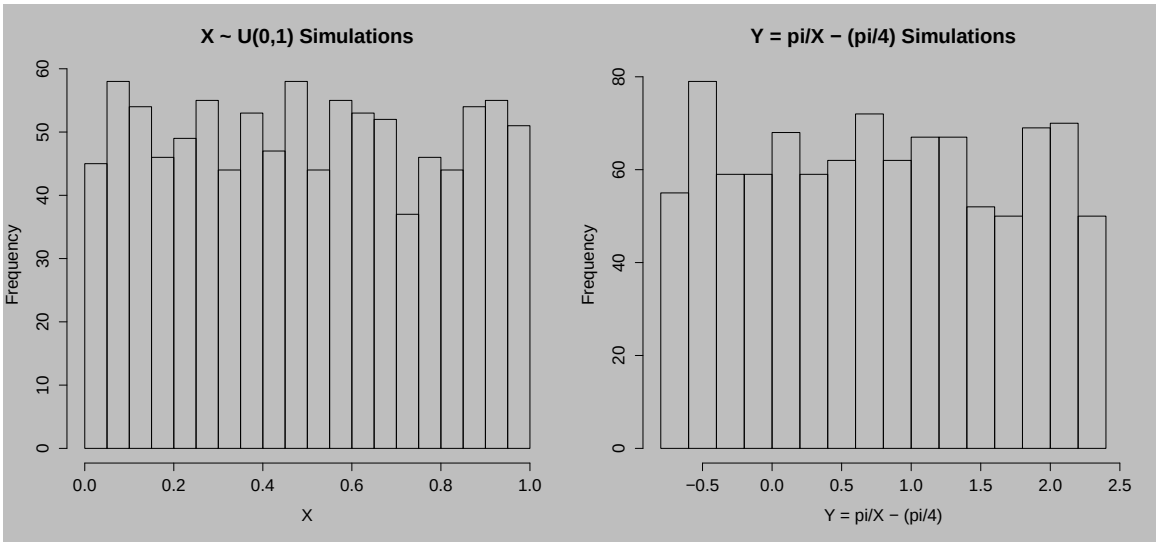
1. No work required for question 1
2. My answer to # 2, has multiple parts.

   (a) X is distributed as a uniform random variable $X \sim U(0,1)$) and was simulated 1000 times (Figure 1 - Left panel). A second histogram was generated plugging in X into the formula $Y = \pi X - \frac{\pi}{4}$ (Figure 1 - Right panel).

   Figure 1: Histograms of ($X \sim U(0,1)$) (Left panel) and $Y = \pi X - \frac{\pi}{4}$ (Right panel) simulated 1000 times



   The R code used for question 2 part a was:

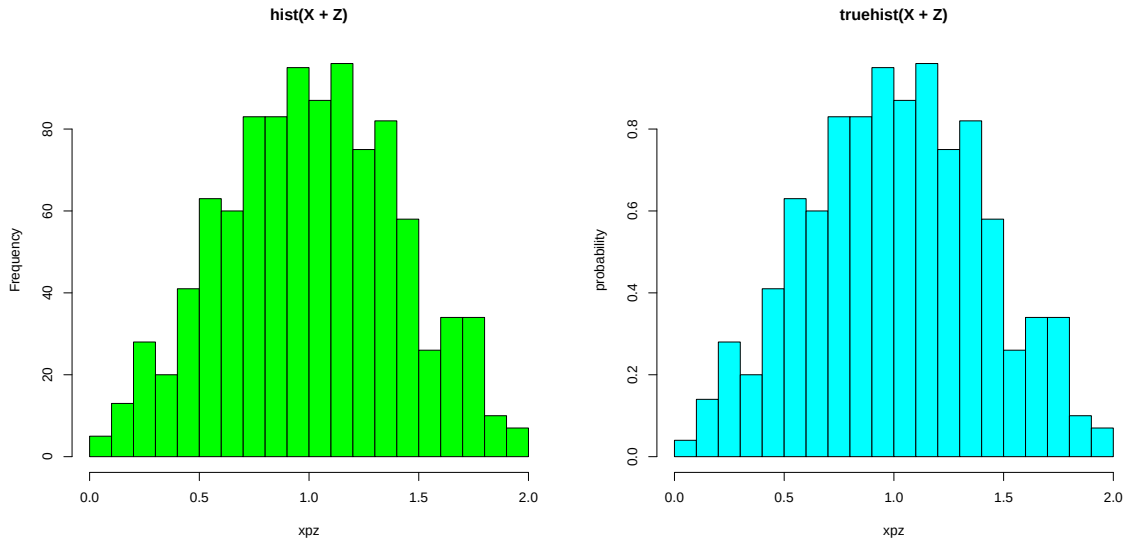
```
#part 2a-1
runif.histogram <- runif(1000,0,1)

#part 2a-2
x <- runif.histogram
y <- 3.14*x + 3.14/4

pdf("hw1-q2a-runiform-histogram.pdf")
par(mfrow=c(1,2),bg="gray")
hist(runif.histogram, main="X ~ U(0,1) Simulations", xlab = 'X', breaks=25)
hist(y, main="Y = pi/X - (pi/4) Simulations", xlab = 'Y = pi/X - (pi/4), breaks=20)
dev.off()
```

   (b) Looking at the histogram in Y (Figure 1 - Right panel), the distribution appears to be uniform. My guess for the theoretical distribution is $f(x) = \frac{1}{B-A}$ for $A \leq X \leq B$.

   (c) 1000 random samples were generated for Z, another uniform random variable ($Z \sim U(0,1)$) The samples were generated using two separate R functions `hist()` and `truehist()` and subsequently compared.
   The R code used to generate question 2 part c was:

```
#2c
z <- runif(1000,0,1)
xpz <- x + z
```

Figure 2: 1000 random samples were generated for Z, another uniform random variable ($Z \sim U(0,1)$) using `hist()` and `truehist()`.



(a) `hist(X + Z)`

(b) `truehist(X + Z)`

```
pdf("hw1-q2c-xpz.pdf")
hist(xpz,breaks=15,col="green",main="hist(X + Z)")
dev.off()

#2d
library(MASS)
pdf("hw1q2d-truehist.pdf")
truehist(xpz,main="truehist(X + Z)",ylab="probability")
dev.off()
```

(d) The y-axis in `hist()` is relative frequency (Figure 2a) and the y-axis from `truehist()` is the probability (Figure 2b).

(e) The histograms look like they are normally distributed, so the distribution is approximately:
$f(x \mid \mu, \sigma) = \frac{1}{\sigma\sqrt{2\pi}}\, e^{-\frac{(x-\mu)^2}{2\sigma^2}}$

3. Thirty grade randomly uniform observations were generated from 60 and 100 and attached to the STA 511 course roster (Table 1). The corresponding letter grade was attached to the column next to the right of the randomly generated observations (Table 1).

   Here is my code:

```
#question 3
class.roster <- read.table("classlist.txt",sep="\t",header=TRUE)
Percent.Grade <- runif(35, 60, 100)
class.roster.2 <- cbind(class.roster, Percent.Grade)
class.roster.2 <- data.table(class.roster.2)

#remove weird -\xa0 symbol
class.roster.2$Program.and.Plan <- gsub("[-\xa0]", "",class.roster.2$Program.and.Plan)

library(data.table)
class.roster.2[Percent.Grade > 95, Letter.Grade := "A"]
class.roster.2[Percent.Grade >= 90 & Percent.Grade < 95, Letter.Grade := "A-"]
class.roster.2[Percent.Grade >= 85 & Percent.Grade < 90, Letter.Grade := "B+"]
class.roster.2[Percent.Grade >= 80 & Percent.Grade < 85, Letter.Grade := "B"]
class.roster.2[Percent.Grade >= 75 & Percent.Grade < 80, Letter.Grade := "B-"]
```

Table 1: STA 511 Course Roster Randomized Grades and Corresponding Letter Grade

	Name	Program.and.Plan	Level	Percent.Grade	Letter.Grade
1	An,Bo	Pharmaceutcl Sci Doctoral	Doctoral 2	73.00	C
2	Bu,Yahao	Public Health Masters	Masters 2	68.54	C
3	Chang,Huiru	Public Health Masters	Masters 2	63.61	C
4	Chen,Jiangwang	Public Health Masters	Masters 2	71.97	C
5	Eum,Youngseob	Arts & Sciences Doctoral	Doctoral 1	74.52	C
6	Ganley,Kevin	Public Health Masters	Masters 1	67.26	C
7	Hess,Katelyn	Arts & Sciences Masters	Masters 1	84.34	B
8	Hsu,En-Shuo	Public Health Masters	Masters 1	80.25	B
9	Jai Kumar Ahuja,Suruchi	Public Health Masters	Masters 1	82.86	B
10	Jin,Yuxuan	Public Health Doctoral	Doctoral 1	79.65	B-
11	Karaesmen,Ezgi	Roswell Park Doctoral	Doctoral 2	76.51	B-
12	Krishnan,Krithika	Public Health Masters	Masters 1	89.05	B+
13	Lin,Jieya	Public Health Masters	Masters 1	95.36	A
14	Mandava,Aishwarya	Public Health Masters	Masters 1	99.15	A
15	Marsales,Harry	Public Health Masters	Masters 2	68.66	C
16	Morrell,Kayla	Public Health Masters	Masters 1	83.43	B
17	Niu,Jin	Pharmaceutcl Sci Doctoral	Doctoral 2	91.37	A-
18	Rizvi,Abbas	Roswell Park Doctoral	Doctoral 2	92.22	A-
19	Rosario,Spencer Rae	Roswell Park Doctoral	Doctoral 2	84.09	B
20	Schiller,Emily	Public Health Masters	Masters 1	99.41	A
21	Song,Jiaming	Public Health Masters	Masters 1	87.51	B+
22	Spencer,Mary	Public Health Masters	Masters 1	65.71	C
23	Sun,Xiaoxi	Public Health Masters	Masters 1	97.25	A
24	Tanue,Terence Wankah	Public Health Masters	Masters 1	69.08	C
25	Tian,Mingmei	Public Health Masters	Masters 2	63.18	C
26	Vucic,Luther	Public Health Masters	Masters 1	78.60	B-
27	Wackeroth,Wolf Michael	Public Health Masters	Masters 1	68.49	C
28	Wang,Jiefei	Public Health Masters	Masters 1	93.77	A-
29	Wang,Xue	Roswell Park Doctoral	Doctoral 2	89.14	B+
30	Wu,Yin	Grad Sch of Ed Doctoral	Doctoral 2	86.43	B+
31	Yang,Yang	Grad Sch of Ed Doctoral	Doctoral 2	85.94	B+
32	Yang,Yujie	Pharmaceutcl Sci Doctoral	Doctoral 2	81.69	B
33	Yang,Zeyu	Public Health Masters	Masters 1	63.28	C
34	Yu,Xinyang	Biomedical Sci Doctoral	Doctoral 2	78.93	B-
35	Zhao,Yichen	Grad Sch of Ed Doctoral	Doctoral 2	62.93	C

```
class.roster.2[Percent.Grade < 75, Letter.Grade := "C"]

install.packages('xtable')
library(xtable)

roster.table <- xtable(class.roster.2)
print(roster.table)
```