Hw5, Q1b

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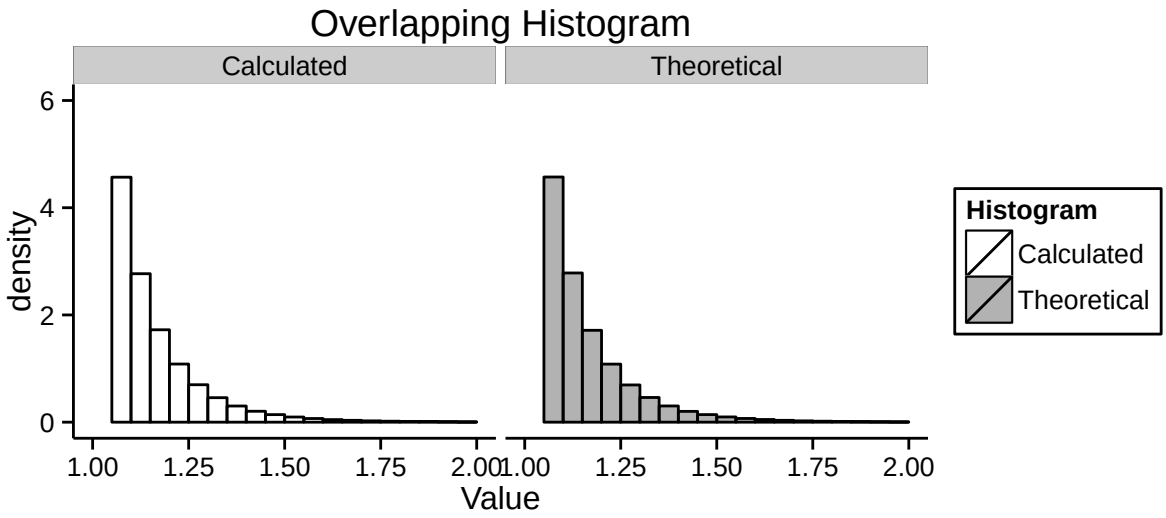
```
#install.packages("actuar")
library(actuar)
library(plyr)
require(ggplot2)
theoretical <- data.frame( dat = rpareto1(1000000, shape = 10, min = 1))
theoretical$da <-  "Theoretical"
calculated <- data.frame(dat =  (1-runif(1000000))^(-1/10))
calculated$da <- "Calculated"
thcalc <- rbind(theoretical, calculated)
```

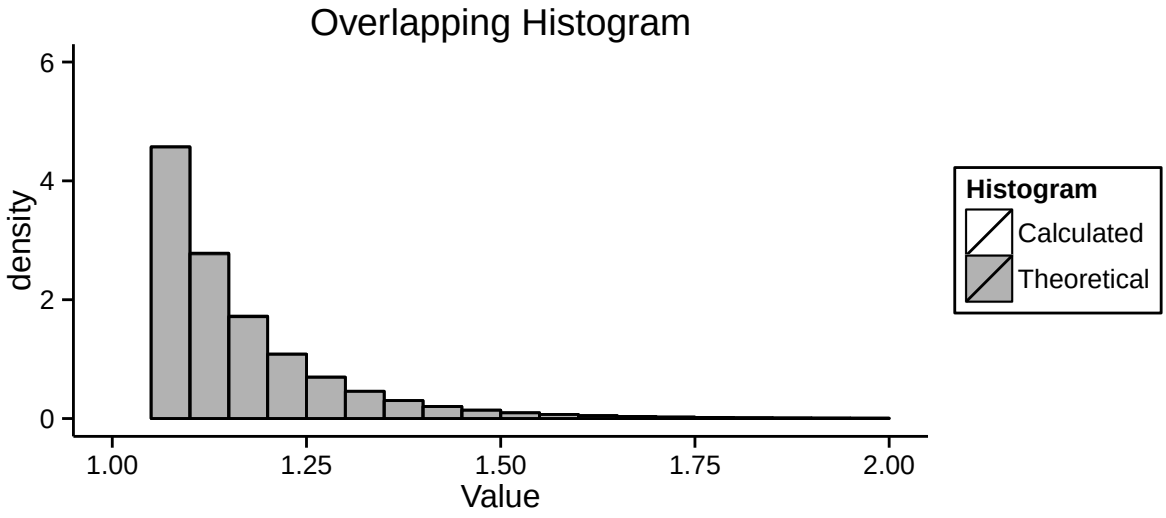
I checked that my method worked via simulation. I simulated large sample from a pareto distribution – in R, I used rpareto1(1000000, shape = a, min= 1). Next, I simulated a large sample from my calculation using a uniform distribution – that is, (1-runif(1000000))^(-1/a). I plotted the two distributions below. I did this for a variety of a's, and the distributions always looked the same. The below example has a = 10.

```
ggplot(thcalc, aes(dat)) +
     geom_histogram(alpha = 0.5, aes(y = ..density.., fill = da),
                    position = 'identity', binwidth = 0.05, color =
                         "black") +
     xlim(1,2) +
     ylim(0, 6) +
     facet_grid(. ~ da)+
     labs(x = "Value", title = "Overlapping Histogram") +
     theme_bw() +
     theme(legend.background = element_rect(colour = "black"),
          plot.background = element_blank() ,
          panel.grid.major = element_blank() ,
          panel.grid.minor = element_blank() ,
          panel.border = element_blank(),
          axis.line = element_line(color = 'black')) +
     scale_fill_manual(name = "Histogram", values = c("white", "grey40"))
```

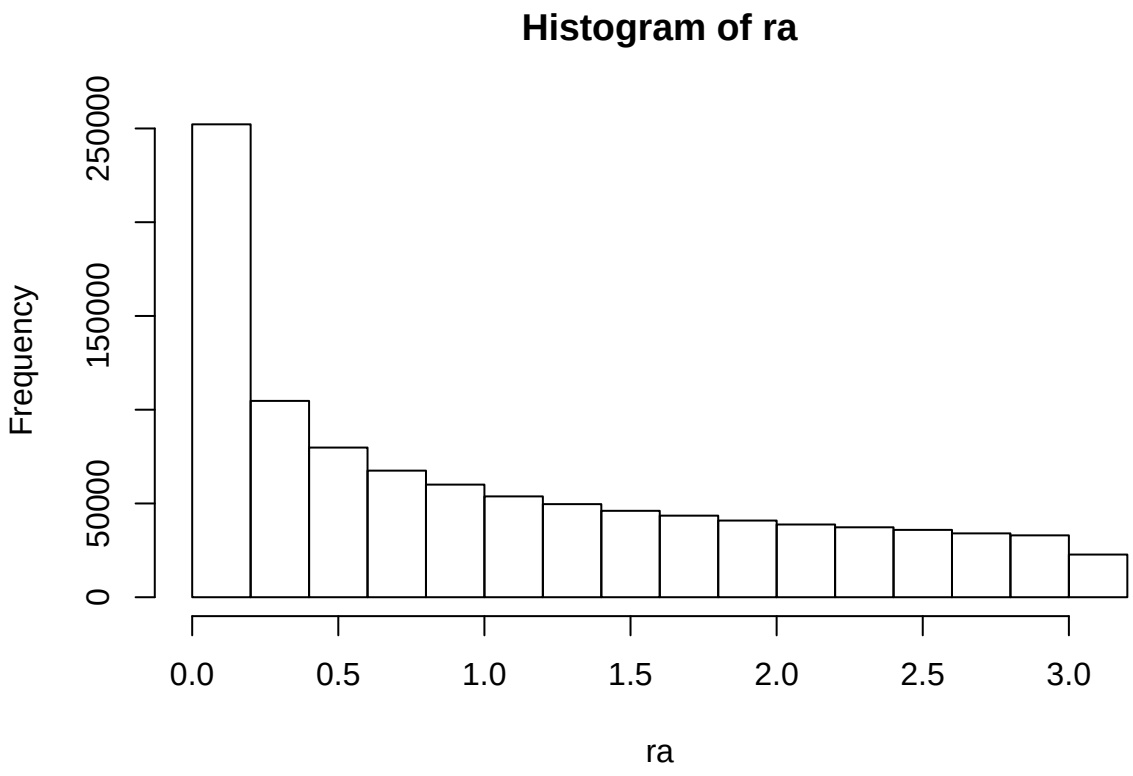


To convince myself that they were the same, I plotted them over the top of one another, and outlined each bar in black. If there was a noticeable difference, I should be able to see a gap between the white and grey on these distributions. However, I see none. This directly checks that my method works for generating pareto rvs.

```
ggplot(thcalc, aes(dat, fill = da)) +
     geom_histogram(alpha = 0.5, aes(y = ..density..),
                    position = 'identity', binwidth = 0.05, color =
                         "black") +
     xlim(1,2) +
     ylim(0, 6) +
     labs(x = "Value", title = "Overlapping Histogram") +
     theme_bw() +
     theme(legend.background = element_rect(colour = "black"),
          plot.background = element_blank() ,
          panel.grid.major = element_blank() ,
          panel.grid.minor = element_blank() ,
          panel.border = element_blank(),
          axis.line = element_line(color = 'black')) +
     scale_fill_manual(name = "Histogram", values = c("white", "grey40"))
```



```r
ra <- pi * runif(1000000)^2
hist(ra)
```




```r
mean(ra)
```

```
## [1] 1.047
```

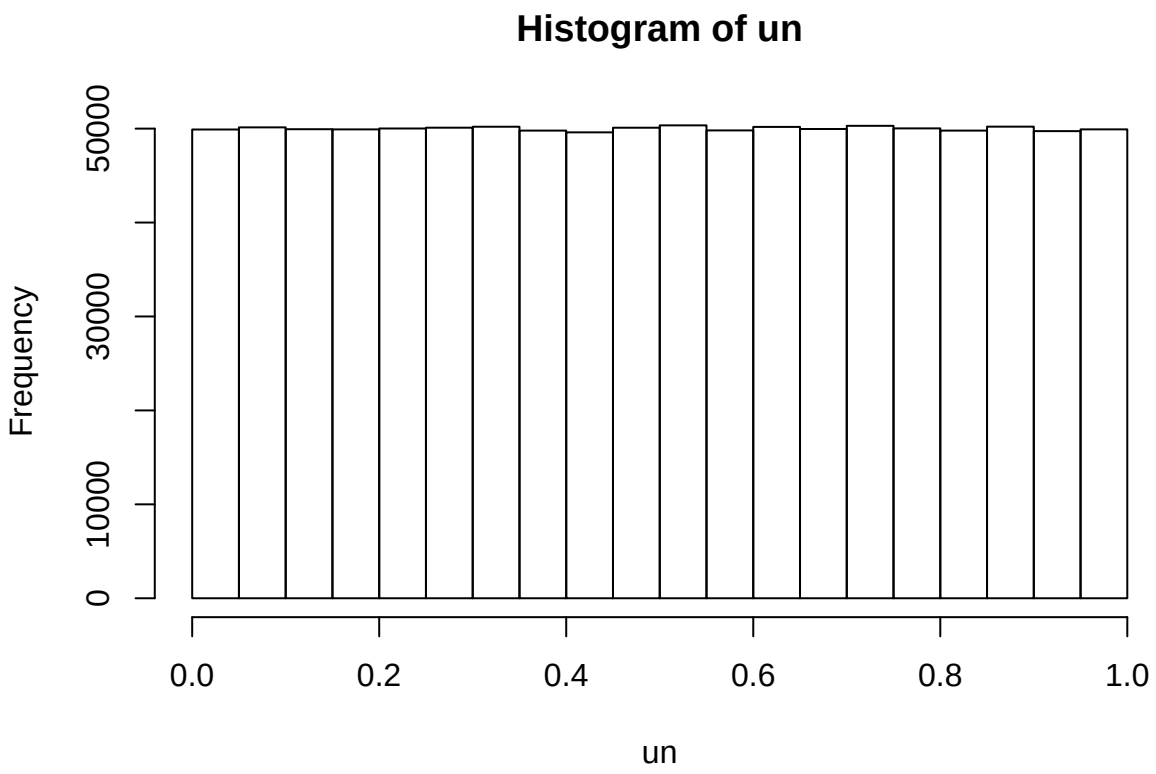
```r
var(ra)
```

```
## [1] 0.8763
```

```r
median(ra)
```

```
## [1] 0.7863
```

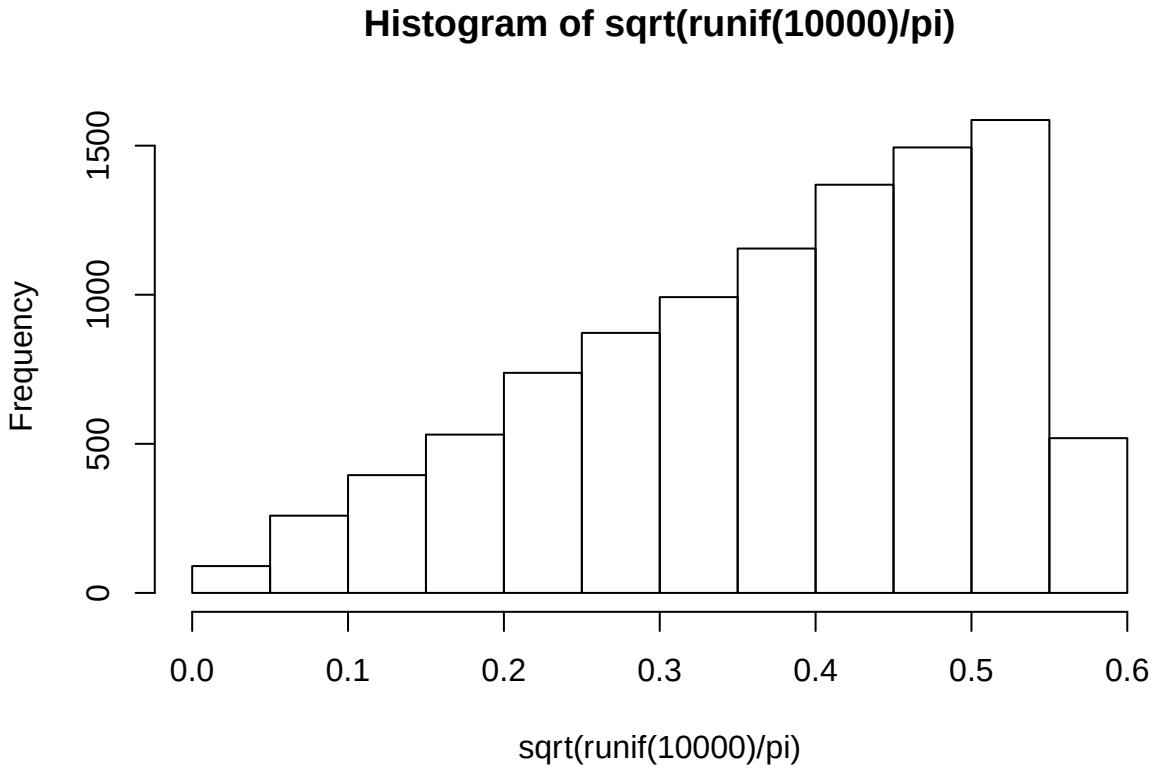
```r
un <- sqrt(ra / pi)
hist(un)
```



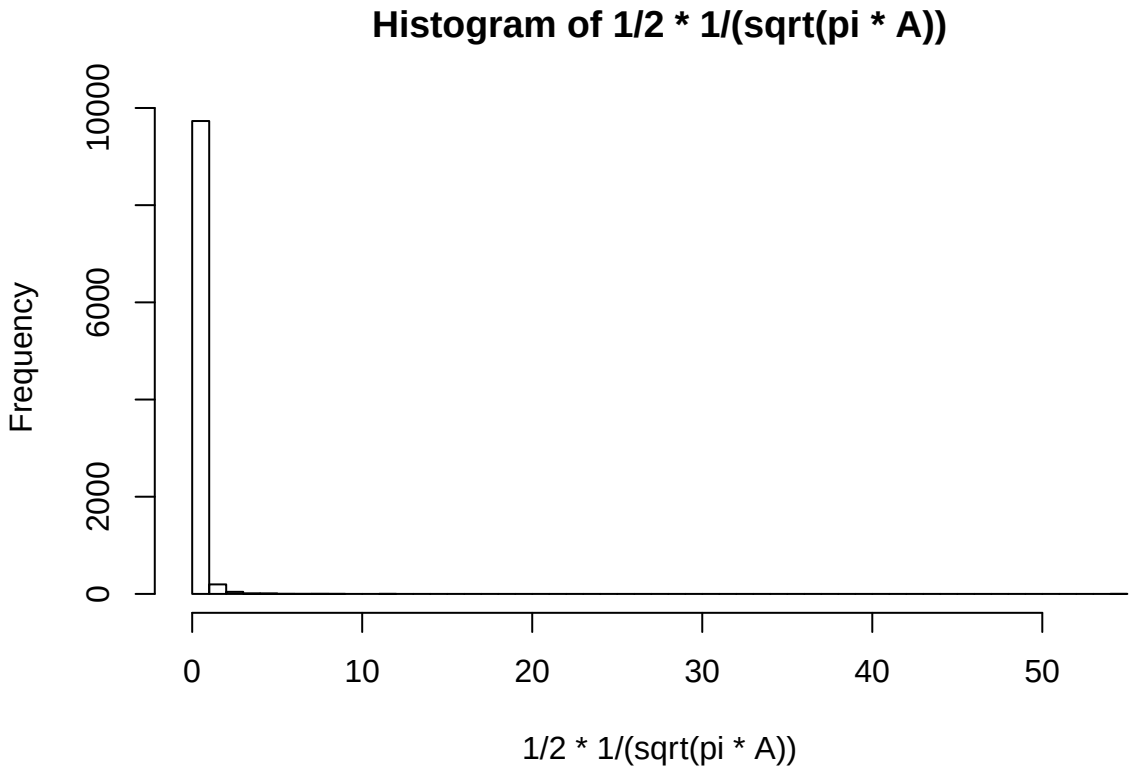

```
mean(un)
```

```
## [1] 0.5
```

```
hist(sqrt(runif(10000) / pi))
```



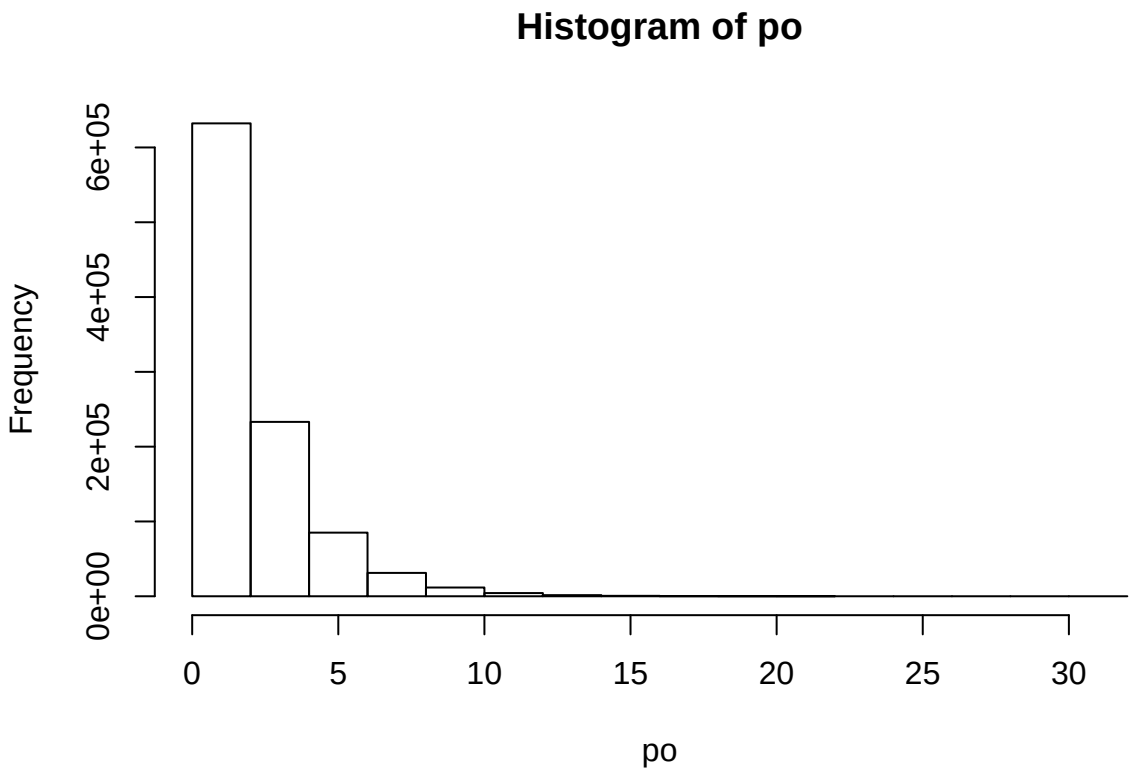
```r
A <- runif(10000, min = 0, max = pi)
hist (1/2 * 1/(sqrt(pi * A)), breaks = 50)
```




```r
max(A)
```

```
## [1] 3.141
```

```r
##
po <- rchisq(1000000, df = 2)
hist(po)
```




```r
mean(po)
```

```
## [1] 1.999
```

```r
median(po)
```

```
## [1] 1.387
```

```r
var(po)
```

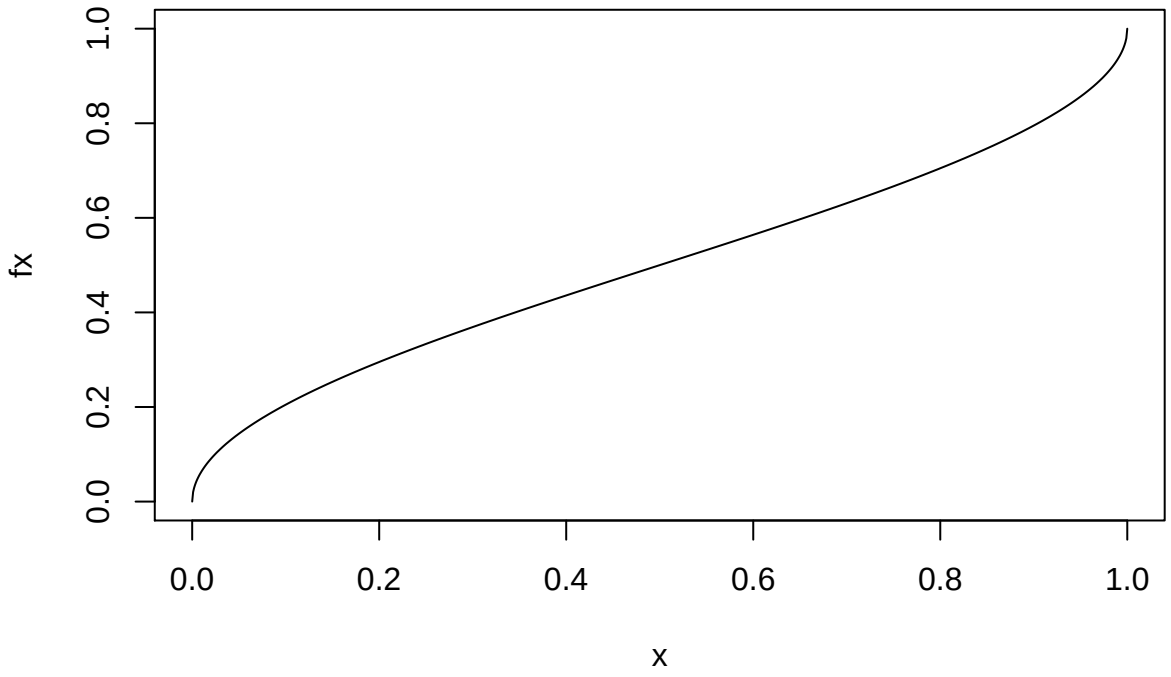
```
## [1] 3.991
```

```r
pi/2
```

```
## [1] 1.571
```

```r
## Q3

x <- seq(0,1, length.out = 1000)
fx <- 2/pi* asin(sqrt(x))
plot(x, fx, type = "l")
```


fx
0.0
0.2
0.4
0.6
0.8
1.0
x
0.0
0.2
0.4
0.6
0.8
1.0