For our portfolio we selected five ETF's.

- ARKK (ARK Innovation) is a fund that invests in companies that are involved in the development of new technologies. (RISKY)
- QQQ (Invesco QQQ Trust) is a ETF with primarily US tech companies. (RISKY)
- IWM (iShares Russell 2000 ETF) is a ETF with primarily US small cap companies. (MODERATELY RISKY)
- SPY (SPDR S&P 500 ETF Trust) is a ETF with primarily US large cap companies. (MODERATELY RISKY)
- GLD (SPDR Gold Trust) is a ETF with primarily gold. (SAFE)

We tried to make three portfolios:

1. Higher weights in risky ETFs (0.4 ARKK, 0.2 QQQ, 0.15 IWM, 0.15 SPY, 0.1 GLD)
2. Equally weighted in all ETFs (0.2 ARKK, 0.2 QQQ, 0.2 IWM, 0.2 SPY, 0.2 GLD)
3. Lower weights in risky ETFs (0.1 ARKK, 0.2 QQQ, 0.2 IWM, 0.2 SPY, 0.3 GLD)

Theoretically portfolio (1) should have the highest VAR, followed by (2) and (3). For our simulations we used 5000 iterations for each portfolio and daily data from 2017-2022. We performed daily rebalancing in all simulations and have reported our VARs at the 95% confidence interval.

Results:

```
## Registered S3 method overwritten by 'mosaic':
##   method                           from
##   fortify.SpatialPolygonsDataFrame ggplot2
```

```
##
## The 'mosaic' package masks several functions from core packages in order to add
## additional features.  The original behavior of these functions should not be affected by this.
```

```
##
## Attaching package: 'mosaic'
```

```
## The following objects are masked from 'package:dplyr':
##
##     count, do, tally
```

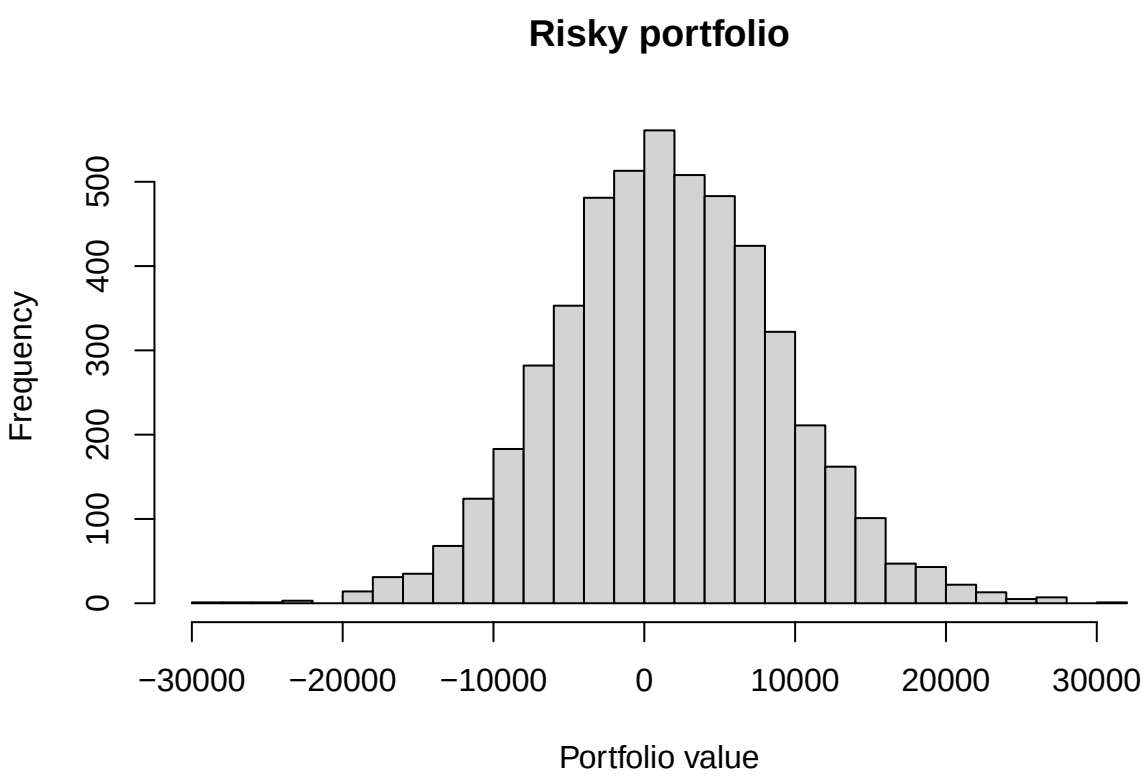
```
## The following object is masked from 'package:Matrix':
##
##     mean
```

```
## The following object is masked from 'package:ggplot2':
##
##     stat
```

```
## The following objects are masked from 'package:stats':
##
##     binom.test, cor, cor.test, cov, fivenum, IQR, median, prop.test,
##     quantile, sd, t.test, var
```

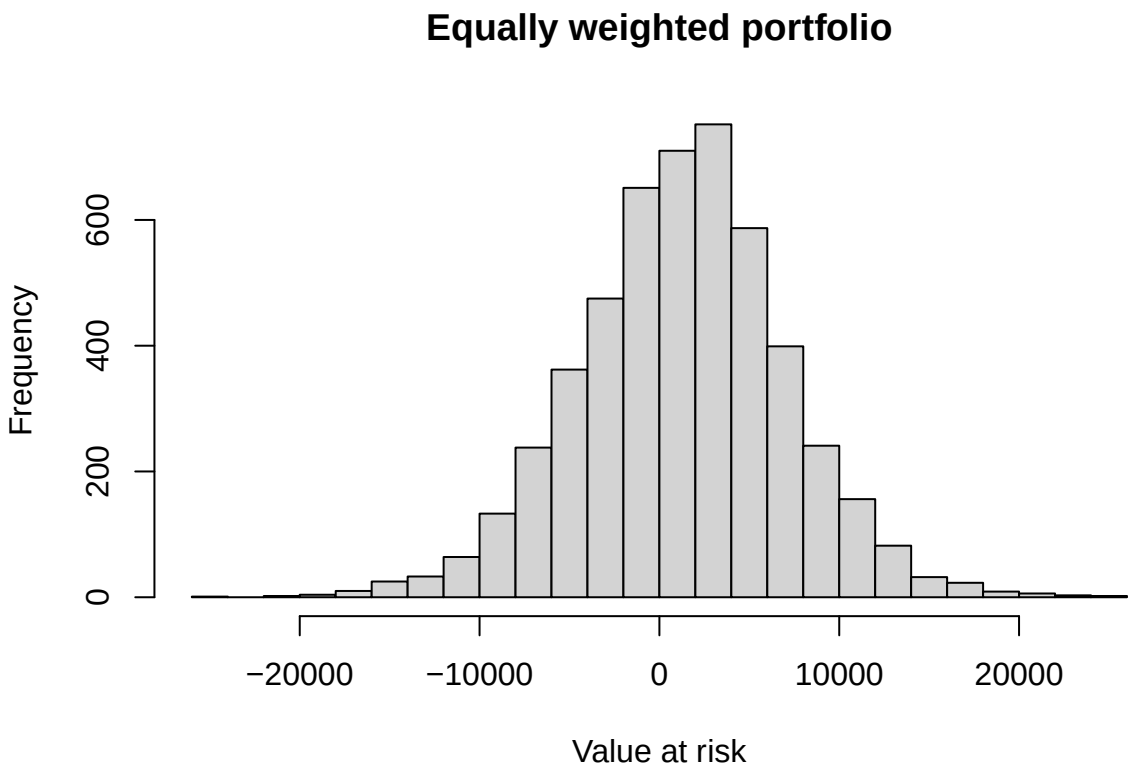
```
## The following objects are masked from 'package:base':
##
##     max, mean, min, prod, range, sample, sum

## Loading required package: xts

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

##
## Attaching package: 'xts'

## The following objects are masked from 'package:dplyr':
##
##     first, last

## Loading required package: TTR

## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query2.finance.yahoo.com/v7/finance/download/ARKK?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query2.finance.yahoo.com/v7/finance/download/ARKK?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query1.finance.yahoo.com/v7/finance/download/QQQ?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query2.finance.yahoo.com/v7/finance/download/QQQ?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query1.finance.yahoo.com/v7/finance/download/IWM?
```

```
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query1.finance.yahoo.com/v7/finance/download/IWM?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query1.finance.yahoo.com/v7/finance/download/SPY?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query1.finance.yahoo.com/v7/finance/download/SPY?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query2.finance.yahoo.com/v7/finance/download/GLD?
## period1=-2208988800&period2=1660521600&interval=1d&events=div'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query2.finance.yahoo.com/v7/finance/download/GLD?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'

## Warning in read.table(file = file, header = header, sep = sep,
## quote = quote, : incomplete final line found by readTableHeader
## on 'https://query1.finance.yahoo.com/v7/finance/download/GLD?
## period1=-2208988800&period2=1660521600&interval=1d&events=split'
```



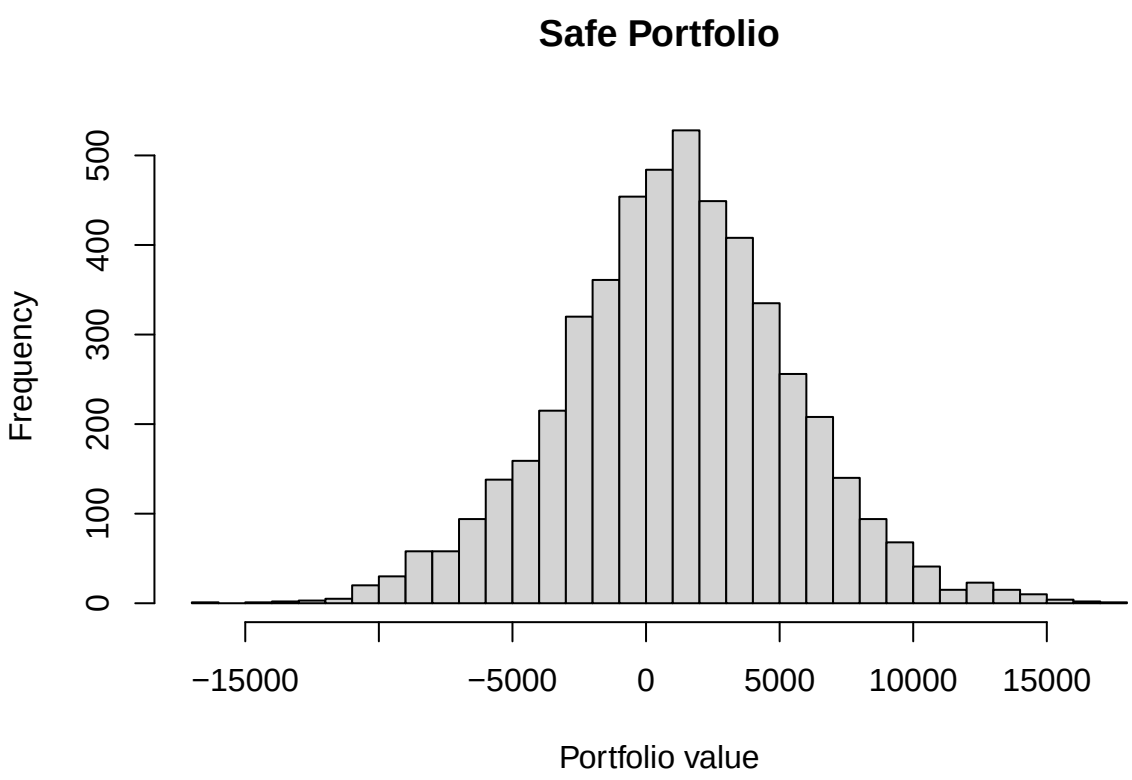

```
## [1] "The value at risk for 4-weeks of the risky portfolio is  -10374.86 USD ( -10.37 %)"
```

```
## [1] "The mean return for 4-weeks of the risky portfolio is  1.6022 %"
```




```
## [1] "The value at risk for 4-weeks of the equally weighted portfolio is  -8211.49 USD ( -8.21 %)"
```

```
## [1] "The mean return for 4-weeks of the equally weighted portfolio is  1.2601 %"
```




```
## [1] "The value at risk for 4-weeks of the safe portfolio is  -6178.11 USD ( -6.18 %)"
```

```
## [1] "The mean return for 4-weeks of the safe portfolio is  1.1514 %"
```

Comments: As expected the Risky Portfolio has the highest value at risk 7.11%, followed by the Equally Weighted portfolio at 6.82%. Finally the Safe Portfolio has the lowest value at risk at 6.68%. We expected the portfolios with the highest VARs to have the highest returns as well (Risk-Return trade off).