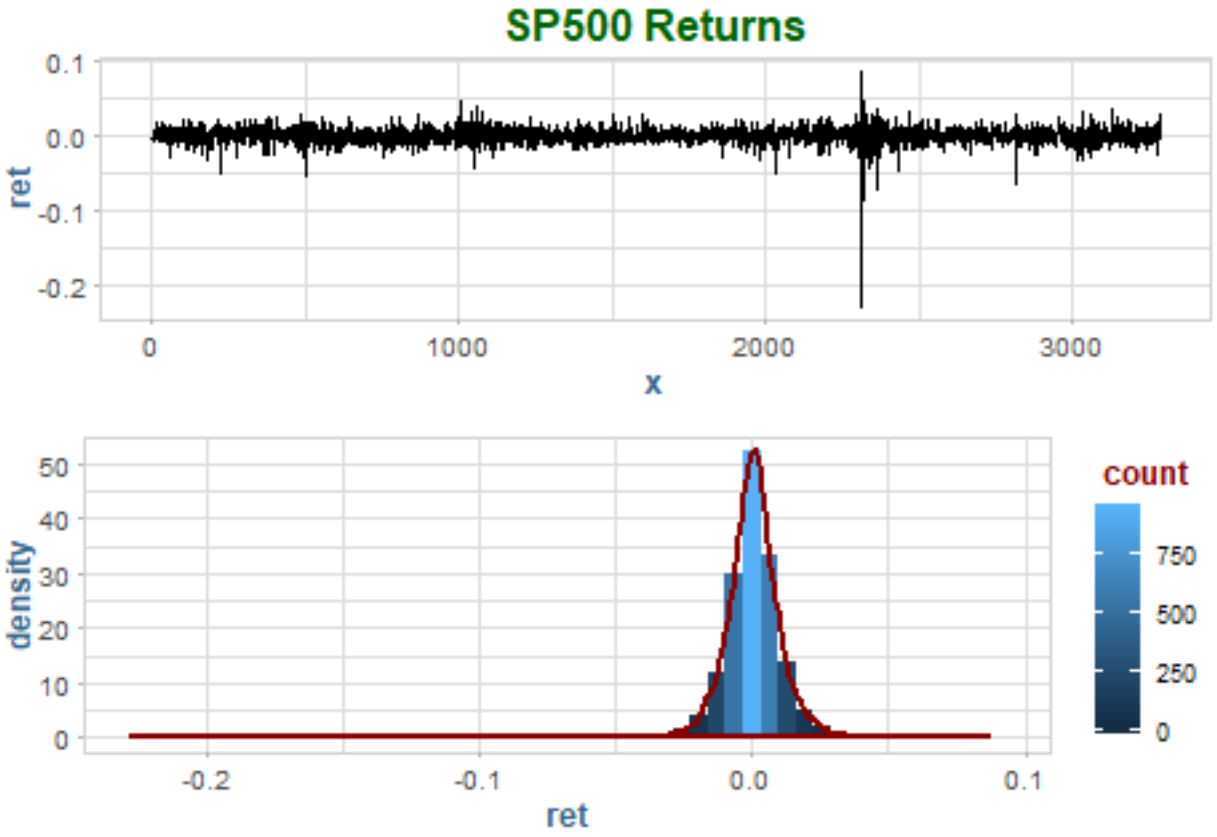
Problem Background

Black Monday

On Black Monday, the return on the S&P500 was *-22.8%*.

In this lab we are going to look at GARCH models and how they relate to predicting extreme events in financial markets.

```
data(SP500, package = "Ecdat")

returnBlMon <- SP500$r500

p1 <- ggplot(data.table(ret = returnBlMon), aes(ret, y = ..density..)) +
   geom_histogram(aes(fill = ..count..), bins = 50) +
   geom_density(aes(y = ..density..), col = "darkred", lwd = 1)

x <- SP500$r500[(1804 - 2*253+1 ): 1804]

p2 <- ggplot(data.table(ret = c(x, returnBlMon))[, x := .I], aes(x, ret)) +
   geom_line() +
   labs(title = "SP500 Returns")

grid.arrange(p2, p1, nrow = 2)
```



Now, we fit the GARCH model.

```
spec <- ugarchspec( mean.model = list( armaOrder = c(1, 0) ),
                    variance.model = list( garchOrder = c(1, 1)),
                    distribution.model = "std")

summary(fit <- ugarchfit(data = x, spec = spec))
```

```
   Length     Class      Mode
        1 uGARCHfit        S4
```

```
dfhat <- coef(fit)[6]

forecast <- ugarchforecast(fit, data = x, n.ahead = 1)
forecast
```

```
*----------------------------------*
*       GARCH Model Forecast       *
*----------------------------------*
Model: sGARCH
Horizon: 1
Roll Steps: 0
Out of Sample: 0

0-roll forecast [T0=1971-05-21 20:00:00]:
       Series   Sigma
T+1 -0.003204 0.01208
```