Yield Curve Modeling

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This comes from Yield Curve Modeling

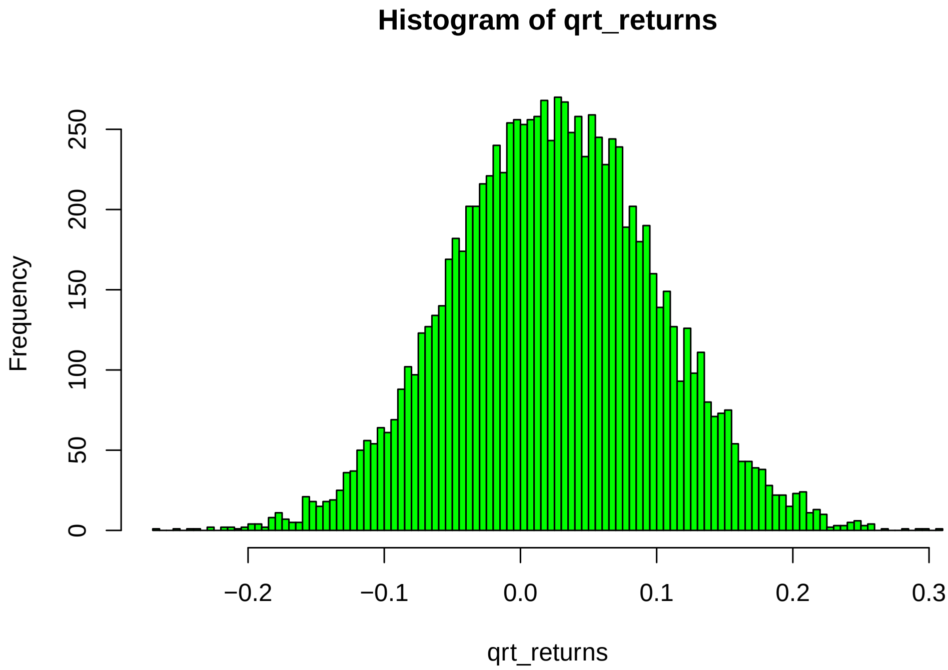
This based on the simple model that the return to a security evolves acording to the mechanics of *Brownian motion*

$$\mu \Delta t + \sigma Z \sqrt{\delta t} \tag{1}$$

Where μ is the mean annual return of the security (also called the drift), σ is the annualised volatility (standard deviation), Z is a standard Normal random variable which introduces the stochastic element. Time is measured in units of years (t). Therefore a quarter is $t/4$.

To generate a simulated distribution of quarterly returns when $\mu = 10\%$ and $\sigma = 15\%$

```
n <- 10000
set.seed(106)
z <- rnorm(n)
mu <- 0.1
sd <- 0.15
delta_t <- 0.25
qrt_returns <- mu * delta_t + sd * z * sqrt(delta_t)
hist(qrt_returns, breaks = 100, col = "green")
```




```
stats <- c(mean(qrt_returns) * 4, sd(qrt_returns) * 2)
names(stats) <- c("mean", "volatility")
stats

##       mean volatility
##    0.09901    0.14976
```

This is close to the assumption that the return was 10% and the volatility 15%. Now it is necessary to take the dates for the yeild curve.

```
require(lubridate)
require(xts)
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require(xts)
ad <- ymd(20140514, tz = "UTC")
marketDates <- c(ad, ad + days(1), ad + weeks(1), ad + months(1), ad + months(2)
    ad + months(3), ad + months(6), ad + months(9), ad + years(1), ad = years(2)
    ad + years(3), ad + years(5), ad + years(7), ad + years(10), ad + years(15),
    ad + years(20), ad + years(25), ad + years(30))
# use substring() to get rid of the time zone.
marketDates <- as.Date(substring(marketDates, 1, 10))
```

```
marketRates <- c(0, 0.08, 0.125, 0.15, 0.2, 0.255, 0.35, 0.55, 1.65, 2.25, 2.85,
    3.1, 3.35, 3.65, 3.95, 4.65, 5.15, 5.85) * 0.01
marketData.xts <- as.xts(marketRates, order.by = marketDates)
head(marketData.xts)

##                [,1]
## 1970-01-01 0.02250
## 2014-05-14 0.00000
## 2014-05-15 0.00080
## 2014-05-21 0.00125
## 2014-06-14 0.00150
## 2014-07-14 0.00200
```

Now plot the datae

```
colnames(marketData.xts) <- "ZeroRate"
plot(x = marketData.xts[, "ZeroRate"], xlab = "Time", ylab = "Zero Rate", main =
    ylim = c(0, 0.06), major.ticks = "years", minor.ticks = FALSE, col = "red")
```