

ECO374_PS3

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Install and load required packages

```
library(quantmod) # functions: getSymbols
library(ggplot2)  # functions: ggplot
library(rugarch)  # functions: ugarchspec
library(rmgarch)  # functions: dccspec, dccfit, dccforecast
library(timetk)   # functions: tk_index, tk_make_future_timeseries
library(xts)      # functions: xts
library(forecast) # functions: auto.arima
```

1. Data

Data: NASDAQ Composite Index (daily close price), source: [<https://finance.yahoo.com/quote/%5EIXIC/history?period1=34560000&period2=1680048000&interval=1d&filter=history&frequency=1d&includeAdjustedClose=true>]

```
table <- read.csv(file = "^IXIC.csv", header = TRUE, sep = ",")
ind <- as.Date(table$Date, format = "%Y-%m-%d")
table <- subset(table, select = -c(Date))
NASDAQ <- xts(x = table, order.by = ind)
start_date <- as.Date("2010-01-01")
IXIC <- subset(NASDAQ, ind >= start_date)
colnames(IXIC) <- "NASDAQ_Index"
IXIC_r <- na.omit(diff(log(IXIC)))
```

2. ARMA(1,1)-GARCH(1,1) model specification

```
model <- ugarchspec(variance.model = list(model = "sGARCH", garchOrder = c(1, 1)),
                    mean.model = list(armaOrder = c(1, 1)))
model
```

```
##
## *-----*
## *      GARCH Model Spec      *
## *-----*
##
```

```
## Conditional Variance Dynamics
## -----
## GARCH Model      : sGARCH(1,1)
## Variance Targeting : FALSE
##
## Conditional Mean Dynamics
## -----
## Mean Model       : ARFIMA(1,0,1)
## Include Mean      : TRUE
## GARCH-in-Mean     : FALSE
##
## Conditional Distribution
## -----
## Distribution : norm
## Includes Skew : FALSE
## Includes Shape : FALSE
## Includes Lambda : FALSE
```

Estimate the model

```
model_fit <- ugarchfit(spec=model, data=IXIC_r)
```

3. Forecast: Value at Risk (VaR)

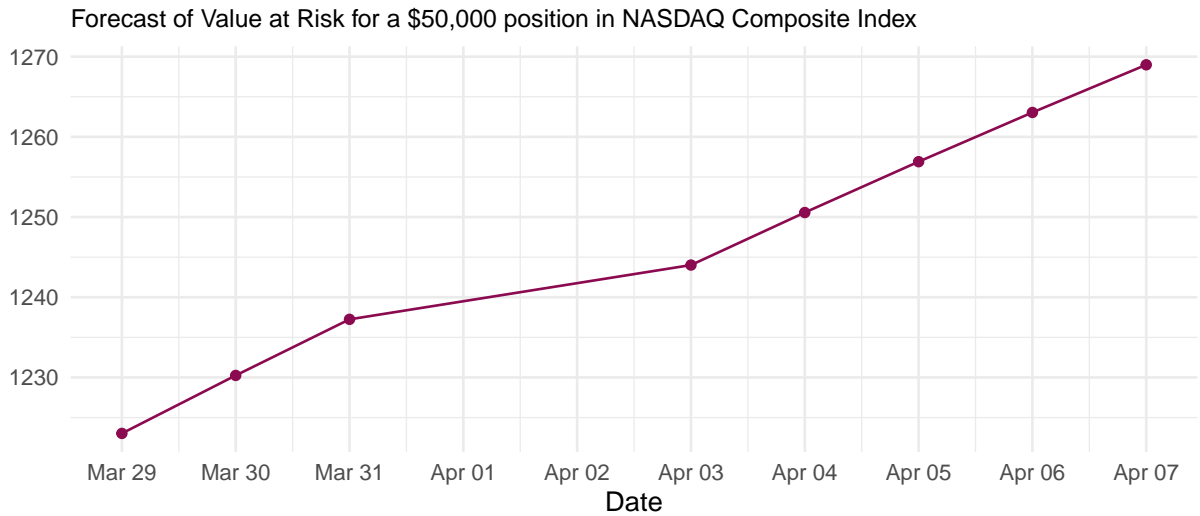
Forecast the position in the Index for the next 8 days

```
n.future <- 8 #set the range of forecast to 8 days
model_forecast <- ugarchforecast(fit=model_fit, n.ahead=n.future)
id <- tk_index(IXIC_r)
id.f <- tk_make_future_timeseries(id, length_out=n.future, inspect_weekdays=TRUE)
```

VaR at $\alpha = 1\%$ for a \$50,000 position in NASDAQ Composite Index

```
f_mean <- as.numeric(model_forecast@forecast$seriesFor)
f_std <- as.numeric(model_forecast@forecast$sigmaFor)
VaR_f <- 50000*abs(f_mean-2.33*f_std)
VaR_f <- xts(VaR_f, order.by=id.f)
colnames(VaR_f) <- "VaR"

ggplot(data=VaR_f, aes(x=index(VaR_f), y=VaR)) +
  geom_line(color="deeppink4") +
  geom_point(color="deeppink4") +
  labs(x="Date", y="", title="Forecast of Value at Risk for a $50,000 position in NASDAQ Composite Index") +
  theme_minimal() + scale_x_date(date_breaks="1 day", date_labels = "%b %d") +
  theme(plot.title = element_text(size=10))
```



4. Forecast: Expected Shortfall

Expected Shortfall at $\alpha = 1\%$ for a \$50,000 position in NASDAQ Composite Index

```
ES <- 50000*abs(f_mean-2.64*f_std)
ES <- xts(ES, order.by=id.f)
colnames(ES) <- "es"

ggplot(data=ES, aes(x=index(ES), y=es)) +
  geom_line(color="springgreen4") +
  geom_point(color="springgreen4") +
  labs(x="Date", y="", title="Expected Shortfall for a $50,000 position in NASDAQ Composite Index") +
  theme_minimal() + scale_x_date(date_breaks="1 day", date_labels = "%b %d") +
  theme(plot.title = element_text(size=10))
```

