CAPM Fitting and Testing

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Abstract

Standard Capital Asset Pricing Model (CAPM) fitting and testing using Quandl data.

CAPM Assumptions 1. Identical investors who are price takers; 2. Investment over the same time horizon; 3. No transaction costs or taxes; 4. Can borrow and lend at risk-free rate; 5. Investors only care about portfolio expected return and variance; 6. Market consists of all publicly traded assets.

The Consumption-Oriented CAPM is analogous to the simple form of the CAPM. Except that the growth rate of per capita consumption has replaced the rate of return on the market porfolio as the influence effecting returns.

Contents

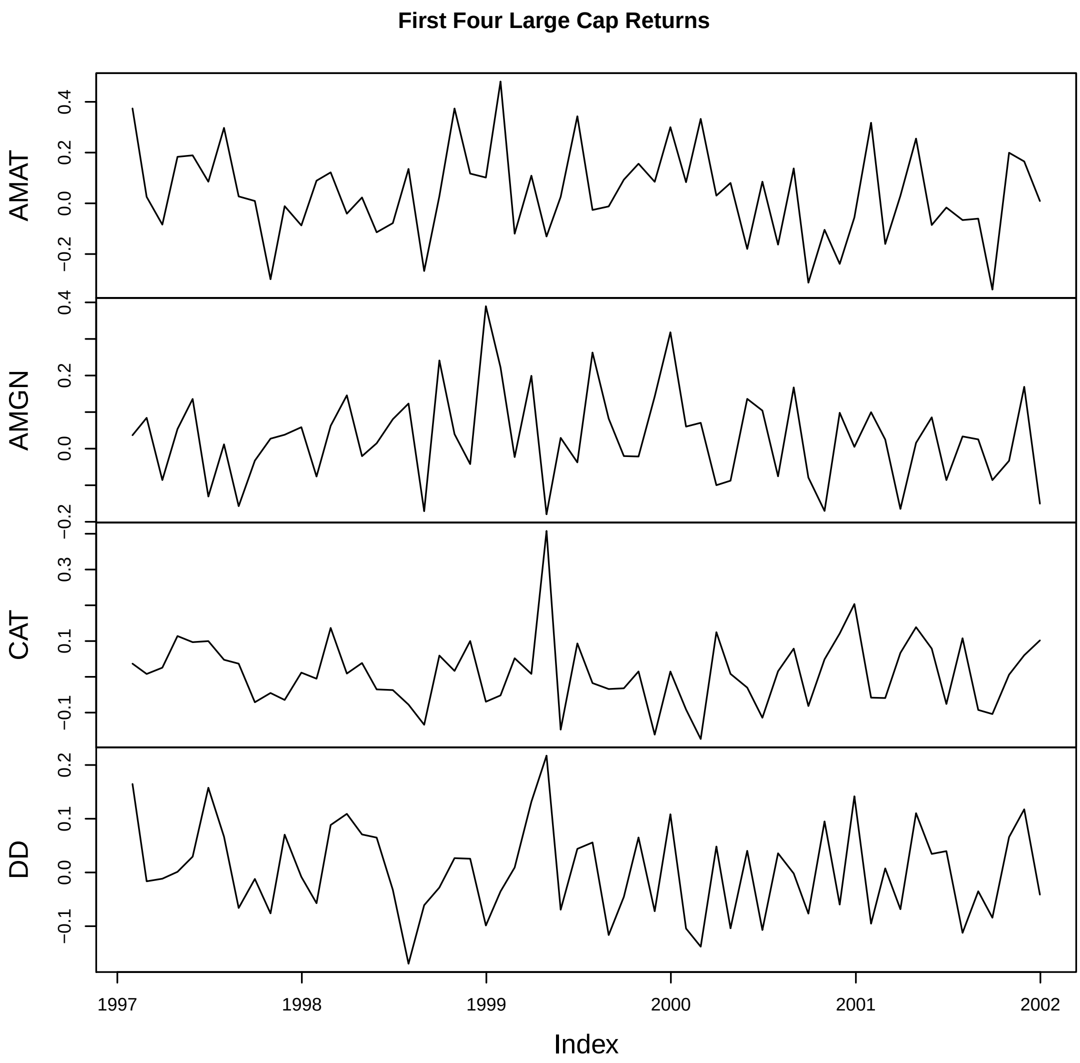
1 Fitting CAPM

1.1 Selected Returns Time Series

```r
# 'Load the GARPFRM package and CRSP dataset for CAPM analysis.
suppressMessages(library(GARPFRM))
options(digits = 3)
data(crsp.short)

stock.df <- largecap.ts[, 1:20]
mrkt <- largecap.ts[, "market"]
rfr <- largecap.ts[, "t90"]

# Plot first four stocks from
plot.zoo(stock.df[, 1:4], main = "First Four Large Cap Returns")
```



Summarize the start and end dates corresponding to the first 4 large cap returns.

```
# Illustrate the type of data being analzyed: start-end dates.
start(stock.df[, 1:4])

## [1] "1997-01-31"

end(stock.df[, 1:4])

## [1] "2001-12-31"

# Count the number of rows: sample size.
nrow(stock.df)

## [1] 60
```

1.2 Estimate Excess Returns

Estimate excess returns: subtracting off risk-free rate.

```
# Excess Returns initialized before utilizing in CAPM
exReturns <- Return.excess(stock.df, rfr)
colnames(exReturns) = c(colnames(stock.df))
```

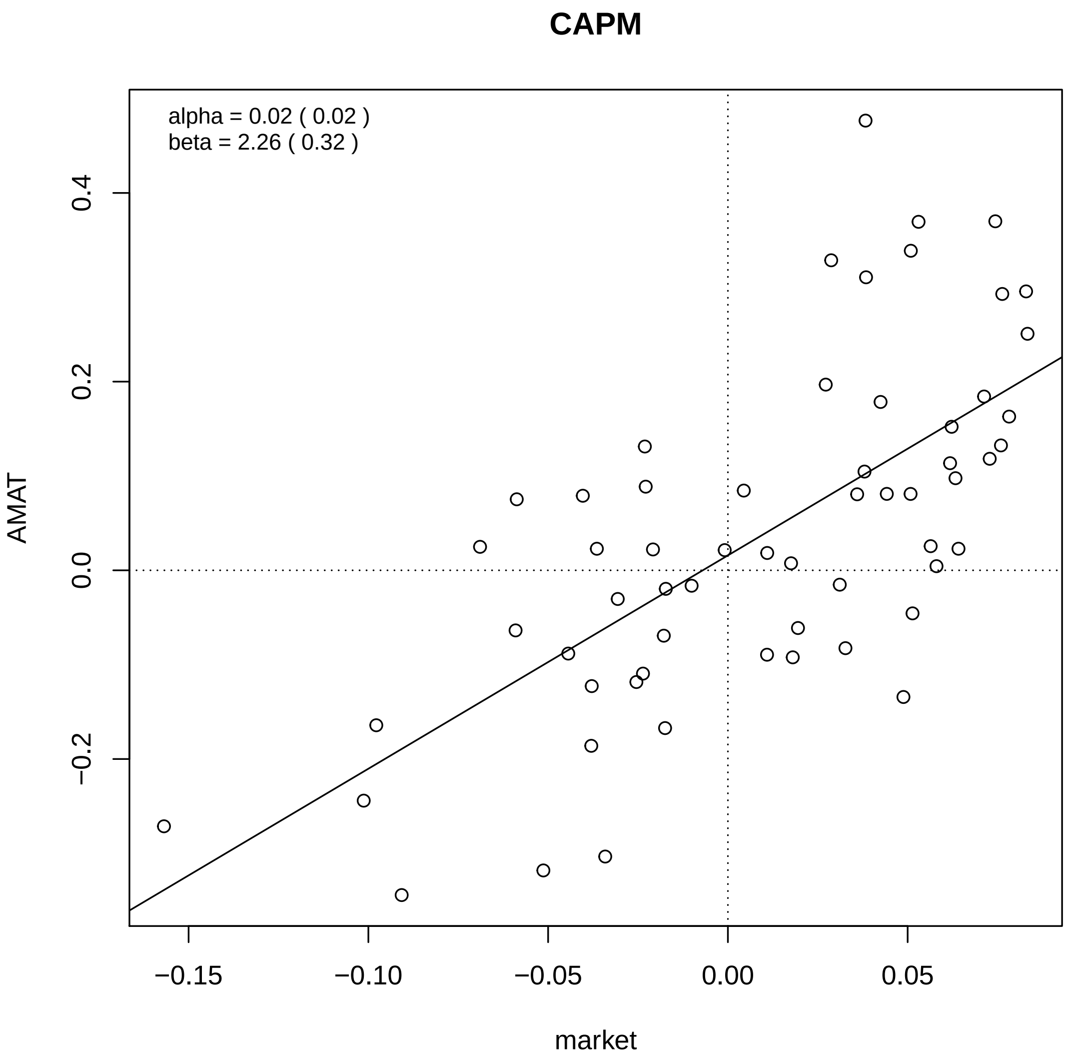
1.3 Fitting CAPM Model: Univariate

Run CAPM regression for AMAT and estimate CAPM with $\alpha = 0$ & $\beta = 1$ for asset.

```
# Univariate CAPM
uv <- CAPM(exReturns[, 1], mrkt)
getStatistics(uv)

##             Estimate Std. Error t value Pr(>|t|)
## alpha. AMAT   0.0158     0.0174   0.909 0.366872
## beta.  AMAT   2.2611     0.3192   3.951 0.000213

# Plot data with regression line
plot(uv)
```



1.4 CAPM Model: Multiple Asset Analysis

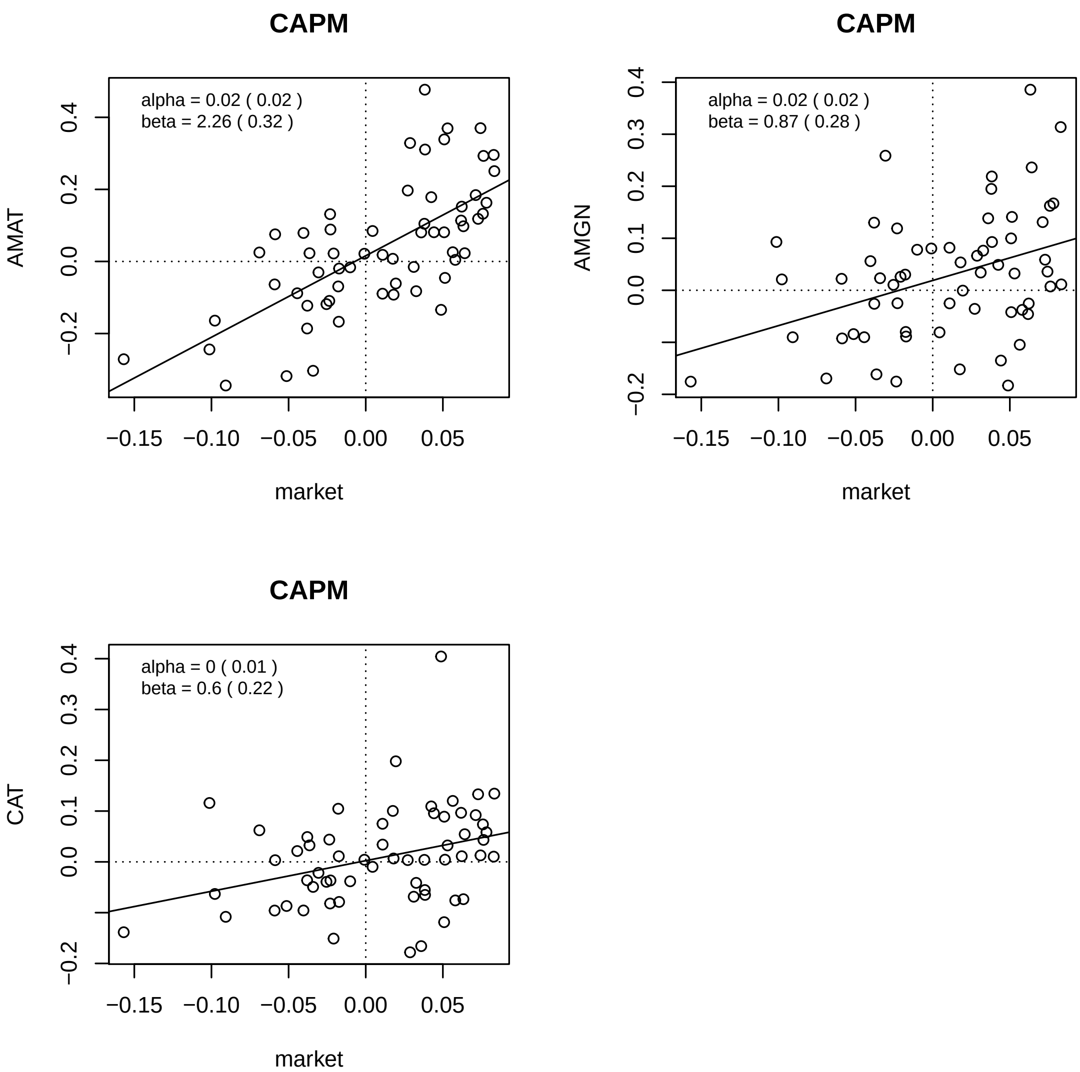
Run CAPM regression

```
# MLM CAPM for AMAT, AMGN, and CAT
mlm <- CAPM(exReturns[, 1:3], mrkt)
getStatistics(mlm)
```

```
##              Estimate Std. Error t value Pr(>|t|)
## alpha. AMAT  0.01580     0.0174   0.909 0.366872
## beta.  AMAT  2.26113     0.3192   3.951 0.000213
```

```
## alpha. AMGN  0.01887      0.0150   1.256 0.214198
## beta.  AMGN  0.86859      0.2760  -0.476 0.635765
## alpha. CAT   0.00231      0.0122   0.190 0.850330
## beta.  CAT   0.60218      0.2241  -1.775 0.081064

# Plot data with regression line
plot(mlm)
```



2 Testing CAPM

2.1 Retrieve α & β and Estimate Result Significance

Retrieve α & β from CAPM object for one or multiple assets and run hypothesis test.

```
# For uv
getBetas(uv)

## beta.  AMAT
##        2.26

getAlphas(uv)

## alpha. AMAT
##      0.0158

hypTest(uv, CI = 0.05)

## $alpha
## [1] FALSE
##
## $beta
## [1] TRUE

# For mlm
getBetas(mlm)

## beta.  AMAT beta.  AMGN  beta.  CAT
##       2.261       0.869       0.602

getAlphas(mlm)

## alpha. AMAT alpha. AMGN  alpha. CAT
##     0.01580     0.01887     0.00231

hypTest(mlm, CI = 0.05)

## $alpha
## alpha. AMAT alpha. AMGN  alpha. CAT
##       FALSE       FALSE       FALSE
```

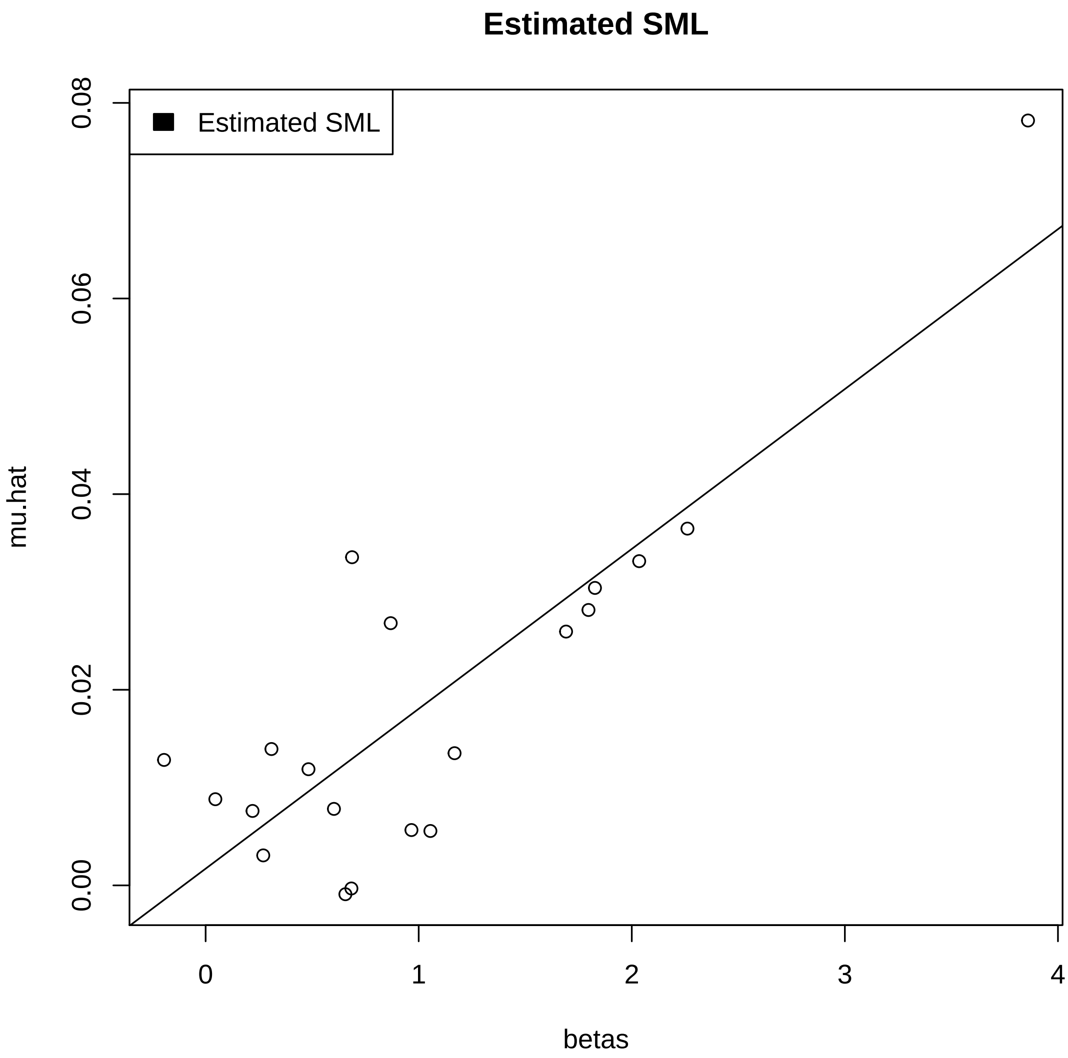
```
##
## $beta
## beta.  AMAT beta.  AMGN  beta.  CAT
##        TRUE       FALSE       FALSE
```

2.2 Estimate Expected Returns and Plot

Plot expected return versus beta. Estimate expected returns

```
# MLM CAPM
mlm <- CAPM(exReturns[, ], mrkt)

# Plot expected returns versus betas
chartSML(mlm)
```



3 Consumption-Oriented CAPM

3.1 Fitting C-CAPM

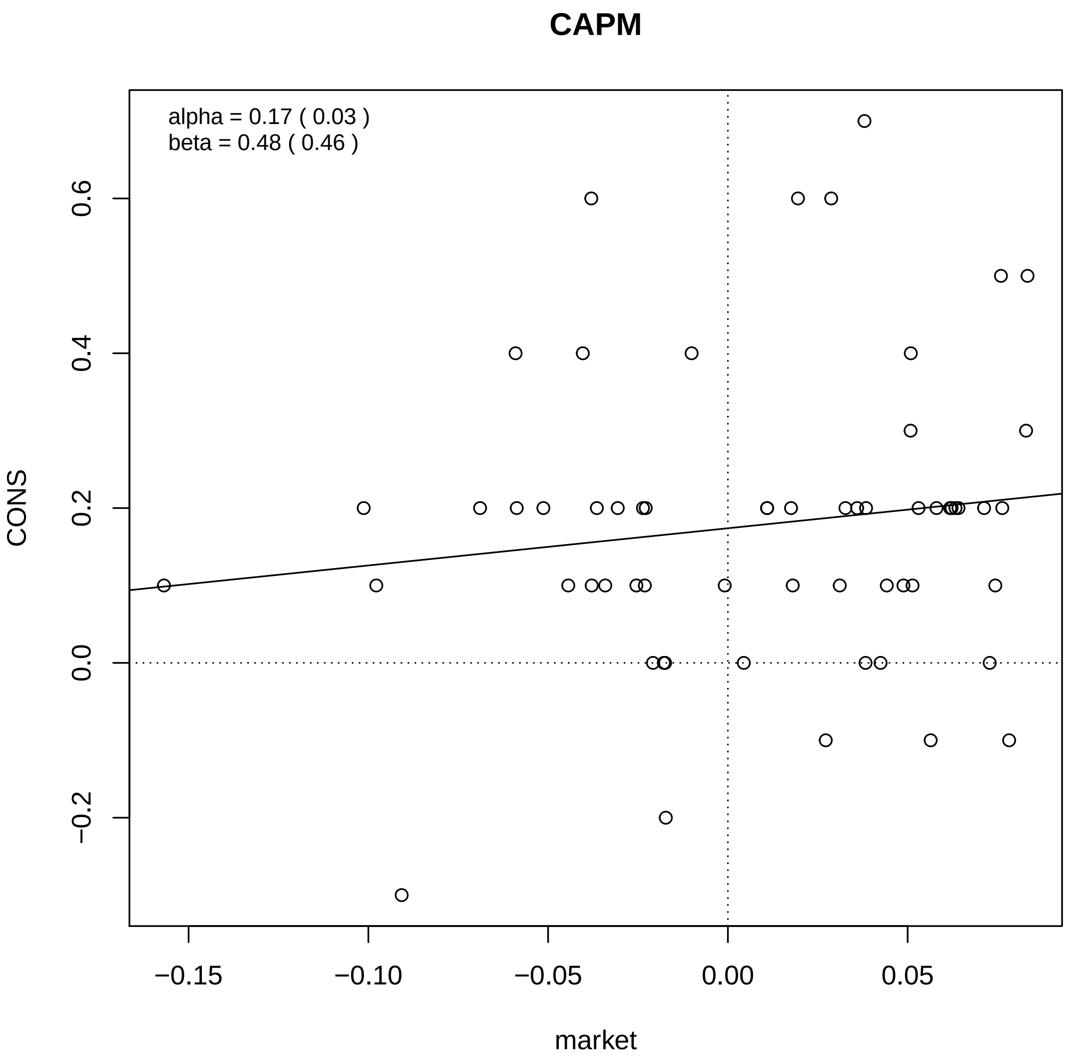
Run C-CAPM regression for CONS (Consumption).

```
# Load FED consumption data: CONS
data(cons)
cons <- xts(cons[, 2], index(largecap.ts))
colnames(cons) = c("CONS")
```

```r
capm.cons = CAPM(cons, mrkt)
coef(summary(capm.cons))

##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)    0.174      0.025    6.94 3.64e-09
## Rmkt           0.481      0.460    1.04 3.01e-01

# Plot data with regression line
plot(capm.cons)
```



NOTE: Specific problems with CCAPM is that it suffers from two puzzles: the equity premium puzzle (EPP) and the risk-free rate puzzle (RFRP). EPP implies that investors are extremely risk averse to explain the existence of a market risk premium. While RFRP stipulates that investors save in TBills despite the low rate of return.