

# Volatility analysis

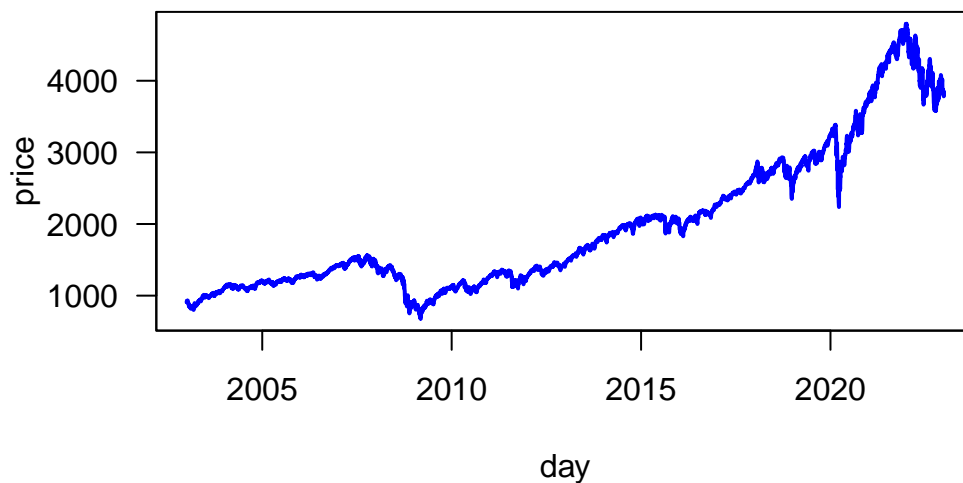
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## Data

We are analysing SP-500 returns from 2003-01-03 to 2022-12-30, 5034 observations. If you like thousand commas in your numbers, then 5,034 observations.

### The SP-500 index



## Analysis of SP-500 volatility

When we estimate a GARCH(1,1), we get these parameters

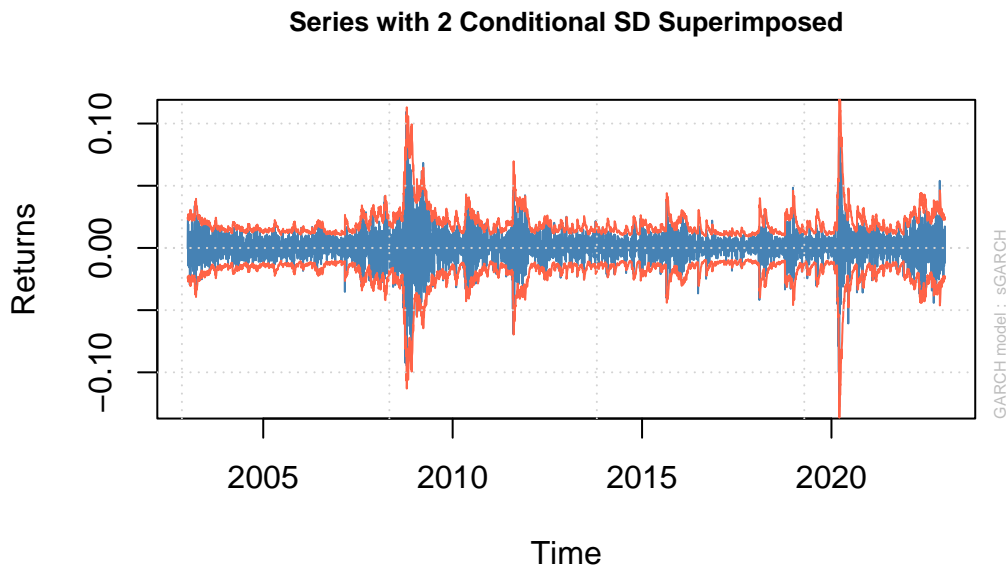
	Estimate	Std. Error	t value	Pr(> t )
omega	0.0000024	0.0000008	3.140765	0.0016851
alpha1	0.1202890	0.0097730	12.308242	0.0000000
beta1	0.8594914	0.0106664	80.579245	0.0000000

Note that since  $\alpha + \beta = 0.98 < 1$ , the model is covariance stationary.

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The Log Likelihood is 16,443.07 .

### Returns with 2 times volatility



### Some VaR analysis

```
Portfolio = 1000  
sigma = 0.01  
p = 0.05  
VaR = -qnorm(p) * Portfolio * sigma
```

Risk is \$16.4 according to the VaR.