Cristian Heredia
Physics 250
J. Rundle
W13

Project 5

Physics 250 Econophysics

In this project, the goal is to write a computer code that will compute historical volatilities for your 10 time series, and then to compute the correlation coefficient between the volatility and its original time series.

Note that the historical volatility for the SPX is *not* the VIX, although it is similar in some ways.

1. To compute the historical volatility we use the closing prices of the time series as for Project 3, $P(t_i)$ on trading day i. Then the historical volatility $V(t_i)$ on trading day i will be defined by:

$$V(t_i) = \sqrt{\frac{252}{21}\left(\sum_{j=1}^{21}\left(Log\left(\frac{P(t_{i-j})}{P(t_{i-j-1})}\right)\right)^2\right)}$$

break this up into smaller variables in matlab, in order to keep track of order of operations

Make sure you read this formula carefully:

a. You compute the ratio of the price on day *i* to the price on day *i*-1.
b. Then compute the natural Log of this ratio.
c. Then square it.
d. Then repeat a.-c. with the ratio of day *i*-1 to day *i*-2 and add to the term from a.-c.
e. Keep repeating this process until you have added up 21 terms over the last 21 trading days (counting today as the 1st day – thus today is *i*=1).
f. Now divide by 21 to compute a ratio.
g. "Annualize" the result by multiplying by 252 trading days = 1 year.
h. Take the square root.

2. The correlation coefficient ρ_{xy} of 2 time series, $x(t), y(t)$, is defined as follows:

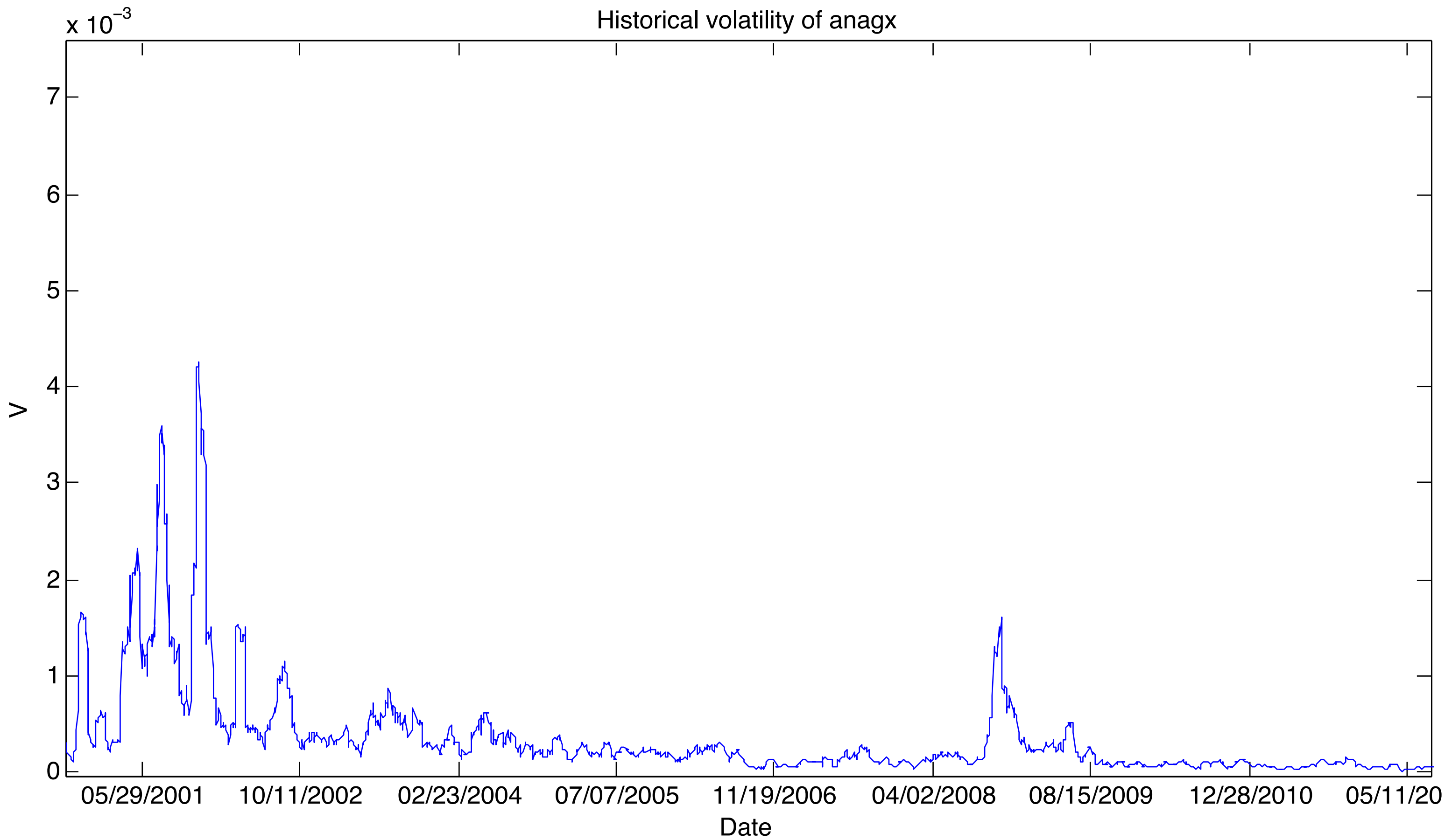
$$\sigma_x^2 = \frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} x(t)x(t)dt$$

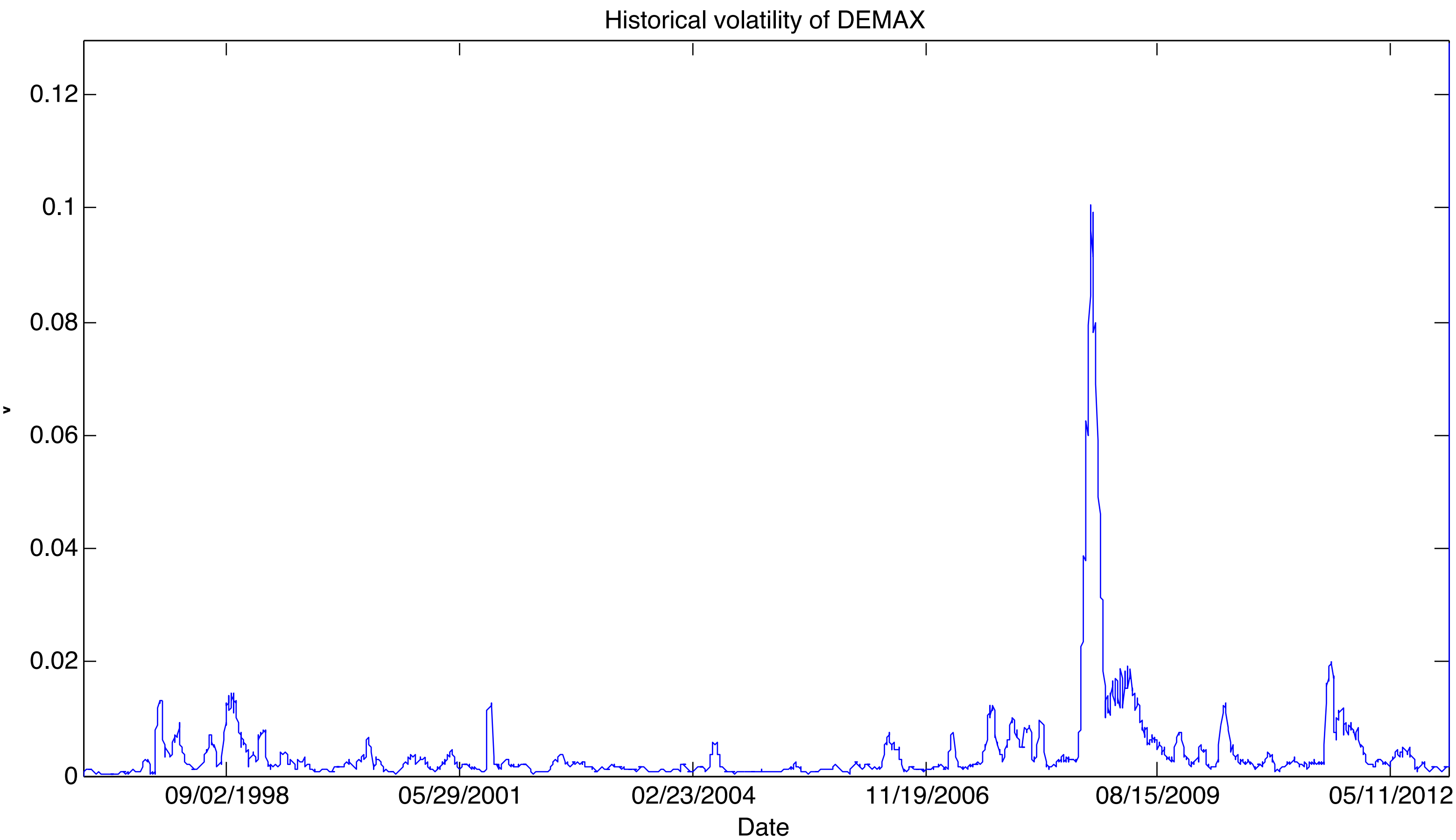
$$\sigma_y^2 = \frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} y(t)y(t)dt$$

$$\rho_{xy} = \left(\frac{1}{\sigma_x\sigma_y}\right)\left[\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} x(t)y(t)dt\right]$$

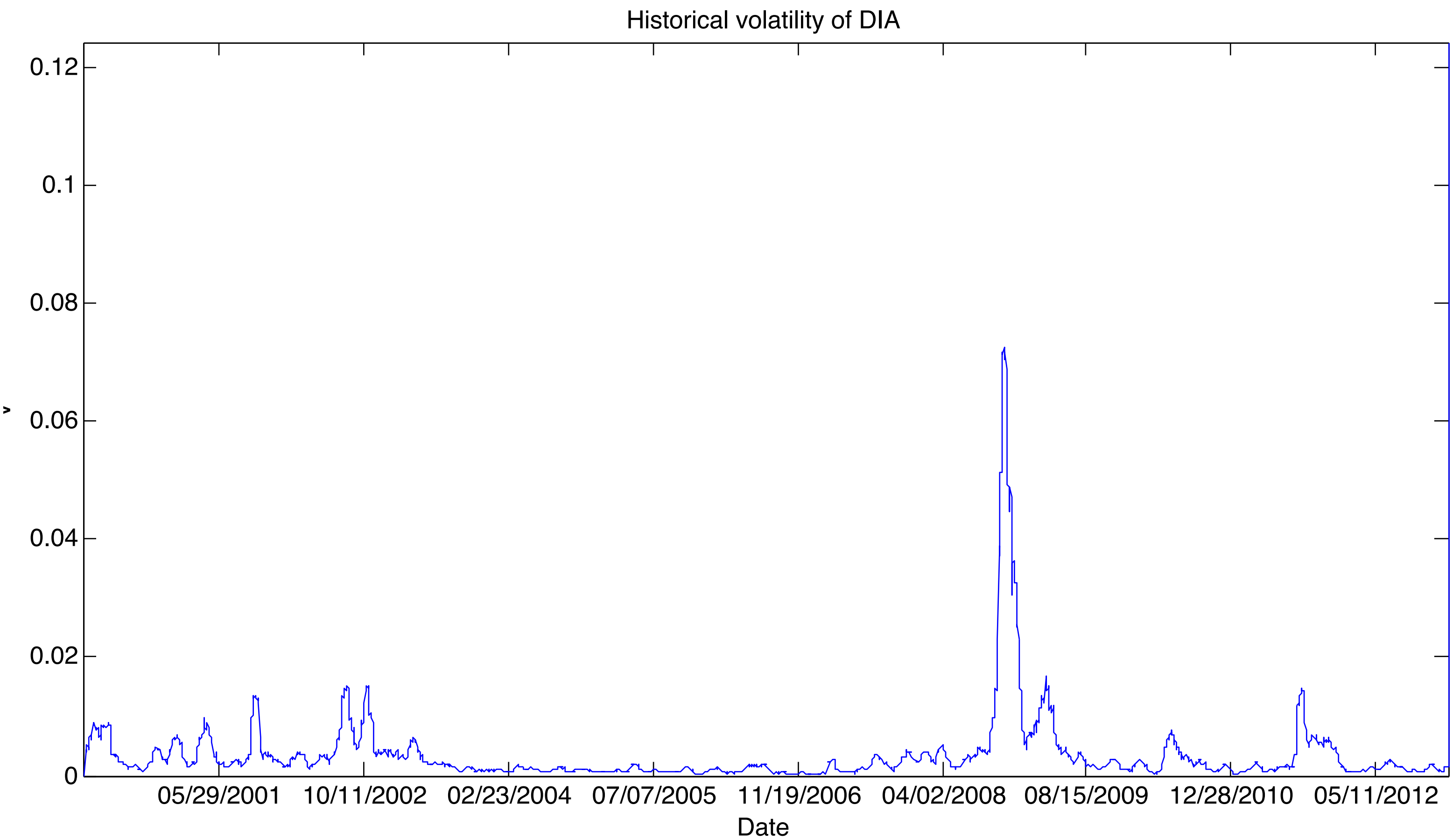
Compute the correlation coefficient for 1995-today where possible, but in any case, since 2000.

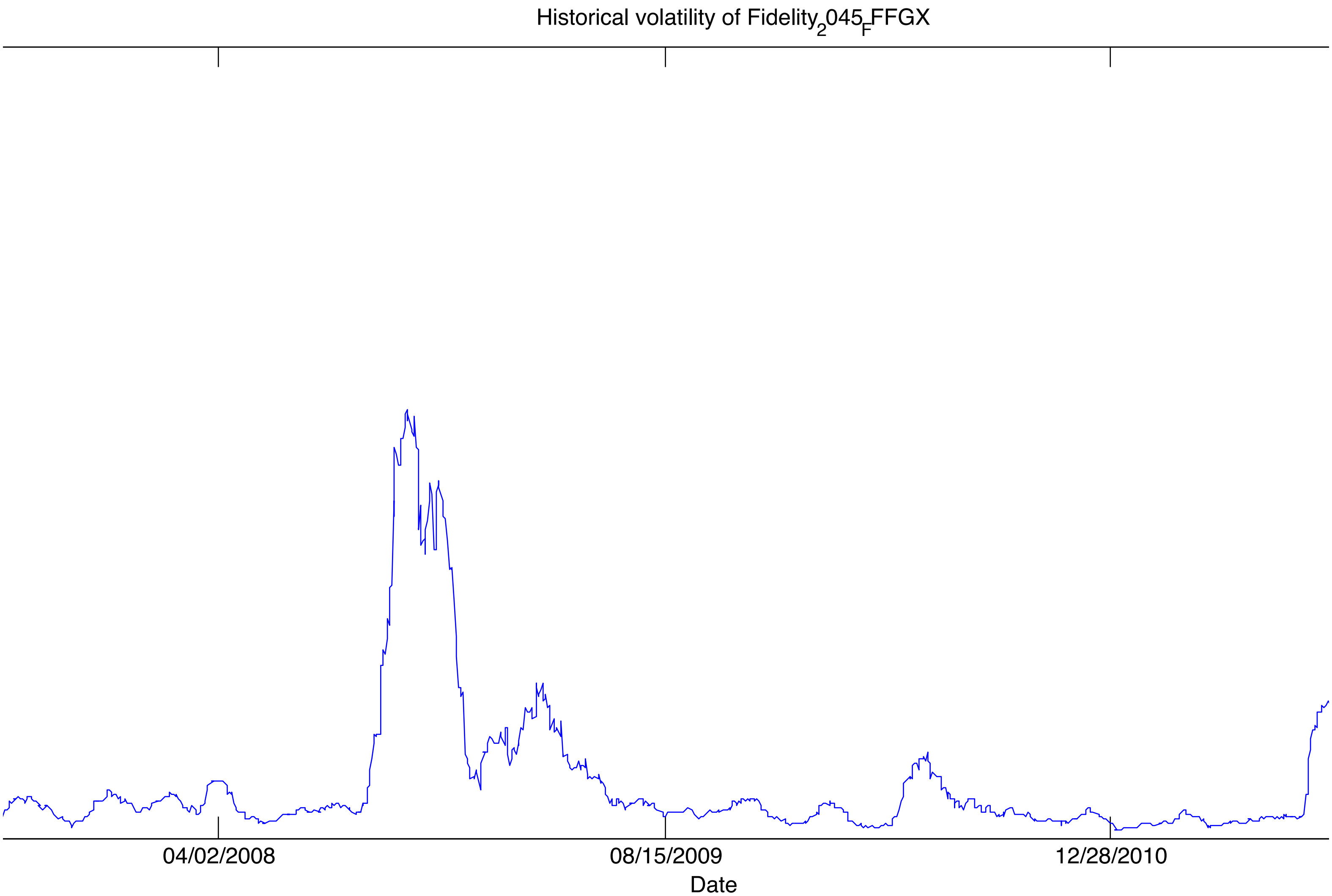
```
%READ CSV FILE
%This creates a matrix without the headings
clear, clc
str = 'VIX';
fileID = fopen([str '.csv']);
C = textscan(fileID, '%s%*f%*f%*f%*f%*f%f','HeaderLines',1,'Delimiter',',');
fclose(fileID);%This grabs the dates and adjusted closing price

date = C{1,1}; %First cell contains dates
date_format= 'yyyy-mm-dd';  %used to convert to datenum
date=datenum(date,date_format);


closing = C{1,2}; %Second cell contains closing values

date=flipud(date); %reverse the order of date
closing=flipud(closing); %reverse the order of date

%a. You compute the ratio of the price on day i to the price on day i-1.
%b. Then compute the natural Log of this ratio.
%c. Then square it.

%Define delta_P function. This For loop function steps through the date array
% and performs the delta_P alogorithm, saving it to an array called delta_P

for i = 23:numel(date, :, 1)%starts on day 22 and ends with number of elements in date
array

    %d. Then repeat a.-c. with the ratio of day i-1 to day i-2 and add to the term from
a.-c.
    %e. Keep repeating this process until you have added up 21 terms over the last 21
trading
    %days (counting today as the 1st day ? thus today is i=1).
    sum_P =0;
    for j = 1:21 %21 days
        delta_P(i) = log(closing(i-j)/closing(i-j-1))^2;
        sum_P = sum_P + delta_P(i);
    end
    V(i) = sum_P;
end

%f. Now divide by 21 to compute a ratio.
%g. ?Annualize? the result by multiplying by 252 trading days = 1 year.
%h. Take the square root.
V(i) = sqrt((252/21)*V(i));

figure(1)
plot(date,V)
title(['Historical volatility of ', str])
ylabel('V')
xlabel('Date')
datetick('x','mm/dd/yyyy', 'keepticks')
hold
axis ([min(date(:))+23 max(date(:))-1 min(V(:)) max(V(:))])
```


Historical volatility of anagx
x 10^-3
7
6
5
4
3
2
1
0
V
05/29/2001
10/11/2002
02/23/2004
07/07/2005
11/19/2006
04/02/2008
08/15/2009
12/28/2010
05/11/201
Date

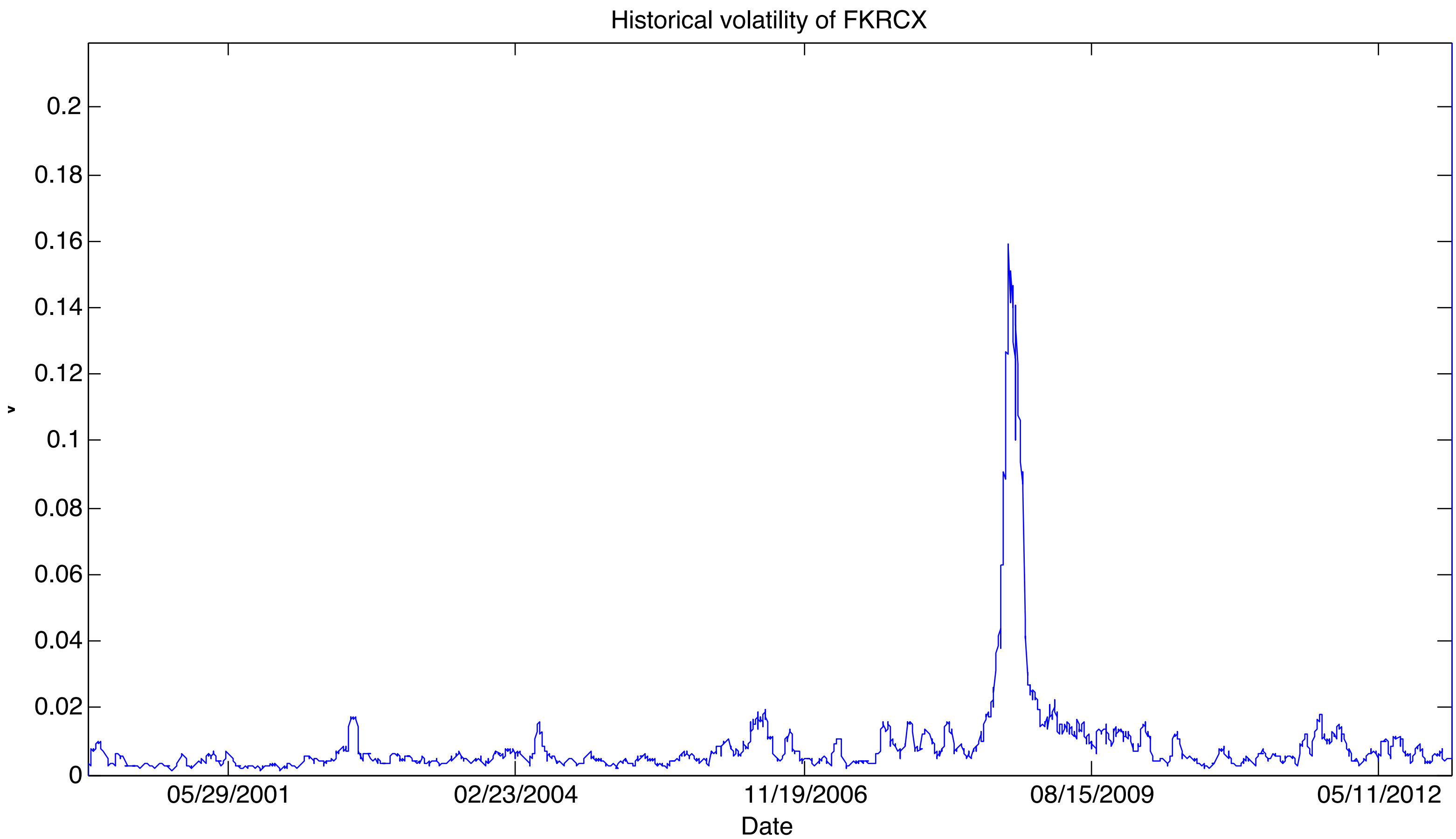


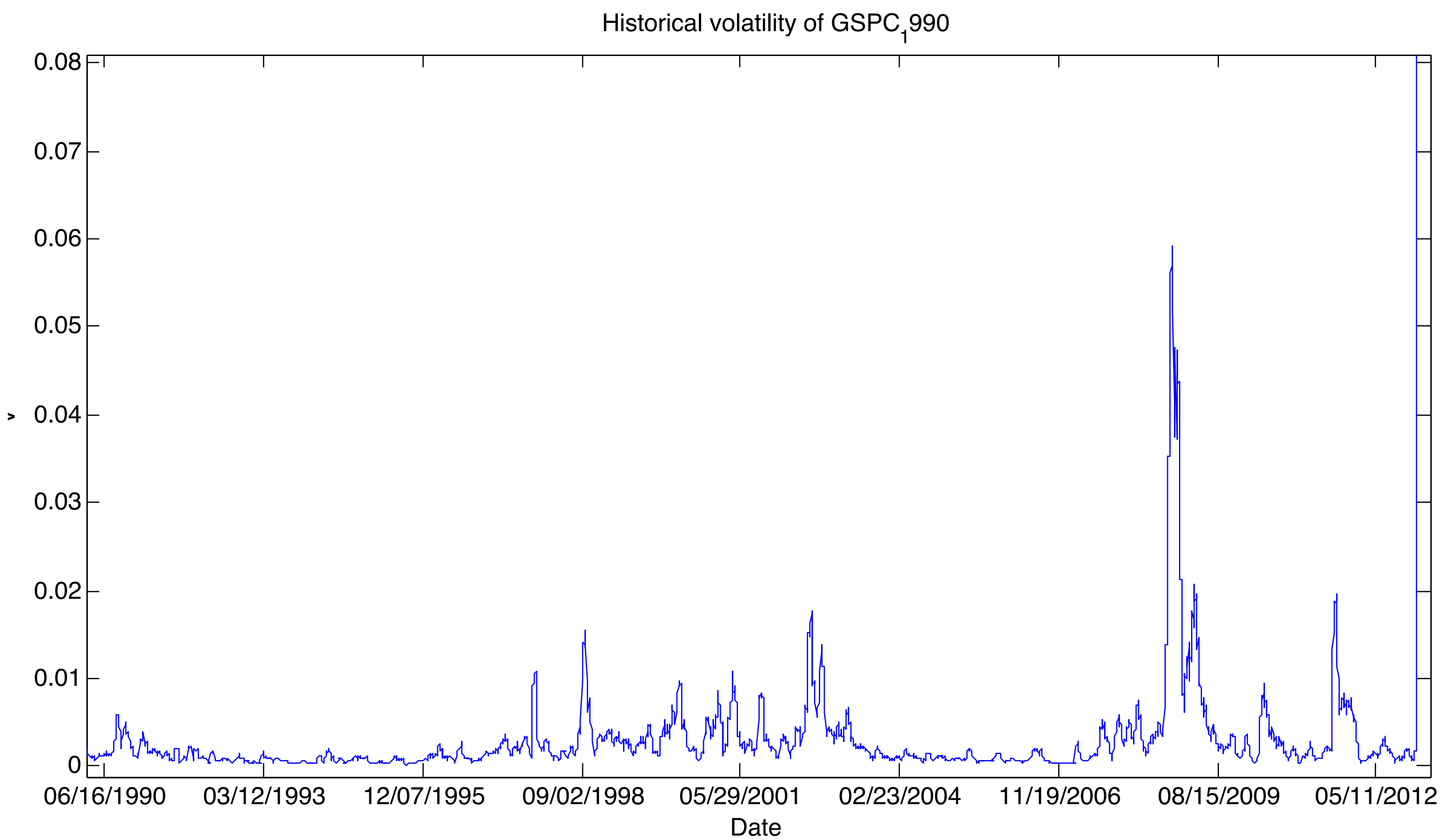
Historical volatility of DEMAX
0.12
0.1
0.08
0.06
0.04
0.02
0
v
09/02/1998
05/29/2001
02/23/2004
11/19/2006
08/15/2009
05/11/2012
Date


Historical volatility of DIA
0.12
0.1
0.08
0.06
0.04
0.02
0
v
05/29/2001
10/11/2002
02/23/2004
07/07/2005
11/19/2006
04/02/2008
08/15/2009
12/28/2010
05/11/2012
Date

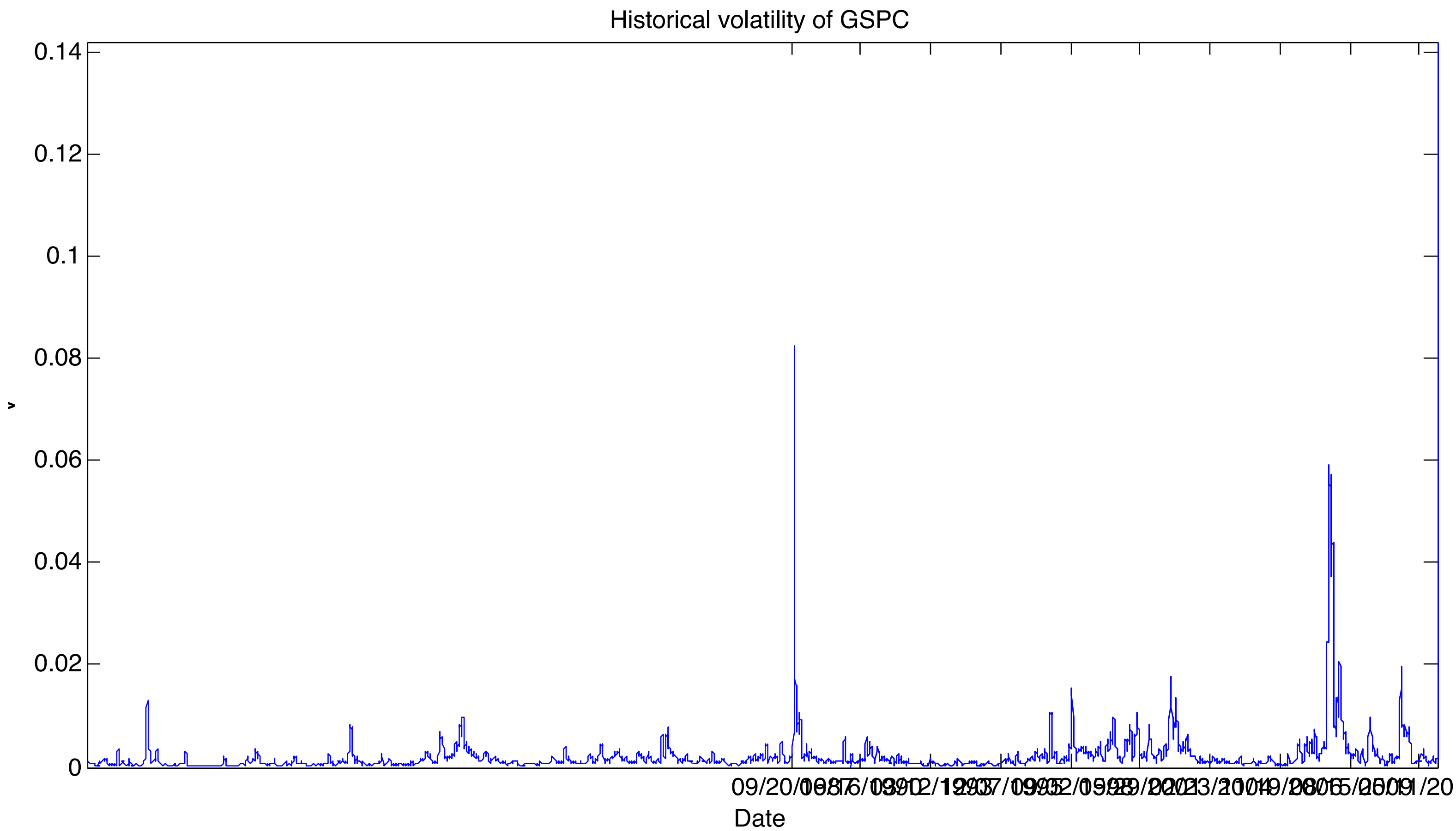


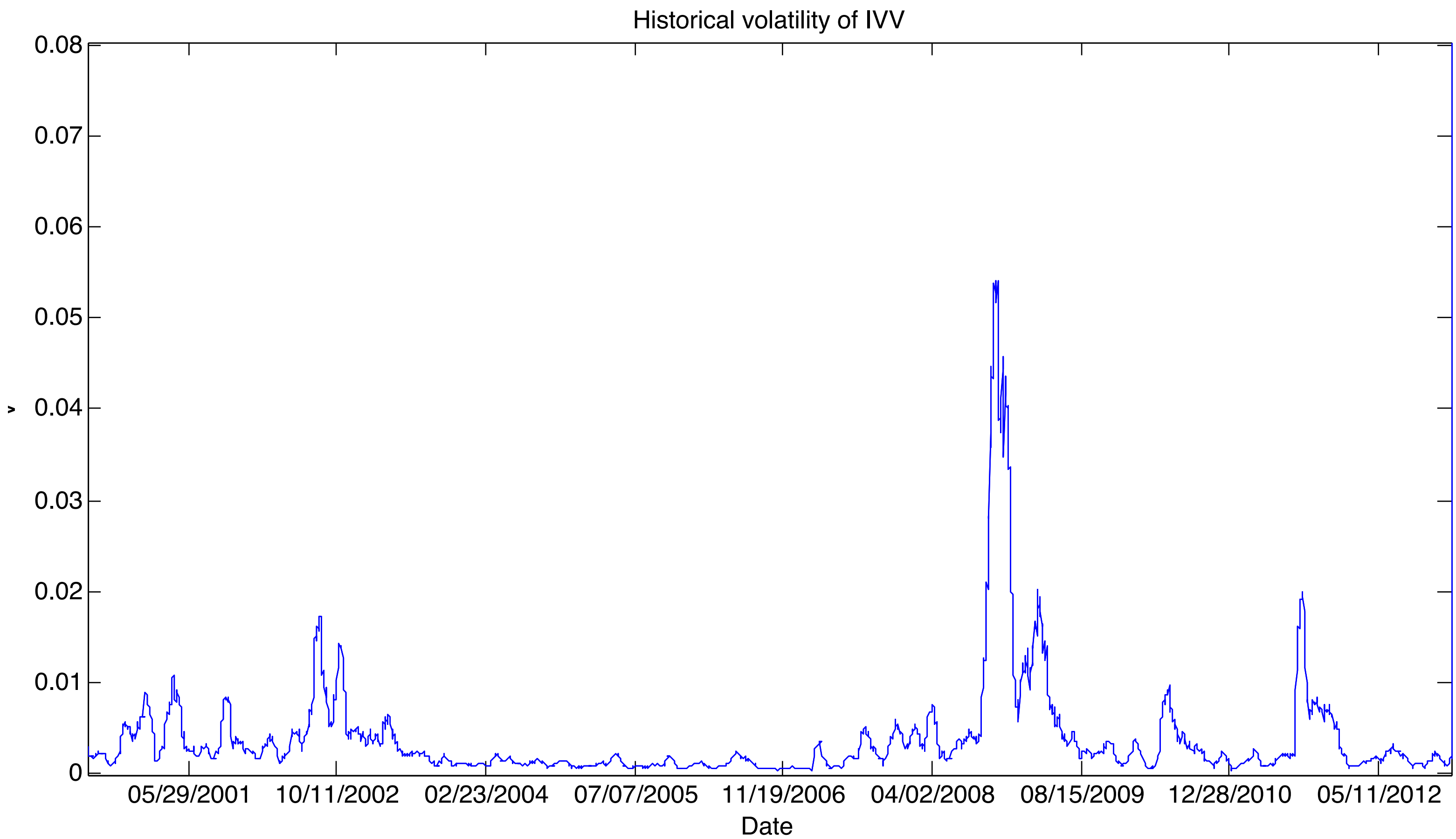
Historical volatility of Fidelity_2045_FFGX
04/02/2008
08/15/2009
12/28/2010
Date

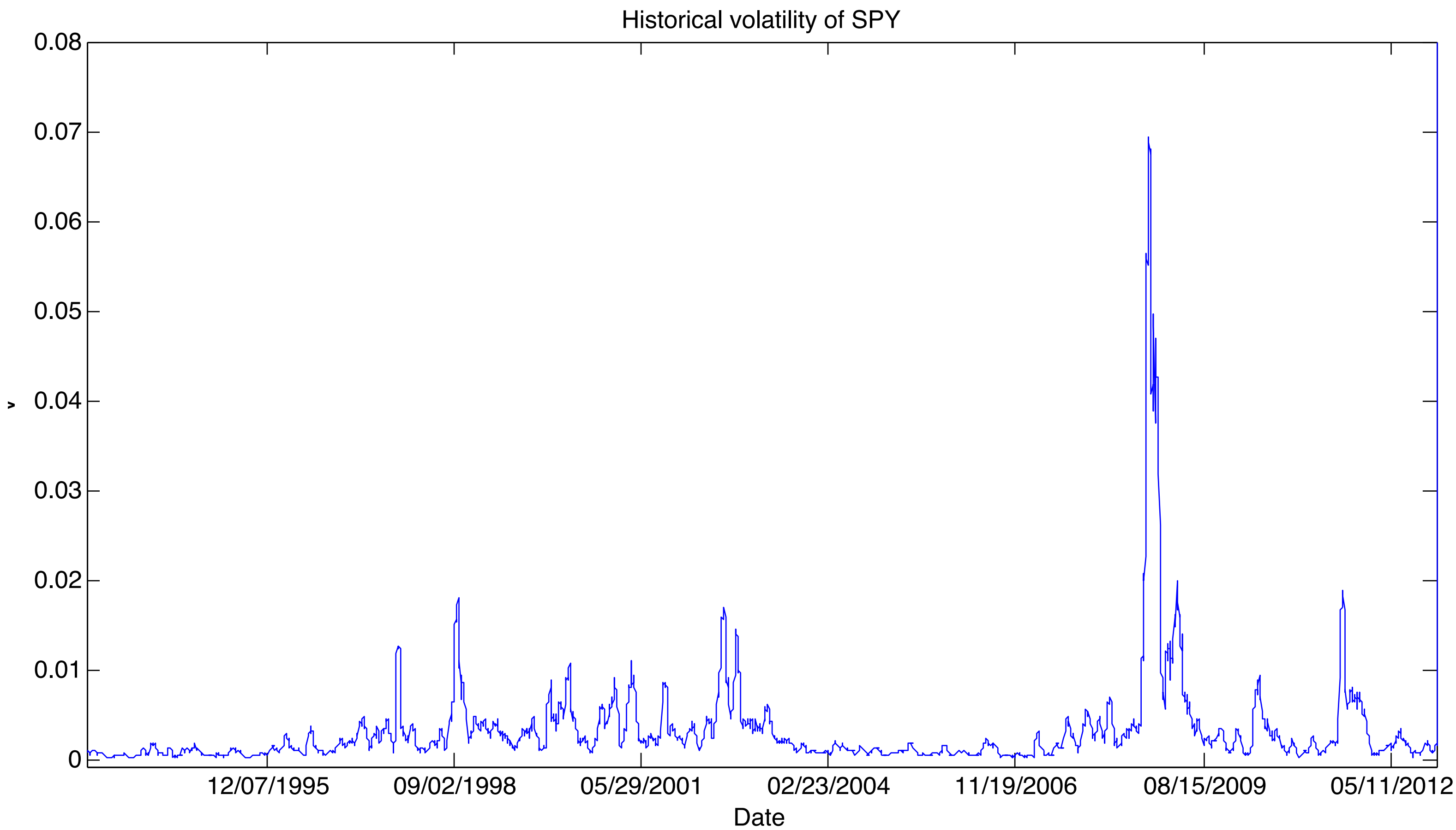

Historical volatility of FKRCX
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
v
05/29/2001
02/23/2004
11/19/2006
08/15/2009
05/11/2012
Date



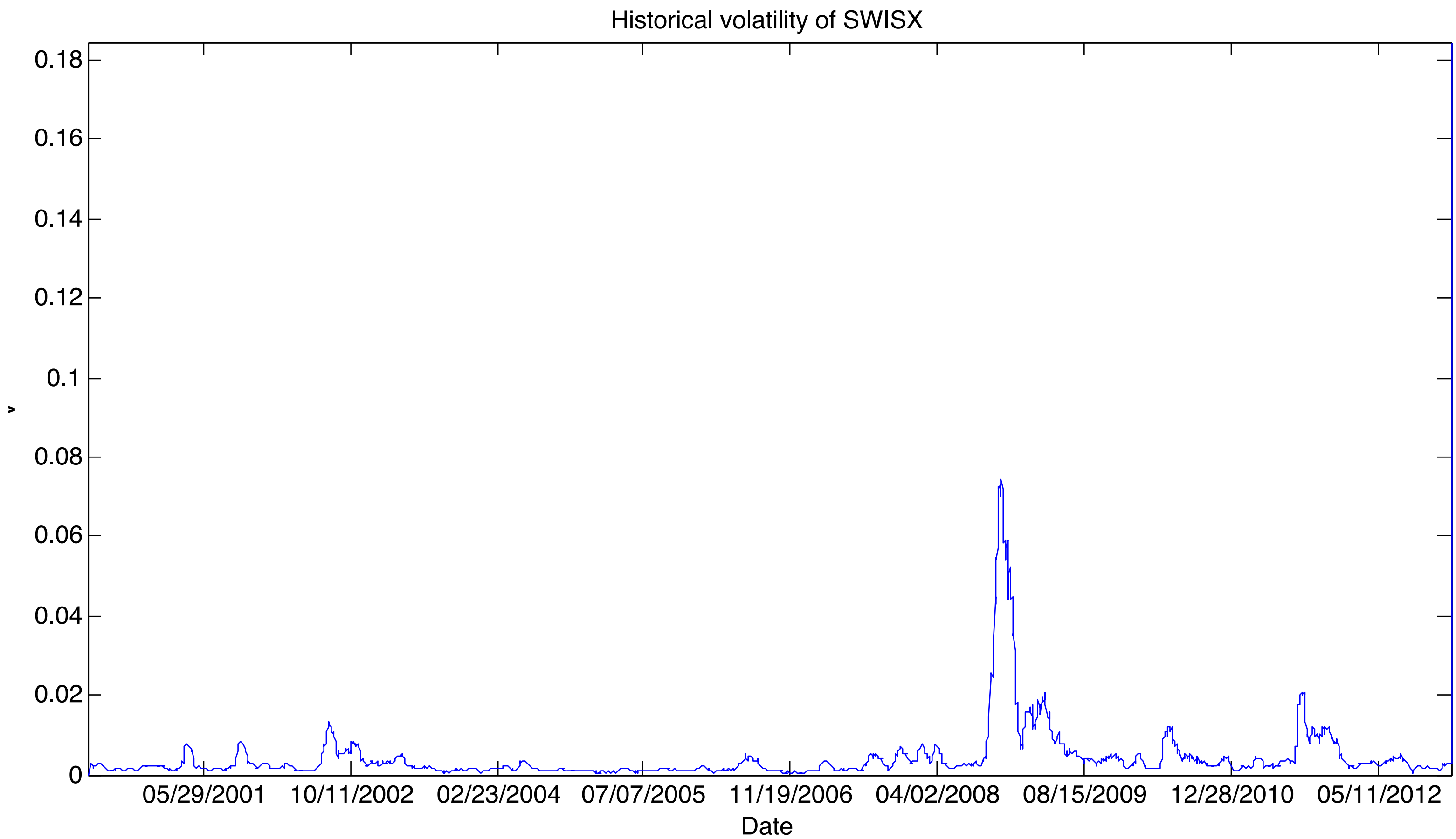
Historical volatility of GSPC_1990
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
06/16/1990
03/12/1993
12/07/1995
09/02/1998
05/29/2001
02/23/2004
11/19/2006
08/15/2009
05/11/2012
Date


Historical volatility of GSPC
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
v
Date

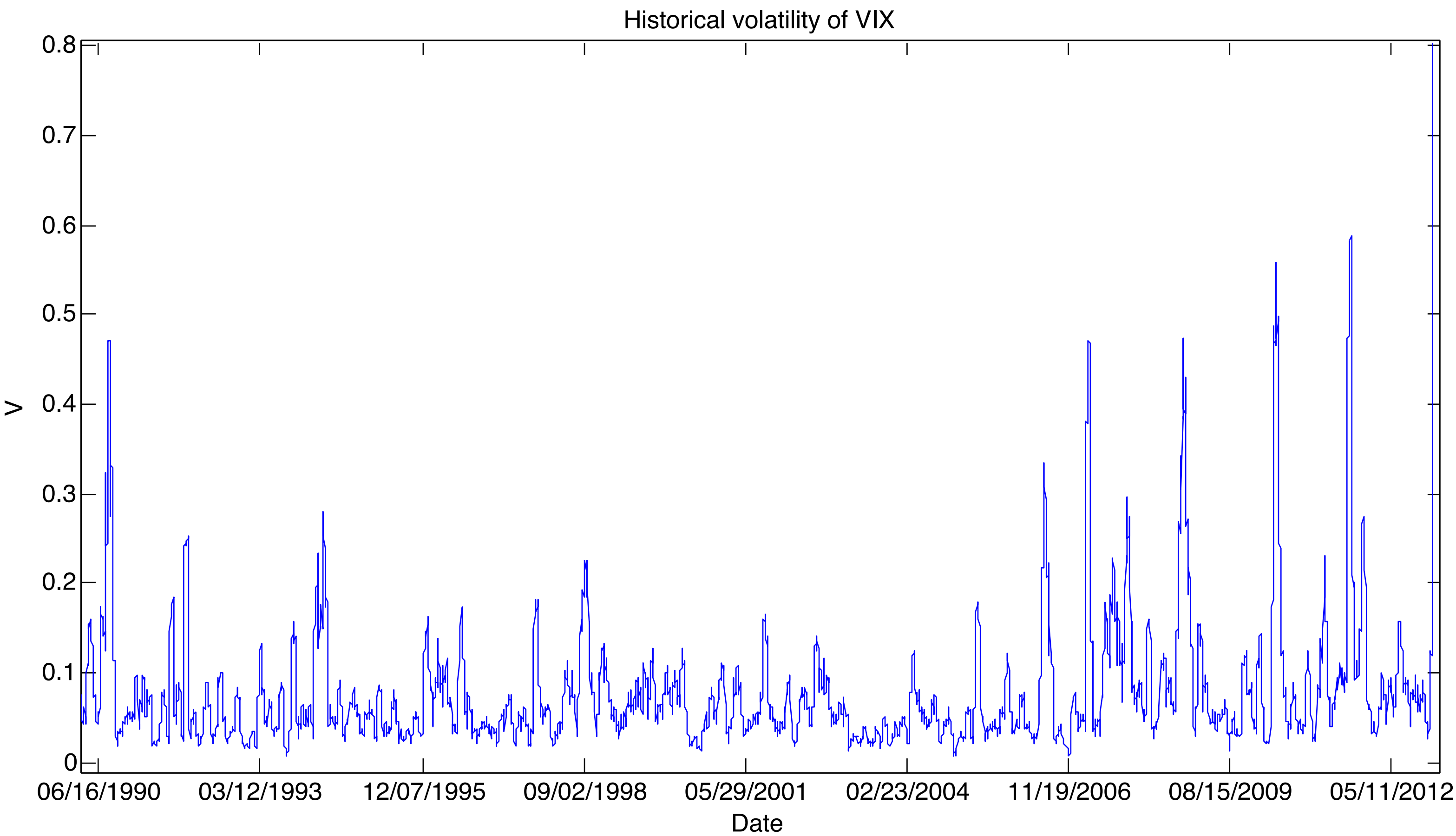

Historical volatility of IVV
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
v
05/29/2001
10/11/2002
02/23/2004
07/07/2005
11/19/2006
04/02/2008
08/15/2009
12/28/2010
05/11/2012
Date



Historical volatility of SPY
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
v
12/07/1995
09/02/1998
05/29/2001
02/23/2004
11/19/2006
08/15/2009
05/11/2012
Date



Historical volatility of SWISX
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
v
05/29/2001
10/11/2002
02/23/2004
07/07/2005
11/19/2006
04/02/2008
08/15/2009
12/28/2010
05/11/2012
Date



Historical volatility of VIX
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
V
06/16/1990
03/12/1993
12/07/1995
09/02/1998
05/29/2001
02/23/2004
11/19/2006
08/15/2009
05/11/2012
Date

```
%READ CSV FILE
%This creates a matrix without the headings, these are x(t) inputs
clear, clc
str = 'VIX';
fileID = fopen([str '.csv']);
C = textscan(fileID, '%s%*f%*f%*f%*f%*f%f','HeaderLines',1,'Delimiter',',');
fclose(fileID);%This grabs the dates and adjusted closing price

date = C{1,1}; %First cell contains dates
date_format= 'yyyy-mm-dd';  %used to convert to datenum
date=datenum(date,date_format);

%This creates a matrix without the headings, these are y(t) inputs
str2 = 'GSPC';
fileID = fopen([str2 '.csv']);
C2 = textscan(fileID, '%s%*f%*f%*f%*f%*f%f','HeaderLines',1,'Delimiter',',');
fclose(fileID);%This grabs the dates and adjusted closing price

date2 = C2{1,1}; %First cell contains dates
date2=datenum(date2,date_format);



closing = C{1,2}; %Second cell contains closing values
closing2 = C2{1,2};

date=flipud(date); %reverse the order of date
closing=flipud(closing); %reverse the order of closing
date2=flipud(date2); %reverse the order of date
closing2=flipud(closing2); %reverse the order of closing


t1 = datenum('1995-01-04',date_format);%converts string date to serial date
%datestr(t1,date_format) %converts serial date to sting date

%find(date == t1)%locates indix for given serial date

t2 = datenum('2013-01-03',date_format);%converts string date to serial date
%datestr(t2,date_format) %converts serial date to sting date

ts1x = find(date == t1);%locates index for given serial date
ts2x = find(date == t2);%locates index for given serial date
ts1y = find(date2 == t1);%locates index for given serial date
ts2y = find(date2 == t2);%locates index for given serial date
%sometimes these yield errors because not all of the stocks are traded on
%the same dates



%By subtracting dates we can insure vectors of the same lenght, this might
%be a problem because not all stocks have the same number of trading days
deltat = ts2x-ts1x;
newdate = date(ts2x-deltat:ts2x);     % Extract the ith through the jth elements for x
(t)
closingPx = closing(ts2x-deltat:ts2x);% Extract the ith through the jth elements

newdate2 = date2(ts2y-deltat:ts2y);     % Extract the ith through the jth elements
closingPy = closing2(ts2y-deltat:ts2y); % Extract the ith through the jth elements

%Find variance by integrating over time period
varx = (1/deltat)*trapz(newdate,closingPx.^2);
vary = (1/deltat)*trapz(newdate2,closingPy.^2);

rhoxy = (1/sqrt(varx*vary))*(1/(deltat))*trapz(newdate2,closingPx.*closingPy)%this does
yield for the same x(t)
```

The Correlation coefficient for GPSC and VIX is rhoxy =0.8974