ValueAtRisk

September 29, 2021

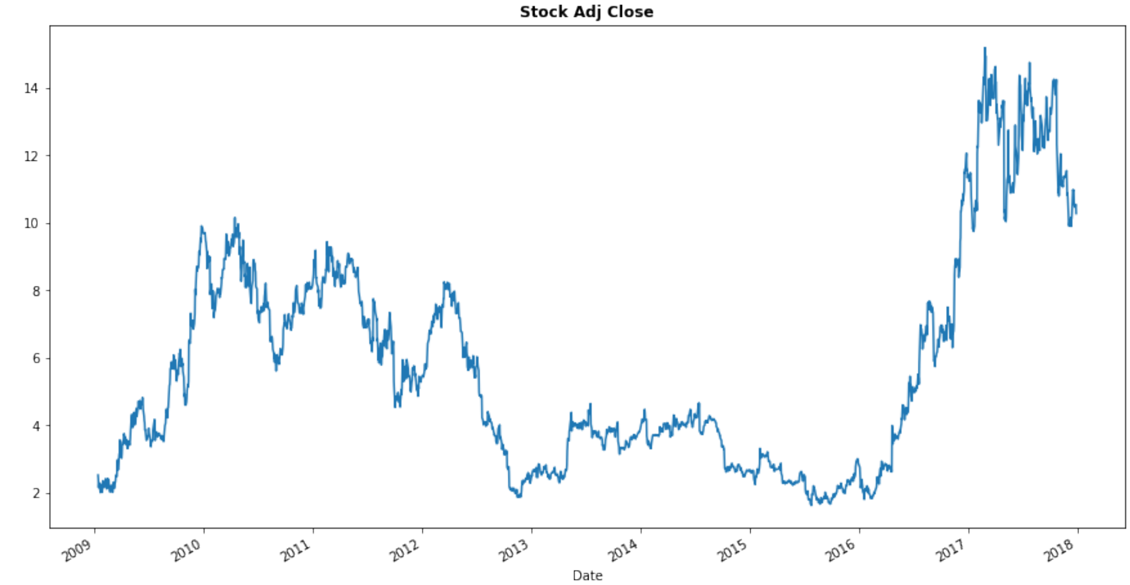
Value at Risk for Stock Market Trends

[83]:
```
import numpy
import scipy.stats
import matplotlib.pyplot as plt
%matplotlib inline

import warnings
warnings.filterwarnings("ignore")

from pandas_datareader import data as pdr
import fix_yahoo_finance as yf
yf.pdr_override()
```

[84]:
```
start = '2009-01-11'
end = '2018-01-01'
df = pdr.get_data_yahoo("AMD", start, end)
```

```
[*********************100%***********************]  1 of 1 downloaded
```

[85]:
```
plt.figure(figsize=(15,8))
df["Adj Close"].plot()
plt.title("Stock Adj Close", weight='bold')
plt.show()
```

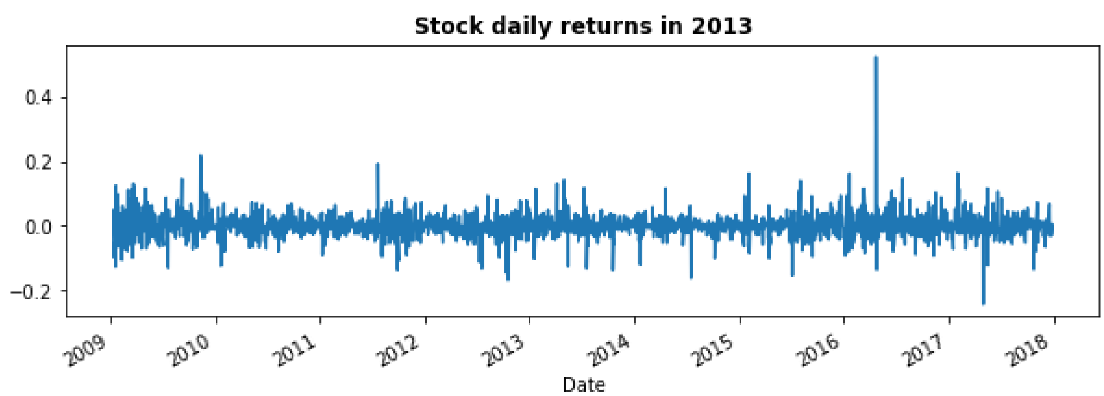


[86]:
```
df.head()
```

[86]:

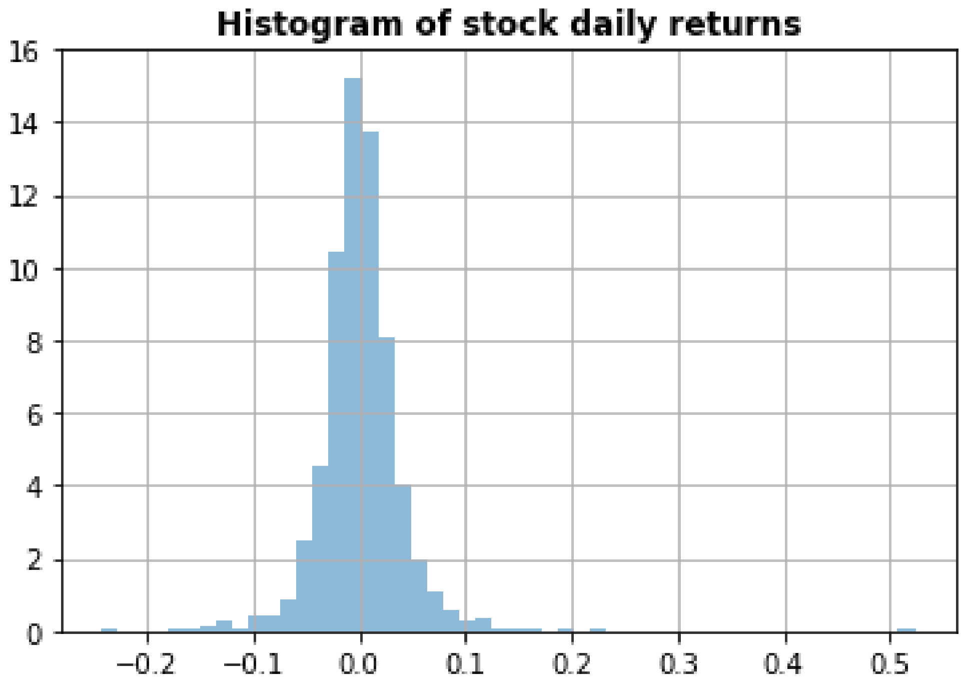
	Open	High	Low	Close	Adj Close	Volume
Date						
2009-01-12	2.69	2.69	2.45	2.52	2.52	13085600
2009-01-13	2.42	2.47	2.30	2.38	2.38	21157100
2009-01-14	2.29	2.30	2.11	2.15	2.15	14821600
2009-01-15	2.15	2.30	2.05	2.26	2.26	16022500
2009-01-16	2.32	2.40	2.20	2.29	2.29	15182600

[87]:
```
fig = plt.figure()
fig.set_size_inches(10,3)
df["Adj Close"].pct_change().plot()
plt.title(u"Stock daily returns in 2013", weight='bold');
```

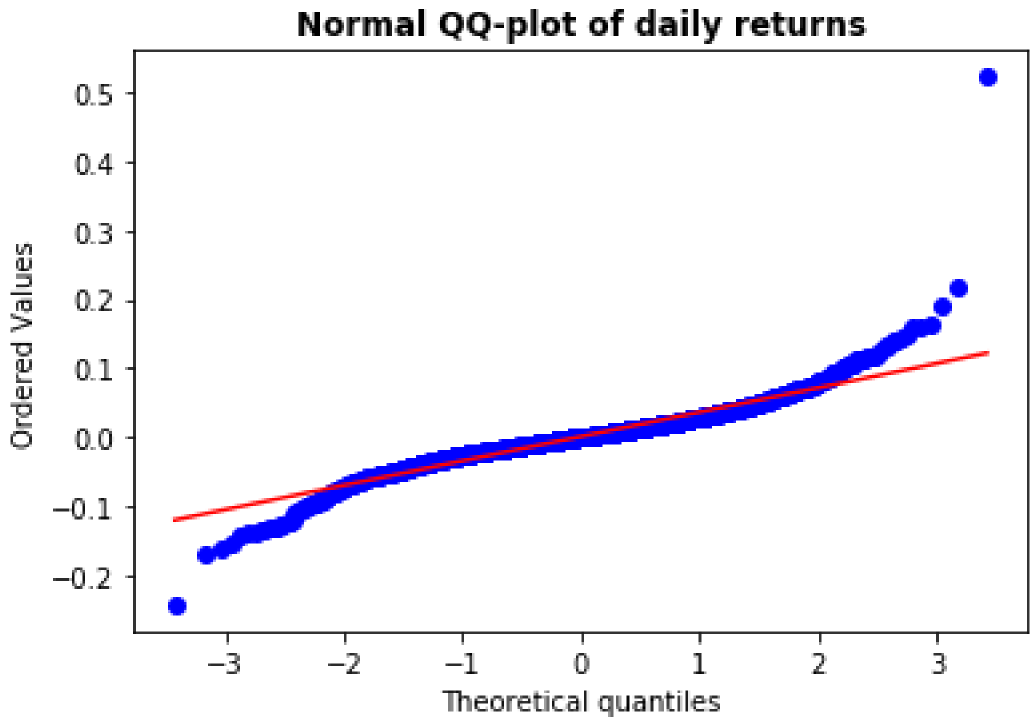


[88]:
```
df["Adj Close"].pct_change().hist(bins=50, normed=True, histtype='stepfilled',␣
↪alpha=0.5)
plt.title(u"Histogram of stock daily returns", weight='bold')
df["Adj Close"].pct_change().std()
```

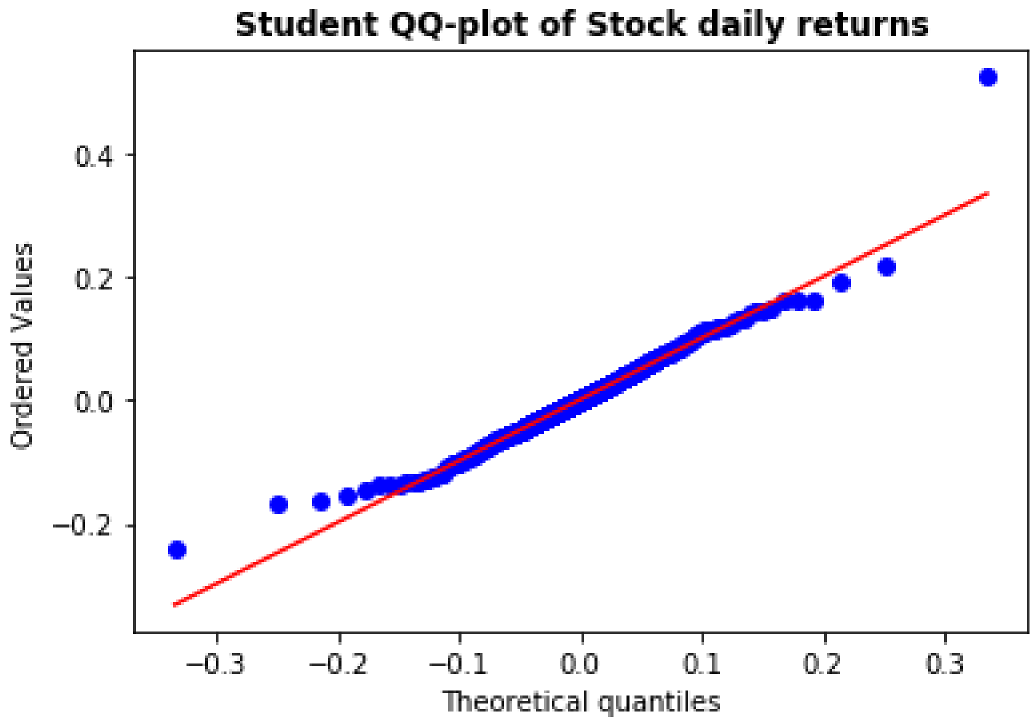
[88]: 0.037288597160603014



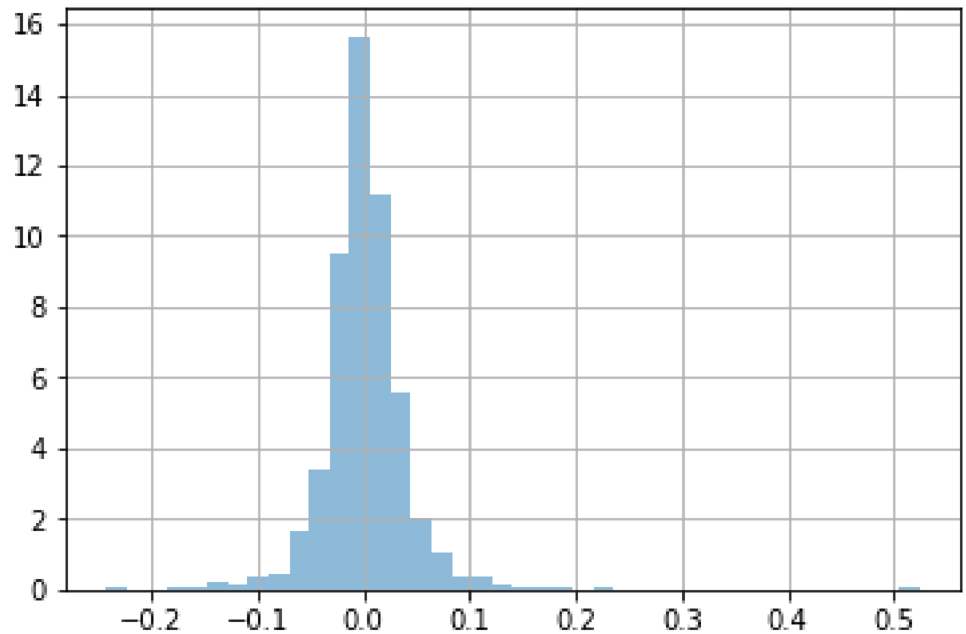
[89]:
```
Q = df["Adj Close"].pct_change().dropna().as_matrix()
scipy.stats.probplot(Q, dist=scipy.stats.norm, plot=plt.figure().
↪add_subplot(111))
plt.title("Normal QQ-plot of daily returns", weight="bold");
```



[90]:
```
tdf, tmean, tsigma = scipy.stats.t.fit(Q)
scipy.stats.probplot(Q, dist=scipy.stats.t, sparams=(tdf, tmean, tsigma),␣
 ↪plot=plt.figure().add_subplot(111))
plt.title("Student QQ-plot of Stock daily returns", weight="bold");
```



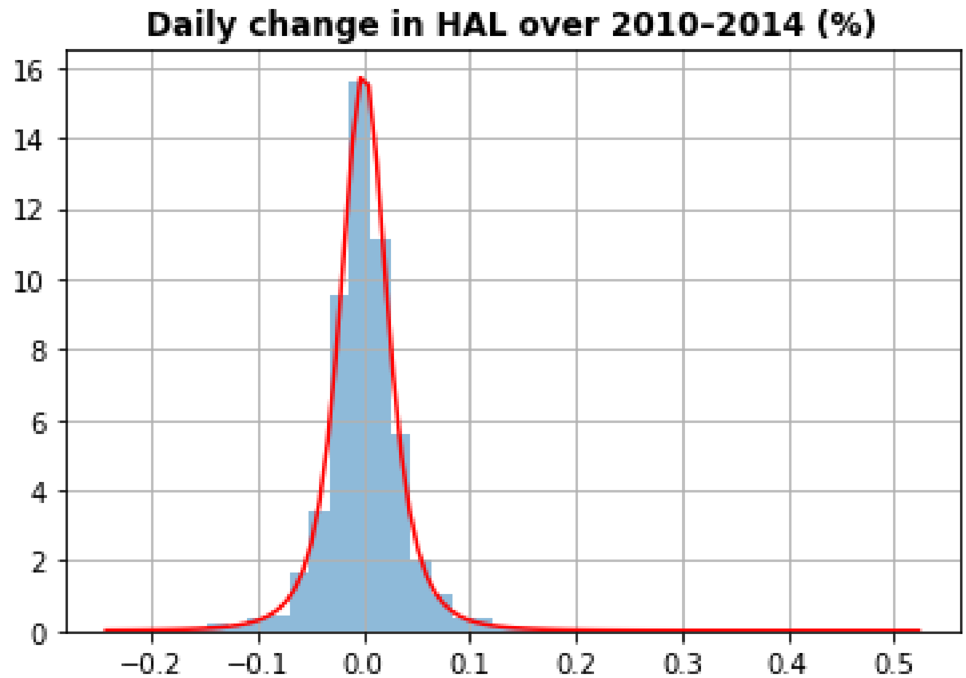
[91]:
```python
# VaR using the historical bootstrap method
returns = df["Adj Close"].pct_change().dropna()
mean = returns.mean()
sigma = returns.std()
tdf, tmean, tsigma = scipy.stats.t.fit(returns.as_matrix())
returns.hist(bins=40, normed=True, histtype='stepfilled', alpha=0.5);
```



[92]:
```
returns.quantile(0.05)
```

[92]: -0.05263157894736839

[93]:
```
# VaR using the variance-covariance method
support = numpy.linspace(returns.min(), returns.max(), 100)
returns.hist(bins=40, normed=True, histtype='stepfilled', alpha=0.5);
plt.plot(support, scipy.stats.t.pdf(support, loc=tmean, scale=tsigma, df=tdf),␣
 ↪"r-")
plt.title("Daily change in HAL over 2010-2014 (%)", weight='bold')
plt.show()
```



[94]:
```
scipy.stats.norm.ppf(0.05, mean, sigma)
```

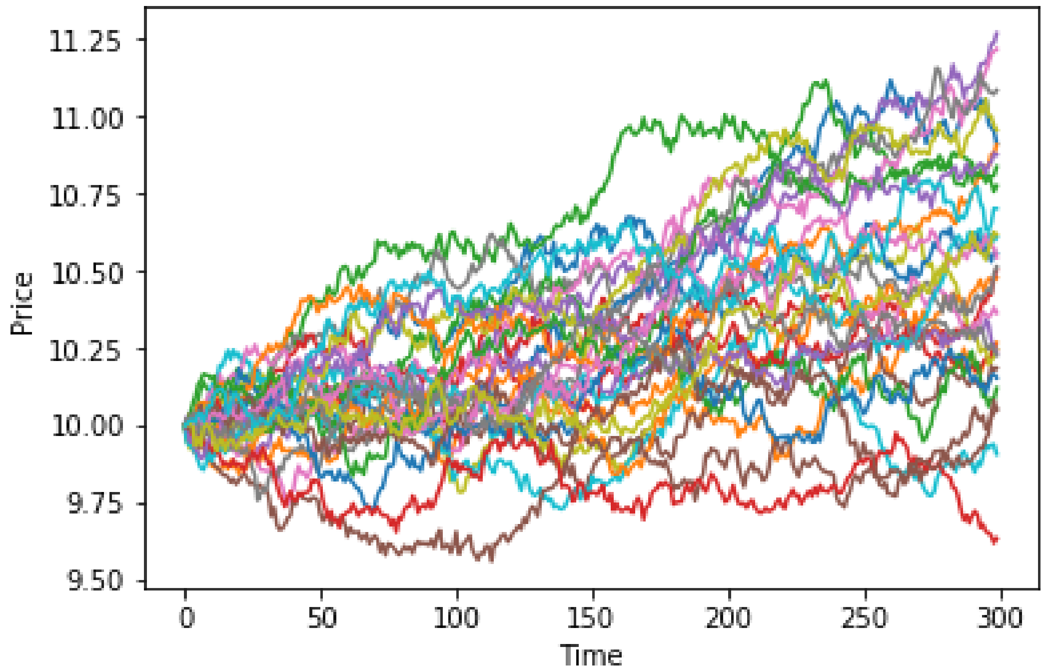
[94]: -0.06003052054204739

[95]:
```
# VaR using Monte Carlo method
days = 300    # time horizon
dt = 1/float(days)
sigma = 0.04 # volatility
mu = 0.05  # drift (average growth rate)
```

[96]:
```
def random_walk(startprice):
    price = numpy.zeros(days)
    shock = numpy.zeros(days)
    price[0] = startprice
    for i in range(1, days):
        shock[i] = numpy.random.normal(loc=mu * dt, scale=sigma * numpy.
 ↪sqrt(dt))
        price[i] = max(0, price[i-1] + shock[i] * price[i-1])
    return price
```

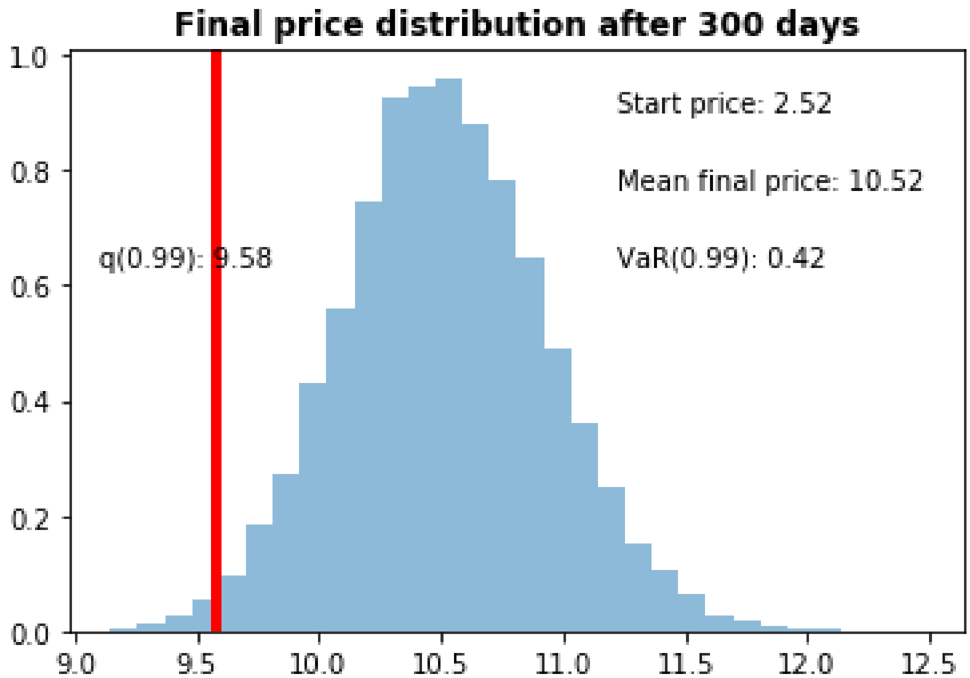
[97]:
```
# Similuations
for run in range(30):
    plt.plot(random_walk(10.0))
plt.xlabel("Time")
```

```
plt.ylabel("Price");
```



[98]:

```
runs = 10000
simulations = numpy.zeros(runs)
for run in range(runs):
    simulations[run] = random_walk(10.0)[days-1]
q = numpy.percentile(simulations, 1)
plt.hist(simulations, normed=True, bins=30, histtype='stepfilled', alpha=0.5)
plt.figtext(0.6, 0.8, "Start price: %.2f" % df["Adj Close"][0])
plt.figtext(0.6, 0.7, "Mean final price: %.2f" % simulations.mean())
plt.figtext(0.6, 0.6, "VaR(0.99): %.2f" % (10 - q,))
plt.figtext(0.15, 0.6, "q(0.99): %.2f" % q)
plt.axvline(x=q, linewidth=4, color='r')
plt.title("Final price distribution after {} days".format(days), weight='bold');
```


Final price distribution after 300 days
Start price: 2.52
Mean final price: 10.52
q(0.99): 9.58
VaR(0.99): 0.42
1.0
0.8
0.6
0.4
0.2
0.0
9.0
9.5
10.0
10.5
11.0
11.5
12.0
12.5