In [1]:

```
%pylab
%matplotlib inline
```

```
Using matplotlib backend: Qt4Agg
Populating the interactive namespace from numpy and matplotlib
```

In [2]:

```
import pandas as pd

#from IPython.display import display
#from IPython.core.pylabtools import figsize, getfigs
import scipy.stats
```

Se añade la carpeta 'funciones' al PYTHONPATCH

In [3]:

```
import sys, os
#sys.path.append('../funciones')

#import inspect
 # realpath() will make your script run, even if you symlink it :)
#cmd_folder = os.path.realpath(os.path.abspath(os.path.split(inspect.getfile( inspect.currentframe() ))
[0]))
cmd_folder = os.path.realpath('funciones')
if cmd_folder not in sys.path:
    sys.path.insert(0, cmd_folder)

from fun_bootstrap import *
from fun_plothist import *
import aeronettools as at
import aeronettools2 as at2
#import aeronettools_pynb as at3
from aeronettools_pynb import extract_aeronet_data
from fun_check import *
```

In [4]:

```
# Autocarga del modulo aeronettools_pynb
%load_ext autoreload
%aimport aeronettools_pynb
%aimport aeronettools
%aimport aeronettools2
#%aimport fun_bootstrap
%aimport fun_bootstrap
%aimport fun_plothist
%aimport fun_check
%autoreload 1
```

# MURCIA 2013

Se comprueba si existe el arcivo con los datos, y si no se descarga y descomprime

In [5]:

```
file_default = '/spred/pn32/Renovables/Red/Aeronet/lev15/130101_131231_Murcia.lev15'
FILE = '130101_131231_Murcia.lev15'

if os.path.isfile(file_default):
    FILE = file_default
elif not os.path.isfile(FILE):
    url = 'http://aeronet.gsfc.nasa.gov/zip_files/130101_131231_Murcia.zip'
    zFILE = FILE.replace('lev15', 'zip')

    import urllib
    urllib.URLopener().retrieve(url, zFILE)
```

```
    #import urllib2
    #file_name = url.split('/')[-1]
    #u = urllib2.urlopen(url)
    #f = open(file_name, 'wb')
    #meta = u.info()
    #file_size = int(meta.getheaders("Content-Length")[0])
    #print "Downloading: %s Bytes: %s" % (file_name, file_size)
    #
    #file_size_dl = 0
    #block_sz = 8192
    #while True:
    #    buffer = u.read(block_sz)
    #    if not buffer:
    #        break
    #
    #    file_size_dl += len(buffer)
    #    f.write(buffer)
    #    status = r"%10d  [%3.2f%%]" % (file_size_dl, file_size_dl * 100. / file_size)
    #    status = status + chr(8)*(len(status)+1)
    #    #print status,
    #
    #f.close()

    import zipfile
    zfile = zipfile.ZipFile(zFILE)
    zfolder = os.path.dirname(os.path.realpath(zFILE))
    zfile.extractall(zfolder)
    # os.getcwd()
    zfile.close()

    os.remove(zFILE)
```

Filtrado de los datos con el algorítmo de AEMet llamado aeronettools.py. Se ha modificado algunos parámetros para tener datos en todos los meses del año.

In [6]:

```
file_aeronet_Murcia = FILE
df_out_Murcia = at2.extract_aeronet_data(file_aeronet_Murcia)
df_out_Murcia['month'] = df_out_Murcia.index.month

aodMen_Murcia = [df_out_Murcia[df_out_Murcia['month']==i]['AOT_500'].mean() for i in range(1,13)]
dataAODmen_Murcia = [len(df_out_Murcia[df_out_Murcia['month']==i]['AOT_500']) for i in range(1,13)]
df_Murcia = pd.DataFrame({'AODmean_Murcia':aodMen_Murcia, 'number of AOD data':dataAODmen_Murcia })
df_Murcia
```

Out[6]:

| | AODmean_Murcia | number of AOD data |
|---|---|---|
| **0** | 0.037084 | 80 |
| **1** | 0.056487 | 121 |
| **2** | 0.058808 | 100 |
| **3** | 0.104211 | 98 |
| **4** | 0.135081 | 157 |
| **5** | 0.160551 | 259 |
| **6** | 0.187269 | 338 |
| **7** | 0.202397 | 213 |
| **8** | 0.168832 | 136 |
| **9** | 0.135315 | 133 |
| **10** | 0.048316 | 148 |
| **11** | 0.095019 | 80 |

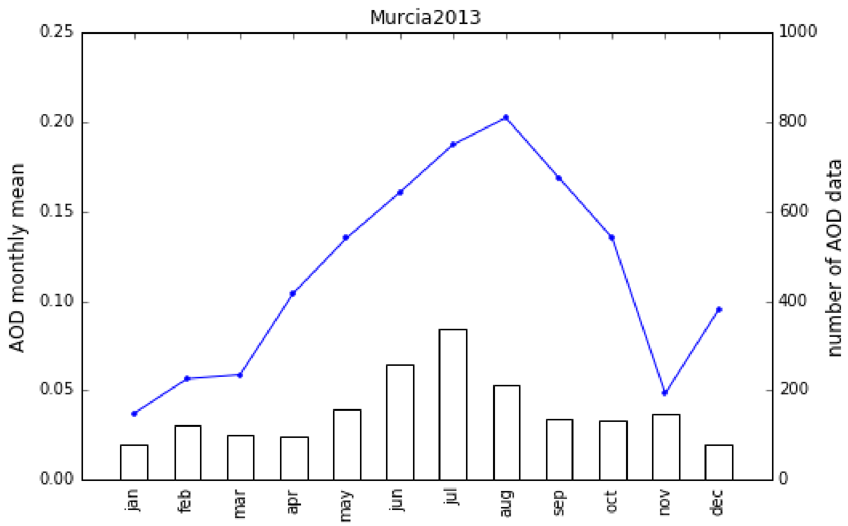
Representación de los datos

In [7]:

```
pylab.figure(figsize=(17,5))
ax = plt.subplot(121)
#ax = df_Murcia.plot(y = 'AODmean_Murcia', marker='.')
ax.plot(df_Murcia.index.values, df_Murcia['AODmean_Murcia'], marker='.')
ax2 = df_Murcia['number of AOD data'].plot(kind = 'bar', secondary_y=True, color ='white',
                                          align='center')
#ax2 =df_Murcia.plot(y = 'number of AOD data', secondary_y=True)

ax.set_ylabel("AOD monthly mean", fontsize=12)
ax2.set_ylabel("number of AOD data", fontsize=12)

#ax.set_ylim(-150,200)
width = 0.3
ind = np.arange(len(dataAODmen_Murcia))
#rects1 = ax2.bar(ind, dataAODmen_Murcia, width, color='white', align='center')
xTickMarks = ['jan', 'feb', 'mar', 'apr', 'may', 'jun', 'jul', 'aug', 'sep',
               'oct', 'nov', 'dec']
ax.set_xticks(ind)
ax.set_ylim(0,0.25)
ax2.set_ylim(0,1000)
xtickNames = ax.set_xticklabels(xTickMarks)
ax.set_xlim(-1,12)
ax2.set_xlim(-1,12)

#bar_label(rects1, dataAODmen_Murcia)
ax.set_title('Murcia2013')
```

Out[7]:

```
<matplotlib.text.Text at 0x1d9a0ba8>
```



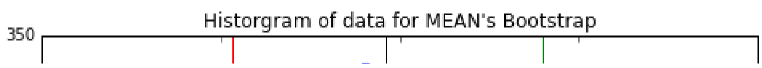

In [8]:

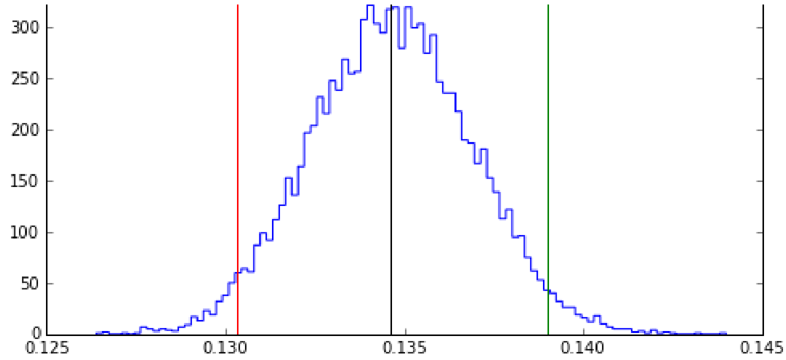
```
x = df_out_Murcia['AOT_500'].values

# find mean 95% CI and 10,000 bootstrap samples
stat_mean, ci_mean = bootstrap(x, np.mean)
obs_mean = np.mean(x)

print "Mean of sample data: \n", obs_mean
pylab.figure(figsize=(8,4))
#pylab.figure(figsize=(18,4))
#ab = pylab.subplot(121)
plot_bootstrap(stat_mean, ci_mean)
pylab.axvline(obs_mean, c='black')
#ab.set_title('Murcia2013')
```

```
Mean of sample data:
0.134623338969
Bootstrapped 95% confidence interval of Mean:
[0.13030805179817498, 0.13902493585614598]
--------------------------------------------------
```

Out[8]:

```
<matplotlib.lines.Line2D at 0x1dadb198>
```

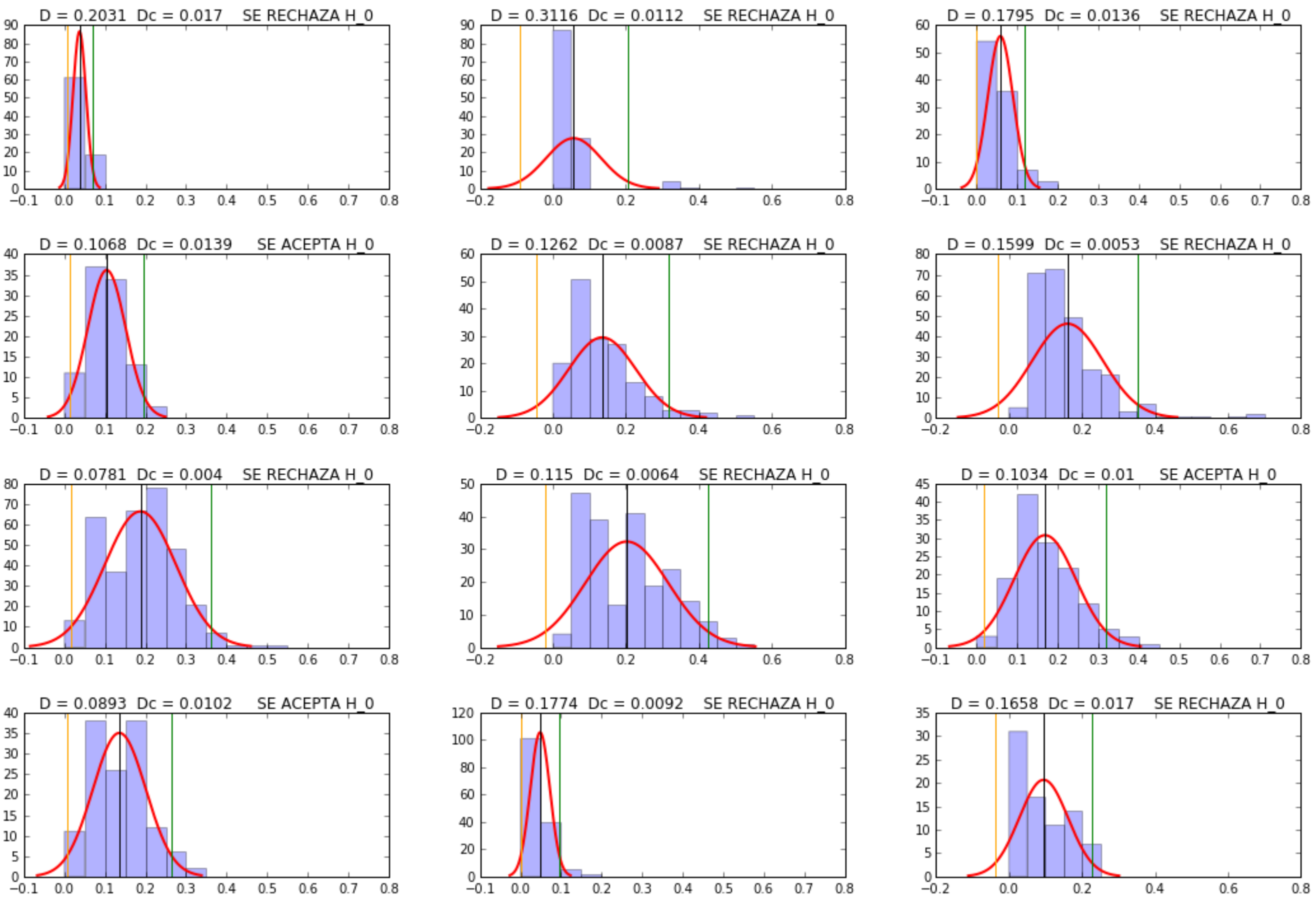





In [9]:

```
fig, axs = plt.subplots(4,3, figsize=(18, 12))
fig.subplots_adjust(hspace = .4, wspace = .25)

axs = axs.ravel()
for i in range(12):
    pylab.subplot(4,3,i+1)
    PlotHist2(df_out_Murcia[df_out_Murcia['month']==i+1]['AOT_500'], bin=np.arange(0,0.75,0.05), cdf="n
orm")
```

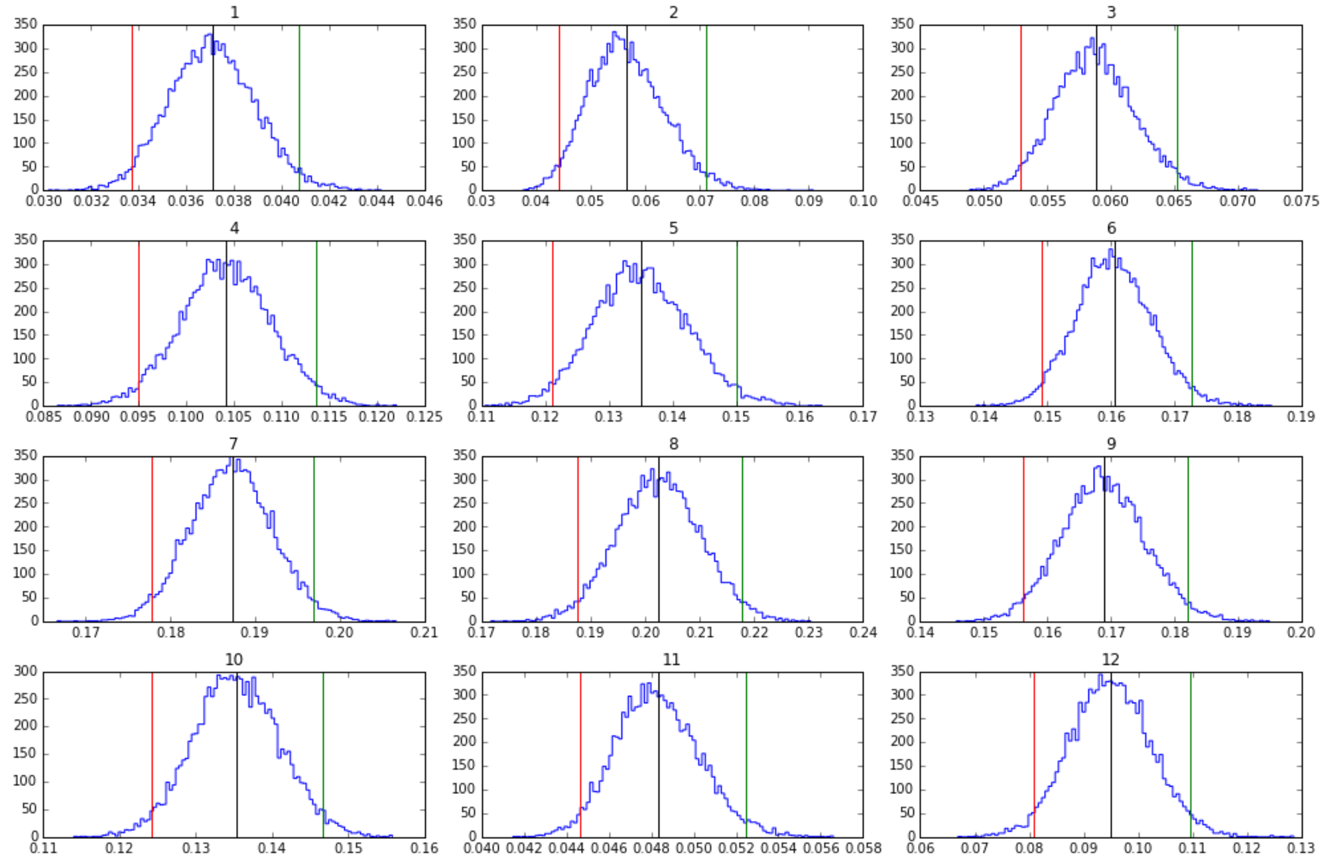
```
mu y sigma:  (0.037083956250000001, 0.015996074733195045)
mu y sigma:  (0.056486512396694208, 0.075342203359141116)
mu y sigma:  (0.058807980000000003, 0.0309174694448721)
mu y sigma:  (0.10421070918367346, 0.046904125169139041)
mu y sigma:  (0.13508058598726111, 0.091927005104025183)
mu y sigma:  (0.16055120270270271, 0.097247064422738158)
mu y sigma:  (0.18726878846153847, 0.088059704667316732)
mu y sigma:  (0.20239741079812204, 0.11410469340921443)
mu y sigma:  (0.16883170588235294, 0.076371755267323968)
mu y sigma:  (0.13531514661654134, 0.065546256859277161)
mu y sigma:  (0.048316212837837831, 0.024207079076358884)
mu y sigma:  (0.095018875000000003, 0.066918059357951906)
```




In [10]:

```
fig, axs = plt.subplots(4,3, figsize=(17, 11))
fig.subplots_adjust(hspace = .3, wspace = .15)
```

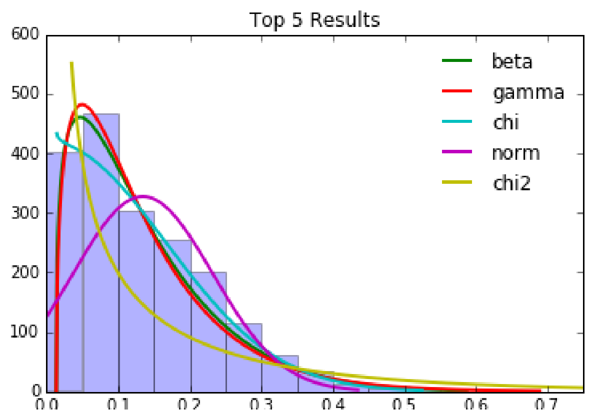
```
axs = axs.ravel()

for i in range(12):
    x = df_out_Murcia[df_out_Murcia['month']==i+1]['AOT_500'].values
    stat_mean, ci_mean = bootstrap(x, np.mean)
    obs_mean = np.mean(x)

    axs[i].hist(stat_mean, 100, histtype='step')
    axs[i].set_title(str(1+i))
    #pylab.hist(stat, 100, histtype='step')
    color = ['red', 'green']
    for j in xrange(2):
        axs[i].axvline(ci_mean[j], c=color[j])
        #pylab.title("Historgram of data for " + statistic.upper() + "\'s Bootstrap")
    axs[i].axvline(obs_mean, c='black')
```



In [11]:

```
distribution_check(df_out_Murcia['AOT_500'].values, verbose=False)
```

```
reading data in file  None ...
-----------------------------------------------------------------
Top 5
-----------------------------------------------------------------
1    beta               p:  0.0107518556587   D:  0.0373574103218
2    gamma              p:  0.00562898864882   D:  0.0396076248531
3    chi                p:  0.00023131791096   D:  0.0492243540352
4    norm               p:  0.0   D:  0.112474053354
5    chi2               p:  0.0   D:  0.256897289801
```



In [12]:

```
fig, axs = plt.subplots(4,3, figsize=(18, 12))
fig.subplots_adjust(hspace = .4, wspace = .25)

axs = axs.ravel()
for i in range(12):
    pylab.subplot(4,3,i+1)
    distribution_check(df_out_Murcia[df_out_Murcia['month']==i+1]['AOT_500'], verbose=False, name='Mont
h '+str(i+1))
```

```
reading data in file  Month 1 ...
-------------------------------------------------------------------
Top 5
-------------------------------------------------------------------
1    gamma             p:  0.272231692541  D:  0.109579889671
2    chi               p:  0.0730036750878  D:  0.141643367657
3    t                 p:  0.015154828929  D:  0.172271925056
4    norm              p:  0.00227277931935  D:  0.203098464067
5    beta              p:  0.000106193186467  D:  0.244610388892
reading data in file  Month 2 ...
-------------------------------------------------------------------
Top 5
-------------------------------------------------------------------
1    t                 p:  0.0254558190956  D:  0.132772070227
2    chi2              p:  0.0238265609644  D:  0.133780680485
3    beta              p:  0.00363374336439  D:  0.159794782042
4    chi               p:  2.76214160433e-07  D:  0.252481754221
5    norm              p:  6.13351591738e-11  D:  0.311647753361
reading data in file  Month 3 ...
-------------------------------------------------------------------
Top 5
-------------------------------------------------------------------
1    gamma             p:  0.515223205536  D:  0.0807294837433
2    chi               p:  0.269430095439  D:  0.0984622427301
3    chi2              p:  0.0555880231572  D:  0.132073512968
4    beta              p:  0.0366111225361  D:  0.139619121751
5    t                 p:  0.0335879148627  D:  0.141125881834
reading data in file  Month 4 ...
-------------------------------------------------------------------
Top 5
-------------------------------------------------------------------
1    beta              p:  0.395800762001  D:  0.0892484688439
2    t                 p:  0.199296959502  D:  0.106765153901
3    norm              p:  0.199257361619  D:  0.106769813603
4    gamma             p:  0.0668775383557  D:  0.129877482327
5    chi2              p:  0.0668483593419  D:  0.129885897384
reading data in file  Month 5 ...
-------------------------------------------------------------------
Top 5
-------------------------------------------------------------------
1    chi2              p:  0.898445143275  D:  0.0456921691207
2    gamma             p:  0.898400858446  D:  0.0456952211998
3    beta              p:  0.770732389804  D:  0.0529571518271
4    chi               p:  0.410337550417  D:  0.0699803746432
5    t                 p:  0.0251938210466  D:  0.11687425961
reading data in file  Month 6 ...
-------------------------------------------------------------------
Top 5
-------------------------------------------------------------------
1    chi2              p:  0.0451258658014  D:  0.0848798168867
2    gamma             p:  0.0451160315725  D:  0.0848822708974
3    beta              p:  0.0444612021815  D:  0.0850467293736
4    chi               p:  0.00116454974629  D:  0.119133124768
5    t                 p:  0.000331041060676  D:  0.128816936059
reading data in file  Month 7 ...
-------------------------------------------------------------------
Top 5
-------------------------------------------------------------------
1    t                 p:  0.0307490453122  D:  0.0780687298974
2    norm              p:  0.0307354706399  D:  0.0780728783944
3    chi2              p:  0.0234268888808  D:  0.0805835220352
4    gamma             p:  0.0234268326551  D:  0.080583543881
5    beta              p:  0.00281374505282  D:  0.0979920443948
reading data in file  Month 8 ...
-------------------------------------------------------------------
```

```
Top 5
--------------------------------------------------------------------
1     beta              p:  0.0235070413002  D:  0.101288209299
2     norm              p:  0.0065651522336  D:  0.114975568261
3     t                 p:  0.00656069078185  D:  0.114982426942
4     chi2              p:  0.00086436452024  D:  0.133869017967
5     gamma             p:  0.000863857664648  D:  0.133874094832
reading data in file  Month 9 ...
--------------------------------------------------------------------
Top 5
--------------------------------------------------------------------
1     gamma             p:  0.947394058757  D:  0.0448372175392
2     chi2              p:  0.947388776444  D:  0.0448377785827
3     beta              p:  0.940141892166  D:  0.0455782971959
4     chi               p:  0.762513422346  D:  0.0573401508204
5     t                 p:  0.300303189837  D:  0.082279739563
reading data in file  Month 10 ...
--------------------------------------------------------------------
Top 5
--------------------------------------------------------------------
1     beta              p:  0.634425970506  D:  0.0644818926875
2     chi               p:  0.328114732572  D:  0.0811965735992
3     t                 p:  0.226561860692  D:  0.0892342050755
4     norm              p:  0.226248680732  D:  0.0892628795701
5     gamma             p:  0.160369107209  D:  0.0961331518101
reading data in file  Month 11 ...
--------------------------------------------------------------------
Top 5
--------------------------------------------------------------------
1     chi2              p:  0.336832779539  D:  0.0764640607181
2     beta              p:  0.309861081601  D:  0.0782581469122
3     t                 p:  0.0725405301562  D:  0.104683193818
4     chi               p:  0.0428965330161  D:  0.1127318554
5     norm              p:  0.000152073964935  D:  0.177377334252
reading data in file  Month 12 ...
--------------------------------------------------------------------
Top 5
--------------------------------------------------------------------
1     beta              p:  0.162068987143  D:  0.12321245601
2     chi               p:  0.143689547055  D:  0.126166779292
3     chi2              p:  0.0280208642301  D:  0.161000047848
4     gamma             p:  0.0261010682017  D:  0.162342131829
5     norm              p:  0.0216504304214  D:  0.165824742248
```