# FittingLines_r

May 11, 2020

[46]:
```
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
from scipy.optimize import curve_fit

%matplotlib inline
plt.style.use(["fivethirtyeight", "seaborn-paper"])
```

[5]:
```
# you will most probably have to change this to correctly read in your data
import pandas as pd
table = pd.read_csv(
    "/Users/alix/Desktop/NEP2581_r.cat",
    sep="\s+",
    comment="#",
    index_col=0,
    header="infer",
    names=[
        "Number",
        "MagIso",
        "MagErrIso",
        "MagIsoCor",
        "MagErrIsoCor",
        "MagAper1",
        "MagAper2",
        "MagAper3",
        "MagErrAper1",
        "MagErrAper2",
        "MagErrAper3",
        "FluxAuto",
        "FluxErrAuto",
        "MagAuto",
        "MagErrAuto",
        "X",
        "Y",
        "RA",
        "DEC",
        "Flags",
```

```
    ],
)
```

```
␣
↪---------------------------------------------------------------------------

       FileNotFoundError                         Traceback (most recent call␣
↪last)

       <ipython-input-5-7ec03514c0b2> in <module>
        27         "RA",
        28         "DEC",
   ---> 29         "Flags",
        30     ],
        31 )


       ~/opt/anaconda3/lib/python3.7/site-packages/pandas/io/parsers.py in␣
↪parser_f(filepath_or_buffer, sep, delimiter, header, names, index_col,␣
↪usecols, squeeze, prefix, mangle_dupe_cols, dtype, engine, converters,␣
↪true_values, false_values, skipinitialspace, skiprows, skipfooter, nrows,␣
↪na_values, keep_default_na, na_filter, verbose, skip_blank_lines, parse_dates,␣
↪infer_datetime_format, keep_date_col, date_parser, dayfirst, cache_dates,␣
↪iterator, chunksize, compression, thousands, decimal, lineterminator,␣
↪quotechar, quoting, doublequote, escapechar, comment, encoding, dialect,␣
↪error_bad_lines, warn_bad_lines, delim_whitespace, low_memory, memory_map,␣
↪float_precision)
       683         )
       684
   --> 685         return _read(filepath_or_buffer, kwds)
       686
       687     parser_f.__name__ = name


       ~/opt/anaconda3/lib/python3.7/site-packages/pandas/io/parsers.py in␣
↪_read(filepath_or_buffer, kwds)
       455
       456     # Create the parser.
   --> 457     parser = TextFileReader(fp_or_buf, **kwds)
       458
       459     if chunksize or iterator:


       ~/opt/anaconda3/lib/python3.7/site-packages/pandas/io/parsers.py in␣
↪__init__(self, f, engine, **kwds)
       893             self.options["has_index_names"] = kwds["has_index_names"]
```

```
      894
--> 895         self._make_engine(self.engine)
      896
      897     def close(self):


      ~/opt/anaconda3/lib/python3.7/site-packages/pandas/io/parsers.py in␣
↪_make_engine(self, engine)
     1133     def _make_engine(self, engine="c"):
     1134         if engine == "c":
-> 1135             self._engine = CParserWrapper(self.f, **self.options)
     1136         else:
     1137             if engine == "python":


      ~/opt/anaconda3/lib/python3.7/site-packages/pandas/io/parsers.py in␣
↪__init__(self, src, **kwds)
     1915         kwds["usecols"] = self.usecols
     1916
-> 1917         self._reader = parsers.TextReader(src, **kwds)
     1918         self.unnamed_cols = self._reader.unnamed_cols
     1919


      pandas/_libs/parsers.pyx in pandas._libs.parsers.TextReader.__cinit__()


      pandas/_libs/parsers.pyx in pandas._libs.parsers.TextReader.
↪_setup_parser_source()


      FileNotFoundError: [Errno 2] File b'/Users/alix/Desktop/NEP2581_r.cat'␣
↪does not exist: b'/Users/alix/Desktop/NEP2581_r.cat'
```

[137]:
```
table
```

[137]:

| Number | MagIso | MagErrIso | MagIsoCor | MagErrIsoCor | MagAper1 | MagAper2 |
|---|---|---|---|---|---|---|
| 1 | -13.3767 | 0.0022 | -13.3908 | 0.0023 | -12.2390 | -12.8005 |
| 2 | -9.4826 | 0.0215 | -9.6280 | 0.0286 | -8.4765 | -9.0611 |
| 3 | -8.8818 | 0.0382 | -9.4492 | 0.0550 | -7.1400 | -7.8576 |
| 4 | -8.1896 | 0.0528 | -8.7703 | 0.0757 | -6.9821 | -7.7208 |
| 5 | -11.5036 | 0.0066 | -11.5520 | 0.0075 | -10.3737 | -10.8996 |
| … | … | … | … | … | … | … |
| 212 | -5.9144 | 0.1639 | -6.8463 | 0.2006 | -6.2306 | -6.7739 |
| 213 | -7.6993 | 0.0682 | -8.3779 | 0.0944 | -6.7552 | -7.5006 |

```
214    -11.7319     0.0055   -11.7652        0.0060  -10.5481  -11.1445
215     -9.5718     0.0207    -9.7192        0.0276   -8.4803   -9.0633
216    -12.5467     0.0036   -12.5723        0.0038  -11.4433  -11.9824

        MagAper3  MagErrAper1  MagErrAper2  MagErrAper3     FluxAuto  \
Number
1       -13.0661       0.0030       0.0023       0.0021  218483.1000
2        -9.3449       0.0256       0.0213       0.0208    7008.0870
3        -8.3640       0.0733       0.0562       0.0467    6151.5810
4        -8.1035       0.0840       0.0633       0.0586    3906.4750
5       -11.1428       0.0077       0.0062       0.0059   41285.4000
…          …           …            …            …           …
212      -7.1079       0.1625       0.1458       0.1420     660.1039
213      -7.9312       0.1020       0.0766       0.0681    2045.5990
214     -11.4207       0.0070       0.0054       0.0050   49678.2000
215      -9.3752       0.0254       0.0212       0.0203    7523.8860
216     -12.2182       0.0044       0.0035       0.0032  101974.3000

        FluxErrAuto  MagAuto  MagErrAuto          X          Y          RA  \
Number
1          416.5467 -13.3485      0.0021   931.7031   328.2632  275.258573
2          186.1411  -9.6140      0.0288   737.7443   295.1588  275.290740
3          299.3925  -9.4725      0.0529  1457.0001   304.5081  275.171347
4          261.6770  -8.9795      0.0727  1593.2390   299.5876  275.148727
5          271.0937 -11.5395      0.0071   952.7084   312.8791  275.255071
…             …       …          …         …          …          …
212        112.9133  -7.0490      0.1858  1199.2676  1309.1158  275.214927
213        155.5080  -8.2771      0.0826   634.0111  1243.7678  275.308951
214        258.0924 -11.7404      0.0056   366.1382  1270.9669  275.353564
215        171.6220  -9.6911      0.0248   545.5924  1225.6635  275.323646
216        322.4636 -12.5212      0.0034   847.0334  1207.2085  275.273463

              DEC  Flags
Number
1       68.419623      2
2       68.417534      0
3       68.418325      2
4       68.418057      0
5       68.418690      0
…           …    …
212     68.479600      0
213     68.475419      0
214     68.476971      0
215     68.474279      0
216     68.473265      2

[216 rows x 19 columns]
```

$$R_{PS} = R_{SX} + ZP + c_0 * (R_{PS} - I_{PS})$$

we *have* $R_{SX}$ from source extractor catalog, we also have $R_{PS}, I_{PS}$ from the MAST PanStarrs catalog download

We need to fit for $ZP$ and $c_0$

$$y = x + ZP + c_0 * Q = x + \hat{b}$$

$$\hat{b} = ZP + c_0 * Q$$

[138]:
```
R_SX = table["MagAuto"]
# you should be getting these from a table, not making up numbers willy-nilly
R_PS = R_SX + np.random.rand(*R_SX.shape)
I_PS = R_SX + 2 * np.random.rand(*R_SX.shape)
```

[69]:
```
def calib_R(x, ZP, c0):
    return x + ZP + c0 * (R_PS - I_PS)
```

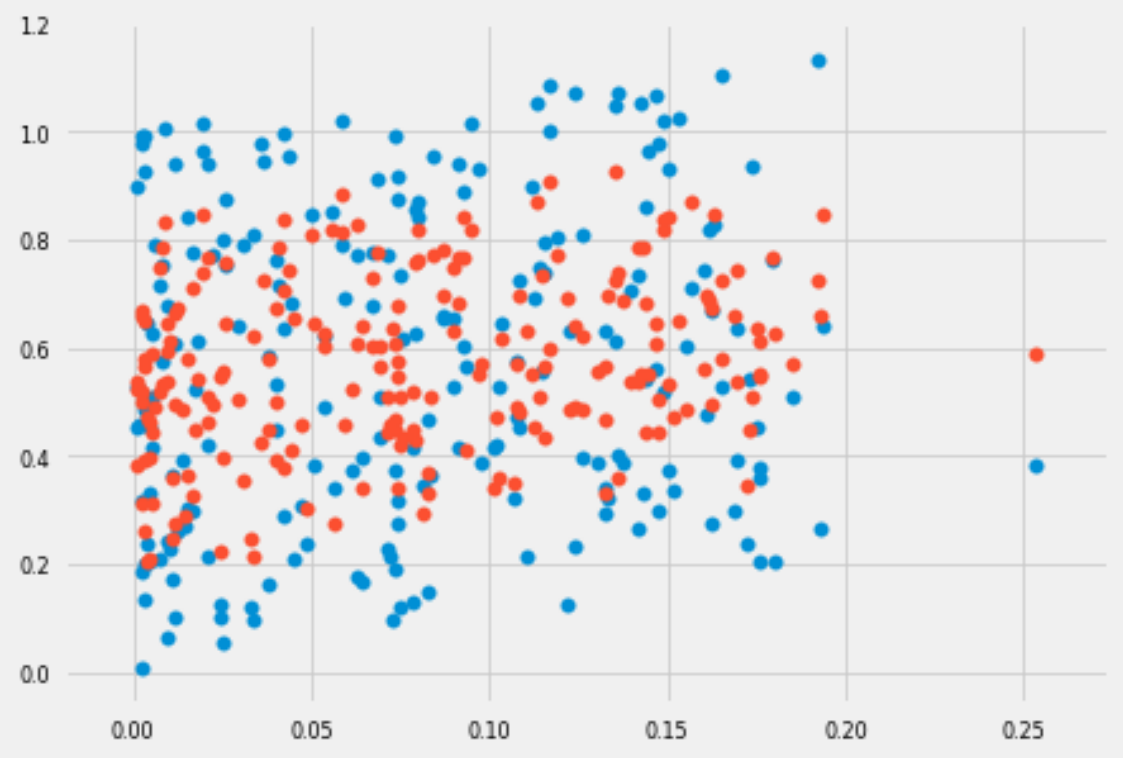
[70]:
```
popt, pcov = curve_fit(calib_R, R_SX, R_PS, p0=[1, 1])
```

[71]:
```
print(popt)
print(pcov)
```

```
[0.60865843 0.23365893]
[[0.00041564 0.0002966 ]
 [0.0002966  0.00059265]]
```

[73]:
```
plt.scatter(R_SX, R_PS)
plt.scatter(
    R_SX, calib_R(R_SX, *popt)
)  # equiv to plt.plot(R_SX, calib(R_SX, popt[0], popt[1]))

plt.tight_layout();
```




### 0.1 Same c

[74]:
```
def calib(X, ZPr, ZPi, ZPz, c):
    R_SX, I_SX, Z_SX = X
    y1 = R_SX + ZPr + c * (R_PS - I_PS)
    y2 = I_SX + ZPi + c * (R_PS - I_PS)
    y3 = Z_SX + ZPz + c * (I_PS - Z_PS)
    return np.hstack([y1, y2, y3])
```

[109]:
```
popt, pcov = curve_fit(
    calib, np.vstack([R_SX, I_SX, Z_SX]), np.hstack([R_PS, I_PS, Z_PS]), p0=[0,␣
 ↪0, 0, 1]
)
```

[110]:
```
print(popt)
print(pcov)
```

```
[ 0.22957457  0.68173358  0.73097073 -0.52380152]
[[ 0.00427717  0.00044218 -0.00040808  0.00088353]
 [ 0.00044218  0.00427717 -0.00040808  0.00088353]
 [-0.00040808 -0.00040808  0.0042116  -0.0008154 ]
 [ 0.00088353  0.00088353 -0.0008154   0.00176542]]
```

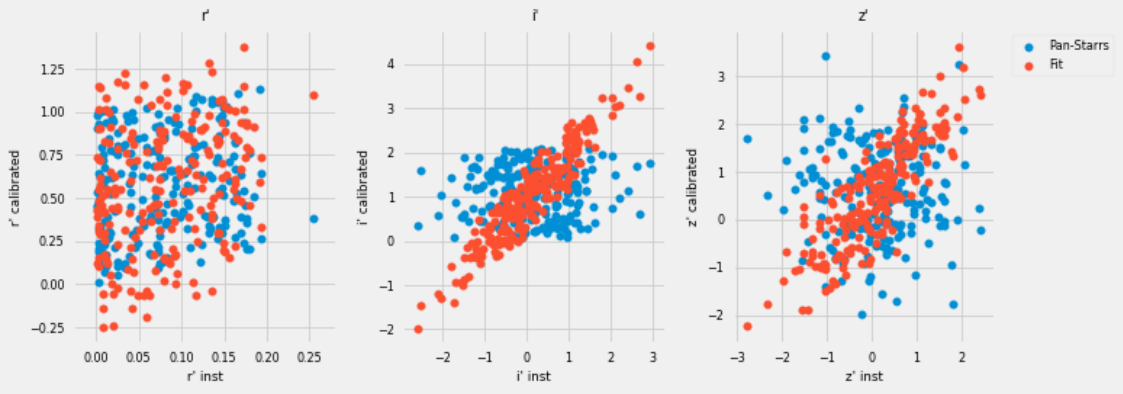
[112]:
```
output = calib(
    np.vstack([R_SX, I_SX, Z_SX]), *popt
)  # equiv to calib(X, popt[0], popt[1], ...)
y1, y2, y3 = np.reshape(output, (3, -1))

plt.figure(figsize=(11, 4))
plt.subplot(131)
plt.scatter(R_SX, R_PS)
plt.scatter(R_SX, y1)
plt.xlabel("r' inst")
plt.ylabel("r' calibrated")
plt.title("r'")

plt.subplot(132)
plt.scatter(I_SX, I_PS)
plt.scatter(I_SX, y2)
plt.xlabel("i' inst")
plt.ylabel("i' calibrated")
plt.title("i'")

plt.subplot(133)
plt.scatter(Z_SX, Z_PS, label="Pan-Starrs")
plt.scatter(Z_SX, y3, label="Fit")
plt.xlabel("z' inst")
plt.ylabel("z' calibrated")
plt.title("z'")
plt.legend(bbox_to_anchor=(1.04, 1), fancybox=True)

plt.tight_layout();
```




[79]:
```
np.reshape([1, 2, 3, 1, 2, 3], (2, 3))
```

```
[79]: array([[1, 2, 3],
             [1, 2, 3]])
```