▾ QQ Plot - Non Gaussian vs Gaussian

```
from scipy import stats
import seaborn as sns
import  numpy as np
import matplotlib.pyplot as plt


data =[ 0.04177737,   0.97977259,   1.19684675,   0.75969411,   0.2772351 ,
        1.20400739,   1.19512711,  -1.33315966,   0.47241401,   0.58453053,
        0.21167461,   0.87106215,  -0.56663286,   0.3702523 ,   0.72724427,
        0.41126015,   0.33358864,   0.72878097,   0.69929305,   0.72581333,
        1.67334826,  -1.54572083,  -1.22840893,   0.47103287,   0.895276  ,
        0.16538052,  -0.43575904,   1.62784202,   0.98340417,   0.90482144,
       -0.47914975,   0.71812022,   1.14243   ,  -0.04393411,   1.24946471,
       -0.8699551 ,   1.60196517,   1.00140898,   1.48233878,  -0.37088602,
       -0.0954339 ,   1.2969551 ,   0.0457524 ,  -0.06486335,   0.43257115,
       -0.18945797,   0.46525944,   0.12974487,  -0.10501035,   0.94060547,
       -1.57714093,   0.24292938,   0.68759359,   0.24113398,   0.74353881,
        0.0129037 ,   0.47936105,  -0.0596165 ,   0.3300311 ,  -0.19409805,
       -2.15213968,  -0.9169724 ,   1.40476752,   0.74067023,   0.36119747,
        1.04507563,  -0.54692221,   0.65000261,   0.5359208 ,   0.40091749,
        0.16959609,   0.43828974,   1.69191812,  -0.40588725,   0.52772481,
        0.2410331 ,   1.8226663 ,  -1.36677194,   0.41745297,   0.94050797,
        1.15797033,   0.13883716,   0.9648131 ,   0.71495948,   1.73284151,
        0.9571359 ,   0.38785662,   0.41390929,  -1.10391874,  -0.41368798,
       -0.90497721,   1.37201217,   0.52934518,   0.45456489,  -0.23302007,
        0.1206425 ,   1.43043074,   0.0599792 ,   0.39871742,  -0.03524401,
       -1.59860382,  -1.94105256,   1.22334603,  -1.76544176,  -0.80324714,
        1.16037195,   0.38303564,  -0.44427508,   1.13694237,   0.58281873,
        1.01938666,   0.85409657,   0.32051415,   0.08834169,   0.15365941,
        1.68716621,  -0.24197654,   1.2676363 ,   1.48518839,  -0.47335603,
        1.15654111,   0.76654086,  -0.11389136,   1.30586524,   0.32307392,
        0.54523295,   0.38590127,   0.50793605,  -0.34701396,   0.74541391,
        0.79535705,   1.01896308,  -0.22023158,  -0.48871769,   0.05838767,
       -0.25024374,   0.69928181,   2.21454052,   0.20445216,   1.32931331,
        0.08653597,   0.07823139,   1.14485681,   0.91738973,   0.0543534 ,
       -1.45447157,   1.08313814,  -0.27451755,   1.15577356,   1.15404113,
       -1.82969195,   0.17610396,   1.08855269,   0.67994842,   0.0750844 ,
       -0.30914221,   0.68824746,  -2.02655603,  -0.65056827,   0.03919982,
        0.06828509,   1.17926148,   0.86701368,   1.45238655,   1.63738079,
        0.63609739,  -1.31232421,   0.98509236,   1.15594405,   0.20902709,
        0.96664264,   0.11769247,   0.48530914,   1.12505311,   0.60806881,
       -1.54771281,   0.92716597,   1.16839655,  -0.06376581,   0.75839488,
        1.05027756,   1.41329557,   0.85657177,  -0.2160035 ,   1.12248554,
        0.20020919,   1.1861288 ,   0.76429072,  -1.83554409,  -0.04585441,
        1.06873376,   0.10936729,   1.48407643,   0.52580339,   1.19815856,
        0.53797982,  -0.42615522,  -0.38198519,   0.53974062,   0.06254645,
        0.11724433,   0.67580552,   0.63406064,   1.03362043,  -1.88639841,
        0.62474754,   0.89065659,   0.5328413 ,   0.92901562,   0.82901618,
       -1.40196713,   0.25330113,  -0.11682618,   0.79230788,  -1.37307874,
        0.37353503,   0.65753252,   0.61958929,   0.95358877,  -0.63137426,
```

```
        0.73935171, -0.3392893 ,  0.90018122,  1.13697138,  1.07777798,
       -0.67428172,  1.20112044,  0.13277637,  0.88485663, -0.73037033,
        0.73817138,  0.1309939 ,  0.77936817,  1.16422402,  1.22697646,
        0.31219482,  0.6517649 ,  1.35374234, -0.11302125,  1.38551431,
        1.4890138 ,  0.75586738,  1.76803848,  0.56651688, -0.67678907,
        0.19554616,  0.46406559, -0.06019572,  1.53990381, -1.13432049,
       -0.80700753, -2.31246741,  1.33986194,  1.38730476,  0.82881232,
        0.70062208, -0.12381894, -0.46690349, -1.57527874,  1.72209985,
        0.18183212,  0.8400035 ,  0.418469  ,  1.36179378, -0.92426075,
        0.22270703, -0.13774932,  0.93111539, -0.88921133,  1.0997085 ,
       -0.9937949 ,  0.38843634,  1.01148004, -0.43816108, -0.95414947,
        1.32330751,  0.30404196,  0.88512404,  0.91372546,  0.32134319,
        0.14559158, -0.19978188,  0.88329649,  0.30335937,  0.76175674,
        0.57364537,  1.02631156,  1.66794999, -1.03792174, -0.31515864,
        1.07180383,  0.59720417, -0.32040037, -0.7674771 ,  0.25057312,
        0.27762623,  0.54672121, -1.34336276,  0.53814872,  1.24214509,
       -1.12005068,  1.37171113,  0.0616415 , -0.74262483,  1.01415696,
        0.3901361 ,  0.70918134,  0.20065952,  0.94970448,  0.73886174,
        1.06909761,  0.86064287,  1.15752969,  0.82554495,  1.36024967,
        0.59598245,  0.89922565,  0.7362065 ,  1.00841732,  0.55340554,
        0.41274327,  0.50711349,  0.45157236, -0.2457261 ,  1.07731295,
       -0.50619092,  0.77516586, -2.71031075,  0.69192707,  0.84959366,
        1.45540949, -0.44551638,  1.28008884,  0.61377305, -0.54839374,
        1.16915428,  1.1075064 ,  1.0229388 ,  1.22989514,  1.24266425,
        0.17096114,  1.00952836, -0.28128762, -0.31360414,  0.50315717,
        0.23675518, -0.15479312,  0.28744327,  0.66566966, -0.14055415,
        0.60945716, -1.45725682, -1.76229852,  0.10049782,  0.59945138,
        0.60902798,  0.92513724,  1.3161839 , -0.02831568,  0.53837944,
       -3.63123097,  2.24728714,  0.14248232,  1.15824823,  0.1331667 ,
        1.30352524,  0.31862759,  1.48258693,  0.82365142,  1.22927344,
        0.65581787,  1.49120079,  1.26751206,  0.6596013 , -0.30466474,
        0.92502302,  1.05893148,  1.25006908,  1.51266005, -0.36946192,
        0.20367163,  1.54883376, -0.07722085,  0.29042734, -0.07913684,
        1.0009701 ,  0.66712984,  1.72579542,  1.81505526,  1.02742471,
        1.31574026, -1.10915715, -0.54120723,  0.51054351, -0.88139742,
       -1.72785233,  1.9585019 ,  1.09644834, -1.27615429, -2.11919702,
        0.10586263,  0.70464499,  0.61638469,  0.30262653, -0.40630085,
       -0.2274666 ,  1.20697563,  0.36656195,  0.57455917, -0.95850539,
        0.57487625,  0.09909038, -2.02132122,  0.79842403,  0.29482801,
       -0.56063591,  1.22430722, -0.26074589, -0.61835677,  0.91307203,
        0.98181937,  1.60472708,  0.80975178,  0.57399004,  0.20730555,
        1.03604696,  1.99239206,  1.35579176, -1.06755095,  0.79769852,
       -0.11886134,  0.92591275,  0.31100381,  1.45719763, -0.18650384,
        0.98158411,  0.38823413,  0.03501161,  1.3873394 ,  1.06988861,
       -0.61101705,  0.64726664,  0.71829533,  0.37560761,  0.32028192,
        0.46012344,  0.92880202,  0.67717555,  0.04629136,  0.47546512,
        1.4513086 ,  1.45343272,  1.54991229,  0.62037232,  0.01407354,
        0.46979478,  0.05595689, -1.73249288,  0.23003225,  1.29352827,
        0.80189453,  1.61966331,  0.69681106,  1.03215339, -1.21549361,
        0.93475221,  1.30143537,  0.7254352 ,  0.22841529,  1.50249735,
       -0.02415314, -0.18205881,  0.95388083,  0.66182587,  0.08282857,
        1.53432986,  1.07818559,  1.04804152,  0.62920033,  0.2221568 ,
        1.11689153,  0.70328342,  1.48907562, -0.85967934,  0.37330663,
        0.10042743,  0.43601618, -0.84872277, -0.18902961,  1.16872747,
```

```
        0.49445364,  0.97912906,  0.16970087,  1.43121388,  0.67825154,
        0.8233865 ,  1.20263091,  0.49206124,  0.34548617,  1.58287164]
```
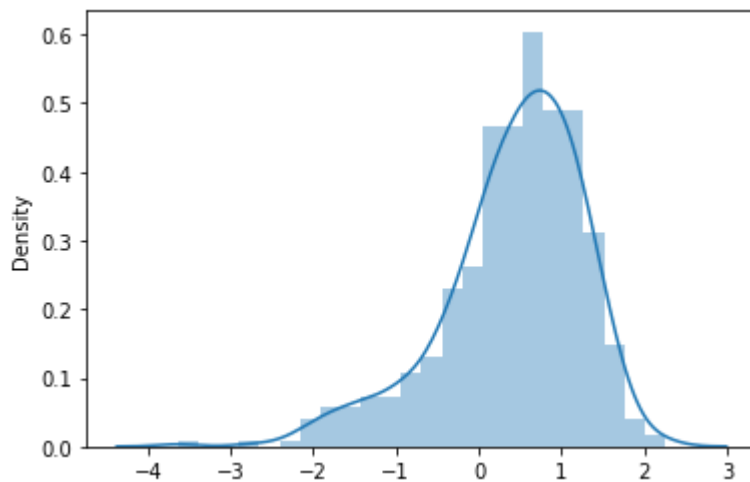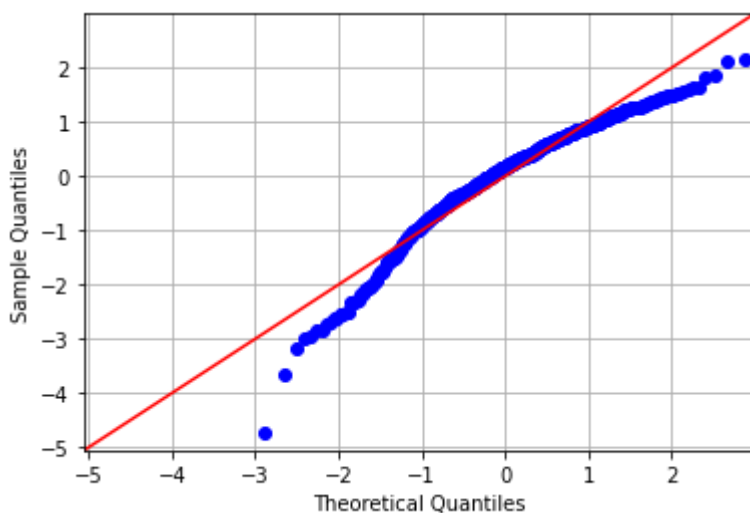
```
x = np.array(data)
```

```
x.shape
```

```
(500,)
```

```
sns.distplot(x)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWa
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f146d788c50>
```



```
import statsmodels.api as sm
fig = sm.qqplot(x, line='45', fit=True)
plt.grid()
```
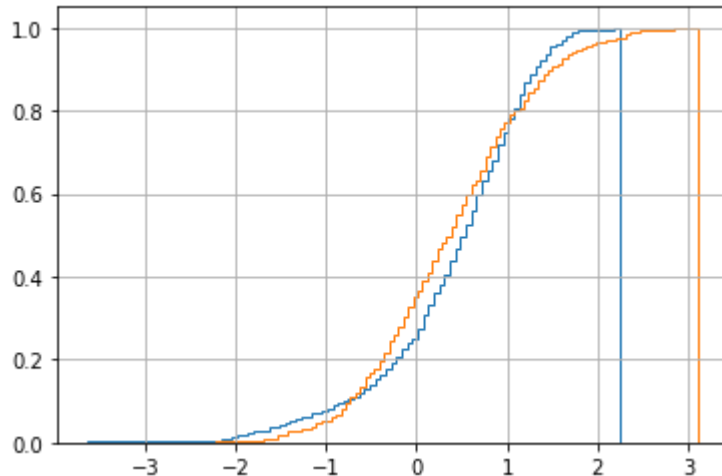


```
# Let us compare CDFs also
mu = np.mean(x)
s = np.std(x)
print(mu,s)
```

```
      0.40812679178 0.8571215209422999
```

```python
# normally distributed data with mean=mu, std-dev=s
y = stats.norm.rvs(loc=mu, scale=s, size=500)


plt.grid()
a = plt.hist(x, bins=100, cumulative=True, label='CDF', density=True, histtype='ste
b = plt.hist(y, bins=100, cumulative=True, label='CDF', density=True, histtype='ste
plt.show()
```


QQ Plot: Gaussian vs Gaussian

```python
x = np.array([11.57784747, 11.2491053 , 13.61389724, 10.43431545, 19.07394786,
        9.82403715, 13.4244426 ,  9.44118008, 14.38563498, 20.18550907,
       19.4045435 , 12.68474753,  8.71613424, 15.37961119, 11.5821208 ,
       13.87797766,  9.49664077, 10.85808951, 14.63660789,  8.03715599,
       13.9350733 ,  9.73475394, 15.88874849, 13.93616509, 13.37910841,
       13.54297006, 12.49945327,  6.52392492,  6.31793451, 14.52702842,
        7.59369013, 11.77629841, 10.45925437, 13.06359334, 13.81378955,
       11.82158292, 16.93834671, 10.48777936, 14.17230283,  6.63886888,
        7.2857522 , 14.62914074, 11.41255324, 14.38723848, 14.80092607,
       10.45656004, 15.31127067, 14.33445367,  9.40400727,  6.36676962,
       14.1418542 , 15.25370069, 12.48852017, 18.07942359, 12.1269647 ,
       12.74866696, 16.74745308, 15.42834694, 12.10071153,  9.87623163,
       12.50152178,  7.62084636, 10.40931342, 10.83547897, 10.2147319 ,
       11.88774592, 15.56120705, 11.4014432 , 12.67275508, 11.25627126,
       14.4804238 , 14.94150826,  8.1418573 ,  9.16408019,  7.71009653,
        9.84448243, 13.7946926 ,  4.65222642, 11.48392034, 11.36194669,
       11.2585006 , 13.59213915, 12.70468726, 16.27678778, 15.30801449,
       19.80718169, 13.96550335,  4.51583695, 12.43701101, 11.50437664,
        4.74791649, 12.16490674, 14.6385116 , 15.85842418, 15.76061832,
       14.14511039, 13.37113669, 11.85226093, 15.79962348,  9.12222972,
       11.60917497,  9.56242753, 13.01923881, 14.36331826,  7.40176422,
       11.81959174, 13.72300771, 15.83969842, 11.57059114,  9.91605704,
       19.34938723,  8.162288  , 10.74142509, 15.63186143, 11.58238432,
        9.89346539,  9.38142614, 12.89340615, 12.96678986,  9.66350771,
       16.99826563,  2.58284943, 12.70393319,  8.06963446,  9.73111822,
```

```
13.38506972, 15.10831298, 15.08498269,  6.92483515,  8.80525993,
10.390112  , 13.5461753 ,  8.75106316, 11.36924482,  9.69871704,
 9.23275979, 12.43550329, 15.23176802,  9.91491463, 10.95943307,
11.77935338, 12.02364726, 13.3787093 , 10.75947082, 16.19614796,
10.92101502,  9.47236272, 13.91946103, 10.62493488, 12.2627494 ,
16.91801027, 12.71757097, 12.13055668, 16.36272878,  3.03983226,
14.19186518,  8.08063056,  9.8224435 ,  7.52489477, 11.28703284,
13.65644155, 14.0003042 , 14.13200882, 17.11634758, 14.96438543,
15.60263135,  9.27161065, 10.95739162, 11.63160764, 13.23908988,
10.0719898 ,  9.8796056 , 13.05554173, 14.7211202 , 14.83531548,
12.41639441, 17.26388048,  7.19055017, 10.74548465, 14.71763177,
 7.48907317, 10.47710346,  9.97995926,  7.6495366 , 16.09693928,
13.26458585,  9.79034016, 18.74994343, 13.39659268, 14.24175426,
14.23621363,  6.78345096,  9.15719056, 11.61440847, 16.91722468,
13.90746381, 12.44531802, 12.62615478, 10.59495711, 10.13040348,
 3.76657486, 15.81098028,  8.93455288, 11.95859969, 15.16344815,
11.80785278, 11.60122961, 11.99121613, 11.30130027,  9.99075238,
14.59353462,  9.08941503, 13.52158757, 15.40176301, 13.46787943,
11.74853818,  5.83513502, 12.15539973, 16.7891168 ,  8.09875172,
10.6310082 , 10.25618539,  6.21767497, 11.39837608,  9.59825852,
11.49465916, 14.29015963, 11.48315165, 15.66291869, 15.77957956,
 4.88255399,  9.04458048, 15.62509581, 16.95018948, 13.3775874 ,
12.88460329, 13.24887651, 13.02214038, 13.8878541 , 15.66745438,
17.20639472, 11.9222186 ,  8.85100222,  9.95637784, 13.45446542,
13.54589738, 10.19396684, 10.31850862, 13.65769365, 10.26450834,
13.03164463, 16.4101971 , 11.89410484, 13.30320091,  9.38985916,
 9.36131454, 14.93142961,  8.37673077, 11.5666218 , 15.51856477,
16.93052606, 11.46392373, 10.7071838 , 11.03657804,  9.18587141,
12.66000884,  9.10254542,  9.01776288, 13.90184705, 10.85414438,
15.81496996, 13.09905247, 10.07405055, 13.55861097, 14.82254442,
13.25174647,  8.17114623, 11.4953884 ,  8.02098619, 16.40002953,
 9.4421317 , 11.88583757, 13.31227571, 14.95553065, 12.98428806,
11.1544708 , 13.40493049, 14.68919196, 12.440527  , 14.80701851,
 6.57335148, 13.12571847, 13.82276238, 11.27165485,  9.65698752,
10.44903102, 10.95038812, 12.44366971,  9.86378511,  8.19112957,
10.2571676 ,  9.78105677, 11.21610962, 12.20475101, 10.45296661,
11.36748801, 14.9713108 ,  9.35001919, 15.99673101, 10.01563558,
 9.59455089, 12.56848901,  8.17248203, 13.1895009 , 12.4293327 ,
13.14075275, 10.86593221, 13.32774828, 11.81153178, 13.90469108,
11.92063022, 13.71915611, 12.43453495, 15.70137597, 18.45901754,
14.6197433 ,  9.08884872,  5.15850014, 13.62333839, 11.04689724,
10.32119393, 17.91836777, 16.12399235, 12.41544643, 10.61299773,
19.2215383 , 15.18056861, 13.67688575, 11.33347782, 17.25661304,
15.16867507,  9.40715939, 14.03765542, 15.1503099 , 10.622078  ,
14.46106249, 11.04414728,  9.4665142 , 11.8714194 , 10.75685762,
10.77930357, 18.27803743, 13.44076954,  9.09071156, 12.99549238,
21.08760397,  9.02794452, 10.58456245, 13.02807663, 13.99149013,
13.69021892, 13.34233145, 18.46203371, 12.09409091, 13.89071504,
 8.04164928, 10.33845976, 15.75377701,  9.89822645, 13.44711474,
14.3879143 , 17.20070526, 14.29210793, 18.27220542, 13.06642842,
13.00203395, 12.67410587,  7.12242434, 12.44652844, 10.13101132,
 8.46635559, 11.9721057 , 15.47008364, 10.96698706,  6.05834163,
 9.7531667 , 11.07756905,  9.59407186, 12.87481635, 11.694318  ,
14.78554439, 22.33221432,  6.84246646, 15.54975901, 11.11097571,
12.10674748,  9.49406724, 17.01665082, 10.99313794, 10.04778473,
```

```
        14.40618557, 11.66664777, 11.98496279,  7.9726323 ,  8.56541709,
        14.52105503, 14.68946799, 12.9448191 , 12.42843901, 16.15789865,
         8.8113074 , 14.6655148 , 11.88793674, 14.76393398, 10.65796408,
        10.66200286, 15.73645844, 12.20152003, 10.00266264, 12.9524175 ,
        10.98355626, 20.35114473, 17.47530313,  9.14644249, 12.39268866,
         9.40639098, 11.04232065, 12.24852286, 12.26360038, 10.87001996,
        11.3733785 , 14.72465634, 13.50317832, 11.93362816,  7.52379566,
        10.4680425 ,  7.8258331 , 11.19155117, 13.65729264,  7.01196691,
        12.93385747, 13.31150831, 12.64664186, 14.78618476,  4.44415109,
        12.81294031, 13.34684482, 12.1277528 ,  8.99405593, 13.46200704,
         6.91128576,  9.35019668,  8.97055521, 11.28466444, 10.64399464,
        12.05216807, 14.59059316, 12.31426901,  9.24310909, 14.54720685,
         6.76053488,  8.09768217, 12.32363793,  9.02387847, 17.0286219 ,
        19.0669372 , 15.84366113,  5.42203737,  9.41875147, 14.37555289,
        11.15951297, 10.28333559, 14.49172936, 17.77046609,  9.16512068,
        16.9575815 , 10.56507815, 13.64254405, 13.08350843, 13.81232518,
        11.11322292,  9.4135368 , 10.26330365,  9.7081287 , 11.41922434,
        13.66072764, 14.0416686 ,  9.661806  , 13.28447577,  9.80461106,
         7.13412165, 10.26586752, 14.90528691, 13.65151123, 11.46129682,
        14.28189362,  9.25854953, 10.40331241, 14.82192117,  9.85303781])
```
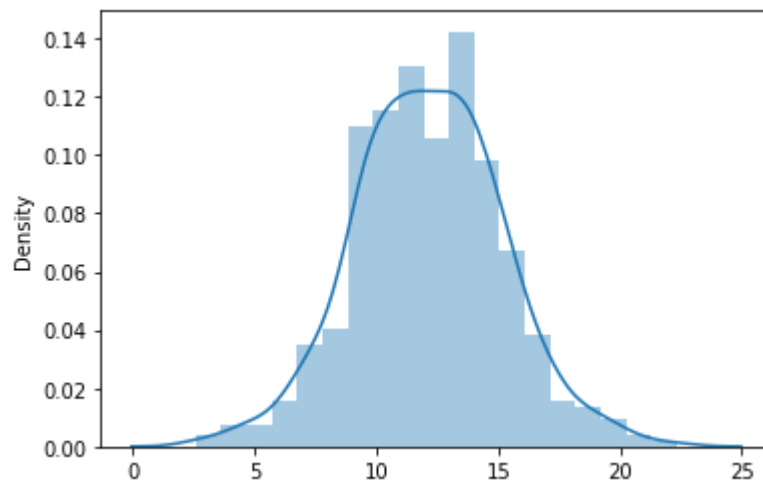
```
sns.distplot(x)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWa
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f146d5e9690>
```
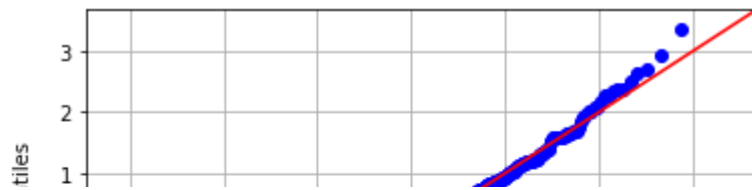


```
fig = sm.qqplot(x, line='45', fit=True)
plt.grid()
```

QQ Plot between Non Gaussian and Non-gaussian
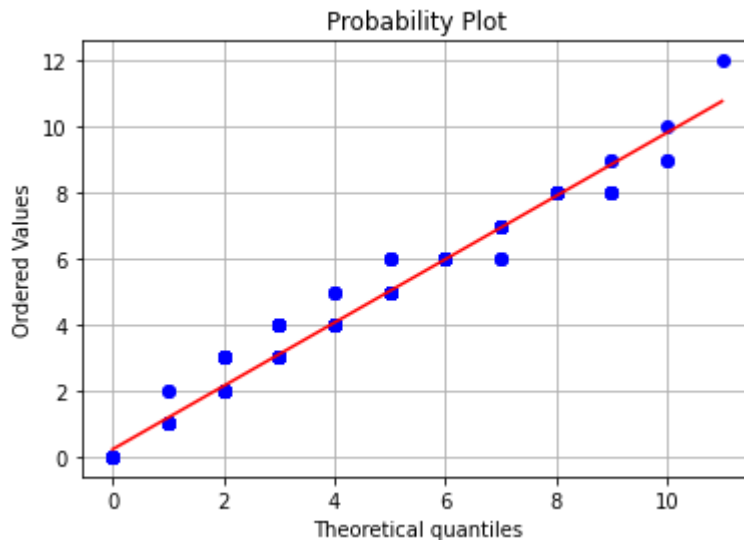


```
from scipy.stats import poisson
x = np.array([ 3,  4,  2,  6,  5,  2,  5,  8,  5,  2,  4,  2,  4,  5,  1,  3,  4,
       3,  4,  4,  2,  3,  4,  3,  5,  5,  2,  5,  6,  3,  6,  3,  1,  3,
       4,  3,  5,  6,  6,  7,  4,  4,  3,  4,  5,  3,  6,  2,  4,  6,  9,
       4,  4,  0,  2,  0,  1,  8,  2,  4,  0,  1,  4,  6,  0,  3,  5,  2,
       3,  4,  6,  8,  7,  6,  3,  2,  4,  1,  3,  5,  3,  4,  4,  7,  4,
       2,  3,  5,  5,  6,  3,  3,  7,  3,  3,  3,  3,  4,  4,  6,  4,  5,
       5,  4,  3,  3,  4,  5,  2,  2,  6,  5,  3,  6,  4,  8,  8,  2,  5,
       3,  5,  3,  5,  0,  6,  3,  5,  4,  7,  7,  2,  2,  4,  4,  3,  4,
       4,  4,  3,  7,  4,  4,  2,  6,  3,  2,  1,  5,  4,  2,  3,  2,  5,
       1,  5,  5,  5,  6,  2,  4,  3,  5,  5,  4,  5,  3,  1,  4,  6,  6,
       4,  1,  5,  3,  0,  3,  2,  5,  1,  4,  6,  4,  3,  6,  5,  1,  4,
       4,  5,  5,  2,  6,  1,  3,  4,  6,  6,  4,  3,  5,  6,  3,  6,  4,
       3,  4,  4,  6,  4,  1,  6,  2,  2,  4,  4,  2,  5,  4,  1,  2,  2,
       4,  3,  4,  7,  8,  2,  2,  1,  6,  2,  8,  4,  5,  4,  6,  3,  4,
       3,  3,  7,  6,  5,  5,  6,  3,  3,  4,  4,  7,  7,  1,  2,  4,  8,
       6,  4,  4,  1,  1,  4,  2,  5,  4,  5,  9,  8,  3,  3,  5,  3,  6,
       5,  6,  1,  5,  2,  9,  5,  2,  5,  7,  3,  6,  8,  5,  5,  5,  6,
       1,  2,  1,  8,  8,  3,  6,  3,  4,  3,  7,  9,  2,  6,  7,  2,  0,
       4,  2,  3,  3,  2,  7,  2,  4,  4,  4,  1,  5,  3,  5,  5,  5,  8,
       0,  4,  2,  4,  1,  2,  3,  3,  5,  3,  2,  3,  2,  6,  2,  4,  3,
       3,  4,  3,  5,  2,  2,  1,  1,  4,  5,  7,  5,  4,  6,  6,  1,  2,
       2,  1,  3,  1,  6,  5,  5,  0,  3,  3,  2,  7,  7,  2,  4,  5,  3,
       3,  6,  6,  6,  1,  3,  7,  1,  5,  4,  5,  6,  4,  3,  4,  4,  5,
       4,  5,  4,  6,  3,  2,  3,  4,  3,  4,  5,  6,  6,  4,  4,  2,  7,
       7,  6,  5,  4,  4,  5,  3,  4,  3,  4,  7,  3,  8,  4,  6,  3,  4,
       3,  3,  6,  5,  5,  2,  6,  4,  3,  7,  4,  4,  2,  4,  8,  3,  3,
       4,  1,  4,  3,  7,  5,  3,  1, 12,  4,  3,  3,  3,  4,  6,  5,  4,
       8,  1,  5,  5,  7,  6,  5,  8,  4,  4,  4,  6,  5,  3,  7,  1,  2,
      10,  1,  5,  2,  2,  3,  2,  3,  8,  5,  4,  4,  4,  7,  5,  6,  4,
       4,  6,  8,  3,  3,  2,  2])
```

```
sns.distplot(x)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWa
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f146d913f90>
```



```
import scipy.stats as stats
stats.probplot(x, dist='poisson', sparams=(4,), plot=plt)
plt.grid()
plt.show()
```


Box cox transformation

```
x = np.array([ 1.6984114 ,  2.11676219, 1.68866267,  1.3359314 ,  2.28796264,
        0.43816851,  1.53263993,  1.91812243,  1.96258021,  1.6960544 ,
        1.71797183,  1.47457388,  1.33927856,  1.7332889 ,  1.17003155,
        1.69092112,  2.30458645,  2.24746583,  2.01612421,  1.85449887,
        1.18716998,  1.4011684 ,  1.66486748,  1.71254033,  1.90967084,
        0.63229333,  1.72035373,  1.87538406,  1.42036766,  1.83871646,
        1.42228568,  0.96241532,  1.54338081,  2.17024404,  0.88664652,
        1.34816371,  2.07821855,  0.5876574 ,  1.98993643,  1.5697433 ,
        1.76725654,  1.47469754,  1.1163372 ,  2.14722537,  1.72553003,
        1.63280138,  0.85351431,  1.48492384,  0.93556789, -0.54601206,
        1.0797321 ,  1.3330656 ,  1.6612755 ,  1.41347056,  0.68589677,
        1.49580527,  1.24949748,  2.18516272,  1.68131415,  0.94182279,
        2.19927904,  0.94535853,  0.29909642,  1.43903576,  1.2298471 ,
        1.69315051,  1.64324875,  1.61621873,  1.1124339 ,  1.91581696,
        0.4797108 ,  1.95272687,  2.09240499,  1.77743769,  1.49468984,
        0.67738743,  1.29797222,  1.84776825,  1.4792581 ,  2.41561432,
        1.74233309,  1.5410291 ,  1.6254636 ,  1.74745679,  1.45450531,
        0.7685928 ,  1.37465021,  1.03127837,  1.77275422,  1.3055102 ,
        1.40833642,  1.60499809,  2.06302056,  0.75895046,  2.49247059,
```

```
1.23822429,  1.79072427,  1.0576033 ,  1.84979835,  2.10795523,
1.17682829,  1.73750791,  1.8121725 ,  1.61106778,  1.63666896,
1.7199813 ,  0.70231987,  1.1751707 ,  1.65206947,  1.92722714,
2.0791567 ,  0.9161172 ,  1.5446523 ,  2.14508647,  2.10506574,
1.48341445,  2.17111681,  1.56991158,  0.74312814,  1.96912561,
1.01831772,  1.45501819,  1.6626107 ,  1.55703386,  1.64284955,
0.86963362,  2.09103995,  1.59973636,  1.50312393,  1.42713777,
1.14799124,  1.46862882,  2.41240931,  1.5923317 ,  2.08059503,
2.3006615 ,  1.72948408,  1.07883721,  0.86997497,  0.80525715,
0.54185001,  1.57628036,  1.71377353,  1.67762097,  1.31476146,
1.08214789,  1.97655489,  1.67573106,  1.5169046 ,  1.52174216,
1.19330444,  2.0972259 ,  2.16004173,  1.39225488,  1.0366776 ,
1.9286189 ,  0.64097199,  1.62908075,  1.18649711,  1.63194509,
2.05059869,  0.66384763,  1.05533884,  1.66339484,  1.1840038 ,
1.04693683,  1.38015528,  0.83578989,  1.59908595,  2.14989518,
1.87557121,  1.8275504 ,  0.97758645,  1.94530691,  1.63353198,
2.25915608,  0.70800948,  2.21290829,  1.34180364,  1.56875979,
1.86347435,  1.85044544,  1.53866617,  2.16165628,  1.35531054,
1.61009927,  1.66127005,  1.48285769,  1.08556636,  1.93866174,
2.46218212,  1.50205051,  2.00062792,  1.17736758,  1.89747601,
1.07963783,  1.57015759,  1.04770389,  1.87470612,  1.82887295,
1.42835267,  2.27867597,  0.89600622,  1.61650923,  1.30830399,
1.67642548,  0.64464438,  1.81620887,  1.35343645,  1.70506388,
1.34990569,  2.09407131,  1.60674369,  1.59116134,  1.05849347,
1.13377741,  2.05185356,  1.33437573,  0.96991616,  1.1689837 ,
1.94336458,  0.72324587,  1.04862366,  1.12779118,  1.5331399 ,
0.85469343,  2.17847755,  2.09268718,  1.59678841,  2.04244276,
2.01928014,  1.33214042,  1.42634613,  2.02246474,  1.64064191,
1.67908855,  0.46331749,  1.16434492,  1.19564657,  1.1197111 ,
1.29988507,  1.97453254,  1.64821211,  1.84791284,  1.50274318,
1.89642363,  1.03580629,  1.58548379,  0.63315254,  1.90507995,
0.89466077,  0.83845101,  1.71074066,  1.42214729,  1.31184444,
1.50563485,  1.8162332 ,  2.48862664,  0.56329471,  1.30618771,
1.71058289,  0.79347374,  1.97528283,  1.42358541,  1.26691627,
0.57658694,  1.30347476,  1.63603081,  0.6301248 ,  1.12061144,
1.41876785,  1.66496734,  1.78462037,  1.72466713,  1.96820984,
0.56936154,  2.3723478 ,  0.61745898,  1.6227874 ,  1.47307013,
2.11576386,  1.27799388,  1.48762164,  1.82052535,  1.59360598,
1.29377159,  0.56945751,  1.84480395,  1.88356099,  1.35105267,
0.13125854,  1.46023798,  0.84188862,  1.67687342,  1.70796311,
1.43494516,  0.638518  ,  1.63334154,  1.13567005,  1.7032772 ,
1.31894844,  1.86373825,  1.97449009,  0.96626401,  1.16138436,
1.3647452 ,  1.46853378,  1.23425115,  1.35935347,  1.30771573,
0.83790455,  1.15319308,  1.81761435,  1.59881214,  1.92992423,
1.45618531,  1.07189818,  1.22486824,  1.98300182,  1.18600293,
2.02443229,  1.61517479,  1.40730564,  1.67651825,  1.91093539,
0.30106822,  1.53690433,  1.32260404,  1.45739928,  1.45199567,
1.91117731,  1.70200571,  1.34187759,  1.79541005,  1.80121188,
0.91876258,  1.31118913,  2.13521213,  1.50955818,  1.31011118,
1.32492152,  1.77859789,  1.38798287,  1.66611857,  1.66401956,
1.97254774,  2.0599534 ,  1.36685062,  1.48619436,  1.54101197,
1.56700761,  1.66123673,  1.32201064,  1.3297968 ,  1.30244479,
1.95854368,  1.12589148,  1.47219325,  1.57785581,  1.5578607 ,
1.45195836,  1.20106734,  2.30152253,  1.62787809,  1.25491691,
1.26862373,  2.16145059,  1.51069364,  1.32193092,  2.08860844,
1.37568941,  1.78239298,  1.62718563,  1.70345849,  1.67189145,
```

```
         1.2/568941,  1.78238398,  1.63/18563,  1.70345849,  1.67189145,
         1.25196633,  1.31364876,  2.2556749 ,  0.4856558 ,  1.20787072,
         1.18762905,  2.17996792,  2.14699616,  1.8058056 ,  1.36184375,
         0.86781083,  1.97446107,  1.33433256,  1.91221242,  1.87686867,
         1.0414156 ,  0.94255095,  1.68740759,  2.02735478,  1.40651024,
         1.30693522,  1.4364609 ,  1.6129844 ,  1.75978187,  1.65677605,
         2.42567885,  0.87222551,  1.09721268,  1.6540656 ,  1.1427429 ,
         0.86604914,  1.69574162,  1.58506734,  1.27123889,  1.69426436,
         0.76661077,  1.59251576,  1.45068216,  1.75509659,  0.02195572,
         1.65688223,  2.10900693,  1.70917737,  1.20166533,  1.7040536 ,
         2.27926559,  1.65419419,  1.12034395,  1.18032428,  2.04541147,
         2.05880959,  1.49066126,  1.44991027,  1.43825689,  1.6166367 ,
         1.60152065,  2.24649705,  1.73589905,  1.92231764,  0.32587227,
         1.66001676,  1.59084199,  2.08202517,  1.51605894,  1.89843247,
         1.92773864,  1.66141312,  1.77996698,  1.6794148 ,  2.12527961,
         2.23162002,  1.35415705,  1.85962918,  0.63878444,  1.23589253,
         1.40466561,  2.10860074,  1.5499985 ,  2.16293571,  1.68549068,
         0.85598559,  1.52076371,  1.48699493,  1.48738748,  0.40269948,
         1.60472511,  1.10379633,  0.605542  ,  1.17518126,  0.55354588,
         0.8585032 ,  1.68921107,  1.46531162,  1.3196177 ,  1.16192288,
         1.43168621,  1.26143338,  1.84155032,  1.38570742,  1.21464683,
         1.28275748,  1.8630367 ,  1.0571319 ,  2.13928872,  1.57957302,
         1.77941111,  1.34278423,  1.71716711,  0.65062018,  1.21563629,
         1.15967701,  1.17641134,  1.42195765,  1.74659142,  1.18935892,
         0.72554874,  1.63277054,  1.43865372,  1.54706203,  1.72601101,
         2.25537468,  2.16927262,  1.54655718,  1.32206303,  1.66707631])
```
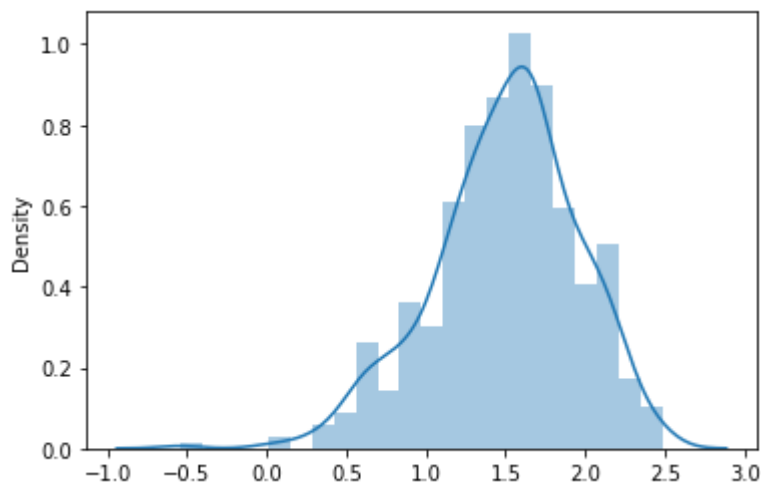
```
sns.distplot(x)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWa
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f146d53c650>
```
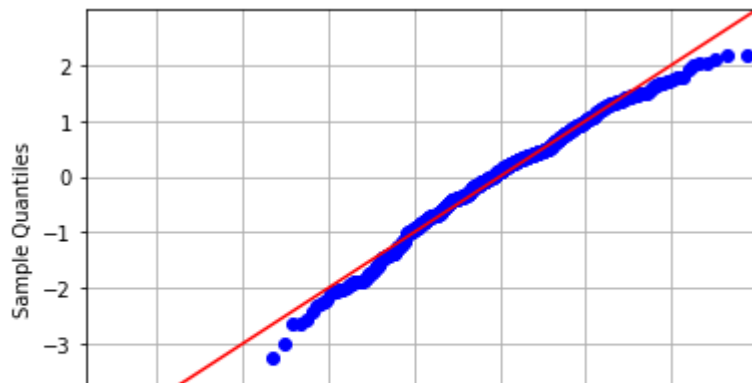


```
fig = sm.qqplot(x, line='45', fit=True)
plt.grid()
```

```
xt, l = stats.boxcox(x)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-46-80d99d196c18> in <module>()
----> 1 xt, l = stats.boxcox(x)

/usr/local/lib/python3.7/dist-packages/scipy/stats/morestats.py in boxcox(x,
lmbda, alpha)
   1043
   1044     if any(x <= 0):
-> 1045         raise ValueError("Data must be positive.")
   1046
   1047     if lmbda is not None:  # single transformation

ValueError: Data must be positive.
```

> SEARCH STACK OVERFLOW

```
print(np.min(x))
```

```
-0.54601206
```

```
x1 = x + 1
```

```
xt, l = stats.boxcox(x1)
```

```
print(l)
```

```
1.8162672858204911
```

```
fig = sm.qqplot(xt, line='45', fit=True)
plt.grid()
```