Descriptive Stats, Normality Tests

February 6, 2024

1 Ketamine VR5 Stats, Plots - COLOCALIZED DATA ONLY

Jonathan Ramos 2/6/2024 Plotting data and running normality tests is annoying in prism. We have 28 stain type combinations to consider as well which makes this process unnecessarily very tedious. In this notebook I'll just quickly do some exploratory analyses of the normalized adjusted mean-background data we generated in our previous notbook.

In particular, in this notebook I plan to focus on: - generating histograms - generating QQ plots - running some normalit tests (probably just Shapiro-Wilk)

```
[1]: import glob
     import numpy as np
     import pandas as pd
     import seaborn as sns
     import matplotlib.pyplot as plt
     from statsmodels.graphics.gofplots import qqplot
     from scipy.stats import shapiro
     from scipy.stats import lognorm

     plt.rcParams.update({'figure.max_open_warning': 0})
```

```
/var/folders/b2/3h2lpxx14kgb12pp_7pltxnc0000gn/T/ipykernel_5120/536631275.py:3:
DeprecationWarning:
Pyarrow will become a required dependency of pandas in the next major release of
pandas (pandas 3.0),
(to allow more performant data types, such as the Arrow string type, and better
interoperability with other libraries)
but was not found to be installed on your system.
If this would cause problems for you,
please provide us feedback at https://github.com/pandas-dev/pandas/issues/54466

  import pandas as pd
```

```
[2]: # load data
     files = sorted(glob.glob('normalized adjusted mean-background/NORM/*.csv'))
     dfs = [pd.read_csv(f) for f in files]

     # let's take a look!
```

```
dfs[0].head(9)
```

[2]:
```
   Unnamed: 0  index     rat_n treatment stain_type       coloc_stain_type  \
0        5526  14487  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA
1        5527  14488  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA
2        5528  14489  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA
3        5529  14490  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA
4        5530  14491  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA
5        5544  14555  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA
6        5545  14556  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA
7        5546  14557  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA
8        5547  14558  KET-10-12   FR1_KET      Npas4  Npas4_coloc_w_PV,WFA

                    filename            image_name   CoM_x   CoM_y  \
0  KET-10-12_PFC_3.7_A_4.tif  KET-10-12_PFC_3.7_A  170.95  312.57
1  KET-10-12_PFC_3.7_A_4.tif  KET-10-12_PFC_3.7_A   36.62  458.40
2  KET-10-12_PFC_3.7_A_4.tif  KET-10-12_PFC_3.7_A  306.85  306.78
3  KET-10-12_PFC_3.7_A_4.tif  KET-10-12_PFC_3.7_A  154.15  476.33
4  KET-10-12_PFC_3.7_A_4.tif  KET-10-12_PFC_3.7_A  299.44  422.83
5  KET-10-12_PFC_3.7_B_4.tif  KET-10-12_PFC_3.7_B  354.26   78.17
6  KET-10-12_PFC_3.7_B_4.tif  KET-10-12_PFC_3.7_B  429.88  365.95
7  KET-10-12_PFC_3.7_B_4.tif  KET-10-12_PFC_3.7_B  305.49  492.30
8  KET-10-12_PFC_3.7_B_4.tif  KET-10-12_PFC_3.7_B  146.83  485.75

   mean_intensity  background       snr  \
0        503.0890    573.9955  0.876469
1        471.7593    573.9955  0.821887
2        485.9018    573.9955  0.846526
3        524.3108    573.9955  0.913441
4        544.4831    573.9955  0.948584
5        493.5040    591.0376  0.834979
6        586.1046    591.0376  0.991654
7        582.2947    591.0376  0.985208
8        507.1195    591.0376  0.858016

                        coloc_roi_id_grouping  roi_id_grouping_counts  \
0  ('0-000-00008_PV', '0-FFF-00002_WFA', '0-FFF-0…                       3
1  ('0-000-00005_PV', '0-FFF-00006_WFA', '0-FFF-0…                       3
2  ('0-000-00003_PV', '0-FFF-00003_WFA', '0-FFF-0…                       3
3  ('0-000-00002_PV', '0-FFF-00005_WFA', '0-FFF-0…                       3
4  ('0-000-00000_PV', '0-FFF-00004_WFA', '0-FFF-0…                       3
5  ('0-000-00010_PV', '0-FFF-00002_WFA', '0-FFF-0…                       3
6  ('0-000-00007_PV', '0-FFF-00007_WFA', '0-FFF-0…                       3
7  ('0-000-00001_PV', '0-FFF-00008_WFA', '0-FFF-0…                       3
8  ('0-000-00000_PV', '0-FFF-00009_WFA', '0-FFF-0…                       3

   mean-background  adjusted_mean-background  norm_adjusted_mean-background
```

```
0      -70.906494          96.585815          0.684314
1     -102.236176          65.256134          0.462342
2      -88.093690          79.398620          0.562542
3      -49.684692         117.807620          0.834672
4      -29.512390         137.979920          0.977593
5      -97.533600          69.958710          0.495660
6       -4.932983         162.559330          1.151739
7       -8.742920         158.749390          1.124746
8      -83.918090          83.574220          0.592127
```

2 Visualizing distributions

```python
[3]: def plot_dist(df):
         f, ax = plt.subplots(nrows=1, ncols=2, figsize=(15,5))
         f.suptitle(df.coloc_stain_type.unique().item(), fontsize=24)
         ax = ax.flatten()
         sns.histplot(ax=ax[0], data=df, x='norm_adjusted_mean-background',
     ↪hue='treatment', binwidth=0.1, palette='pastel')
         sns.boxplot(ax=ax[1], data=df, x='norm_adjusted_mean-background',
     ↪hue='treatment', gap=0.1, palette='pastel')

     def plot_qq(df):
         f, ax = plt.subplots(nrows=2, ncols=2, figsize=(9,8))
         f.suptitle(df.coloc_stain_type.unique().item(), fontsize=24)
         ax = ax.flatten()
         for i, tx in enumerate(df.treatment.unique()):
             qqplot(df[df.treatment == tx]['norm_adjusted_mean-background'],
     ↪line='s', ax=ax[i])
             ax[i].set_title(tx, fontsize=16)
         plt.tight_layout()
```

```python
[4]: for df in dfs:
         plot_dist(df)
         plot_qq(df)
```
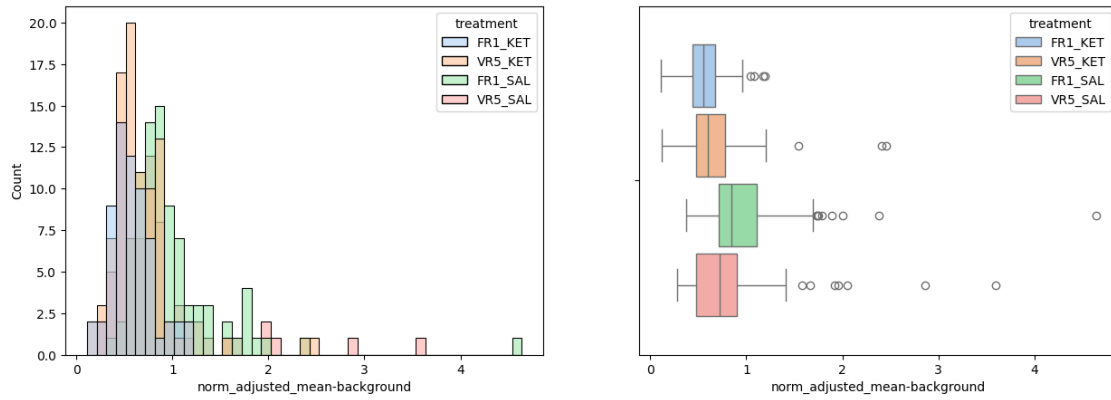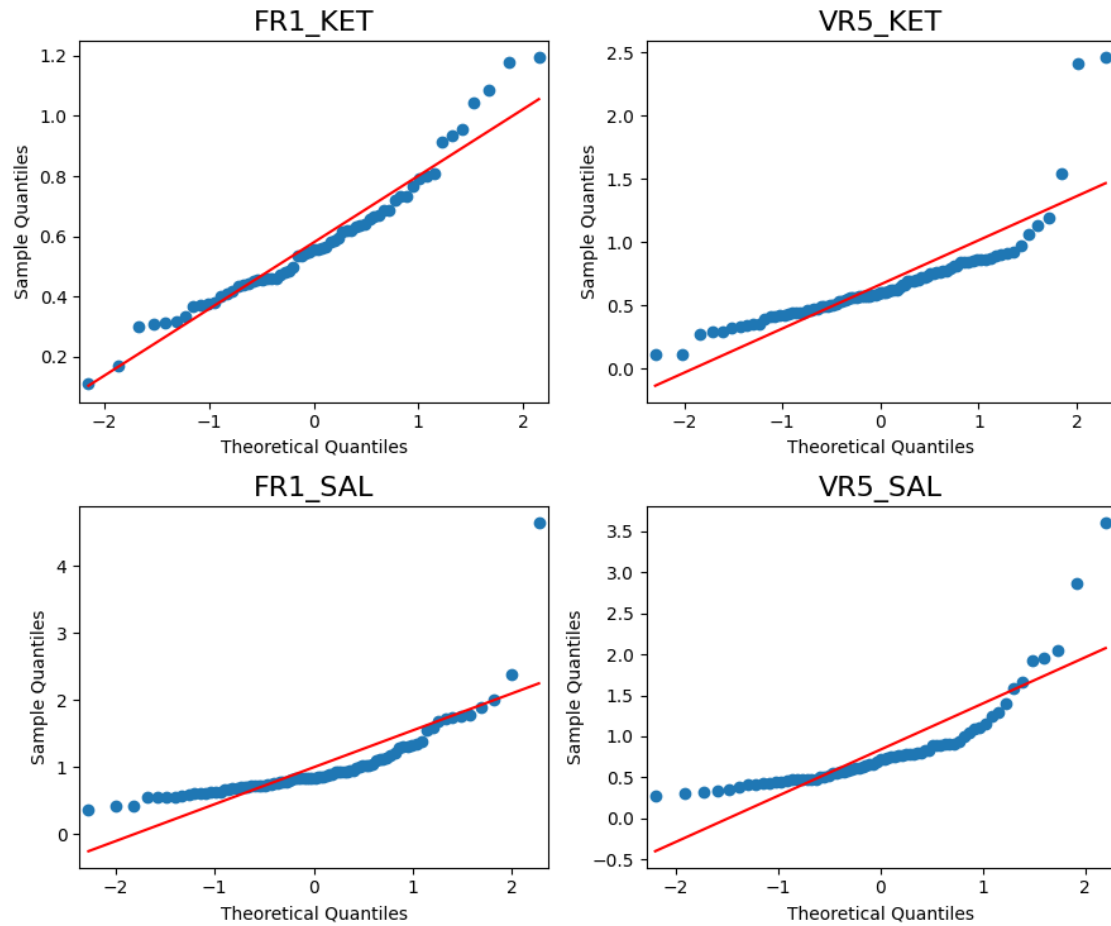
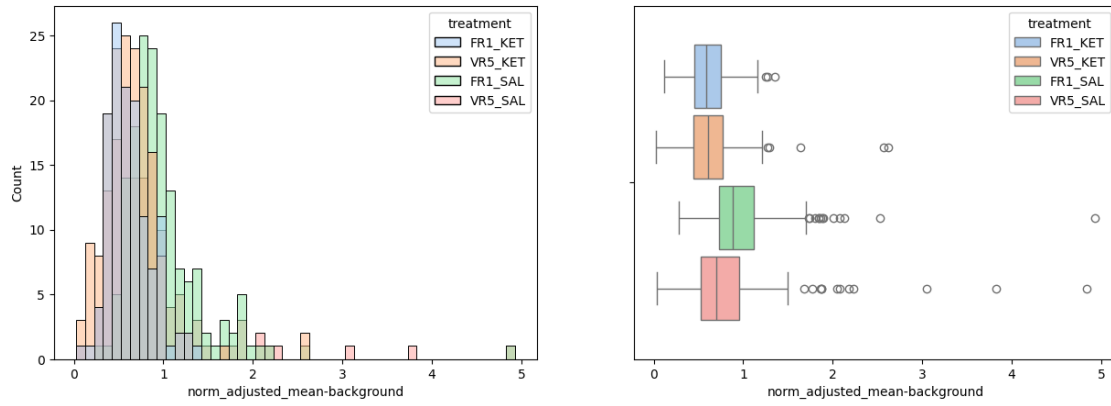# Npas4_coloc_w_PV,WFA
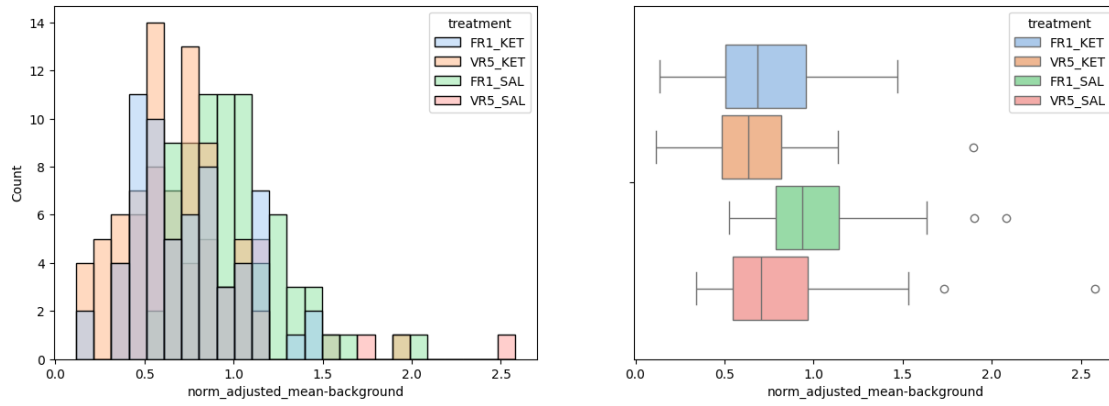
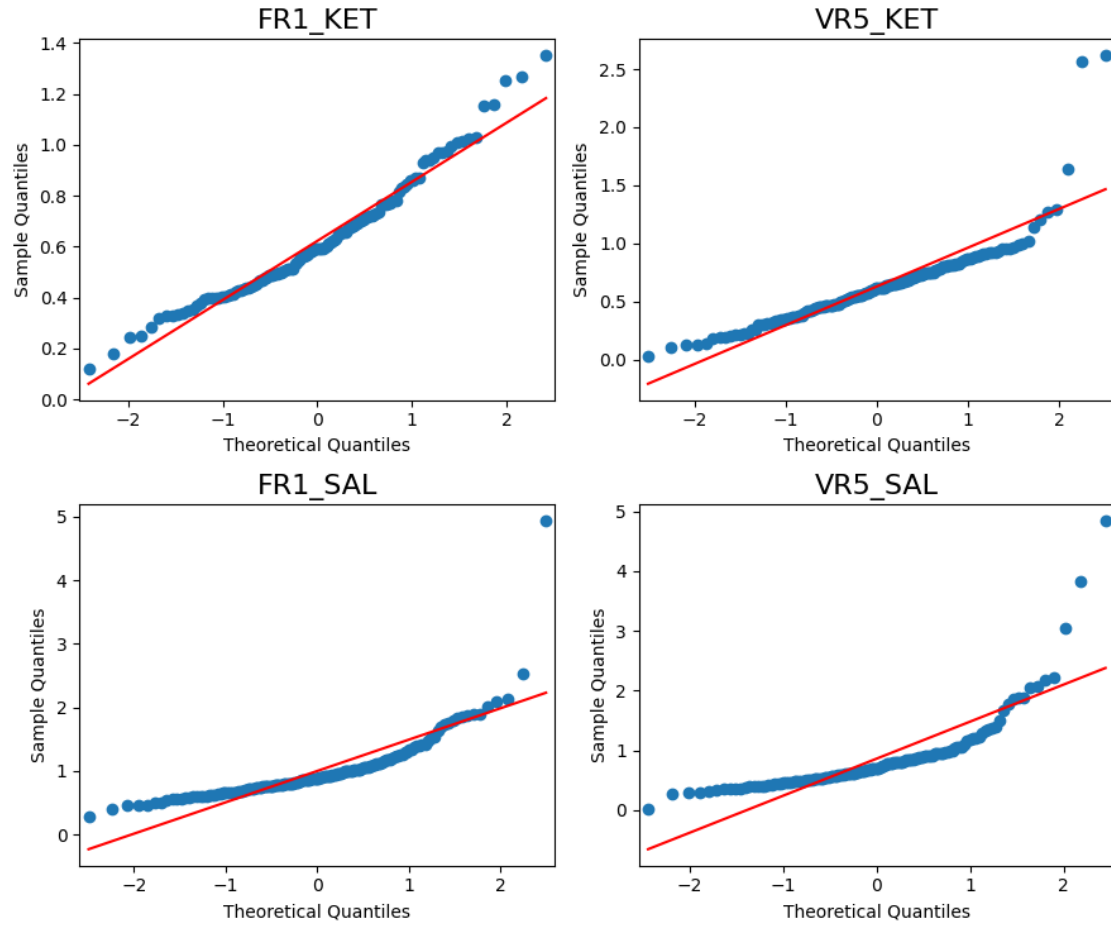# Npas4_coloc_w_PV,WFA
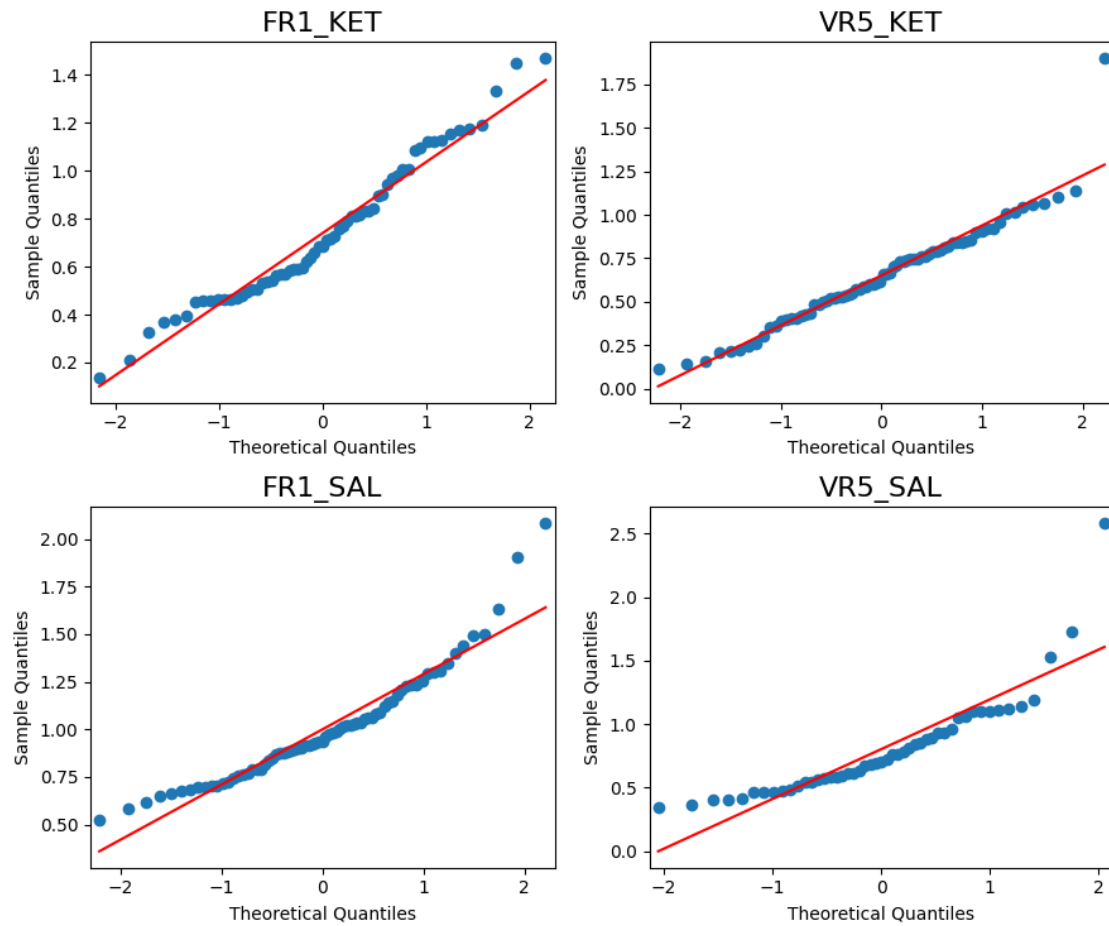
Npas4_coloc_w_PV,cFos
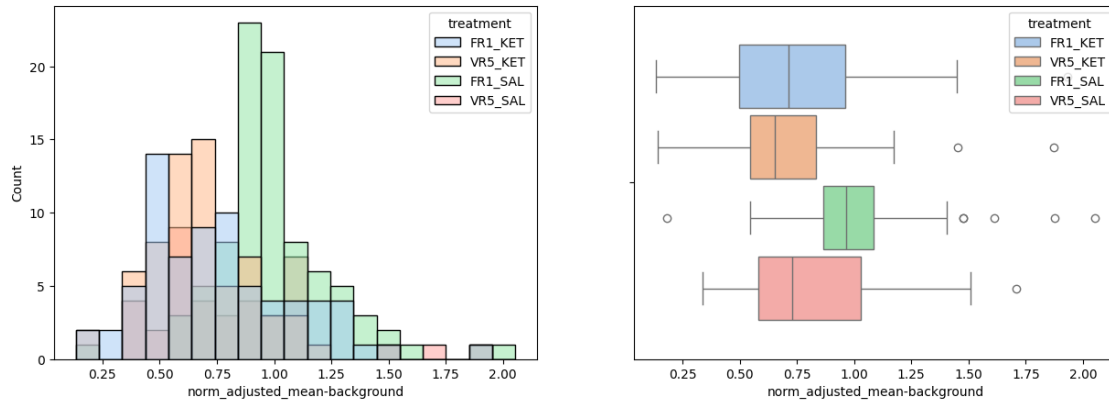

Npas4_coloc_w_PV,cFos
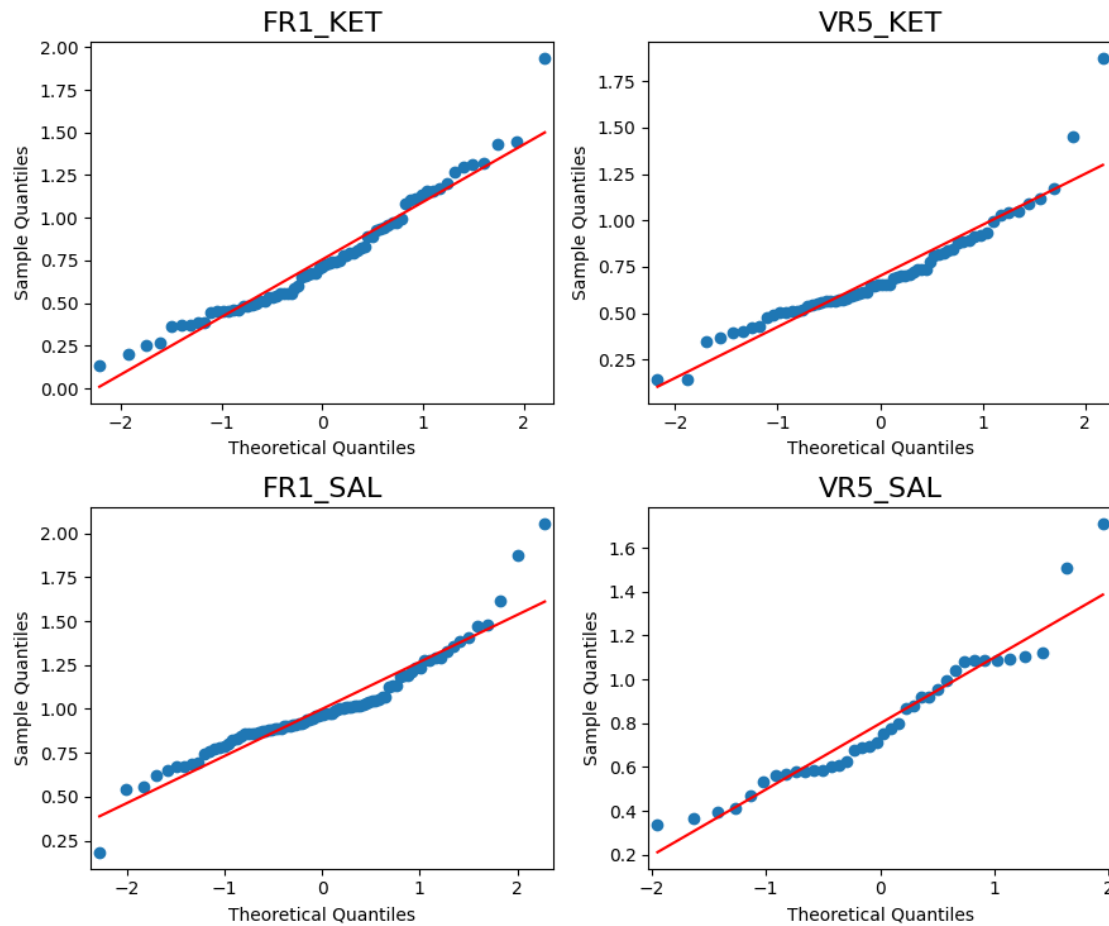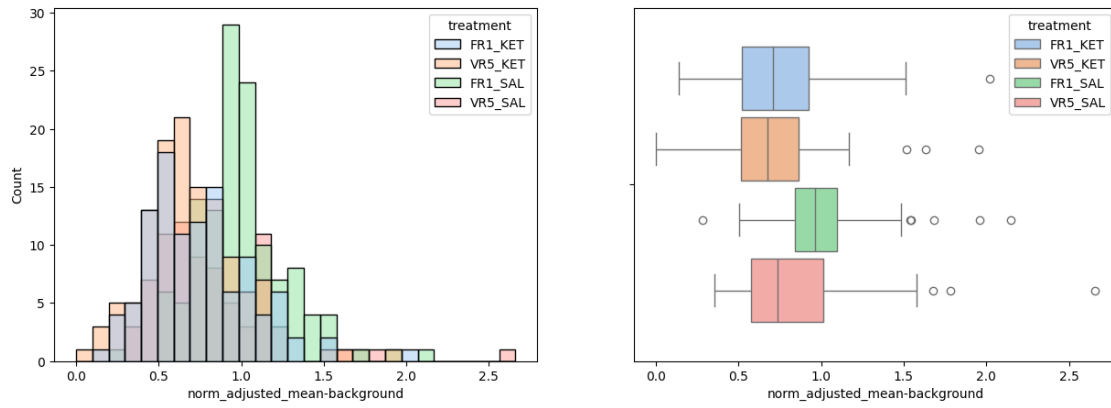
Npas4_coloc_w_PV

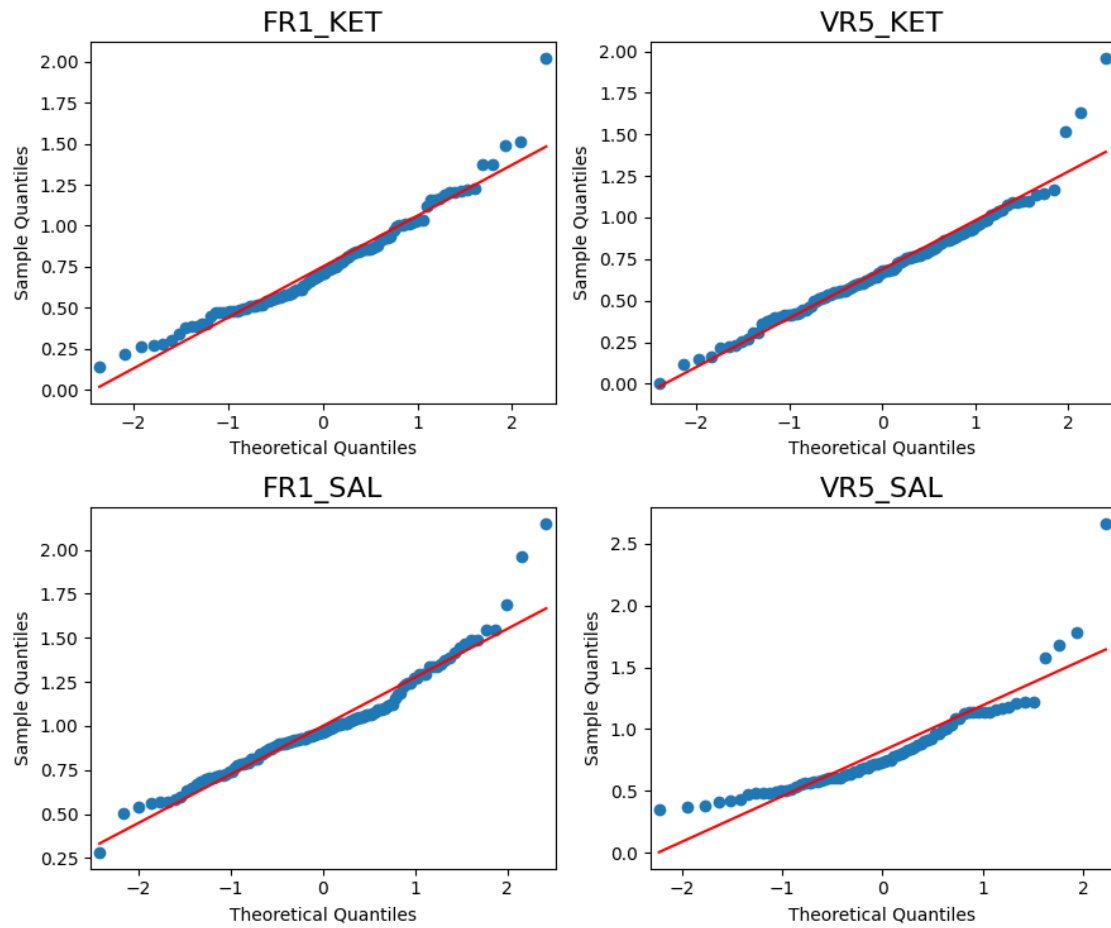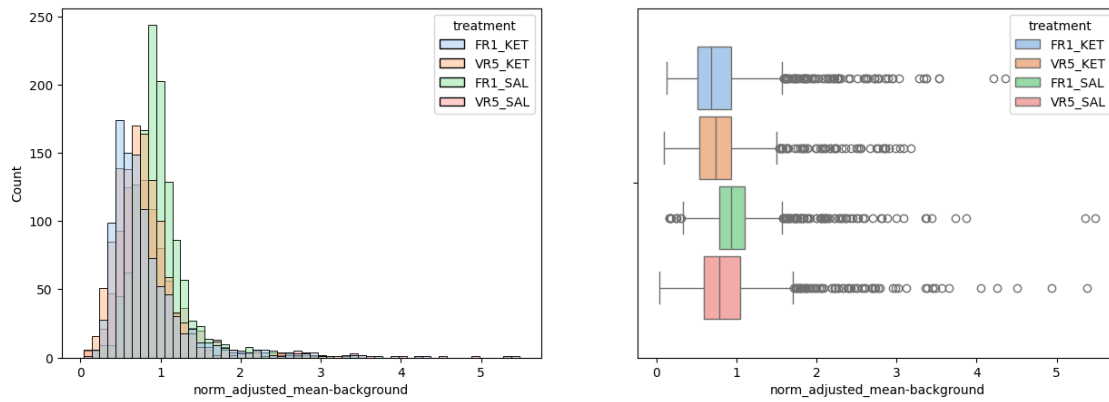# Npas4_coloc_w_PV

Npas4_coloc_w_WFA,cFos

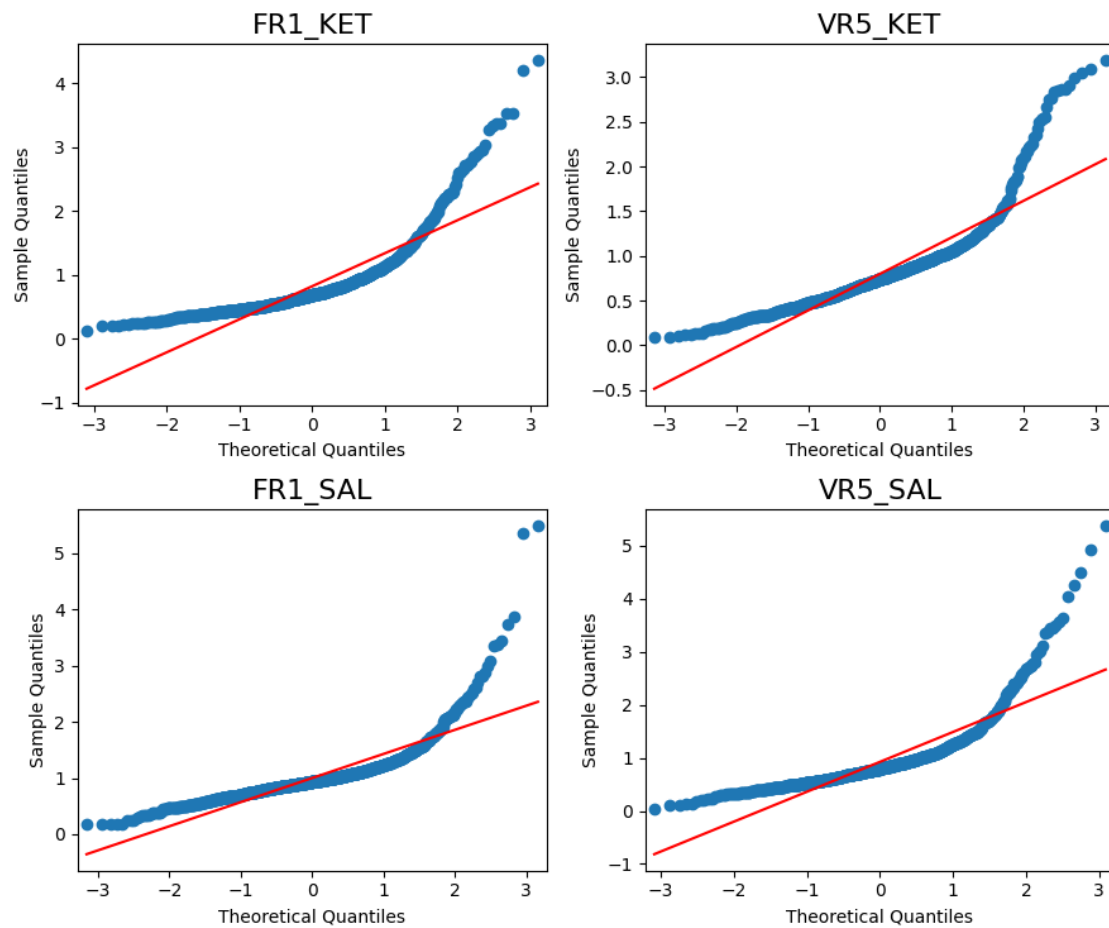# Npas4_coloc_w_WFA,cFos
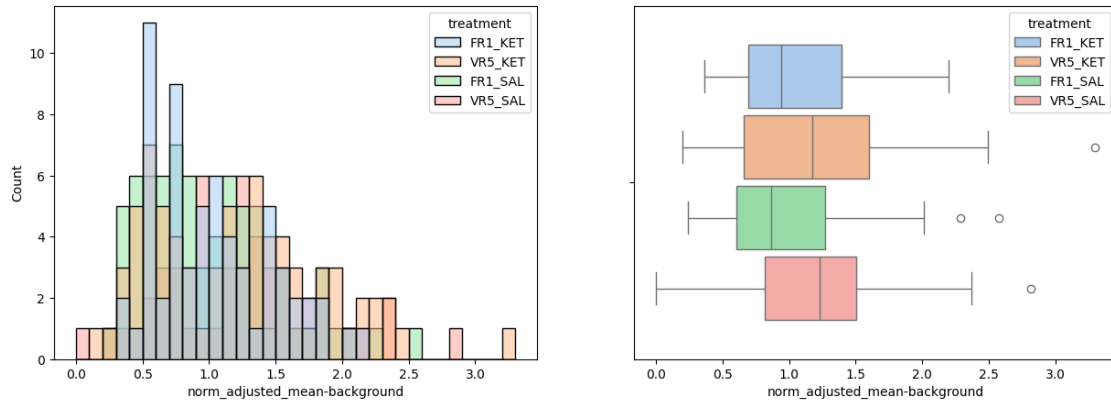
Npas4_coloc_w_WFA

Npas4_coloc_w_WFA

Npas4_coloc_w_cFos

Npas4_coloc_w_cFos

PV_coloc_w_Npas4,WFA

PV_coloc_w_Npas4,WFA

FR1_KET

VR5_KET

FR1_SAL

VR5_SAL

PV_coloc_w_Npas4,cFos
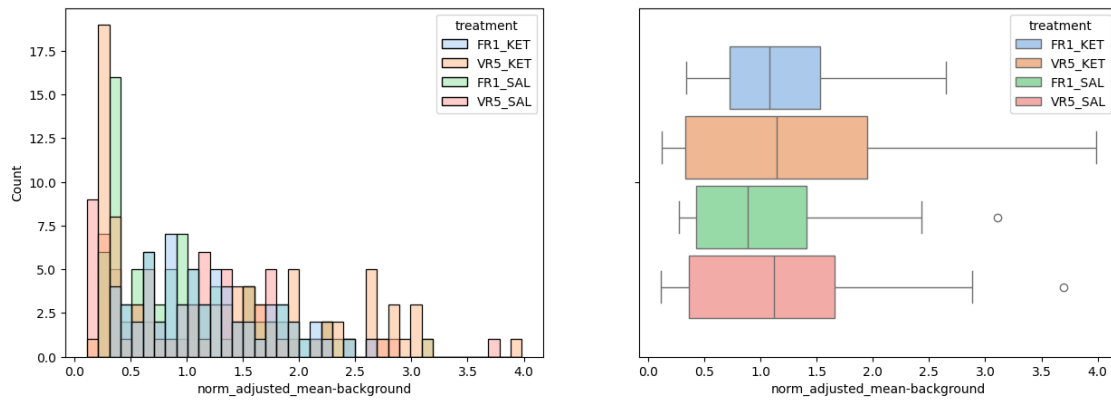
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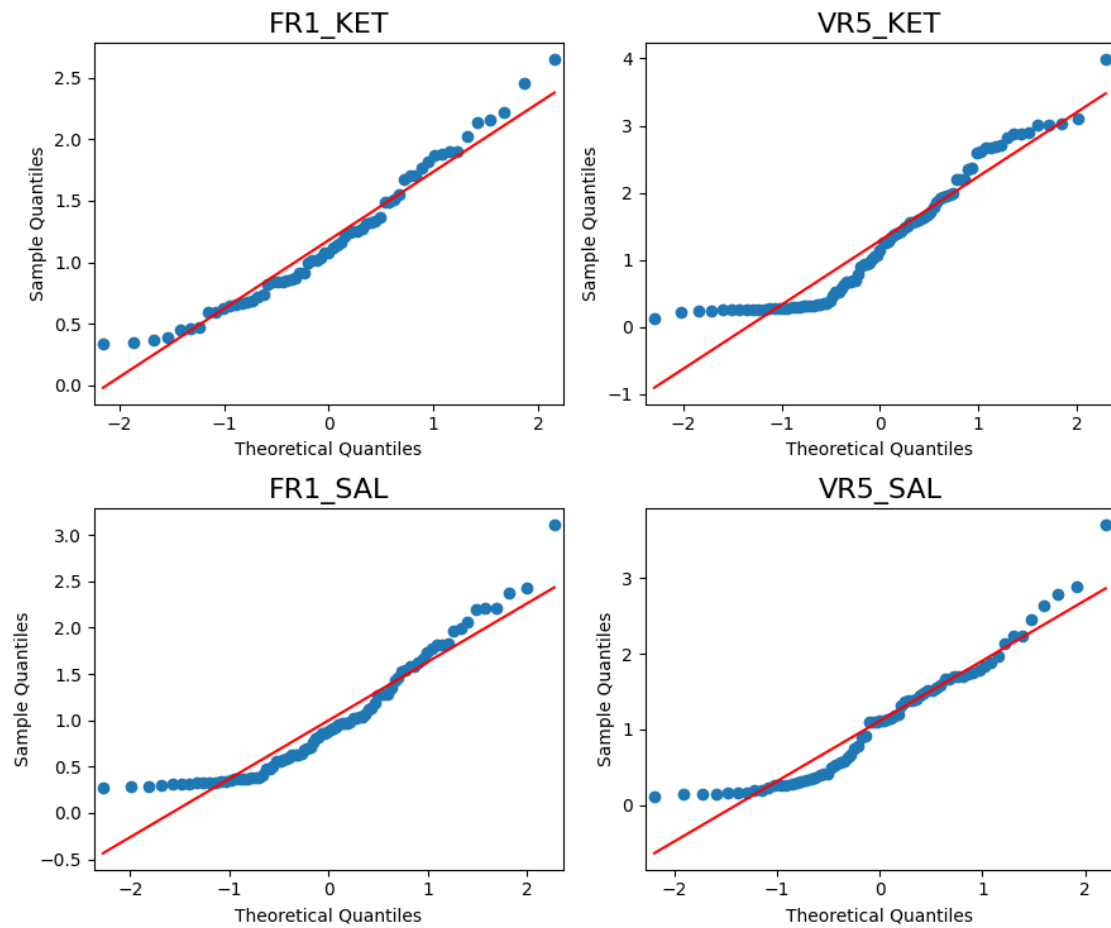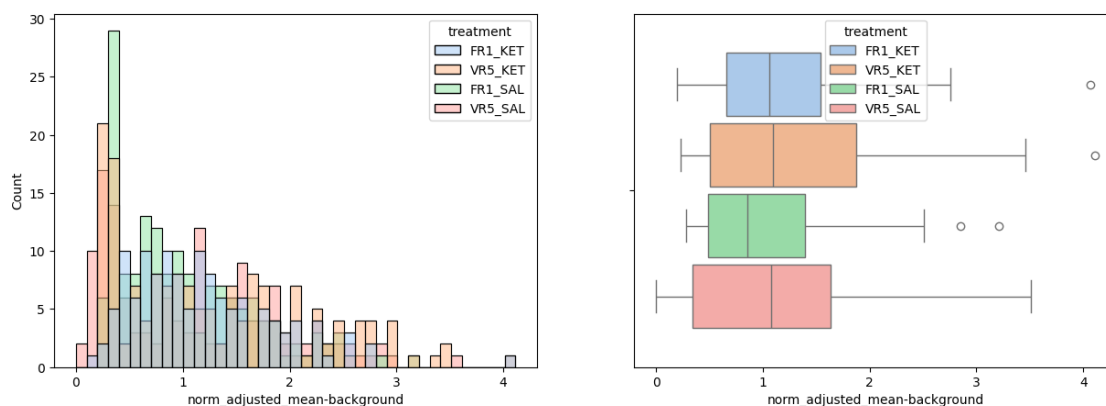
PV_coloc_w_Npas4

PV_coloc_w_Npas4

FR1_KET

VR5_KET

FR1_SAL

VR5_SAL
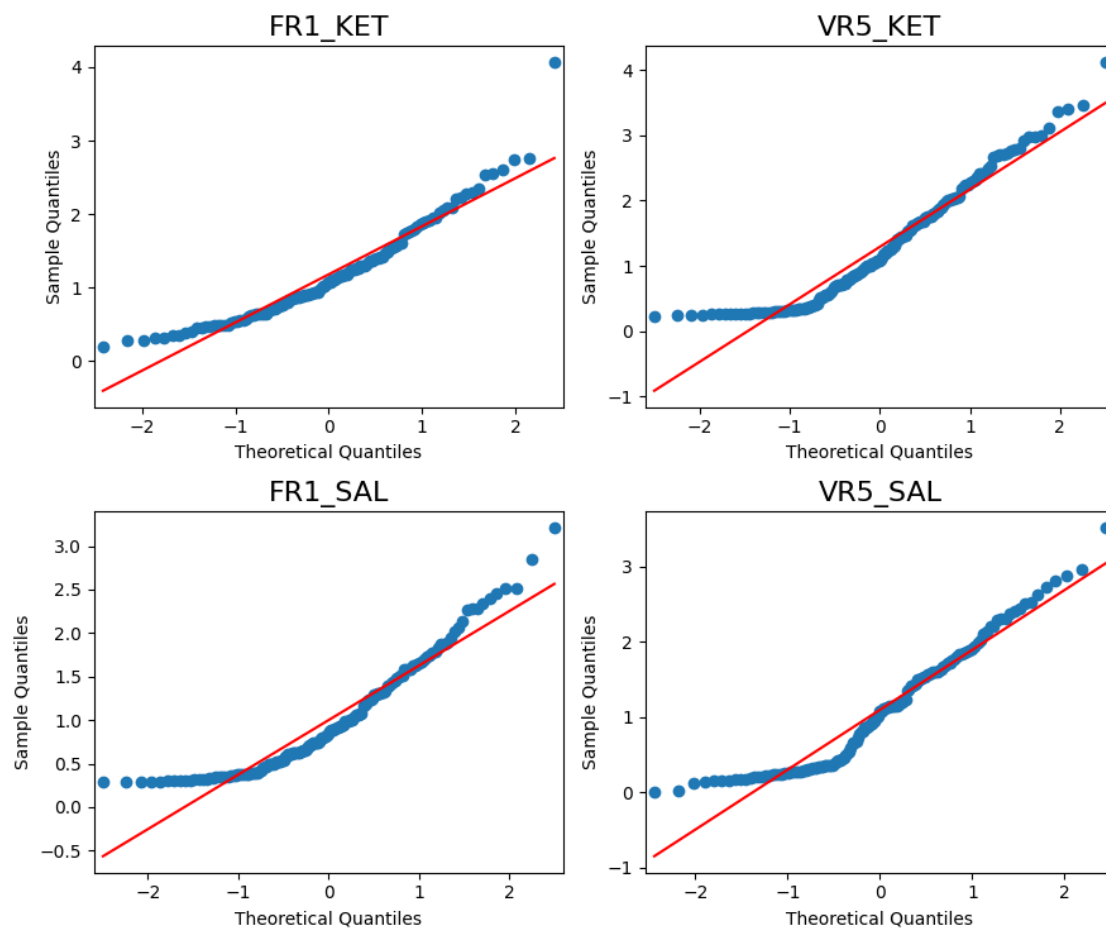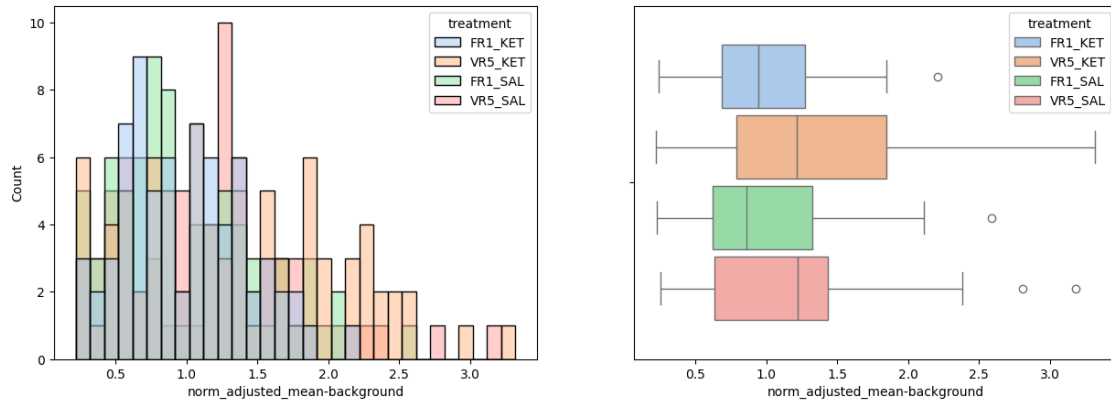
PV_coloc_w_WFA,cFos

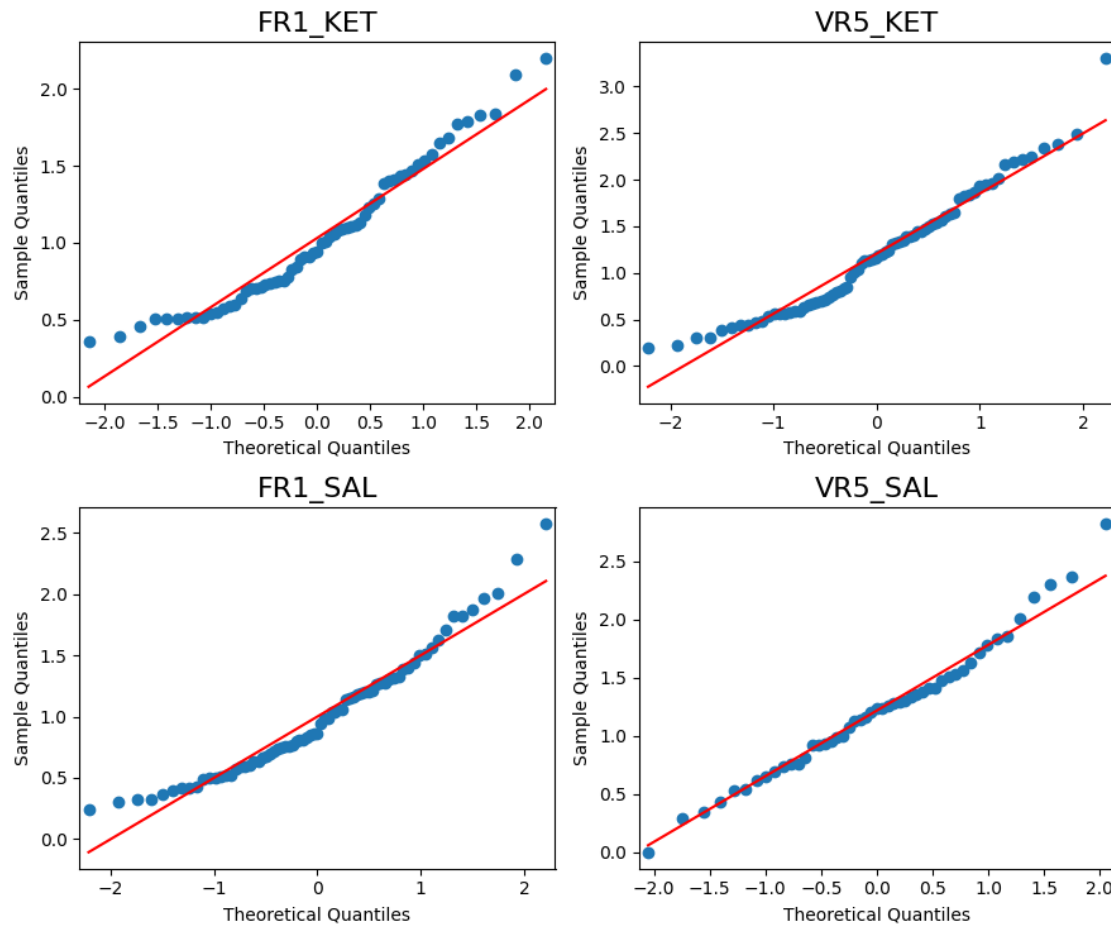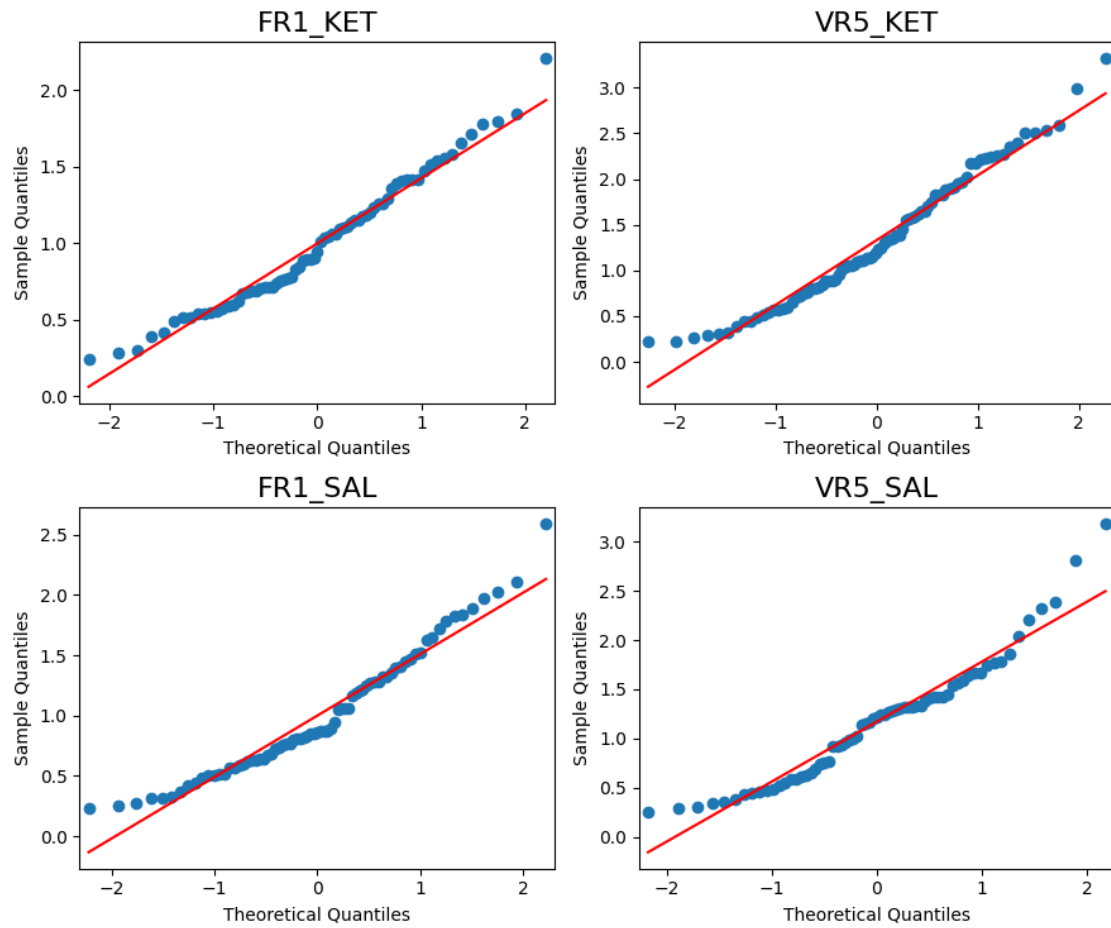# PV_coloc_w_WFA,cFos
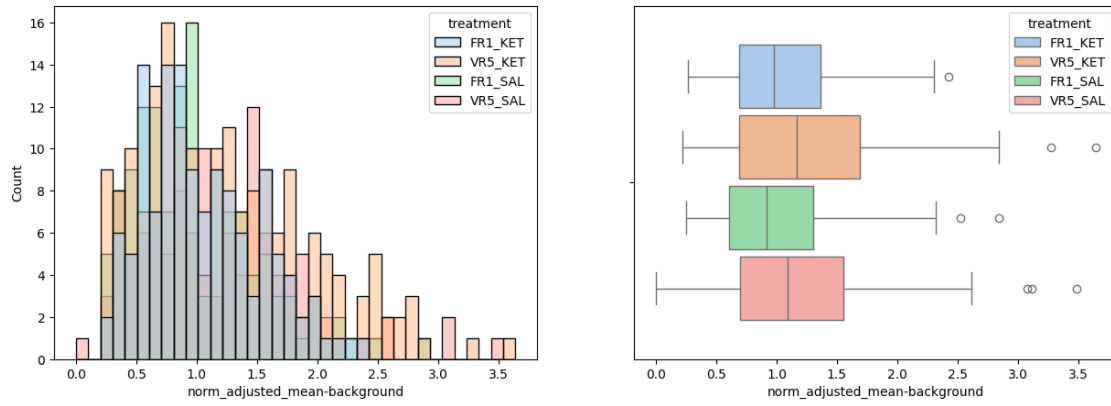
PV_coloc_w_WFA

PV_coloc_w_WFA
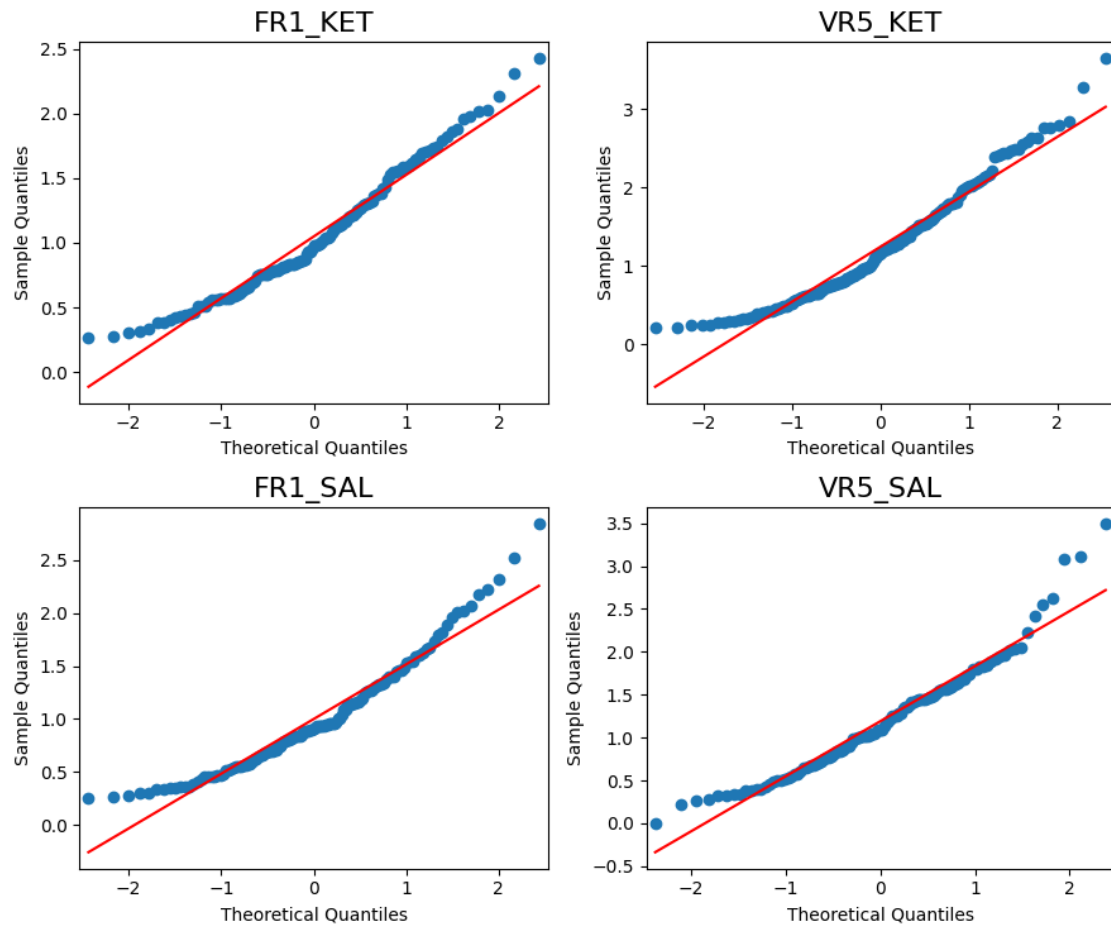
PV_coloc_w_cFos

PV_coloc_w_cFos

FR1_KET

VR5_KET

FR1_SAL

VR5_SAL
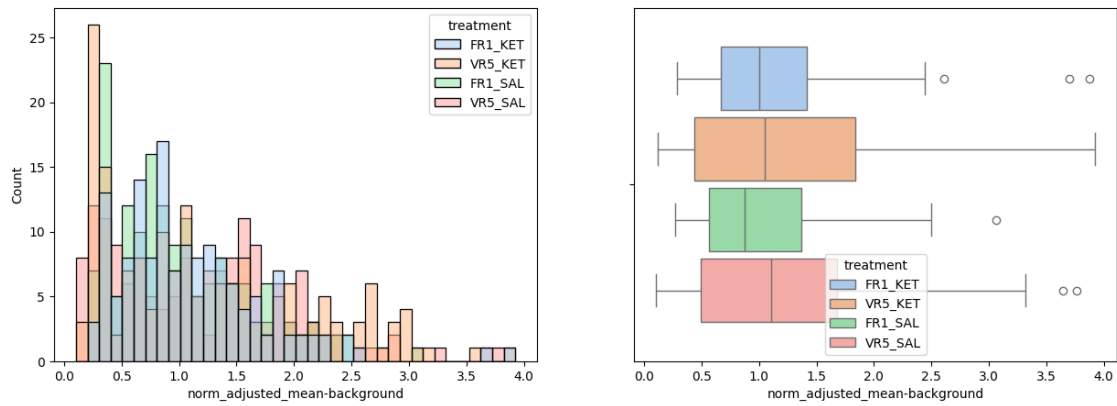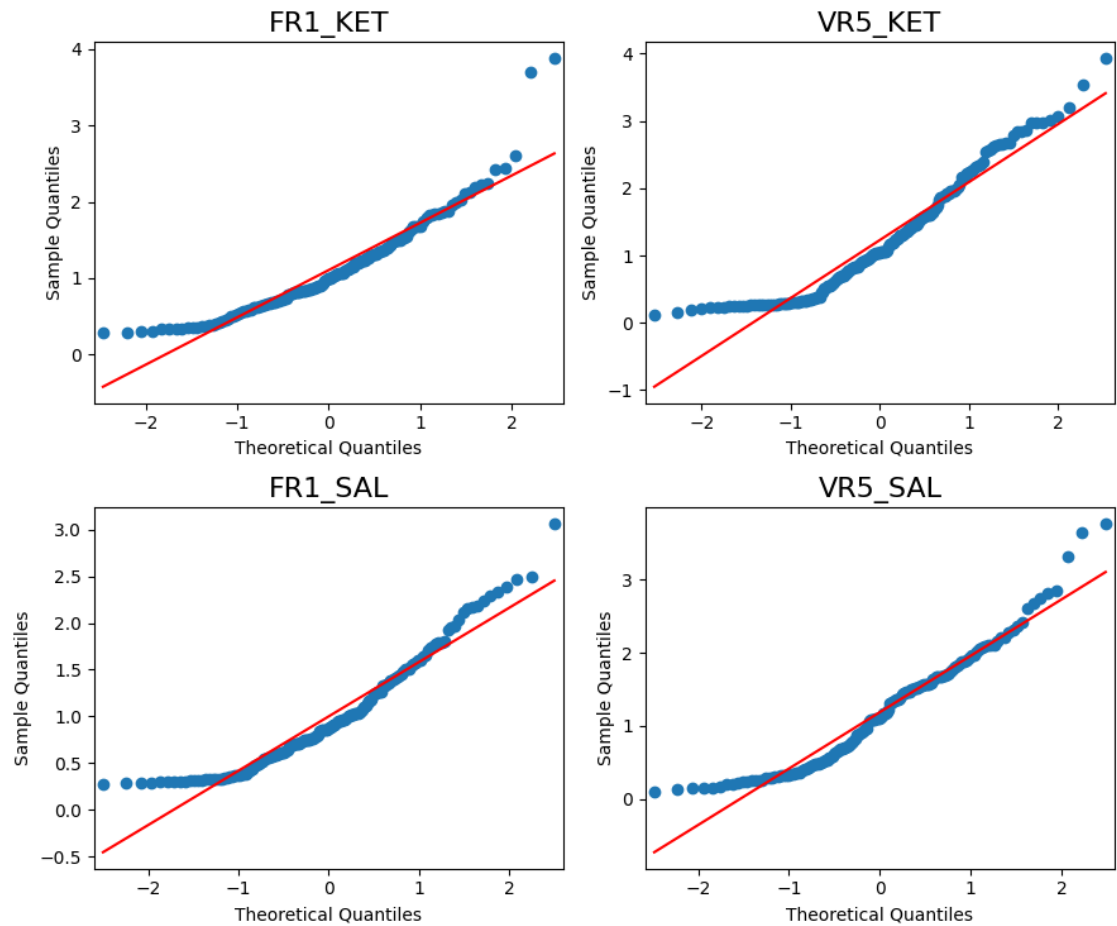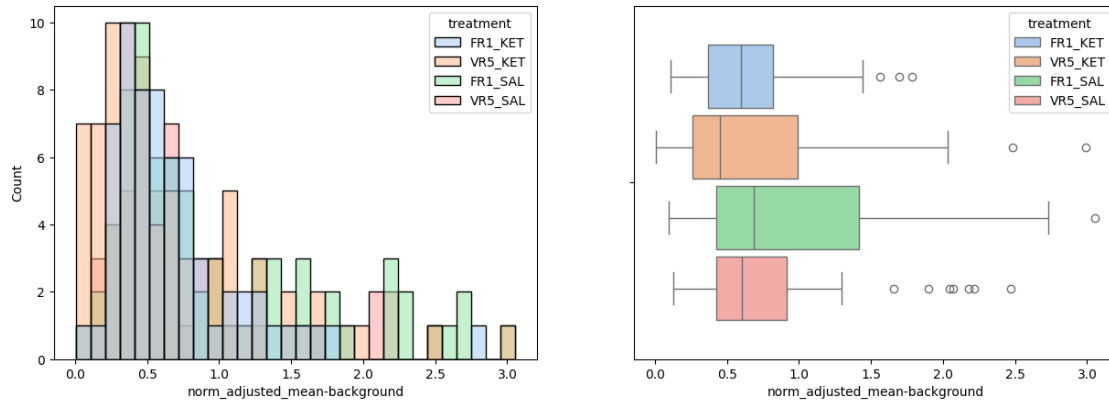
WFA_coloc_w_Npas4,PV
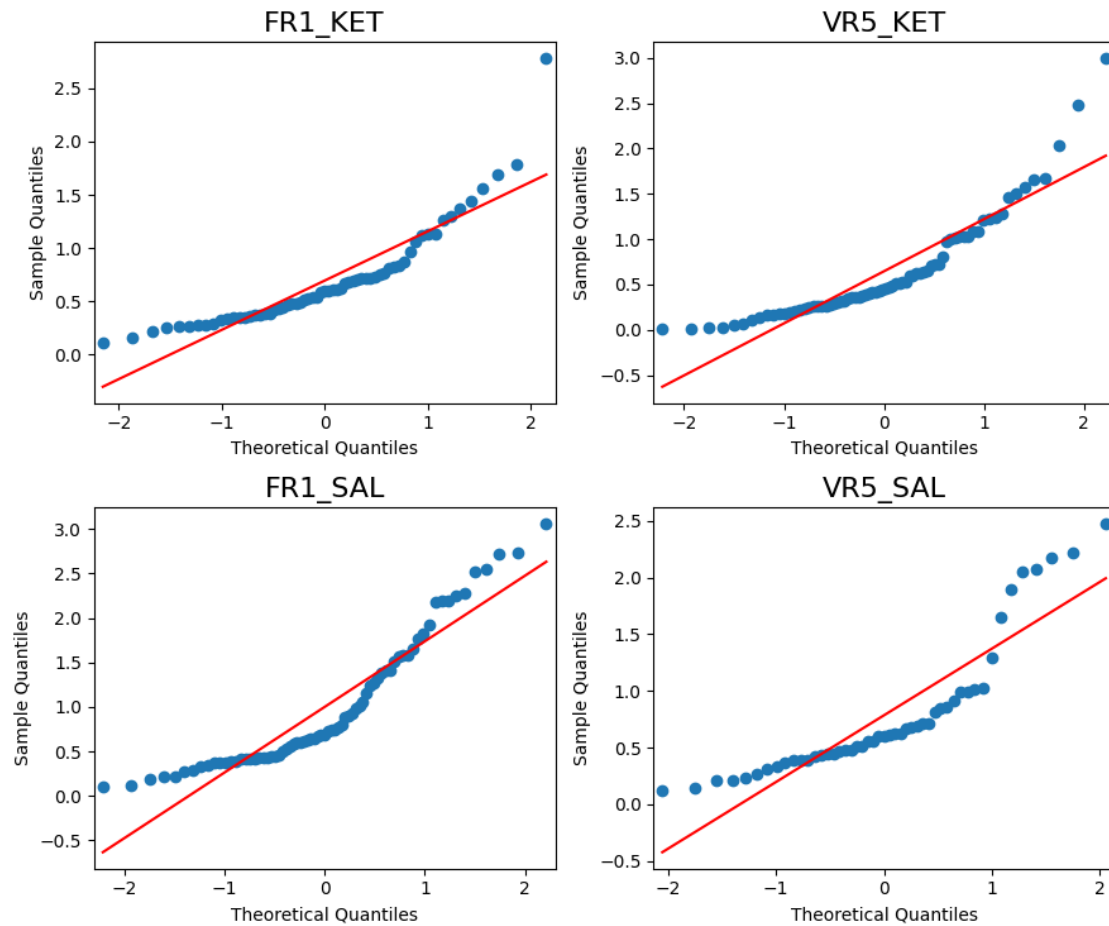
WFA_coloc_w_Npas4,PV

WFA_coloc_w_Npas4,cFos
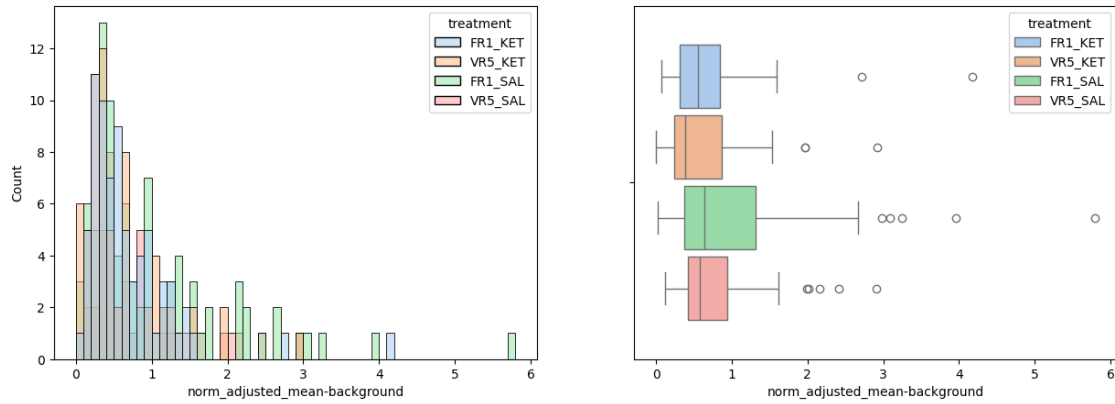
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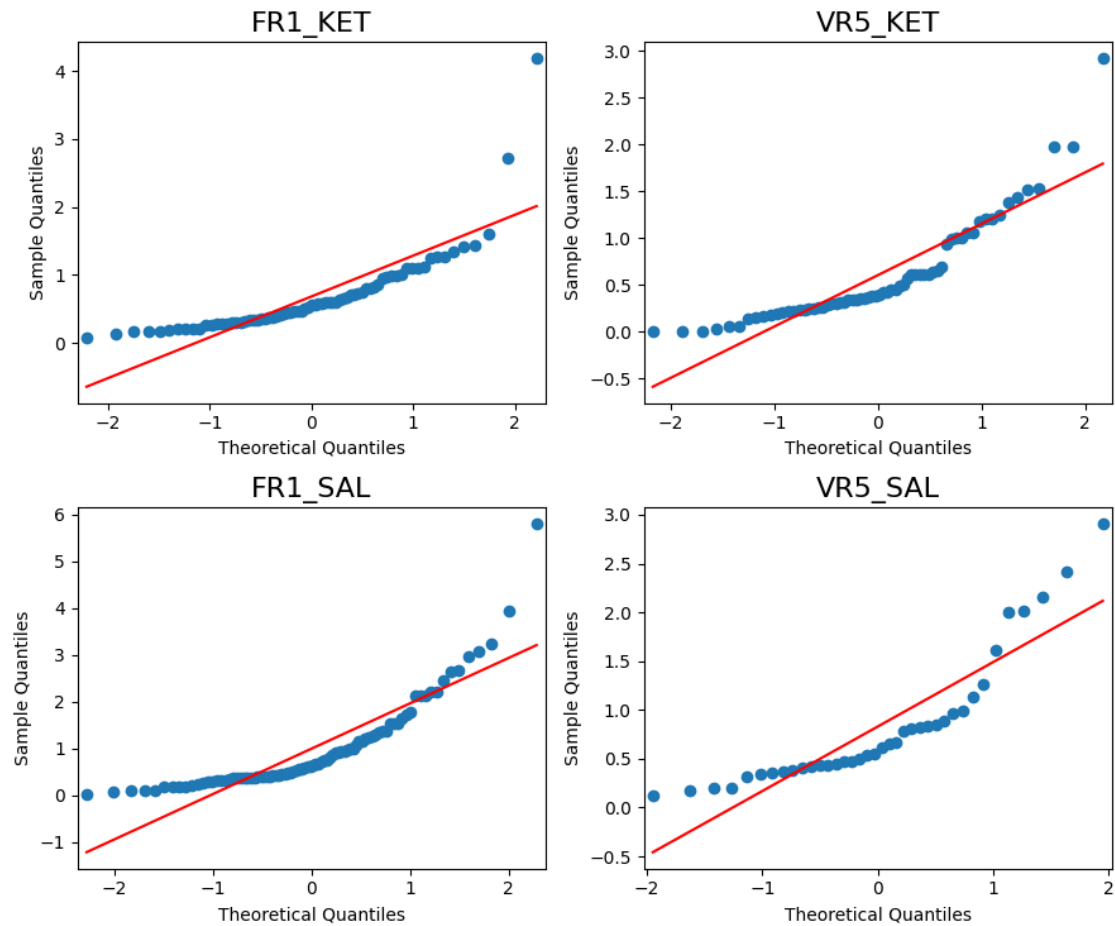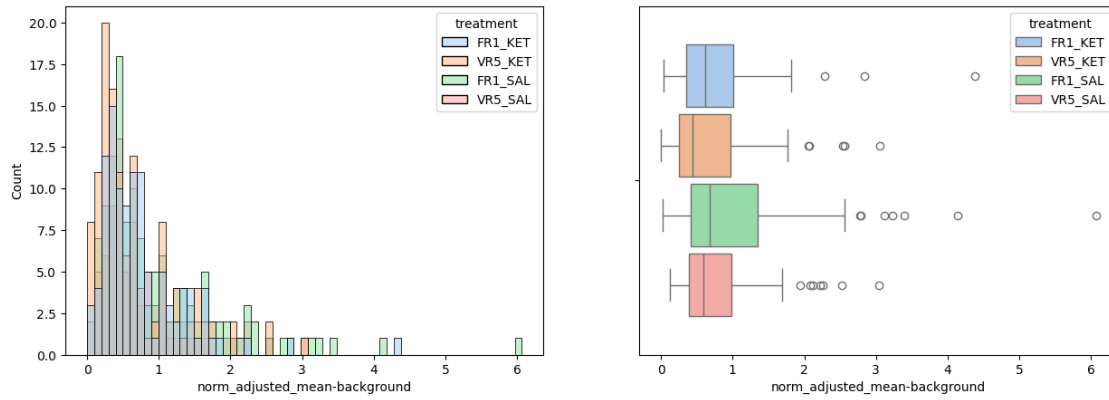
WFA_coloc_w_Npas4

WFA_coloc_w_Npas4
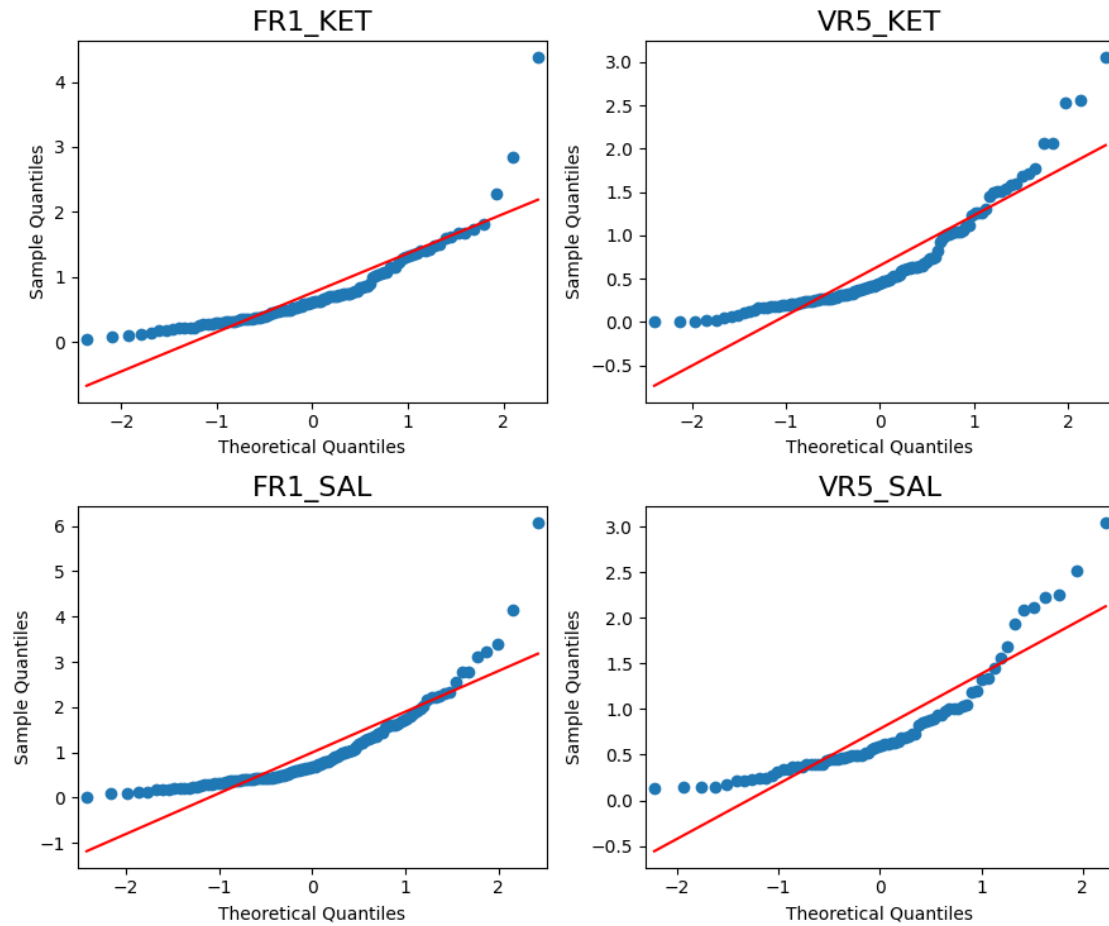
WFA_coloc_w_PV,cFos
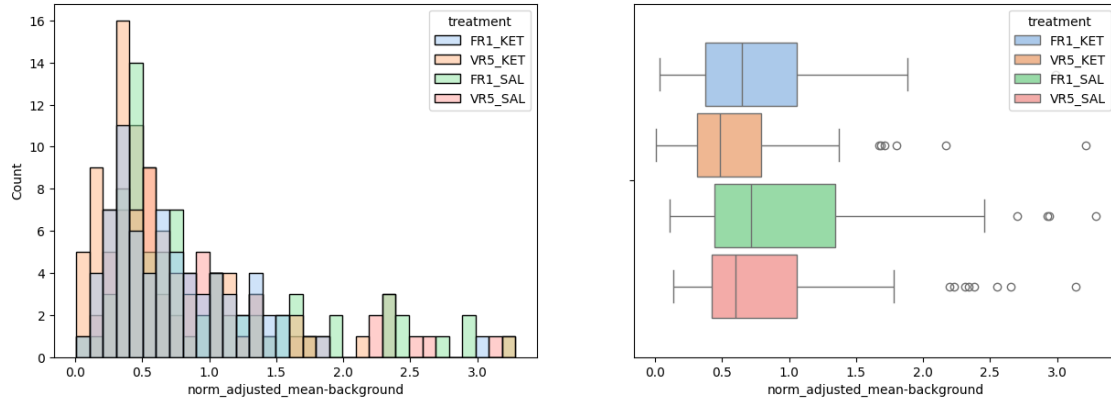
WFA_coloc_w_PV,cFos
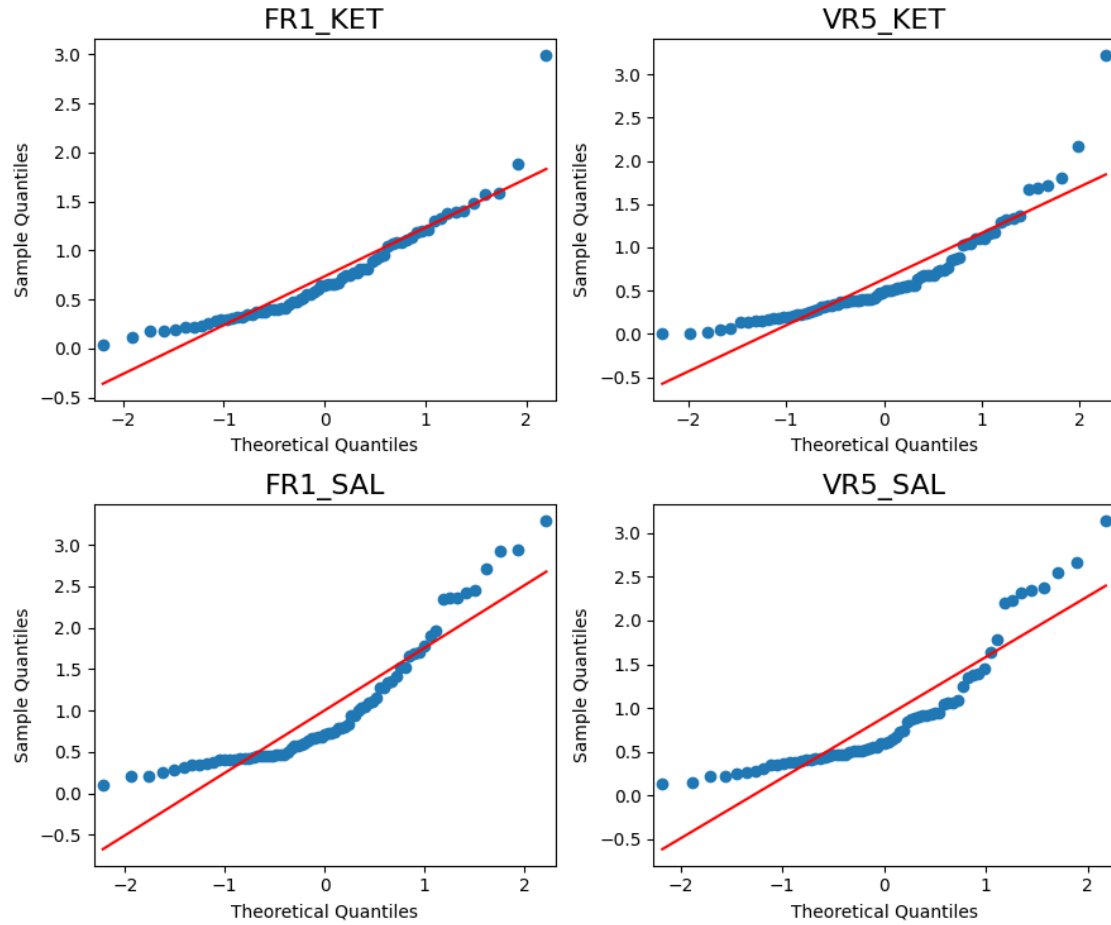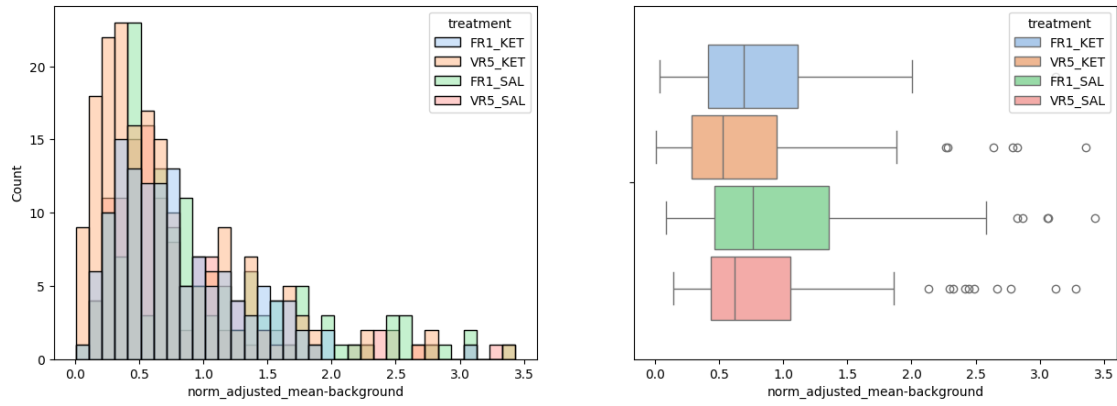
WFA_coloc_w_PV

WFA_coloc_w_PV
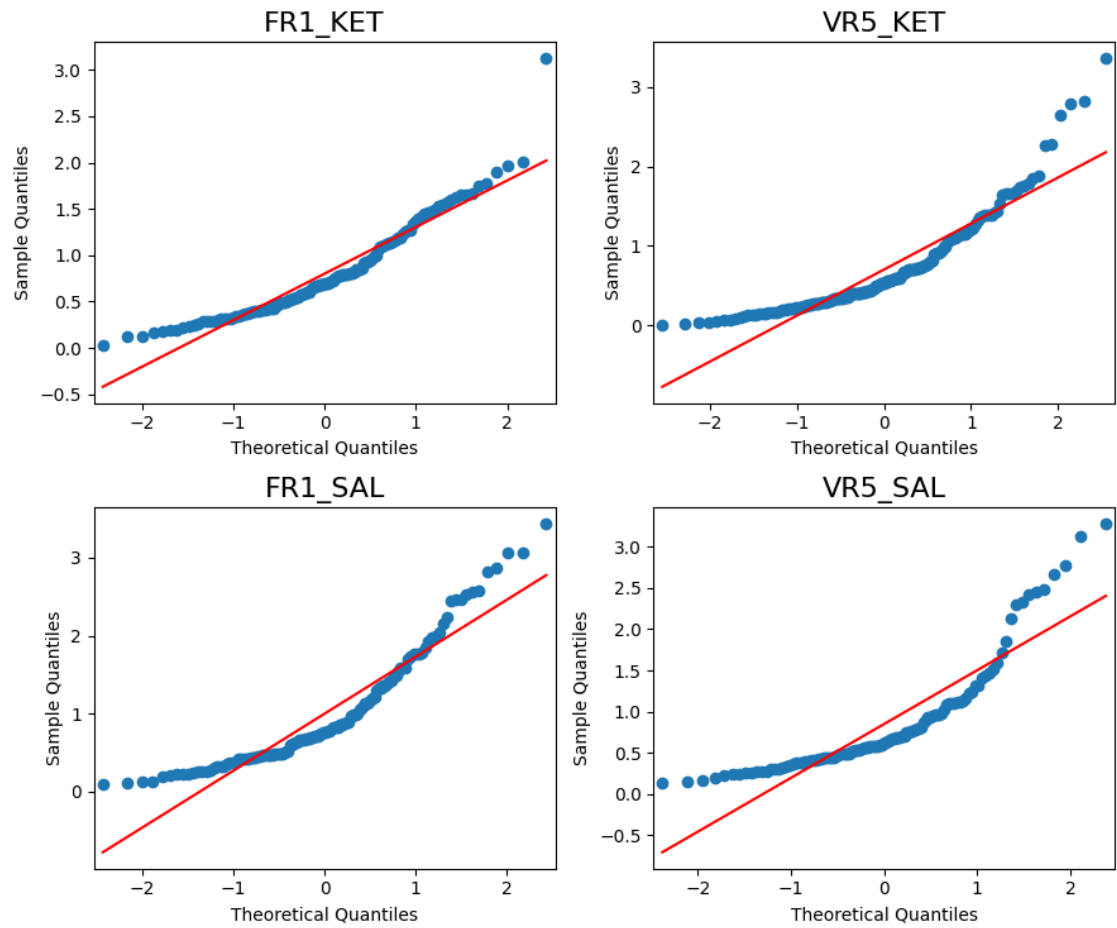
WFA_coloc_w_cFos
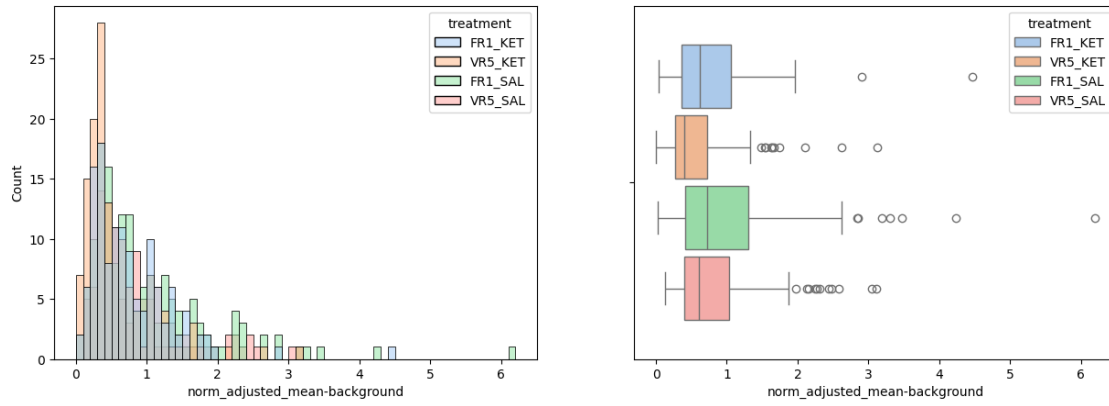
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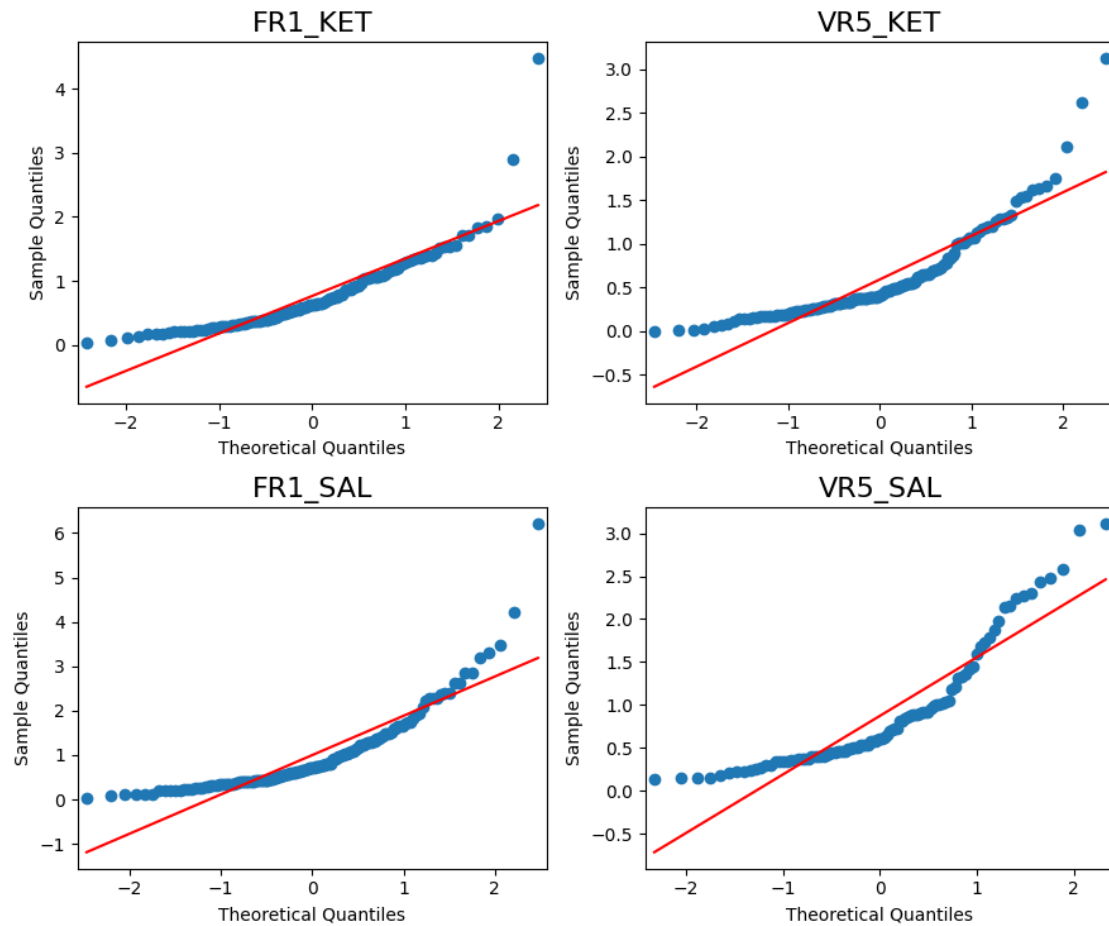
cFos_coloc_w_Npas4,PV
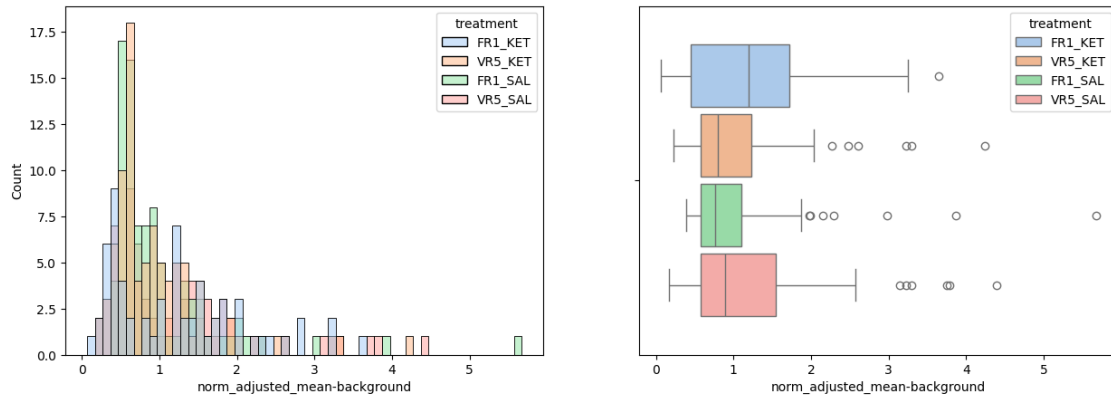
cFos_coloc_w_Npas4,PV
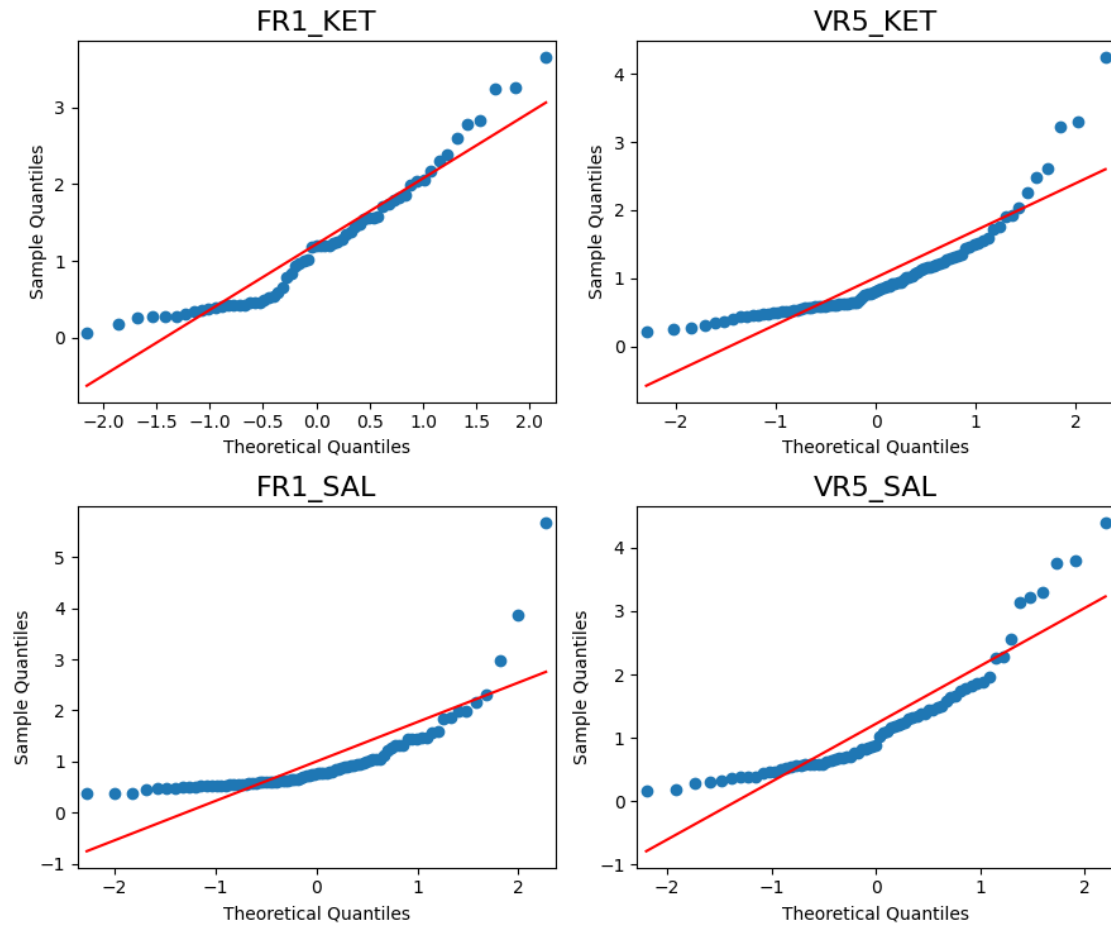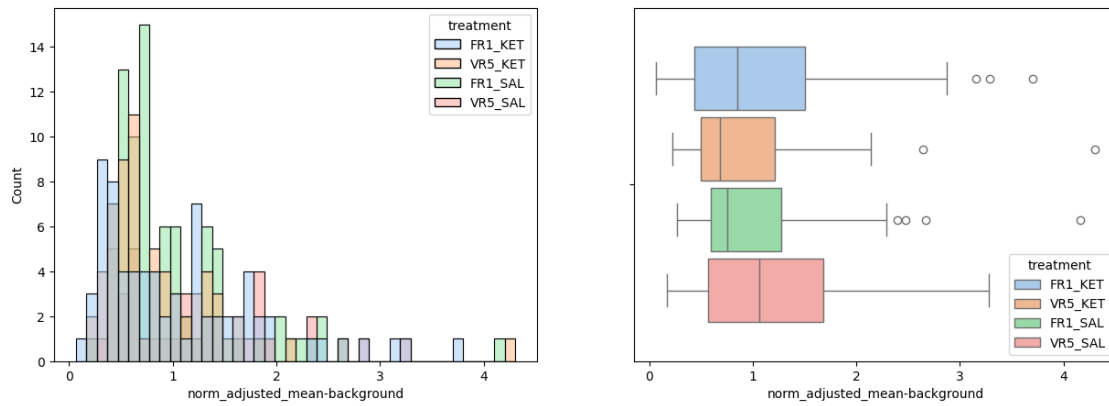
cFos_coloc_w_Npas4,WFA

cFos_coloc_w_Npas4,WFA

FR1_KET

VR5_KET

FR1_SAL

VR5_SAL
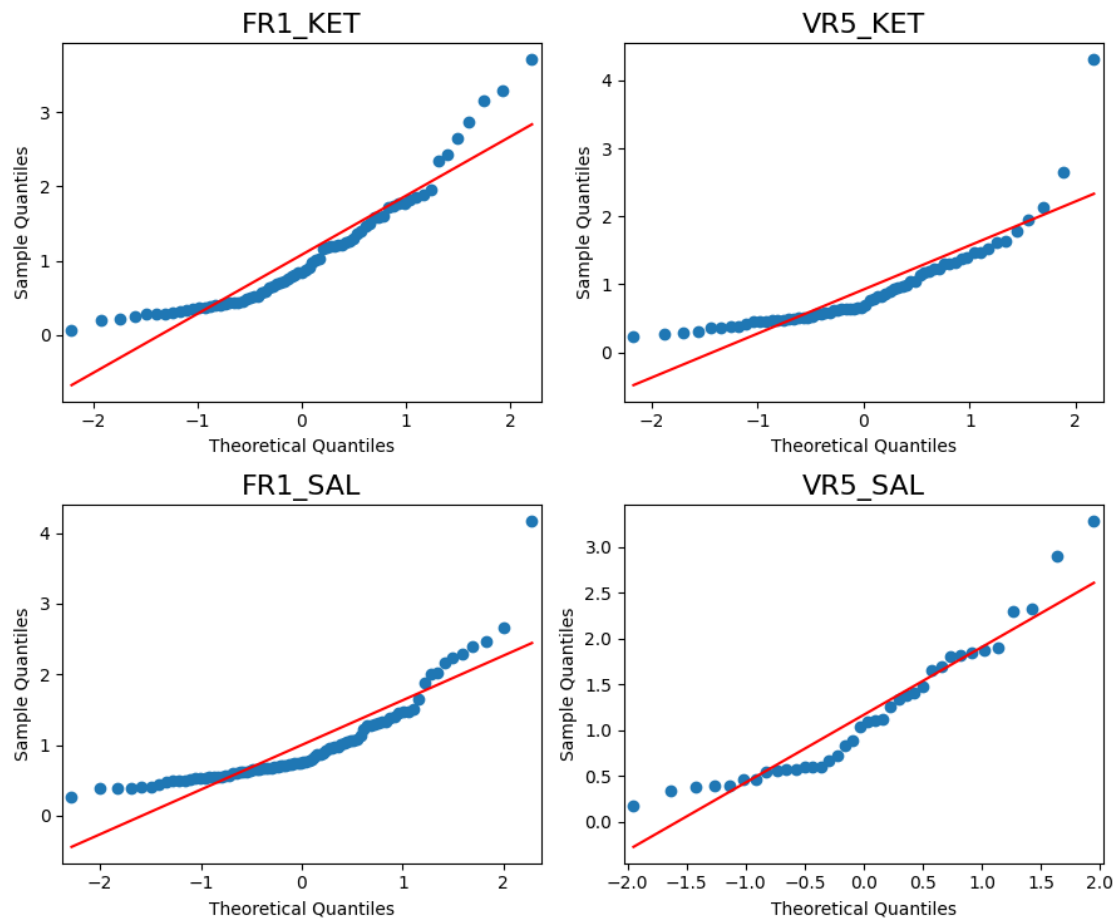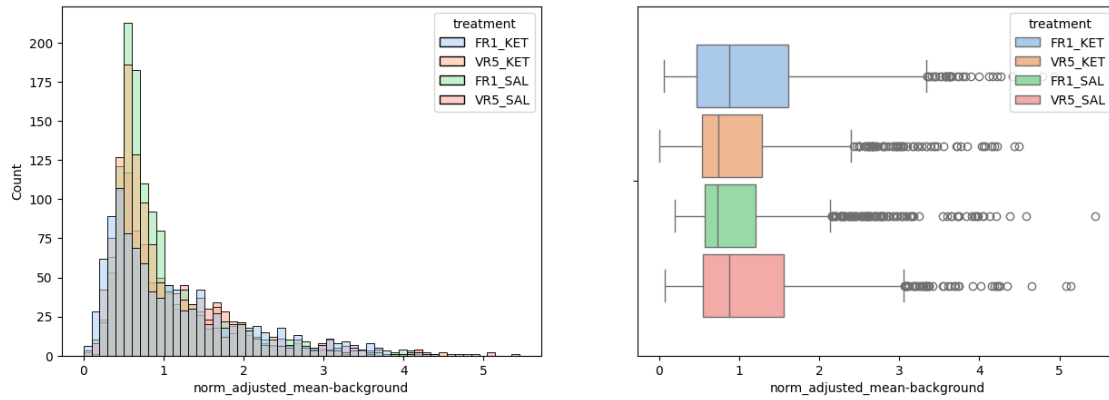
cFos_coloc_w_Npas4
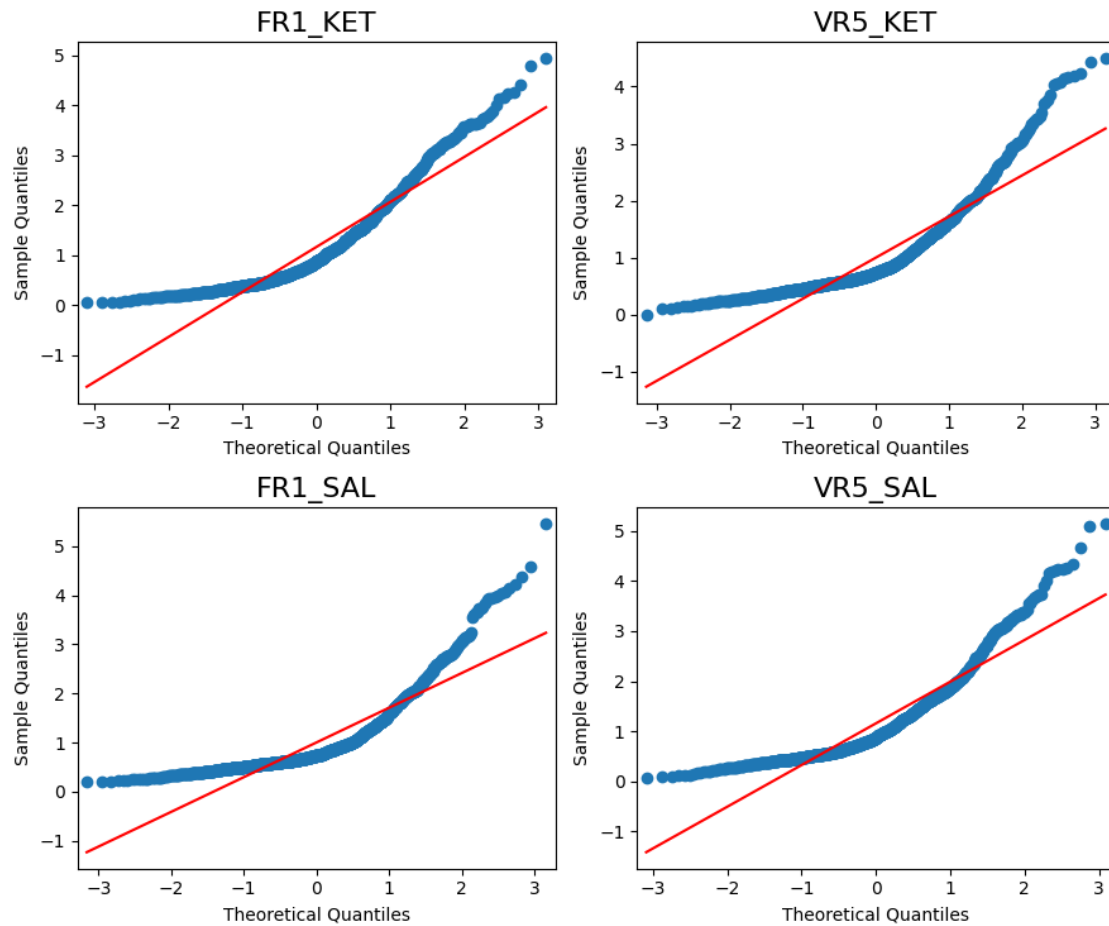
cFos_coloc_w_Npas4

cFos_coloc_w_PV,WFA
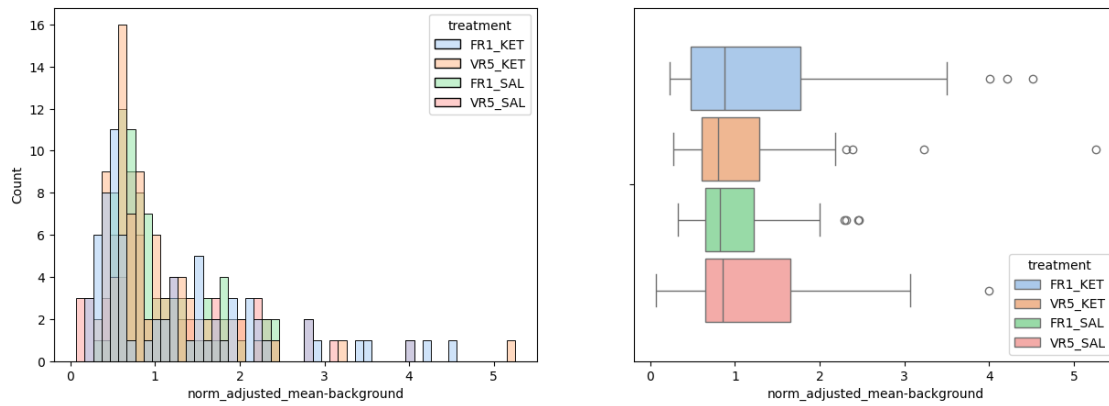
cFos_coloc_w_PV,WFA
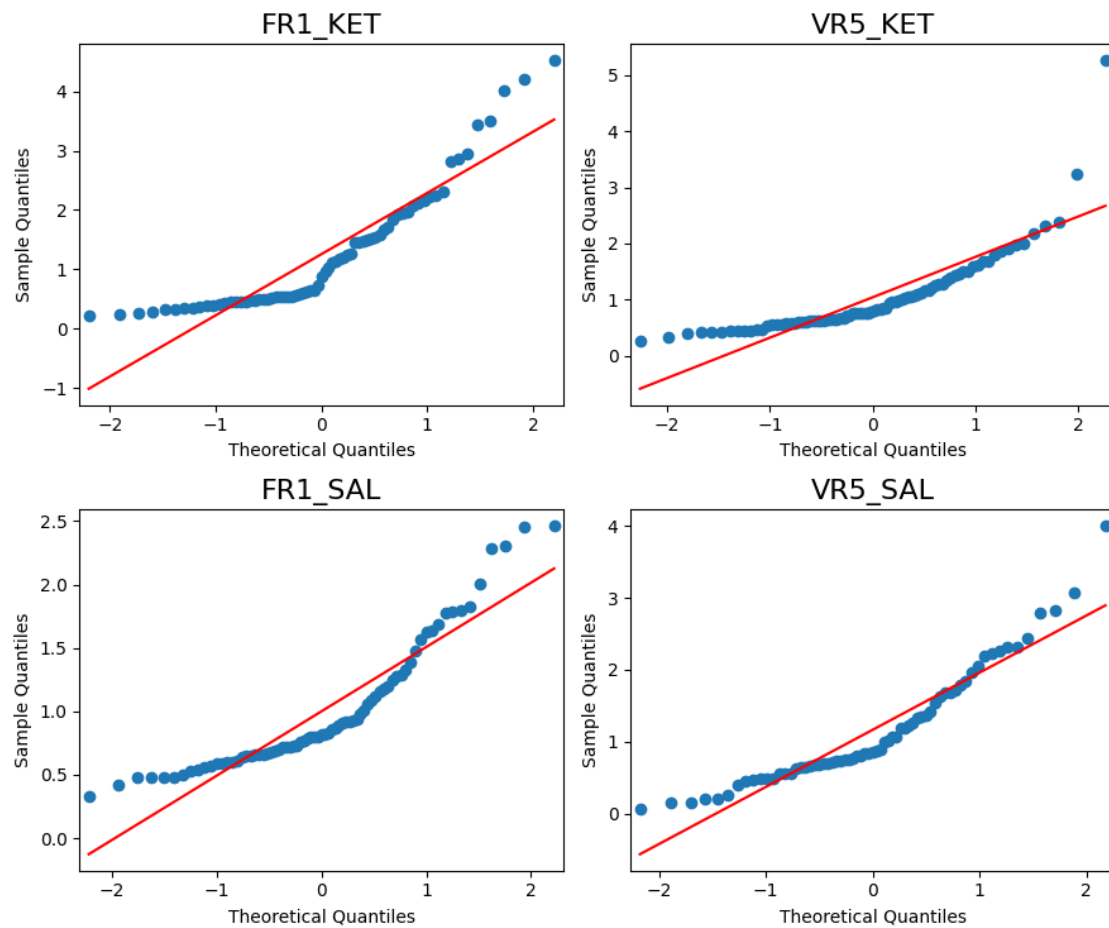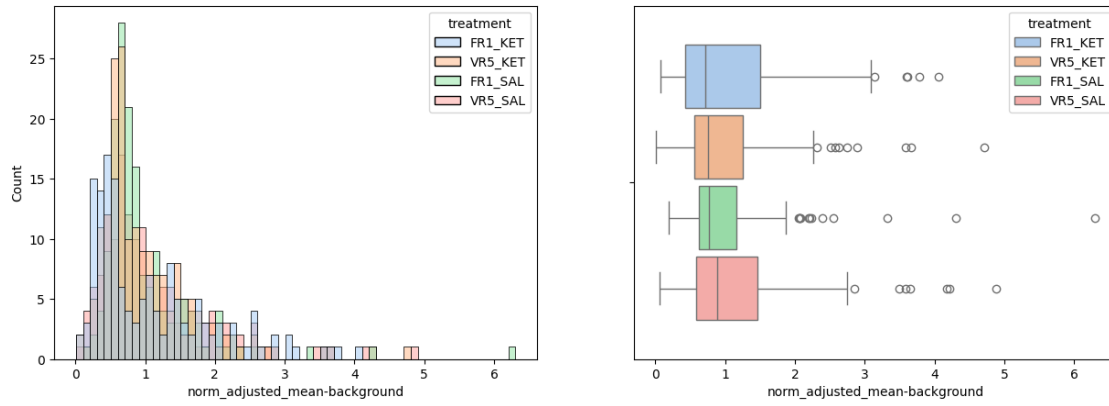
cFos_coloc_w_PV

cFos_coloc_w_PV

FR1_KET

VR5_KET

FR1_SAL

VR5_SAL
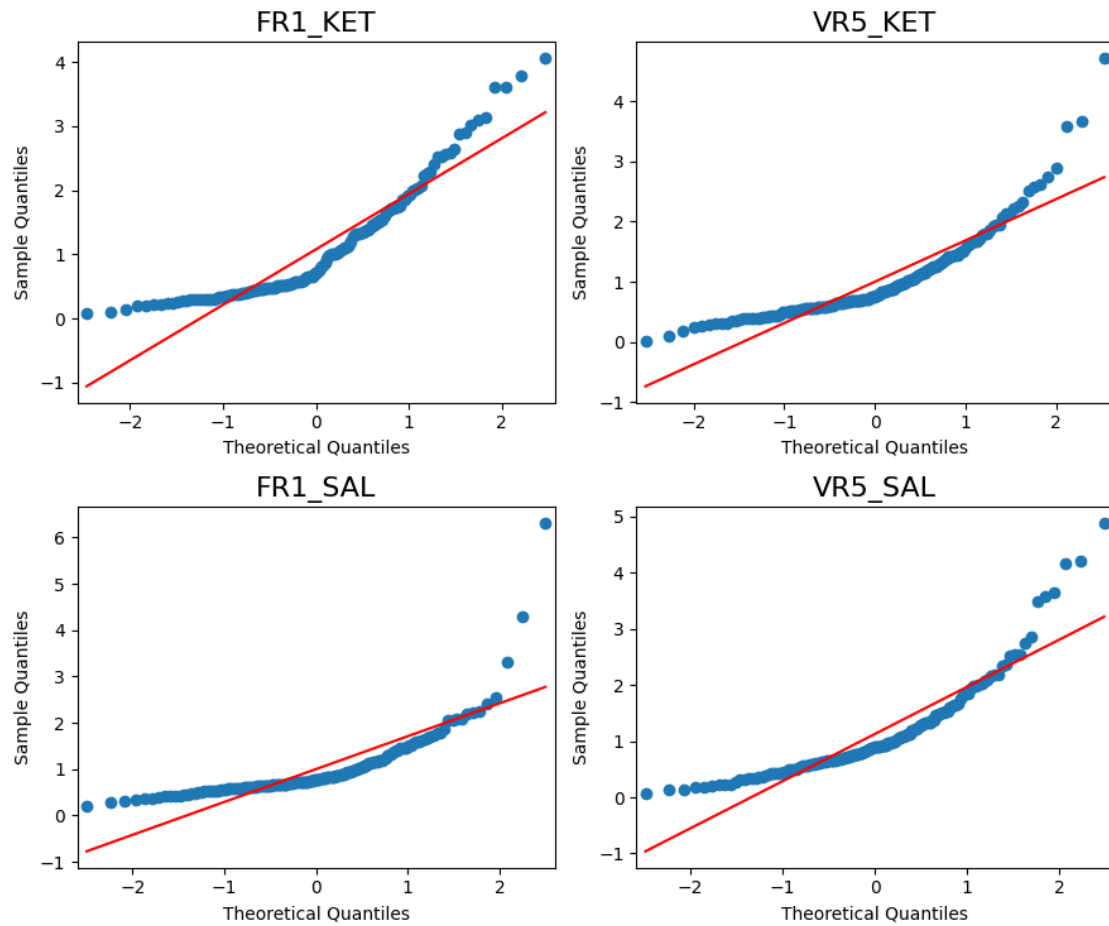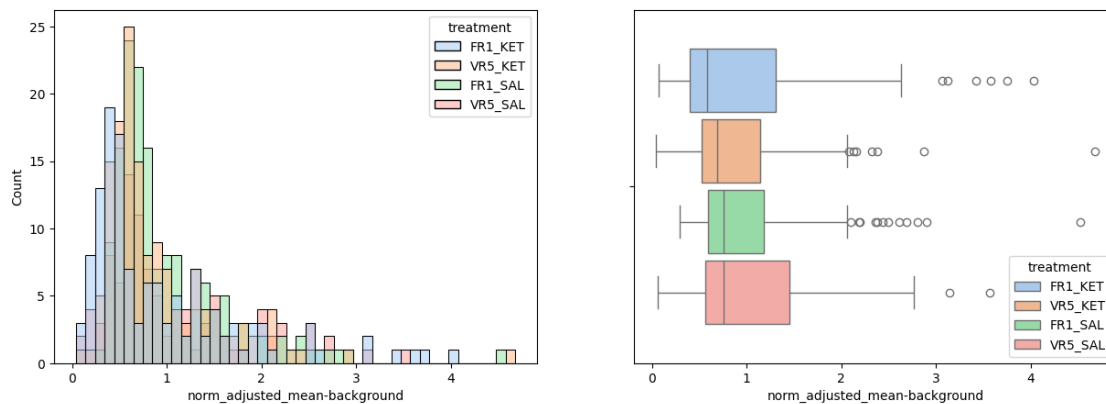
cFos_coloc_w_WFA
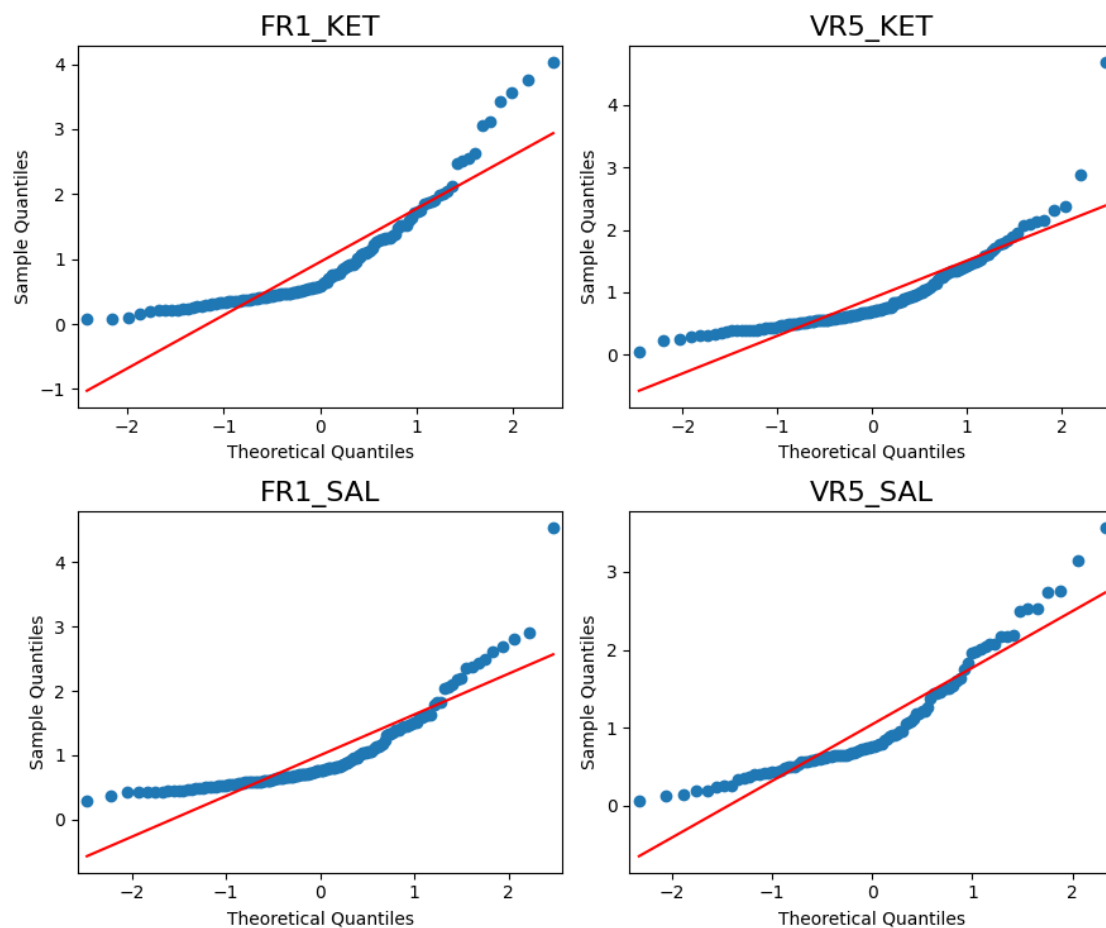
quad_Npas4
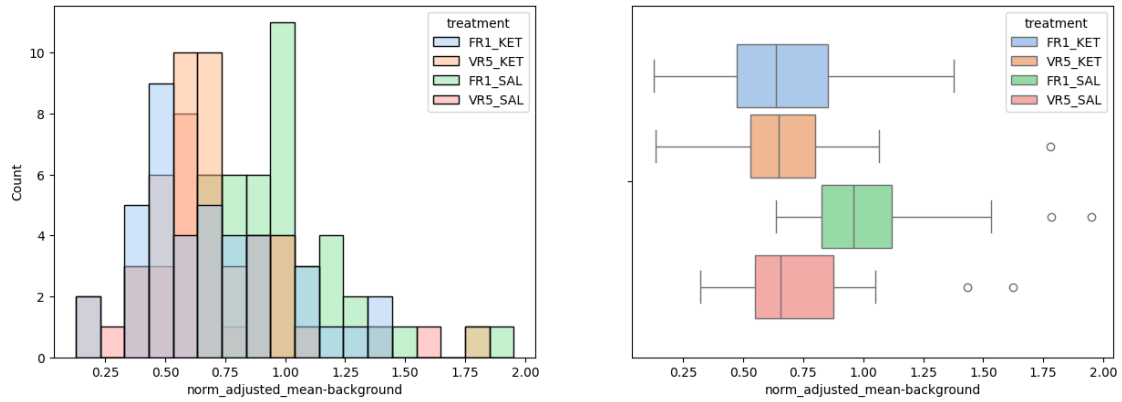
quad_Npas4
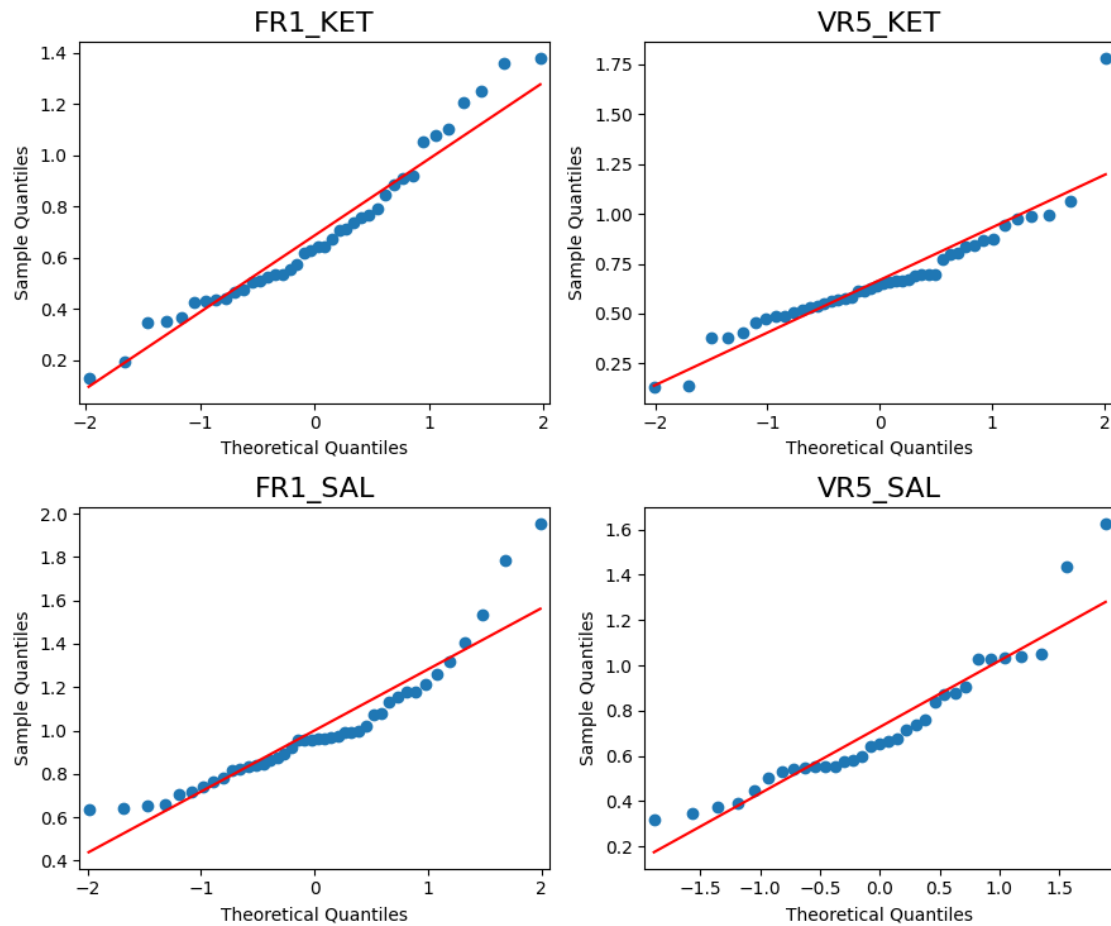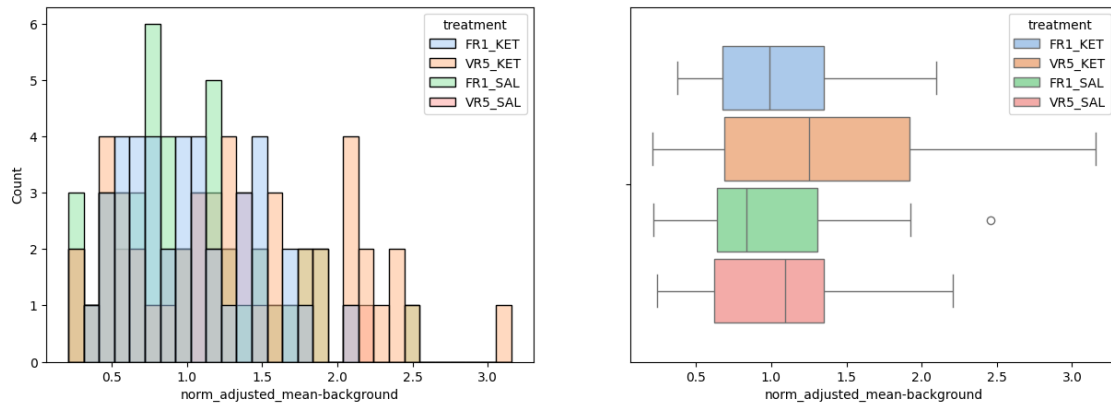
quad_PV
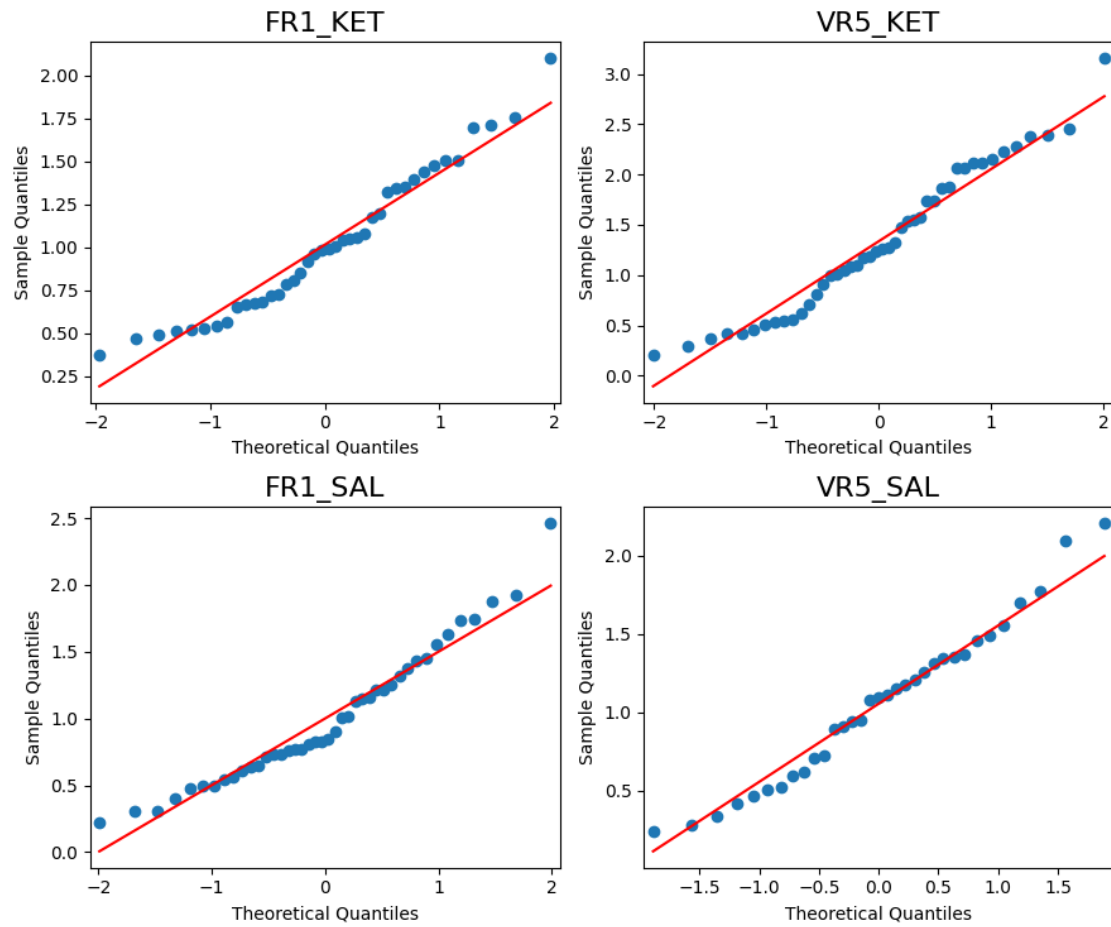
quad_WFA
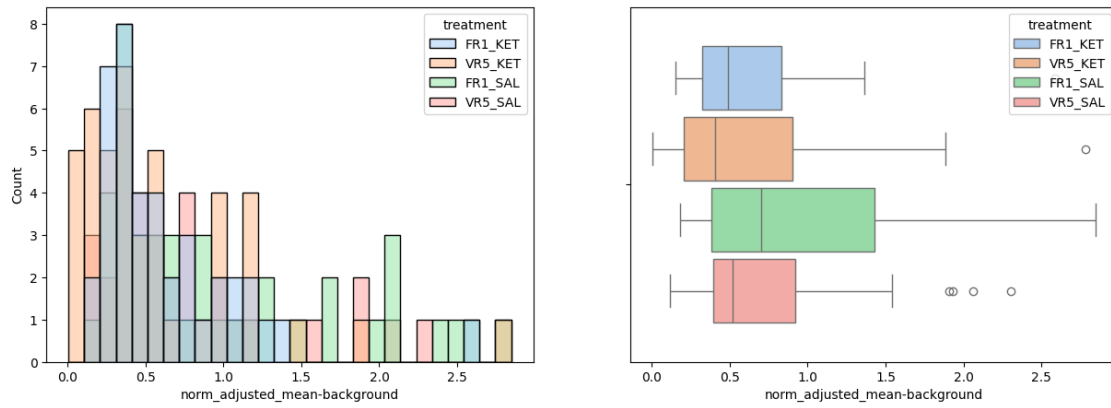
quad_WFA
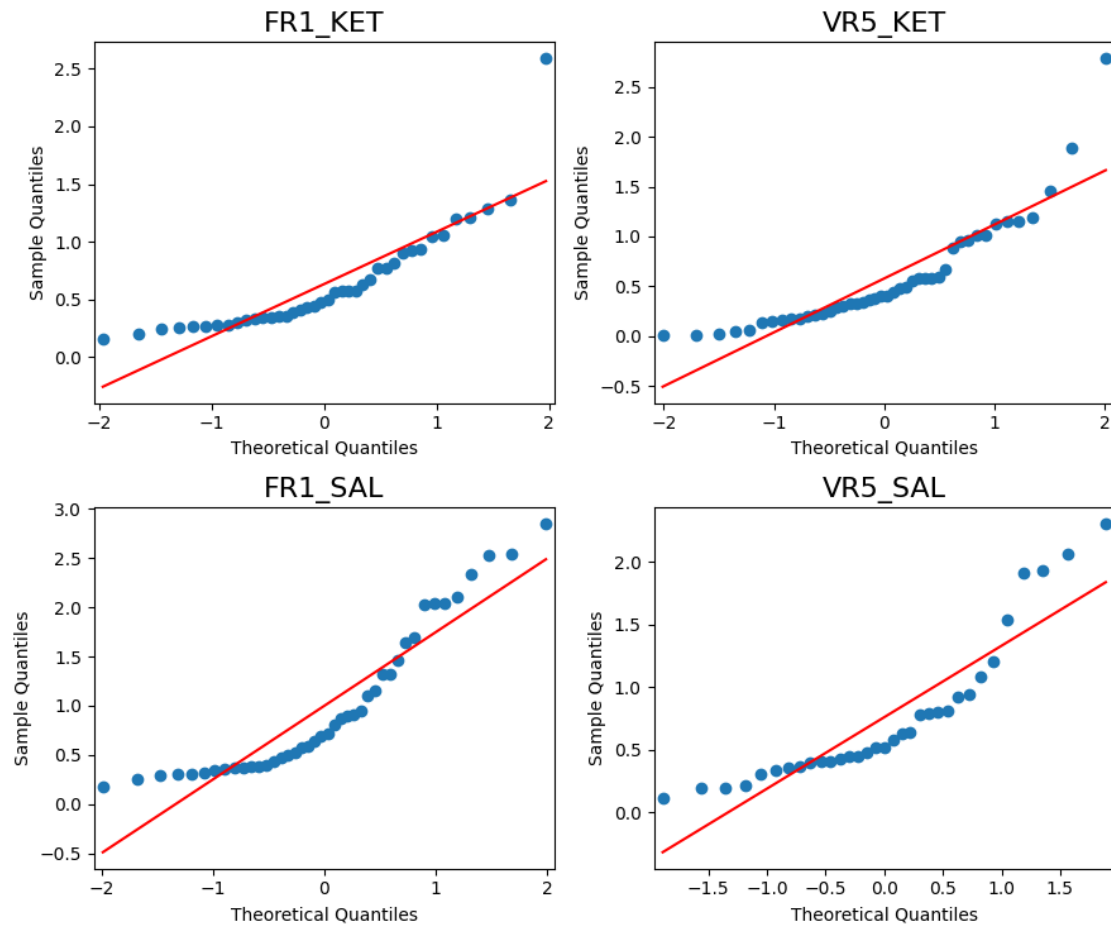
quad_cFos
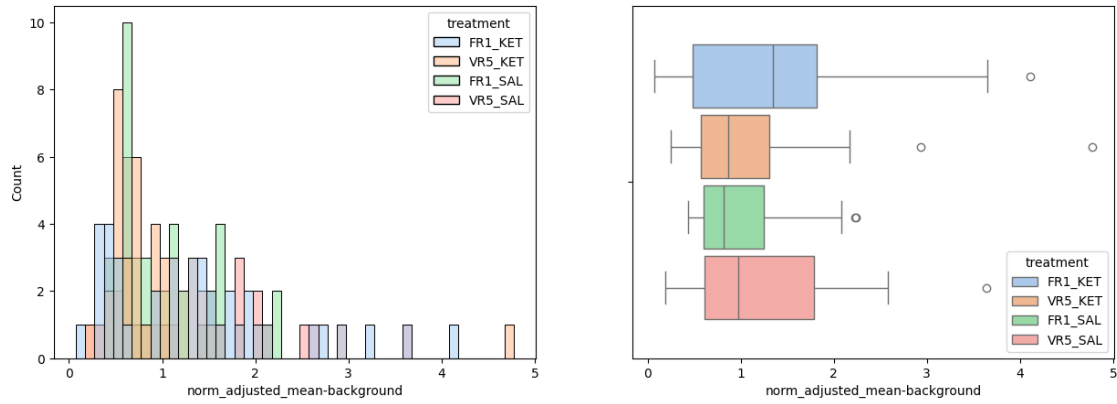
quad_cFos
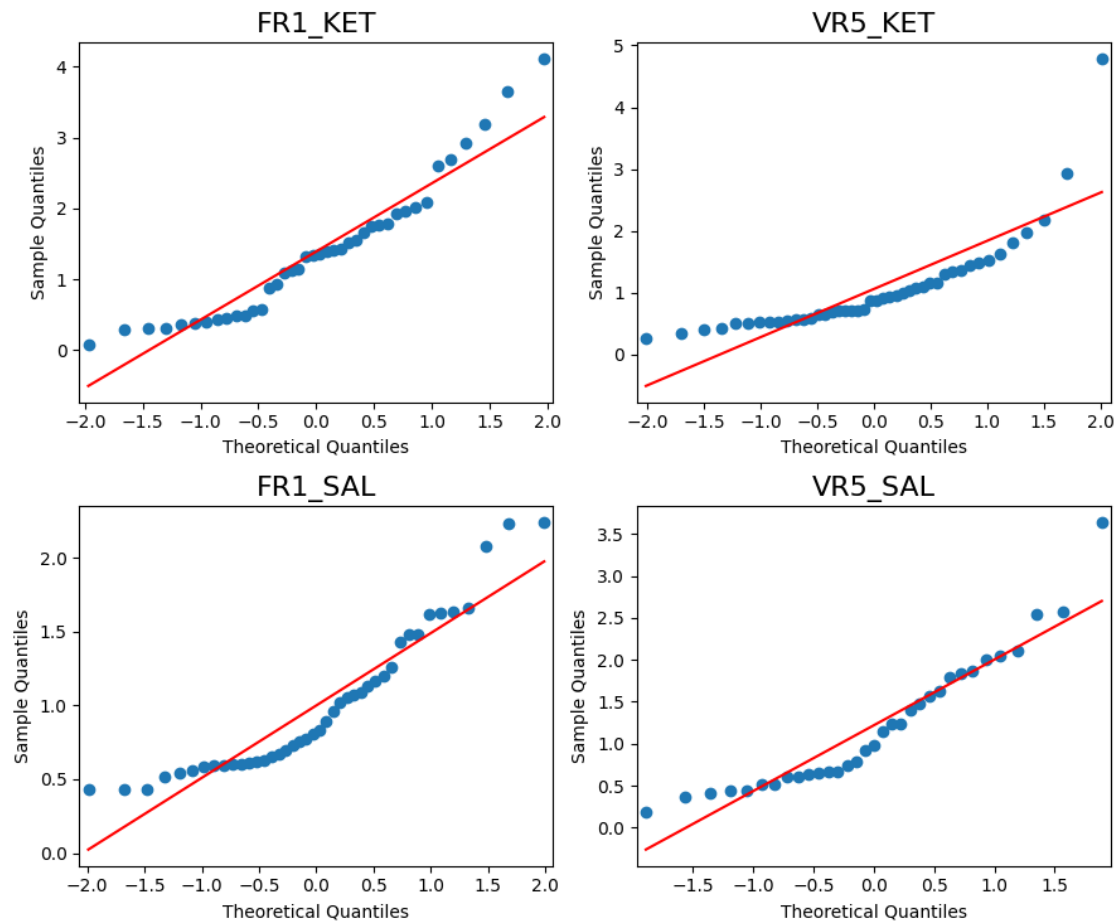
3 Check Normality

I think, probably, all of these will fail the Shapiro-Wilk test

```
[5]: def shapiro_bytreatment(df):
         print(f'\n\n===== {df.coloc_stain_type.unique().item()} =====')
         for tx in df.treatment.unique():
             print(f'\n--- {tx} --- ')
             print(shapiro(df[df.treatment == tx]['norm_adjusted_mean-background']))
             print(df[df.treatment == tx]['norm_adjusted_mean-background'].
      ↪describe())

     for df in dfs:
         shapiro_bytreatment(df)
```

```
===== Npas4_coloc_w_PV,WFA =====

--- FR1_KET ---
ShapiroResult(statistic=0.9654971361160278, pvalue=0.07437312602996826)
count    63.000000
mean      0.739800
std       0.299023
min       0.135969
25%       0.504967
50%       0.686945
75%       0.956265
max       1.469017
Name: norm_adjusted_mean-background, dtype: float64

--- VR5_KET ---
ShapiroResult(statistic=0.9430275559425354, pvalue=0.0022859987802803516)
count    74.000000
mean      0.651413
std       0.289064
min       0.115312
25%       0.483723
50%       0.634977
75%       0.820519
max       1.898053
Name: norm_adjusted_mean-background, dtype: float64

--- FR1_SAL ---
ShapiroResult(statistic=0.9200804829597473, pvalue=0.0001947178243426606)
count    73.000000
mean      1.000000
std       0.291874
```

```
min        0.525330
25%        0.787819
50%        0.934279
75%        1.142330
max        2.082143
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.8137882947921753, pvalue=2.235083229606971e-06)
count    49.000000
mean      0.804205
std       0.395738
min       0.341253
25%       0.548132
50%       0.707031
75%       0.967081
max       2.581204
Name: norm_adjusted_mean-background, dtype: float64



===== Npas4_coloc_w_PV,cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.9518912434577942, pvalue=0.015289162285625935)
count    63.000000
mean      0.579596
std       0.222751
min       0.110492
25%       0.439471
50%       0.556091
75%       0.678308
max       1.193761
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.73887699842453, pvalue=2.0035981554422655e-11)
count    91.000000
mean      0.666863
std       0.351018
min       0.115728
25%       0.476589
50%       0.603575
75%       0.777312
max       2.461798
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.6758450865745544, pvalue=1.7503570207827446e-12)
```

```
count     86.000000
mean       1.000000
std        0.553117
min        0.372103
25%        0.716380
50%        0.843954
75%        1.107809
max        4.640051
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.7240134477615356, pvalue=3.0155439256773775e-10)
count     71.000000
mean       0.838188
std        0.566680
min        0.277311
25%        0.481128
50%        0.725884
75%        0.902512
max        3.601472
Name: norm_adjusted_mean-background, dtype: float64




===== Npas4_coloc_w_PV =====

--- FR1_KET ---
ShapiroResult(statistic=0.9648599028587341, pvalue=0.002215959597378969)
count     127.000000
mean        0.622419
std         0.233098
min         0.117474
25%         0.448675
50%         0.591025
75%         0.749134
max         1.351069
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.8137047290802002, pvalue=3.4587016952726535e-13)
count     164.000000
mean        0.627991
std         0.334964
min         0.024517
25%         0.442884
50%         0.611036
75%         0.772246
max         2.617350
Name: norm_adjusted_mean-background, dtype: float64
```

```
--- FR1_SAL ---
ShapiroResult(statistic=0.7212589979171753, pvalue=5.723016224606307e-16)
count    158.000000
mean       1.000000
std        0.494938
min        0.278811
25%        0.732874
50%        0.883522
75%        1.119866
max        4.933239
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.6860493421554565, pvalue=9.823952708517603e-16)
count    137.000000
mean       0.863381
std        0.621977
min        0.029627
25%        0.522906
50%        0.700045
75%        0.953828
max        4.835964
Name: norm_adjusted_mean-background, dtype: float64



===== Npas4_coloc_w_WFA,cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.9568105936050415, pvalue=0.01370486430823803)
count     73.000000
mean       0.755483
std        0.339175
min        0.134129
25%        0.498729
50%        0.713913
75%        0.959598
max        1.933134
Name: norm_adjusted_mean-background, dtype: float64

--- VR5_KET ---
ShapiroResult(statistic=0.9098366498947144, pvalue=0.00015251111472025514)
count     66.000000
mean       0.700942
std        0.277320
min        0.140485
25%        0.545532
50%        0.652424
```

```
75%        0.834607
max        1.872366
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9233691692352295, pvalue=6.411760114133358e-05)
count    88.000000
mean      1.000000
std       0.269698
min       0.183413
25%       0.866727
50%       0.965554
75%       1.085483
max       2.053964
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9329199194908142, pvalue=0.024815203621983528)
count    38.000000
mean      0.798979
std       0.305518
min       0.336635
25%       0.581075
50%       0.730407
75%       1.027915
max       1.708870
Name: norm_adjusted_mean-background, dtype: float64



===== Npas4_coloc_w_WFA =====

--- FR1_KET ---
ShapiroResult(statistic=0.9552238583564758, pvalue=0.0010526345577090979)
count    109.000000
mean       0.750519
std        0.311636
min        0.140116
25%        0.519745
50%        0.707895
75%        0.923342
max        2.019419
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.9559152722358704, pvalue=0.0005675225402228534)
count    121.000000
mean       0.688249
std        0.295536
```

```
min          0.000000
25%          0.514607
50%          0.676571
75%          0.861506
max          1.955939
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9480761885643005, pvalue=9.216777834808454e-05)
count    128.000000
mean       1.000000
std        0.276728
min        0.283453
25%        0.838978
50%        0.964927
75%        1.098576
max        2.145643
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.840989351272583, pvalue=1.4483578070212388e-07)
count     76.000000
mean       0.824699
std        0.370791
min        0.351660
25%        0.578211
50%        0.735470
75%        1.013950
max        2.659924
Name: norm_adjusted_mean-background, dtype: float64



===== Npas4_coloc_w_cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.7505794167518616, pvalue=5.353846651181272e-37)
count    1047.000000
mean        0.825369
std         0.516688
min         0.130537
25%         0.511048
50%         0.688790
75%         0.940204
max         4.354241
Name: norm_adjusted_mean-background, dtype: float64

--- VR5_KET ---
ShapiroResult(statistic=0.8270268440246582, pvalue=5.042312864388454e-34)
```

```
count     1193.000000
mean         0.799144
std          0.408603
min          0.093317
25%          0.542009
50%          0.738897
75%          0.939676
max          3.183538
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.7464034557342529, pvalue=2.445335885170022e-40)
count     1275.000000
mean         1.000000
std          0.428793
min          0.168266
25%          0.784590
50%          0.934823
75%          1.100981
max          5.481836
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.7433080077171326, pvalue=1.4984887591201143e-36)
count      991.000000
mean         0.925018
std          0.564306
min          0.036809
25%          0.599428
50%          0.791630
75%          1.044606
max          5.373743
Name: norm_adjusted_mean-background, dtype: float64



===== PV_coloc_w_Npas4,WFA =====

--- FR1_KET ---
ShapiroResult(statistic=0.9457880258560181, pvalue=0.0077455900609493256)
count       63.000000
mean         1.031599
std          0.452319
min          0.362028
25%          0.692072
50%          0.939445
75%          1.395131
max          2.196279
Name: norm_adjusted_mean-background, dtype: float64
```

```
--- VR5_KET ---
ShapiroResult(statistic=0.9573706984519958, pvalue=0.013795641250908375)
count    74.000000
mean      1.207933
std       0.649666
min       0.197177
25%       0.659921
50%       1.171721
75%       1.601584
max       3.301311
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9469823837280273, pvalue=0.003994235768914223)
count    73.000000
mean      1.000000
std       0.504635
min       0.241124
25%       0.601429
50%       0.863914
75%       1.272179
max       2.573901
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.983601987361908, pvalue=0.7214993834495544)
count    49.000000
mean      1.217318
std       0.569699
min       0.000000
25%       0.817553
50%       1.233001
75%       1.507978
max       2.820401
Name: norm_adjusted_mean-background, dtype: float64



===== PV_coloc_w_Npas4,cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.9580516815185547, pvalue=0.030997537076473236)
count    63.000000
mean      1.179136
std       0.562164
min       0.336905
25%       0.724635
50%       1.076030
```

```
75%        1.531458
max        2.649828
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.9032617807388306, pvalue=5.111252448841697e-06)
count    91.000000
mean      1.287939
std       0.959422
min       0.122123
25%       0.328074
50%       1.145575
75%       1.949554
max       3.983058
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9064953327178955, pvalue=1.216263171954779e-05)
count    86.000000
mean      1.000000
std       0.634086
min       0.275212
25%       0.425866
50%       0.888229
75%       1.406840
max       3.105432
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9267542362213135, pvalue=0.00047899369383230805)
count    71.000000
mean      1.113022
std       0.800578
min       0.113412
25%       0.358733
50%       1.116642
75%       1.662619
max       3.699731
Name: norm_adjusted_mean-background, dtype: float64



===== PV_coloc_w_Npas4 =====

--- FR1_KET ---
ShapiroResult(statistic=0.9258815050125122, pvalue=3.0512285320583032e-06)
count    127.000000
mean       1.178730
std        0.657520
```

```
min          0.198827
25%          0.660575
50%          1.065274
75%          1.537805
max          4.062707
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.9258753657341003, pvalue=1.8669216217404028e-07)
count    164.000000
mean       1.293507
std        0.880772
min        0.229067
25%        0.503040
50%        1.098489
75%        1.879129
max        4.112885
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9047608375549316, pvalue=1.2803632820634903e-08)
count    158.000000
mean       1.000000
std        0.628893
min        0.284182
25%        0.489156
50%        0.855137
75%        1.392889
max        3.206653
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.928381085395813, pvalue=2.022544094870682e-06)
count    137.000000
mean       1.096113
std        0.799347
min        0.000000
25%        0.340797
50%        1.077929
75%        1.636014
max        3.513751
Name: norm_adjusted_mean-background, dtype: float64



===== PV_coloc_w_WFA,cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.9731106162071228, pvalue=0.13100306689739227)
```

```
count    71.000000
mean      0.999797
std       0.428496
min       0.242210
25%       0.685429
50%       0.945174
75%       1.274404
max       2.207481
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.9662333726882935, pvalue=0.02649570070207119)
count    84.000000
mean      1.331590
std       0.712865
min       0.222890
25%       0.791134
50%       1.212052
75%       1.845136
max       3.318150
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9485256671905518, pvalue=0.004142317920923233)
count    75.000000
mean      1.000000
std       0.512708
min       0.229270
25%       0.622383
50%       0.860017
75%       1.321665
max       2.587029
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9450562000274658, pvalue=0.005143319256603718)
count    67.000000
mean      1.171364
std       0.613070
min       0.252757
25%       0.638068
50%       1.222697
75%       1.433030
max       3.178542
Name: norm_adjusted_mean-background, dtype: float64



===== PV_coloc_w_WFA =====
```

```
--- FR1_KET ---
ShapiroResult(statistic=0.9619185328483582, pvalue=0.0009988468373194337)
count    131.000000
mean       1.047894
std        0.479949
min        0.265955
25%        0.689273
50%        0.977884
75%        1.367111
max        2.423896
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.9501721858978271, pvalue=4.980784069630317e-06)
count    183.000000
mean       1.243162
std        0.702435
min        0.217612
25%        0.690231
50%        1.170668
75%        1.687133
max        3.643450
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9376064538955688, pvalue=1.146130762208486e-05)
count    133.000000
mean       1.000000
std        0.518321
min        0.251746
25%        0.605059
50%        0.913269
75%        1.305396
max        2.840653
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9524484276771545, pvalue=0.000451576808700338)
count    115.000000
mean       1.191130
std        0.644418
min        0.000000
25%        0.699474
50%        1.087688
75%        1.557001
max        3.490156
Name: norm_adjusted_mean-background, dtype: float64
```

```
===== PV_coloc_w_cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.9020664095878601, pvalue=2.435457169269739e-08)
count    146.000000
mean       1.104358
std        0.621915
min        0.286603
25%        0.670589
50%        0.998278
75%        1.417973
max        3.878415
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.9219920039176941, pvalue=4.2391491206217324e-08)
count    176.000000
mean       1.230565
std        0.863053
min        0.120383
25%        0.437394
50%        1.045719
75%        1.840700
max        3.926317
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9231774210929871, pvalue=1.6234517374869029e-07)
count    160.000000
mean       1.000000
std        0.583894
min        0.271291
25%        0.560186
50%        0.872158
75%        1.365584
max        3.061193
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9419389367103577, pvalue=6.5114841163449455e-06)
count    152.000000
mean       1.187191
std        0.775004
min        0.102493
25%        0.492308
50%        1.107169
```

```
75%         1.677160
max         3.761121
Name: norm_adjusted_mean-background, dtype: float64


===== WFA_coloc_w_Npas4,PV =====

--- FR1_KET ---
ShapiroResult(statistic=0.8313855528831482, pvalue=5.484154712576128e-07)
count     63.000000
mean       0.694267
std        0.466370
min        0.107692
25%        0.371598
50%        0.595493
75%        0.818894
max        2.780485
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.8369541168212891, pvalue=1.4525976155255194e-07)
count     74.000000
mean       0.646168
std        0.578693
min        0.006737
25%        0.260711
50%        0.449937
75%        0.990963
max        2.991838
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.8728464841842651, pvalue=2.5650911084085237e-06)
count     73.000000
mean       1.000000
std        0.743463
min        0.098530
25%        0.427524
50%        0.688668
75%        1.417459
max        3.056577
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.804037868976593, pvalue=1.32040327116556e-06)
count     49.000000
mean       0.785047
std        0.594314
```

```
min         0.125607
25%         0.424668
50%         0.605692
75%         0.914735
max         2.471912
Name: norm_adjusted_mean-background, dtype: float64


===== WFA_coloc_w_Npas4,cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.7002906799316406, pvalue=6.44767988999817e-11)
count    73.000000
mean      0.682592
std       0.604791
min       0.075199
25%       0.317998
50%       0.550814
75%       0.848582
max       4.181726
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.8256121277809143, pvalue=2.3192419007500575e-07)
count    66.000000
mean      0.603458
std       0.552434
min       0.000000
25%       0.245384
50%       0.388747
75%       0.870489
max       2.916734
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.7810260057449341, pvalue=4.057880975683048e-10)
count    88.000000
mean      1.000000
std       0.974618
min       0.022544
25%       0.375272
50%       0.634900
75%       1.315297
max       5.798660
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.8078368306159973, pvalue=1.5156281733652577e-05)
```

```
count     38.000000
mean       0.830293
std        0.669374
min        0.122454
25%        0.416816
50%        0.577461
75%        0.946013
max        2.904738
Name: norm_adjusted_mean-background, dtype: float64


===== WFA_coloc_w_Npas4 =====

--- FR1_KET ---
ShapiroResult(statistic=0.7858425378799438, pvalue=2.634242476928783e-11)
count    109.000000
mean       0.755775
std        0.608712
min        0.040060
25%        0.355758
50%        0.612798
75%        1.010710
max        4.374511
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.8349509239196777, pvalue=2.588141090331675e-10)
count    121.000000
mean       0.651941
std        0.580523
min        0.000000
25%        0.256123
50%        0.444742
75%        0.972230
max        3.051200
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.7909576892852783, pvalue=3.1942556238950814e-12)
count    128.000000
mean       1.000000
std        0.904414
min        0.023583
25%        0.408675
50%        0.677366
75%        1.355466
max        6.065987
Name: norm_adjusted_mean-background, dtype: float64
```

```
--- VR5_SAL ---
ShapiroResult(statistic=0.8231213092803955, pvalue=4.0991608329932205e-08)
count    76.000000
mean      0.783794
std       0.606528
min       0.128099
25%       0.395772
50%       0.597255
75%       0.979189
max       3.038651
Name: norm_adjusted_mean-background, dtype: float64


===== WFA_coloc_w_PV,cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.882461428642273, pvalue=7.391656254185364e-06)
count    71.000000
mean      0.736246
std       0.501320
min       0.033677
25%       0.371846
50%       0.648339
75%       1.055149
max       2.989040
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.824185848236084, pvalue=1.3481884053589965e-08)
count    84.000000
mean      0.633523
std       0.536807
min       0.007242
25%       0.310481
50%       0.484426
75%       0.788478
max       3.216246
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.8444189429283142, pvalue=2.1520955328924174e-07)
count    75.000000
mean      1.000000
std       0.759095
min       0.105920
25%       0.444722
50%       0.715847
```

```
75%          1.341578
max          3.285842
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.8167970180511475, pvalue=1.1191934135013071e-07)
count    67.000000
mean      0.891865
std       0.696580
min       0.135029
25%       0.421330
50%       0.602047
75%       1.059737
max       3.137117
Name: norm_adjusted_mean-background, dtype: float64



===== WFA_coloc_w_PV =====

--- FR1_KET ---
ShapiroResult(statistic=0.9121458530426025, pvalue=3.3092749163188273e-07)
count   131.000000
mean      0.802185
std       0.504236
min       0.035181
25%       0.414223
50%       0.692618
75%       1.113937
max       3.122563
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.8473669290542603, pvalue=1.4537925984575706e-12)
count   183.000000
mean      0.700576
std       0.581788
min       0.007566
25%       0.289063
50%       0.530011
75%       0.949564
max       3.359918
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.8781093955039978, pvalue=4.653175622593153e-09)
count   133.000000
mean      1.000000
std       0.732772
```

```
min          0.087163
25%          0.465824
50%          0.765343
75%          1.356871
max          3.432623
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.7961717844009399, pvalue=2.474674111463404e-11)
count    115.000000
mean       0.848640
std        0.656220
min        0.141060
25%        0.433442
50%        0.619947
75%        1.058371
max        3.277255
Name: norm_adjusted_mean-background, dtype: float64



===== WFA_coloc_w_cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.8045763373374939, pvalue=9.132832511082878e-12)
count    128.000000
mean       0.764417
std        0.588346
min        0.032674
25%        0.362310
50%        0.625650
75%        1.053510
max        4.473899
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.8156591653823853, pvalue=3.954728471783353e-12)
count    143.000000
mean       0.591942
std        0.501211
min        0.000000
25%        0.267164
50%        0.405727
75%        0.729076
max        3.120523
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.792470395565033, pvalue=2.941441578155346e-13)
```

```
count     149.000000
mean        1.000000
std         0.886708
min         0.024119
25%         0.409244
50%         0.718289
75%         1.310263
max         6.203805
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.8304490447044373, pvalue=2.7316182649173015e-09)
count      99.000000
mean        0.873378
std         0.686277
min         0.131010
25%         0.400209
50%         0.601320
75%         1.028197
max         3.107689
Name: norm_adjusted_mean-background, dtype: float64



===== cFos_coloc_w_Npas4,PV =====

--- FR1_KET ---
ShapiroResult(statistic=0.9167803525924683, pvalue=0.0004083287203684449)
count      63.000000
mean        1.218516
std         0.863105
min         0.064790
25%         0.444902
50%         1.194758
75%         1.724960
max         3.648492
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.7955842018127441, pvalue=6.660075269060428e-10)
count      91.000000
mean        1.010083
std         0.696869
min         0.222185
25%         0.574556
50%         0.804461
75%         1.231393
max         4.242297
Name: norm_adjusted_mean-background, dtype: float64
```

```
--- FR1_SAL ---
ShapiroResult(statistic=0.6411203145980835, pvalue=3.4886037201392606e-13)
count    86.000000
mean      1.000000
std       0.777458
min       0.384267
25%       0.575963
50%       0.758301
75%       1.102695
max       5.672581
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.8410918712615967, pvalue=3.047219934160239e-07)
count    71.000000
mean      1.221699
std       0.919861
min       0.169246
25%       0.581595
50%       0.889068
75%       1.547030
max       4.390841
Name: norm_adjusted_mean-background, dtype: float64



===== cFos_coloc_w_Npas4,WFA =====

--- FR1_KET ---
ShapiroResult(statistic=0.8842035531997681, pvalue=6.639831099164439e-06)
count    73.000000
mean      1.081474
std       0.798053
min       0.065778
25%       0.436570
50%       0.850819
75%       1.505199
max       3.704088
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.7732741236686707, pvalue=1.0143870632361995e-08)
count    66.000000
mean      0.924793
std       0.652955
min       0.225570
25%       0.496096
50%       0.680906
```

```
75%        1.217575
max        4.306941
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.7898107171058655, pvalue=7.132744950233416e-10)
count     88.000000
mean       1.000000
std        0.635949
min        0.267201
25%        0.598742
50%        0.755068
75%        1.278064
max        4.165587
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9117796421051025, pvalue=0.005576615687459707)
count     38.000000
mean       1.165496
std        0.749288
min        0.171825
25%        0.569210
50%        1.061280
75%        1.680771
max        3.277941
Name: norm_adjusted_mean-background, dtype: float64



===== cFos_coloc_w_Npas4 =====

--- FR1_KET ---
ShapiroResult(statistic=0.8744861483573914, pvalue=3.335390477825438e-28)
count   1047.000000
mean       1.167868
std        0.900666
min        0.059361
25%        0.469359
50%        0.872218
75%        1.619145
max        4.936207
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.8159998655319214, pvalue=7.617558681904184e-35)
count   1193.000000
mean       0.999593
std        0.720920
```

```
min         0.000000
25%         0.535085
50%         0.735604
75%         1.285827
max         4.492207
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.7712706327438354, pvalue=7.357694150543957e-39)
count    1275.000000
mean        1.000000
std         0.706812
min         0.195719
25%         0.568825
50%         0.732788
75%         1.199825
max         5.449396
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.8506049513816833, pvalue=1.4135006228863852e-29)
count     991.000000
mean        1.157195
std         0.833003
min         0.066854
25%         0.551792
50%         0.871589
75%         1.552281
max         5.137442
Name: norm_adjusted_mean-background, dtype: float64



===== cFos_coloc_w_PV,WFA =====

--- FR1_KET ---
ShapiroResult(statistic=0.835781455039978, pvalue=2.0991262772440678e-07)
count      71.000000
mean        1.255039
std         1.038842
min         0.223101
25%         0.476310
50%         0.872018
75%         1.775429
max         4.519753
Name: norm_adjusted_mean-background, dtype: float64

--- VR5_KET ---
ShapiroResult(statistic=0.7395789623260498, pvalue=6.669183955088087e-11)
```

```
count      84.000000
mean        1.043911
std         0.722476
min         0.275242
25%         0.611039
50%         0.795871
75%         1.281435
max         5.255358
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.8592257499694824, pvalue=6.602206212846795e-07)
count      75.000000
mean        1.000000
std         0.510747
min         0.326040
25%         0.653263
50%         0.819298
75%         1.220722
max         2.461951
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9000645875930786, pvalue=5.584529571933672e-05)
count      67.000000
mean        1.165432
std         0.800433
min         0.067941
25%         0.652343
50%         0.853714
75%         1.655440
max         3.999765
Name: norm_adjusted_mean-background, dtype: float64



===== cFos_coloc_w_PV =====

--- FR1_KET ---
ShapiroResult(statistic=0.8573141098022461, pvalue=1.413581474096759e-10)
count     146.000000
mean        1.079376
std         0.868537
min         0.072004
25%         0.431934
50%         0.718994
75%         1.502633
max         4.054710
Name: norm_adjusted_mean-background, dtype: float64
```

```
--- VR5_KET ---
ShapiroResult(statistic=0.8199390172958374, pvalue=1.8138423163623074e-13)
count    176.000000
mean       1.000191
std        0.688366
min        0.008772
25%        0.560568
50%        0.759111
75%        1.254765
max        4.714628
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.6760336756706238, pvalue=2.5990526044034687e-17)
count    160.000000
mean       1.000000
std        0.711913
min        0.194610
25%        0.618471
50%        0.773123
75%        1.158538
max        6.304158
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.833734393119812, pvalue=7.571682864027096e-12)
count    152.000000
mean       1.128566
std        0.844828
min        0.060950
25%        0.591578
50%        0.892881
75%        1.461675
max        4.879711
Name: norm_adjusted_mean-background, dtype: float64



===== cFos_coloc_w_WFA =====

--- FR1_KET ---
ShapiroResult(statistic=0.813984751701355, pvalue=1.9434256287587104e-11)
count    128.000000
mean       0.955527
std        0.821927
min        0.071150
25%        0.394750
50%        0.583602
```

```
75%           1.309622
max           4.024660
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.794560968875885, pvalue=6.940779873586267e-13)
count    143.000000
mean       0.903833
std        0.604791
min        0.041865
25%        0.522398
50%        0.687915
75%        1.141821
max        4.679688
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.7776857018470764, pvalue=9.25567402668831e-14)
count    149.000000
mean       1.000000
std        0.634695
min        0.290326
25%        0.591381
50%        0.759052
75%        1.177684
max        4.526100
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.8808197379112244, pvalue=2.1994954124693322e-07)
count     99.000000
mean       1.042470
std        0.730779
min        0.060498
25%        0.567079
50%        0.754393
75%        1.455281
max        3.561632
Name: norm_adjusted_mean-background, dtype: float64



===== quad_Npas4 =====

--- FR1_KET ---
ShapiroResult(statistic=0.9540198445320129, pvalue=0.10432028770446777)
count     40.000000
mean       0.686536
std        0.303232
```

```
min        0.127486
25%        0.471705
50%        0.635934
75%        0.854810
max        1.377363
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.884358823299408, pvalue=0.0003722843248397112)
count    44.000000
mean      0.668619
std       0.266797
min       0.133527
25%       0.529769
50%       0.647136
75%       0.798090
max       1.779630
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.8817659020423889, pvalue=0.0004282173467800021)
count    42.000000
mean      1.000000
std       0.285382
min       0.636810
25%       0.826655
50%       0.960199
75%       1.117532
max       1.952234
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9030858874320984, pvalue=0.006411497946828604)
count    33.000000
mean      0.727475
std       0.297006
min       0.319962
25%       0.548735
50%       0.653904
75%       0.874797
max       1.624232
Name: norm_adjusted_mean-background, dtype: float64



===== quad_PV =====

--- FR1_KET ---
ShapiroResult(statistic=0.9541926980018616, pvalue=0.10576236248016357)
```

```
count    40.000000
mean      1.016336
std       0.423540
min       0.374505
25%       0.674288
50%       0.989773
75%       1.347841
max       2.098650
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.9584710597991943, pvalue=0.11408291012048721)
count    44.000000
mean      1.336422
std       0.725617
min       0.211901
25%       0.686866
50%       1.253944
75%       1.921529
max       3.154561
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.9512266516685486, pvalue=0.0714656263589859)
count    42.000000
mean      1.000000
std       0.505217
min       0.217966
25%       0.640180
50%       0.834687
75%       1.304727
max       2.459485
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9719945192337036, pvalue=0.5372167229652405)
count    33.000000
mean      1.054601
std       0.506414
min       0.240296
25%       0.622042
50%       1.090450
75%       1.352451
max       2.204717
Name: norm_adjusted_mean-background, dtype: float64



===== quad_WFA =====
```

```
--- FR1_KET ---
ShapiroResult(statistic=0.7910507321357727, pvalue=4.4319949665805325e-06)
count    40.000000
mean      0.634062
std       0.458239
min       0.152773
25%       0.325811
50%       0.489816
75%       0.833960
max       2.588464
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.8200638890266418, pvalue=8.223880286095664e-06)
count    44.000000
mean      0.577770
std       0.546987
min       0.006272
25%       0.205818
50%       0.405574
75%       0.902682
max       2.785221
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.8555320501327515, pvalue=8.603925380157307e-05)
count    42.000000
mean      1.000000
std       0.756243
min       0.181928
25%       0.384610
50%       0.702440
75%       1.431025
max       2.845490
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.826041579246521, pvalue=0.00010553505126154050)
count    33.000000
mean      0.759480
std       0.578972
min       0.116933
25%       0.395340
50%       0.521363
75%       0.920125
max       2.301202
Name: norm_adjusted_mean-background, dtype: float64
```

```
===== quad_cFos =====

--- FR1_KET ---
ShapiroResult(statistic=0.919887125492096, pvalue=0.007638394366949797)
count    40.000000
mean      1.394250
std       0.975210
min       0.072987
25%       0.486551
50%       1.350855
75%       1.819808
max       4.110045
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_KET ---
ShapiroResult(statistic=0.7258466482162476, pvalue=9.986828786168189e-08)
count    44.000000
mean      1.057016
std       0.789575
min       0.250292
25%       0.567819
50%       0.871064
75%       1.307814
max       4.778970
Name: norm_adjusted_mean-background, dtype: float64


--- FR1_SAL ---
ShapiroResult(statistic=0.8808974027633667, pvalue=0.0004050391144119203)
count    42.000000
mean      1.000000
std       0.496240
min       0.432879
25%       0.601469
50%       0.820401
75%       1.245572
max       2.238780
Name: norm_adjusted_mean-background, dtype: float64


--- VR5_SAL ---
ShapiroResult(statistic=0.9040673971176147, pvalue=0.006803496275097132)
count    33.000000
mean      1.219911
std       0.796872
min       0.190656
25%       0.612805
50%       0.977951
```

```
75%         1.785905
max         3.637194
Name: norm_adjusted_mean-background, dtype: float64
```

[ ]: