```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
sns.set(style="ticks")

# Будем анализировать данные только на обучающей выборке
data = pd.read_csv('test.csv', sep=",")

# Первые 5 строк датасета
data.head()
```

```
   id  battery_power  blue  clock_speed  dual_sim  fc  four_g
int_memory  \
0   1           1043     1          1.8         1  14       0
5
1   2            841     1          0.5         1   4       1
61
2   3           1807     1          2.8         0   1       0
27
3   4           1546     0          0.5         1  18       1
25
4   5           1434     0          1.4         0  11       1
49

   m_dep  mobile_wt  ...  pc  px_height  px_width   ram  sc_h  sc_w  \
0    0.1        193  ...  16        226      1412  3476    12     7
1    0.8        191  ...  12        746       857  3895     6     0
2    0.9        186  ...   4       1270      1366  2396    17    10
3    0.5         96  ...  20        295      1752  3893    10     0
4    0.5        108  ...  18        749       810  1773    15     8

   talk_time  three_g  touch_screen  wifi
0          2        0             1     0
1          7        1             0     0
2         10        0             1     1
3          7        1             1     0
4          7        1             0     1

[5 rows x 21 columns]
```

```
# Размер датасета - 1000 строк, 21 колонок
data.shape
```

```
(1000, 21)
```

```
total_count = data.shape[0]
print('Всего строк: {}'.format(total_count))
```

```
Всего строк: 1000
```

```
# Список колонок
data.columns
```

```
Index(['id', 'battery_power', 'blue', 'clock_speed', 'dual_sim', 'fc',
       'four_g', 'int_memory', 'm_dep', 'mobile_wt', 'n_cores', 'pc',
       'px_height', 'px_width', 'ram', 'sc_h', 'sc_w', 'talk_time',
'three_g',
       'touch_screen', 'wifi'],
      dtype='object')
```

```
# Список колонок с типами данных
data.dtypes
```

```
id                 int64
battery_power      int64
blue               int64
clock_speed      float64
dual_sim           int64
fc                 int64
four_g             int64
int_memory         int64
m_dep            float64
mobile_wt          int64
n_cores            int64
pc                 int64
px_height          int64
px_width           int64
ram                int64
sc_h               int64
sc_w               int64
talk_time          int64
three_g            int64
touch_screen       int64
wifi               int64
dtype: object
```

```
# Проверим наличие пустых значений
# Цикл по колонкам датасета
for col in data.columns:
    # Количество пустых значений - все значения заполнены
    temp_null_count = data[data[col].isnull()].shape[0]
    print('{} - {}'.format(col, temp_null_count))
```

```
id - 0
battery_power - 0
blue - 0
clock_speed - 0
dual_sim - 0
fc - 0
four_g - 0
```

```
int_memory - 0
m_dep - 0
mobile_wt - 0
n_cores - 0
pc - 0
px_height - 0
px_width - 0
ram - 0
sc_h - 0
sc_w - 0
talk_time - 0
three_g - 0
touch_screen - 0
wifi - 0
```

```
# Основные статистические характеристки набора данных
data.describe()
```

```
                id  battery_power          blue  clock_speed
dual_sim  \
count  1000.000000    1000.000000  1000.000000  1000.000000
1000.000000
mean    500.500000    1248.510000     0.516000     1.540900
0.517000
std     288.819436     432.458227     0.499994     0.829268
0.499961
min       1.000000     500.000000     0.000000     0.500000
0.000000
25%     250.750000     895.000000     0.000000     0.700000
0.000000
50%     500.500000    1246.500000     1.000000     1.500000
1.000000
75%     750.250000    1629.250000     1.000000     2.300000
1.000000
max    1000.000000    1999.000000     1.000000     3.000000
1.000000

                fc       four_g   int_memory        m_dep   mobile_wt
...  \
count  1000.000000  1000.000000  1000.000000  1000.000000  1000.00000
...
mean      4.593000     0.487000    33.652000     0.517500   139.51100
...
std       4.463325     0.500081    18.128694     0.280861    34.85155
...
min       0.000000     0.000000     2.000000     0.100000    80.00000
...
25%       1.000000     0.000000    18.000000     0.300000   109.75000
...
50%       3.000000     0.000000    34.500000     0.500000   139.00000
```

```
...
75%       7.000000     1.000000    49.000000     0.800000   170.00000
...
max      19.000000     1.000000    64.000000     1.000000   200.00000
...

                pc    px_height     px_width          ram         sc_h
\
count  1000.000000  1000.000000  1000.000000  1000.000000  1000.000000

mean     10.054000   627.121000  1239.774000  2138.998000    11.995000

std       6.095099   432.929699   439.670981  1088.092278     4.320607

min       0.000000     0.000000   501.000000   263.000000     5.000000

25%       5.000000   263.750000   831.750000  1237.250000     8.000000

50%      10.000000   564.500000  1250.000000  2153.500000    12.000000

75%      16.000000   903.000000  1637.750000  3065.500000    16.000000

max      20.000000  1907.000000  1998.000000  3989.000000    19.000000


              sc_w    talk_time      three_g  touch_screen
wifi
count  1000.000000  1000.000000  1000.000000    1000.00000
1000.000000
mean      5.316000    11.085000     0.756000       0.50000
0.507000
std       4.240062     5.497636     0.429708       0.50025
0.500201
min       0.000000     2.000000     0.000000       0.00000
0.000000
25%       2.000000     6.750000     1.000000       0.00000
0.000000
50%       5.000000    11.000000     1.000000       0.50000
1.000000
75%       8.000000    16.000000     1.000000       1.00000
1.000000
max      18.000000    20.000000     1.000000       1.00000
1.000000

[8 rows x 21 columns]
```

```
# Определим уникальные значения для целевого признака
data['battery_power'].unique()
```

```
array([1043,  841, 1807, 1546, 1434, 1464, 1718,  833, 1111, 1520,
1500,
```

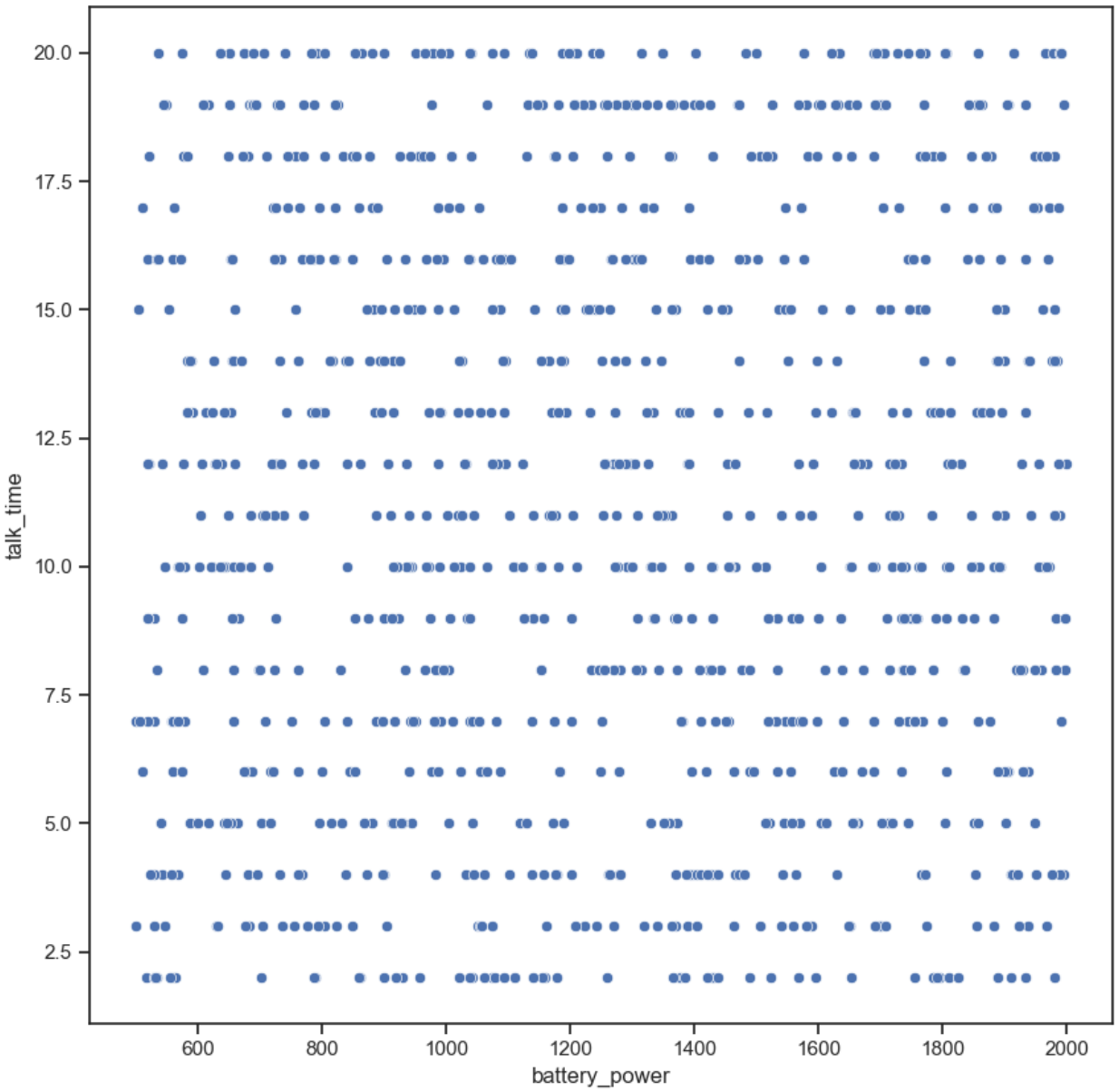
```
       1343,  900, 1190,  630, 1846, 1985, 1042, 1231, 1488,  968,
529,
       1558,  533, 1037, 1025, 1858,  980,  644, 1024, 1981, 1380,
1557,
       1201, 1074, 1175, 1280, 1715, 1165,  567, 1952,  822,  685,
1388,
       1972, 1411, 1094, 1653,  916, 1712,  882,  632, 1442, 1630,
1596,
       1272, 1640, 1889, 1907,  578, 1634, 1533,  660, 1847, 1206,
549,
       1705, 1366, 1991, 1102, 1452, 1810, 1166,  881, 1134, 1031,
1376,
       1391,  979, 1075, 1999, 1626,  942, 1182, 1982, 1373, 1151,
1650,
       1663, 1965,  679, 1465, 1809,  757, 1034, 1119,  559, 1204,
1008,
       1397,  697, 1939, 1039, 1605,  769,  861,  504, 1930, 1795,
1363,
       1901, 1319,  859, 1664,  955,  517, 1806, 1348, 1455, 1611,
1573,
        557, 1599, 1051, 1857, 1986,  591, 1140,  923, 1582,  723,
1251,
        574,  948, 1571,  564, 1466,  597,  895, 1535, 1832, 1045,
1483,
        976, 1840,  624, 1963, 1307, 1933, 1496, 1532, 1004,  945,
1081,
       1012, 1762,  796, 1547,  988, 1180,  852,  607, 1765, 1250,
1577,
       1153,  651, 1186, 1429,  556, 1735, 1859,  915,  890,  758,
541,
        586,  762,  683, 1526, 1771,  639, 1783, 1384, 1770, 1202,
885,
       1629, 1072, 1863, 1739, 1278,  562, 1249, 1811,  560, 1773,
725,
        800, 1300, 1001,  500, 1378,  951, 1038,  987, 1698,  785,
1851,
       1976, 1649, 1157, 1702, 1040,  790,  739, 1364, 1580, 1519,
989,
       1240, 1273, 1784, 1169,  703,  959, 1292, 1927, 1477, 1759,
831,
       1803, 1361, 1183,  917, 1247,  930, 1019, 1855, 1730, 1887,
1590,
        603, 1396, 1598, 1692,  628, 1883,  819, 1367, 1744, 1086,
899,
        896, 1714, 1395,  786, 1687,  669, 1423, 1600, 1621, 1672,
1934,
       1700, 1550,  626, 1737, 1370, 1899,  848, 1430,  768, 1856,
1729,
       1210, 1880,  996, 1263, 1956,  992,  911, 1979, 1095,  656,
```

```
1394,
       1632, 1225, 1337, 1178, 1269,  986, 1904,  803, 1399,  788,
579,
       1010,  530, 1289, 1877, 1764, 1709, 1690,  600,  743, 1850,
1297,
       1706, 1967, 1392, 1248,  894, 1829, 1372,  706,  649, 1137,
1320,
        792,  918,  929,  767, 1315,  569,  712, 1603, 1472, 1543,
652,
        546, 1408, 1021, 1658, 1088,  542,  576,  950,  518, 1996,
1197,
       1006, 1679, 1262,  904, 1834,  681,  687,  863,  944, 1283,
817,
        804, 1177, 1997, 1745, 1187, 1422,  658,  521,  666,  805,
1655,
       1224, 1234, 1093,  583, 1988, 1746,  907, 1427, 1101, 1403,
657,
       1688,  876, 1065, 1235, 1959,  650, 1030,  853,  744,  690,
590,
       1266,  815, 1893,  717, 1439,  983,  718,  776, 1018,  875,
1341,
       1719, 1703,  701, 1560,  695, 1487,  511,  507, 1490, 1257,
926,
       1303, 1812, 1943, 1082,  721,  654, 1948, 1242, 1453, 1232,
795,
       1915,  532, 1767, 1667, 1346,  958, 1176, 1911, 1789,  972,
1256,
       1900,  756, 1728, 1970,  888, 1419,  588, 1607, 1171, 1138,
1096,
        906,  740, 1435, 1995, 1813,  812,  977, 1125, 1733, 1333,
964,
       1613, 1123, 1913, 1302,  797, 1502, 1457, 1514, 1604, 1919,
1152,
        664, 1848, 1189, 1130,  727, 1275, 1108,  839,  750, 1749,
1229,
       1506,  709,  941,  763, 1581, 1308,  702,  868,  877,  510,
1203,
       1780, 1334,  825, 1894, 1383,  837,  640, 1194,  520,  558,
880,
       1938, 1842, 1567,  914, 1568,  873, 1371, 1507,  735, 1216,
621,
        934, 1962, 1078,  761, 1758, 1657, 1329, 1923,  613, 1268,
519,
        936, 1878, 1141,  794, 1260, 1281, 1208, 1023, 1515, 1637,
1131,
       1544,  844,  985, 1906,  617,  716,  676,  524,  553,  823,
1928,
       1517, 1425,  547, 1886, 1804, 1352, 1785, 1184,  886, 1309,
734,
```

```
       1296,  782,  965, 1946, 1701, 1754,  897, 1742, 1181,  933,
913,
       1651, 1154,  534, 1324, 1888, 1540, 1774, 1159,  543, 1836,
1290,
        645, 1654, 1156, 1541, 1693, 1564, 1787,  770, 1748,  975,
1597,
       1941, 1061, 1620, 1570, 1524, 1179, 1555,  981, 1920, 1470,
1852,
       1055, 1989, 1146, 1091, 1360, 1220, 1636, 1800,  674, 1591,
572,
       1143, 1492, 1825, 1450,  575, 1057, 1992,  974, 1724, 1036,
1336,
       1890,  608,  535, 1191,  922,  966, 1351,  732, 1005, 1575,
1306,
       1170, 1741, 1288, 1270, 1246,  671,  582, 1951,  733,  820,
1723,
       1869, 1670, 1734,  602, 1060, 1445,  536, 1255, 1252, 1471,
842,
        643,  667, 1791, 1104, 1276,  927, 1162, 1876, 1926, 1949,
1556,
       1955, 1421, 1332, 1628, 1752,  854, 1053, 1652,  646, 1359,
1691,
        675, 1062,  781, 1480,  946, 1545,  898, 1662, 1056, 1772,
694,
       1387, 1259, 1066,  940, 1595,  708,  726,  871, 1347, 1659,
544,
       1891,  937,  840,  710,  623,  700,  995, 1325, 1401,  636,
1207,
       1198, 1796, 1882, 1489, 1980,  829, 1998, 1814, 1711,  971,
991,
        905,  635, 1797, 1895,  609, 1185], dtype=int64)
```

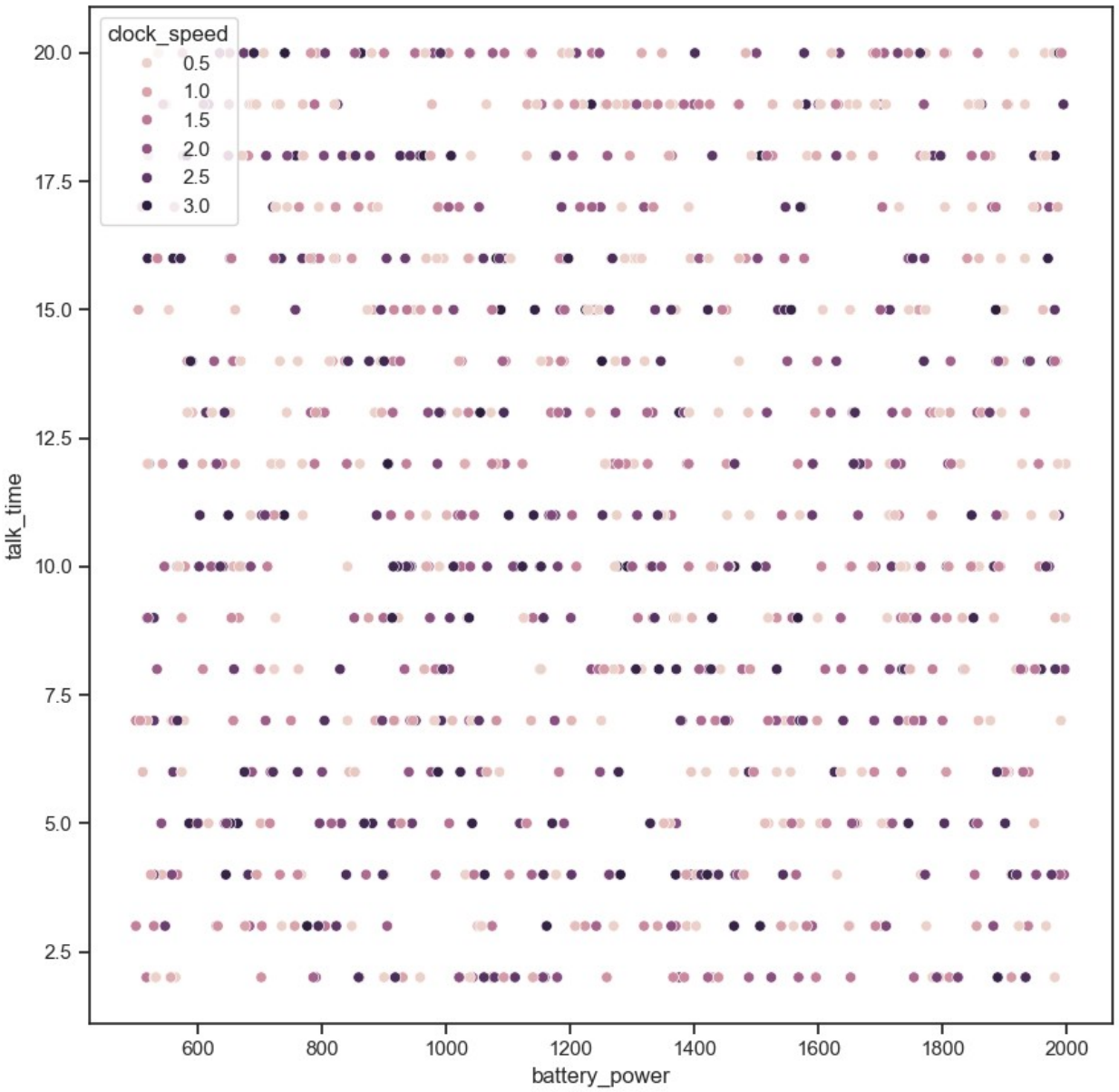
```
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x='battery_power', y='talk_time', data=data)
```

```
<Axes: xlabel='battery_power', ylabel='talk_time'>
```




```
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x='battery_power', y='talk_time', data=data,
hue='clock_speed')
```

```
<Axes: xlabel='battery_power', ylabel='talk_time'>
```

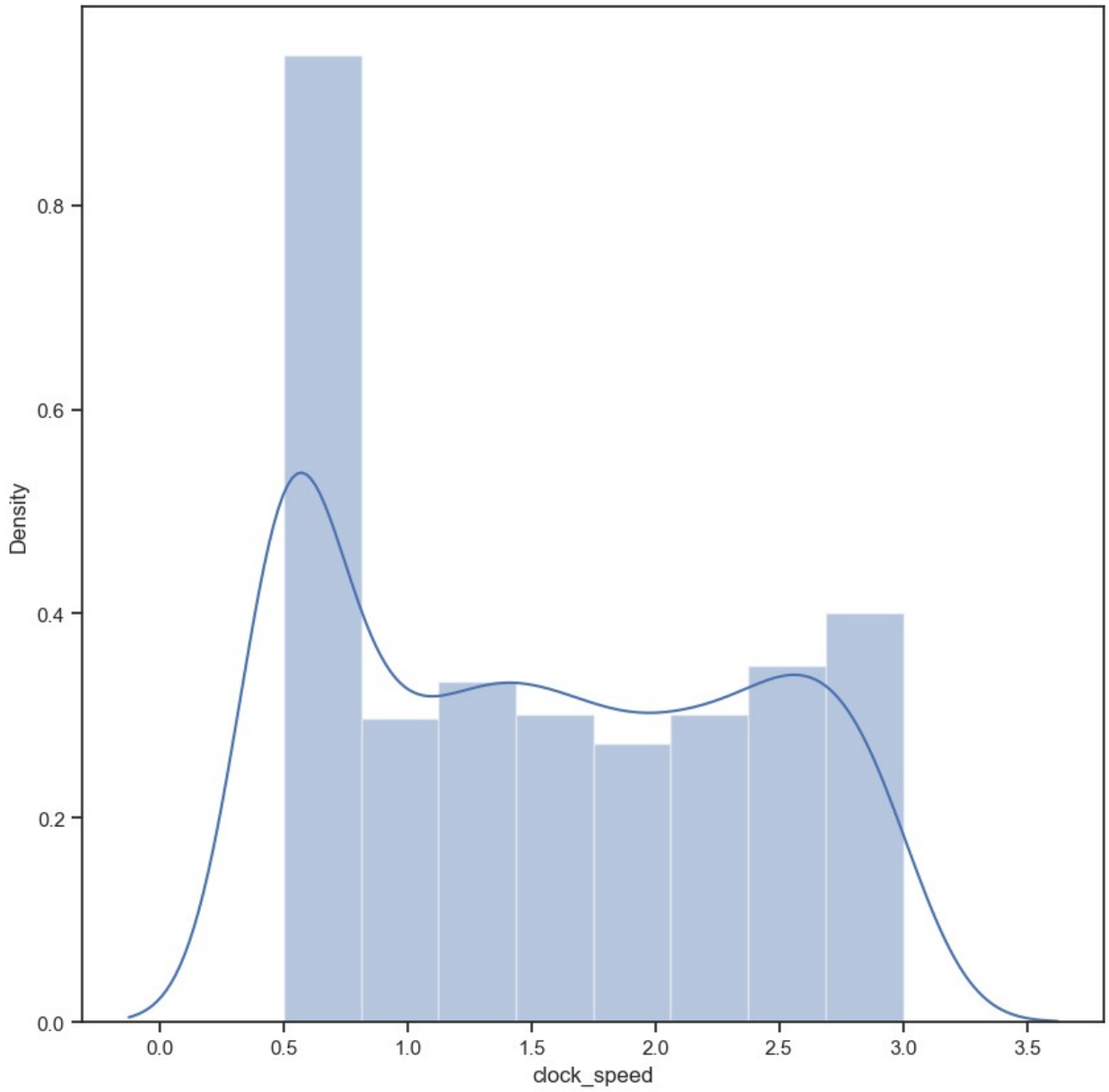



```
fig, ax = plt.subplots(figsize=(10,10))
sns.distplot(data['clock_speed'])
```

```
C:\Users\Yan note\AppData\Local\Temp\ipykernel_5944\4208595754.py:2:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).
```

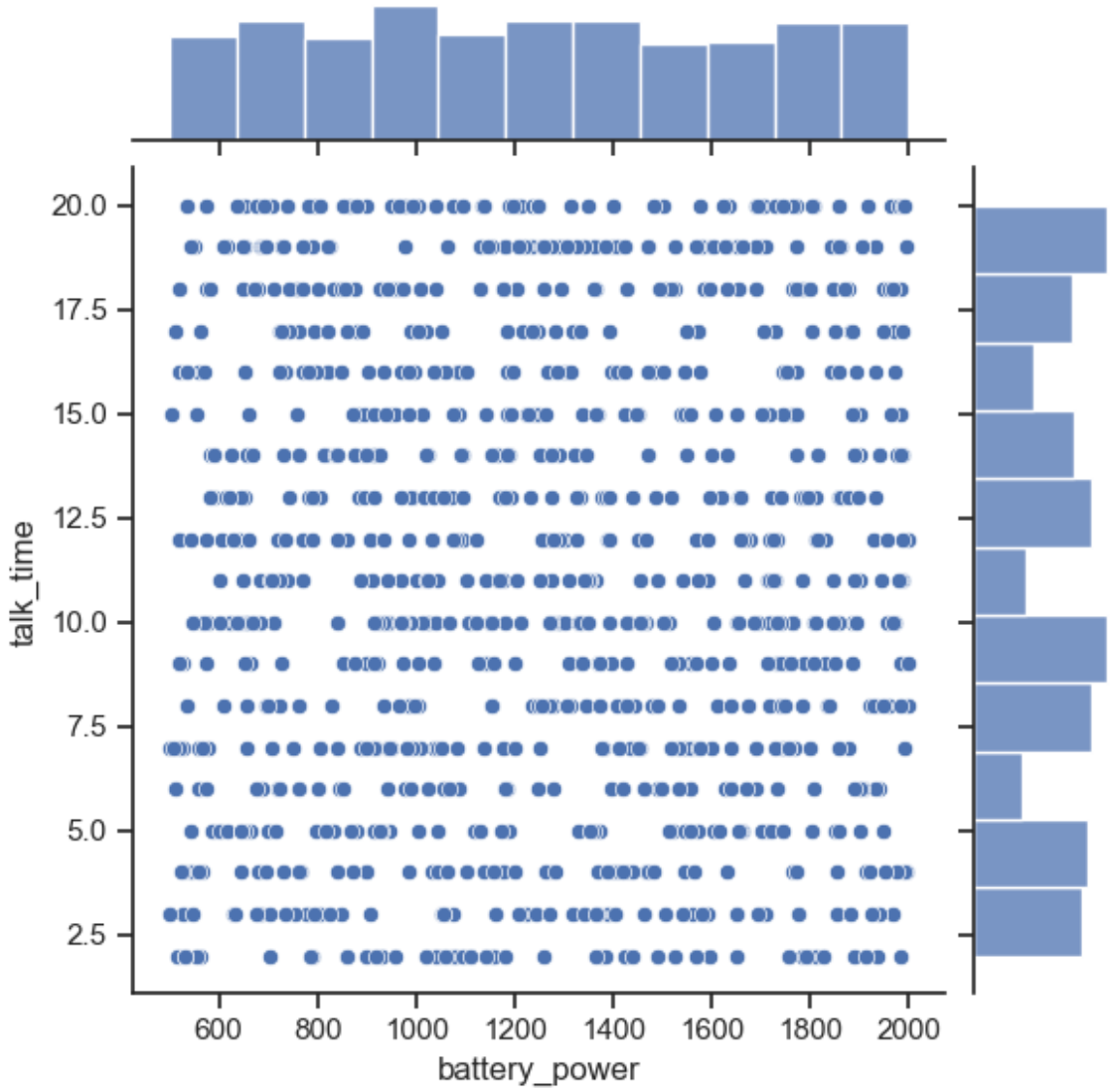
```
For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data['clock_speed'])
```

```
<Axes: xlabel='clock_speed', ylabel='Density'>
```



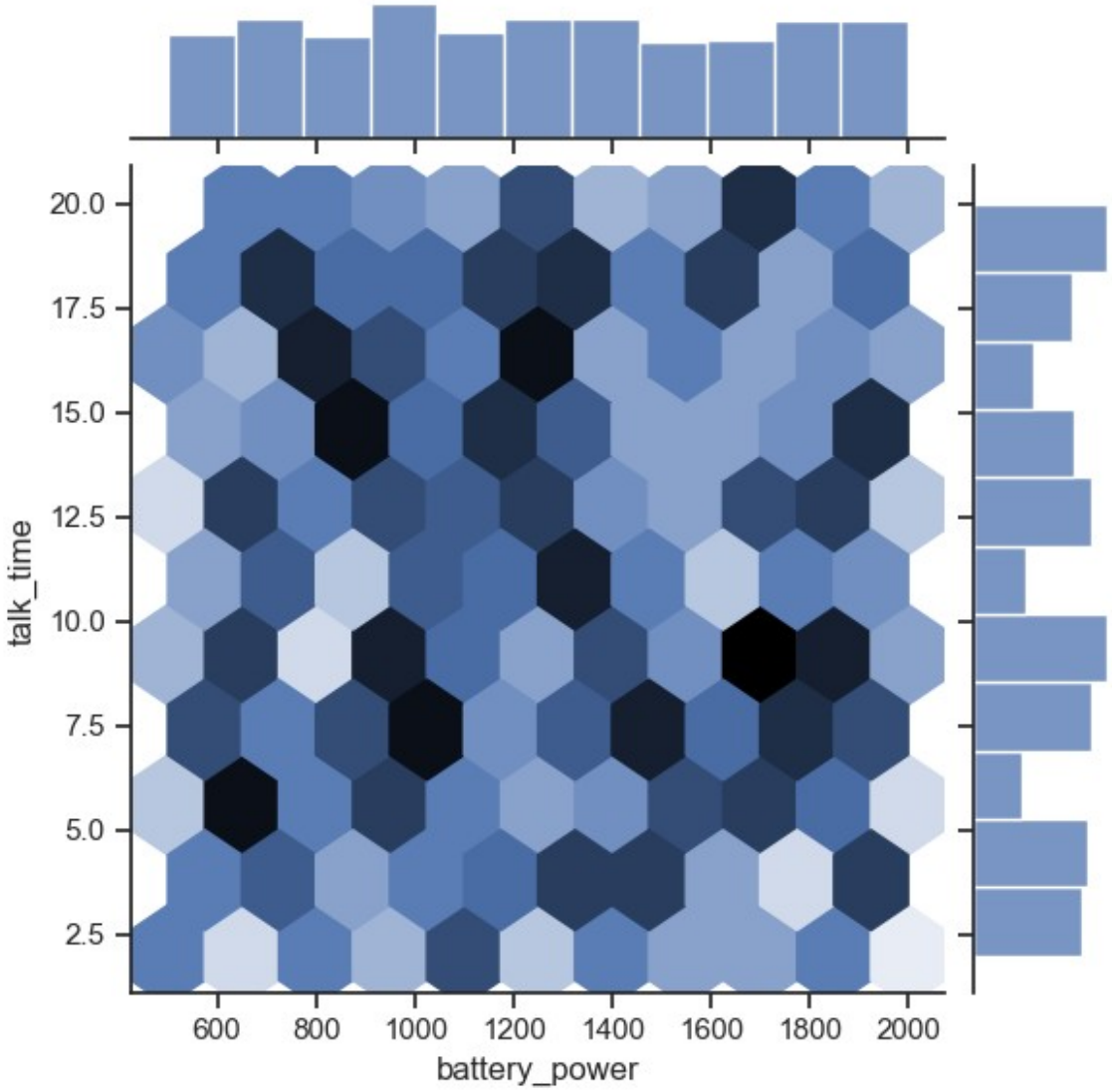

```
sns.jointplot(x='battery_power', y='talk_time', data=data)
```

```
<seaborn.axisgrid.JointGrid at 0x1456f737ed0>
```



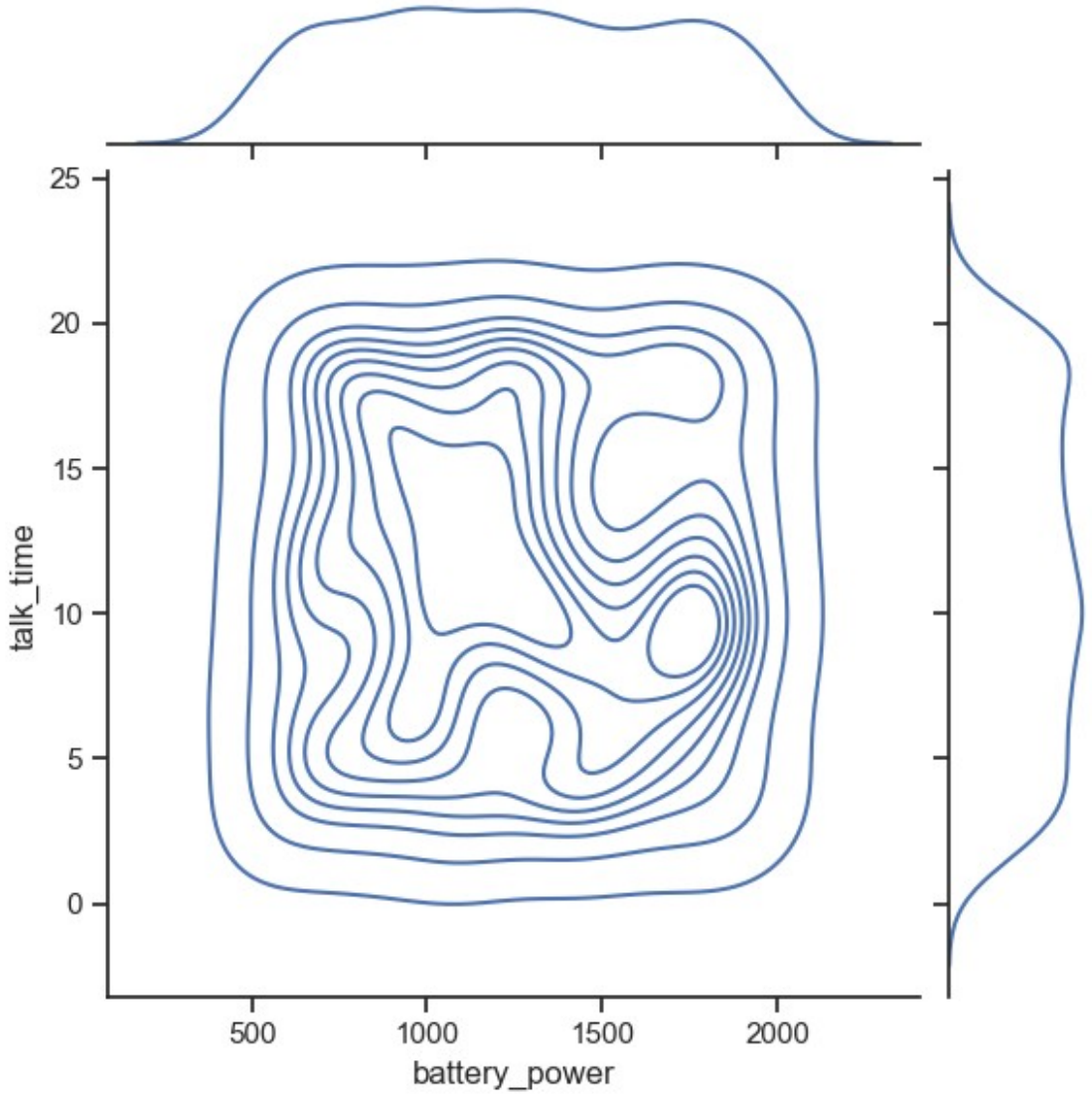

```
sns.jointplot(x='battery_power', y='talk_time', data=data, kind="hex")
```

```
<seaborn.axisgrid.JointGrid at 0x1456f6bddd0>
```



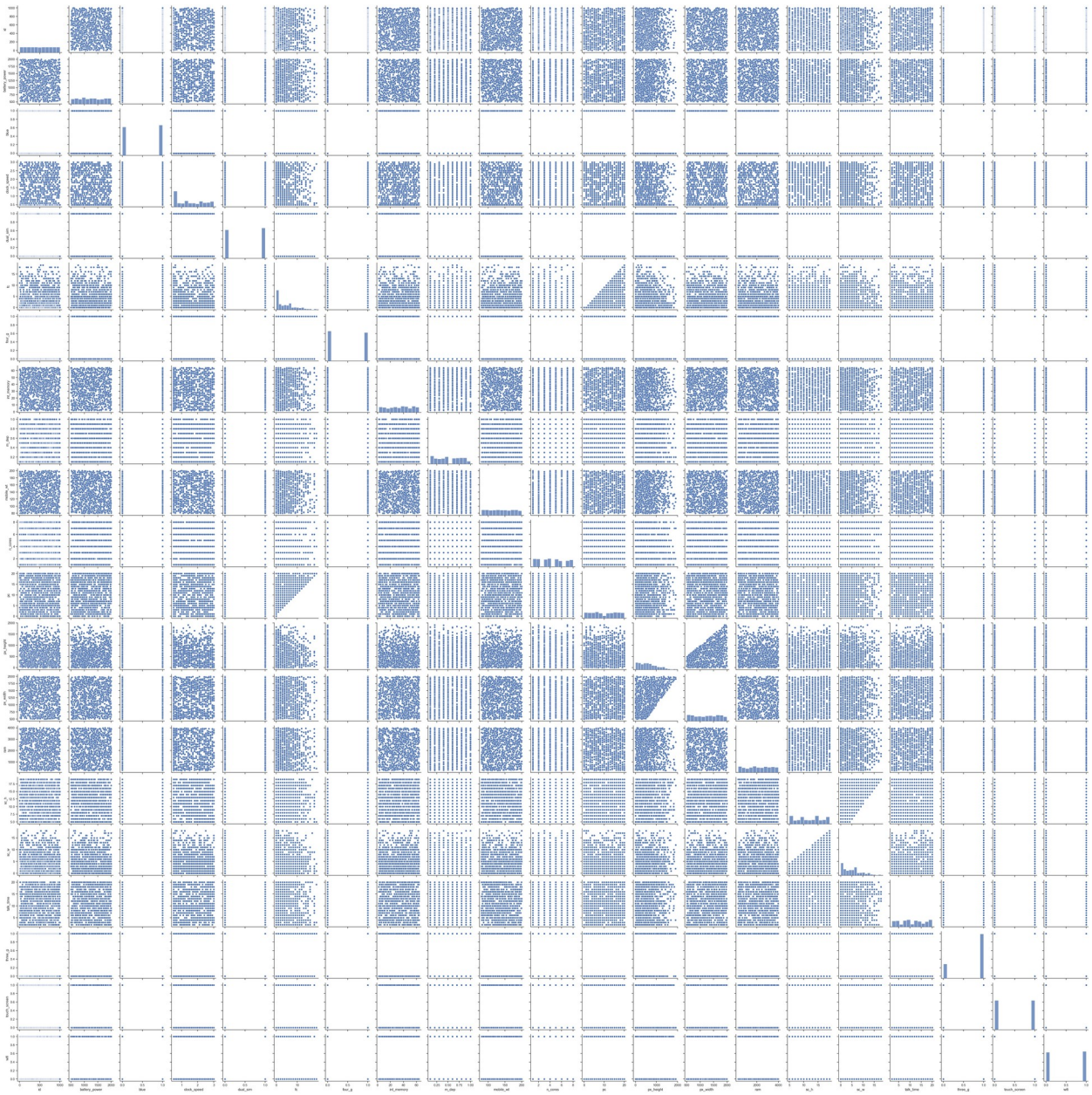

```
sns.jointplot(x='battery_power', y='talk_time', data=data, kind="kde")
```

```
<seaborn.axisgrid.JointGrid at 0x1457266f910>
```




```
sns.pairplot(data)
```

```
<seaborn.axisgrid.PairGrid at 0x145726dbd10>
```

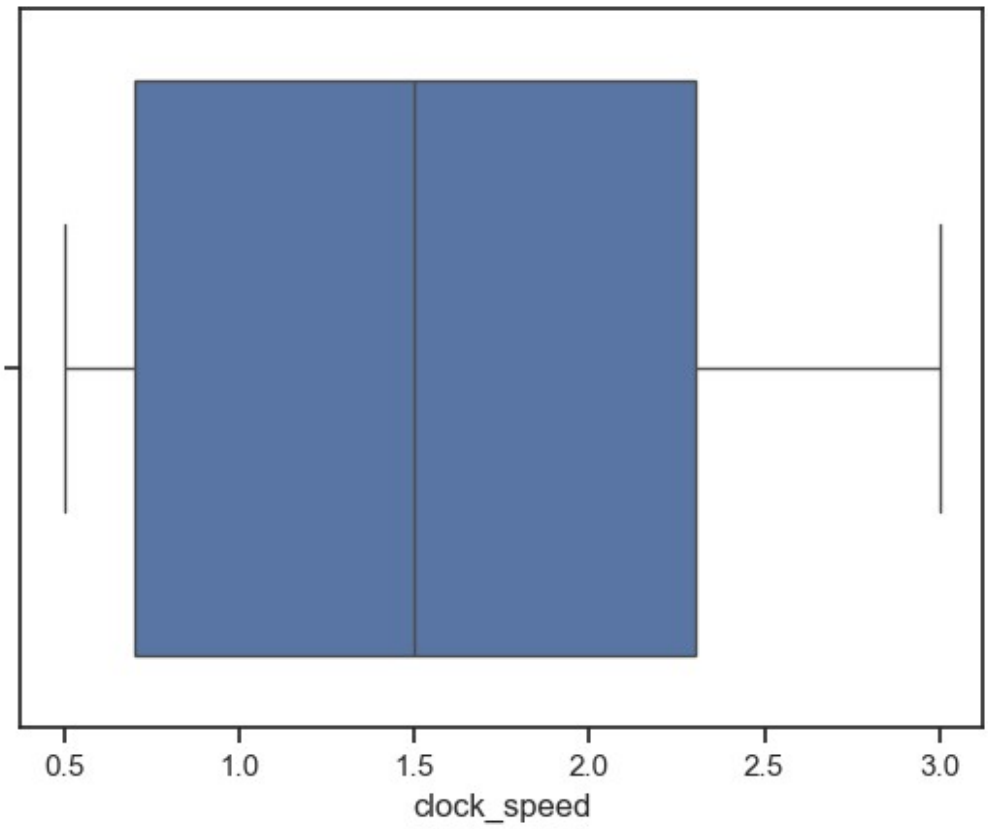


```
sns.pairplot(data, hue="clock_speed")
```

```
<seaborn.axisgrid.PairGrid at 0x14508c20f50>
```

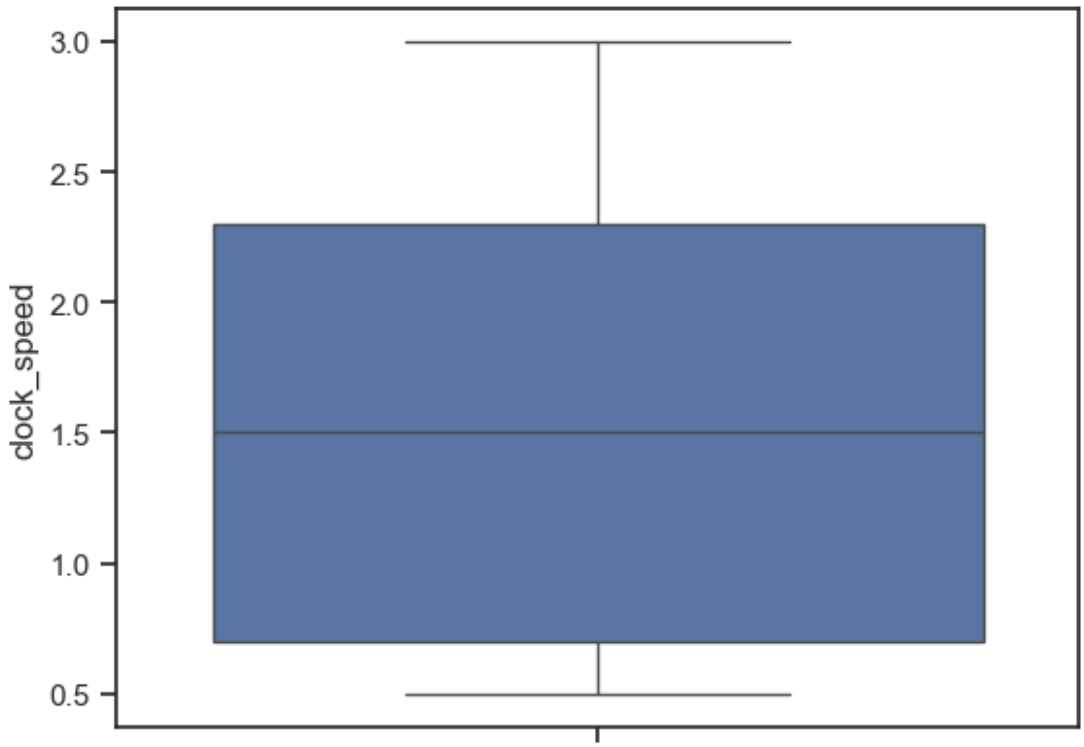
```
sns.boxplot(x=data['clock_speed'])
```

```
<Axes: xlabel='clock_speed'>
```



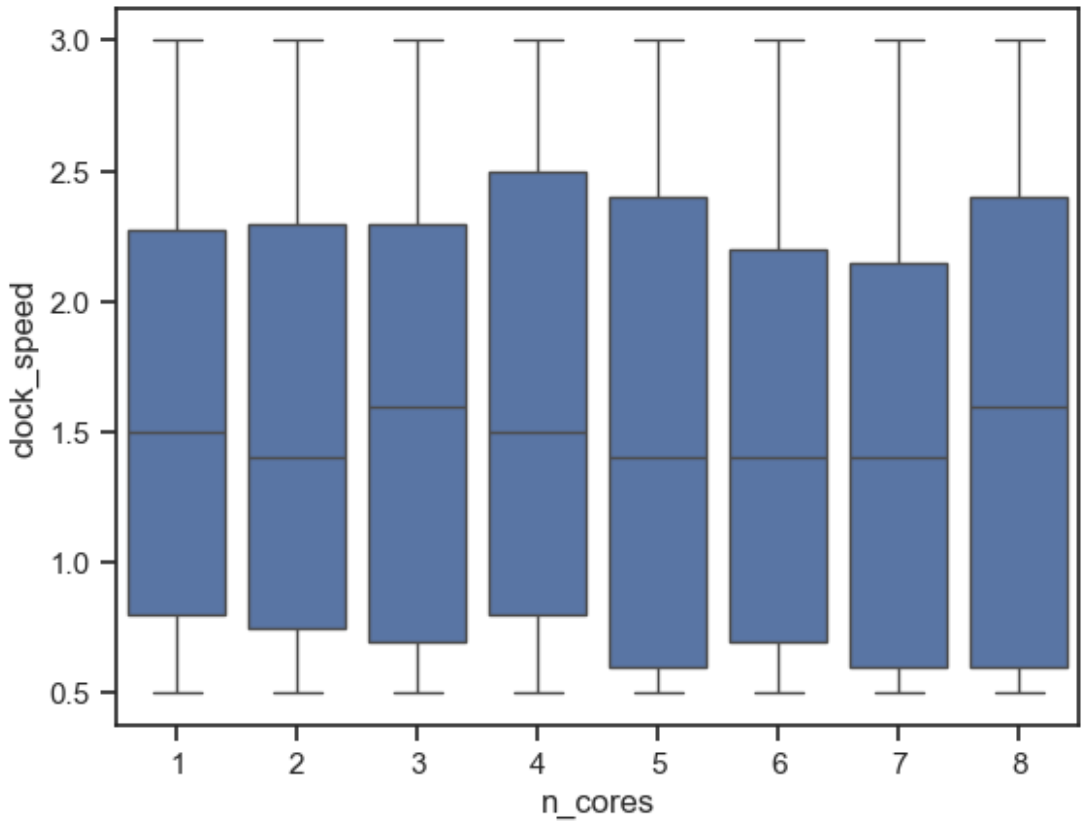

```
# По вертикали
sns.boxplot(y=data['clock_speed'])
```

```
<Axes: ylabel='clock_speed'>
```



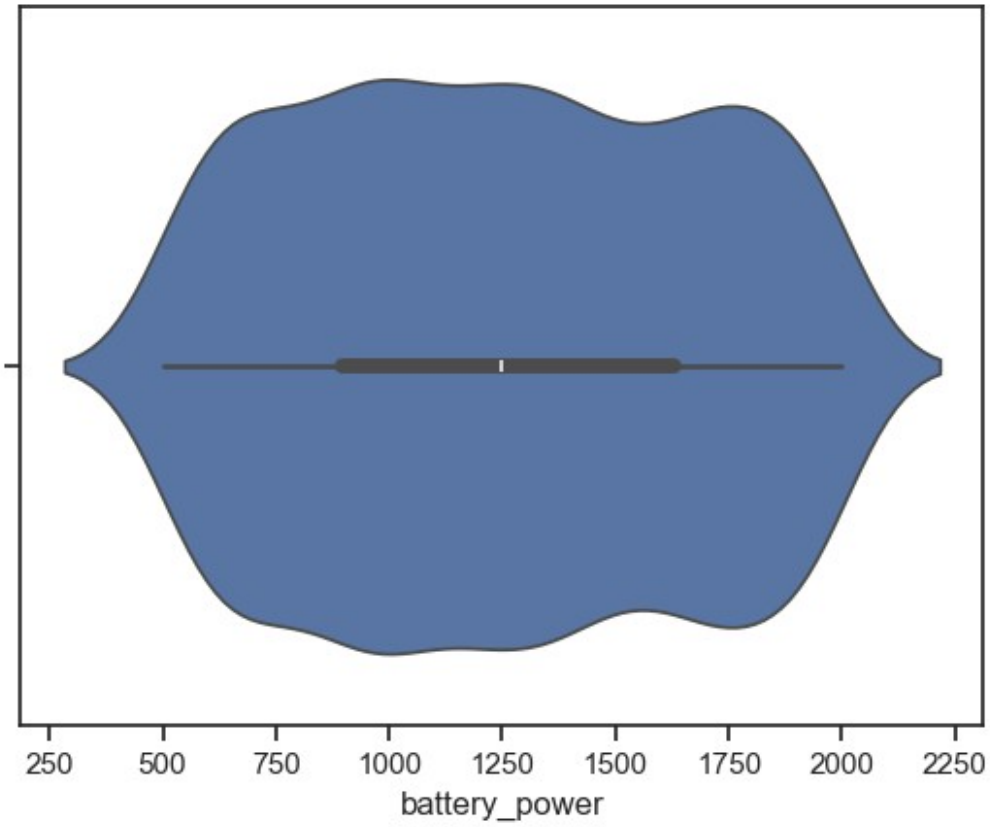

```
# Распределение параметра clock_speed сгруппированные по n_cores.
sns.boxplot(x='n_cores', y='clock_speed', data=data)
```

```
<Axes: xlabel='n_cores', ylabel='clock_speed'>
```




```
sns.violinplot(x=data['battery_power'])
```

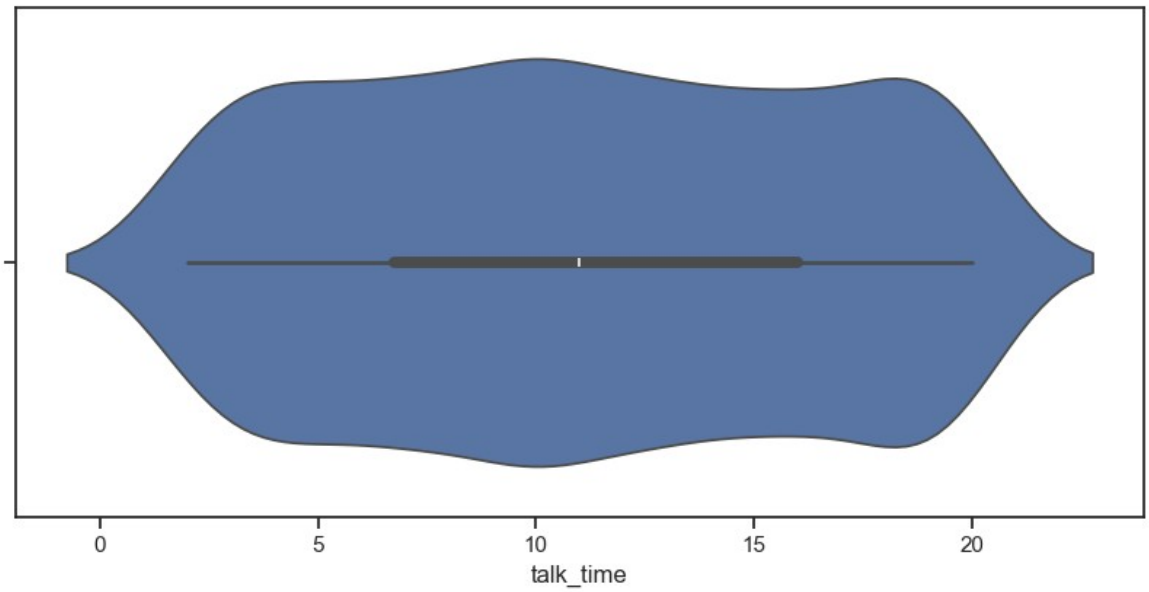
```
<Axes: xlabel='battery_power'>
```

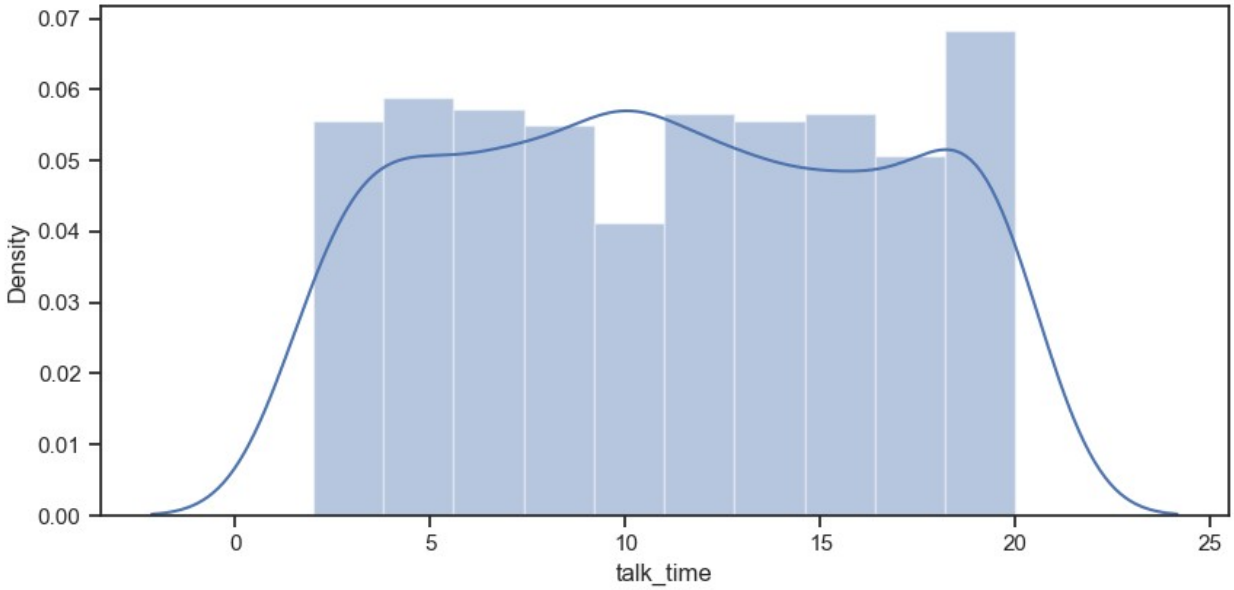



```
fig, ax = plt.subplots(2, 1, figsize=(10,10))
sns.violinplot(ax=ax[0], x=data['talk_time'])
sns.distplot(data['talk_time'], ax=ax[1])
```

```
C:\Users\Yan note\AppData\Local\Temp\ipykernel_5944\3938310945.py:3:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data['talk_time'], ax=ax[1])
```

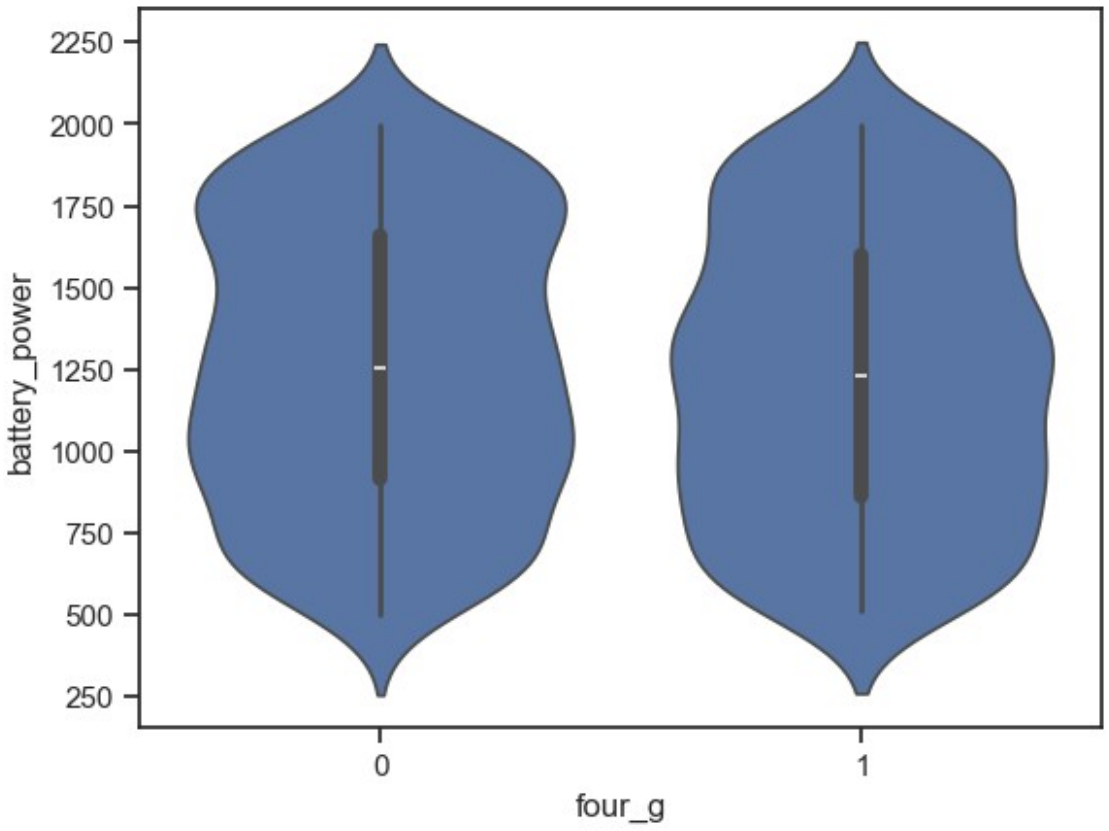
```
<Axes: xlabel='talk_time', ylabel='Density'>
```





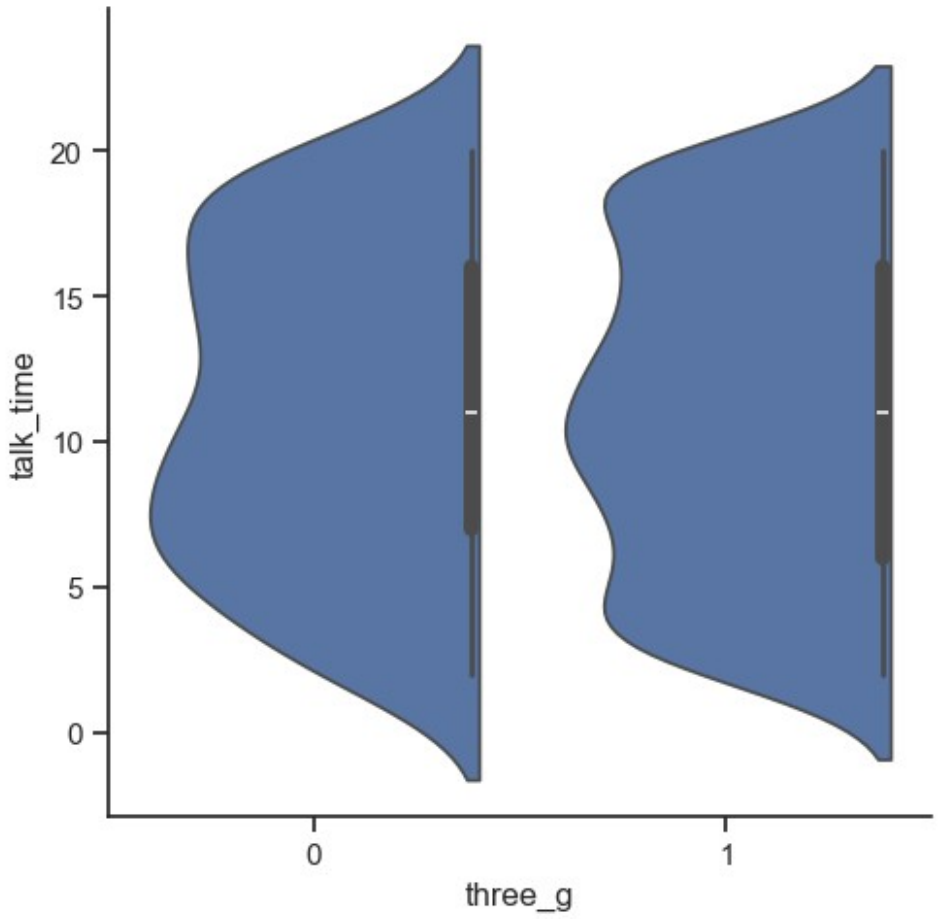

```
# Распределение параметра Humidity сгруппированные по Occupancy.
sns.violinplot(x='four_g', y='battery_power', data=data)
```

```
<Axes: xlabel='four_g', ylabel='battery_power'>
```




```
sns.catplot(y='talk_time', x='three_g', data=data, kind="violin",
split=True)
```

```
<seaborn.axisgrid.FacetGrid at 0x14526fa3690>
```




```
data.corr()
```

```
                      id  battery_power      blue  clock_speed
dual_sim  \
id              1.000000      -0.021511  0.000464     0.035917 -
0.002721
battery_power -0.021511       1.000000 -0.046610    -0.039075 -
0.061171
blue            0.000464      -0.046610  1.000000     0.034754 -
0.011100
clock_speed     0.035917      -0.039075  0.034754     1.000000 -
0.012423
dual_sim       -0.002721      -0.061171 -0.011100    -0.012423
1.000000
fc              0.016934      -0.007846 -0.056063     0.010127
0.057606
four_g          0.030921      -0.042520 -0.001169    -0.024665
0.024907
int_memory     -0.014023       0.003751 -0.012416    -0.030487 -
0.012158
m_dep          -0.002794      -0.009065  0.018319     0.016995
```

```
0.021760
mobile_wt     -0.007541      -0.047065  0.023513    -0.014107 -
0.001734
n_cores        -0.015935       0.025732  0.003283    -0.012247 -
0.003129
pc              0.001969       0.012847 -0.025247     0.047469
0.073936
px_height      -0.025056       0.048647 -0.058810     0.017277
0.006842
px_width       -0.012138       0.053365 -0.032054     0.070585
0.015610
ram            -0.043442      -0.032366  0.057570    -0.000650
0.048171
sc_h           -0.011972      -0.055665  0.012780    -0.039503
0.006295
sc_w            0.002918      -0.023905  0.004223    -0.027138 -
0.002064
talk_time       0.030807       0.015546 -0.031995    -0.078797
0.004390
three_g         0.049571       0.031514  0.013530    -0.021406
0.000690
touch_screen    0.039768      -0.010138 -0.060031     0.061893
0.034020
wifi           -0.036643      -0.000414  0.025568    -0.048593
0.031545

                      fc    four_g  int_memory     m_dep
mobile_wt  ...  \
id              0.016934  0.030921   -0.014023 -0.002794  -
0.007541  ...
battery_power -0.007846 -0.042520    0.003751 -0.009065  -
0.047065  ...
blue           -0.056063 -0.001169   -0.012416  0.018319
0.023513  ...
clock_speed     0.010127 -0.024665   -0.030487  0.016995  -
0.014107  ...
dual_sim        0.057606  0.024907   -0.012158  0.021760  -
0.001734  ...
fc              1.000000  0.032832   -0.006565  0.020859
0.018353  ...
four_g          0.032832  1.000000   -0.037488  0.014806  -
0.000509  ...
int_memory     -0.006565 -0.037488    1.000000 -0.004386  -
0.010447  ...
m_dep           0.020859  0.014806   -0.004386  1.000000  -
0.041994  ...
mobile_wt       0.018353 -0.000509   -0.010447 -0.041994
1.000000  ...
n_cores         0.020828  0.066716    0.021601  0.010062  -
```

```
0.038908  ...
pc             0.659338  0.037669    0.022682  0.012663
0.027343  ...
px_height     -0.017982  0.033655   -0.009564  0.062559
0.011157  ...
px_width       0.030550  0.036545   -0.003877  0.034861  -
0.014577  ...
ram           -0.051997  0.030821   -0.007107  0.018349
0.028786  ...
sc_h           0.045158 -0.015087   -0.009249 -0.026160  -
0.022053  ...
sc_w           0.006115 -0.000893    0.024521 -0.023393
0.022148  ...
talk_time     -0.051458  0.013692    0.023759  0.024124  -
0.021704  ...
three_g       -0.011121  0.553528   -0.015922 -0.029278
0.006262  ...
touch_screen   0.015467 -0.010003    0.022186  0.040254
0.044525  ...
wifi          -0.060373 -0.035652    0.011860 -0.039705
0.069762  ...

                     pc  px_height  px_width       ram      sc_h
sc_w  \
id             0.001969  -0.025056 -0.012138 -0.043442 -0.011972
0.002918
battery_power  0.012847   0.048647  0.053365 -0.032366 -0.055665 -
0.023905
blue          -0.025247  -0.058810 -0.032054  0.057570  0.012780
0.004223
clock_speed    0.047469   0.017277  0.070585 -0.000650 -0.039503 -
0.027138
dual_sim       0.073936   0.006842  0.015610  0.048171  0.006295 -
0.002064
fc             0.659338  -0.017982  0.030550 -0.051997  0.045158
0.006115
four_g         0.037669   0.033655  0.036545  0.030821 -0.015087 -
0.000893
int_memory     0.022682  -0.009564 -0.003877 -0.007107 -0.009249
0.024521
m_dep          0.012663   0.062559  0.034861  0.018349 -0.026160 -
0.023393
mobile_wt      0.027343   0.011157 -0.014577  0.028786 -0.022053
0.022148
n_cores        0.014376  -0.054433 -0.059388 -0.042750 -0.034057
0.012830
pc             1.000000   0.028910  0.056397 -0.045987  0.019738 -
0.006316
px_height      0.028910   1.000000  0.517650  0.027945  0.011162
```

```
0.043486
px_width       0.056397   0.517650  1.000000 -0.026378 -0.022610
0.004692
ram           -0.045987   0.027945 -0.026378  1.000000  0.022894
0.030678
sc_h           0.019738   0.011162 -0.022610  0.022894  1.000000
0.497154
sc_w          -0.006316   0.043486  0.004692  0.030678  0.497154
1.000000
talk_time     -0.038434   0.052383  0.053423 -0.003419  0.026062
0.063990
three_g       -0.015220  -0.011125  0.019439  0.029712 -0.019528
0.001156
touch_screen   0.021996  -0.019637 -0.039986 -0.043654 -0.013662 -
0.047665
wifi          -0.054955  -0.012459 -0.073997 -0.031904 -0.002994
0.015475

                talk_time       three_g  touch_screen      wifi
id               0.030807  4.957099e-02  3.976791e-02 -0.036643
battery_power    0.015546  3.151417e-02 -1.013784e-02 -0.000414
blue            -0.031995  1.352986e-02 -6.003074e-02  0.025568
clock_speed     -0.078797 -2.140644e-02  6.189276e-02 -0.048593
dual_sim         0.004390  6.895838e-04  3.401967e-02  0.031545
fc              -0.051458 -1.112104e-02  1.546706e-02 -0.060373
four_g           0.013692  5.535283e-01 -1.000338e-02 -0.035652
int_memory       0.023759 -1.592239e-02  2.218589e-02  0.011860
m_dep            0.024124 -2.927827e-02  4.025363e-02 -0.039705
mobile_wt       -0.021704  6.261881e-03  4.452531e-02  0.069762
n_cores         -0.005640  5.093589e-02 -1.661558e-02 -0.007256
pc              -0.038434 -1.522038e-02  2.199588e-02 -0.054955
px_height        0.052383 -1.112460e-02 -1.963656e-02 -0.012459
px_width         0.053423  1.943857e-02 -3.998625e-02 -0.073997
ram             -0.003419  2.971246e-02 -4.365416e-02 -0.031904
sc_h             0.026062 -1.952833e-02 -1.366232e-02 -0.002994
sc_w             0.063990  1.155939e-03 -4.766466e-02  0.015475
talk_time        1.000000 -1.805074e-03  2.893599e-02  0.016710
three_g         -0.001805  1.000000e+00 -6.016503e-17 -0.024645
touch_screen     0.028936 -6.016503e-17  1.000000e+00 -0.026003
wifi             0.016710 -2.464544e-02 -2.600255e-02  1.000000

[21 rows x 21 columns]
```

```
data.corr(method='pearson')
```

```
                     id  battery_power      blue  clock_speed
dual_sim  \
id             1.000000      -0.021511  0.000464     0.035917 -
0.002721
battery_power -0.021511       1.000000 -0.046610    -0.039075 -
```

```
0.061171
blue            0.000464      -0.046610  1.000000     0.034754 -
0.011100
clock_speed     0.035917      -0.039075  0.034754     1.000000 -
0.012423
dual_sim       -0.002721      -0.061171 -0.011100    -0.012423
1.000000
fc              0.016934      -0.007846 -0.056063     0.010127
0.057606
four_g          0.030921      -0.042520 -0.001169    -0.024665
0.024907
int_memory     -0.014023       0.003751 -0.012416    -0.030487 -
0.012158
m_dep          -0.002794      -0.009065  0.018319     0.016995
0.021760
mobile_wt      -0.007541      -0.047065  0.023513    -0.014107 -
0.001734
n_cores        -0.015935       0.025732  0.003283    -0.012247 -
0.003129
pc              0.001969       0.012847 -0.025247     0.047469
0.073936
px_height      -0.025056       0.048647 -0.058810     0.017277
0.006842
px_width       -0.012138       0.053365 -0.032054     0.070585
0.015610
ram            -0.043442      -0.032366  0.057570    -0.000650
0.048171
sc_h           -0.011972      -0.055665  0.012780    -0.039503
0.006295
sc_w            0.002918      -0.023905  0.004223    -0.027138 -
0.002064
talk_time       0.030807       0.015546 -0.031995    -0.078797
0.004390
three_g         0.049571       0.031514  0.013530    -0.021406
0.000690
touch_screen    0.039768      -0.010138 -0.060031     0.061893
0.034020
wifi           -0.036643      -0.000414  0.025568    -0.048593
0.031545

                       fc    four_g  int_memory     m_dep
mobile_wt  ...  \
id              0.016934  0.030921   -0.014023 -0.002794  -
0.007541  ...
battery_power -0.007846 -0.042520    0.003751 -0.009065  -
0.047065  ...
blue           -0.056063 -0.001169   -0.012416  0.018319
0.023513  ...
clock_speed     0.010127 -0.024665   -0.030487  0.016995  -
```

```
0.014107  ...
dual_sim       0.057606  0.024907   -0.012158  0.021760  -
0.001734  ...
fc             1.000000  0.032832   -0.006565  0.020859
0.018353  ...
four_g         0.032832  1.000000   -0.037488  0.014806  -
0.000509  ...
int_memory    -0.006565 -0.037488    1.000000 -0.004386  -
0.010447  ...
m_dep          0.020859  0.014806   -0.004386  1.000000  -
0.041994  ...
mobile_wt      0.018353 -0.000509   -0.010447 -0.041994
1.000000  ...
n_cores        0.020828  0.066716    0.021601  0.010062  -
0.038908  ...
pc             0.659338  0.037669    0.022682  0.012663
0.027343  ...
px_height     -0.017982  0.033655   -0.009564  0.062559
0.011157  ...
px_width       0.030550  0.036545   -0.003877  0.034861  -
0.014577  ...
ram           -0.051997  0.030821   -0.007107  0.018349
0.028786  ...
sc_h           0.045158 -0.015087   -0.009249 -0.026160  -
0.022053  ...
sc_w           0.006115 -0.000893    0.024521 -0.023393
0.022148  ...
talk_time     -0.051458  0.013692    0.023759  0.024124  -
0.021704  ...
three_g       -0.011121  0.553528   -0.015922 -0.029278
0.006262  ...
touch_screen   0.015467 -0.010003    0.022186  0.040254
0.044525  ...
wifi          -0.060373 -0.035652    0.011860 -0.039705
0.069762  ...

                     pc  px_height  px_width       ram      sc_h
sc_w  \
id             0.001969  -0.025056 -0.012138 -0.043442 -0.011972
0.002918
battery_power  0.012847   0.048647  0.053365 -0.032366 -0.055665 -
0.023905
blue          -0.025247  -0.058810 -0.032054  0.057570  0.012780
0.004223
clock_speed    0.047469   0.017277  0.070585 -0.000650 -0.039503 -
0.027138
dual_sim       0.073936   0.006842  0.015610  0.048171  0.006295 -
0.002064
fc             0.659338  -0.017982  0.030550 -0.051997  0.045158
```

```
0.006115
four_g         0.037669   0.033655  0.036545  0.030821 -0.015087 -
0.000893
int_memory     0.022682  -0.009564 -0.003877 -0.007107 -0.009249
0.024521
m_dep          0.012663   0.062559  0.034861  0.018349 -0.026160 -
0.023393
mobile_wt      0.027343   0.011157 -0.014577  0.028786 -0.022053
0.022148
n_cores        0.014376  -0.054433 -0.059388 -0.042750 -0.034057
0.012830
pc             1.000000   0.028910  0.056397 -0.045987  0.019738 -
0.006316
px_height      0.028910   1.000000  0.517650  0.027945  0.011162
0.043486
px_width       0.056397   0.517650  1.000000 -0.026378 -0.022610
0.004692
ram           -0.045987   0.027945 -0.026378  1.000000  0.022894
0.030678
sc_h           0.019738   0.011162 -0.022610  0.022894  1.000000
0.497154
sc_w          -0.006316   0.043486  0.004692  0.030678  0.497154
1.000000
talk_time     -0.038434   0.052383  0.053423 -0.003419  0.026062
0.063990
three_g       -0.015220  -0.011125  0.019439  0.029712 -0.019528
0.001156
touch_screen   0.021996  -0.019637 -0.039986 -0.043654 -0.013662 -
0.047665
wifi          -0.054955  -0.012459 -0.073997 -0.031904 -0.002994
0.015475

                talk_time       three_g  touch_screen      wifi
id               0.030807  4.957099e-02  3.976791e-02 -0.036643
battery_power    0.015546  3.151417e-02 -1.013784e-02 -0.000414
blue            -0.031995  1.352986e-02 -6.003074e-02  0.025568
clock_speed     -0.078797 -2.140644e-02  6.189276e-02 -0.048593
dual_sim         0.004390  6.895838e-04  3.401967e-02  0.031545
fc              -0.051458 -1.112104e-02  1.546706e-02 -0.060373
four_g           0.013692  5.535283e-01 -1.000338e-02 -0.035652
int_memory       0.023759 -1.592239e-02  2.218589e-02  0.011860
m_dep            0.024124 -2.927827e-02  4.025363e-02 -0.039705
mobile_wt       -0.021704  6.261881e-03  4.452531e-02  0.069762
n_cores         -0.005640  5.093589e-02 -1.661558e-02 -0.007256
pc              -0.038434 -1.522038e-02  2.199588e-02 -0.054955
px_height        0.052383 -1.112460e-02 -1.963656e-02 -0.012459
px_width         0.053423  1.943857e-02 -3.998625e-02 -0.073997
ram             -0.003419  2.971246e-02 -4.365416e-02 -0.031904
sc_h             0.026062 -1.952833e-02 -1.366232e-02 -0.002994
```

```
sc_w            0.063990  1.155939e-03 -4.766466e-02  0.015475
talk_time       1.000000 -1.805074e-03  2.893599e-02  0.016710
three_g        -0.001805  1.000000e+00 -6.016503e-17 -0.024645
touch_screen    0.028936 -6.016503e-17  1.000000e+00 -0.026003
wifi            0.016710 -2.464544e-02 -2.600255e-02  1.000000

[21 rows x 21 columns]
```

```
data.corr(method='kendall')
```

```
                     id  battery_power      blue  clock_speed
dual_sim  \
id             1.000000      -0.014642  0.000379     0.022913 -
0.002223
battery_power -0.014642       1.000000 -0.037355    -0.028638 -
0.049750
blue           0.000379      -0.037355  1.000000     0.030896 -
0.011100
clock_speed    0.022913      -0.028638  0.030896     1.000000 -
0.009859
dual_sim      -0.002223      -0.049750 -0.011100    -0.009859
1.000000
fc             0.015286      -0.003582 -0.048711     0.013716
0.045883
four_g         0.025259      -0.034800 -0.001169    -0.018862
0.024907
int_memory    -0.008959       0.002243 -0.009262    -0.022505 -
0.008761
m_dep         -0.002062      -0.008088  0.015996     0.012130
0.017487
mobile_wt     -0.005062      -0.031098  0.019124    -0.012124 -
0.001706
n_cores       -0.011758       0.018770  0.005953    -0.008628 -
0.003189
pc             0.001245       0.008131 -0.020289     0.037885
0.060287
px_height     -0.017399       0.039296 -0.050259     0.004449
0.005753
px_width      -0.007790       0.033978 -0.025943     0.045304
0.012074
ram           -0.028539      -0.021184  0.047686     0.000222
0.039924
sc_h          -0.007840      -0.036942  0.009751    -0.021303
0.004931
sc_w           0.004784      -0.023354  0.014992    -0.012842 -
0.013582
talk_time      0.022192       0.009927 -0.027108    -0.057189
0.004367
three_g        0.040495       0.025221  0.013530    -0.013938
0.000690
```

```
touch_screen   0.032487      -0.008552 -0.060031     0.053901
0.034020
wifi          -0.029934      -0.001161  0.025568    -0.040399
0.031545

                       fc    four_g  int_memory     m_dep
mobile_wt  ...  \
id              0.015286  0.025259   -0.008959 -0.002062  -
0.005062  ...
battery_power -0.003582 -0.034800    0.002243 -0.008088  -
0.031098  ...
blue           -0.048711 -0.001169   -0.009262  0.015996
0.019124  ...
clock_speed     0.013716 -0.018862   -0.022505  0.012130  -
0.012124  ...
dual_sim        0.045883  0.024907   -0.008761  0.017487  -
0.001706  ...
fc              1.000000  0.030866   -0.010924  0.000634
0.015602  ...
four_g          0.030866  1.000000   -0.030211  0.011636  -
0.001006  ...
int_memory     -0.010924 -0.030211    1.000000 -0.001610  -
0.006933  ...
m_dep           0.000634  0.011636   -0.001610  1.000000  -
0.030057  ...
mobile_wt       0.015602 -0.001006   -0.006933 -0.030057
1.000000  ...
n_cores         0.015419  0.058351    0.016631  0.006442  -
0.029137  ...
pc              0.546284  0.031323    0.015071  0.009311
0.018852  ...
px_height      -0.001417  0.019940   -0.001466  0.048218
0.011434  ...
px_width        0.029260  0.029401   -0.004318  0.027173  -
0.009812  ...
ram            -0.033854  0.025328   -0.005489  0.012503
0.019197  ...
sc_h            0.033189 -0.013382   -0.006207 -0.017984  -
0.016760  ...
sc_w            0.009005  0.001614    0.015771 -0.007319
0.017805  ...
talk_time      -0.035938  0.011647    0.017143  0.017664  -
0.014857  ...
three_g        -0.009002  0.553528   -0.013434 -0.026419
0.004717  ...
touch_screen    0.008588 -0.010003    0.018601  0.033910
0.036312  ...
wifi           -0.043004 -0.035652    0.009572 -0.035468
0.056605  ...
```

```
                      pc  px_height  px_width       ram      sc_h
sc_w  \
id              0.001245  -0.017399 -0.007790 -0.028539 -0.007840
0.004784
battery_power   0.008131   0.039296  0.033978 -0.021184 -0.036942 -
0.023354
blue           -0.020289  -0.050259 -0.025943  0.047686  0.009751
0.014992
clock_speed     0.037885   0.004449  0.045304  0.000222 -0.021303 -
0.012842
dual_sim        0.060287   0.005753  0.012074  0.039924  0.004931 -
0.013582
fc              0.546284  -0.001417  0.029260 -0.033854  0.033189
0.009005
four_g          0.031323   0.019940  0.029401  0.025328 -0.013382
0.001614
int_memory      0.015071  -0.001466 -0.004318 -0.005489 -0.006207
0.015771
m_dep           0.009311   0.048218  0.027173  0.012503 -0.017984 -
0.007319
mobile_wt       0.018852   0.011434 -0.009812  0.019197 -0.016760
0.017805
n_cores         0.011005  -0.029142 -0.042910 -0.029093 -0.026638 -
0.000156
pc              1.000000   0.021810  0.038336 -0.030843  0.014137 -
0.002272
px_height       0.021810   1.000000  0.347057  0.024180  0.003424
0.025140
px_width        0.038336   0.347057  1.000000 -0.017139 -0.015578
0.009231
ram            -0.030843   0.024180 -0.017139  1.000000  0.016342
0.015160
sc_h            0.014137   0.003424 -0.015578  0.016342  1.000000
0.344987
sc_w           -0.002272   0.025140  0.009231  0.015160  0.344987
1.000000
talk_time      -0.027056   0.031633  0.036659 -0.002956  0.017656
0.047871
three_g        -0.012737  -0.011179  0.016553  0.024672 -0.016770 -
0.002061
touch_screen    0.017892  -0.018923 -0.032686 -0.036533 -0.011444 -
0.038675
wifi           -0.045848  -0.002684 -0.059612 -0.026712 -0.002528
0.008221

                talk_time   three_g  touch_screen      wifi
id               0.022192  0.040495      0.032487 -0.029934
battery_power    0.009927  0.025221     -0.008552 -0.001161
```

```
blue           -0.027108  0.013530     -0.060031  0.025568
clock_speed    -0.057189 -0.013938      0.053901 -0.040399
dual_sim        0.004367  0.000690      0.034020  0.031545
fc             -0.035938 -0.009002      0.008588 -0.043004
four_g          0.011647  0.553528     -0.010003 -0.035652
int_memory      0.017143 -0.013434      0.018601  0.009572
m_dep           0.017664 -0.026419      0.033910 -0.035468
mobile_wt      -0.014857  0.004717      0.036312  0.056605
n_cores        -0.001907  0.045229     -0.014090 -0.006480
pc             -0.027056 -0.012737      0.017892 -0.045848
px_height       0.031633 -0.011179     -0.018923 -0.002684
px_width        0.036659  0.016553     -0.032686 -0.059612
ram            -0.002956  0.024672     -0.036533 -0.026712
sc_h            0.017656 -0.016770     -0.011444 -0.002528
sc_w            0.047871 -0.002061     -0.038675  0.008221
talk_time       1.000000 -0.000860      0.023849  0.012891
three_g        -0.000860  1.000000      0.000000 -0.024645
touch_screen    0.023849  0.000000      1.000000 -0.026003
wifi            0.012891 -0.024645     -0.026003  1.000000

[21 rows x 21 columns]
```

```
data.corr(method='spearman')
```

```
                     id  battery_power      blue  clock_speed
dual_sim  \
id             1.000000      -0.021645  0.000464     0.033698 -
0.002721
battery_power -0.021645       1.000000 -0.045712    -0.040932 -
0.060879
blue           0.000464      -0.045712  1.000000     0.036733 -
0.011100
clock_speed    0.033698      -0.040932  0.036733     1.000000 -
0.011722
dual_sim      -0.002721      -0.060879 -0.011100    -0.011722
1.000000
fc             0.022188      -0.004957 -0.057047     0.019657
0.053735
four_g         0.030921      -0.042585 -0.001169    -0.022425
0.024907
int_memory    -0.013187       0.004165 -0.011249    -0.032033 -
0.010639
m_dep         -0.002531      -0.010292  0.018642     0.016878
0.020379
mobile_wt     -0.007972      -0.046219  0.023316    -0.017397 -
0.002080
n_cores       -0.016260       0.027111  0.006870    -0.011211 -
0.003680
pc             0.002013       0.012198 -0.024266     0.053668
0.072106
```

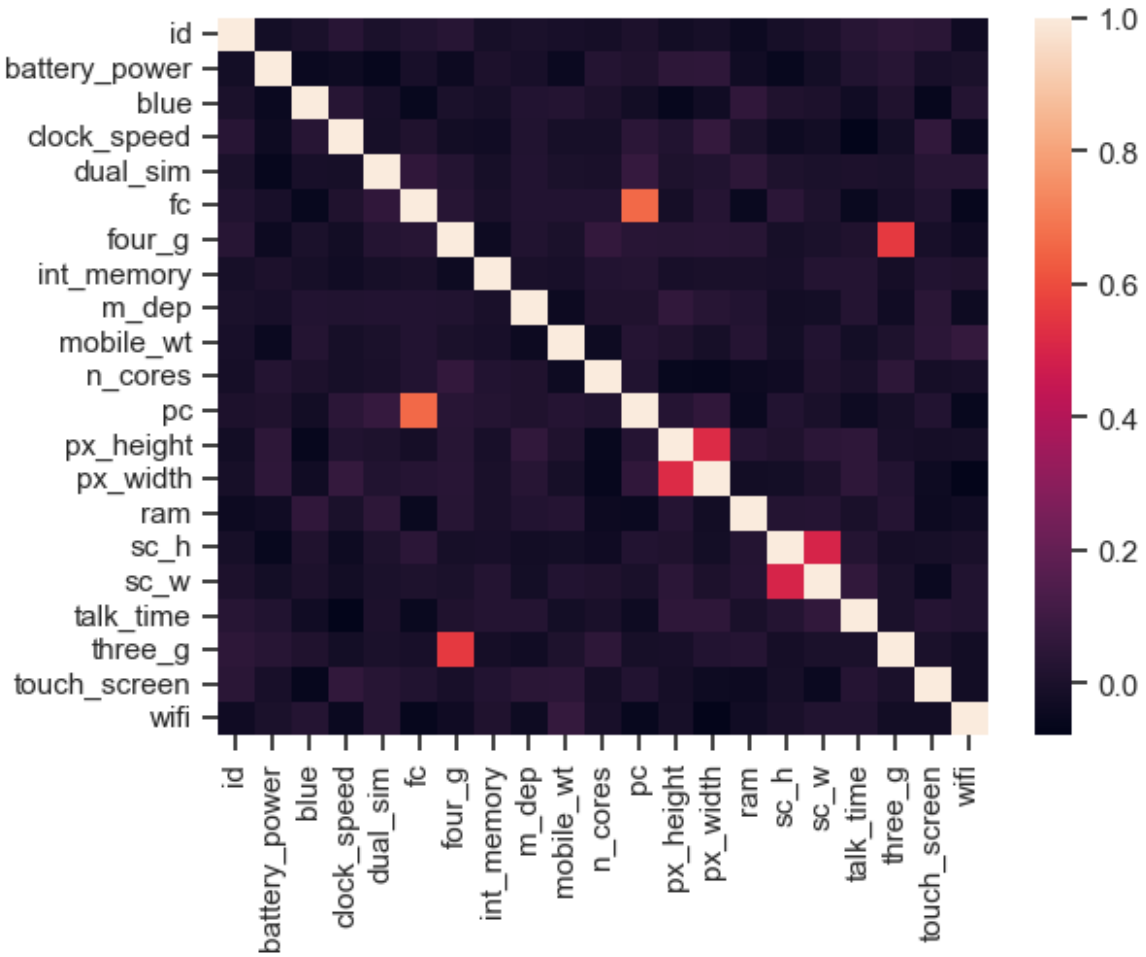
```
px_height     -0.026025       0.058443 -0.061499     0.006631
0.007040
px_width      -0.012132       0.050862 -0.031747     0.066784
0.014776
ram           -0.044083      -0.031898  0.058365    -0.000620
0.048865
sc_h          -0.011866      -0.054201  0.011561    -0.030142
0.005847
sc_w           0.007179      -0.033250  0.017696    -0.018160 -
0.016031
talk_time      0.031473       0.014609 -0.032343    -0.082377
0.005210
three_g        0.049571       0.030863  0.013530    -0.016571
0.000690
touch_screen   0.039768      -0.010465 -0.060031     0.064083
0.034020
wifi          -0.036643      -0.001420  0.025568    -0.048031
0.031545

                      fc    four_g  int_memory     m_dep
mobile_wt  ...  \
id             0.022188  0.030921   -0.013187 -0.002531  -
0.007972  ...
battery_power -0.004957 -0.042585    0.004165 -0.010292  -
0.046219  ...
blue          -0.057047 -0.001169   -0.011249  0.018642
0.023316  ...
clock_speed    0.019657 -0.022425   -0.032033  0.016878  -
0.017397  ...
dual_sim       0.053735  0.024907   -0.010639  0.020379  -
0.002080  ...
fc             1.000000  0.036149   -0.016247  0.001482
0.021846  ...
four_g         0.036149  1.000000   -0.036689  0.013561  -
0.001227  ...
int_memory    -0.016247 -0.036689    1.000000 -0.003027  -
0.010549  ...
m_dep          0.001482  0.013561   -0.003027  1.000000  -
0.042208  ...
mobile_wt      0.021846 -0.001227   -0.010549 -0.042208
1.000000  ...
n_cores        0.020417  0.067340    0.023026  0.008950  -
0.041256  ...
pc             0.680815  0.037463    0.021581  0.012423
0.027469  ...
px_height     -0.001856  0.024399   -0.001635  0.069661
0.016203  ...
px_width       0.041365  0.035980   -0.006883  0.036466  -
0.014540  ...
```

```
ram           -0.048185  0.031000   -0.007517  0.018082
0.028370  ...
sc_h           0.045861 -0.015865   -0.008829 -0.025489  -
0.023558  ...
sc_w           0.012284  0.001906    0.022713 -0.011340
0.024994  ...
talk_time     -0.049499  0.013896    0.024067  0.024175  -
0.022406  ...
three_g       -0.010543  0.553528   -0.016315 -0.030789
0.005751  ...
touch_screen   0.010057 -0.010003    0.022589  0.039519
0.044273  ...
wifi          -0.050364 -0.035652    0.011625 -0.041335
0.069015  ...

                     pc  px_height  px_width       ram      sc_h
sc_w  \
id             0.002013  -0.026025 -0.012132 -0.044083 -0.011866
0.007179
battery_power  0.012198   0.058443  0.050862 -0.031898 -0.054201 -
0.033250
blue          -0.024266  -0.061499 -0.031747  0.058365  0.011561
0.017696
clock_speed    0.053668   0.006631  0.066784 -0.000620 -0.030142 -
0.018160
dual_sim       0.072106   0.007040  0.014776  0.048865  0.005847 -
0.016031
fc             0.680815  -0.001856  0.041365 -0.048185  0.045861
0.012284
four_g         0.037463   0.024399  0.035980  0.031000 -0.015865
0.001906
int_memory     0.021581  -0.001635 -0.006883 -0.007517 -0.008829
0.022713
m_dep          0.012423   0.069661  0.036466  0.018082 -0.025489 -
0.011340
mobile_wt      0.027469   0.016203 -0.014540  0.028370 -0.023558
0.024994
n_cores        0.014934  -0.039956 -0.059633 -0.040996 -0.036079 -
0.000381
pc             1.000000   0.032969  0.056482 -0.045722  0.019686 -
0.003126
px_height      0.032969   1.000000  0.490341  0.036293  0.005863
0.034444
px_width       0.056482   0.490341  1.000000 -0.025264 -0.022339
0.012969
ram           -0.045722   0.036293 -0.025264  1.000000  0.023798
0.021638
sc_h           0.019686   0.005863 -0.022339  0.023798  1.000000
0.455533
```

```
sc_w          -0.003126   0.034444  0.012969  0.021638  0.455533
1.000000
talk_time     -0.038339   0.046151  0.054265 -0.004716  0.025060
0.068015
three_g       -0.015234  -0.013679  0.020257  0.030198 -0.019882 -
0.002432
touch_screen   0.021399  -0.023154 -0.040000 -0.044715 -0.013569 -
0.045649
wifi          -0.054836  -0.003284 -0.072951 -0.032694 -0.002997
0.009703

                talk_time   three_g  touch_screen      wifi
id               0.031473  0.049571      0.039768 -0.036643
battery_power    0.014609  0.030863     -0.010465 -0.001420
blue            -0.032343  0.013530     -0.060031  0.025568
clock_speed     -0.082377 -0.016571      0.064083 -0.048031
dual_sim         0.005210  0.000690      0.034020  0.031545
fc              -0.049499 -0.010543      0.010057 -0.050364
four_g           0.013896  0.553528     -0.010003 -0.035652
int_memory       0.024067 -0.016315      0.022589  0.011625
m_dep            0.024175 -0.030789      0.039519 -0.041335
mobile_wt       -0.022406  0.005751      0.044273  0.069015
n_cores         -0.003324  0.052197     -0.016261 -0.007478
pc              -0.038339 -0.015234      0.021399 -0.054836
px_height        0.046151 -0.013679     -0.023154 -0.003284
px_width         0.054265  0.020257     -0.040000 -0.072951
ram             -0.004716  0.030198     -0.044715 -0.032694
sc_h             0.025060 -0.019882     -0.013569 -0.002997
sc_w             0.068015 -0.002432     -0.045649  0.009703
talk_time        1.000000 -0.001026      0.028455  0.015381
three_g         -0.001026  1.000000      0.000000 -0.024645
touch_screen     0.028455  0.000000      1.000000 -0.026003
wifi             0.015381 -0.024645     -0.026003  1.000000

[21 rows x 21 columns]
```

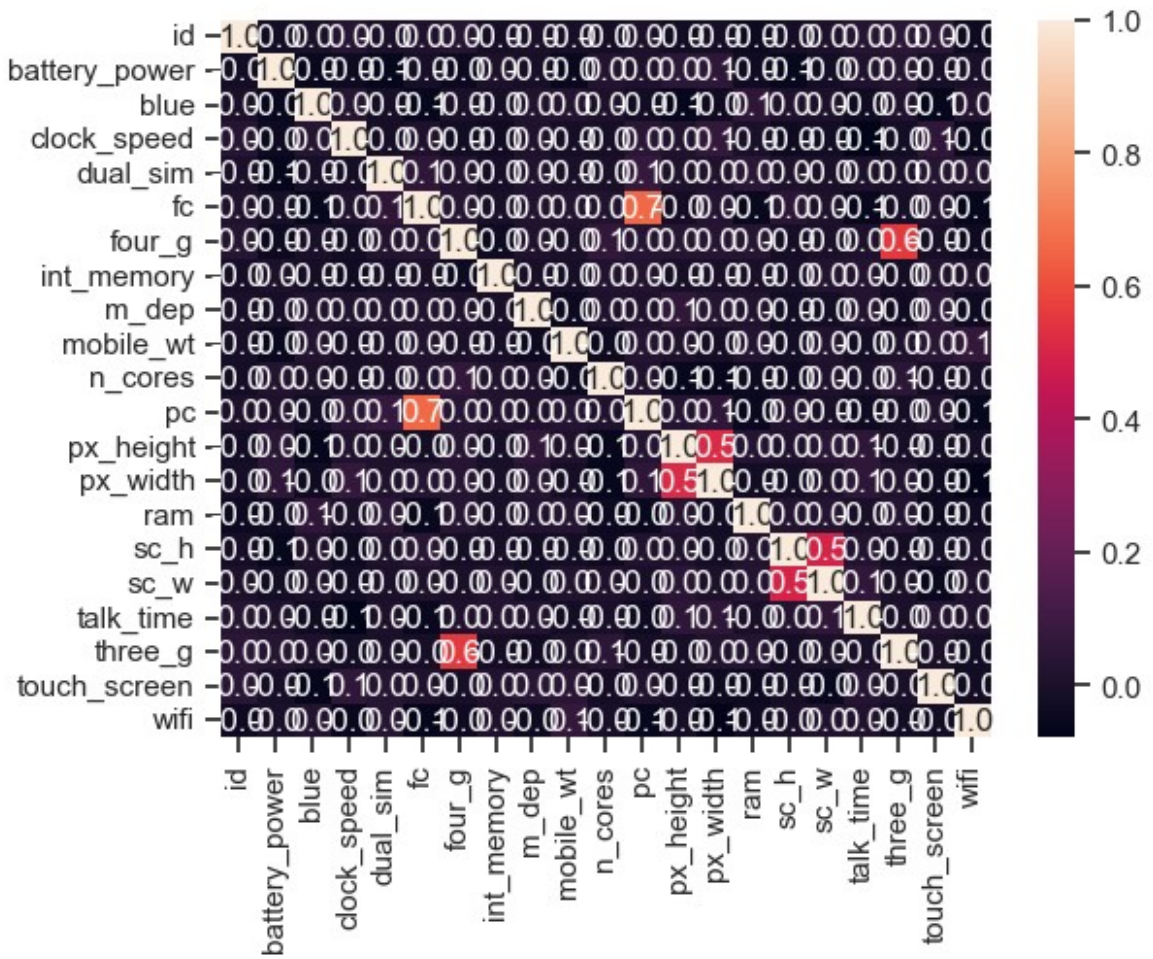
```
sns.heatmap(data.corr())
```

```
<Axes: >
```



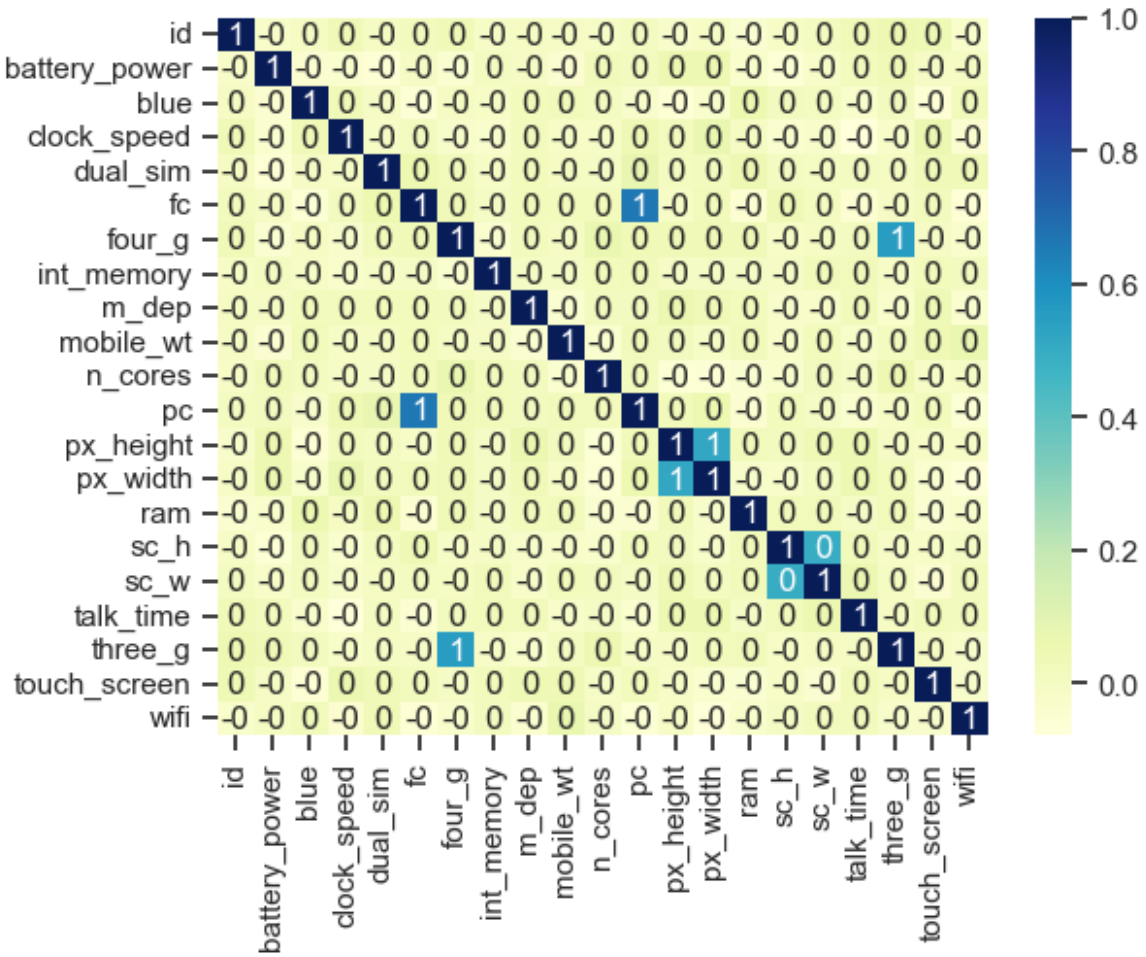

```
# Вывод значений в ячейках
sns.heatmap(data.corr(), annot=True, fmt='.1f')
```

```
<Axes: >
```



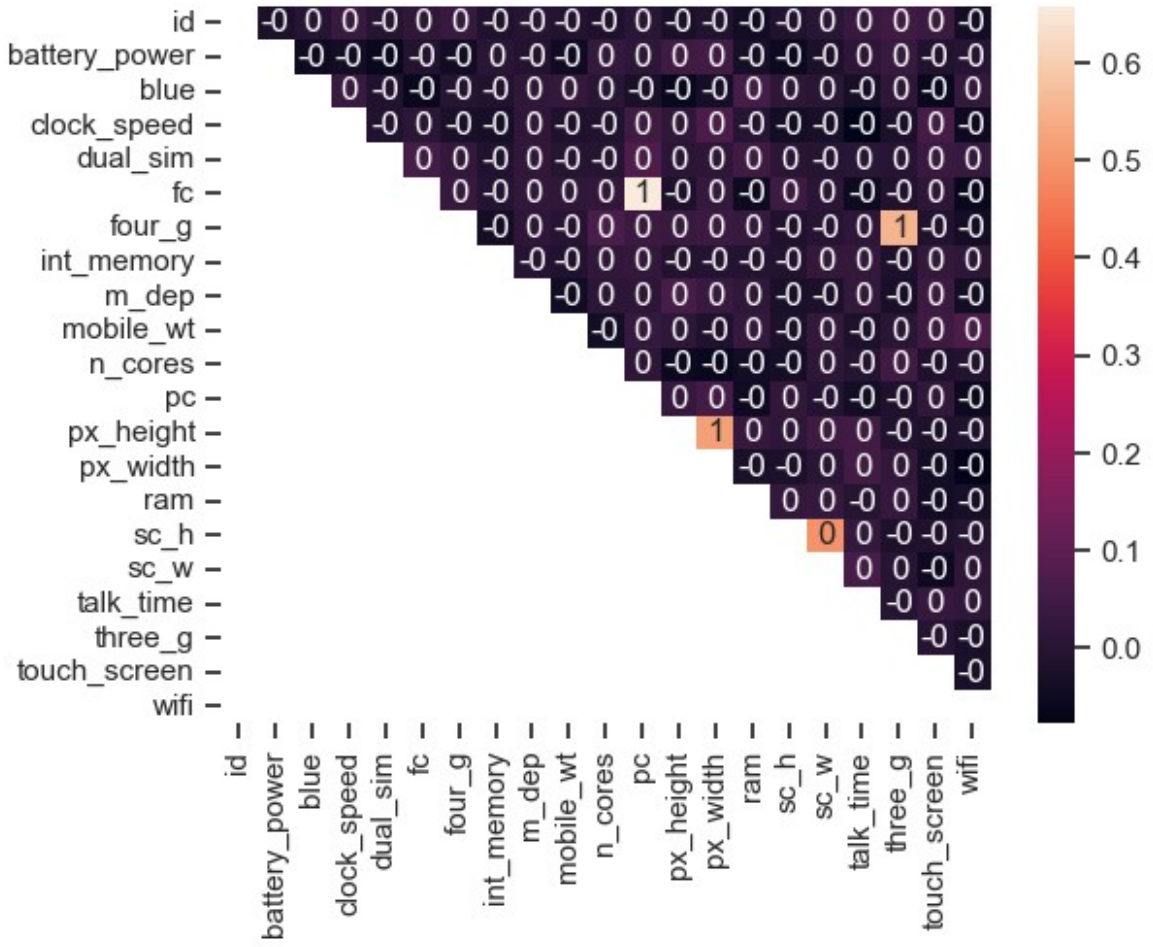

```
# Изменение цветовой гаммы
sns.heatmap(data.corr(), cmap='YlGnBu', annot=True, fmt='.0f')
```

```
<Axes: >
```

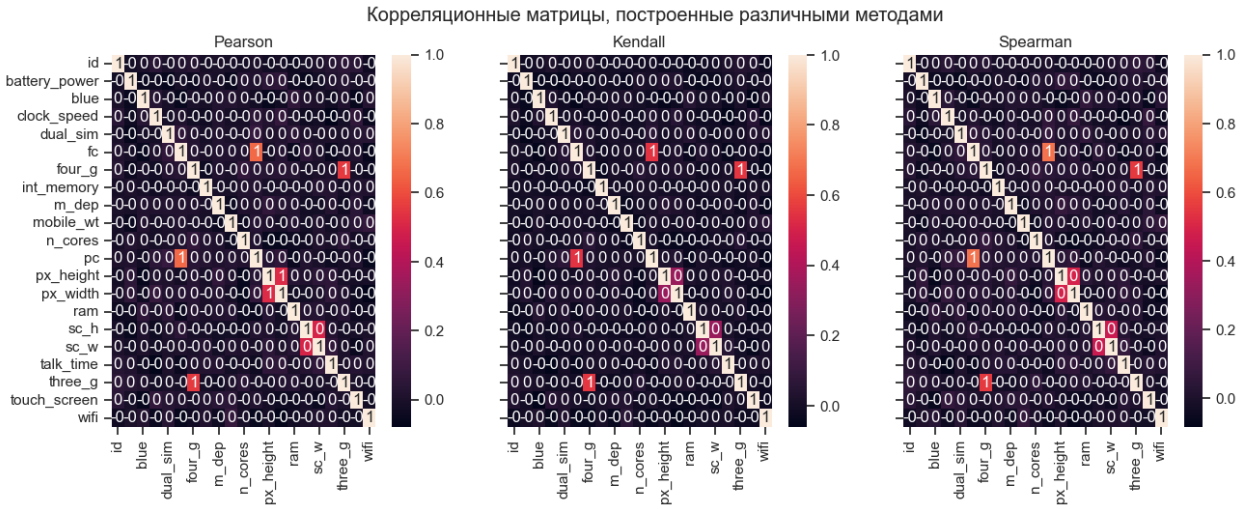



```
# Треугольный вариант матрицы
mask = np.zeros_like(data.corr(), dtype=bool)
# чтобы оставить нижнюю часть матрицы
# mask[np.triu_indices_from(mask)] = True
# чтобы оставить верхнюю часть матрицы
mask[np.tril_indices_from(mask)] = True
sns.heatmap(data.corr(), mask=mask, annot=True, fmt='.0f')
```

```
<Axes: >
```




```
fig, ax = plt.subplots(1, 3, sharex='col', sharey='row',
figsize=(15,5))
sns.heatmap(data.corr(method='pearson'), ax=ax[0], annot=True,
fmt='.0f')
sns.heatmap(data.corr(method='kendall'), ax=ax[1], annot=True,
fmt='.0f')
sns.heatmap(data.corr(method='spearman'), ax=ax[2], annot=True,
fmt='.0f')
fig.suptitle('Корреляционные матрицы, построенные различными
методами')
ax[0].title.set_text('Pearson')
ax[1].title.set_text('Kendall')
ax[2].title.set_text('Spearman')
```




```
fig, ax = plt.subplots(1, 1, sharex='col', sharey='row',
figsize=(10,5))
fig.suptitle('Корреляционная матрица')
sns.heatmap(data.corr(), ax=ax, annot=True, fmt='.1f')
```

```
<Axes: >
```