

1. Použijte neparametrický Spearmanův korelační koeficient pro vyjádření korelace všech dvou proměnných.
2. Testujte normalitu u jednotlivých proměnných.
3. U proměnných s normálním rozdělením testujte korelaci rovněž za použití Pearsonova parametrického korelačního koeficientu.
4. Porovnejte předešlé výsledky.
5. Pomocí metody lineární regrese odhadněte výsledky měření místo chybějících hodnot na listu **Víceproměnná regrese**.
6. Stanovte  $R^2$  lineární regrese, pearsonovu korelaci obou proměnných a diskutujte jejich vzájemnou závislost.
7. Na listu **Víceproměnná regrese** spočítejte statistickou významnost prediktorů nezaměstnanosti.
8. Opakujte analýzu pouze s významnými prediktory.

vojic proměnných na listu **Korelace**.

ametrického korelačního koeficientu.


listu **Regrese**.

ájemný vztah.

losti na vzorku 30 obcí.

| naphthalene | acenaphtylene | acenaphtene | fluorene | phenantrene |
|-------------|---------------|-------------|----------|-------------|
| 0.3350      | 0.0340        | 0.0490      | 1.3210   | 2.3890      |
| 0.1540      | 0.0240        | 0.0270      | 0.2030   | 4.3500      |
| 1.9570      | 0.6320        | 0.3630      | 3.1240   | 4.7480      |
| 1.3110      | 0.6070        | 0.2570      | 3.0960   | 4.5120      |
| 2.4230      | 0.7830        | 0.5000      | 4.5490   | 7.9960      |
| 0.9970      | 0.9060        | 0.2170      | 1.2570   | 2.5610      |
| 2.7270      | 0.2390        | 0.2200      | 2.1560   | 3.2000      |
| 0.1870      | 0.0500        | 0.0310      | 0.2830   | 4.5180      |
| 1.0250      | 0.2350        | 0.1860      | 4.3550   | 3.0000      |
| 0.5510      | 0.0820        | 0.0640      | 0.6330   | 3.7980      |
| 4.0990      | 0.7570        | 0.4300      | 3.9020   | 6.4680      |
| 0.8540      | 0.5080        | 0.1900      | 2.2080   | 7.2790      |
| 2.9900      | 3.4790        | 1.0650      | 6.0760   | 6.4480      |
| 2.2800      | 1.6620        | 0.7150      | 8.3740   | 6.1840      |
| 2.2670      | 0.7560        | 0.4500      | 7.6330   | 6.1760      |
| 0.6010      | 0.2080        | 0.2060      | 1.9190   | 4.9650      |
| 2.7400      | 0.7530        | 0.6760      | 4.3610   | 8.5370      |
| 4.2290      | 0.5820        | 0.6190      | 5.5250   | 9.9340      |
| 0.5080      | 0.0360        | 0.0450      | 1.7220   | 5.5920      |
| 2.6250      | 0.3670        | 0.5410      | 3.6010   | 7.0370      |
| 3.0080      | 0.7640        | 0.4700      | 3.4450   | 7.1940      |
| 2.4190      | 0.4930        | 0.5780      | 3.9640   | 7.6280      |
| 7.1160      | 1.5390        | 0.5700      | 3.5850   | 7.6150      |
| 2.5430      | 0.3660        | 0.3420      | 6.9150   | 9.2100      |
| 0.7540      | 0.0940        | 0.1200      | 2.5040   | 6.1430      |
| 0.9420      | 0.6260        | 0.3350      | 4.1310   | 7.9380      |
| 1.4370      | 0.1640        | 0.2110      | 1.8500   | 3.3610      |
| 0.5930      | 0.1620        | 0.1580      | 1.3690   | 2.8620      |
| 0.7570      | 0.0760        | 0.0860      | 1.6310   | 2.1060      |
| 0.1990      | 0.0630        | 0.1010      | 0.9280   | 2.6540      |
| 0.0970      | 0.0650        | 0.0400      | 0.6890   | 2.0100      |
| 0.1360      | 0.0050        | 0.0310      | 0.2530   | 0.4400      |
| 0.1130      | 0.0320        | 0.0630      | 0.6660   | 3.9210      |
| 0.1750      | 0.0080        | 0.0230      | 0.3770   | 5.9870      |
| 0.1550      | 0.0220        | 0.0370      | 0.5450   | 1.2450      |
| 1.4810      | 0.0260        | 0.0860      | 1.5170   | 3.4500      |
| 0.0790      | 0.0140        | 0.0420      | 0.4010   | 5.8190      |
| 0.1280      | 0.0390        | 0.0440      | 0.3350   | 5.9180      |
| 0.0790      | 0.0060        | 0.0430      | 0.3570   | 1.4480      |
| 0.0840      | 0.0120        | 0.0590      | 0.3990   | 5.1840      |
| 0.0790      | 0.0110        | 0.0240      | 0.2930   | 8.1760      |
| 0.1720      | 0.0180        | 0.0400      | 0.3640   | 0.9650      |
| 0.0480      | 0.0060        | 0.0170      | 0.1530   | 0.6860      |
| 0.1830      | 0.0140        | 0.0210      | 0.4020   | 5.2760      |
| 0.1370      | 0.0040        | 0.0160      | 0.2420   | 0.6490      |
| 0.1340      | 0.0100        | 0.0440      | 0.3890   | 5.1060      |

|         |         |        |         |         |
|---------|---------|--------|---------|---------|
| 0.3020  | 0.1020  | 0.0590 | 0.9040  | 4.1270  |
| 0.2500  | 0.0450  | 0.0540 | 0.5620  | 2.5250  |
| 0.4320  | 0.0430  | 0.0910 | 0.5440  | 4.7710  |
| 1.1000  | 0.0990  | 0.1820 | 1.2640  | 2.5610  |
| 0.6930  | 0.0960  | 0.0730 | 1.0030  | 5.5790  |
| 0.5900  | 0.2100  | 0.1670 | 1.8900  | 4.4920  |
| 0.9220  | 0.2550  | 0.4560 | 2.5320  | 7.8460  |
| 0.2700  | 0.0450  | 0.0410 | 0.6890  | 2.5750  |
| 2.0440  | 0.2530  | 0.2730 | 3.0620  | 6.9810  |
| 1.7580  | 0.1740  | 0.2980 | 3.6910  | 10.2970 |
| 1.3610  | 0.5320  | 0.2380 | 5.7520  | 8.8520  |
| 0.8100  | 0.1220  | 0.1170 | 2.0210  | 10.5730 |
| 2.4600  | 1.7210  | 0.4070 | 6.6220  | 5.0900  |
| 0.9110  | 0.3190  | 0.2200 | 4.0290  | 2.1240  |
| 0.2930  | 0.2960  | 0.0960 | 1.2170  | 4.7560  |
| 4.5740  | 1.9910  | 0.8430 | 7.9400  | 11.9780 |
| 3.9740  | 2.7820  | 0.9040 | 9.3220  | 4.7040  |
| 11.2670 | 12.7290 | 1.6480 | 10.8740 | 6.9610  |
| 1.3600  | 1.8350  | 0.7030 | 8.6810  | 5.4140  |
| 1.9060  | 0.9140  | 0.5800 | 5.9130  | 10.9880 |
| 0.8220  | 0.2880  | 0.2400 | 3.8040  | 8.4070  |
| 1.2230  | 0.3850  | 0.3050 | 5.3710  | 12.0130 |
| 2.0030  | 0.9190  | 0.5430 | 4.3040  | 9.1220  |
| 10.9690 | 3.0550  | 1.8250 | 12.8100 | 4.7520  |
| 2.4650  | 1.2830  | 0.7060 | 5.8540  | 5.4570  |
| 23.3830 | 1.9420  | 1.5770 | 11.1090 | 5.3020  |
| 3.8770  | 1.9050  | 1.0530 | 11.2770 | 10.8130 |
| 13.5230 | 2.8030  | 1.6620 | 12.1940 | 9.2130  |
| 10.1280 | 0.4030  | 0.4970 | 4.1350  | 7.3550  |
| 2.0030  | 0.6970  | 0.3730 | 3.2490  | 6.6860  |
| 0.4660  | 0.0390  | 0.0310 | 1.6020  | 3.6670  |
| 1.6890  | 1.0770  | 0.3920 | 4.9600  | 6.3660  |
| 0.0480  | 0.0810  | 0.0250 | 0.9160  | 3.1690  |
| 0.4860  | 0.0490  | 0.0410 | 1.3100  | 3.3410  |
| 0.1970  | 0.0780  | 0.0560 | 1.7170  | 4.5780  |
| 1.4880  | 0.0840  | 0.1290 | 1.4590  | 2.0460  |
| 0.3400  | 0.0610  | 0.0690 | 1.0890  | 2.9600  |
| 0.2220  | 0.0410  | 0.0540 | 0.6480  | 2.1270  |
| 0.0190  | 0.0250  | 0.0100 | 0.2210  | 1.0650  |
| 0.3610  | 0.0680  | 0.0680 | 1.1300  | 5.8900  |
| 0.2150  | 0.0330  | 0.0590 | 0.4870  | 6.7070  |
| 0.3040  | 0.0340  | 0.0700 | 0.4290  | 3.8830  |
| 2.7230  | 0.2360  | 0.1400 | 0.6570  | 2.2880  |
| 0.3130  | 0.0220  | 0.0470 | 0.8850  | 4.3790  |
| 0.2250  | 0.0340  | 0.0300 | 0.8880  | 2.0420  |
| 0.8170  | 0.0650  | 0.0510 | 0.8390  | 2.8260  |
| 0.7240  | 0.1110  | 0.1410 | 0.8390  | 6.6250  |
| 1.1410  | 0.1130  | 0.1390 | 1.3450  | 3.6890  |
| 0.2530  | 0.0310  | 0.1030 | 0.6200  | 1.7470  |
| 0.3580  | 0.0210  | 0.0650 | 0.8650  | 2.8000  |



|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 0.1670 | 0.0220 | 0.0410 | 0.7010 | 3.6910 |
| 0.0590 | 0.0100 | 0.0130 | 0.2180 | 0.9290 |
| 0.4000 | 0.0290 | 0.0320 | 0.5120 | 3.4910 |
| 0.1370 | 0.0460 | 0.0440 | 0.2880 | 0.1170 |

**anthracene**  
 2.5437  
 4.2336  
 4.6400  
 4.2876  
 8.1435  
 2.5096  
 2.9186  
 4.6902  
 2.7366  
 3.8726  
 6.6419  
 7.3421  
 6.2560  
 6.3339  
 6.0043  
 4.6709  
 8.3418  
 9.9432  
 5.3703  
 7.1314  
 7.1471  
 7.4945  
 7.5255  
 9.0396  
 5.9770  
 7.8596  
 3.4772  
 2.7535  
 1.8223  
 2.6965  
 1.9878  
 0.4709  
 3.8012  
 5.7704  
 1.3499  
 3.1572  
 5.9061  
 5.6190  
 1.5260  
 4.9185  
 8.0057  
 0.8941  
 3.5614  
 5.4001  
 0.7229  
 4.8916

Spearmanův korelační koeficient:

|               | naphthalene | acenaphtylene | acenaphtene |
|---------------|-------------|---------------|-------------|
| naphthalene   |             |               |             |
| acenaphtylene |             |               |             |
| acenaphtene   |             |               |             |
| fluorene      |             |               |             |
| phenantrene   |             |               |             |
| anthracene    |             |               |             |

Pearsonův korelační koeficient:

3.9399  
2.6733  
4.6414  
2.4106  
5.6582  
4.5860  
8.0146  
2.3160  
6.8887  
10.1000  
8.5854  
10.3497  
4.9459  
2.2745  
4.5837  
12.0445  
4.5519  
6.7372  
5.2876  
11.0227  
8.1593  
12.0797  
8.8949  
4.5892  
5.3309  
5.2189  
10.6621  
9.2928  
7.3913  
6.6142  
3.6793  
6.2823  
3.0933  
3.2206  
4.4091  
1.9913  
2.6965  
1.9638  
1.0037  
5.7813  
6.8846  
3.7906  
2.4700  
4.2190  
1.8162  
2.5966  
6.5933  
3.5271  
1.8281  
2.9160

|        |
|--------|
| 3.4409 |
| 0.6640 |
| 3.5313 |
| 0.0712 |



fluorene

phenantrene

anthracene





Pomocí metody lineární regrese a software Statistica odhadněte ze znalosti koncentrací PCB 153 a PCB 180 konstantní část a sklon regresní přímky,  $R^2$  výsledného modelu a Pearsonův korelační koeficient  $r$ .  
 Existuje nějaký vztah mezi  $r$  a  $R^2$ ?  
 Ověřte výsledek pomocí odpovídajících funkcí v Excelu.

| PCB 153 | PCB 180 |
|---------|---------|
| 4.27    | 5.10    |
| 2.56    | 4.72    |
| 5.27    | 5.64    |
| 5.26    | 5.75    |
| 5.27    | 5.64    |
| 5.03    | 6.28    |
| 3.77    | 5.03    |
| 4.58    | 5.37    |
| 5.30    | 5.67    |
| 4.52    | 5.41    |
| 5.16    | 5.57    |
| 4.95    | 5.46    |
| 5.51    | 5.82    |
| 5.21    | 5.74    |
| 4.96    | 5.53    |
| 5.19    | 6.37    |
| 4.61    | 5.33    |
| 4.58    | 5.45    |
| 3.51    | 4.97    |
| 3.79    | 5.13    |
| 4.23    | 5.14    |
| 4.23    | 5.24    |
| 4.13    | 5.26    |
| 5.58    | 5.97    |
| 4.99    | 5.49    |
| 4.68    | 5.43    |
| 4.69    | 5.49    |
| 3.90    | 5.13    |
| 3.69    | 5.00    |
| 3.85    | 5.00    |
| 3.46    | 4.81    |
| 1.66    | 4.80    |
| 2.78    | 5.01    |
| 1.58    | 4.71    |
| 2.27    | 4.68    |
| 2.68    | 4.72    |
| 0.70    | 4.66    |
| 1.58    | 4.88    |
| 1.04    | 4.76    |
| 2.14    | 4.67    |
| 1.17    | 4.56    |
| 1.39    | 4.82    |

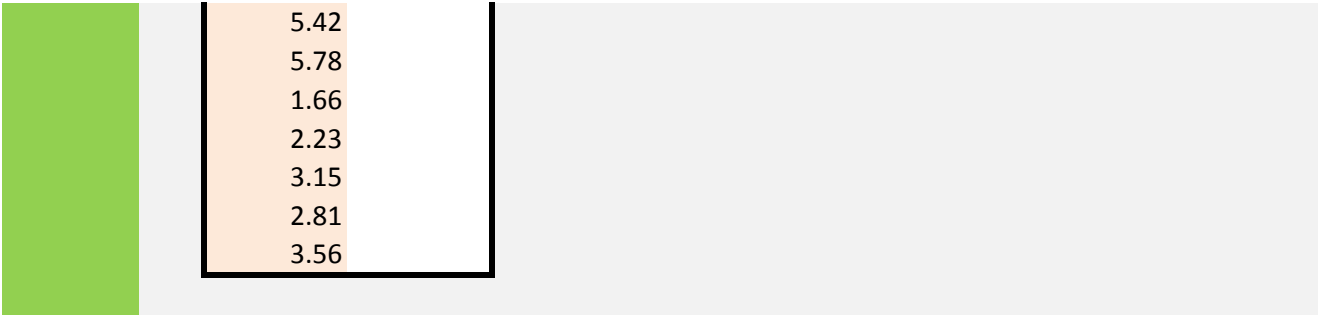
$R^2$  regresního modelu (přímky)

Korelační koeficient  $r$

Konstantní část (hodnota v  $x=0$ )

Sklon regresní přímky

|      |      |
|------|------|
| 1.66 | 4.73 |
| 2.35 | 4.80 |
| 3.46 | 5.05 |
| 3.20 | 5.04 |
| 3.27 | 4.88 |
| 2.88 | 4.82 |
| 4.03 | 5.09 |
| 3.89 | 5.07 |
| 3.69 | 5.11 |
| 3.93 | 5.13 |
| 3.00 | 4.78 |
| 4.64 | 5.32 |
| 5.01 | 5.51 |
| 5.15 | 5.73 |
| 5.61 | 5.94 |
| 5.35 | 5.84 |
| 5.05 | 5.63 |
| 4.92 | 5.51 |
| 4.64 | 5.31 |
| 5.64 | 6.00 |
| 5.96 | 6.21 |
| 5.19 | 5.36 |
| 5.79 | 6.08 |
| 5.29 | 5.80 |
| 4.86 | 5.54 |
| 5.45 | 5.77 |
| 5.12 | 5.66 |
| 5.16 | 5.34 |
| 5.07 | 5.54 |
| 5.67 | 6.79 |
| 5.83 | 6.13 |
| 5.13 | 5.34 |
| 5.08 | 5.62 |
| 4.51 | 5.33 |
| 4.54 | 5.23 |
| 5.70 | 6.82 |
| 5.53 | 5.88 |
| 4.66 | 5.47 |
| 5.06 | 5.62 |
| 4.48 | 5.40 |
| 3.59 | 4.83 |
| 1.66 | 4.86 |
| 2.56 | 4.58 |
| 4.10 | 4.99 |
| 3.10 |      |
| 2.42 |      |
| 4.96 |      |
| 2.04 |      |
| 1.93 |      |
| 4.46 |      |



5.42  
5.78  
1.66  
2.23  
3.15  
2.81  
3.56

.53 výsledky měření PCB 180 místo chybějících hodnot.  
koeficient.

Statistica

Excel



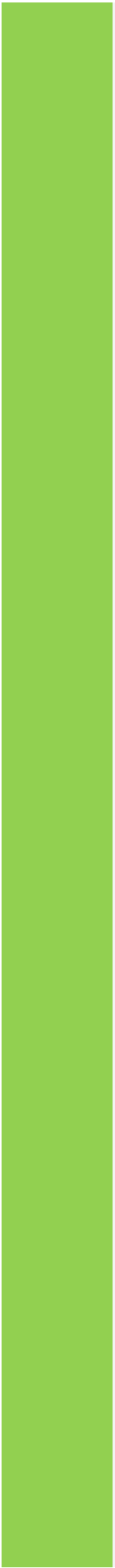


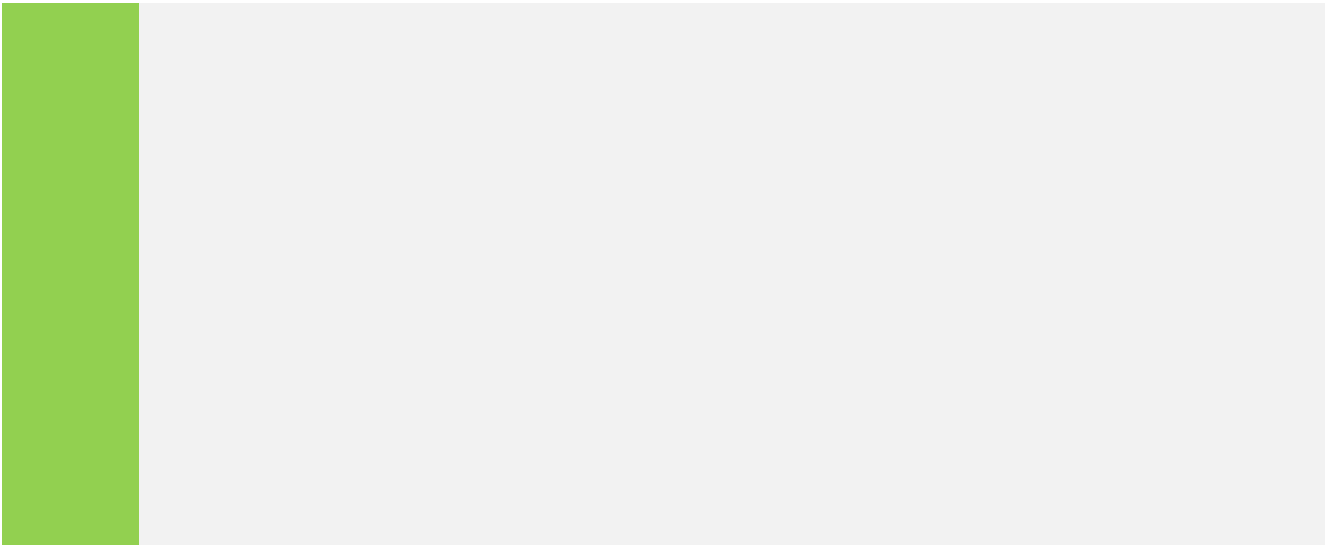


Na níže uvedeném vzorku obcí testujte (v software Statistica), zda lze nezaměstnanost (nezaměstnanost) predikovat pomocí  
 počet obyvatel (obyvatel), podíl důchodců (stari), počet ekonomických subjektů (plyn), zastavení katastru (katastr) a zastavení zahrad (zahrady).  
 Z prediktorů vyberte pouze statisticky významné ( $p < 0,05$ ) a analýzu opakujte. Výsledky uveďte v tabulce níže.

| Název prediktoru | velikost | p |
|------------------|----------|---|
| intercept        |          |   |

| nazev                    | zuj    | obyvatel | stari    | plyn | katastr | zahrady |
|--------------------------|--------|----------|----------|------|---------|---------|
| Adamov                   | 581291 | 4583     | 17.3249  | 0    | 378     | 11      |
| Bílá Voda                | 525227 | 326      | 11.34969 | 1    | 1500    | 22      |
| Blatnička                | 586056 | 449      | 15.14477 | 0    | 882     | 10      |
| Brno                     | 582786 | 378327   | 18.45256 | 0    | 23020   | 2063    |
| Cetenov                  | 563943 | 129      | 19.37985 | 1    | 605     | 15      |
| Čáslav                   | 534005 | 10138    | 17.61689 | 0    | 2646    | 60      |
| Česká Třebová            | 580031 | 15892    | 17.68185 | 0    | 4101    | 251     |
| Dobrá Voda u Českých Běl | 535206 | 2542     | 20.49567 | 0    | 154     | 49      |
| Domamil                  | 590568 | 296      | 17.90541 | 0    | 1096    | 7       |
| Domažlice                | 553425 | 11104    | 16.57961 | 0    | 2461    | 95      |
| Frýdek-Místek            | 598003 | 57523    | 14.90013 | 0    | 5153    | 404     |
| Hamr na Jezeře           | 544337 | 402      | 9.20398  | 1    | 1767    | 7       |
| Horní Lideč              | 542725 | 1398     | 12.37482 | 0    | 721     | 13      |
| Hradec nad Svitavou      | 572691 | 1713     | 14.47753 | 0    | 2471    | 59      |
| Jamné nad Orlicí         | 580392 | 700      | 16.57143 | 0    | 1059    | 31      |
| Jeseník                  | 536385 | 11711    | 17.00965 | 0    | 3823    | 100     |
| Jevíčko                  | 578193 | 2841     | 15.31151 | 0    | 2323    | 46      |
| Kladno                   | 532053 | 68551    | 16.76562 | 0    | 3697    | 208     |
| Lenešice                 | 566322 | 1439     | 13.96803 | 0    | 1371    | 17      |
| Liberec                  | 563889 | 102113   | 16.17424 | 0    | 10609   | 869     |
| Malinová                 | 565377 | 79       | 11.39241 | 1    | 328     | 4       |
| Nepomyšl                 | 566501 | 396      | 14.14141 | 1    | 2821    | 12      |
| Neveklov                 | 530310 | 2524     | 14.1046  | 1    | 5445    | 100     |
| Olomouc                  | 500496 | 99471    | 17.1829  | 0    | 10333   | 531     |
| Ostromeř                 | 573272 | 1365     | 16.63004 | 0    | 1233    | 42      |
| Pernink                  | 555452 | 700      | 17.14286 | 0    | 1571    | 4       |
| Praha                    | 554782 | 1241664  | 17.19531 | 0    | 49610   | 3965    |
| Vlastec                  | 598844 | 211      | 10.90047 | 1    | 750     | 12      |
| Volárna                  | 533882 | 502      | 15.33865 | 1    | 406     | 11      |
| Žulová                   | 541575 | 1276     | 14.42006 | 0    | 1475    | 38      |





h) vyjádřit jako lineární kombinaci následujících prediktorů (faktorů):  
 h subjektů (podnik), zeměpisná délka (delka) a šířka (sirka).  
 Vložte do tabulky níže.

| skoly | nemoc | podnik | nezam | trava | status           | delka    | sirka    |
|-------|-------|--------|-------|-------|------------------|----------|----------|
| 1     | 0     | 824    | 8.54  | 10    | Město            | 16.65861 | 49.30056 |
| 0     | 0     | 55     | 39.32 | 186   | Obec             | 16.91583 | 50.44194 |
| 0     | 0     | 116    | 14.35 | 94    | Obec             | 17.53    | 48.93556 |
| 151   | 11    | 124040 | 9.18  | 326   | Statutární město | 16.59972 | 49.19528 |
| 0     | 0     | 36     | 3.85  | 135   | Obec             | 14.9175  | 50.64444 |
| 10    | 1     | 2275   | 10.3  | 32    | Město            | 15.38972 | 49.91111 |
| 9     | 0     | 3244   | 10.93 | 601   | Město            | 16.44722 | 49.90194 |
| 1     | 0     | 683    | 5.26  | 12    | Obec             | 14.525   | 48.96833 |
| 1     | 0     | 45     | 12.8  | 62    | Obec             | 15.69556 | 49.08333 |
| 8     | 1     | 3061   | 6.94  | 374   | Město            | 12.92972 | 49.44056 |
| 28    | 1     | 12643  | 9.79  | 543   | Statutární město | 18.34833 | 49.68528 |
| 0     | 0     | 112    | 9.66  | 166   | Obec             | 14.83806 | 50.70278 |
| 2     | 0     | 261    | 10.53 | 157   | Obec             | 18.06111 | 49.18111 |
| 1     | 0     | 322    | 11.64 | 286   | Obec             | 16.48056 | 49.71139 |
| 1     | 0     | 149    | 4.23  | 198   | Obec             | 16.63278 | 50.03972 |
| 1     | 1     | 3722   | 10.56 | 482   | Město            | 17.20472 | 50.22944 |
| 1     | 0     | 581    | 13.2  | 154   | Město            | 16.71139 | 49.63222 |
| 32    | 2     | 15617  | 9.86  | 30    | Statutární město | 14.10278 | 50.14722 |
| 0     | 0     | 261    | 13.65 | 18    | Obec             | 13.76583 | 50.37528 |
| 50    | 1     | 35028  | 8.72  | 1912  | Statutární město | 15.05611 | 50.76722 |
| 0     | 0     | 14     | 28.13 | 11    | Obec             | 13.66694 | 50.04778 |
| 0     | 0     | 72     | 20.1  | 767   | Městys           | 13.31333 | 50.21806 |
| 1     | 0     | 628    | 7.64  | 595   | Město            | 14.53278 | 49.75361 |
| 50    | 2     | 27662  | 9.41  | 340   | Statutární město | 17.25083 | 49.59389 |
| 1     | 0     | 309    | 13.46 | 120   | Obec             | 15.54944 | 50.3725  |
| 1     | 0     | 614    | 7.77  | 422   | Obec             | 12.78361 | 50.36583 |
| 445   | 27    | 529377 | 4.88  | 876   | Hlavní město     | 14.42417 | 50.08778 |
| 0     | 0     | 39     | 10.42 | 82    | Obec             | 14.21167 | 49.36556 |
| 0     | 0     | 79     | 15.49 | 2     | Obec             | 15.24056 | 50.09167 |
| 1     | 0     | 345    | 18.83 | 111   | Město            | 17.09861 | 50.30944 |





