Assignment 1 Geo1001

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1 Introduction

This assignment was made for the class Geo1001. A statistical analysis was done using a heat stress measurement dataset with five sensors [1]. Analysing was done in visual studio code using Python 3.7.5. Plotting was done with the use of Matplotlib. Sourcecode of this assignment can be found on GitHub: https://github.com/Lisageers/geo1001_hw1 hoi

2 A1

2.1 Mean statistics

In table 1 the calculated mean statistics of all sensors are displayed. The means of the sensors are quite similar for all variables. The means of the wind variables Direction - True, Wind Speed, Crosswind Speed and Headwind Speed differ the most between sensors. This is logical, because wind can differ greatly over short distances. This is in contrast with other variables like Temperature and Relative Humidity, which are less dynamic and thus have a similar mean for all sensors

| | Mrm A | Mark II | Mean C | Mess D | Hrm E | | | | Standard Develop D | | | Verlance II | Variouse C | Value D | Various E |
|------------------------------|-------------------------|----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|-------------------------------|----------------------------|------------------------------|-----------------------------|-------------------------------|------------------------------|------------------------|-------------------------------|-----------------------------|
| Direction * True | 213,416311145463266 | 193,41231964297251 | 1932389358181832 | 1367115331811183577 | 33742634263434343 | 1117.03281881393 | | | 50 2 5 50 5 1 36 6 1 5 3 3 4 | 35,17913113113633 | 1111534031776361 | 9977 217779 434334 | 770.818(6181 | \$133,530,036255521 | 3315,28316 37333183 |
| What Same | 1.251315345555217 | 1,242124234154188 | 1.371 46321746 6816 | 1.58 548 511 72 588 | 1335242 04342 042 | 1.11 535 517 3 532 4 2 | 1249537244974 | 12 5 521 9 79 7 95 911 4 5 | | 12130124697639 | 1,251154-019142452 | 1.16 16 16 16 17 17 17 | 1.4013211978952973 | 1.7355167696550236 | 1.0:226751333603 |
| Cranwind Speed | E354942-67155E-44 | 0.5335215705215401 | 1,96125511214415.6 | 1,2103032396535295 | 1.4151151311513 | E 96 2 18 5 95 17 E 9 26 9 | 1317115 1555 E 1E | 1.02(06)3225714031 | 1.2847933388483547 | 1,3 5 20 5 71 5 77 1 4 93 5 | 132532764652866 | 1,5753551103.63554 | 1,0423749022049617 | 1.42 (123131 2016) | 1.2 534 984 (1348) |
| Headwind Secret | 11 533255555 437513 | 4.12558513530376414 | 4.2625941955237974 | 1,1815555181-05 | 12 3 0 43 0 4343 0 436 | 1.46 7 32 8 85 5 8 5 4 7 66 | 122010301039734 | 12 27711 833163 887 | | 12191211111111 | 1,03 (04) (11) (32) (327) | 1,2567193159381538 | 1.2717321755325317 | 1.23219271235955 | 0.30 5167 3107 793 5 34 0 4 |
| Temperature | 17,35% 133535566 | 15,853425185554884 | 17.51 2 166216568 | 17,98636218632.51 | | 3,9629973213127863 | 4,877973293739655 | 4.01 20 46 00 452 0551 | 4 (0.31772163701107 | 425264274272613 | | | 1821613218357244 | | |
| Glake Temperature | 21.3465584323434 | 2.75541421551146 | 2.357255542577363 | 21.35529669512916 | 21 2 761 6161 61 6161 5 | 5,25750535193743 | 51 270 7 30 5 82 5 95 2 6 | 5.2426313578 5253 | 7,523155555553425 | 7.53 (6) 77 3 6 4 6 23 (| | 86,0452 685 87516 | | 61.2022525107413 | |
| Wind Chill | 17.535216752 27217 | 17.3 439 2 8 54 8 8 4 62 3 | 17,27,283313139236 | 17,933167525353534 | 1525021212121212 | 4/01/02/07 (4/01/04 | 42 27447532547275 | 4.8 579 7 7 59 2 37 3 12 | 4,669,611,979,977,92 | 427-6927-58-73933 | 182644672377832 | 17,433523777573356 | 15,3411 225 521 5145 3 | 1 5, 55 5 5 52 1 25 1 15 5 16 | 191 3745244852325 |
| Relative Headalty | 75250735257388 | 77,87,9311,793,2,496 | 77.55253167.525354 | 77,94213719674213 | 762301315131315 | 19,331978814151324 | 28,214429749479729 | | 19.24 672 6314976 | 28,187,1782841818 | | | 2746226431461316 | | |
| Heat Stone lades | 17,533538 22779573 | 15311-05118554594 | 17.51523333333333 | 17,321 5245353 4317 | 1525542 @ 4242 @ 45 | 1.5725754445852345 | 3,515255014212517 | 3.51 57 65 59 7 65 5 30 24 | 3,955(4) 420 025 05 | 42552533525236553 | 1439654502166577 | 15. 05157 02365522 | 15,335233551153237 | 13,07642775596240 | 15,475241035213524 |
| Des Polat | 13,332677221324713 | 13,5315352 9719213 | 13,439 246 4743 552 | 12,01551932921775 | 13,3367,5797,97,9797,5 | 211524515557159 | 32 1 627 6 538 5 8 2 67 | 22735349839538 | 3,17382311977997943 | 3,859623011781565 | 5.7.23471 525767792 | 3,636315216856334 | 114114 41413 31111 | 18,471 95 25 525 6 7 2 | 5.423814339751 |
| Product Wel Bull Tennerature | 19,27 (7) (8) (14) 2033 | 19,293516962943294 | 152 586 45185135883 | 13,26115593071039 | 12/10/20/20/20/20/20 | 2,63313220141197 | 2.511972531338138 | 2.591597225951722 | 2.6541254105257197 | 2,5 432 5 54 5 % 21 68 5 | 5,544027115333333 | 5,779 2 52 7 22 3 49 4 2 5 | 7,2352 14459558 7 | 7,844412576535257 | 5.997443-02-07979 |
| Station Persons | 1816,1652552584027 | 1815,657827465632 | 1015,05512512.527 | 18 \$2290 (3) 77 8 42 | | 5, 20 2 32 0 96 5 2 71 1 44 | EJESC 107 4417 17 | 62 33333 65 652 (10.2 | 2.8 284721751933 | 6,248 53359524953 | 15,471 2696111 5-653 | | | 14,99779119911491 | 15,5195134457556 |
| Harmately Province | 1 815,125 (2255 6261 2 | 181 5 6 6 475 1 51 5 25 5 | 181 5,651 5 59 7 17 4 77 7 | 18 9 5 5 5 5 5 6 5 77 3 54 | 18161277797879798 | 6,212333881896132 | 5.8 5 55 7 52 4 25 21 2 5 5 | 62 358 47177535 8233 | 3.9(2)(523(3)512) | 5239519533414554 | 35.46753838313314 | 26,52556775246246 | 17,673623 5556535 | 24952325535446234 | 35,532,7853571534 |
| Allede | 23.55787592651751 | 31 155 553 967 676 | 31315251524955 | -31.453193219377327 | 13.56 2121 2 2121 2 | 51.519474.752851 | 58,4351(1564) 7216 | 51 27251554372564 | 492 31655511 343511 | \$1,557 532 477 \$17 8 3 | 26926411431221113 | 25452853396723 | 2695,3246241346.75 | 24572215855555 | 2692,3533637573307 |
| Desity Atlinda | 137,3166287431637 | 133,3977344425403 | | 1 32 41 1 17 3 15 1 55 1 55 | 138.94 | 162,51513233332172 | 1 63 - 91 1 31 3 79 7 15 4 96 | 1642733963297163 | 162,53772522307755 | 172,281153101628 | 2672 1.214 (24722303 | RESTRIBUTED | 269864812971121962 | 26516.1257325273 | 29714292759292192 |
| NA Wel Hall Tenn malace | 13,351342618353461 | 15,556515265351325 | 19.53 (03.695 (97) 797 | 13,835,050312694 | 19,536 5 5 5 5 5 5 5 5 5 5 | 2(64)3) €32-8314 | 32 319729344565936 | 3,2373259;73593957 | 3,1512511355343217 | 2,87(15501300055 | 1 8 2 1 2 1 8 7 5 7 5 3 7 5 6 | 5,51523445223.35 | 11,45127505971154 | 5,557 4341 3355 4652 | 5.02153325-02555 |
| WHET | 17.23 (02) 45 (25 (6 7 | 17,321971921941162 | 17,2239292 819330 | 17,1767967863461 | 172 8533333333334 | 4.8 557 67 5317 27 | 2,97505521-035023 | 4,8 577 6 5 85 7 12 5 241 | 3,937 % 6313 5 96 8 96 | 1,512171719547455 | 162 2021 98 5 68 576 1 | 11.0131470155 | 18245421421828281 | 13,00719499017019 | 15,459671531676462 |
| TWL | 311,33233214652676 | 253,472 53525 (0.255) | 301.5597374777598 | 310.23 (967 912 82) | 2540 5303 3 303 4 | 252441834006 | 25 (1817) (1928) 46 | 27.69624164573333 | 24,51 95 4495 4245 225 | 33,513361161032334 | 51 47653541 967 974 | 75 (4 6 52 2) 3 6 26 5 1 2 | 755,12031358 5263 | 515213517273444 | 1253 8 2262 8253 83 |
| | | | | | | | | | | | | | | | |

2.2 Histograms

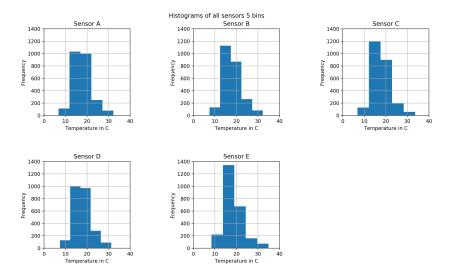


Figure 1: Histograms of all sensors with 5 bins

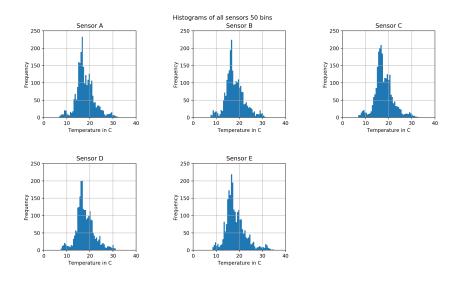


Figure 2: Histograms of all sensors with 50 bins

In figures 1 and 2, the histograms of the temperature of the five sensors are displayed. As can be seen, there is a significant difference between the figures

due to the bin sizes. Figure 2 with binsize 50 is much more detailed, which makes this figure more useful for analysation. The binsize calculated with Rice's rule is approximately in the middle between 5 and 50. Rice's rule $2 * \sqrt[3]{N}$ with N = 2474 gives 27 as a number of bins.

2.3 Frequency polygons

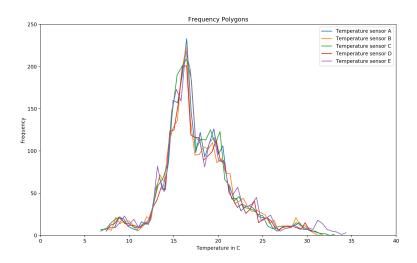


Figure 3: Frequency polygon of all sensors for the variable Temperature

2.4 Boxplots

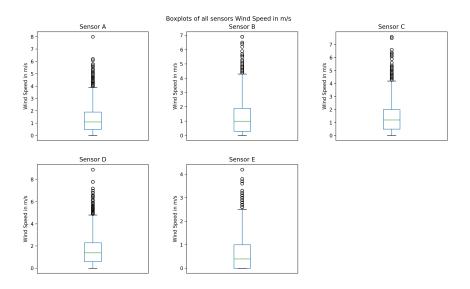


Figure 4: Boxplots of all sensors for the variable Wind Speed

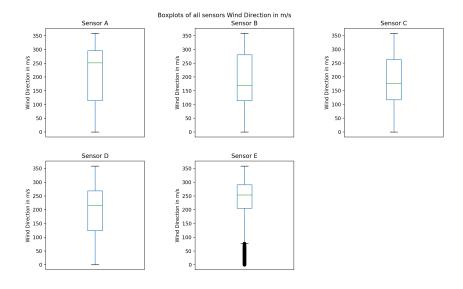


Figure 5: Boxplots of all sensors for the variable Wind Direction

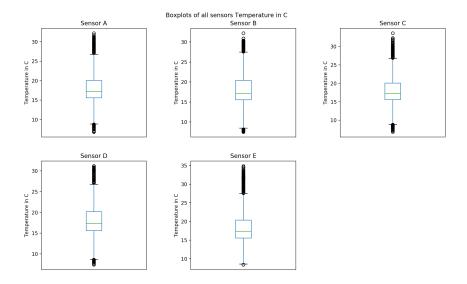


Figure 6: Boxplots of all sensors for the variable Temperature

3 A2

3.1 Functions Temperature

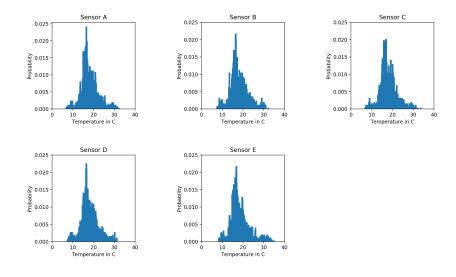


Figure 7: Probability Mass Functions of Temperature for all sensors

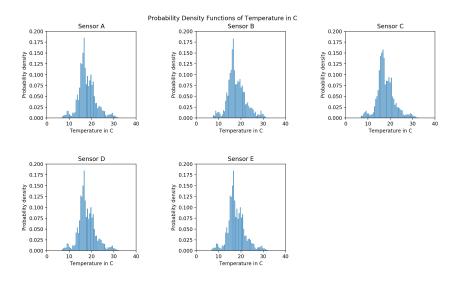


Figure 8: Probability Density Functions of Temperature for all sensors

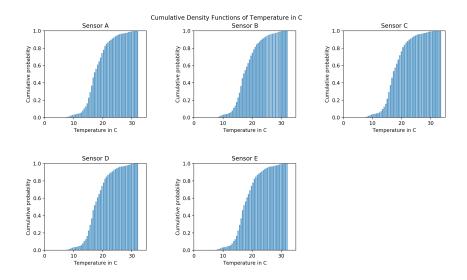


Figure 9: Cumilative Density Functions of Temperature for all sensors

3.2 Functions Wind Speed

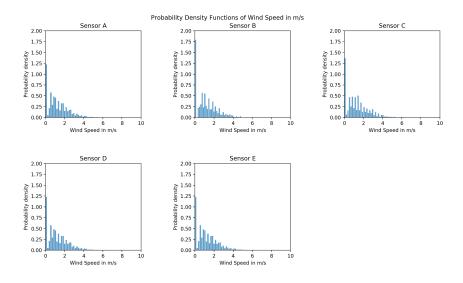


Figure 10: Probability Density Functions of Wind Speed for all sensors

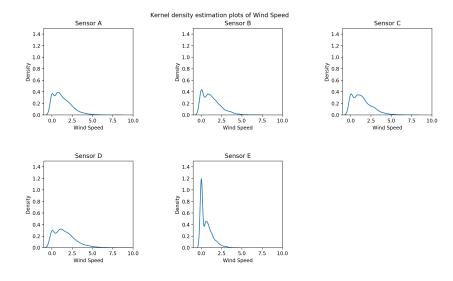


Figure 11: Kernel Density Estimation of Wind Speed for all sensors

4 A3

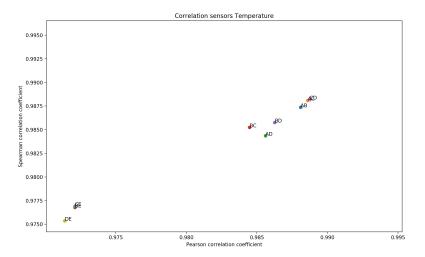


Figure 12: Spearman and Pearson correlation plot for all sensor combinations of Temperature ${\bf P}$

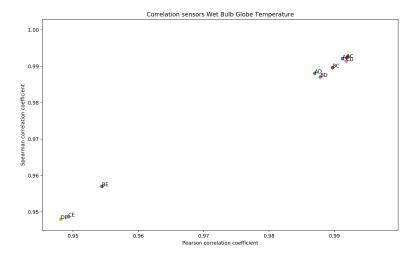


Figure 13: Spearman and Pearson correlation plot for all sensor combinations of Wet Bulb Globe Temperature

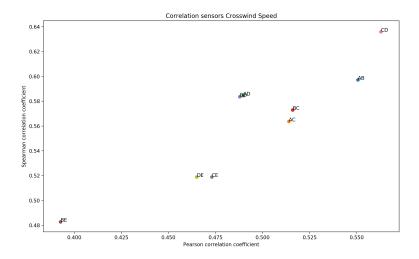


Figure 14: Spearman and Pearson correlation plot for all sensor combinations of Crosswind Speed

5 A4

5.1 Cumulative Density Functions

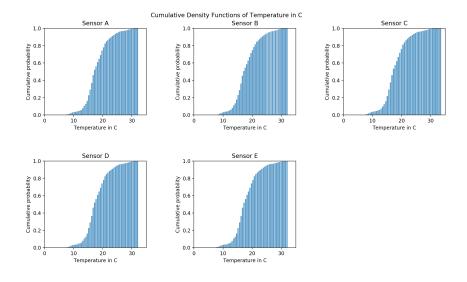


Figure 15: Cumilative Density Functions of Temperature for all sensors

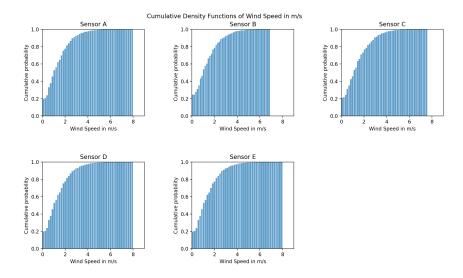


Figure 16: Cumilative Density Functions of Wind Speed for all sensors

5.2 Confidence Intervals

Table 2: Confidence intervals of Temperature for all sensors Temperature

- A (17.81214113267346, 18.126065652463858)
- B (17.90472689963894, 18.226129320070267)
- C (17.754926235060246, 18.071347006653575)
- $D \quad (17.83814660824381, \, 18.15457772482005)$
- E (18.181933946027776, 18.525944841851015)

Table 3: Confidence intervals of Wind Speed for all sensors ind Speed

- A (1.246227038990971, 1.3343868543854427)
- B (1.1971663346979249, 1.287082453670411)
- C = (1.3243037885948932, 1.418622646328308)
- D (1.5296480419653757, 1.633650260379006)
- E = (0.5680599051948441, 0.6244249432900044)

5.3 Hypothesis Test

Table 4: Confidence intervals of Wind Speed for all sensors

| 100010 | i. Commediate mice care of | |
|--------------|----------------------------|------------------------|
| | Temperature | Wind Speed |
| p-value E, D | 0.0027270117155346967 | 4.899592405994867e-212 |
| p-value C, D | 0.4657972008220813 | 4.610149126224334e-09 |
| p-value B, C | 0.18562772895626528 | 9.40075204600199e-05 |
| p-value A, B | 0.40185871871215073 | 0.13247973112544695 |

References

[1] Daniela Maiullari and Clara Garcia Sanchez. Measured Climate Data in Rijsenhout, 8 2020.