Assignment 1 Geo1001

Lisa Geers

September 21, 2020

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

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

Table 1	Mean	Statistics	of al	Lsensors

	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	1112/032/1001303			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	133524264342642	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	1,96125511214418.6	1,2103032396535295	1.4151151311511	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 (0) 46 (0) 450 (651)	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	124066666666666	2,63313220141197	2.511972531338135	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	1 10 5 25 55 55 53 577 3 54	18161277797879798	6,21233351196132	5.8 5 55 7 52 4 25 21 2 5 5	62 358 47177535 8233	3.9(2)(525(3)512)	5239519533414554	35.46753838313314	26,52556775246246	17,673623 5556535	24952325535446234	35,532,7853571534
Allede	23.55787592651751	31 15 5 5 531 967 17 6	31315251524955	-31.453193219377327	13.56 2121 2 2121 2	51.519474.752851	58,4351(1564) 7216	51 27251554372564	492 31655 (1 5435))	\$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

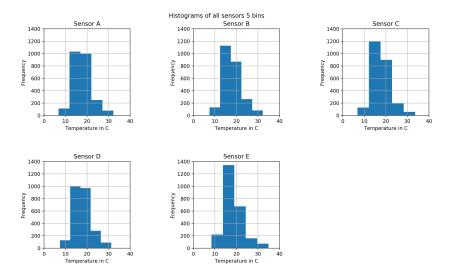


Figure 1: Histograms of all sensors with 5 bins

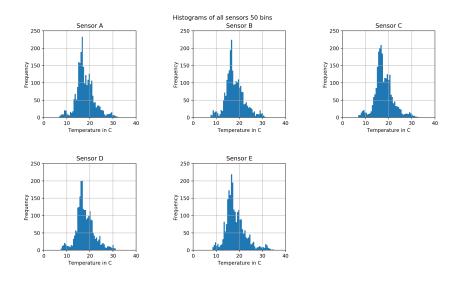


Figure 2: Histograms of all sensors with 50 bins

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

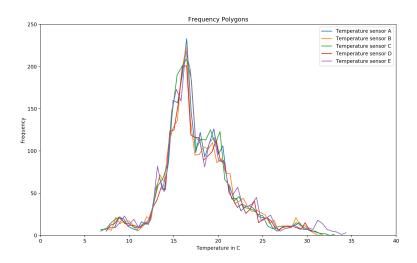


Figure 3: Frequency polygon of all sensors for the variable Temperature

2.4 Boxplots

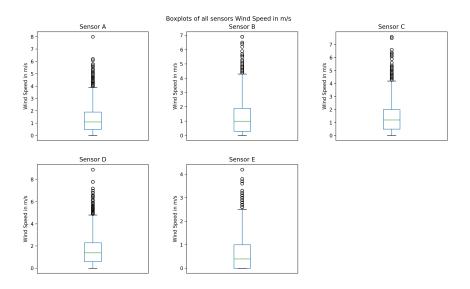


Figure 4: Boxplots of all sensors for the variable Wind Speed

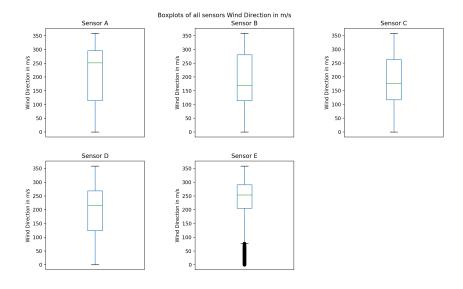


Figure 5: Boxplots of all sensors for the variable Wind Direction

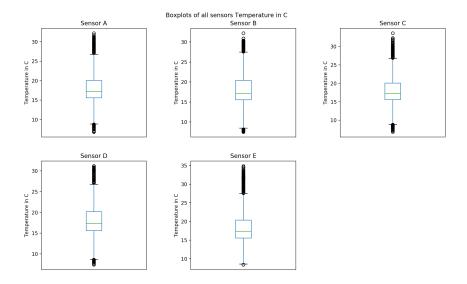


Figure 6: Boxplots of all sensors for the variable Temperature

3 A2

3.1 Functions Temperature

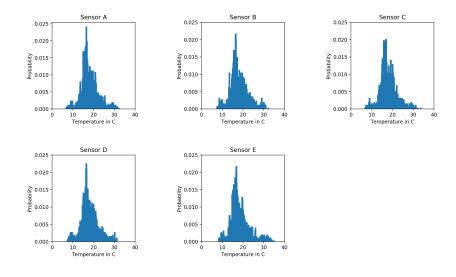


Figure 7: Probability Mass Functions of Temperature for all sensors

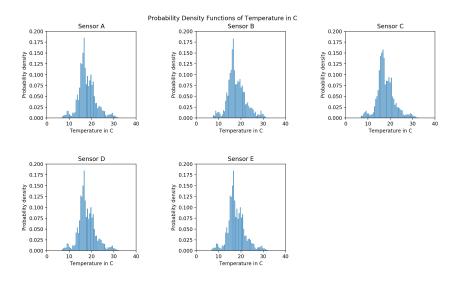


Figure 8: Probability Density Functions of Temperature for all sensors

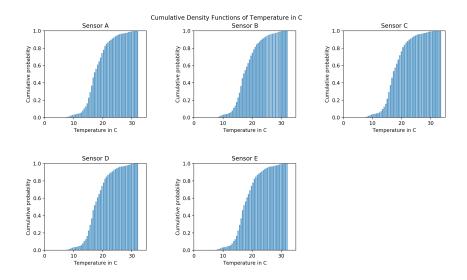


Figure 9: Cumilative Density Functions of Temperature for all sensors

3.2 Functions Wind Speed

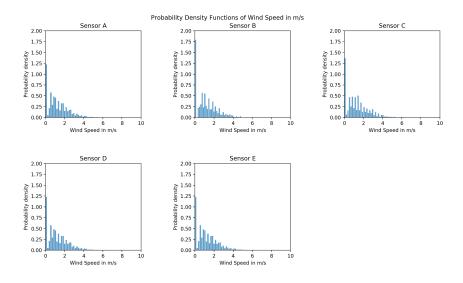


Figure 10: Probability Density Functions of Wind Speed for all sensors

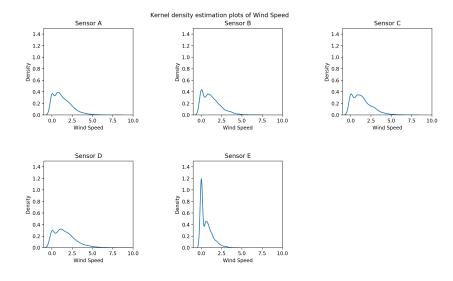


Figure 11: Kernel Density Estimation of Wind Speed for all sensors

4 A3

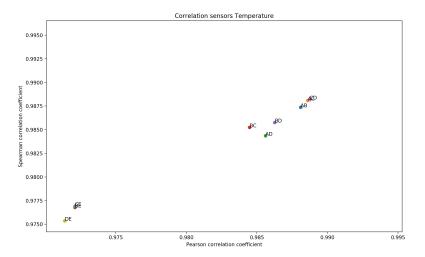


Figure 12: Spearman and Pearson correlation plot for all sensor combinations of Temperature ${\bf P}$

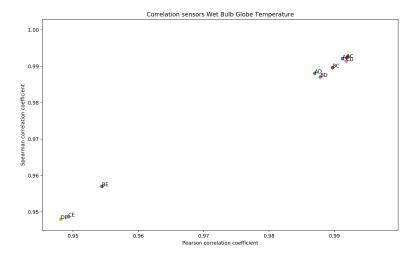


Figure 13: Spearman and Pearson correlation plot for all sensor combinations of Wet Bulb Globe Temperature

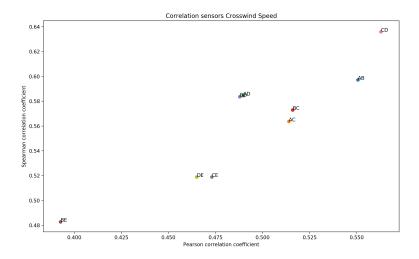


Figure 14: Spearman and Pearson correlation plot for all sensor combinations of Crosswind Speed

5 A4

5.1 Cumulative Density Functions

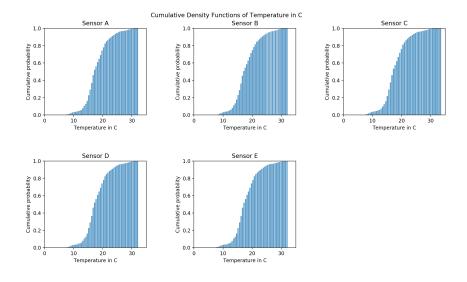


Figure 15: Cumilative Density Functions of Temperature for all sensors

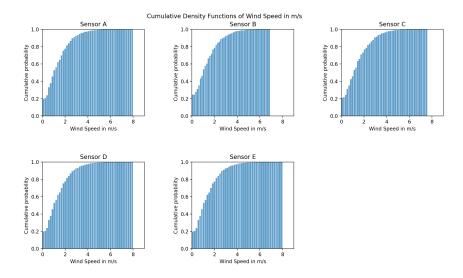


Figure 16: Cumilative Density Functions of Wind Speed for all sensors

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.