

LAB2_CSE3506

Sparsh Raj_19BPS1028

29/01/2022

R Markdown

```
data=read.csv("SolarPond.csv",header=TRUE)
head(data)
```

##	Time	Tinf	Twi	UCZ	NCZ	LCZ0	LCZ3	LCZ5	Two0	Two3	Two5	T10	T13	T15	W0	W3
## 1	06:00	29	28	28	28	28	28	28	28	28.0	28.0	0	0.0	0.0	0.00	0.00
## 2	06:30	29	28	28	28	28	28	28	28	28.0	28.0	0	0.0	0.0	0.00	0.00
## 3	07:00	29	28	28	28	28	28	28	28	28.0	28.0	0	0.0	0.0	0.00	0.00
## 4	07:30	30	29	29	29	29	29	29	29	29.0	29.2	0	0.0	0.2	0.00	0.00
## 5	08:00	30	29	29	30	32	32	32	29	29.7	30.2	0	0.7	1.2	0.00	36.58
## 6	08:30	30	29	29	31	33	33	33	30	30.4	30.6	1	1.4	1.6	52.25	73.15
##	W5	April	May	June	W	n0			n3		n5		n5.1		X T20	
## 1	0.00	200	210	NA	252	0.000000	0.0000000		0.0000000		0.0000000		0.0000000		0	
## 2	0.00	260	280	NA	336	0.000000	0.0000000		0.0000000		0.0000000		0.0000000		0	
## 3	0.00	290	300	NA	360	0.000000	0.0000000		0.0000000		0.0000000		0.0000000		0	
## 4	10.45	312	320	NA	384	0.000000	0.0000000		0.0000000		2.721354		2.721354		0	
## 5	62.70	340	360	NA	432	0.000000	8.466435		8.466435		14.513889		14.513889		3	
## 6	83.60	390	420	NA	504	10.36706	14.513889		4.146825		16.587302		6.220238		4	
##	T23	T25	Q0		Q3		Q5		E0		E3		E5			
## 1	0	0	0.00		0.00		0.00		0.00		0.00000000		0.0			
## 2	0	0	0.00		0.00		0.00		0.00		0.00000000		0.0			
## 3	0	0	0.00		0.00		0.00		0.00		0.00000000		0.0			
## 4	0	0	0.00		0.00		0.00		0.00		0.00000000		0.0			
## 5	3	3	156.75	156.75	156.75	0.00	0.23333333		0.4							
## 6	4	4	209.00	209.00	209.00	0.25	0.35000000		0.4							

Data Sampling

```
data1<-data[1:5,]
data2<-data[6:15,]
data3<-data[15:26,]
```

data1

##	Time	Tinf	Twi	UCZ	NCZ	LCZ0	LCZ3	LCZ5	Two0	Two3	Two5	T10	T13	T15	W0	W3
## 1	06:00	29	28	28	28	28	28	28	28	28.0	28.0	0	0.0	0.0	0	0.00
## 2	06:30	29	28	28	28	28	28	28	28	28.0	28.0	0	0.0	0.0	0	0.00
## 3	07:00	29	28	28	28	28	28	28	28	28.0	28.0	0	0.0	0.0	0	0.00
## 4	07:30	30	29	29	29	29	29	29	29	29.0	29.2	0	0.0	0.2	0	0.00
## 5	08:00	30	29	29	30	32	32	32	29	29.7	30.2	0	0.7	1.2	0	36.58
##	W5	April	May	June	W	n0	n3	n5	n5.1	X	T20	T23	T25			
## 1	0.00	200	210	NA	252	0	0.0000000	0.0000000	0.0000000	0.0000000	0	0	0			
## 2	0.00	260	280	NA	336	0	0.0000000	0.0000000	0.0000000	0.0000000	0	0	0			
## 3	0.00	290	300	NA	360	0	0.0000000	0.0000000	0.0000000	0.0000000	0	0	0			
## 4	10.45	312	320	NA	384	0	0.0000000	0.0000000	2.721354	2.721354	0	0	0			
## 5	62.70	340	360	NA	432	0	8.466435	8.466435	14.513889	14.513889	3	3	3			
##	Q0	Q3	Q5	E0	E3	E5										
## 1	0.00	0.00	0.00	0	0.00000000	0.0										
## 2	0.00	0.00	0.00	0	0.00000000	0.0										
## 3	0.00	0.00	0.00	0	0.00000000	0.0										
## 4	0.00	0.00	0.00	0	0.00000000	0.0										
## 5	156.75	156.75	156.75	0	0.23333333	0.4										

data2

##	Time	Tinf	Twi	UCZ	NCZ	LCZ0	LCZ3	LCZ5	Two0	Two3	Two5	T10	T13	T15	W0
## 6	08:30	30	29.0	29	31	33	33	33	30.0	30.4	30.6	1.0	1.4	1.6	52.25
## 7	09:00	30	29.0	29	32	35	35	35	30.0	30.7	31.1	1.0	1.7	2.1	52.25
## 8	09:30	31	29.0	29	33	37	37	37	30.3	31.0	31.5	1.3	2.0	2.5	67.93
## 9	10:00	31	29.0	30	35	39	39	39	31.0	31.4	32.0	2.0	2.4	3.0	104.50
## 10	10:30	32	30.0	30	36	41	41	41	32.0	32.8	33.5	2.0	2.8	3.5	104.50
## 11	11:00	33	31.0	32	37	42	42	42	33.4	33.9	34.7	2.4	2.9	3.7	125.40
## 12	11:30	34	32.0	33	36	44	44	44	34.5	35.0	36.0	2.5	3.0	4.0	130.63
## 13	12:00	35	33.0	34	37	46	46	46	35.5	36.2	37.0	2.5	3.2	4.0	130.63
## 14	12:30	36	34.0	35	38	48	48	48	36.5	37.5	38.4	2.5	3.5	4.4	130.63
## 15	13:00	36	34.4	36	39	50	50	50	37.5	38.0	39.5	3.1	3.6	5.1	161.98
##	W3	W5	April	May	June	W	n0	n3	n5	n5.1					
## 6	73.15	83.60	390	420	NA	504	10.36706	14.51389	4.146825	16.58730					
## 7	88.83	109.73	435	460	NA	552	9.46558	16.09149	6.625906	19.87772					
## 8	104.50	130.63	540	500	NA	600	11.32083	17.41667	6.095833	21.77083					
## 9	125.40	156.75	542	560	NA	672	15.55060	18.66071	3.110119	23.32589					
## 10	146.30	182.88	598	640	NA	768	13.60677	19.04948	5.442708	23.81185					
## 11	151.53	193.33	680	680	NA	816	15.36765	18.56924	3.201593	23.69179					
## 12	156.75	209.00	715	800	NA	960	13.60677	16.32812	2.721354	21.77083					
## 13	167.20	209.00	862	880	NA	1056	12.36979	15.83333	3.463542	19.79167					
## 14	182.88	229.90	900	970	NA	1164	11.22208	15.71091	4.488832	19.75086					
## 15	188.10	266.48	890	940	NA	1128	14.35949	16.67553	2.316046	23.62367					
##	X	T20	T23	T25	Q0	Q3	Q5	E0	E3	E5					
## 6	6.220238	4.0	4.0	4.0	209.00	209.00	209.00	0.2500000	0.3500000	0.4000000					
## 7	10.412138	6.0	6.0	6.0	313.50	313.50	313.50	0.1666667	0.2833333	0.3500000					
## 8	10.450000	8.0	8.0	8.0	418.00	418.00	418.00	0.1625000	0.2500000	0.3125000					
## 9	7.775298	10.0	10.0	10.0	522.50	522.50	522.50	0.2000000	0.2400000	0.3000000					
## 10	10.205078	11.0	11.0	11.0	574.75	574.75	574.75	0.1818182	0.2545455	0.3181818					
## 11	8.324142	11.0	11.0	11.0	574.75	574.75	574.75	0.2181818	0.2636364	0.3363636					
## 12	8.164062	12.0	12.0	12.0	627.00	627.00	627.00	0.2083333	0.2500000	0.3333333					
## 13	7.421875	13.0	13.0	13.0	679.25	679.25	679.25	0.1923077	0.2461538	0.3076923					
## 14	8.528780	14.0	14.0	14.0	731.50	731.50	731.50	0.1785714	0.2500000	0.3142857					
## 15	9.264184	15.6	15.6	15.6	815.10	815.10	815.10	0.1987179	0.2307692	0.3269231					

data3

##	Time	Tinf	Twi	UCZ	NCZ	LCZ0	LCZ3	LCZ5	Two0	Two3	Two5	T10	T13	T15	W0
## 15	13:00	36	34.4	36	39	50	50.0	50	37.5	38.0	39.5	3.1	3.6	5.1	161.98
## 16	13:30	36	34.0	37	41	47	47.0	47	37.0	37.5	38.4	3.0	3.5	4.4	156.75
## 17	14:00	35	33.0	36	39	45	45.0	44	35.5	36.0	37.0	2.5	3.0	4.0	130.63
## 18	14:30	35	33.0	34	37	43	42.0	42	35.0	36.0	36.5	2.0	3.0	3.5	104.50
## 19	15:00	34	33.0	34	35	41	39.0	39	35.0	35.2	36.0	2.0	2.2	3.0	104.50
## 20	15:30	33	32.0	33	34	39	37.5	38	33.6	34.0	34.8	1.6	2.0	2.8	83.60
## 21	16:00	33	32.5	33	34	37	36.0	36	33.5	34.0	34.6	1.0	1.5	2.1	52.25
## 22	16:30	33	32.0	33	33	35	35.0	35	32.8	33.2	33.7	0.8	1.2	1.7	41.80
## 23	17:00	32	32.0	32	32	33	32.0	34	32.0	32.5	33.0	0.0	0.5	1.0	0.00
## 24	17:30	32	32.0	32	32	32	32.0	32	32.0	32.0	32.5	0.0	0.0	0.5	0.00
## 25	18:00	31	32.0	32	32	32	32.0	32	32.0	32.0	32.0	0.0	0.0	0.0	0.00
## NA	<NA>	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
##	W3	W5	April	May	June	W	n0	n3	n5	n5.1					
## 15	188.10	266.48	890	940	NA	1128	14.359486	16.675532	2.316046	23.623670					
## 16	182.88	229.90	888	900	NA	1080	14.513889	16.932870	2.418981	21.287037					
## 17	156.75	209.00	832	850	NA	1020	12.806373	15.367647	2.561275	20.490196					
## 18	156.75	182.88	780	790	NA	948	11.023207	16.534810	5.511603	19.290612					
## 19	114.95	156.75	740	760	NA	912	11.458333	12.604167	1.145833	17.187500					
## 20	104.50	146.30	683	700	NA	840	9.952381	12.440476	2.488095	17.416667					
## 21	78.38	109.73	611	640	NA	768	6.803385	10.205078	3.401693	14.287109					
## 22	62.70	88.83	503	560	NA	672	6.220238	9.330357	3.110119	13.218006					
## 23	26.13	52.25	430	460	NA	552	0.000000	4.732790	4.732790	9.465580					
## 24	0.00	26.13	342	350	NA	420	0.000000	0.000000	0.000000	6.220238					
## 25	0.00	0.00	238	300	NA	360	0.000000	0.000000	0.000000	0.000000					
## NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
##	X	T20	T23	T25	Q0	Q3	Q5	E0	E3						
## 15	9.264184	15.6	15.6	15.6	815.100	815.100	815.100	0.1987179	0.2307692						
## 16	6.773148	13.0	13.0	13.0	679.250	679.250	679.250	0.2307692	0.2692308						
## 17	7.683824	12.0	12.0	11.0	627.000	627.000	574.750	0.2083333	0.2500000						
## 18	8.267405	10.0	9.0	9.0	522.500	470.250	470.250	0.2000000	0.3333333						
## 19	5.729167	8.0	6.0	6.0	418.000	313.500	313.500	0.2500000	0.3666667						
## 20	7.464286	7.0	5.5	6.0	365.750	287.375	313.500	0.2285714	0.3636364						
## 21	7.483724	4.5	3.5	3.5	235.125	182.875	182.875	0.2222222	0.4285714						
## 22	6.997768	3.0	3.0	3.0	156.750	156.750	156.750	0.2666667	0.4000000						
## 23	9.465580	1.0	0.0	2.0	52.250	0.000	104.500	0.0000000	0.0000000						
## 24	6.220238	0.0	0.0	0.0	0.000	0.000	0.000	0.0000000	0.0000000						
## 25	0.000000	0.0	0.0	0.0	0.000	0.000	0.000	0.0000000	0.0000000						
## NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
##	E5														
## 15	0.3269231														
## 16	0.3384615														
## 17	0.3636364														
## 18	0.3888889														
## 19	0.5000000														
## 20	0.4666667														
## 21	0.6000000														
## 22	0.5666667														
## 23	0.5000000														
## 24	0.0000000														
## 25	0.0000000														
## NA	NA														

Task1

```
rbind (data1, data2)
```

##	Time	Tinf	Twi	UCZ	NCZ	LCZ0	LCZ3	LCZ5	Two0	Two3	Two5	T10	T13	T15	W0
## 1	06:00	29	28.0	28	28	28	28	28	28.0	28.0	28.0	0.0	0.0	0.0	0.00
## 2	06:30	29	28.0	28	28	28	28	28	28.0	28.0	28.0	0.0	0.0	0.0	0.00
## 3	07:00	29	28.0	28	28	28	28	28	28.0	28.0	28.0	0.0	0.0	0.0	0.00
## 4	07:30	30	29.0	29	29	29	29	29	29.0	29.0	29.2	0.0	0.0	0.2	0.00
## 5	08:00	30	29.0	29	30	32	32	32	29.0	29.7	30.2	0.0	0.7	1.2	0.00
## 6	08:30	30	29.0	29	31	33	33	33	30.0	30.4	30.6	1.0	1.4	1.6	52.25
## 7	09:00	30	29.0	29	32	35	35	35	30.0	30.7	31.1	1.0	1.7	2.1	52.25
## 8	09:30	31	29.0	29	33	37	37	37	30.3	31.0	31.5	1.3	2.0	2.5	67.93
## 9	10:00	31	29.0	30	35	39	39	39	31.0	31.4	32.0	2.0	2.4	3.0	104.50
## 10	10:30	32	30.0	30	36	41	41	41	32.0	32.8	33.5	2.0	2.8	3.5	104.50
## 11	11:00	33	31.0	32	37	42	42	42	33.4	33.9	34.7	2.4	2.9	3.7	125.40
## 12	11:30	34	32.0	33	36	44	44	44	34.5	35.0	36.0	2.5	3.0	4.0	130.63
## 13	12:00	35	33.0	34	37	46	46	46	35.5	36.2	37.0	2.5	3.2	4.0	130.63
## 14	12:30	36	34.0	35	38	48	48	48	36.5	37.5	38.4	2.5	3.5	4.4	130.63
## 15	13:00	36	34.4	36	39	50	50	50	37.5	38.0	39.5	3.1	3.6	5.1	161.98
##	W3	W5	April	May	June	W	n0	n3	n5	n5.1					
## 1	0.00	0.00	200	210	NA	252	0.000000	0.000000	0.000000	0.000000					
## 2	0.00	0.00	260	280	NA	336	0.000000	0.000000	0.000000	0.000000					
## 3	0.00	0.00	290	300	NA	360	0.000000	0.000000	0.000000	0.000000					
## 4	0.00	10.45	312	320	NA	384	0.000000	0.000000	0.000000	2.721354					
## 5	36.58	62.70	340	360	NA	432	0.000000	8.466435	8.466435	14.513889					
## 6	73.15	83.60	390	420	NA	504	10.36706	14.513889	4.146825	16.587302					
## 7	88.83	109.73	435	460	NA	552	9.46558	16.091486	6.625906	19.877717					
## 8	104.50	130.63	540	500	NA	600	11.32083	17.416667	6.095833	21.770833					
## 9	125.40	156.75	542	560	NA	672	15.55060	18.660714	3.110119	23.325893					
## 10	146.30	182.88	598	640	NA	768	13.60677	19.049479	5.442708	23.811849					
## 11	151.53	193.33	680	680	NA	816	15.36765	18.569240	3.201593	23.691789					
## 12	156.75	209.00	715	800	NA	960	13.60677	16.328125	2.721354	21.770833					
## 13	167.20	209.00	862	880	NA	1056	12.36979	15.833333	3.463542	19.791667					
## 14	182.88	229.90	900	970	NA	1164	11.22208	15.710911	4.488832	19.750859					
## 15	188.10	266.48	890	940	NA	1128	14.35949	16.675532	2.316046	23.623670					
##	X	T20	T23	T25	Q0	Q3	Q5	E0	E3	E5					
## 1	0.000000	0.0	0.0	0.0	0.00	0.00	0.00	0.0000000	0.0000000	0.0000000					
## 2	0.000000	0.0	0.0	0.0	0.00	0.00	0.00	0.0000000	0.0000000	0.0000000					
## 3	0.000000	0.0	0.0	0.0	0.00	0.00	0.00	0.0000000	0.0000000	0.0000000					
## 4	2.721354	0.0	0.0	0.0	0.00	0.00	0.00	0.0000000	0.0000000	0.0000000					
## 5	14.513889	3.0	3.0	3.0	156.75	156.75	156.75	0.0000000	0.2333333	0.4000000					
## 6	6.220238	4.0	4.0	4.0	209.00	209.00	209.00	0.2500000	0.3500000	0.4000000					
## 7	10.412138	6.0	6.0	6.0	313.50	313.50	313.50	0.1666667	0.2833333	0.3500000					
## 8	10.450000	8.0	8.0	8.0	418.00	418.00	418.00	0.1625000	0.2500000	0.3125000					
## 9	7.775298	10.0	10.0	10.0	522.50	522.50	522.50	0.2000000	0.2400000	0.3000000					
## 10	10.205078	11.0	11.0	11.0	574.75	574.75	574.75	0.1818182	0.2545455	0.3181818					
## 11	8.324142	11.0	11.0	11.0	574.75	574.75	574.75	0.2181818	0.2636364	0.3363636					
## 12	8.164062	12.0	12.0	12.0	627.00	627.00	627.00	0.2083333	0.2500000	0.3333333					
## 13	7.421875	13.0	13.0	13.0	679.25	679.25	679.25	0.1923077	0.2461538	0.3076923					
## 14	8.528780	14.0	14.0	14.0	731.50	731.50	731.50	0.1785714	0.2500000	0.3142857					
## 15	9.264184	15.6	15.6	15.6	815.10	815.10	815.10	0.1987179	0.2307692	0.3269231					

Task2

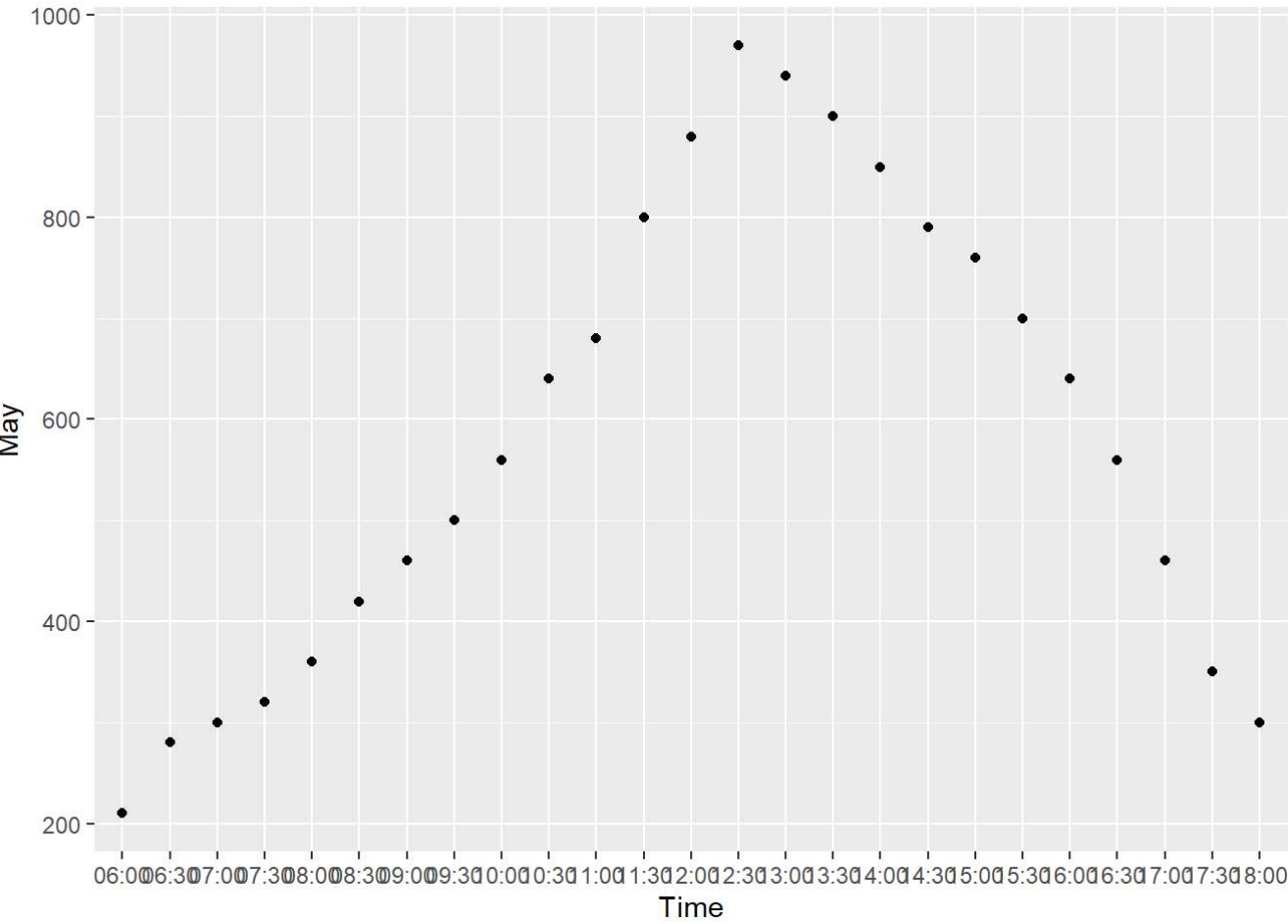
```
v1<-data$LCZ0
v2<-data$LCZ3
v3<-data$LCZ5

cbind(v1,v2,v3)
```

```
##      v1  v2 v3
## [1,] 28 28.0 28
## [2,] 28 28.0 28
## [3,] 28 28.0 28
## [4,] 29 29.0 29
## [5,] 32 32.0 32
## [6,] 33 33.0 33
## [7,] 35 35.0 35
## [8,] 37 37.0 37
## [9,] 39 39.0 39
## [10,] 41 41.0 41
## [11,] 42 42.0 42
## [12,] 44 44.0 44
## [13,] 46 46.0 46
## [14,] 48 48.0 48
## [15,] 50 50.0 50
## [16,] 47 47.0 47
## [17,] 45 45.0 44
## [18,] 43 42.0 42
## [19,] 41 39.0 39
## [20,] 39 37.5 38
## [21,] 37 36.0 36
## [22,] 35 35.0 35
## [23,] 33 32.0 34
## [24,] 32 32.0 32
## [25,] 32 32.0 32
```

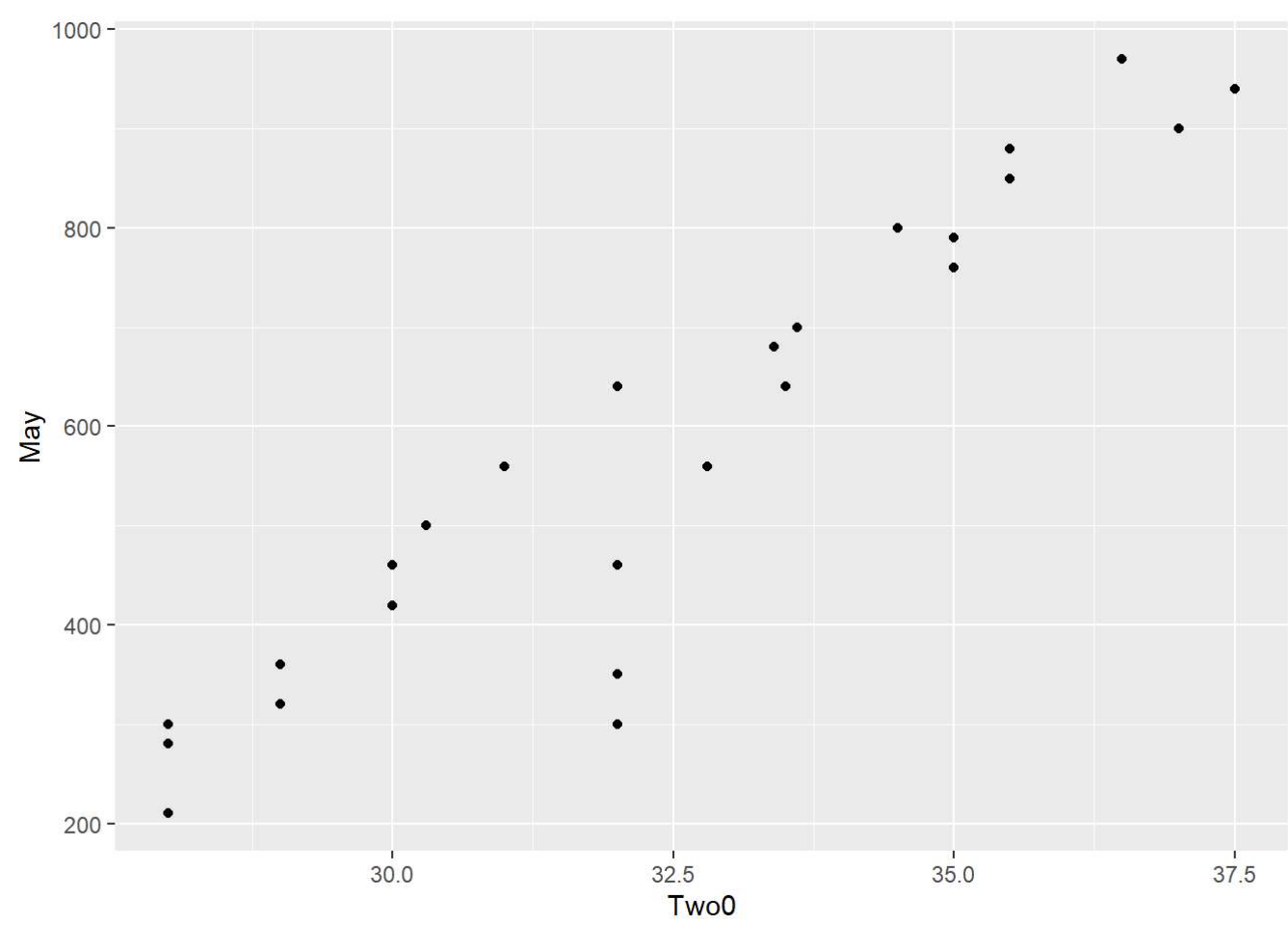
Task3

```
library("ggplot2")
ggplot(data,aes(x=Time,y=May))+geom_point()
```



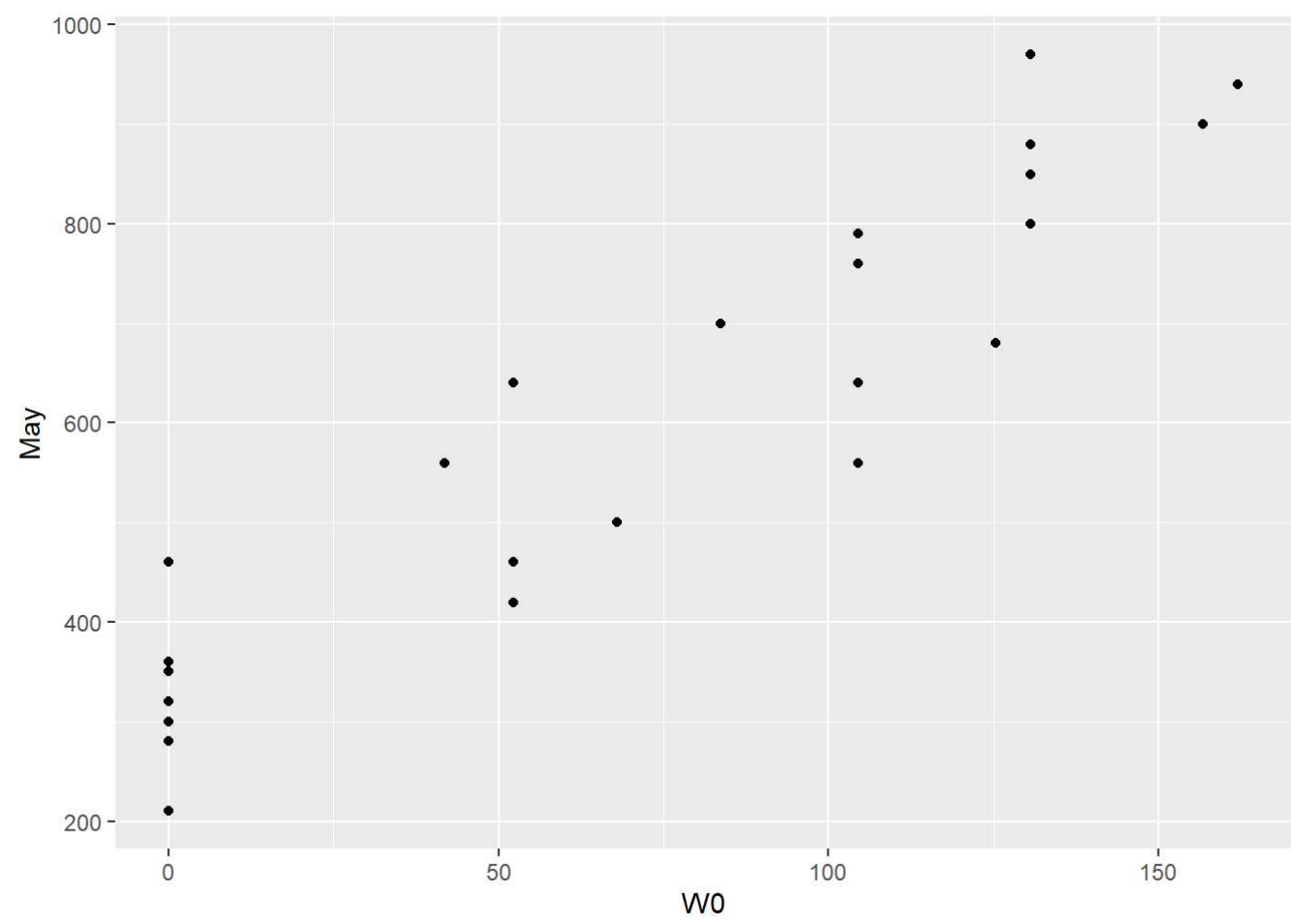
Task4

```
library("ggplot2")
ggplot(data,aes(x=Two0,y=May))+geom_point()
```



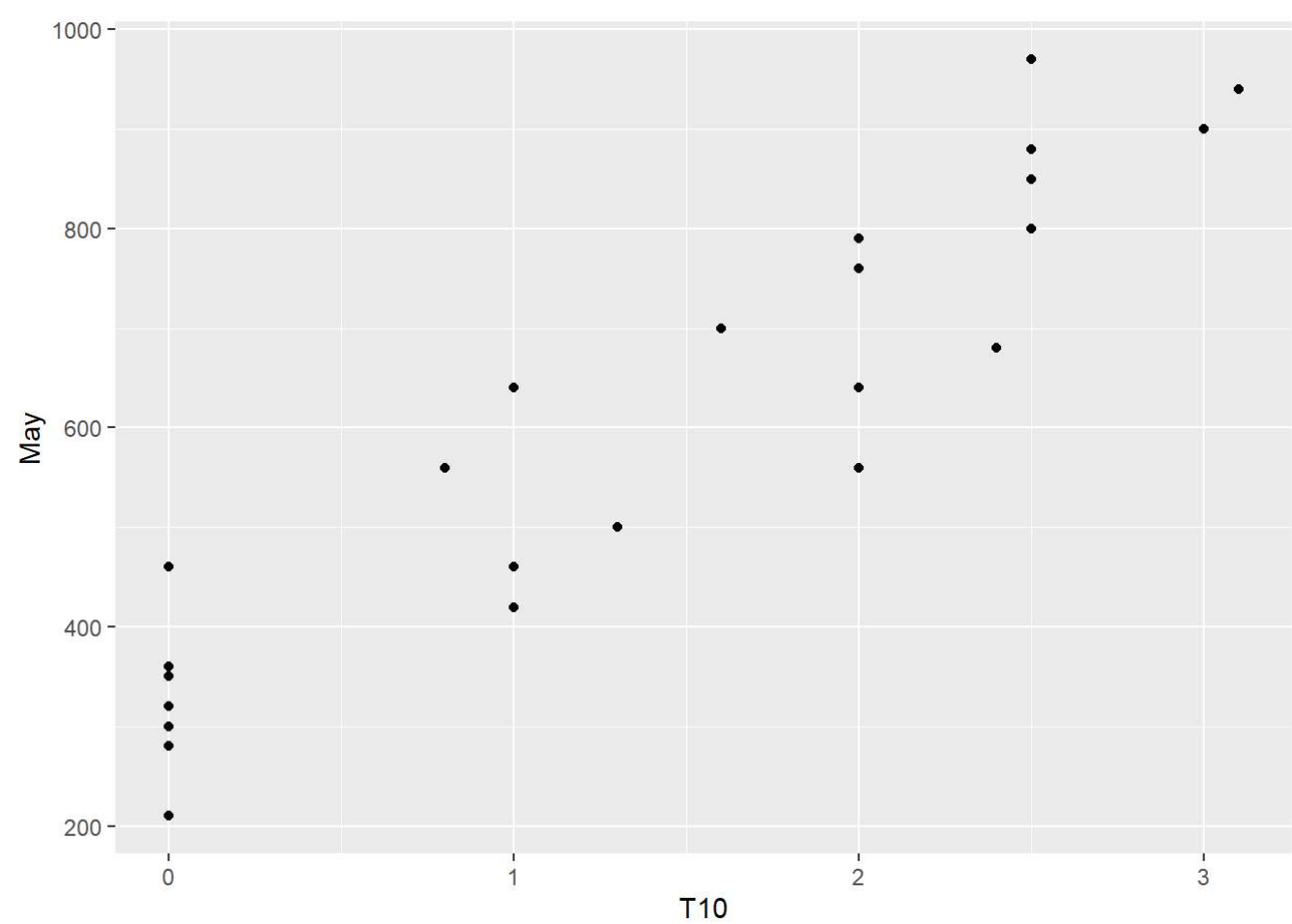
Task5

```
library("ggplot2")
ggplot(data,aes(x=W0,y=May))+geom_point()
```



Task6

```
library("ggplot2")
ggplot(data,aes(x=T10,y=May))+geom_point()
```



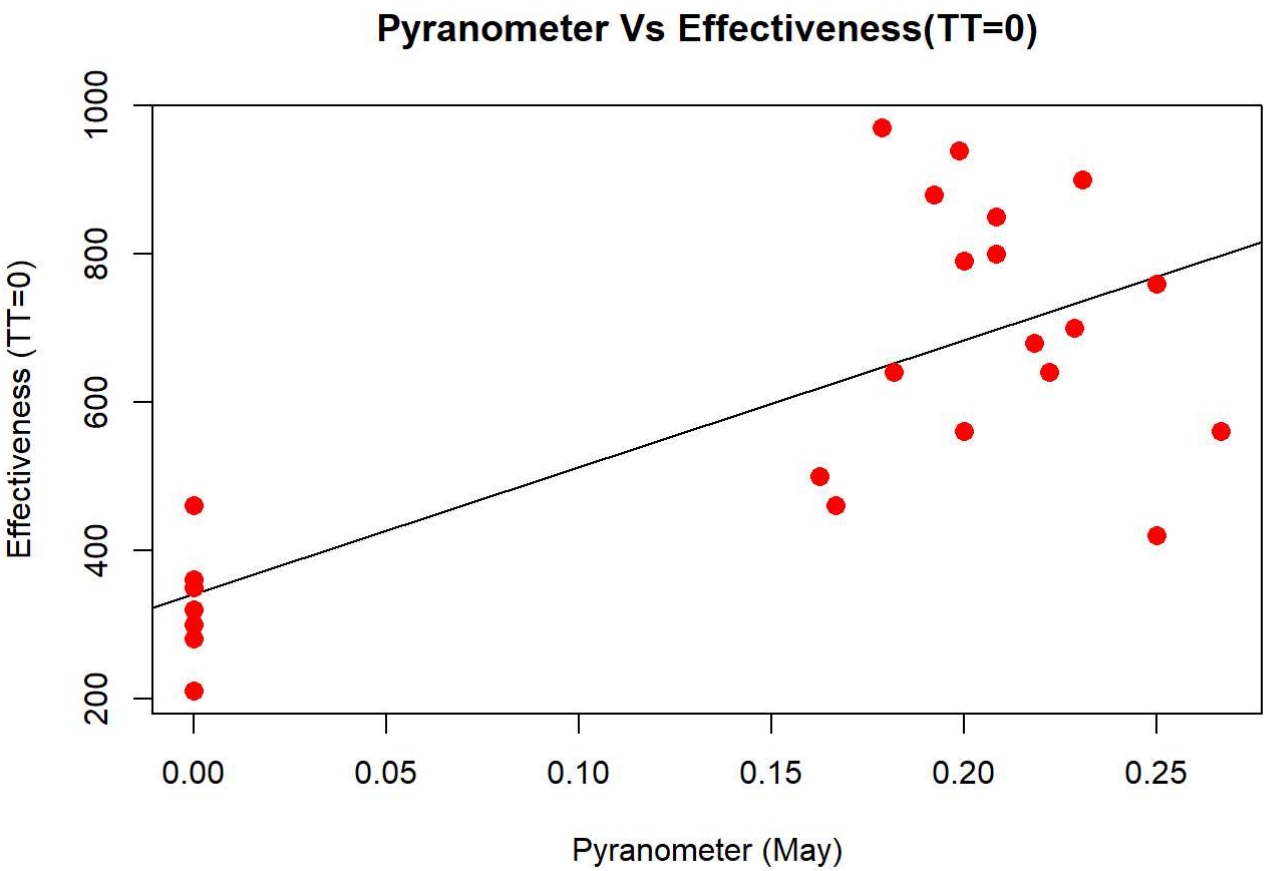
Task7: Best Linear Fit

```
blf<-lm(data3$May~data3$E0)
summary(blf)
```

```
##
## Call:
## lm(formula = data3$May ~ data3$E0)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -260.60  -80.61  -34.35   97.83  226.42
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    400.63      83.08   4.822 0.000944 ***
## data3$E0       1574.88     429.60   3.666 0.005187 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 145.8 on 9 degrees of freedom
## (1 observation deleted due to missingness)
## Multiple R-squared:  0.5989, Adjusted R-squared:  0.5543
## F-statistic: 13.44 on 1 and 9 DF, p-value: 0.005187
```

Task8: Plot Best

```
plot(data$E0,data$May,col = "red",main = "Pyranometer Vs Effectiveness(TT=0)",
abline(lm(data$May~data$E0)),cex = 1.3,pch = 16,xlab = "Pyranometer (May)",ylab = "Effectiveness (TT=0)")
```



Task9: Residual Sum of Squares

```
res<-sum(resid(blfe)^2)
res
```

```
## [1] 191194
```

Task10: Plot the residuals

```
res=resid(blfe)
length(res)
```

```
## [1] 11
```

```
plot(data3$E0[1:11], res, ylab="Residuals", xlab="Effectiveness (TT=0)", main="Best Linear Fit Residuals",col="red")
abline(0, 0)
```

