Question 1.

I work on a software development team that uses Agile Scrum to plan and manage our workload. A key metric that we use for this purpose is throughout, which is measured by “story points” completed in each sprint. Knowing the throughput value helps to determine how much work to plan for in the upcoming work period (sprint), but it can be very erratic from sprint to sprint. Exponential smoothing would be appropriate to smooth the random variation in story point throughput. The necessary data for this model would be the throughput metric from previous sprints. I would expect to use an ɑ value closer to 0 because there tends to be a lot of variation in throughput between sprints.

Question 2.

Building on the week 3 assignment; I've built an exponential smoothing model for each year and applied the fitted values to the previously produced CUSUM model ($S_t = \max\{0, S_{t-1} + (x_t - \mu - C)\}$ where μ = 83°, C = 1, and T = 50) to determine if the unofficial end of summer has gotten later over the 20 years.

Since the temperature dataset is limited to a portion of each year, I've treated the falling temperatures as a trend and not cyclic seasonality. The function configuration I used to calculate the model for each year is: model ← HoltWinters(temps_ts[,year], gamma = FALSE).

After modeling, I output the fitted temperature values as a CSV for use in Alteryx (to calculate CUSUM) and Tableau (visualize the CUSUM results). Using the CUSUM model, I determined the "unofficial" end of summer date. To determine if a trend was present in the ending dates, I calculated the median (30-Sep) end date and difference between year end date and median end date. The difference value was plotted to determine if there was a visual trend present. Also, I used the Augmented Dicker-Fuller test on the difference values to test for stationarity. The result was a p-value of 0.07327, which at 95% confidence, indicates that we can't reject the null hypothesis that the data isn't stationary. **Based on this, I've concluded that the "unofficial" end of summer is trending slightly later.**

Fig. 1: Table of "Unofficial" End of Summer Dates - when T is exceeded and stays exceeded

"Unofficial" End of Summer		
Year	End Date	Median Date minus End Date
1996	1-Oct	-1
1997	28-Sep	2
1998	10-Oct	-10
1999	26-Sep	4
2000	18-Sep	12
2001	29-Sep	1
2002	30-Sep	0
2003	29-Sep	1
2004	21-Sep	9
2005	11-Oct	-11
2006	30-Sep	0
2007	13-Oct	-13
2008	4-Oct	-4
2009	18-Sep	12
2010	5-Oct	-5
2011	3-Oct	-3
2012	8-Oct	-8
2013	28-Sep	2
2014	5-Oct	-5
2015	27-Sep	3

Fig. 2: Plot of difference between year end date and median end date

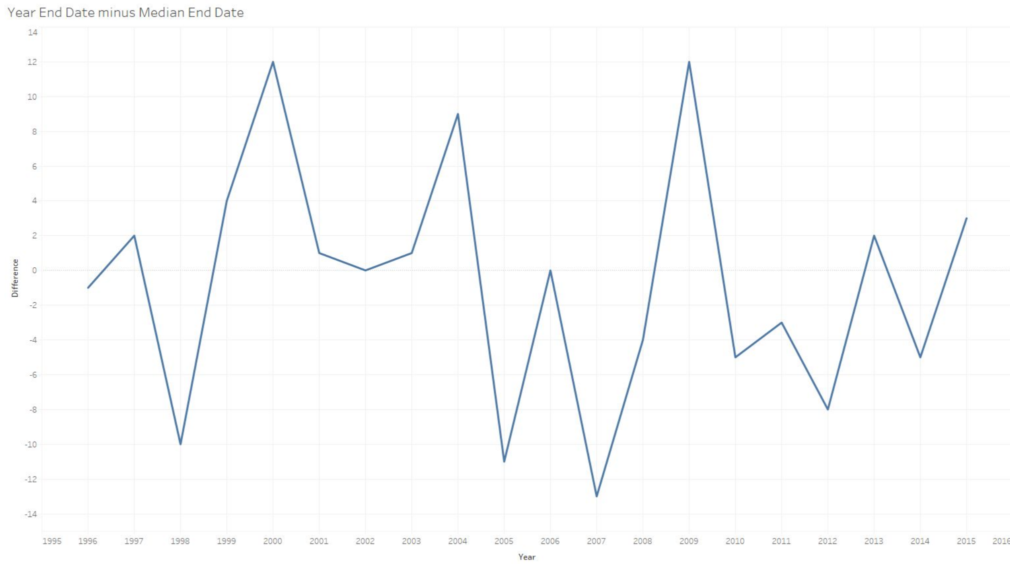


Fig 3: ADF test on year end date minus median end date

```
        Augmented Dickey-Fuller Test

data:  end_ts
Dickey-Fuller = -3.4324, Lag order = 2, p-value = 0.07327
alternative hypothesis: stationary
```

Fig. 4: Plot of St values over the years:

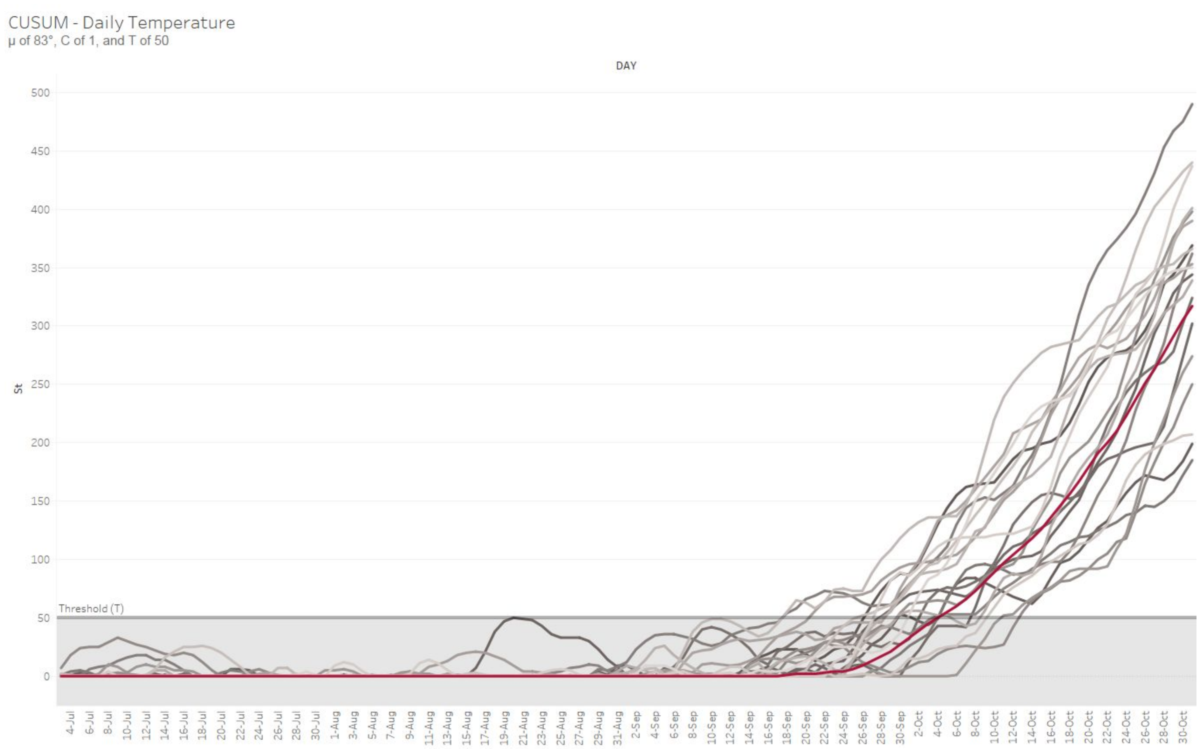
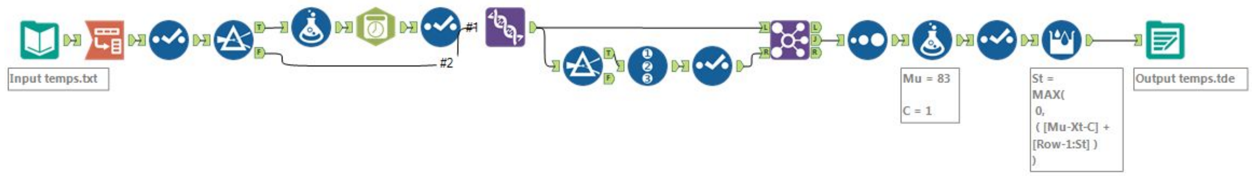


Fig. 5: Chart of St values across the years (red text exceeds threshold)

CUSUM - Daily Temperature
μ of 83°, C of 1, and T of 50

		YEAR																			
DAY	Overall..	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
3-Jul	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	7.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0
4-Jul	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	18.0	0.0	0.0	4.0	0.0	0.0	1.0	0.0	0.0
5-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	0.0	5.0	0.0	0.0	3.0	0.0	0.0
6-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	6.0	3.0	0.0	0.0	1.0	0.0	0.0
7-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	25.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0
8-Jul	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	2.0	29.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0
9-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	3.0	33.0	0.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0
10-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.0	30.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	0.0
11-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	1.0	27.0	0.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0
12-Jul	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	25.0	0.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0
13-Jul	0.0	0.0	0.0	0.0	6.0	0.0	0.0	5.0	0.0	0.0	8.0	0.0	22.0	0.0	14.0	0.0	0.0	2.0	0.0	0.0	0.0
14-Jul	0.0	0.0	0.0	0.0	16.0	0.0	0.0	5.0	0.0	0.0	8.0	0.0	19.0	0.0	14.0	0.0	0.0	0.0	1.0	0.0	0.0
15-Jul	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	18.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0
16-Jul	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	20.0	0.0	5.0	0.0	2.0	0.0	0.0	0.0	0.0
17-Jul	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18-Jul	0.0	0.0	0.0	0.0	26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19-Jul	0.0	0.0	0.0	0.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-Jul	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0
21-Jul	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	6.0	0.0
22-Jul	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	6.0	0.0
23-Jul	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	3.0	0.0	0.0	0.0	0.0	5.0	0.0
24-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26-Jul	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27-Jul	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28-Jul	0.0	1.0	0.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29-Jul	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30-Jul	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31-Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Aug	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Aug	0.0	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
3-Aug	0.0	0.0	10.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-Aug	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9-Aug	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10-Aug	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11-Aug	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12-Aug	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13-Aug	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	2.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14-Aug	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	18.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15-Aug	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16-Aug	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0
17-Aug	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0
18-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.0	0.0	0.0
19-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.0	0.0	0.0
20-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
21-Aug	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.0	0.0	0.0
22-Aug	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.0	0.0	0.0
23-Aug	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.0	0.0	0.0
24-Aug	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	3.0	1.0	0.0	0.0	0.0	36.0	0.0	0.0
25-Aug	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	33.0	0.0	0.0
26-Aug	0.0	0.0	5.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	33.0	0.0	0.0
27-Aug	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	33.0	0.0	0.0
28-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0
29-Aug	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	6.0	0.0	0.0	4.0	23.0	0.0	0.0
30-Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	5.0	0.0	0.0	1.0	14.0	0.0	1.0
31-Aug	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	5.0	8.0	0.0	9.0
1-Sep	0.0	0.0	0.0	0.0	0.0	0.0	3.0	9.0	0.0	0.0	0.0	1.0	0.0	0.0	12.0	0.0	0.0	0.0	1.0	0.0	9.0
2-Sep	0.0	2.0	0.0	0.0	0.0	4.0	6.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	0.0	0.0	0.0	0.0	0.0	5.0
3-Sep	0.0	9.0	0.0	0.0	0.0	6.0	14.0	5.0	0.0	2.0	0.0	0.0	1.0	0.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0
4-Sep	0.0	9.0	0.0	4.0	0.0	7.0	24.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	35.0	0.0	0.0	0.0	0.0	0.0	0.0
5-Sep	0.0	9.0	1.0	0.0	0.0	2.0	26.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	36.0	0.0	3.0	7.0	0.0	1.0	0.0
6-Sep	0.0	6.0	3.0	0.0	0.0	4.0	18.0	0.0	0.0	4.0	1.0	0.0	0.0	0.0	36.0	0.0	8.0	5.0	0.0	0.0	0.0
7-Sep	0.0	1.0	4.0	0.0	0.0	21.0	12.0	0.0	11.0	5.0	3.0	0.0	0.0	0.0	34.0	0.0	16.0	3.0	0.0	0.0	0.0
8-Sep	0.0	0.0	1.0	0.0	0.0	38.0	7.0	0.0	20.0	3.0	3.0	2.0	0.0	0.0	32.0	0.0	30.0	0.0	0.0	0.0	0.0
9-Sep	0.0	0.0	0.0	0.0	0.0	46.0	3.0	0.0	22.0	10.0	1.0	2.0	0.0	0.0	28.0	0.0	40.0	0.0	0.0	0.0	0.0
10-Sep	0.0	0.0	0.0	1.0	1.0	49.0	0.0	0.0	23.0	11.0	0.0	2.0	0.0	0.0	26.0	0.0	42.0	0.0	0.0	0.0	0.0
11-Sep	0.0	0.0	2.0	5.0	0.0	49.0	0.0	0.0	27.0	10.0	0.0	0.0	0.0	0.0	28.0	0.0	40.0	0.0	0.0	0.0	0.0
12-Sep	0.0	0.0	3.0	8.0	0.0	47.0	0.0	0.0	30.0	9.0	0.0	0.0	0.0	0.0	35.0	0.0	36.0	0.0	0.0	0.0	0.0
13-Sep	0.0	0.0	0.0	8.0	0.0	43.0	0.0	0.0	32.0	10.0	0.0	0.0	0.0	0.0	38.0	0.0	31.0	2.0	0.0	0.0	3.0
14-Sep	0.0	2.0	0.0	3.0	0.0	38.0	0.0	7.0	30.0	13.0	0.0	10.0	0.0	0.0	41.0	0.0	24.0	4.0	0.0	0.0	10.0
15-Sep	0.0	5.0	0.0	0.0	0.0	34.0	0.0	11.0	31.0	17.0	0.0	14.0	2.0	0.0	42.0	0.0	14.0	4.0	0.0	5.0	16.0
16-Sep	0.0	4.0	0.0	0.0	0.0	37.0	6.0	2.0	32.0	26.0	0.0	15.0	4.0	1.0	45.0	0.0	10.0	0.0	0.0	8.0	19.0
17-Sep	0.0	4.0	0.0	0.0	0.0	45.0	12.0	0.0	34.0	34.0	0.0	15.0	11.0	3.0	46.0	0.0	21.0	0.0	0.0	5.0	23.0
18-Sep	1.0	5.0	0.0	0.0	1.0	55.0	14.0	0.0	36.0	38.0	0.0	13.0	17.0	13.0	54.0	0.0	25.0	0.0	2.0	2.0	23.0
19-Sep	2.0	9.0	0.0	0.0	2.0	65.0	16.0	1.0	38.0	42.0	0.0	11.0	22.0	17.0	58.0	0.0	31.0	4.0	6.0	0.0	23.0
20-Sep	2.0	13.0	0.0	2.0	5.0	63.0	17.0	3.0	36.0	47.0	0.0	13.0	23.0	20.0	66.0	0.0	37.0	6.0	6.0	0.0	19.0
21-Sep	2.0	17.0	0.0	3.0	17.0	58.0	15.0	0.0	31.0	56.0	0.0	21.0	25.0	23.0	69.0	0.0	38.0	10.0	3.0	0.0	13.0
22-Sep	3.0	22.0	0.0	4.0	24.0	64.0	11.0	0.0	32.0	64.0	0.0	29.0	29.0	29.0	73.0	0.0	34.0	7.0	10.0	0.0	17.0
23-Sep	4.0	25.0	12.0	0.0	34.0	74.0	6.0	5.0	41.0	68.0	0.0	31.0	26.0	30.0	72.0	0.0	37.0	2.0	12.0	1.0	23.0
24-Sep	4.0	25.0	16.0	0.0	43.0	75.0	0.0	5.0	43.0	68.0	0.0	28.0	25.0	31.0	71.0	0.0	36.0	4.0	13.0	7.0	25.0
25-Sep	6.0	25.0	17.0	1.0	49.0	73.0	14.0	14.0	46.0	69.0	0.0	26.0	18.0	34.0	68.0	0.0	37.0	9.0	23.0	12.0	33.0
26-Sep	9.0	22.0	33.0	2.0	52.0	73.0	31.0	27.0	46.0	70.0	0.0	32.0	12.0	36.0	63.0	0.0	31.0	10.0	38.0	18.0	48.0
27-Sep	13.0	20.0	47.0	1.0	54.0	88.0	42.0	34.0	46.0	73.0	5.0	37.0	9.0	38.0	60.0	4.0	27.0	6.0	46.0	27.0	61.0
28-Sep	17.0	22.0	66.0	0.0	58.0	100.0	50.0	41.0	46.0	82.0	2.0	41.0	6.0	43.0	61.0	7.0	25.0	0.0	51.0	32.0	73.0
29-Sep	21.0	28.0	82.0	1.0	61.0	108.0	55.0	44.0	57.0	88.0	0.0	43.0	3.0	42.0	61.0	14.0	29.0	0.0	57.0	41.0	82.0
30-Sep	27.0	37.0	89.0	7.0	66.0	118.0	67.0	53.0	75.0	93.0	0.0	54.0	4.0	39.0	70.0	19.0	27.0	0.0	64.0	53.0	88.0
1-Oct	33.0	53.0	86.0	15.0	76.0	126.0	79.0	56.0	88.0	96.0	0.0	62.0	8.0	36.0	79.0	26.0	32.0	13.0	70.0	51.0	87.0
2-Oct	39.0	70.0	93.0	15.0	86.0	132.0	87.0	56.0	99.0	97.0	0.0	63.0	12.0	41.0	87.0	31.0	50.0	22.0	72.0	47.0	97.0
3-Oct	45.0	83.0	103.0	18.0	95.0	136.0	89.0	54.0	115.0	98.0	0.0	64.0	13.0	48.0	95.0	36.0	65.0	34.0	73.0	44.0	113.0
4-Oct	50.0	87.0	111.0	23.0	97.0	136.0	90.0	52.0	133.0	100.0	0.0	65.0	19.0	52.0	102.0	50.0	73.0	43.0	74.0	49.0	130.0
5-Oct	55.0	97.0	116.0	25.0	106.0	137.0	92.0	52.0	138.0	102.0	0.0	64.0	23.0	53.0	111.0	66.0	76.0	43.0	72.0	67.0	144.0
6-Oct	60.0	112.0	118.0	26.0	116.0	137.0	96.0	47.0	142.0	104.0	1.0	61.0	25.0	53.0	130.0	80.0	75.0	43.0	70.0	79.0	155.0
7-Oct	66.0	130.0	119.0	34.0	127.0	147.0	109.0	43.0	150.0	111.0	11.0	66.0	26.0	53.0	144.0	91.0	77.0	42.0	68.0	84.0	162.0
8-Oct	73.0	151.0	119.0	37.0	138.0	164.0	124.0	45.0	160.0	119.0	22.0	75.0	25.0	53.0	150.0	95.0	81.0	59.0	74.0	84.0	164.0
9-Oct	81.0	162.0	119.0	48.0	148.0	192.0	127.0	56.0	170.0	128.0	32.0	85.0	24.0	60.0	153.0	96.0	86.0	81.0	84.0	80.0	165.0
10-Oct	89.0	174.0	121.0	59.0	159.0	220.0	144.0	72.0	180.0	139.0	45.0	90.0	25.0	68.0	151.0	94.0	97.0	94.0	92.0	76.0	166.0
11-Oct	97.0	186.0	122.0	70.0	170.0	239.0	154.0	84.0	190.0	151.0	52.0	93.0	27.0	75.0	157.0	91.0	112.0	104.0	96.0	72.0	176.0
12-Oct	104.0	199.0	122.0	76.0	180.0	251.0	162.0	88.0	208.0	158.0	53.0	96.0	42.0	80.0	163.0	87.0	130.0	111.0	100.0	68.0	186.0
13-Oct	111.0	213.0	125.0	81.0	192.0	261.0	167.0	86.0	212.0	167.0	61.0	106.0	55.0	86.0	178.0	88.0	140.0	114.0	102.0	65.0	193.0
14-Oct	118.0	224.0	128.0	86.0	209.0	269.0	172.0	89.0	216.0	184.0	67.0	125.0	65.0	92.0	189.0	90.0	149.0	122.0	103.0	62.0	195.0
15-Oct	126.0	231.0	142.0	93.0	220.0	277.0	180.0	103.0	220.0	203.0	72.0	139.0	71.0	96.0	205.0	99.0	155.0	127.0	107.0	70.0	199.0
16-Oct	136.0	235.0	162.0	98.0	230.0	282.0	188.0	128.0	234.0	224.0	76.0	152.0	75.0	98.0	226.0	105.0	157.0	132.0	120.0	84.0	201.0
17-Oct	146.0	238.0	188.0	103.0	237.0	284.0	209.0	144.0	245.0	238.0	82.0	174.0	81.0	98.0	249.0	112.0	155.0	141.0	130.0	97.0	206.0
18-Oct	156.0	240.0	206.0	108.0	241.0	286.0	232.0	162.0	260.0	247.0	90.0	187.0	82.0	107.0	280.0	115.0	152.0	149.0	141.0	100.0	217.0
19-Oct	167.0	251.0	225.0	113.0	250.0	288.0	251.0	176.0	273.0	257.0	92.0	194.0	86.0	121.0	310.0	119.0	155.0	158.0	151.0	107.0	233.0
20-Oct	179.0	268.0	239.0	115.0	265.0	298.0	263.0	187.0	280.0	271.0	92.0	201.0	92.0	138.0	335.0	120.0	171.0	168.0	169.0	117.0	252.0
21-Oct	191.0	284.0	252.0	121.0	286.0	308.0	271.0	196.0	284.0	283.0	92.0	213.0	100.0	155.0	352.0	125.0	195.0	180.0	183.0	127.0	265.0
22-Oct	200.0	292.0	265.0	130.0	306.0	316.0	274.0	207.0	281.0	293.0	94.0	226.0	105.0	168.0	365.0	128.0	215.0	186.0	195.0	133.0	273.0
23-Oct	210.0	296.0	286.0	148.0	319.0	319.0	276.0	225.0	285.0	303.0	109.0	239.0	115.0	183.0	374.0	132.0	230.0	189.0	209.0	146.0	277.0
24-Oct	223.0	306.0	306.0	168.0	341.0	327.0	277.0	248.0	289.0	315.0	122.0	265.0	118.0	202.0	384.0	138.0	243.0	193.0	228.0	157.0	279.0
25-Oct	237.0	316.0	327.0	181.0	365.0	335.0	280.0	262.0	299.0	325.0	148.0	291.0	140.0	228.0	396.0	140.0	253.0	196.0	246.0	166.0	285.0
26-Oct	251.0	326.0	336.0	190.0	386.0	339.0	290.0	284.0	309.0	331.0	177.0	318.0	165.0	248.0	413.0	146.0	260.0	198.0	271.0	172.0	296.0
27-Oct	263.0	335.0	347.0	195.0	402.0	347.0	309.0	298.0	324.0	335.0	200.0	340.0	183.0	264.0	431.0	145.0	266.0	200.0	294.0	170.0	311.0
28-Oct	277.0	343.0	372.0	199.0	412.0	351.0	342.0	311.0	344.0	337.0	220.0	357.0	200.0	285.0	453.0	150.0	269.0	214.0	310.0	168.0	336.0
29-Oct	291.0	347.0	400.0	202.0	422.0	353.0	370.0	318.0	372.0	341.0	241.0	376.0	213.0	315.0	467.0	158.0	278.0	244.0	328.0	174.0	344.0
30-Oct	305.0	349.0	420.0	206.0	432.0	361.0	390.0	325.0	385.0	348.0	260.0	388.0	233.0	341.0	475.0	172.0	302.0	273.0	338.0	184.0	356.0
31-Oct	317.0	350.0	437.0	207.0	440.0	366.0	401.0	339.0	390.0	353.0	274.0	398.0	250.0	362.0	490.0	185.0	324.0	302.0	344.0	199.0	369.0

Analysis was done using Alteryx and Tableau



R SCRIPT

```r
# Read in temps.txt into a data frame
temps_df <- read.table("temps.txt", header=TRUE)

# Add an overall average column to temps_df
avg.temps <- function(x) {
  return(mean(as.numeric(temps_df[x,2:21])))
}
Overall_Avg <- matrix(0, ncol = 1, nrow = 123)
for(i in 1:123) {
  Overall_Avg[i,1] <- avg.temps(i)
}
temps_df <- cbind(temps_df, Overall_Avg)

# Convert temps_df to a time-series object
temps_ts <- ts(temps_df[,2:22])

# Function that creates an es model for each year and returns fitted values
es.model <- function(year) {
    # Passes in data for each year and set to only use trending
  model <- HoltWinters(temps_ts[,year], gamma = FALSE)
    # Return the fitted temp values for the model
  return(data.frame(model$fitted[,'xhat']))
}

# Create the data frame structure for fitted temps
temps_fitted <- data.frame(temps_df[3:123, 'DAY'])

# Loop through each year of temp data
for(i in 1:21) {
  temps_fitted <- cbind(temps_fitted, es.model(i))
}

# Update column names to match temps_df
colnames(temps_fitted) <- names(temps_df)
# Output temps_fitted for CUSUM calculation in Alteryx and visualization in Tableau
write.csv(temps_fitted, file = "temps_fitted.csv")
```