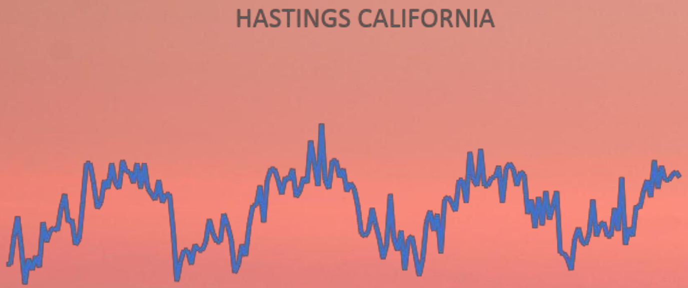
Evaluation of a supply-chain climate model for its long-range temperature forecasting ability.



Wayne Bancroft


USW00023232, SACROMENTO AIRPORT
120
100
80
60
40
20
0
1/1/19
6/30/19
1/1/20
6/30/20
1/1/21
6/30/21
1/1/22
Act TMAX

USW00023232, SACROMENTO AIRPORT

Weekly Temperature History & Forecast Sacramento, Ca

HASTINGS CALIFORNIA, CA US					
DATE	DAILY TMAX	DAILY TMIN	day	AVERAGE TMAX	AVERAGE TMIN
1/1/2019	54	30	1		
1/2/2019	57	32	2		
1/3/2019	60	39	3		
1/4/2019	60	40	4		
1/5/2019	50	41	5		
1/6/2019	54	39	6		
1/7/2019	56	45	7	55.9	38.0
1/8/2019	57	46	8		
1/9/2019	58	43	9		
1/10/2019	60	42	10		
1/11/2019	59	43	11		
1/12/2019	54	44	12		
1/13/2019	54	40	13		
1/14/2019	51	44	14	56.1	43.1
1/15/2019	52	46	15		
1/16/2019	58	50	16		
1/17/2019	53	46	17		
1/18/2019	62	44	18		
1/19/2019	70	47	19		
1/20/2019	62	42	20		
1/21/2019	49	39	21	58.0	44.9
1/22/2019	56	36	22		
1/23/2019	64	39	23		

Preparing the data

- Daily climate data (TMAX and TMIN) were obtained for five weather stations from NOAA National Centers for Environmental Information. The daily data was rolled up into weeks and used to generate the next 52-week forecasts. The weekly TMAX value was set equal to the average daily TMAX value. The weekly TMIN value was set equal to the average daily TMIN value. Two years of history are used to generate the forecast. The third year of history was used to measure the forecast error. All examples used the same date range with the first week of history ending 1/7/2019.

MISSOULA INTERNATIONAL AIRPORT, MT US,

POCATELLO REGIONAL AIRPORT, ID US,

SACRAMENTO AIRPORT

HASTINGS CALIFORNIA, CA US.

CARMEL VALLEY, CA U

IDYLLWILD FIRE DEPARTMENT, CA

FIGUEROA, CA US.

Multiplicative Trend Seasonal Model.

The forecast model:

$T_t = (a + b * t) * S_t$

a – Base Level

b – Slope

S_t – Seasonal ratios at week t = (1 to 52)

T_t – Temperature Forecast at week t = (1 to 52)

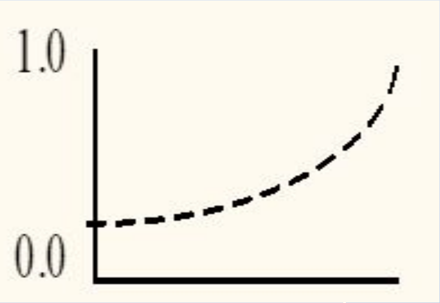
Multiplicative Trend Seasonal Model.

- These are the steps used by the software to solve for the model parameters.
- 104 weeks of history are loaded into the DB.
- Data outliers are identified and reduced to the normal level.
- The trend line (a +b*t) is calculated. There are many methods available. We use discounted regression method.
- 52 weekly seasonal ratios are derived by comparing the actual data to the corresponding trend line value.
- Now you have all the parameters needed to generate the 52 weekly forecasts.

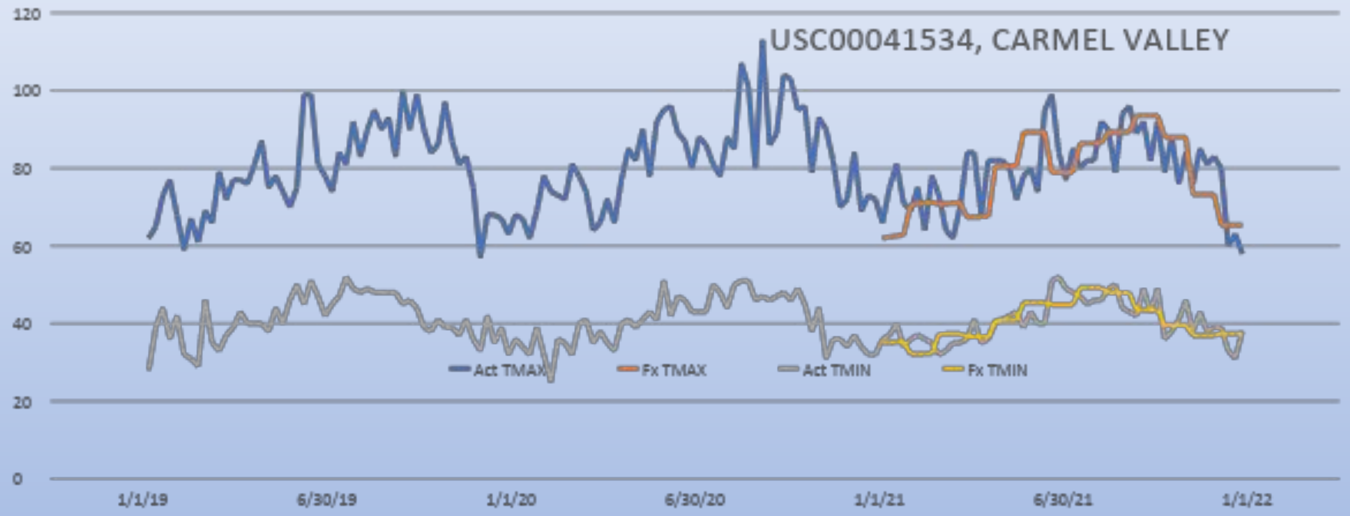
Multiplicative Trend Seasonal Model.

Parameters of the model.

Seasonal Option	Discount Weight
Y: Use Seasonal Ratios N: Don't use Seasonal Ratios T: Test Seasonal Ratios	Assigns less weight to each older period. DW .95 default

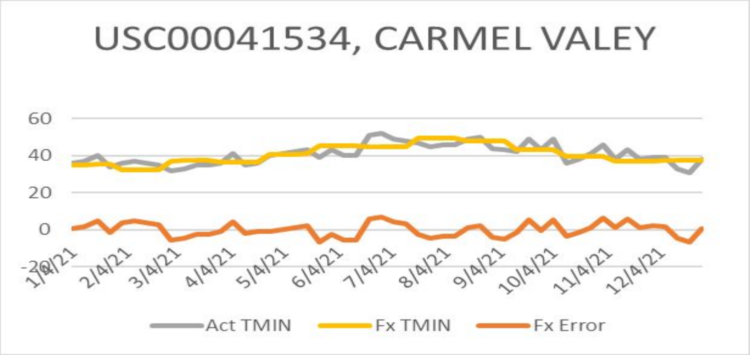


Weekly Temperature History & Forecast



A good temperature forecast will align with the temperatures of the future.

The Forecast Error



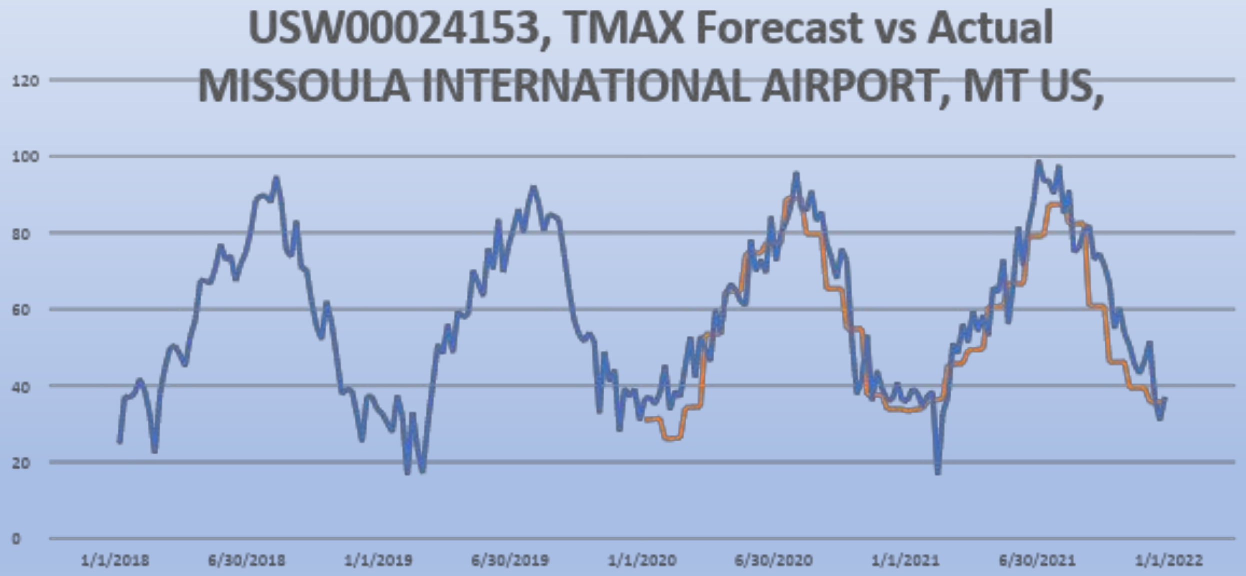
<- Forecast
<-actual

E_t =(forecast – actual)$_t$

- t = week (1 – 52)
- E_t =(forecast – actual)$_t$
- N = Number of weeks = 52
- $\overline{\boldsymbol{E}} = \sum \boldsymbol{E}/\boldsymbol{N}$ = Average Error
- S = Standard Forecast error

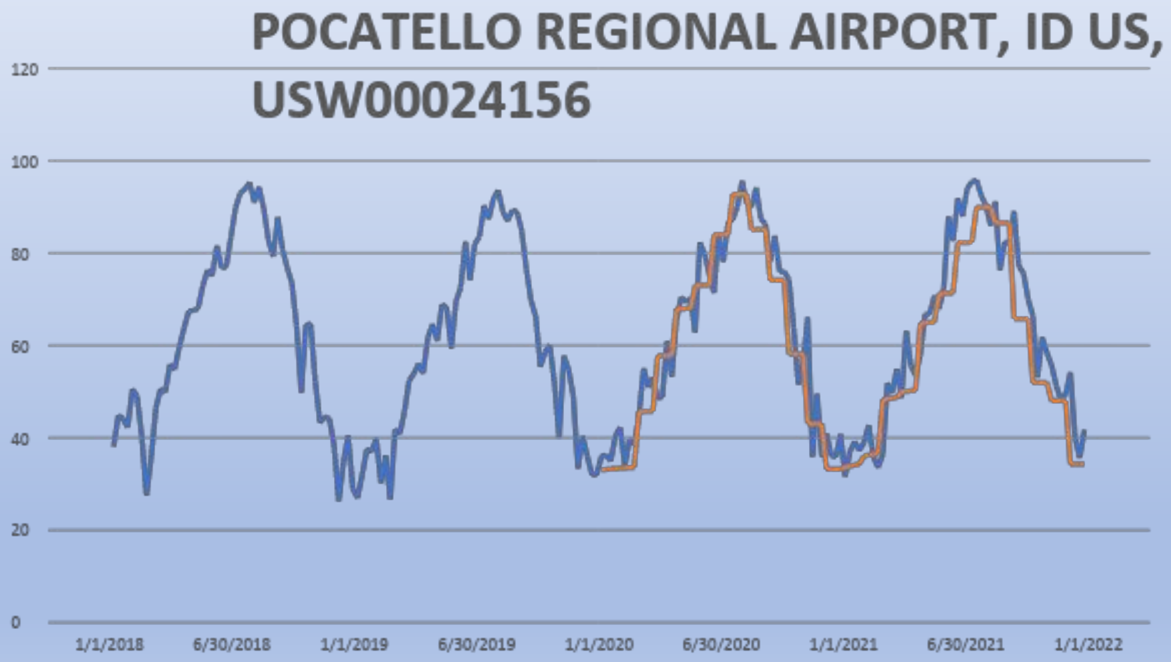
Coefficient of variation (COV)
This is a relative measure of the forecast error
f1 = average one-week forecast
s = standard deviation of the 52 weekly forecast error
COV = s/f1 = coefficient of variation

Weekly TMAX History & Forecast



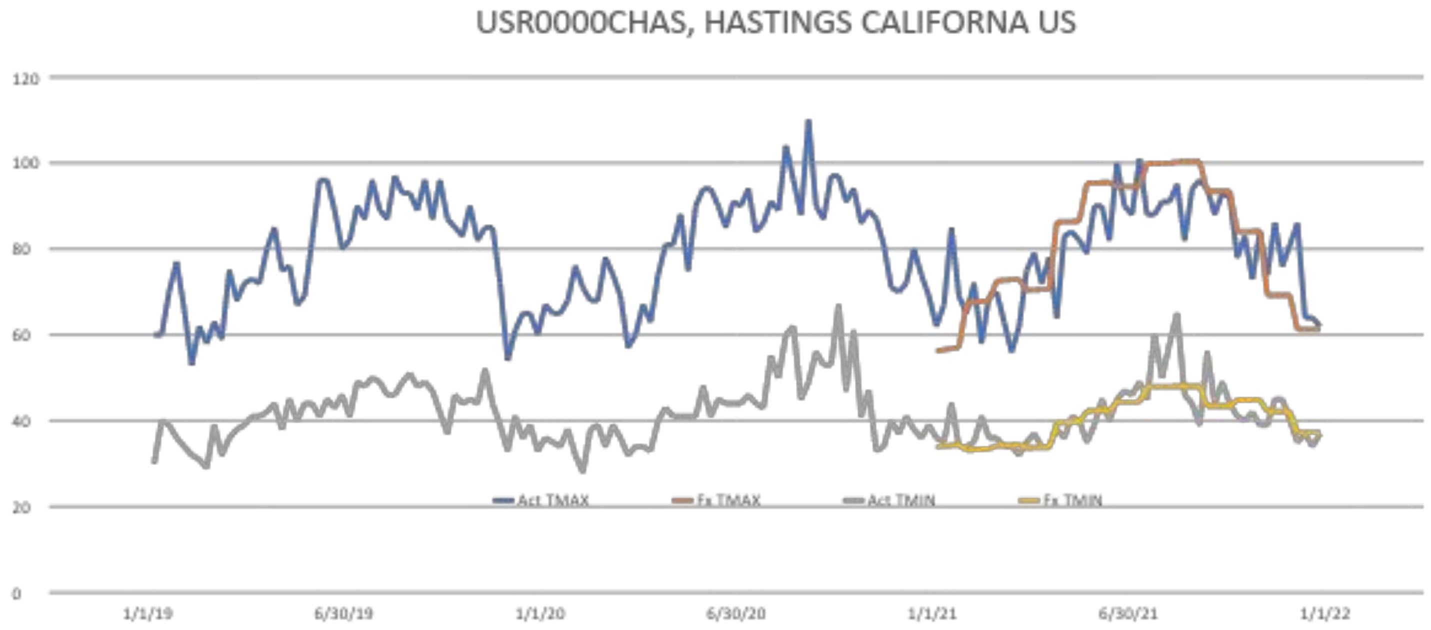
Summary Report		
Year		COV * 100
2020	-3.5	16.1
2021.	-5.0	17.1

Weekly TMAX History & Forecast

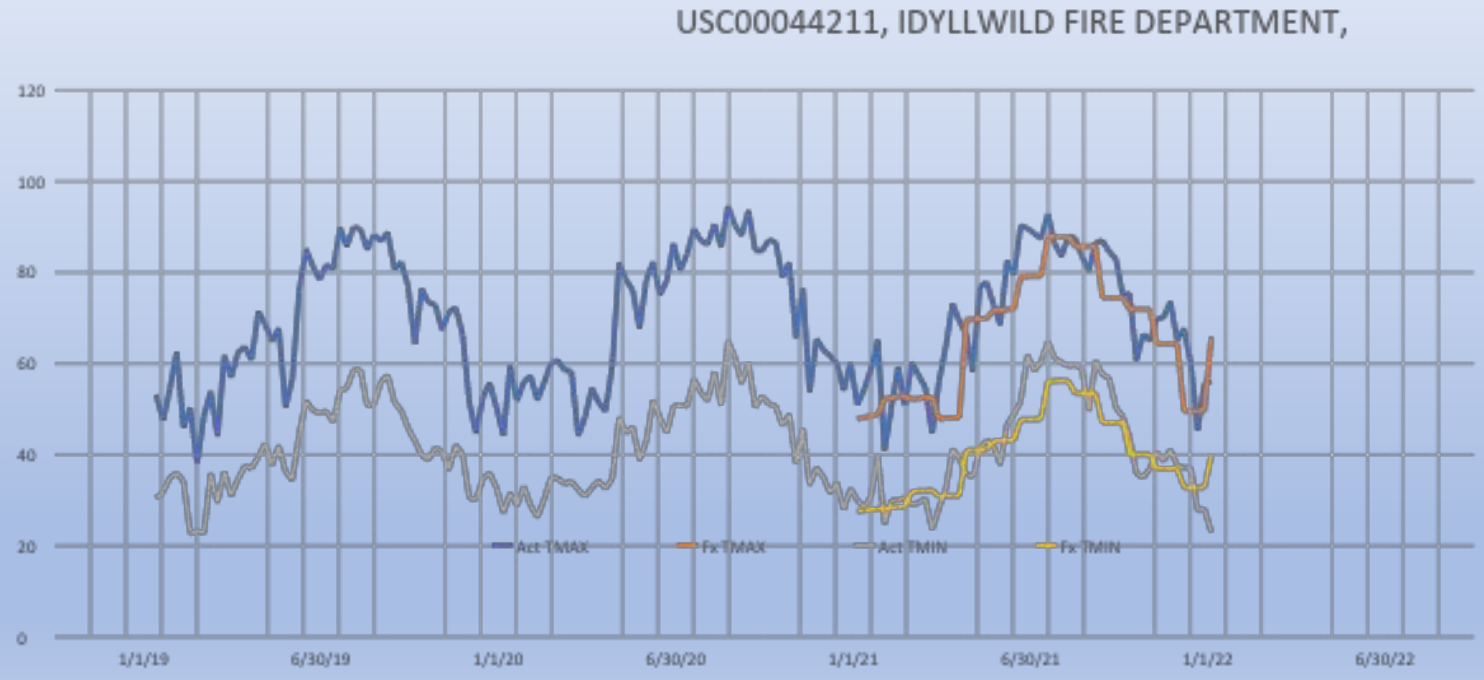


Summary Report		
Year		COV * 100
2020	2.1	11.2
2021.	4.7	13.1

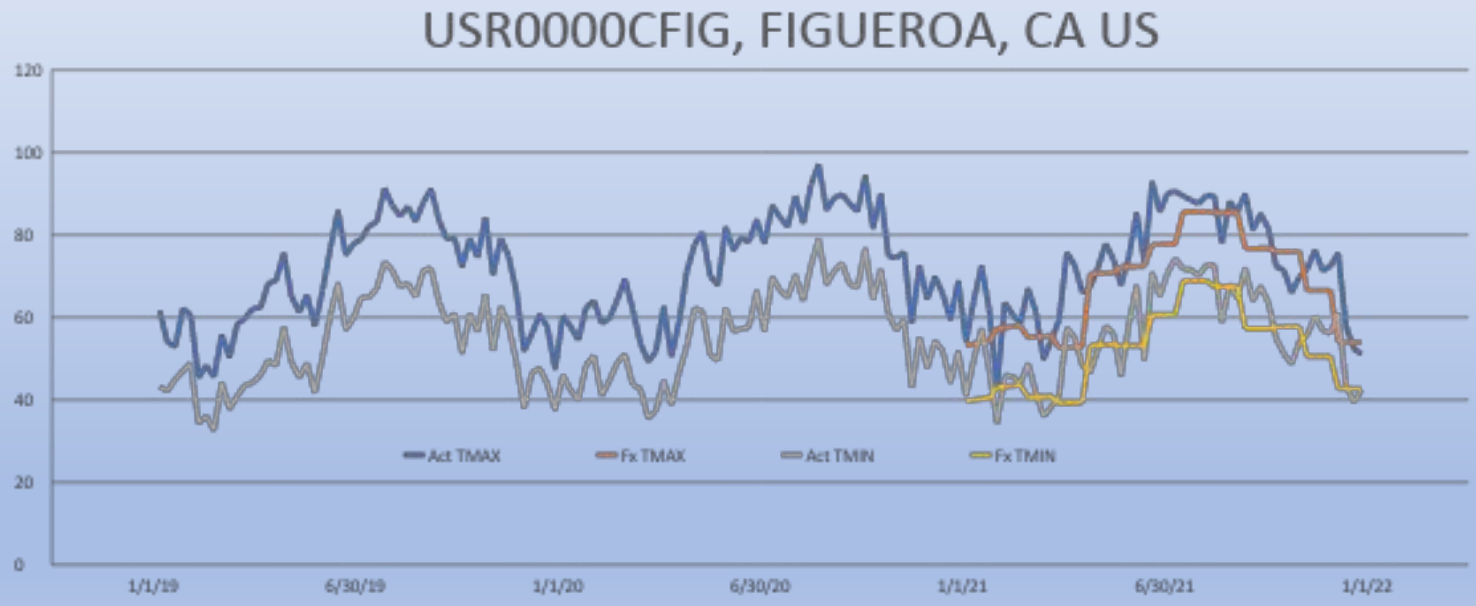
Weekly Temperature History & Forecast



Weekly Temperature History & Forecast



Weekly Temperature History & Forecast



Weather Temp Forecast Errors Error E = (Forecast - Actual), DW = 0.9		TMAX		TMIN	
Weather Station ID	Weather Station Name		COV*100		COV*100
USC00041534	CARMEL VALLEY, CA US.	0.91	9.06	-0.44	7.76
USC00044211	IDYLLWILD FIRE DEPARTMENT, CA US.	4.19	13.86	2.27	14.66
USR0000CHAS	HASTINGS CALIFORNIA, CA US.	3.14	12.18	-3.79	13.44
USR0000CFIG	FIGUEROA, CA US.	4.66	13.41	3.63	15.50
USW00023232	SACRAMENTO AIRPORT, CA US.	1.70	9.52	-0.25	7.20

Conclusion

My main objective was to introduce and demonstrate a long-range weather forecasting model and to do a walkthrough of the application logic.

History and forecast charts provide a visual representation of the results.

Error measurements include $\overline{E}$ and COV.

Overall, this is a very small study and may be expanded to include other areas.

A good temperature forecast will align with the temperatures of the future.

THANK YOU

Wayne E. Bancroft, Jr.
webancroft@msn.com
630 903 4971