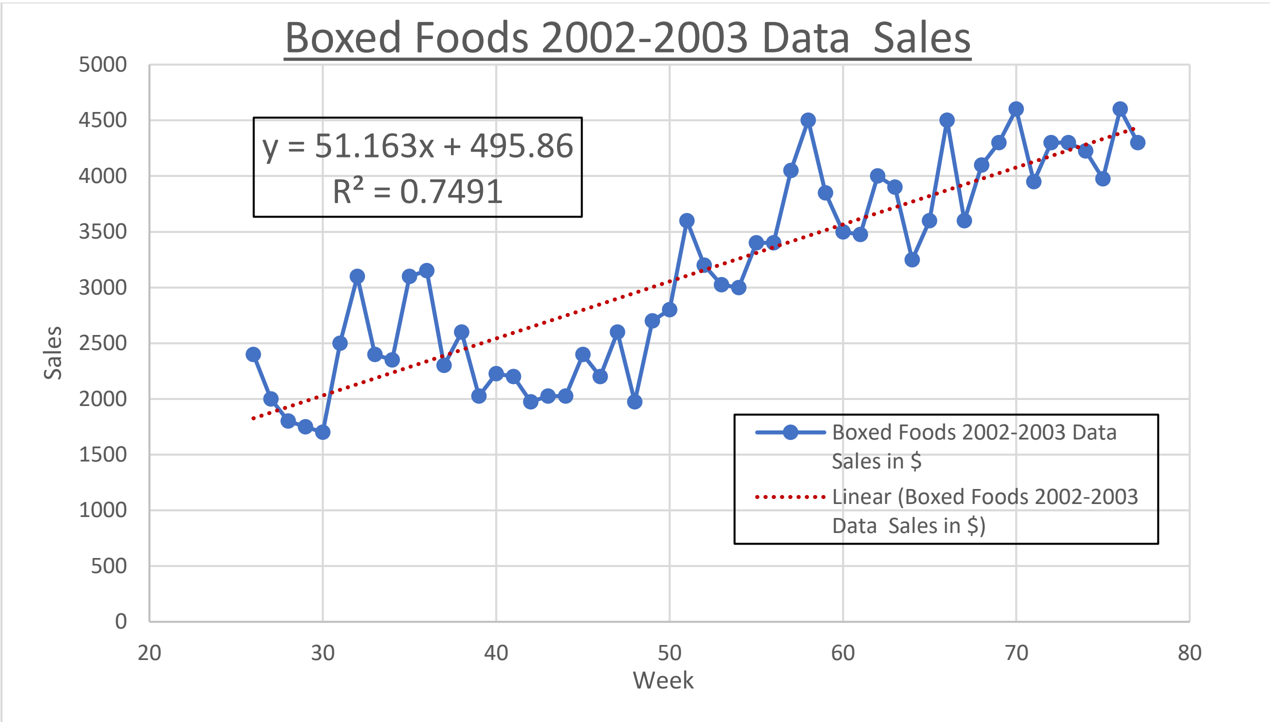
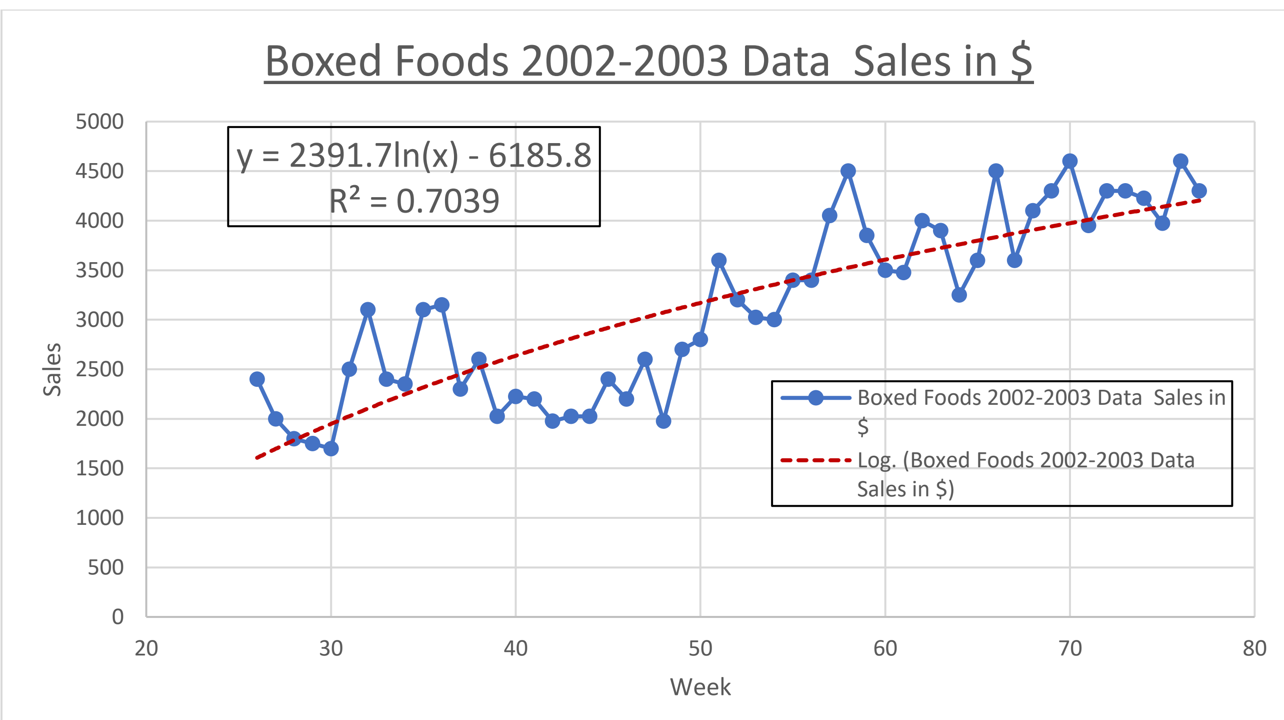
STOPAS EXAMPLE 4

Jason Stopas

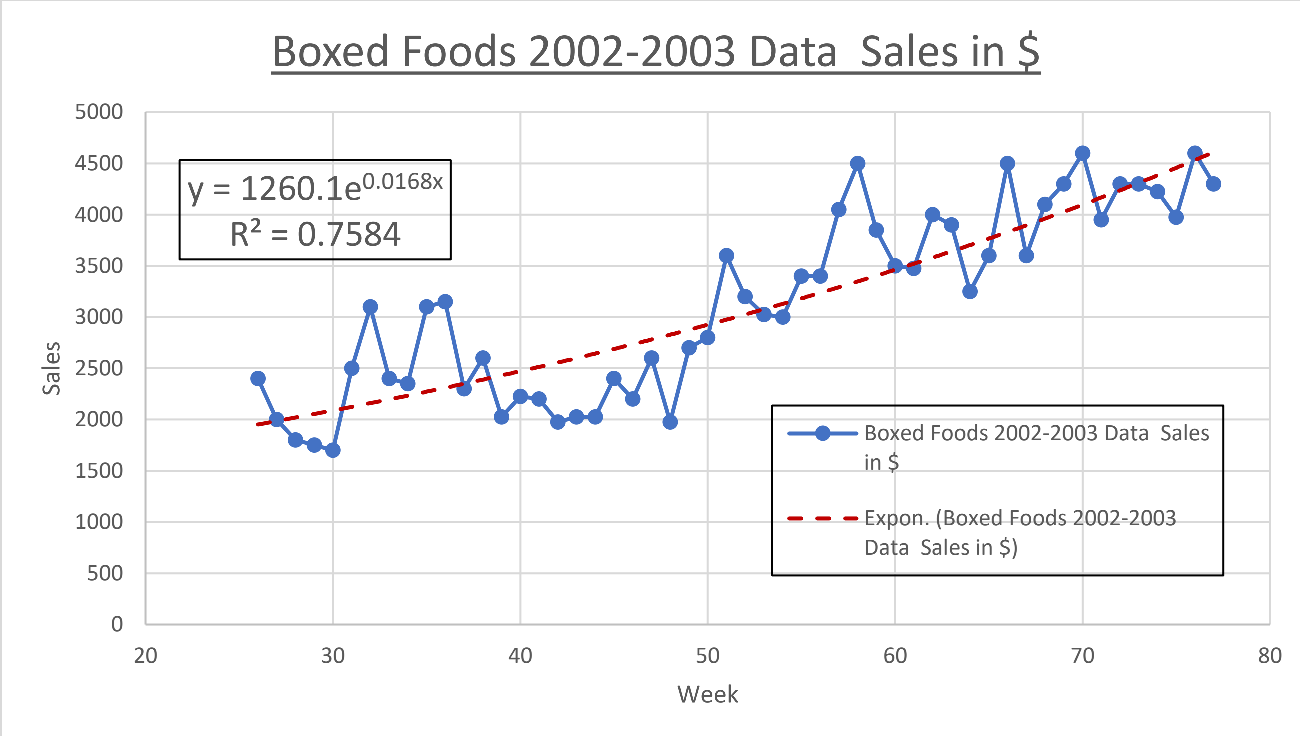
3 MODELS USING **ALL** AVALABLE DATA



The liner model fits as a very close second behind the exponential model.



This Logarithmic model is the third (least) best fitting.



The exponential trendline is the best fitting model of the three.

USING ALL DATA POINTS

Linear trendline: L(x) = 51.163x + 495.86; R^2 = 0.7491

L'(x) = 51.163

Implying the rate of change is constant at around $51/week.

Projections

Week	Total sales	
79	$4,537.74	
		+$102.33
81	$4,640.06	
		+$102.33
83	$4,742.39	

NOTE: The liner model is likely the easiest one to work with (i.e. presentations/etc.) and envision future growth during a long life cycle. It is also especially close to the best fitting model (within the R^2 value of ± 0.01 to the exponential trendline).

Logarithmic trendline: $G(x) = 2391.7\ln(x) - 6185.8$; $R^2 = 0.7039$

$$G'(x) = [2391.7/(x)]$$

Implying there is a sweet spot concerning the growth ratio (which has passed) and the rate of growth will continue slow as the weeks go on.

Projections

Week	Total sales	
79	$4,264.61	
		+$59.80
81	$4,324.40	
		+$58.34
83	$4,382.74	

NOTE: The model fits less closely than the other two and is also the most pessimistic.

Exponential trendline: $E(x) = 1260.1e^{(0.0168x)}$; $R^2 = 0.7584$

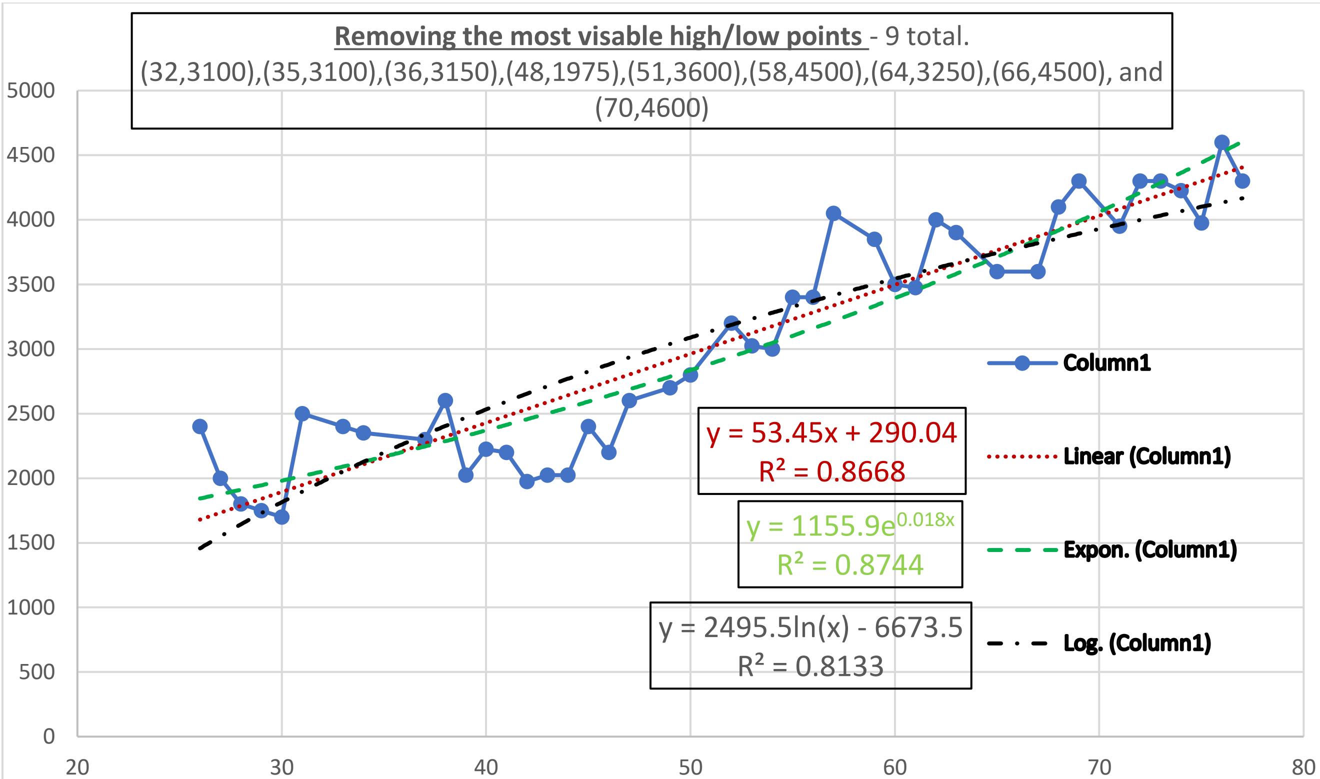
$$E'(x) = 21.16968e^{(0.0168x)}$$

Implying the rate of growth is increasing as time goes on.

Projections

Week	Total Sales	
79	$4,751.17	
		+$162.35
81	$4,913.52	
		+$167.90
83	$5,081.42	

NOTE: This is the best fitting model and is also the most optimistic.



As to be expected R^2 values are improved by eliminating the most obvious high/low points. After making the adjustments the exponential model is still the best fitting, reaffirming the true rate of growth is increasing as the weeks continue. NOTE: not by much vs. a very close 2nd linear outlook.

<u>ADJUSTED DATA BY THE REMOVAL 9 TOTAL (HIGH/LOW) POINTS</u>

Linear trendline: L(x) = 53.45x +290.04; R^2 = 0.8668

L'(x) = 53.45.

Implying the growth rate is constant at around $53/week.

Projections

Week	Total sales	
79	$4,512.59	
		+$106.90
81	$4,619.49	
		+$106.90
83	$4,726.39	

Logarithmic trendline: $G(x) = 2495.5\mathbf{ln}(x) – 6673.5$; $R^2 = 0.8133$

$$G'(x) = [(2495.5)/(x)]$$

As before, this implies there is a sweet spot that has already passed concerning marginal growth and the future rate of growth will continue to slow as the weeks go on.

Projections

Week	Total sales	
79	$4,230.46	
		+$62.39
81	$4,292.85	
		+$60.87
83	$4,353.72	

Exponential trendline: $E(x) = 1155.9e^{(0.018x)}$; $R^2 = 0.8744$

$$E'(x) = 20.8062e^{(0.018x)}$$

Implying the rate of growth is increasing as time goes on.

Projections

Week	Total sales	
79	$4,791.67	
		+$175.64
81	$4,967.31	
		+$182.08
83	$5,149.40	

SO, WHAT DOES THE DATA MEAN?

There is certainly some good information here that can be interpreted in a few different ways. One would be to see that the exponential model fits the best and say, "Yep, lets project our sales on the best fitting model" However, I would caution against this as there is a limited amount of data to comfortably look forward into the future very far (51 data points or adjusted to 42 data points) as the R^2 value(s) are still substantially low, in a statistical sense (ideally looking for values closer to R^2 = 0.95 to 0.99).

The liner model is the easiest to visually understand and if I were making a presentation, I would emphasize this as a neutral, moderately conservative, predictor of future sales. In addition, although it is the least close fitting of the three trendlines, I would also tend to sway somewhat on the conservative side of things and assume the rate of change will indeed slow as time goes on, imagining the logarithmic model to be the 'closest to reality' at some future period. The actual time is unknown (months, years, decades). However, with dry goods (a staple of life) the growth would likely coordinate with the concentrated population density within the vicinity of a particular store. In other words, if the population declined, so would the sales of dry goods. If the population increased exponentially, so would the sales of dry goods.

In essence, what I would explain to a board of directors, managers, or purchasers [or something similar] is to "Shoot for exponential growth, be happy if the growth is linear, and expect a logarithmic trendline to fit closest at some point in time". The philosophy of "under-promise and over-deliver".

Seasonally and socially the sales of dry goods could be affected by many variables. One example (as of recent times) is a "lockdown" type event, like one we saw in early 2020 during the Covid19 *pandemic*. This would have been a good time to be in the 'dry goods business' as sales skyrocketed during this period, so much as even interrupting the supply chain and creating inflation. Of course, this would have been an outlier type event and could not be used to predict future events, as even itself would have been unpredictable. But I'd imagine many suppliers and manufacturers have learned a great deal from this and if something similar is ever 'in the pipeline' again [hopefully not], most will surely 'ramp up' production to the best of their ability.

Seasonally, in the New England area, I would assume for the average consumer dry goods sales increase during the winter months and decrease during the summer months, when we have easier access to 'fresh food'. The same to be true in Florida (higher demand in winter); when the 'snowbirds' and/or tourists arrive and the population density increases (2X/5X/10X in some places).

To conclude, although is not technically the 'best' of the three trendlines, I would move forward cautiously with a linear growth trend, be prepared to make adjustments as necessary, and regularly compare the sales data to the ever-changing demographics within a 15-mile radius of the store.