Nonlinear Trends for Several Software Metrics

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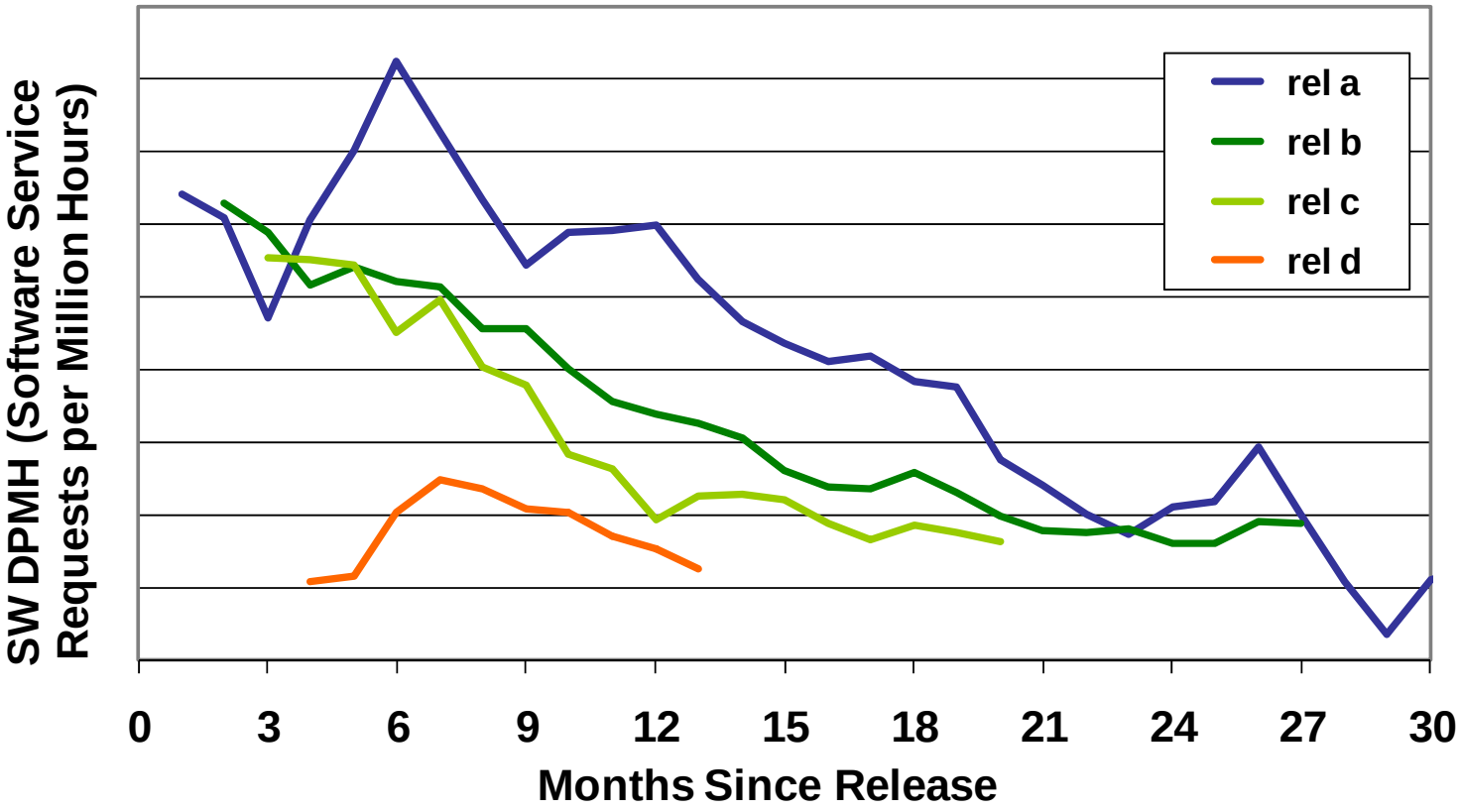
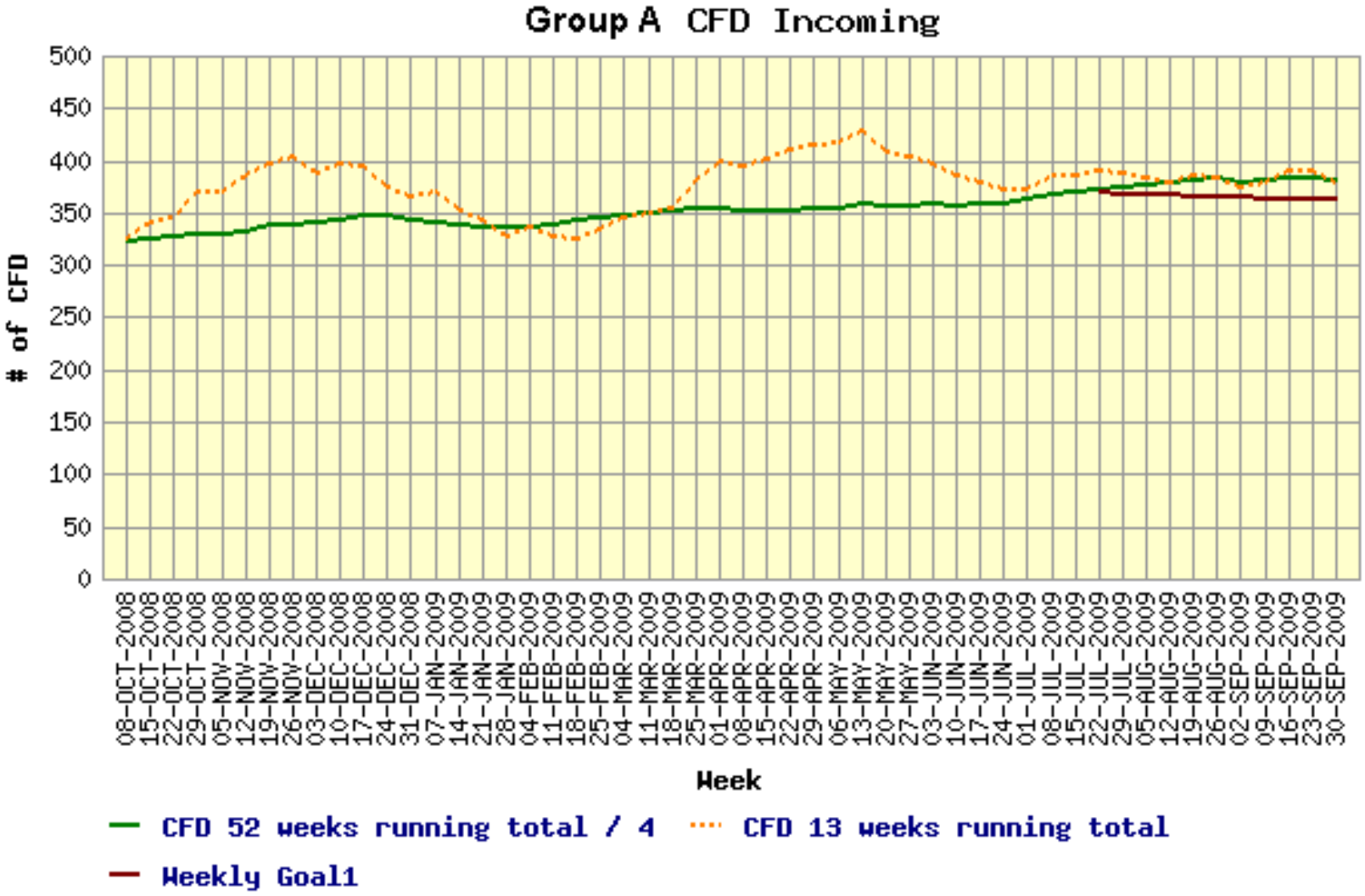
Both normalized and unnormalized software metrics are needed.

Normalized example*:



* Thanks to Bob Mullen.

Unnormalized example:

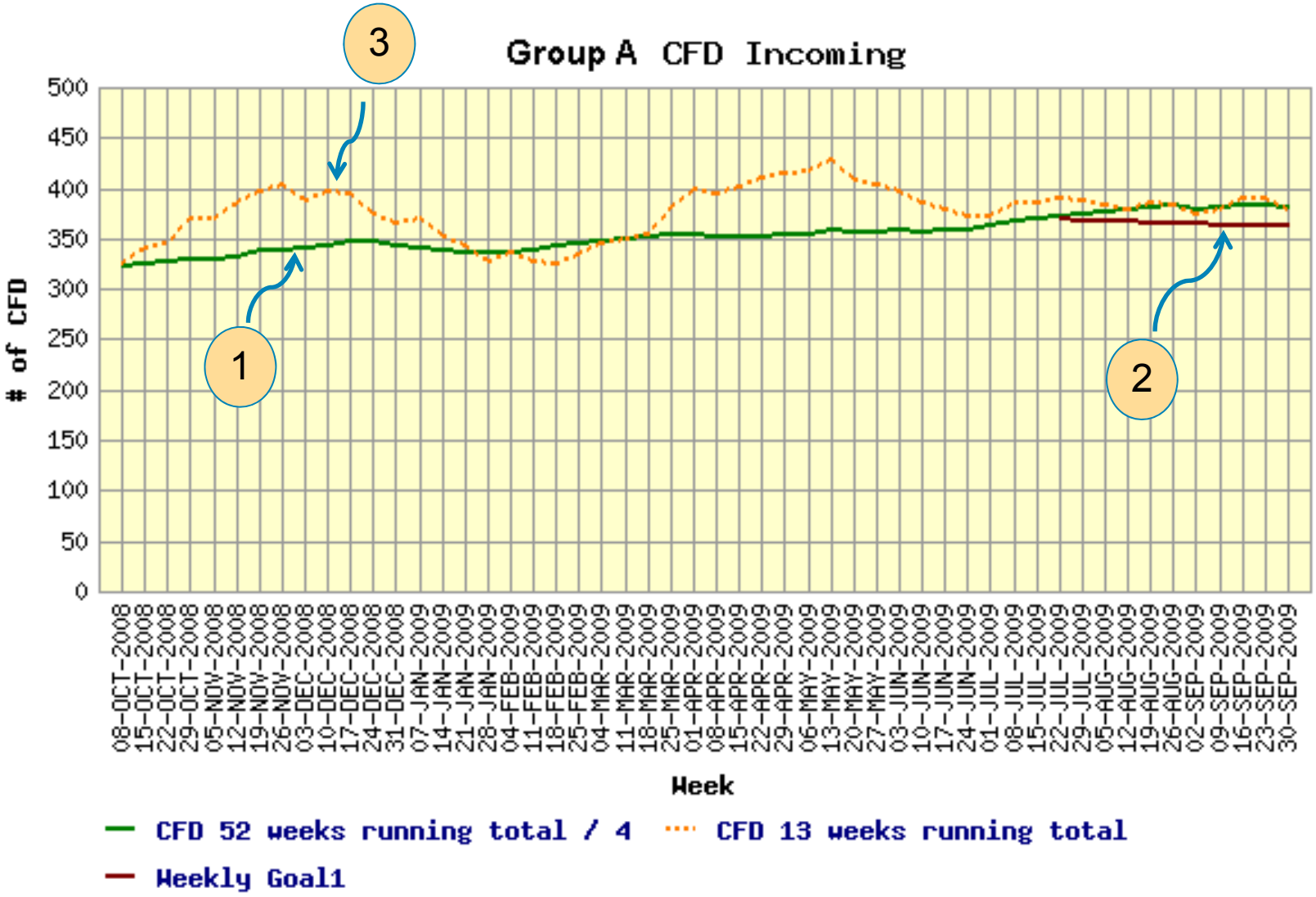


[CFD = customer-found defect.]

(Unnormalized) CFD Incoming:

- How many actual bugs injected by my group are escaping to customers?
- Over time, is my group reducing the number of bugs escaping to the customer?

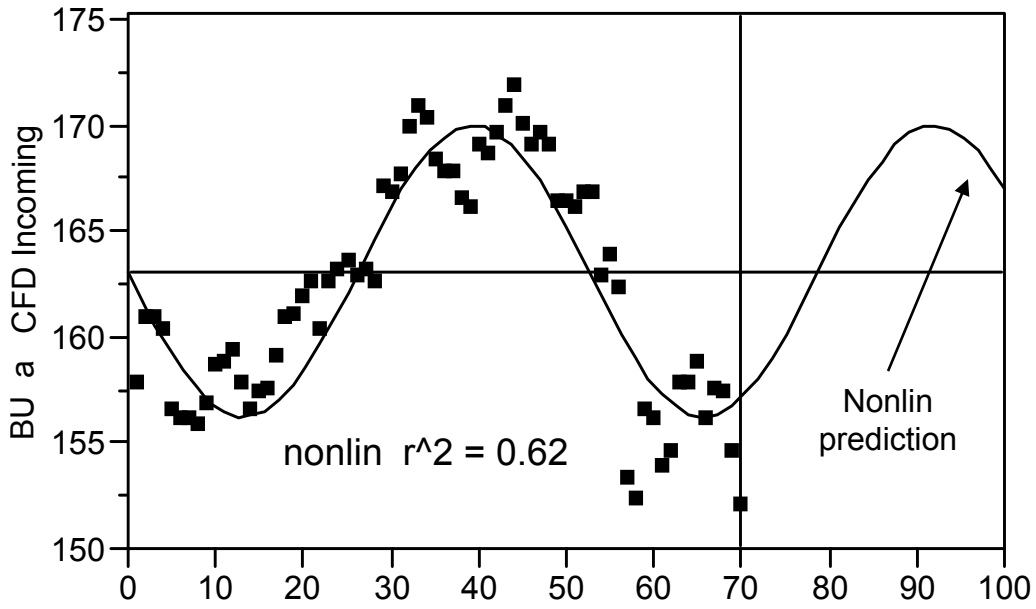
Difficulties in goaling CFD Incoming:



Sine wave is used for nonlinear approach for CFD Incoming

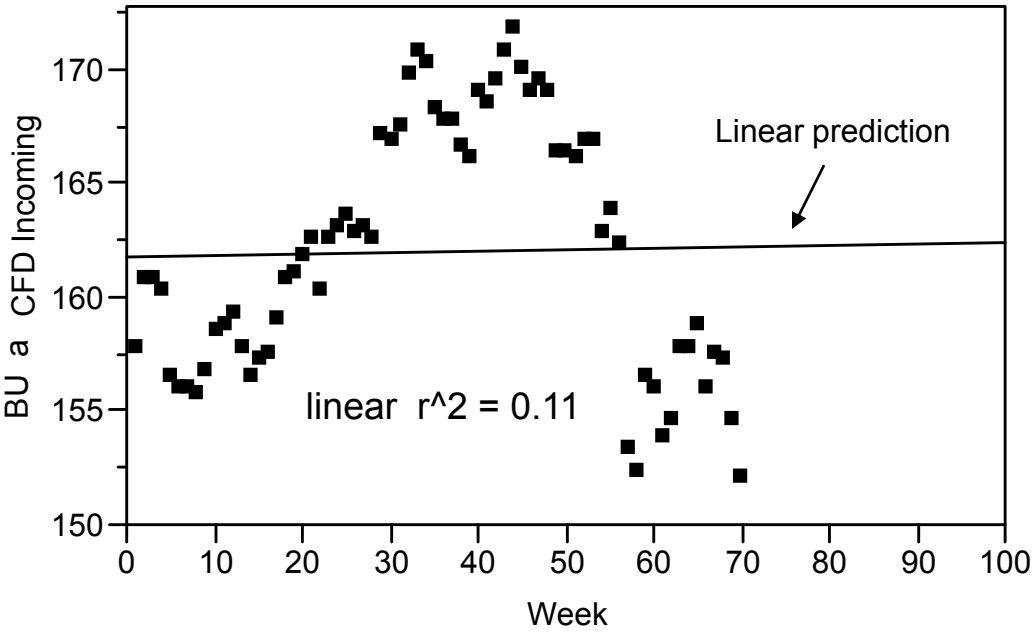
- Why? CFDs arriving from roughly periodic releases tend to ramp up, plateau near max, ramp down, plateau near min, ramp up, etc.
- Wavelength varies from 6 to 24 months or more
- Seasonality is superimposed on release wave, with 6-month wavelength; improvement (or growth) is also superimposed on release wave
- Rolling n-weekly total is used – the number of weeks is not disclosed, for confidentiality reasons
- $y = y_0 + b[\sin(\omega t + \varphi)]$.

BU ‘a’ CFD Incoming



Nonlinear (wave) fit:

- End of year expectation (at week 100) is ~164
- Yearly goal might be a 10% reduction from 164, or 148.



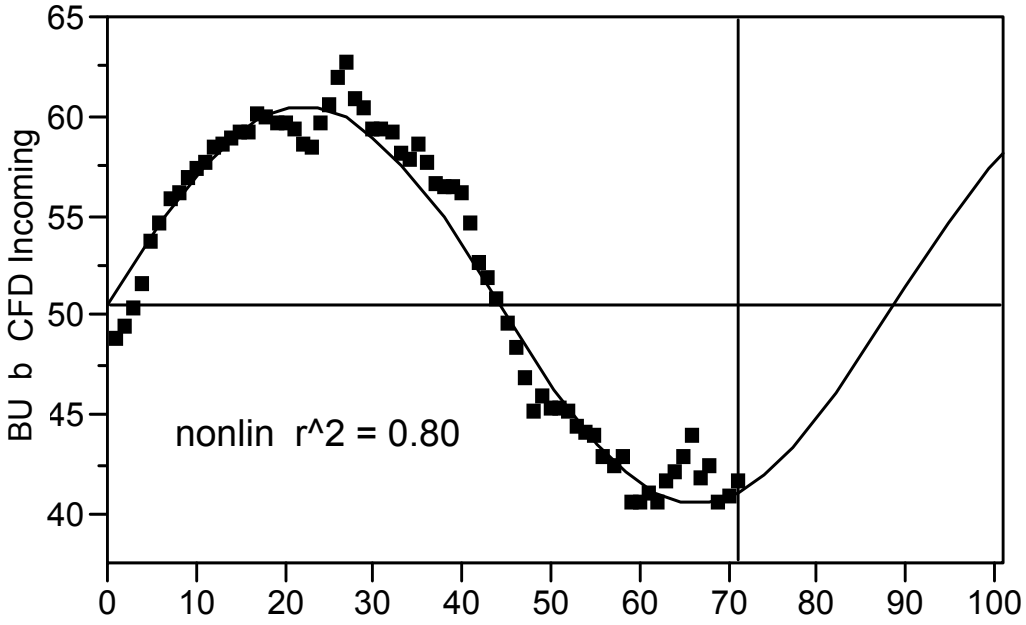
Linear fit:

- End of year expectation is ~163
- 10% reduction from 163 is 147.

Conclusion: Similar results using both approaches.

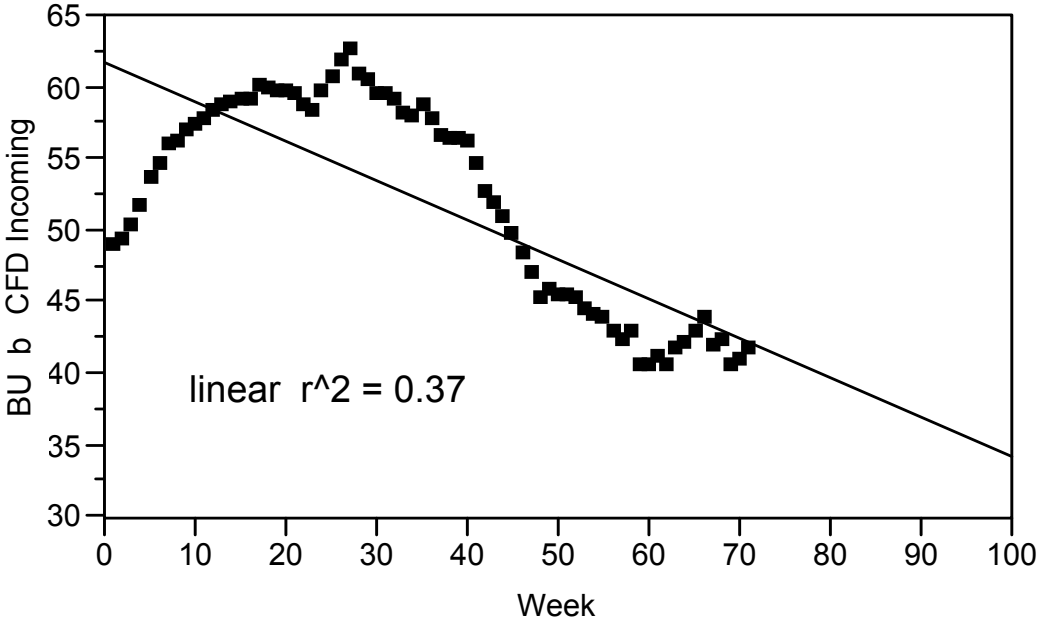
[BU = business unit.]

BU ‘b’ CFD Incoming



Nonlinear (wave) fit:

- End of year expectation (at week 100) is ~57
- Yearly goal might be a 10% reduction from 57, or 51.

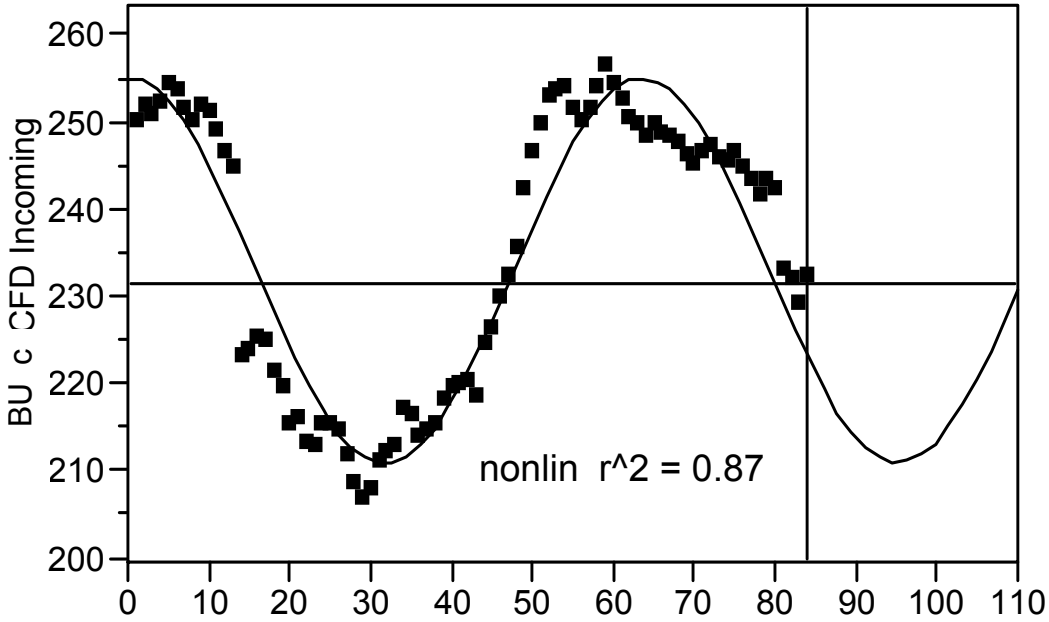


Linear fit:

- End of year expectation is ~35
- 10% reduction from 35 is 31.

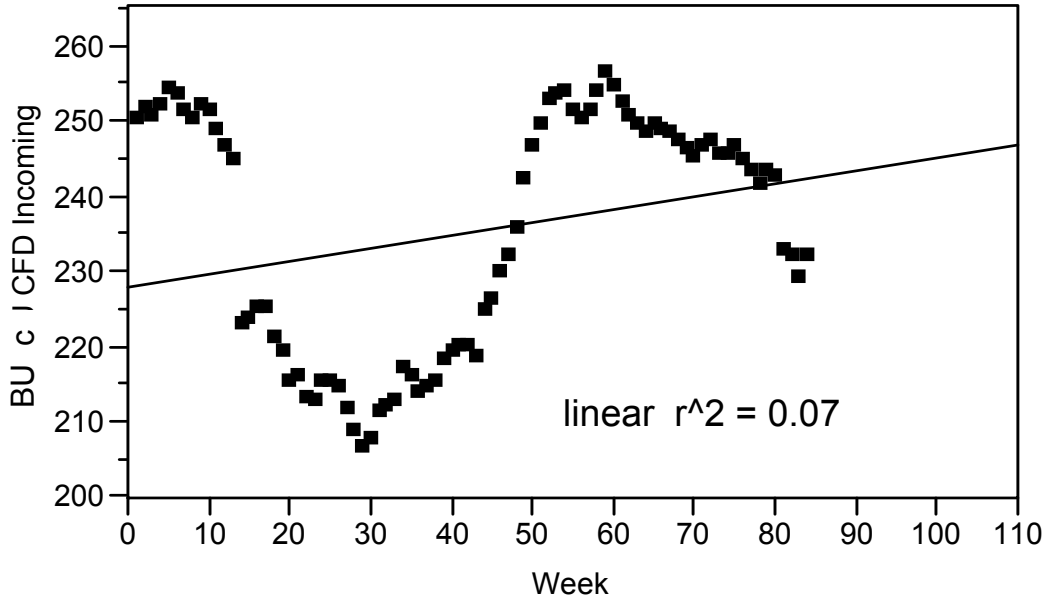
Conclusion: These approaches yield much different results, with better fit using sine wave.

BU ‘c’ CFD Incoming



Nonlinear (wave) fit:

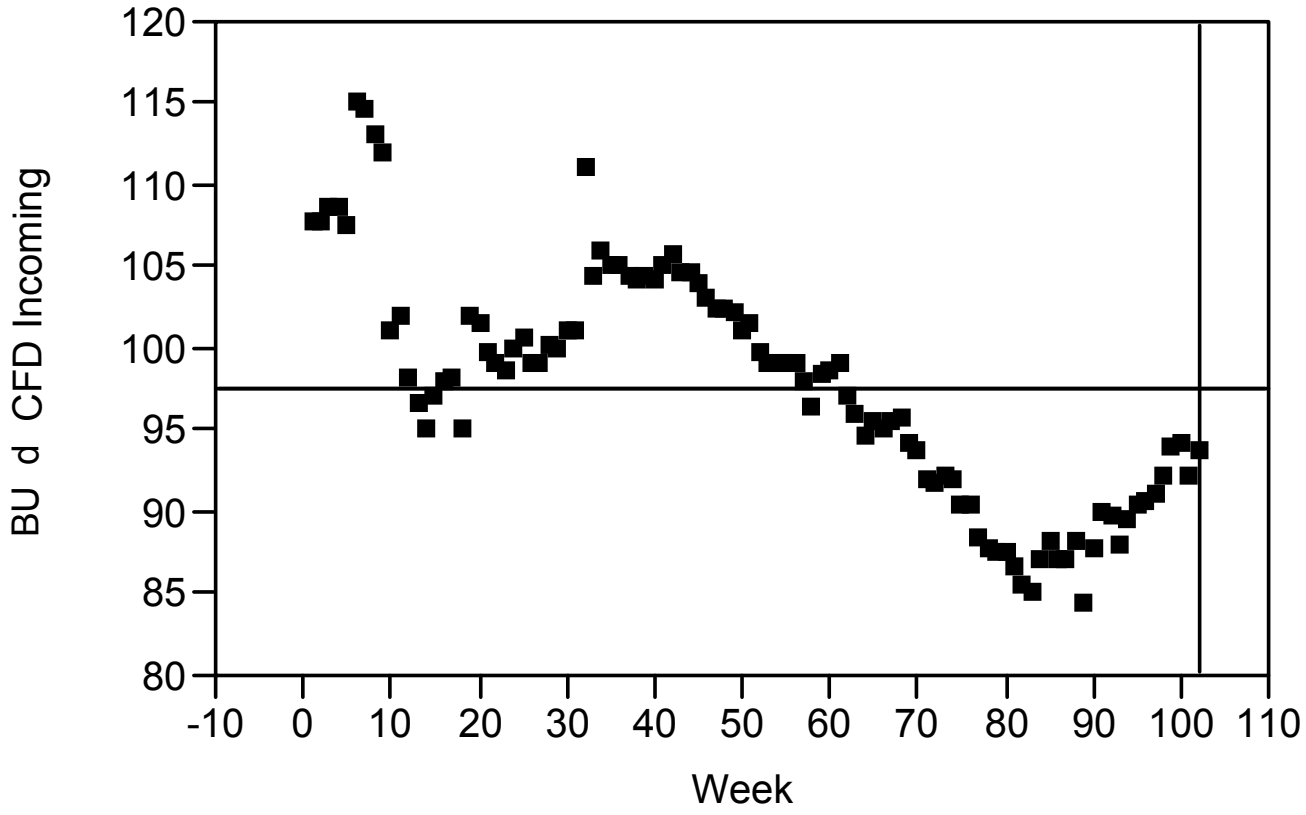
- End of year expectation (at week 110) is ~229
- Yearly goal might be a 10% reduction from 229, or 206.



Linear fit:

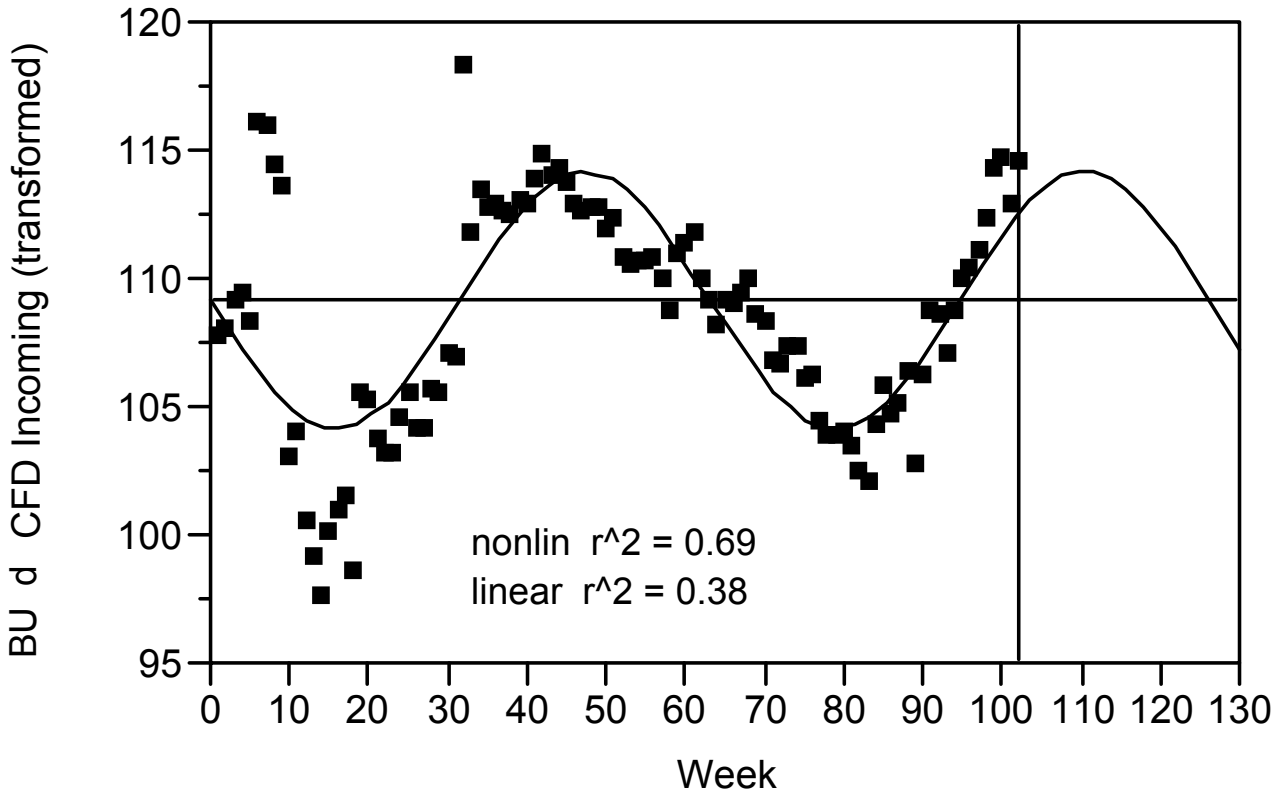
- End of year expectation is ~246
- 10% reduction from 246 is 221.

Conclusion: These approaches yield different results, with better fit using sine wave.



BU ‘d’

- In addition to release/seasonal cyclicality, there appears to be a steady improvement over time in BU ‘d’ CFD Incoming
- (Or the cyclicality could be a result of a reduction in feature volume, or a progressively slower rampup in the customer space – these possibilities need to be checked prior to goaling).

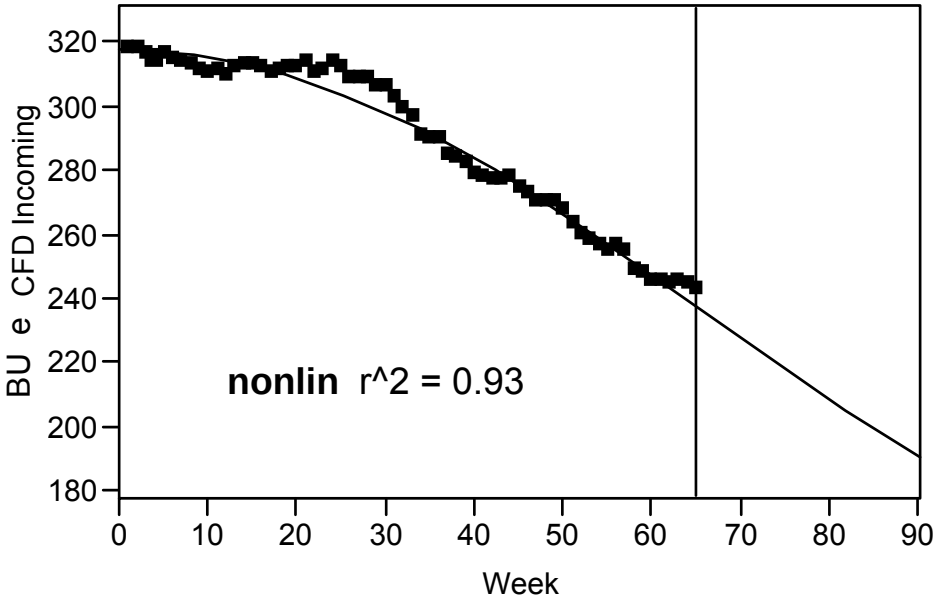


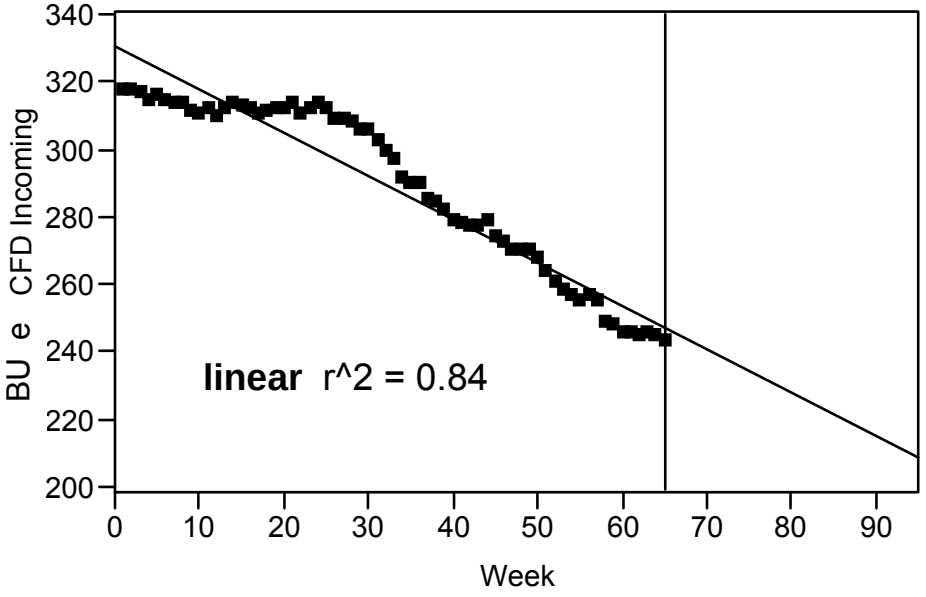
BU ‘d’

• Here is the same data with improvement taken out, and fit to a wave function

• The end of year expectation of ~108 needs to be adjusted downward to ~82 to add expected improvement back in

• A linear model predicts ~83, so no appreciable difference is seen between models.





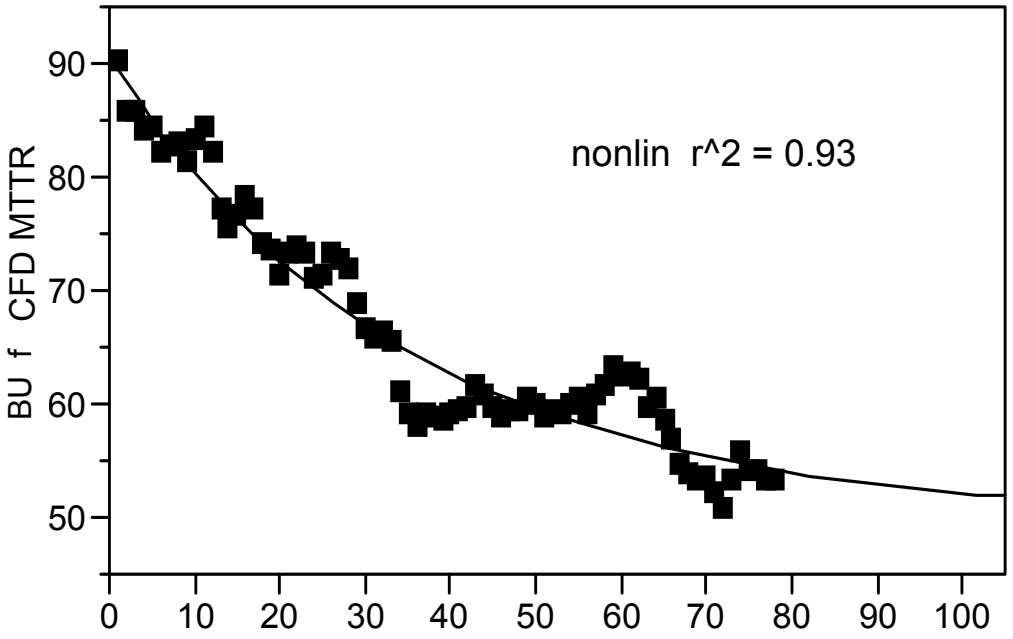
BU ‘e’:

Example of interpretation issue (i.e., is this a long wavelength or a true drop in CFDs?), where yearly nonlin prediction is ~190, and linear prediction is ~210.

Exponential decay is used for nonlinear approach for CFD MTTR (mean time to repair, defined as backlog divided by av. daily close rate)

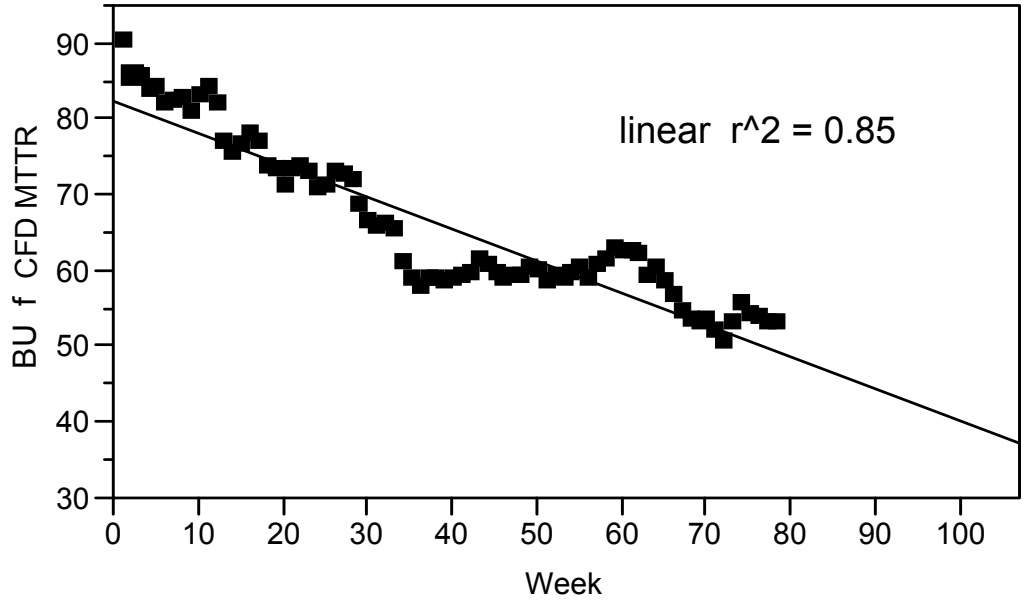
- Why? Reasonable physical interpretation: MTTR reduction is more difficult to improve as close rate increases and backlog of old bugs is depleted.
- Rolling n-weekly totals are used – the number of weeks is not disclosed, for confidentiality reasons
- $y = y_0 e^{-\lambda t}$.

BU ‘f’ CFD MTTR



Nonlinear (exponential decay) fit:

- End of year expectation is ~52
- Yearly goal might be a 10% reduction from 52, or 47.

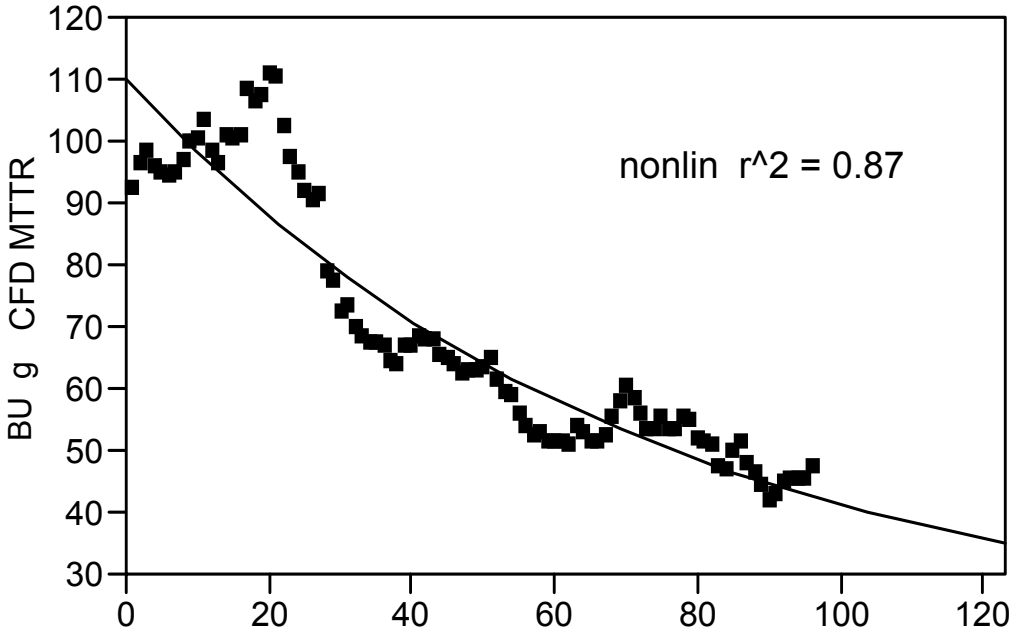


Linear fit:

- End of year expectation is ~38
- 10% reduction from 38 is 34.

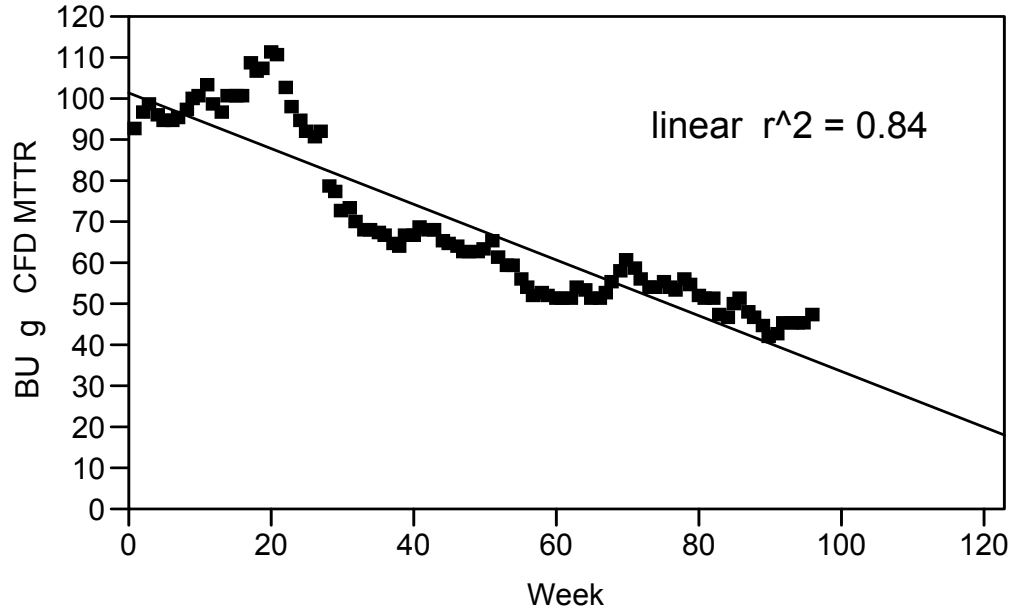
Conclusion: These approaches yield different results, with better fit using sine wave.

BU ‘g’ CFD MTTR



Nonlinear (exponential decay) fit:

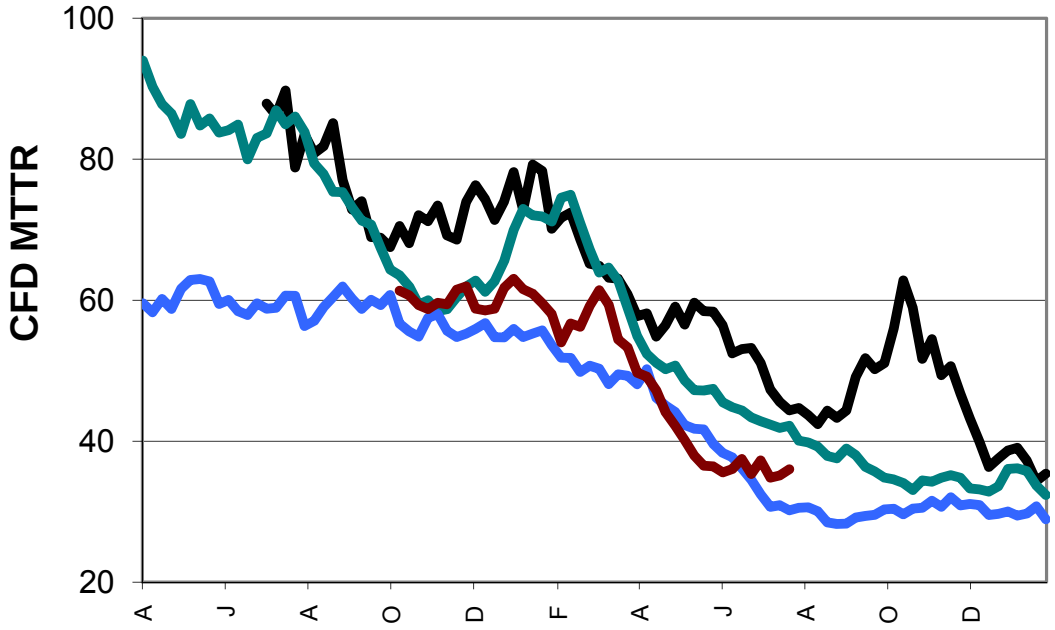
- End of year expectation is ~37
- Yearly goal might be a 10% reduction from 37, or 33.



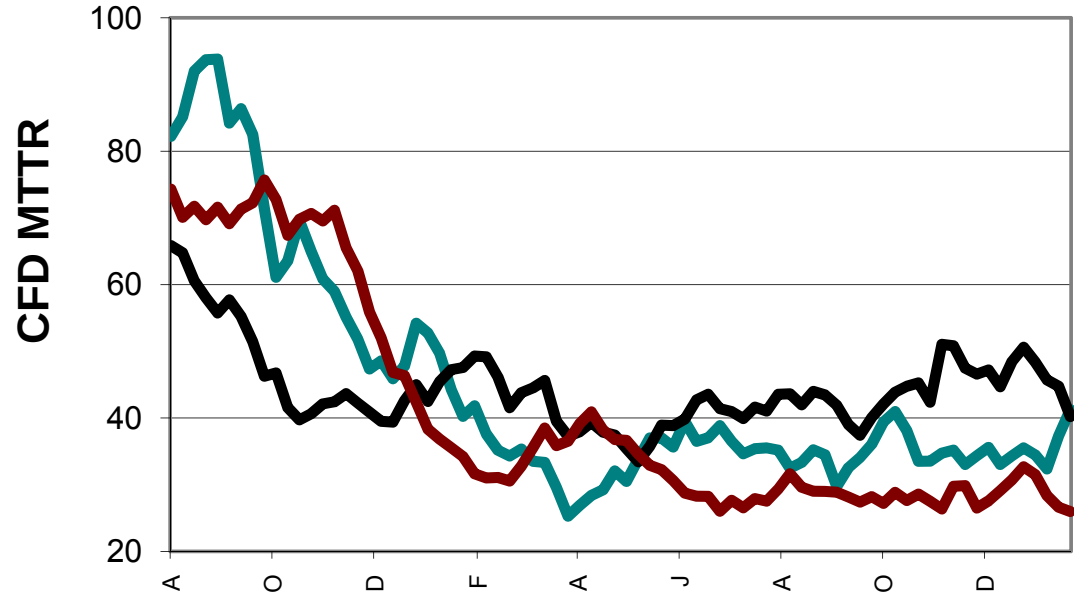
Linear fit:

- End of FY09 expectation is ~22
- 10% reduction from 22 is 20.

Conclusion: These approaches yield different results – linear approach is probably unrealistic.



CFD MTTR data for many teams appears to fit the exponential decay model, similar to the previous examples.



Other teams' CFD MTTR data has flattened out over the past two or three quarters, so for these teams it may suffice to use linear models constructed using historical data from at least two quarters.

Findings

- CFD Incoming
  - •Nonlinear sine wave fit exhibits higher correlation than linear fit – average r-squared is 0.82 vs. 0.54
  - • Average goal for the nonlinear model is 9% different than that for the linear model
- CFD MTTR
  - •Nonlinear exponential decay fit exhibits higher correlation than linear fit – average r-squared is 0.90 vs. 0.81
  - • Average goal for the nonlinear model is 19% different than that for the linear model
- Summary – nonlinear goaling is found to be appropriate for several key software metrics; other key metrics are under investigation.