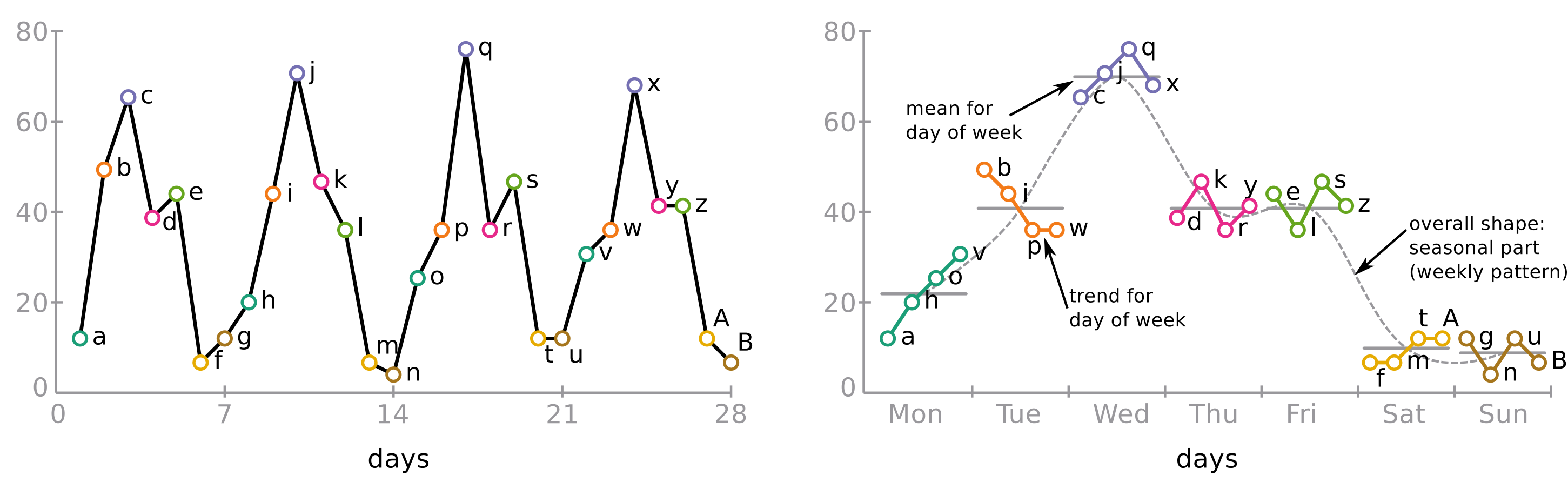


# Visually and Statistically Guided Imputation of Missing Values in Univariate Seasonal Time Series

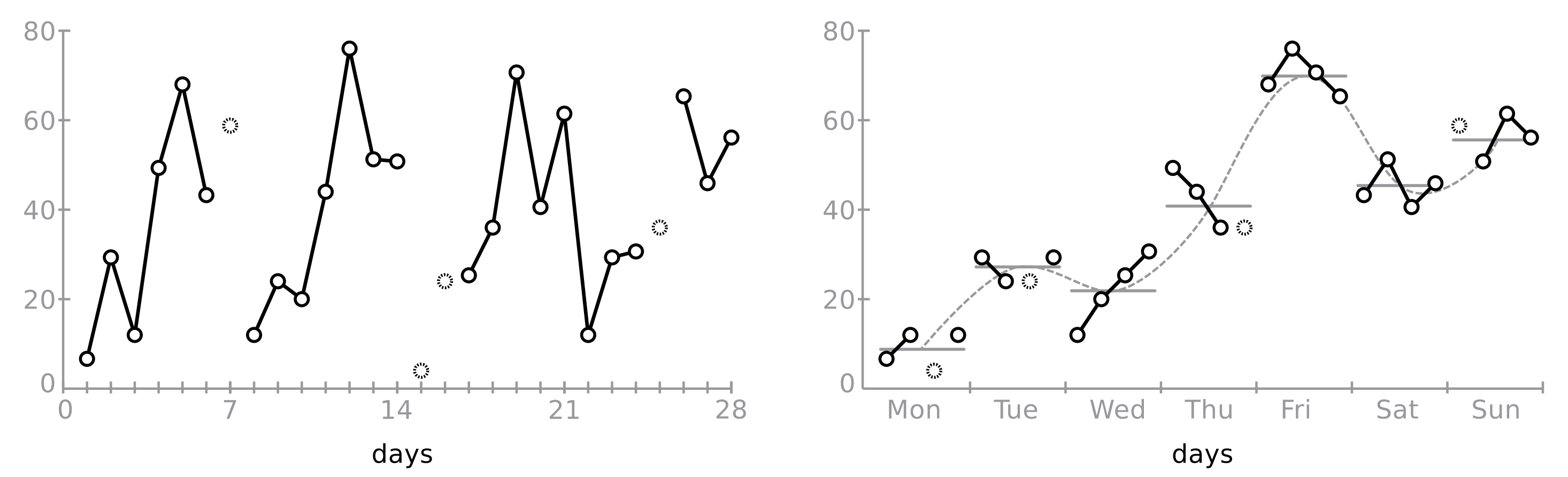
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## Cycle Plot Representation



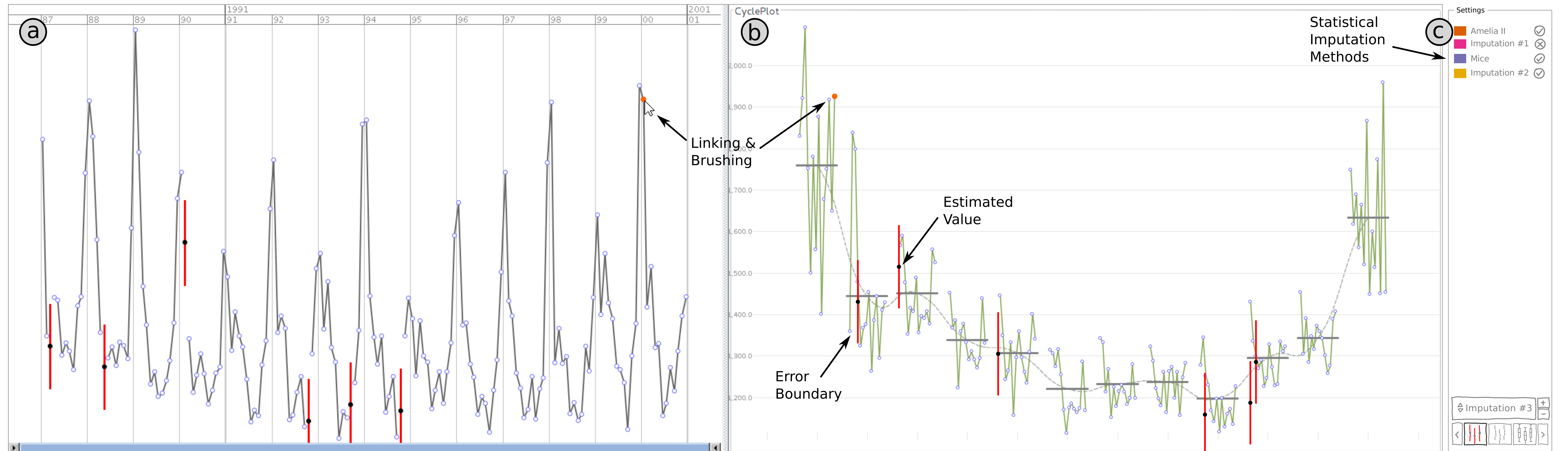
adapted from Aigner et al. [1] and Cleveland [2]

## Audience Task: Impute the values!



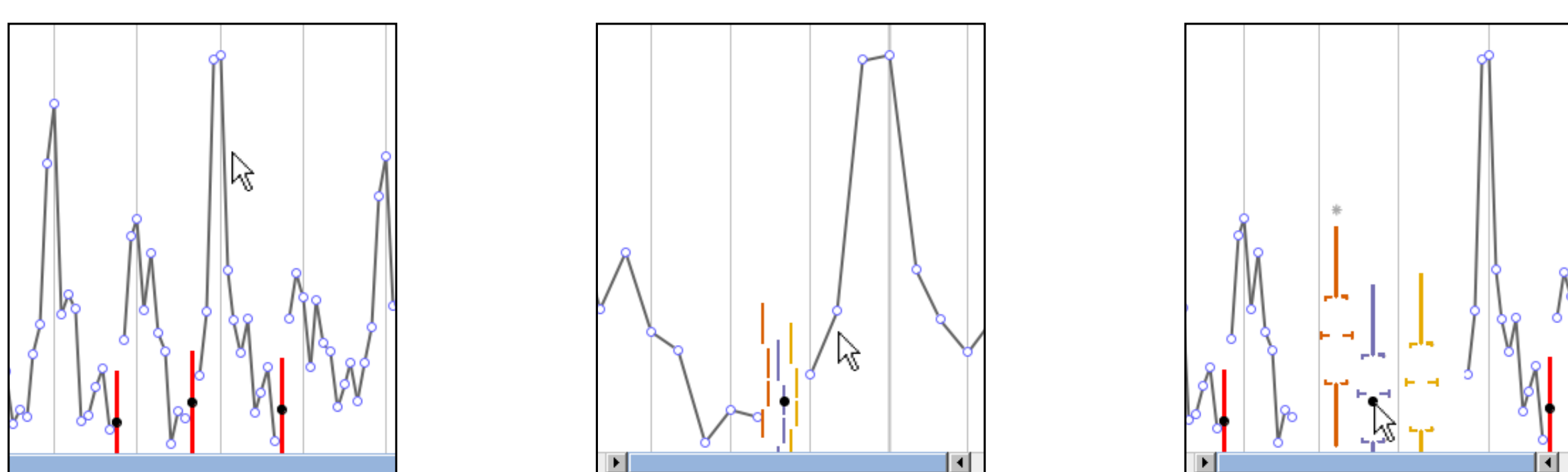
Estimate the values according to the pattern, without using the cycle plot. Then check how you would estimate it considering the information from the cycle plot.

## Our Approach



Coordinated views with (a) a time series line plot using a linear time axis, (b) the corresponding cycle plot, and (c) a configuration panel. The estimated values (black dots) of missing values and boundaries (red bars) are displayed. More details can be shown in both views, (a) and (b). The user can adjust the estimated value via direct manipulation and keep track of the adjustments in both views by linking and brushing.

## Details on Demand



Sequence of interactions for more details on demand. The representation varies according to zoom level and mouse interaction. The transition in zoom level is shown from left to right, depending on the level of detail requested. The color encodes the imputation method, cf. configuration panel above.

## Summary / Results

- Uses domain knowledge and an optimized visual representation
- Combines statistical imputation methods + interactive visual interface
- Two coordinated views: linear line plot + cycle plot for time-series
- Shows imputation estimates (including uncertainty and variation) graphically
- Allows for adjusting imputation values via direct manipulation
- Enables better judgment of adequacy of imputed values

References:  
 [1] W. Aigner, S. Miksch, H. Schumann, and C. Tominski. *Visualization of Time-Oriented Data*. Springer, London, UK, 2011.  
 [2] W. Cleveland. *Visualizing Data*. Hobart Press, Summit, USA, 1993.

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