Temporal Neighborhood Discovery using Markov Models

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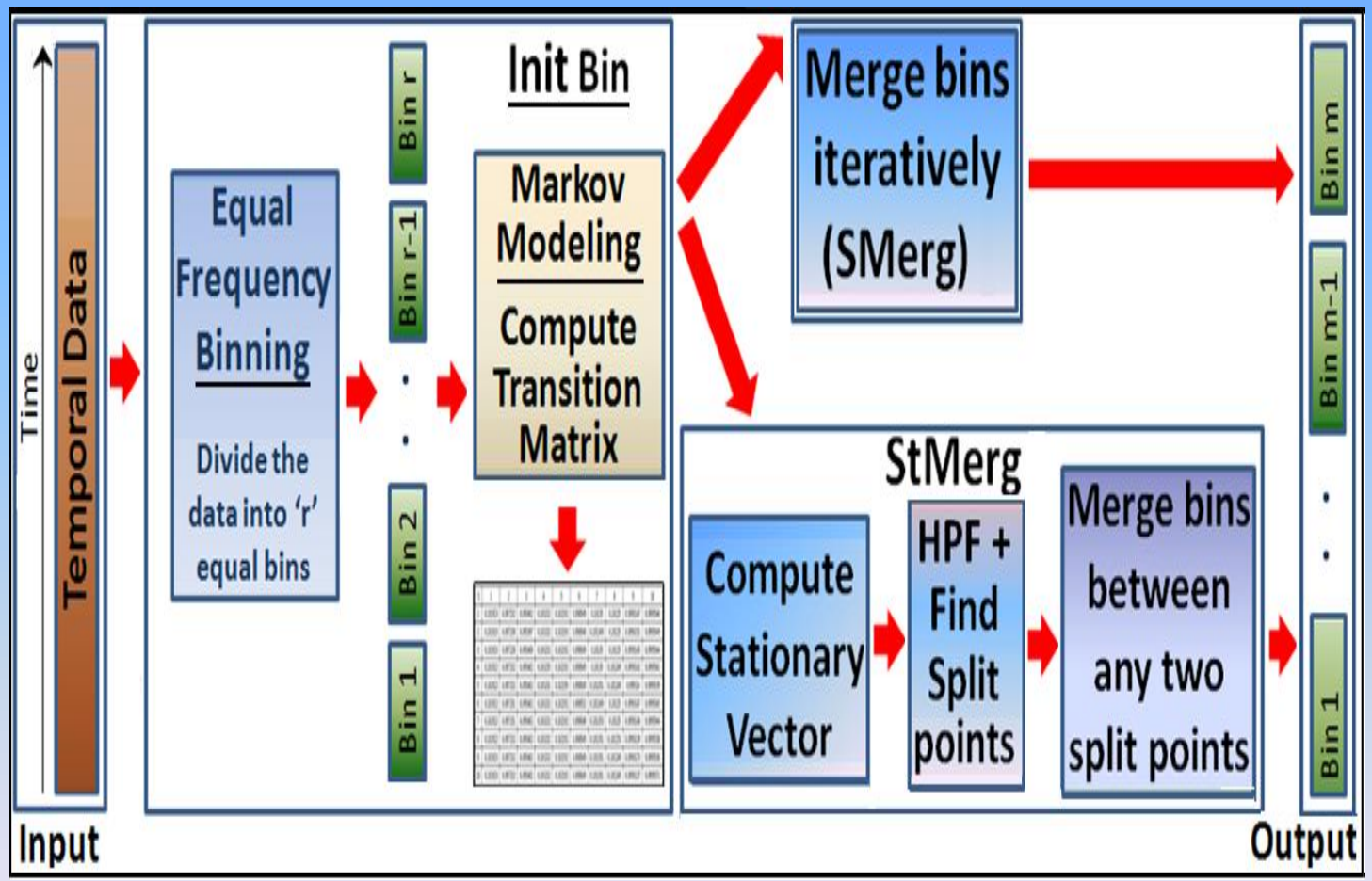
Schematic Diagram



Initial Markov Modeling

- ***Normalize the Temporal Dataset***
- ***Equal Frequency Binning*** *to get initial equi-depth bins*
- *Obtain* ***Temporal Summarization***
- *Compute* ***Transition Probability Matrix*** *using different* ***distance measures***

Distance Measures

Distance	$d(B_i, B_j)$
KL	$\frac{1}{2}\left(2\log_e\left(\frac{\sigma_j}{\sigma_i}\right)+\frac{(\mu_i-\mu_j)^2}{\sigma_j^2}+\frac{\sigma_i^2}{\sigma_j^2}-1\right)$
Divergence	$\frac{1}{2}\left((\mu_i-\mu_j)^2\left(\frac{1}{\sigma_i^2}+\frac{1}{\sigma_j^2}\right)+\frac{\sigma_i^2}{\sigma_j^2}+\frac{\sigma_j^2}{\sigma_i^2}-2\right)$
Mahalanobis	$2.\frac{(\mu_i-\mu_j)^2}{\sigma_i^2+\sigma_j^2}$
Bhattacharyya	$\frac{1}{4}.\frac{(\mu_i-\mu_j)^2}{\sigma_i^2+\sigma_j^2}+\frac{1}{2}log_e\left(\frac{\sigma_i^2+\sigma_j^2}{2\sigma_i\sigma_j}\right)$
Hellinger	$\sqrt{\frac{1}{2}-\sqrt{\frac{\sigma_i\sigma_j}{2(\sigma_i^2+\sigma_j^2)}}e^{-\frac{1}{2}\frac{(\mu_i-\mu_j)^2}{\sigma_i^2+\sigma_j^2}}}$

SMerg

- *Find the **adjacent** bins with **maximum similarity***
- ***Iteratively merge** the maximum similar adjacent bins*
- ***Stop merging** if similarity less than a **threshold***

StMerg

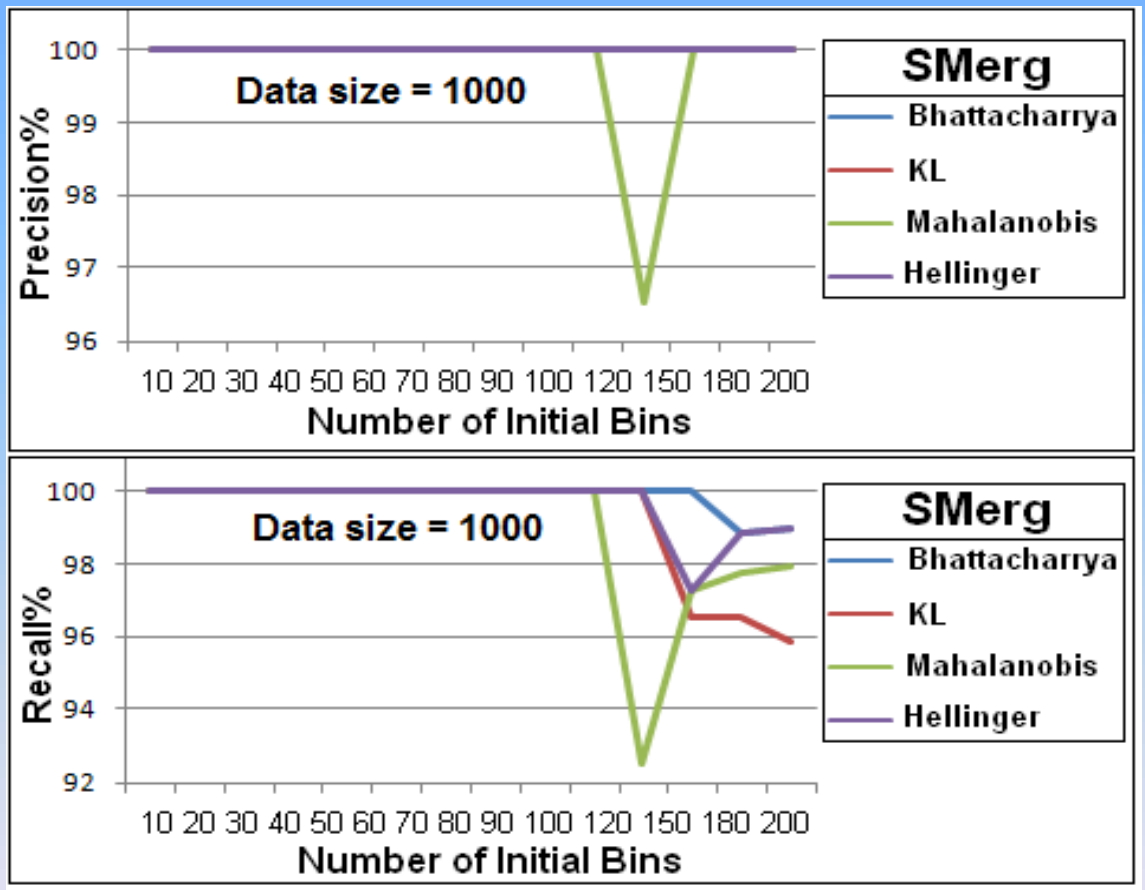
- *Compute **Markov Stationary Distribution** from the Transition Matrix*
- *Use **DFT** as **High Pass Filter** to find **Split points***
- ***Merge all bins** in between **successive spilt points***

Accuracy Measures

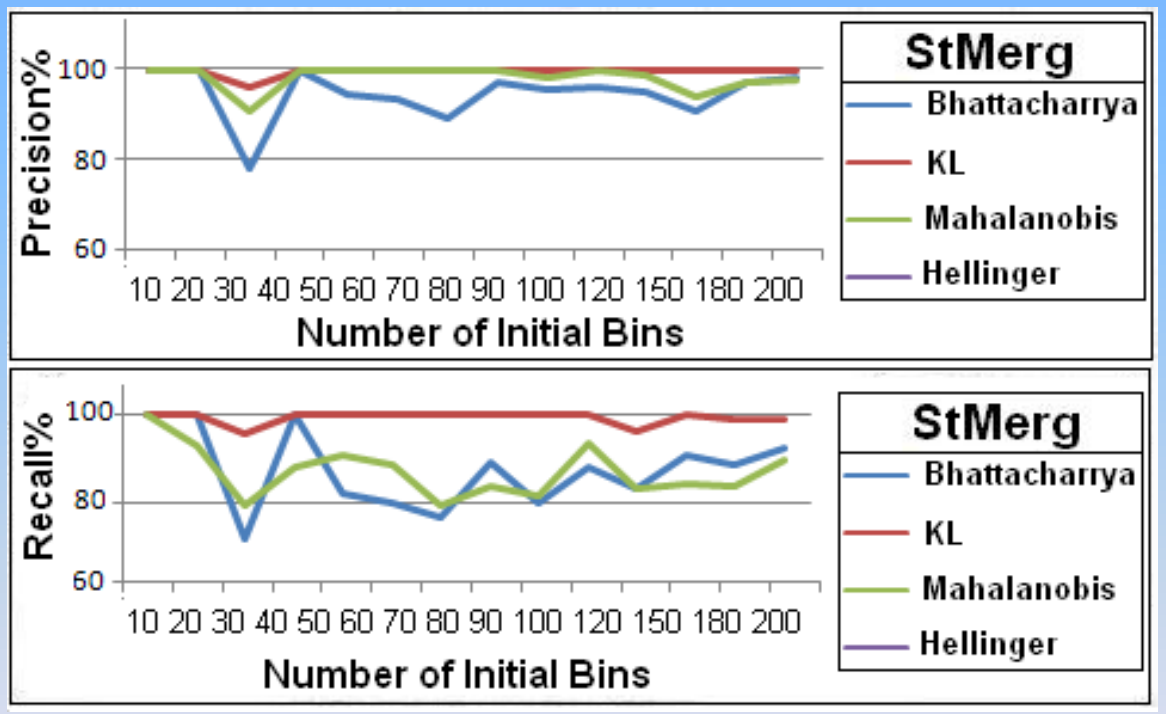
$$\text{Precision} = \frac{\text{number of bins correctly merged}}{\text{total number of bins actually merged}}$$

$$\text{Recall} = \frac{\text{number of bins correctly merged}}{\text{total number of bins expected to be merged}}$$

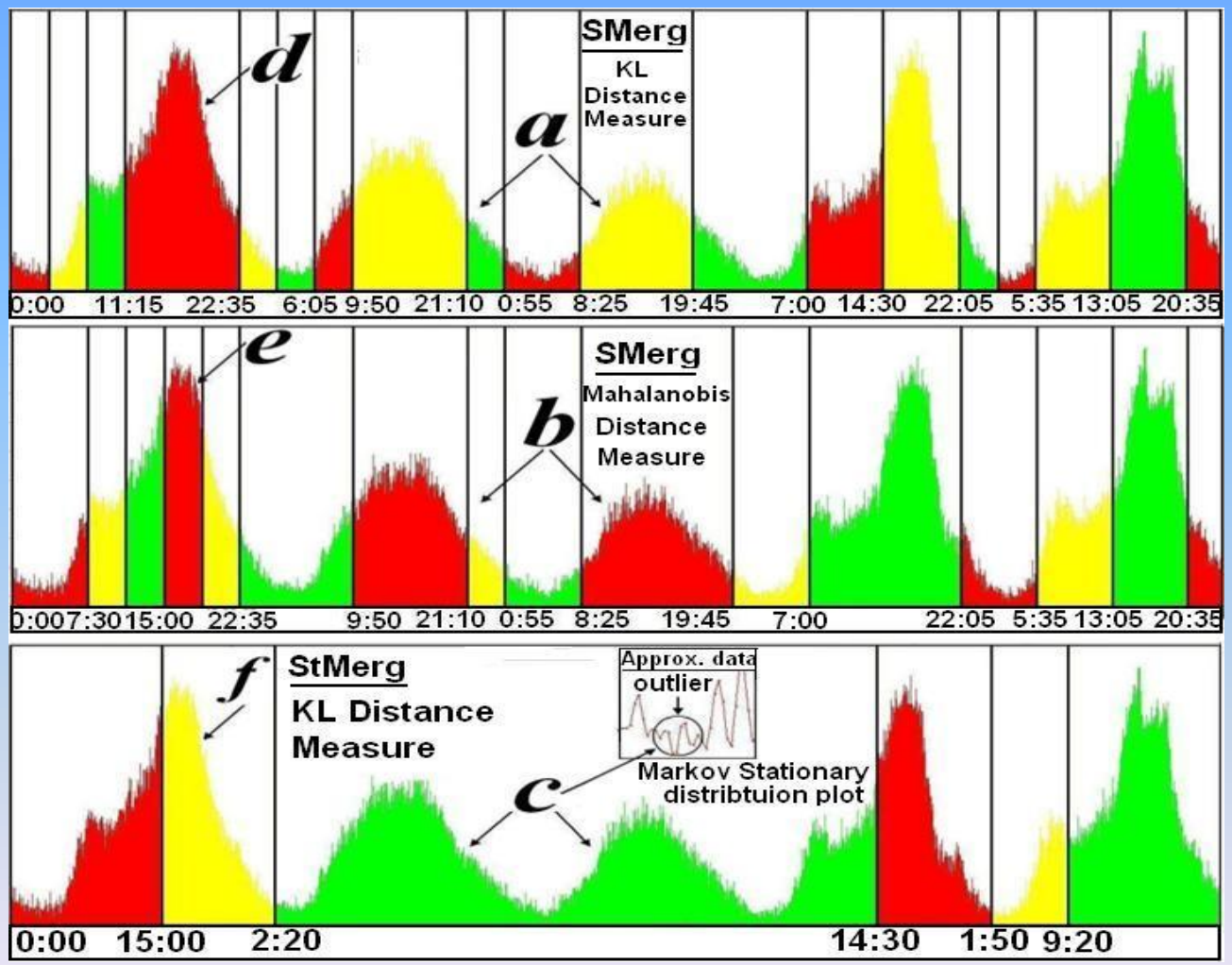
Results



Results



US-50-East



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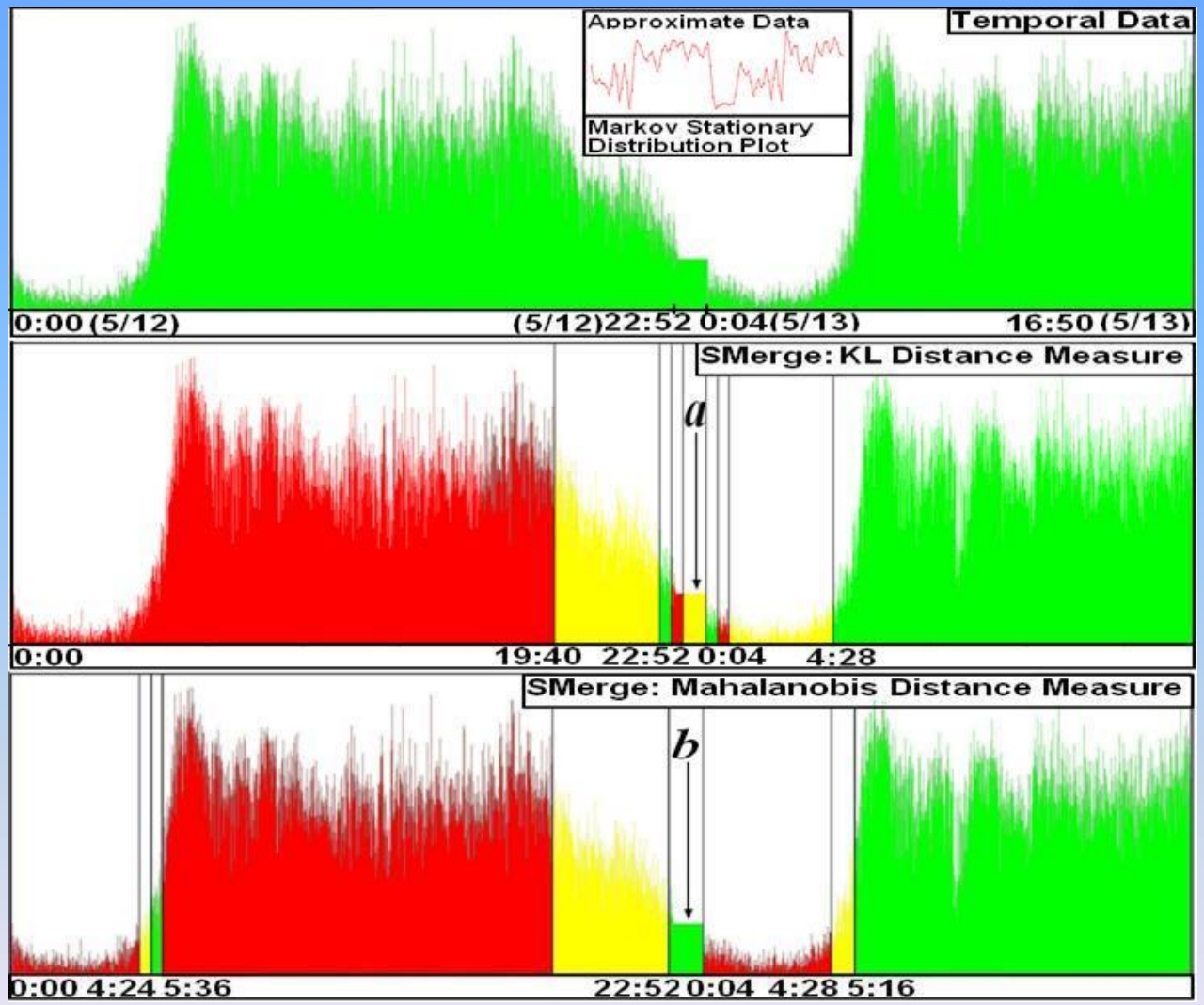

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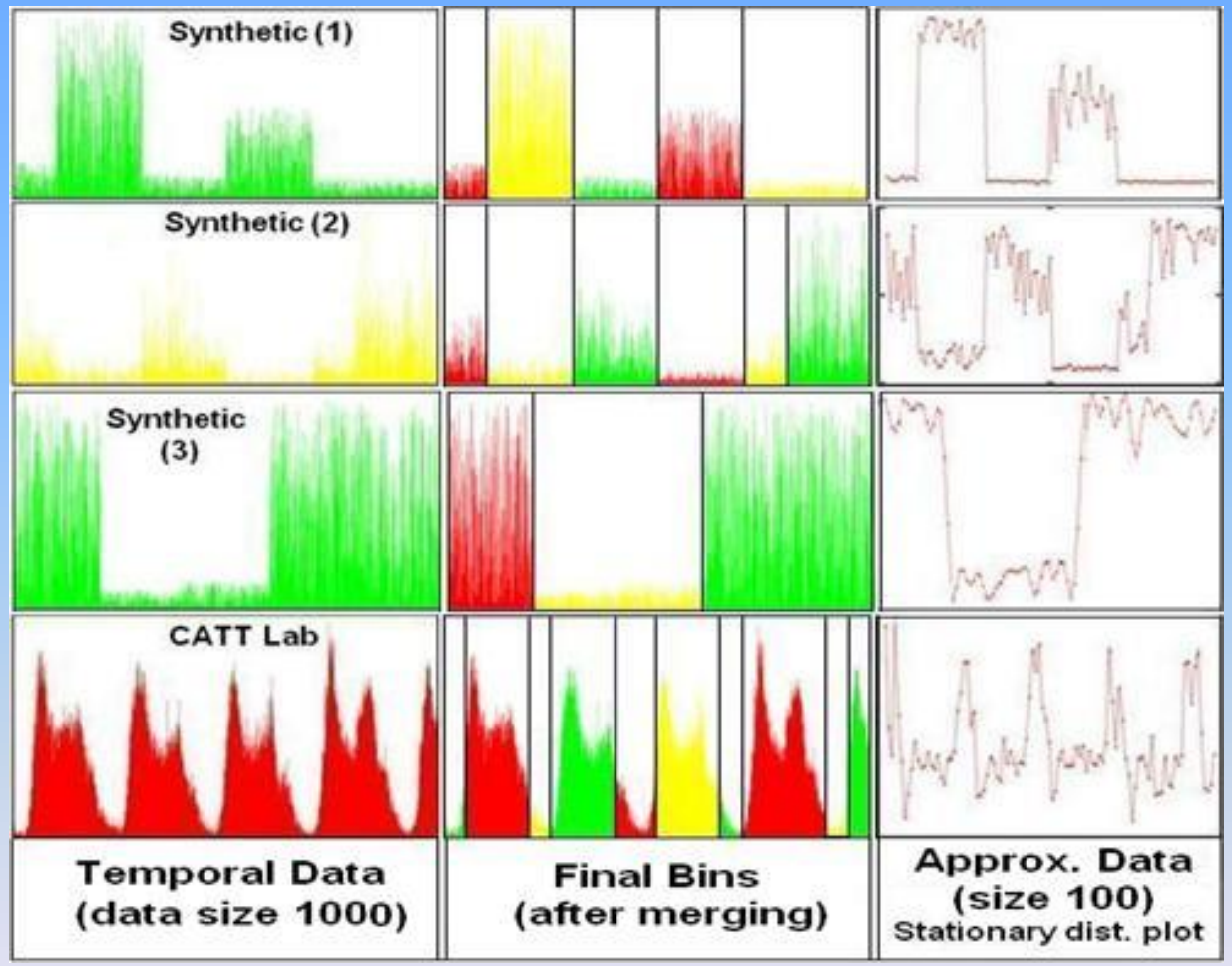
Approximation



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Questions

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