Web Application to Evaluate Statistical Time Series Forecast Models: Application to Walmart Sales

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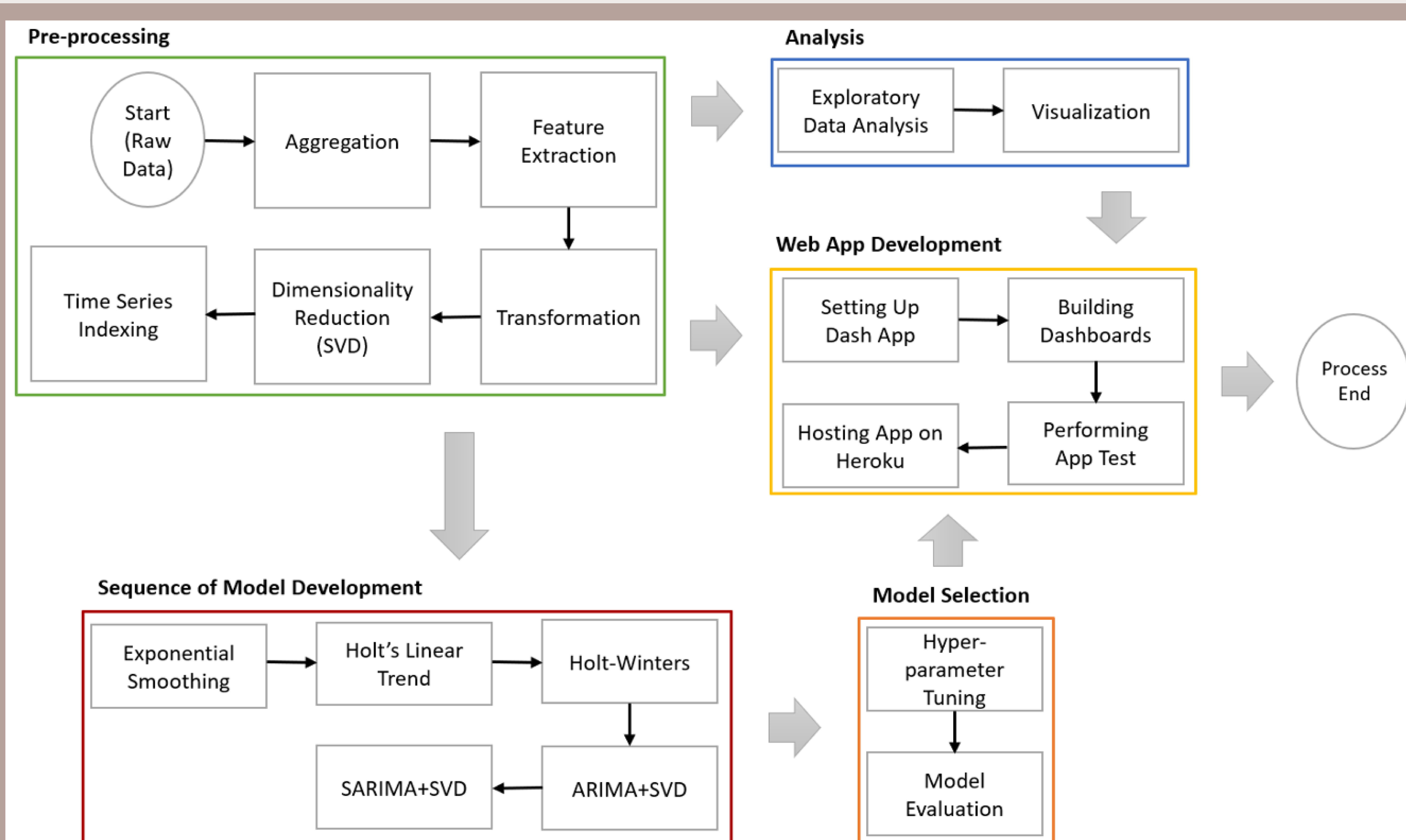

EXPONENTIAL SMOOTHING

Level	$\ell_t = \alpha y_t + (1-\alpha)\ell_{t-1}$
In-sample Forecast	$\hat{y}_t = \ell_{t-1}$
Out-of-sample Forecast	$\hat{y}_{T+\tau} = \ell_T \quad \text{for} \quad \tau = 1, 2, \cdots$
Standard Error	$s = \sqrt{\dfrac{SSE}{T-1}}$
95% Prediction Interval	$\left[\ell_T \pm z_{[.025]} s\sqrt{1+(\tau-1)\alpha^2}\right]$

HOLT'S LINEAR TREND

Level	$\ell_t = \alpha y_t + (1-\alpha)(\ell_{t-1} - b_{t-1})$
Growth Rate	$b_t = \gamma(\ell_t - \ell_{t-1}) + (1-\gamma)b_{t-1}$
In-sample Forecast	$\hat{y}_t = \ell_{t-1} + b_{t-1}$
Out-of-sample Forecast	$\hat{y}_{T+\tau} = \ell_T + \tau b_T \quad \text{for} \quad \tau = 1, 2, \cdots$
Standard Error	$s = \sqrt{\dfrac{SSE}{T-2}}$

95% Prediction Interval

If $\tau = 1$:

$$\left[(\ell_T + b_T) \pm z_{[.025]} s\right]$$

If $\tau \geq 2$:

$$\left[(\ell_T + \tau b_T) \pm z_{[.025]} s \sqrt{1 + \sum_{j=1}^{\tau-1} \alpha^2 (1 + j\gamma)^2}\right]$$

MULTIPLICATIVE HOLT-WINTERS

Level	$\ell_t = \alpha(y_t / sn_{t-L}) + (1-\alpha)(\ell_{t-1} + b_{t-1})$
Growth Rate	$b_t = \gamma(\ell_t - \ell_{t-1}) + (1-\gamma)(b_{t-1})$
Seasonal Factor	$sn_t = \delta(y_t/\ell_t) + (1-\delta)(sn_{t-L})$
In-sample Forecast	$\hat{y}_t = (\ell_{t-1} + b_{t-1}) sn_{t-L}$
Out-of-sample Forecast	$\hat{y}_{T+\tau} = (\ell_T + \tau b_T) sn_{T+\tau-L} \quad \text{for} \quad \tau = 1, 2, \cdots$
Relative Standard Error	$s_r = \sqrt{\dfrac{\sum_{t=1}^{T}\left[\dfrac{y_t - (\ell_{t-1} + b_{t-1}) sn_{t-L}}{(\ell_{t-1} + b_{t-1}) sn_{t-L}}\right]^2}{T-3}}$
95% Prediction Interval	$\left[\hat{y}_{T+\tau}(T) \pm z_{[.025]} s_r (\sqrt{c_\tau})(sn_{T+\tau-L})\right]$ • If $\tau = 1$ then $c_1 = (\ell_T + b_T)^2$ • If $2 \leq \tau \leq L$ then $c_\tau = \sum_{j=1}^{\tau-1} \alpha^2 (1 + [\tau - j]\gamma)^2 (\ell_T + j b_T)^2 + (\ell_T + \tau b_T)^2$

REFERENCES

[1] Bowerman, B. L., O'connell, R. T., & Koehler, A. B. (2005). *Forecasting, time series, and regression : an applied approach*. Thomson Brooks/Cole.

[2] Hyndman, R., Koehler, A. B., J Keith Ord, Snyder, R. D., & Springerlink (Online Service. (2008). *Forecasting with Exponential Smoothing : The State Space Approach*. Springer Berlin Heidelberg.