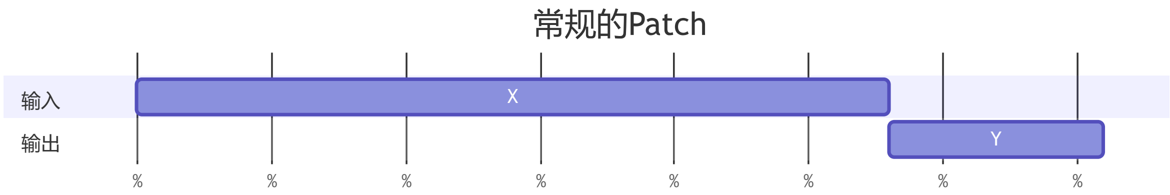
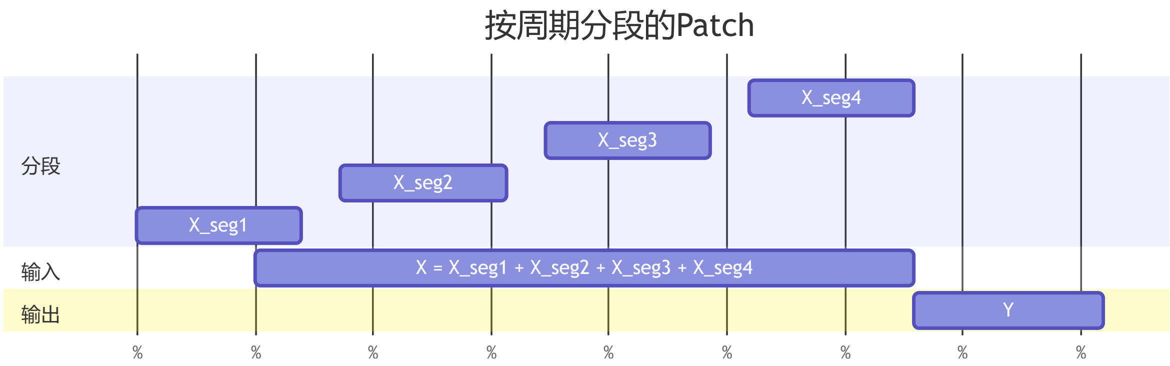




单变量预测对数据的预处理过程中，常规的组成 Patch 的方式忽略了时间序列的周期性，按周期分段再组合成 Patch 的方式，则考虑了周期性，先用 FFT 求出平均周期，每隔一个周期取一小段数据，组合成 Patch

求平均周期ϵ

$\alpha = 2|\mathrm{FFT}(D)|[:\lfloor N/2 \rfloor]/N \in \mathrm{R}^{\lfloor N/2 \rfloor}$

$\zeta = \Phi n[:\lfloor N/2 \rfloor]/N \in \mathrm{R}^{\lfloor N/2 \rfloor}$

$I_k = \mathrm{index}(\mathrm{top}_k(\alpha)) \in \mathrm{R}^k$

$\alpha_k = \alpha[I_k] = 2|\mathrm{FFT}(D)|[:\lfloor N/2 \rfloor][I_k]/N \in \mathrm{R}^k$

$\zeta_k = \zeta[I_k] = \Phi n[:\lfloor N/2 \rfloor][I_k]/N \in \mathrm{R}^k$

令

$\lambda_\alpha = |\mathrm{FFT}(D)|[:\lfloor N/2 \rfloor][I_k] \in \mathrm{R}^k$

$\lambda_\zeta = n[:\lfloor N/2 \rfloor][I_k] \in \mathrm{R}^k$

则有

$\alpha_k = 2\lambda_\alpha/N$

$\zeta_k = \Phi\lambda_\zeta/N$

$\phi = \mathrm{Mean}(\zeta, \mathrm{weights}) = \dfrac{\alpha^T\zeta}{\alpha^T\alpha} = \dfrac{\Phi\lambda_\alpha^T\lambda_\zeta}{2\lambda_\alpha^T\lambda_\alpha} \in \mathrm{R}$

$\tau = 1/\phi = \dfrac{2\lambda_\alpha^T\lambda_\alpha}{\Phi\lambda_\alpha^T\lambda_\zeta} = \dfrac{2T\lambda_\alpha^T\lambda_\alpha}{\lambda_\alpha^T\lambda_\zeta} \in \mathrm{R}$

$$\epsilon = \lfloor \tau / T \rfloor = \lfloor \frac{2\lambda_\alpha^T \lambda_\alpha}{\lambda_\alpha^T \lambda_\zeta} \rfloor \in \mathrm{Z}$$

分段

T为原始数据的采样周期，Φ为采样频率，$\Phi = 1/T$

段长L

段数M

$P = ML$

段定义$m(i,j) = D[i + j\epsilon : i + j\epsilon + L] \in \mathrm{R}^{L\times C}, j \in [0, M-1]$

$$X_S(i) = \underset{j=0}{\overset{M-1}{\mathrm{Concat}}}\{m(i,j)\} \in \mathrm{R}^{ML\times C} = \mathrm{R}^{P\times C}$$

最后一个段为$m(i, M-1) = D[i + (M-1)\epsilon : i + (M-1)\epsilon + L]$

$Y_S(i) = D[i + (M-1)\epsilon + L : i + (M-1)\epsilon + L + F] \in \mathrm{R}^{F\times C}$

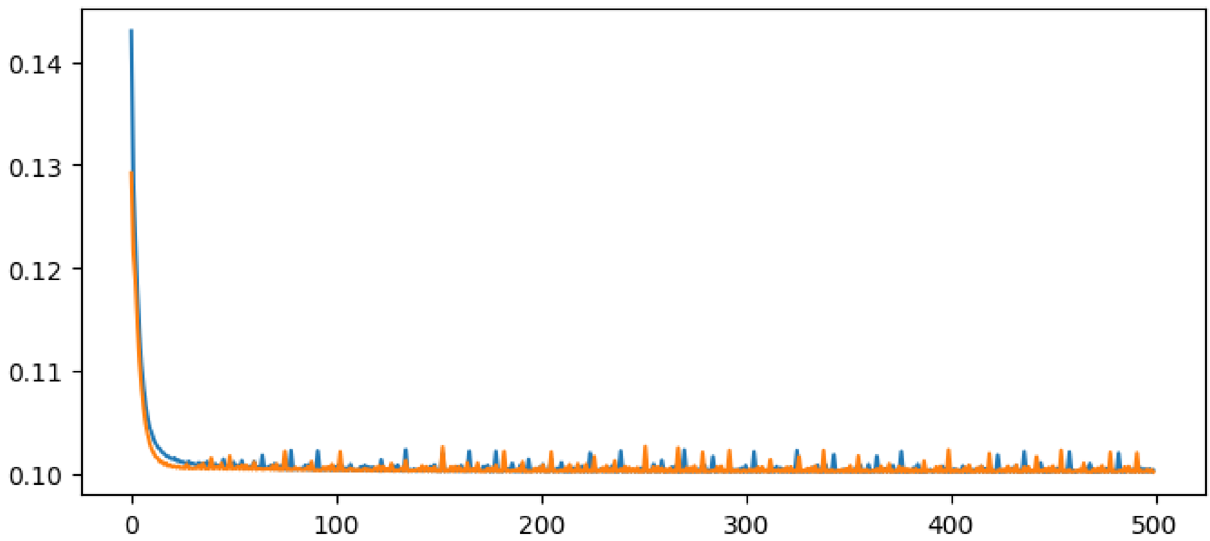
$S[i] = X_S(i), Y_S(i)$

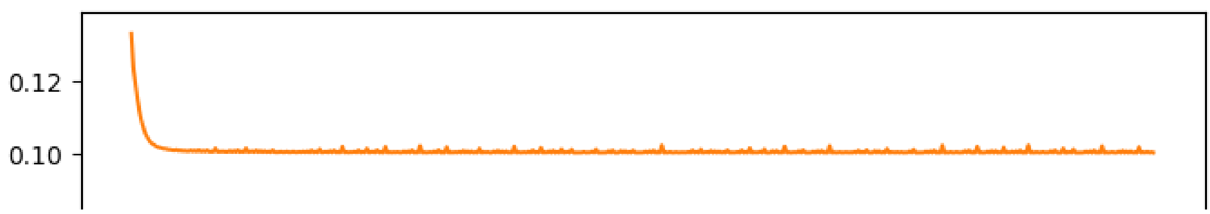
因为$Y_S(i), i + (M-1)\epsilon + L + F < L(D)$

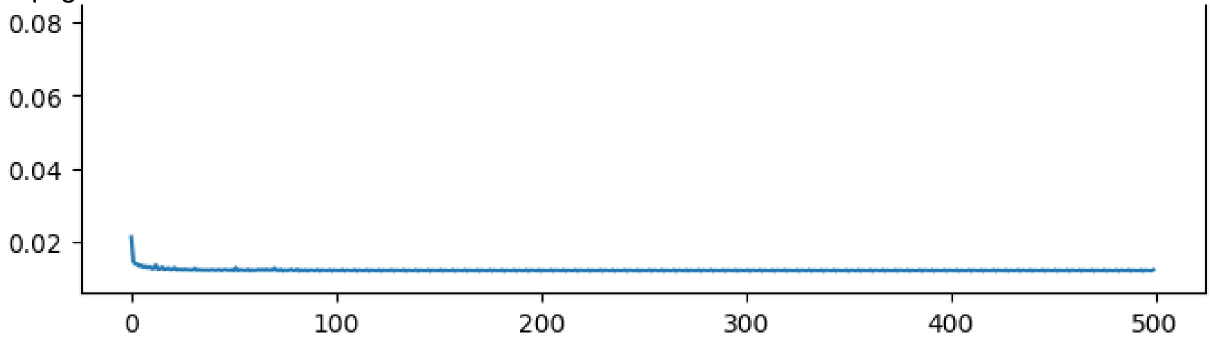
$L(S) = L(D) - (M-1)\epsilon - L - F + 1$

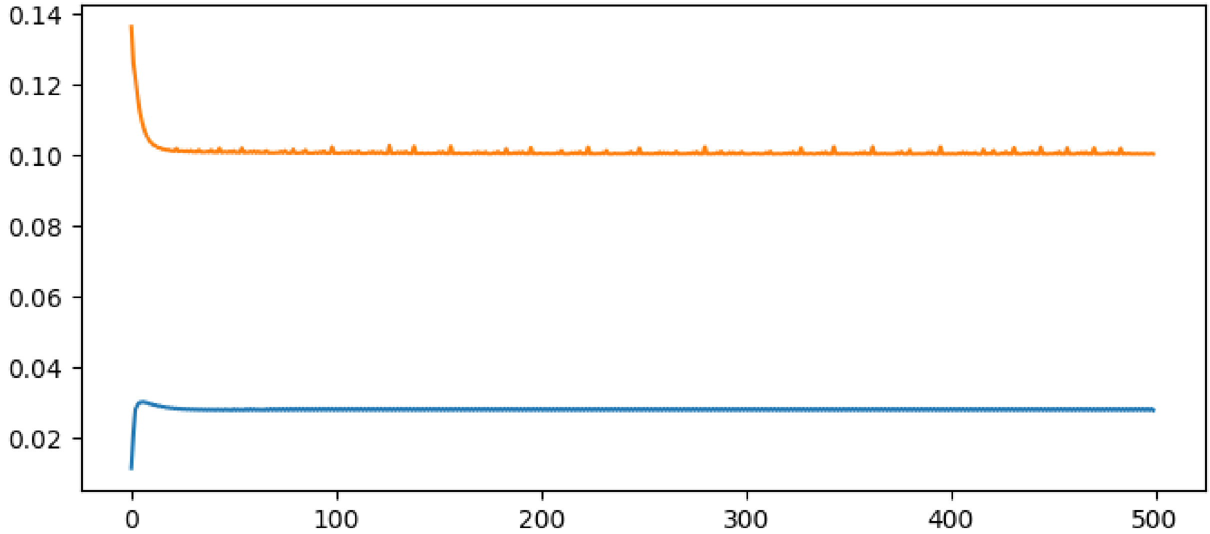
试验

以下是在ETTh1数据集预测OT列时，M从1到4的损失迭代图（$M = 1$时，按周期分段和常规方法等价），蓝色为按周期分段方法，黄色为常规（不分段）方法






0.08
0.06
0.04
0.02
0
100
200
300
400
500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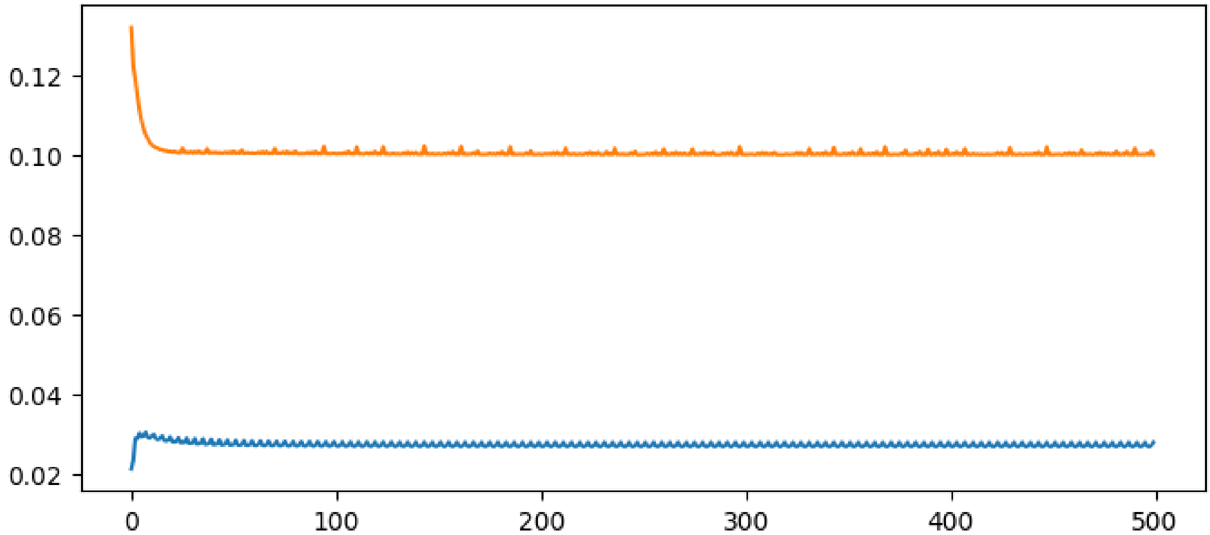
0.12
0.10
0.08
0.06
0.04
0.02
0
100
200
300
400
500


0.12
0.10
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