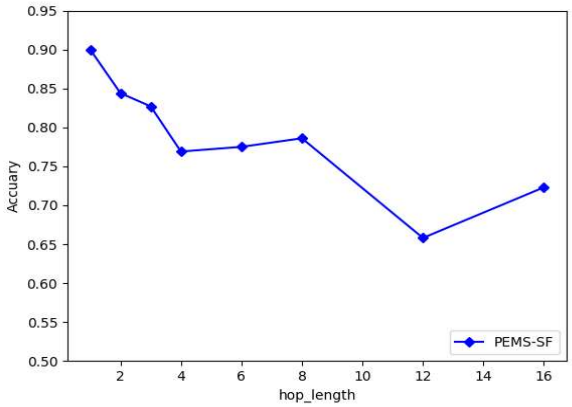
1 Appendices

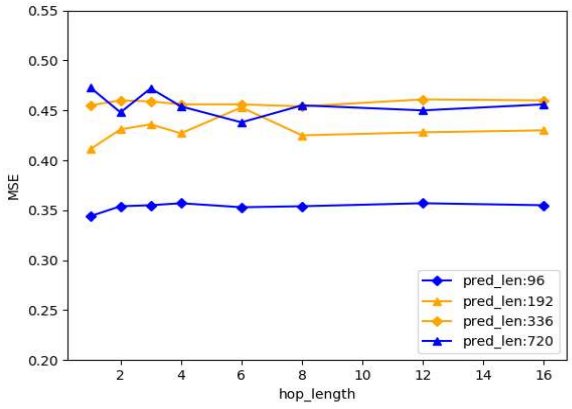
1.1 Implementation-Details

The code used for the benchmark method in this experiment is from TimesNets. Additionally, the code for SpecAR-Net is based on the modification of the TimesNet framework, primarily by replacing TimesBlock with SpecAR-Block. The deep learning framework used is PyTorch (version 1.13.1), and the GPU is two NVIDIA RTX 3090 Ti 24GB.

Model Hyperparameter Configuration: window functions: Hanning, Hamming, and rectangular windows. The window length, denoted as $\mathbf{win\_len}$, and the FFT window length, denoted as $\mathbf{n\_fft}$, are chosen from the range [8, 16, 24]. The $\mathbf{hop\_length}$ represents the overlap between adjacent windows to prevent loss of temporal information. The results of the long-term forecasting (ETTh2) and classification (PEMS-SF) for different values of $\mathbf{hop\_length}$ (predicting time series lengths: 96, 192, 336, 720) are illustrated in Figure 1. It can be observed that the impact of $\mathbf{hop\_length}$ on the long-term forecasting tasks is relatively small. Additionally, as $\mathbf{hop\_length}$ gradually increases, classification accuracy also tends to decrease. So, $\mathbf{hop\_length}$ is 1 in this paper.



(a)Classification



(b) Long-term forecasting

Figure 1: Sensitivity analysis of the model to hop_length.

Parameters related to the complex-domain convolution network: $\mathbf{d\_mode}$ and $\mathbf{d\_ff}$ are selected from the range [16, 512]. $\mathbf{e\_layers}$ denotes the number of SpecAR-Block, which ranges is [1, 2, 3, 4, 5]. $\mathbf{conv\_layers}$ represents the number of $ComplexConv2D\_Block$, which chosen from the range [3, 6].

Metrics: In the classification task, accuracy is used as the metric. For anomaly detection tasks, the F1 score is utilized, which is the harmonic mean of precision (P) and recall (R). In the long- and short-term forecasting tasks, as well as the imputation task, the mean squared error (MSE) and the mean absolute error (MAE) are employed as metrics. In the short-term forecasting task, inspired by N-BEATS, the metrics used include the symmetric mean absolute percentage error (SMAPE), the mean absolute scaled error (MASE), and the overall weighted average (OWA). Notably, OWA is the measurement criterion utilized in the M4 competition. The formulas for calculating these respective metrics are presented as follows:

$$SMAPE = \frac{200}{H}\sum_{i=1}^{H}\frac{|X_i - \hat{\mathrm{X}}_\mathrm{i}|}{|X_i| + |\hat{\mathrm{X}}_\mathrm{i}|} \tag{1}$$

$$MAPE = \frac{100}{H}\sum_{i=1}^{H}\frac{|X_i - \hat{\mathrm{X}}_\mathrm{i}|}{|X_i| + |\hat{\mathrm{X}}_\mathrm{i}|} \tag{2}$$

$$MASE = \frac{1}{H}\sum_{i=1}^{H}\frac{|X_i - \hat{\mathrm{X}}_\mathrm{i}|}{\frac{1}{H-m}\sum_{j=m+1}^{H}|X_j - X_{j-m}|} \tag{3}$$

$$OWA = \frac{1}{2}[\frac{SMAPE}{SMAPE_{Naïve2}} + \frac{MASE}{MASE_{Naïve2}}] \tag{4}$$

Where m represents the period of time series, $\mathbf{X}$, $\hat{\mathrm{X}}$ represent the original time series data and the corresponding predicted data, which the sequence length is $\mathbf{H}$ and the data dimension is $\mathbf{C}$. $\mathbf{F}$ represents the data at the i-th future moment.

Dataset download links: The download address of the datasets used in the prediction tasks are as follows:

1. Electricity is available at https://archive.ics.uci.edu/ml/datasets/ElectricityLoadDiagrams20112014.
2. Traffic is available at https://pems.dot.ca.gov/.
3. Weather is available at https://www.bgc-jena.mpg.de/wetter/.
4. ILI is available at https://gis.cdc.gov/grasp/fluviewfluportaldashboard.html.

1.2 Compared Analysis with Other Conv-based Networks

To validate the capability of the multi-scale parallel complex domain convolutional network (MCN), this experiment employed a dual-channel convolutional network (DCN) and a feature encoding network $Embed(\cdot)$ as control methods. Three sets of experiments were conducted, namely anomaly detection, classification, and imputation. The experimental results are presented in Tables 1, 2, and 3, respectively.

The control method employed in this experiment, namely the dual-channel convolutional network, shares the same network architecture as the multi-scale parallel complex-domain convolutional network. However, it differs in the computation process by omitting the calculation of the correlation between the real and imaginary parts. The experimental results indicate that our proposed multi-scale parallel complex-domain convolutional network achieved the best performance in three sets of controlled experiments: anomaly detection, classification, and missing value imputation. Firstly, in comparison to $Embed(\cdot)$, our method demonstrated overwhelming advantages in all experiments, highlighting its effectiveness in handling time-frequency data. Secondly, our method consistently outperformed the dual-channel convolutional network in all controlled experiments, suggesting that the interplay between the real and imaginary parts, as designed in our approach, is more suitable for processing complex-frequency domain data, thereby enhancing the capability of extracting time- frequency patterns.

Backbone		MCN(Ours)		DCN		$Embed(\cdot)$	
Metric		MSE	MAE	MSE	MAE	MSE	MAE
ETTm1	12.50%	**0.018**	**0.089**	**0.018**	**0.089**	0.045	0.133
	25%	**0.022**	**0.098**	**0.022**	0.099	0.070	0.165
	37.50%	0.028	0.111	**0.027**	**0.109**	0.104	0.196
	50%	0.035	0.124	**0.034**	**0.122**	0.140	0.229
ETTm2	12.50%	**0.018**	0.079	**0.018**	**0.077**	0.026	0.098
	25%	0.020	0.084	**0.019**	**0.083**	0.033	0.114
	37.50%	**0.022**	0.089	**0.022**	**0.088**	0.038	0.125
	50%	**0.025**	0.097	**0.025**	**0.096**	0.045	0.137
ETTh1	12.50%	**0.044**	**0.144**	0.049	0.152	0.069	0.171
	25%	**0.061**	**0.169**	0.063	0.171	0.102	0.208
	37.50%	**0.079**	**0.190**	0.081	0.193	0.140	0.241
	50%	**0.098**	**0.210**	0.108	0.220	0.186	0.277
ETTh2	12.50%	0.038	0.128	**0.037**	**0.125**	0.046	0.139
	25%	0.042	0.136	**0.041**	**0.134**	0.056	0.156
	37.50%	0.047	0.144	**0.046**	**0.140**	0.067	0.172
	50%	0.056	0.157	**0.053**	**0.151**	0.079	0.187
weather	12.50%	**0.027**	**0.052**	**0.027**	0.054	0.027	0.048
	25%	**0.028**	**0.052**	0.029	0.057	0.031	0.059
	37.50%	**0.031**	**0.058**	0.032	0.061	0.036	0.067
	50%	0.036	0.066	**0.035**	**0.064**	0.042	0.075
electricity	12.50%	**0.086**	**0.202**	**0.086**	**0.202**	0.086	0.205
	25%	**0.089**	**0.206**	0.09	0.207	0.095	0.216
	37.50%	**0.094**	**0.212**	0.095	0.213	0.104	0.227
	50%	**0.100**	**0.220**	**0.100**	0.221	0.115	0.240
1^{st} Count		29		29			

Table 1: Comparison of Different Feature Extraction Networks in Imputation Task.

1.3 Generalization ability

To verify the benefits of large-scale pretraining on model performance, this experiment aims to evaluate the performance of the model on a mixed dataset, which includes ETTh1, ETTh2, ETTm1, and ETTm2. It is important to note that ETTh1 and ETTh2 have an hourly sampling period, ETTm1 and ETTm2 have an the sampling period of 15 minutes. As a result, this mixed dataset contains more complex time- and frequency-variations, posing significant challenges in constructing effective time series representations. The experiment yielded results as shown in Table 4, indicating that our method achieved improved performance on all four sub-datasets through pre-training on the mixed dataset. When compared to other methods, our approach outperformed them after pre-training, showcasing its superior feature extraction capability to enable effective handling of large-scale and complex datasets. Furthermore, our method demonstrated remarkable generalization and adaptability on the mixed dataset, implying its potential as a universal network framework for representing temporal data.

DataSets	MCN(Ours)	DCN	$Embed(\cdot)$
	Accuracy		
EthanolConcentration	0.327	0.281	0.270
FaceDetection	0.701	0.652	0.675
Handwriting	0.421	0.328	0.284
Heartbeat	0.780	0.746	0.756
JapaneseVowels	0.984	0.951	0.978
PEMS-SF	0.902	0.844	0.850
SelfRegulationSCP1	0.922	0.891	0.925
SelfRegulationSCP2	0.572	0.528	0.533
SpokenArabicDigits	0.995	0.994	0.975
UWaveGestureLibrary	0.869	0.647	0.856
Average Accuracy	**0.747**	**0.686**	**0.710**

Table 2: Comparison of Different Feature Extraction Networks in Classification Task.

1.4 Full Result

The complete results of the five data analysis tasks are as follows: Table 5 contains the results of the classification task. Table 6 contains the results of the anomaly detection task. Tables 7 and 8 contain the results of the short-term foreacating task. Tables 9 and 10 contain the results of the long-term foreacating task. And Tables 11 and 12 contain the results of imputation task. Additionally,the red font and blue font in the table represent the best and second-best results, respectively. *. in the Transformers indicates the name of *.former.

DataSet	MCN(Ours)			DCN			$Embed(\cdot)$		
	Precision	Recall	F-score	Precision	Recall	F-score	Precision	Recall	F-score
SMD	0.8874	0.8447	0.8655	0.8758	0.8104	0.8419	0.8671	0.7384	0.7976
MSL	0.8997	0.7487	0.8172	0.8777	0.7004	0.7791	0.7901	0.3707	0.5046
SMAP	0.8998	0.6181	0.7328	0.8997	0.5550	0.6865	0.9011	0.5151	0.6555
SWaT	0.9155	0.9536	0.9342	0.9126	0.9530	0.9324	0.9006	0.9559	0.9274
PSM	0.9840	0.9619	0.9728	0.9854	0.9388	0.9615	0.9814	0.8375	0.9038
Average F1	**0.8645**			**0.8403**			**0.7578**		

Table 3: Comparison of Different Feature Extraction Networks in Anomaly Detection Task.

Models	DataSets		ETTm1				ETTm2				ETTh1				ETTh2			
	Mask Ratio		12.50%	25%	37.50%	50%	12.50%	25%	37.50%	50%	12.50%	25%	37.50%	50%	12.50%	25%	37.50%	50%
SpecAR-Net	Unified	MSE	**0.017**	**0.210**	**0.027**	**0.033**	**0.017**	**0.019**	**0.021**	**0.024**	**0.033**	**0.045**	**0.057**	**0.072**	**0.030**	**0.034**	**0.039**	**0.045**
		MAE	**0.086**	**0.096**	**0.107**	**0.119**	**0.074**	**0.080**	**0.086**	**0.093**	**0.122**	**0.143**	**0.161**	**0.181**	**0.107**	**0.116**	**0.126**	**0.136**
	Independent	MSE	**0.018**	**0.022**	**0.028**	**0.035**	**0.018**	**0.020**	**0.022**	**0.025**	0.044	0.061	0.079	0.098	0.038	0.042	0.047	0.056
		MAE	**0.089**	**0.098**	**0.111**	0.124	0.079	**0.084**	**0.089**	**0.097**	0.144	0.169	0.190	0.210	0.128	0.136	0.144	0.157
TimesNet	Unified	MSE	0.019	0.023	0.028	0.037	0.018	0.020	0.022	0.025	**0.035**	**0.046**	**0.057**	**0.075**	**0.032**	**0.036**	**0.040**	**0.047**
		MAE	0.091	0.099	0.109	**0.123**	**0.075**	0.081	0.086	0.095	**0.126**	**0.144**	**0.159**	**0.181**	**0.112**	**0.119**	**0.129**	**0.140**
	Independent	MSE	0.019	0.023	0.029	0.037	0.018	0.020	0.023	0.026	0.057	0.069	0.084	0.102	0.040	0.046	0.052	0.060
		MAE	0.092	0.101	0.111	0.124	0.080	0.085	0.091	0.098	0.159	0.178	0.196	0.215	0.130	0.141	0.151	0.162
FEDformer	Unified	MSE	0.041	0.057	0.073	0.099	0.060	0.089	0.125	0.172	0.077	0.101	0.130	0.164	0.087	0.125	0.161	0.214
		MAE	0.143	0.169	0.192	0.224	0.166	0.205	0.244	0.287	0.196	0.228	0.258	0.289	0.204	0.246	0.283	0.326
	Independent	MSE	0.035	0.052	0.069	0.089	0.056	0.080	0.110	0.156	0.070	0.106	0.124	0.165	0.095	0.137	0.187	0.232
		MAE	0.135	0.166	0.191	0.218	0.159	0.195	0.231	0.276	0.190	0.236	0.258	0.299	0.212	0.258	0.304	0.341
Autoformer	Unified	MSE	0.034	0.048	0.06	0.078	0.023	0.027	0.030	0.034	0.066	0.086	0.114	0.133	0.042	0.049	0.055	0.065
		MAE	0.122	0.146	0.163	0.185	0.091	0.102	0.109	0.117	0.174	0.200	0.229	0.247	0.135	0.147	0.157	0.171
	Independent	MSE	0.034	0.046	0.057	0.067	0.023	0.026	0.030	0.035	0.074	0.090	0.109	0.137	0.044	0.050	0.060	0.068
		MAE	0.124	0.144	0.161	0.174	0.092	0.101	0.108	0.119	0.182	0.203	0.222	0.248	0.138	0.149	0.163	0.173

Table 4: Comparison between unified training and independent training for imputation task.

Models	Classical methods			RNN			TCN		Transformer									MLP		
	DTW (1994)	XGBoost (2016)	Rocket (2020)	LSTM (1997)	LSTNet (2018)	LSSL (2022)	TimesNet (2023)	TCN (2019)	Trans. (2017)	Re. (2020)	In. (2021)	Pyra. (2021a)	Auto. (2021)	Station. (2022a)	FED. (2022)	ETS. (2022)	Flow. (2022)	Dlinear (2023)	LightTS. (2022)	SpecAR-Net (ours)
EthanolConcentration	32.3	43.7	45.2	32.3	39.9	31.1	35.7	28.9	32.7	31.9	31.6	30.8	31.6	32.7	31.2	28.1	33.8	32.6	29.7	32.7
FaceDetection	52.9	63.3	64.7	57.7	65.7	66.7	68.6	52.8	67.3	68.6	67.0	65.7	68.4	68.0	66.0	66.3	67.6	68.0	67.5	70.1
Handwriting	28.6	15.8	58.8	15.2	25.8	24.6	32.1	53.3	32.0	27.4	32.8	29.4	36.7	31.6	28.0	32.5	33.8	27.0	26.1	42.1
Heartbeat	71.7	73.2	75.6	72.2	77.1	72.7	78.0	75.6	76.1	77.1	80.5	75.6	74.6	73.7	73.7	71.2	77.6	75.1	75.1	78.0
JapaneseVowels	94.9	86.5	96.2	79.7	98.1	98.4	98.4	98.9	98.7	97.8	98.9	98.4	96.2	99.2	98.4	95.9	98.9	96.2	96.2	98.4
PEMS-SF	71.1	98.3	75.1	39.9	86.7	86.1	89.6	68.8	82.1	82.7	81.5	83.2	82.7	87.3	80.9	86	83.8	75.1	88.4	90.2
SelfRegulationSCP1	77.7	84.6	90.8	68.9	84	90.8	91.8	84.6	92.2	90.4	90.1	88.1	84.0	89.4	88.7	89.6	92.5	87.3	89.8	92.2
SelfRegulationSCP2	53.9	48.9	53.3	46.6	52.8	52.2	57.2	55.6	53.9	56.7	53.3	53.3	50.6	57.2	54.4	55.0	56.1	50.5	51.1	57.2
SpokenArabicDigits	96.3	69.6	71.2	31.9	100	100	99.0	95.6	98.4	97.0	100	99.6	100	100	100	100	98.8	81.4	100	99.5
UWaveGestureLibrary	90.3	75.9	94.4	41.2	87.8	85.9	85.3	88.4	85.6	85.6	85.6	83.4	85.9	87.5	85.3	85.0	86.6	82.1	80.3	86.9
AverageAccuracy	67.0	66.0	72.5	48.6	71.8	70.9	**73.6**	70.3	71.9	71.5	72.1	70.8	71.1	72.7	70.7	71.0	73.0	67.5	70.4	**74.7**

Table 5: The result of classification task in UAE(10 subsets).We report the classification accuracy(%) as the result.The standard deviation is within 0.1%.

Datasets	SMD			MSL			SMAP			SWaT			PSM			Avg F1
Metrics	P	R	F1	P	R	F1	P	R	F1	P	R	F1	P	R	F1	
LSTM(1997)	78.52	65.47	71.41	78.04	86.22	81.93	91.06	57.49	70.48	78.06	91.72	84.34	69.24	99.53	81.67	77.97
Transformer(2017)	83.58	76.13	79.56	71.57	87.37	78.68	89.37	57.12	69.70	68.84	96.53	80.37	62.75	96.56	76.07	76.88
LogTrans(2019)	83.46	70.13	76.21	73.05	87.37	79.57	89.15	57.59	69.97	68.67	97.32	80.52	63.06	98.00	76.74	76.60
TCN(2019)	84.06	79.07	81.49	75.11	82.44	78.60	86.90	59.23	70.45	76.59	95.71	85.09	54.59	99.77	70.57	77.24
Reformer(2020)	82.58	69.24	75.32	85.51	83.31	84.40	90.91	57.44	70.40	72.50	96.53	82.80	59.93	95.38	73.61	77.31
Informer(2021)	86.60	77.23	81.65	81.77	86.48	84.06	90.11	57.13	69.92	70.29	96.75	81.43	64.27	96.33	77.10	78.83
Anomaly∗(2021)	88.91	82.23	85.49	79.61	87.37	83.31	91.85	58.11	71.18	72.51	97.32	83.10	68.35	94.72	79.40	80.50
Pyraformer(2021a)	85.61	80.61	83.04	83.81	85.93	84.86	92.54	57.71	71.09	87.92	96.00	91.78	71.67	96.02	82.08	82.57
Autoformer(2021)	88.06	82.35	85.11	77.27	80.92	79.05	90.4	58.62	71.12	89.85	95.81	92.74	99.08	88.15	93.29	84.26
LSSL(2022)	78.51	65.32	71.31	77.55	88.18	82.53	89.43	53.43	66.90	79.05	93.72	85.76	66.02	92.93	77.20	76.74
Stationary(2022a)	88.33	81.21	84.62	68.55	89.14	77.50	89.37	59.02	71.09	68.03	96.75	79.88	97.82	96.76	**97.29**	82.08
Dlinear(2023)	83.62	71.52	77.10	84.34	85.42	84.88	92.32	55.41	69.26	80.91	95.30	87.52	98.28	89.26	93.55	82.46
ETSformer(2022)	87.44	79.23	83.13	85.13	84.93	**85.03**	92.25	55.75	69.50	90.02	80.36	84.91	99.31	85.28	91.76	82.87
LightTS(2022)	87.10	78.42	82.53	82.40	75.78	78.95	92.58	55.27	69.21	91.98	94.72	**93.33**	98.37	95.97	97.15	84.23
FEDformer(2022)	87.95	82.39	85.08	77.14	80.07	78.57	90.47	58.10	70.76	90.17	96.42	93.19	97.31	97.16	97.23	84.97
TimesNet(Inception)	87.76	82.63	85.12	82.97	85.42	84.18	91.50	57.8	70.85	88.31	96.24	92.10	98.22	92.21	95.21	85.49
TimesNet(ResNeXt)	88.66	83.14	**85.81**	83.92	86.42	**85.15**	92.52	58.29	**71.52**	86.76	97.32	91.74	98.19	96.76	**97.47**	**86.34**
SpecAR-Net(ours)	88.74	84.47	**86.55**	89.97	74.87	81.72	89.98	61.81	**73.28**	91.55	95.36	**93.42**	98.40	96.19	97.28	**86.45**

Table 6: The result of anomaly detection task. The P, R and F1 represent the represent the precision ,recall and F1-score(%). A higher value of P, R and F1 indicates a better performance.

Models		SpecAR-Net (ours)	TimesNet (2023)	N-HiTS (2022)	N-BEATS (2019)	ETS. (2022)	LightTS (2022)	Dlinear (2023)	FED. (2022)	Stationary (2022a)	Auto. (2021)	Pyra. (2021a)	In. (2021)	LogTrans (2019)	Re. (2020)	LSTM (1997)	TCN (2019)	LSSL (2022)
Yearly	SMAPE	**13.417**	**13.387**	13.418	13.436	18.009	14.247	16.965	13.728	13.717	13.974	15.530	14.727	17.107	16.169	176.040	14.920	61.675
	MASE	**2.992**	**2.996**	3.045	3.043	4.487	3.109	4.283	3.048	3.078	3.134	3.711	3.418	4.177	3.800	31.033	3.364	19.953
	OWA	**0.787**	**0.786**	0.793	0.794	1.115	0.827	1.058	0.803	0.807	0.822	0.942	0.881	1.049	0.973	9.290	0.880	4.397
Quarterly	SMAPE	10.248	**10.100**	10.202	**10.124**	13.376	11.364	12.145	10.792	10.958	11.338	15.449	11.360	13.207	13.313	172.808	11.122	65.999
	MASE	1.201	**1.182**	1.194	**1.169**	1.906	1.328	1.520	1.283	1.325	1.365	2.350	1.401	1.827	1.775	19.753	1.360	17.662
	OWA	0.903	**0.890**	0.899	**0.886**	1.302	1.000	1.106	0.958	0.981	1.012	1.558	1.027	1.266	1.252	15.049	1.001	9.436
Monthly	SMAPE	12.921	**12.670**	12.791	**12.677**	14.588	14.014	13.514	14.260	13.917	13.958	17.642	14.062	16.149	20.128	143.237	15.626	64.664
	MASE	0.955	**0.933**	0.969	**0.937**	1.368	1.053	1.037	1.102	1.097	1.103	1.913	1.141	1.660	2.614	16.551	1.274	16.245
	OWA	0.897	**0.878**	0.899	**0.880**	1.149	0.981	0.956	1.012	0.998	1.002	1.511	1.024	1.340	1.927	12.747	1.141	9.879
Others	SMAPE	**4.872**	**4.891**	5.061	4.925	7.267	15.880	6.709	4.954	6.302	5.485	24.786	24.460	23.236	32.491	186.282	7.186	121.844
	MASE	**3.293**	3.302	**3.216**	3.391	5.240	11.434	4.953	3.264	4.064	3.865	18.581	20.960	16.288	33.355	119.294	4.677	91.650
	OWA	**1.032**	**1.035**	1.040	1.053	1.591	3.474	1.487	1.036	1.304	1.187	5.538	5.879	5.013	8.679	38.411	1.494	27.273
W-Average	SMAPE	11.991	**11.829**	11.927	**11.851**	14.718	13.525	13.639	12.840	12.780	12.909	16.987	14.086	16.018	18.200	160.031	13.961	67.156
	MASE	1.600	**1.585**	1.613	**1.599**	2.408	2.111	2.095	1.701	1.756	1.771	3.265	2.718	3.010	4.223	25.788	1.945	21.208
	OWA	0.860	**0.851**	0.861	**0.855**	1.172	1.051	1.051	0.918	0.930	0.939	1.480	1.230	1.378	1.775	12.642	1.023	8.021

Table 7: The result of short-term forecasting task in M4 datasets. The prediction sequence length is $[6, 8, 13, 16, 24, 48]$.

Models		SpecAR-Net (ours)	TimesNet (2023)	N-HiTS (2022)	N-BEATS (2019)	ETS. (2022)	LightTS (2022)	Dlinear (2023)	FED. (2022)	Stationary (2022a)	Auto. (2021)	Pyra. (2021a)	In. (2021)	LogTrans (2019)	Re. (2020)	LSTM (1997)	TCN (2019)	LSSL (2022)
Yearly	SMAPE	**13.270**	**13.387**	13.418	13.436	18.009	14.247	16.965	13.728	13.717	13.974	15.530	14.727	17.107	16.169	176.040	14.920	61.675
	MASE	**2.983**	**2.996**	3.045	3.043	4.487	3.109	4.283	3.048	3.078	3.134	3.711	3.418	4.177	3.800	31.033	3.364	19.953
	OWA	**0.781**	**0.786**	0.793	0.794	1.115	0.827	1.058	0.803	0.807	0.822	0.942	0.881	1.049	0.973	9.290	0.880	4.397
Quarterly	SMAPE	**10.071**	**10.100**	10.202	10.124	13.376	11.364	12.145	10.792	10.958	11.338	15.449	11.360	13.207	13.313	172.808	11.122	65.999
	MASE	**1.174**	1.182	1.194	**1.169**	1.906	1.328	1.520	1.283	1.325	1.365	2.350	1.401	1.827	1.775	19.753	1.360	17.662
	OWA	**0.885**	0.890	0.899	**0.886**	1.302	1.000	1.106	0.958	0.981	1.012	1.558	1.027	1.266	1.252	15.049	1.001	9.436
Monthly	SMAPE	12.784	**12.670**	12.791	**12.677**	14.588	14.014	13.514	14.26	13.917	13.958	17.642	14.062	16.149	20.128	143.237	15.626	64.664
	MASE	0.944	**0.933**	0.969	**0.937**	1.368	1.053	1.037	1.102	1.097	1.103	1.913	1.141	1.660	2.614	16.551	1.274	16.245
	OWA	0.887	**0.878**	0.899	**0.880**	1.149	0.981	0.956	1.012	0.998	1.002	1.511	1.024	1.340	1.927	12.747	1.141	9.879
Others	SMAPE	**4.762**	**4.891**	5.061	4.925	7.267	15.880	6.709	4.954	6.302	5.485	24.786	24.460	23.236	32.491	186.282	7.186	121.844
	MASE	**3.212**	3.302	**3.216**	3.391	5.240	11.434	4.953	3.264	4.064	3.865	18.581	20.960	16.288	33.355	119.294	4.677	91.650
	OWA	**1.008**	**1.035**	1.040	1.053	1.591	3.474	1.487	1.036	1.304	1.187	5.538	5.879	5.013	8.679	38.411	1.494	27.273
W-Average	SMAPE	**11.844**	**11.829**	11.927	11.851	14.718	13.525	13.639	12.840	12.780	12.909	16.987	14.086	16.018	18.200	160.031	13.961	67.156
	MASE	**1.582**	**1.585**	1.613	1.599	2.408	2.111	2.095	1.701	1.756	1.771	3.265	2.718	3.010	4.223	25.788	1.945	21.208
	OWA	**0.850**	**0.851**	0.861	0.855	1.172	1.051	1.051	0.918	0.930	0.939	1.480	1.230	1.378	1.775	12.642	1.023	8.021

Table 8: The result of short-term forecasting task(order-preserving).

Models		SpecAR-Net (ours)		TimesNet (2023)		ETSformer (2022)		LightTS (2022)		Dlinear (2023)		FEDformer (2022)		Stationary (2022a		Autoformer (2021)		Pyraformer (2021a		Informer (2021)		LogTrans (2019)		Reformer (2020)		LSSL (2022)		LSTM (1997)	
Metrics		MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE
ETTm1	96	0.378	0.397	**0.338**	**0.375**	0.375	0.398	0.374	0.400	**0.345**	**0.372**	0.379	0.419	0.386	0.398	0.505	0.475	0.543	0.51	0.672	0.571	0.600	0.546	0.538	0.528	0.450	0.477	0.863	0.664
	192	0.425	0.419	**0.374**	**0.387**	0.408	0.410	0.400	0.407	**0.380**	**0.389**	0.426	0.441	0.459	0.444	0.553	0.496	0.557	0.537	0.795	0.669	0.840	0.700	0.658	0.592	0.469	0.481	1.113	0.776
	336	**0.413**	0.417	**0.410**	**0.411**	0.435	0.428	0.438	0.438	**0.413**	**0.413**	0.445	0.459	0.495	0.464	0.621	0.537	0.754	0.655	1.212	0.871	1.120	0.832	0.898	0.721	0.583	0.574	1.267	0.832
	720	0.499	0.466	**0.478**	**0.450**	0.499	0.462	0.527	0.502	**0.474**	**0.453**	0.543	0.490	0.585	0.516	0.671	0.561	0.908	0.724	1.166	0.823	1.15	0.820	1.102	0.841	0.632	0.596	1.324	0.858
	Avg	0.429	0.425	**0.400**	**0.406**	0.429	0.425	0.435	0.437	**0.403**	**0.407**	0.448	0.452	0.481	0.456	0.588	0.517	0.691	0.607	0.961	0.734	0.93	0.725	0.799	0.671	0.533	0.532	1.142	0.782
ETTm2	96	**0.187**	**0.269**	**0.187**	**0.267**	**0.189**	0.280	0.209	0.308	0.193	0.292	0.203	0.287	0.192	0.274	0.255	0.339	0.435	0.507	0.365	0.453	0.770	0.642	0.658	0.619	0.243	0.342	2.041	1.073
	192	0.256	**0.312**	**0.249**	**0.309**	**0.253**	0.319	0.311	0.382	0.284	0.362	0.269	0.328	0.280	0.339	0.281	0.340	0.730	0.673	0.533	0.563	0.990	0.757	1.078	0.827	0.392	0.448	2.249	1.112
	336	**0.314**	**0.347**	**0.321**	**0.351**	**0.314**	0.357	0.442	0.466	0.369	0.427	0.325	0.366	0.334	0.361	0.339	0.372	1.201	0.845	1.363	0.887	1.330	0.872	1.549	0.972	0.932	0.724	2.568	1.238
	720	0.424	**0.410**	**0.408**	**0.403**	**0.414**	0.413	0.675	0.587	0.554	0.522	0.421	0.415	0.417	0.413	0.433	0.432	3.625	1.451	3.379	1.338	3.05	1.328	2.631	1.242	1.372	0.879	2.72	1.287
	Avg	0.295	**0.335**	**0.291**	**0.333**	**0.293**	0.342	0.409	0.436	0.350	0.401	0.305	0.349	0.306	0.347	0.327	0.371	1.498	0.869	1.410	0.810	1.540	0.900	1.479	0.915	0.735	0.598	2.395	1.177
ETTh1	96	0.442	0.441	**0.384**	**0.402**	0.494	0.479	0.424	0.432	0.386	**0.400**	**0.376**	0.419	0.513	0.491	0.449	0.459	0.664	0.612	0.865	0.713	0.880	0.740	0.837	0.728	0.548	0.528	1.044	0.773
	192	0.490	0.474	**0.436**	**0.429**	0.538	0.504	0.475	0.462	0.437	**0.432**	**0.420**	0.448	0.534	0.504	0.500	0.482	0.790	0.681	1.008	0.792	1.040	0.824	0.923	0.766	0.542	0.526	1.217	0.832
	336	0.527	0.498	0.491	0.469	0.574	0.521	0.518	0.488	**0.481**	**0.459**	**0.459**	**0.465**	0.588	0.535	0.521	0.496	0.891	0.738	1.107	0.809	1.240	0.932	1.097	0.835	1.298	0.942	1.259	0.841
	720	0.530	0.509	0.521	**0.500**	0.562	0.535	0.547	0.533	0.519	0.516	**0.506**	**0.507**	0.643	0.616	**0.514**	0.512	0.963	0.782	1.181	0.865	1.140	0.852	1.257	0.889	0.721	0.659	1.271	0.838
	Avg	0.498	0.481	0.458	**0.450**	0.542	0.51	0.491	0.479	**0.456**	**0.452**	**0.440**	0.460	0.570	0.537	0.496	0.487	0.827	0.703	1.040	0.795	1.070	0.837	1.029	0.805	0.777	0.664	1.198	0.821
ETTh2	96	**0.339**	**0.376**	0.340	**0.374**	0.340	0.391	0.397	0.437	**0.333**	0.387	0.358	0.397	0.476	0.458	0.346	0.388	0.645	0.597	3.755	1.525	2.120	1.197	2.626	1.317	1.616	1.036	2.522	1.278
	192	0.444	**0.431**	**0.402**	**0.414**	0.430	0.439	0.520	0.504	0.477	0.476	**0.429**	0.439	0.512	0.493	0.456	0.452	0.788	0.683	5.602	1.931	4.320	1.635	11.120	2.979	2.083	1.197	3.312	1.384
	336	**0.475**	**0.457**	**0.452**	**0.452**	0.485	0.479	0.626	0.559	0.594	0.541	0.496	0.487	0.552	0.551	0.482	0.486	0.907	0.747	4.721	1.835	1.120	1.604	9.323	2.769	2.97	1.439	3.291	1.388
	720	**0.458**	**0.460**	**0.462**	**0.468**	0.500	0.497	0.863	0.672	0.831	0.657	0.463	0.474	0.562	0.560	0.515	0.511	0.963	0.783	3.647	1.625	3.190	1.540	3.874	1.697	2.576	1.363	3.257	1.357
	Avg	**0.429**	**0.431**	**0.414**	**0.427**	0.439	0.452	0.602	0.543	0.559	0.515	0.437	0.449	0.526	0.516	0.450	0.459	0.826	0.703	4.431	1.729	2.69	1.494	6.736	2.191	2.311	1.259	3.095	1.352
Eelctricity	96	0.170	**0.273**	**0.168**	**0.272**	0.187	0.304	0.207	0.307	0.197	0.282	0.193	0.308	**0.169**	**0.273**	0.201	0.317	0.386	0.449	0.274	0.368	0.260	0.357	0.312	0.402	0.300	0.392	0.375	0.437
	192	**0.184**	**0.286**	**0.184**	0.289	0.199	0.315	0.213	0.316	0.196	**0.285**	0.201	0.315	**0.182**	**0.286**	0.222	0.334	0.378	0.443	0.296	0.386	0.270	0.368	0.348	0.433	0.297	0.390	0.442	0.473
	336	**0.196**	**0.299**	**0.198**	**0.300**	0.212	0.329	0.230	0.333	0.209	0.301	0.214	0.329	0.200	0.304	0.231	0.338	0.376	0.443	0.300	0.394	0.28	0.380	0.350	0.433	0.317	0.403	0.439	0.473
	720	0.224	**0.320**	**0.220**	**0.320**	0.233	0.345	0.265	0.360	0.245	0.333	0.246	0.355	**0.222**	**0.321**	0.254	0.361	0.376	0.445	0.373	0.439	0.280	0.376	0.34	0.420	0.338	0.417	0.980	0.814
	Avg	0.194	**0.295**	**0.192**	**0.295**	0.208	0.323	0.229	0.329	0.212	0.300	0.214	0.327	**0.193**	**0.296**	0.227	0.338	0.379	0.445	0.311	0.397	0.270	0.370	0.338	0.422	0.313	0.401	0.559	0.549
Traffic	96	0.599	0.329	**0.593**	**0.321**	0.607	0.392	0.615	0.391	0.650	0.396	**0.587**	0.366	0.612	**0.338**	0.613	0.388	0.867	0.468	0.719	0.391	0.680	0.384	0.732	0.423	0.798	0.436	0.843	0.453
	192	0.621	**0.338**	0.617	**0.336**	0.621	0.399	**0.601**	0.382	**0.598**	0.370	0.604	0.373	0.613	0.340	0.616	0.382	0.869	0.467	0.696	0.379	0.690	0.39	0.733	0.420	0.849	0.481	0.847	0.453
	336	0.638	0.340	0.629	**0.336**	0.622	0.396	**0.613**	0.386	**0.605**	0.373	0.621	0.383	0.618	**0.328**	0.622	0.337	0.881	0.469	0.777	0.42	0.730	0.408	0.742	0.420	0.828	0.476	0.853	0.455
	720	0.648	0.356	0.640	**0.350**	**0.632**	0.396	0.658	0.407	0.645	0.394	**0.626**	0.382	0.653	**0.355**	0.660	0.408	0.896	0.473	0.864	0.472	0.720	0.396	0.755	0.423	0.854	0.489	1.500	0.805
	Avg	0.627	0.341	**0.620**	**0.336**	0.621	0.396	0.622	0.392	0.625	0.383	**0.610**	0.376	0.624	**0.340**	0.628	0.379	0.878	0.469	0.764	0.416	0.710	0.395	0.741	0.422	0.832	0.471	1.011	0.541
Weather	96	0.175	0.224	**0.172**	**0.220**	0.197	0.281	0.182	0.242	0.196	0.255	0.217	0.296	**0.173**	**0.223**	0.266	0.336	0.622	0.556	0.300	0.384	0.460	0.49	0.689	0.596	0.174	0.252	0.369	0.406
	192	**0.226**	**0.266**	**0.219**	**0.261**	0.237	0.312	0.227	0.287	0.237	0.296	0.276	0.336	0.245	0.285	0.307	0.367	0.739	0.624	0.598	0.544	0.660	0.589	0.752	0.638	0.238	0.313	0.416	0.435
	336	**0.279**	**0.303**	**0.280**	**0.306**	0.298	0.353	0.282	0.334	0.283	0.335	0.339	0.380	0.321	0.338	0.359	0.395	1.004	0.753	0.578	0.523	0.800	0.652	0.639	0.596	0.287	0.355	0.455	0.454
	720	0.358	**0.355**	0.365	**0.359**	**0.352**	0.288	**0.352**	0.386	**0.345**	0.381	0.403	0.428	0.414	0.410	0.419	0.428	1.420	0.934	1.059	0.741	0.870	0.675	1.130	0.792	0.384	0.415	0.535	0.520
	Avg	**0.260**	**0.287**	**0.259**	**0.287**	0.271	0.334	0.261	**0.312**	0.265	0.317	0.309	0.360	0.288	0.314	0.338	0.382	0.946	0.717	0.634	0.548	0.700	0.602	0.803	0.656	0.271	0.334	0.444	0.454
Exchange	96	0.130	0.264	0.107	0.234	**0.085**	**0.204**	0.116	0.262	**0.088**	**0.218**	0.148	0.278	0.111	0.237	0.197	0.323	1.748	1.105	0.847	0.752	0.970	0.812	1.065	0.829	0.395	0.474	1.453	1.049
	192	**0.181**	**0.314**	0.226	0.344	0.182	**0.303**	0.215	0.359	**0.176**	0.315	0.271	0.380	0.219	0.335	0.300	0.369	1.874	1.151	1.204	0.895	1.040	0.851	1.188	0.906	0.776	0.698	1.846	1.179
	336	0.374	0.442	0.367	0.448	**0.348**	**0.428**	0.377	0.466	**0.313**	**0.427**	0.460	0.500	0.421	0.476	0.509	0.524	1.943	1.172	1.672	1.036	1.66	1.081	1.357	0.976	1.029	0.797	2.136	1.231
	720	0.963	0.749	0.964	0.746	1.025	0.774	**0.831**	**0.699**	**0.839**	**0.695**	1.195	0.841	1.092	0.769	1.447	0.941	2.085	1.206	2.478	1.310	1.940	1.127	1.510	1.016	2.283	1.222	2.984	1.427
	Avg	0.412	0.443	0.416	0.443	0.410	**0.427**	**0.385**	0.447	**0.354**	**0.414**	0.519	0.500	0.461	0.454	0.613	0.539	1.913	1.159	1.55	0.998	1.400	0.968	1.280	0.932	1.121	0.798	2.105	1.221
ILL	24	2.625	0.957	**2.317**	**0.934**	2.527	1.020	8.313	2.144	2.398	1.040	3.228	1.260	**2.294**	**0.945**	3.483	1.287	7.394	2.012	5.764	1.677	4.480	1.444	4.400	1.382	4.381	1.425	5.914	1.734
	36	2.768	1.015	**1.972**	**0.920**	2.615	1.007	6.631	1.902	2.646	1.088	2.679	1.080	**1.825**	**0.848**	3.103	1.148	7.551	2.031	4.755	1.467	4.800	1.467	4.783	1.448	4.442	1.416	6.631	1.845
	48	**2.234**	**0.937**	2.238	0.940	2.359	0.972	7.299	1.982	2.614	1.086	2.622	1.078	**2.010**	**0.900**	2.669	1.085	7.662	2.057	4.763	1.469	4.800	1.468	4.832	1.465	4.559	1.443	6.736	1.857
	60	2.205	0.971	**2.027**	**0.928**	2.487	1.016	7.283	1.985	2.804	1.146	2.857	1.157	**2.178**	**0.963**	2.770	1.125	7.931	2.100	5.264	1.564	5.280	1.560	4.882	1.483	4.651	1.474	6.870	1.879
	Avg	2.458	0.97	**2.139**	**0.931**	2.497	1.004	7.382	2.003	2.616	1.090	2.847	1.144	**2.077**	**0.914**	3.006	1.161	7.635	2.050	5.137	1.544	4.840	1.485	4.724	1.445	4.508	1.440	6.538	1.829
Count 1^{st}		11		30		4		1		4		13		6		7													

Table 9: The result of long-term forecasting task. The input sequence length is set to 36 for the ILI dataset and 96 for the others. *Avg* is average from four predicton lengths.

Models		SpecAR-Net (ours)		TimesNet (2023)		ETSformer (2022)		LightTS (2022)		Dlinear (2023)		FEDformer (2022)		Stationary (2022a)		Autoformer (2021)		Pyraformer (2021a)		Informer (2021)		LogTrans (2019)		Reformer (2020)		LSSL (2022)		LSTM (1997)	
Metrics		MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE
ETTm1	96	**0.323**	**0.365**	**0.338**	0.375	0.375	0.398	0.374	0.400	0.345	**0.372**	0.379	0.419	0.386	0.398	0.505	0.475	0.543	0.510	0.672	0.571	0.600	0.546	0.538	0.528	0.450	0.477	0.863	0.664
	192	**0.375**	0.395	**0.374**	**0.387**	0.408	0.410	0.400	0.407	0.380	**0.389**	0.426	0.441	0.459	0.444	0.553	0.496	0.557	0.537	0.795	0.669	0.837	0.700	0.658	0.592	0.469	0.481	1.113	0.776
	336	**0.413**	0.417	**0.410**	**0.411**	0.435	0.428	0.438	0.438	**0.413**	**0.413**	0.445	0.459	0.495	0.464	0.621	0.537	0.754	0.655	1.212	0.871	1.124	0.832	0.898	0.721	0.583	0.574	1.267	0.832
	720	0.482	**0.451**	**0.478**	**0.450**	0.499	0.462	0.527	0.502	0.474	0.453	0.543	0.490	0.585	0.516	0.671	0.561	0.908	0.724	1.166	0.823	1.153	0.820	1.102	0.841	0.632	0.596	1.324	0.858
	Avg	**0.398**	**0.407**	**0.400**	**0.406**	0.429	0.425	0.435	0.437	0.403	**0.407**	0.448	0.452	0.481	0.456	0.588	0.517	0.691	0.607	0.961	0.734	0.929	0.725	0.799	0.671	0.533	0.532	1.142	0.782
ETTm2	96	**0.183**	**0.265**	**0.187**	**0.267**	0.189	0.280	0.209	0.308	0.193	0.292	0.203	0.287	0.192	0.274	0.255	0.339	0.435	0.507	0.365	0.453	0.768	0.642	0.658	0.619	0.243	0.342	2.041	1.073
	192	**0.251**	**0.308**	**0.249**	**0.309**	0.253	0.319	0.311	0.382	0.284	0.362	0.269	0.328	0.280	0.339	0.281	0.340	0.730	0.673	0.533	0.563	0.989	0.757	1.078	0.827	0.392	0.448	2.249	1.112
	336	**0.311**	**0.348**	0.321	**0.351**	**0.314**	0.357	0.442	0.466	0.369	0.427	0.325	0.366	0.334	0.361	0.339	0.372	1.201	0.845	1.363	0.887	1.334	0.872	1.549	0.972	0.932	0.724	2.568	1.238
	720	0.417	**0.408**	**0.408**	**0.403**	**0.414**	0.413	0.675	0.587	0.554	0.522	0.421	0.415	0.417	0.413	0.433	0.432	3.625	1.451	3.379	1.338	3.048	1.328	2.631	1.242	1.372	0.879	2.720	1.287
	Avg	**0.291**	**0.332**	**0.291**	**0.333**	**0.293**	0.342	0.409	0.436	0.350	0.401	0.305	0.349	0.306	0.347	0.327	0.371	1.498	0.869	1.410	0.810	1.535	0.900	1.479	0.915	0.735	0.598	2.395	1.177
ETTh1	96	0.399	0.416	**0.384**	**0.402**	0.494	0.479	0.424	0.432	0.386	**0.400**	**0.376**	0.419	0.513	0.491	0.449	0.459	0.664	0.612	0.865	0.713	0.878	0.740	0.837	0.728	0.548	0.528	1.044	0.773
	192	0.448	0.446	**0.436**	**0.429**	0.538	0.504	0.475	0.462	0.437	**0.432**	**0.420**	0.448	0.534	0.504	0.500	0.482	0.790	0.681	1.008	0.792	1.037	0.824	0.923	0.766	0.542	0.526	1.217	0.832
	336	0.482	**0.464**	0.491	0.469	0.574	0.521	0.518	0.488	**0.481**	**0.459**	**0.459**	0.465	0.588	0.535	0.521	0.496	0.891	0.738	1.107	0.809	1.238	0.932	1.097	0.835	1.298	0.942	1.259	0.841
	720	**0.504**	**0.494**	0.521	**0.500**	0.562	0.535	0.547	0.533	0.519	0.516	**0.506**	0.507	0.643	0.616	0.514	0.512	0.963	0.782	1.181	0.865	1.135	0.852	1.257	0.889	0.721	0.659	1.271	0.838
	Avg	0.458	0.455	0.458	**0.450**	0.542	0.510	0.491	0.479	**0.456**	**0.452**	**0.440**	0.460	0.570	0.537	0.496	0.487	0.827	0.703	1.040	0.795	1.072	0.837	1.029	0.805	0.777	0.664	1.198	0.821
ETTh2	96	0.352	0.385	**0.340**	**0.374**	0.340	0.391	0.397	0.437	**0.333**	**0.387**	0.358	0.397	0.476	0.458	0.346	0.388	0.645	0.597	3.755	1.525	2.116	1.197	2.626	1.317	1.616	1.036	2.522	1.278
	192	**0.417**	**0.420**	**0.402**	**0.414**	0.430	0.439	0.520	0.504	0.477	0.476	0.429	0.439	0.512	0.493	0.456	0.452	0.788	0.683	5.602	1.931	4.315	1.635	11.120	2.979	2.083	1.197	3.312	1.384
	336	**0.447**	**0.447**	**0.452**	**0.452**	0.485	0.479	0.626	0.559	0.594	0.541	0.496	0.487	0.552	0.551	0.482	0.486	0.907	0.747	4.721	1.835	1.124	1.604	9.323	2.769	2.970	1.439	3.291	1.388
	720	**0.449**	**0.456**	**0.462**	**0.468**	0.500	0.497	0.863	0.672	0.831	0.657	0.463	0.474	0.562	0.56	0.515	0.511	0.963	0.783	3.647	1.625	3.188	1.540	3.874	1.697	2.576	1.363	3.257	1.357
	Avg	**0.416**	**0.427**	**0.414**	**0.427**	0.439	0.452	0.602	0.543	0.559	0.515	0.437	**0.449**	0.526	0.516	0.450	0.459	0.826	0.703	4.431	1.729	2.686	1.494	6.736	2.191	2.311	1.259	3.095	1.352
Eelctricity	96	**0.165**	**0.270**	**0.168**	**0.272**	0.187	0.304	0.207	0.307	0.197	0.282	0.193	0.308	0.169	0.273	0.201	0.317	0.386	0.449	0.274	0.368	0.258	0.357	0.312	0.402	0.300	0.392	0.375	0.437
	192	0.186	0.287	**0.184**	0.289	0.199	0.315	0.213	0.316	0.196	**0.285**	0.201	0.315	**0.182**	**0.286**	0.222	0.334	0.378	0.443	0.296	0.386	0.266	0.368	0.348	0.433	0.297	0.390	0.442	0.473
	336	**0.195**	**0.298**	**0.198**	**0.300**	0.212	0.329	0.230	0.333	0.209	0.301	0.214	0.329	0.200	0.304	0.231	0.338	0.376	0.443	0.300	0.394	0.280	0.380	0.350	0.433	0.317	0.403	0.439	0.473
	720	0.223	**0.321**	**0.220**	**0.320**	0.233	0.345	0.265	0.360	0.245	0.333	0.246	0.355	**0.222**	**0.321**	0.254	0.361	0.376	0.445	0.373	0.439	0.283	0.376	0.340	0.420	0.338	0.417	0.980	0.814
	Avg	**0.192**	**0.294**	**0.192**	**0.295**	0.208	0.323	0.229	0.329	0.212	0.300	0.214	0.327	**0.193**	0.296	0.227	0.338	0.379	0.445	0.311	0.397	0.272	0.370	0.338	0.422	0.313	0.401	0.559	0.549
Traffic	96	0.601	**0.323**	**0.593**	**0.321**	0.607	0.392	0.615	0.391	0.650	0.396	**0.587**	0.366	0.612	0.338	0.613	0.388	0.867	0.468	0.719	0.391	0.684	0.384	0.732	0.423	0.798	0.436	0.843	0.453
	192	0.616	**0.329**	0.617	**0.336**	0.621	0.399	**0.601**	0.382	**0.598**	0.370	0.604	0.373	0.613	**0.340**	0.616	0.382	0.869	0.467	0.696	0.379	0.685	0.390	0.733	0.420	0.849	0.481	0.847	0.453
	336	0.633	0.337	0.629	**0.336**	0.622	0.396	**0.613**	0.386	**0.605**	0.373	0.621	0.383	0.618	**0.328**	0.622	0.337	0.881	0.469	0.777	0.420	0.734	0.408	0.742	0.420	0.828	0.476	0.853	0.455
	720	0.651	0.352	0.640	**0.350**	**0.632**	0.396	0.658	0.407	0.645	0.394	**0.626**	0.382	0.653	**0.355**	0.660	0.408	0.896	0.473	0.864	0.472	0.717	0.396	0.755	0.423	0.854	0.489	1.500	0.805
	Avg	0.625	**0.335**	**0.620**	**0.336**	0.621	0.396	0.622	0.392	0.625	0.383	**0.610**	0.376	0.624	0.340	0.628	0.379	0.878	0.469	0.764	0.416	0.705	0.395	0.741	0.422	0.832	0.471	1.011	0.541
Weather	96	**0.173**	**0.222**	**0.172**	**0.220**	0.197	0.281	0.182	0.242	0.196	0.255	0.217	0.296	**0.173**	0.223	0.266	0.336	0.622	0.556	0.300	0.384	0.458	0.490	0.689	0.596	0.174	0.252	0.369	0.406
	192	**0.220**	**0.261**	**0.219**	**0.261**	0.237	0.312	0.227	**0.287**	0.237	0.296	0.276	0.336	0.245	0.285	0.307	0.367	0.739	0.624	0.598	0.544	0.658	0.589	0.752	0.638	0.238	0.313	0.416	0.435
	336	**0.277**	**0.302**	**0.28**	**0.306**	0.298	0.353	0.282	0.334	0.283	0.335	0.339	0.380	0.321	0.338	0.359	0.395	1.004	0.753	0.578	0.523	0.797	0.652	0.639	0.596	0.287	0.355	0.455	0.454
	720	0.357	**0.352**	0.365	**0.359**	**0.352**	0.288	**0.352**	0.386	**0.345**	0.381	0.403	0.428	0.414	0.41	0.419	0.428	1.42	0.934	1.059	0.741	0.869	0.675	1.130	0.792	0.384	0.415	0.535	0.520
	Avg	**0.257**	**0.284**	**0.259**	**0.287**	0.271	0.334	0.261	0.312	0.265	0.317	0.309	0.360	0.288	0.314	0.338	0.382	0.946	0.717	0.634	0.548	0.696	0.602	0.803	0.656	0.271	0.334	0.444	0.454
Exchange	96	0.109	0.238	0.107	0.234	**0.085**	**0.204**	0.116	0.262	**0.088**	**0.218**	0.148	0.278	0.111	0.237	0.197	0.323	1.748	1.105	0.847	0.752	0.968	0.812	1.065	0.829	0.395	0.474	1.453	1.049
	192	0.198	0.323	0.226	0.344	**0.182**	**0.303**	0.215	0.359	**0.176**	**0.315**	0.271	0.380	0.219	0.335	0.300	0.369	1.874	1.151	1.204	0.895	1.040	0.851	1.188	0.906	0.776	0.698	1.846	1.179
	336	**0.337**	**0.424**	0.367	0.448	0.348	0.428	0.377	0.466	**0.313**	**0.427**	0.460	0.500	0.421	0.476	0.509	0.524	1.943	1.172	1.672	1.036	1.659	1.081	1.357	0.976	1.029	0.797	2.136	1.231
	720	0.890	0.716	0.964	0.746	1.025	0.774	**0.831**	**0.699**	**0.839**	**0.695**	1.195	0.841	1.092	0.769	1.447	0.941	2.085	1.206	2.478	1.310	1.941	1.127	1.510	1.016	2.283	1.222	2.984	1.427
	Avg	**0.384**	**0.425**	0.416	0.443	0.410	0.427	0.385	0.447	**0.354**	**0.414**	0.519	0.500	0.461	0.454	0.613	0.539	1.913	1.159	1.55	0.998	1.402	0.968	1.280	0.932	1.121	0.798	2.105	1.221
ILL	24	**1.859**	**0.858**	2.317	**0.934**	2.527	1.020	8.313	2.144	2.398	1.040	3.228	1.260	**2.294**	0.945	3.483	1.287	7.394	2.012	5.764	1.677	4.480	1.444	4.400	1.382	4.381	1.425	5.914	1.734
	36	2.454	0.985	**1.972**	**0.920**	2.615	1.007	6.631	1.902	2.646	1.088	2.679	1.080	**1.825**	**0.848**	3.103	1.148	7.551	2.031	4.755	1.467	4.799	1.467	4.783	1.448	4.442	1.416	6.631	1.845
	48	**1.919**	**0.846**	2.238	0.940	2.359	0.972	7.299	1.982	2.614	1.086	2.622	1.078	**2.010**	**0.900**	2.669	1.085	7.662	2.057	4.763	1.469	4.800	1.468	4.832	1.465	4.559	1.443	6.736	1.857
	60	**1.972**	**0.921**	**2.027**	**0.928**	2.487	1.016	7.283	1.985	2.804	1.146	2.857	1.157	2.178	0.963	2.770	1.125	7.931	2.100	5.264	1.564	5.278	1.560	4.882	1.483	4.651	1.474	6.870	1.879
	Avg	**2.051**	**0.903**	2.139	0.931	2.497	1.004	7.382	2.003	2.616	1.090	2.847	1.144	**2.077**	**0.914**	3.006	1.161	7.635	2.050	5.137	1.544	4.839	1.485	4.724	1.445	4.508	1.440	6.538	1.829
Count 1^{st}		29		21		3		1		11		5		4															

Table 10: The result of long-term forecasting task(order-preserving).

Models		SpecAR-Net (ours)		TimesNet (2023)		ETS. (2022)		LightTS (2022)		DLinear (2023)		FED. (2022)		Stationary (2022a)		Auto. (2021)		Pyra. (2021a)		In. (2021)		LogTrans (2019)		Re. (2020)		LSTM (1997)		TCN (2019)		LSSL (2022)	
	MaskRate	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE
ETTm1	12.50%	**0.019**	**0.093**	**0.019**	**0.092**	0.067	0.188	0.075	0.180	0.058	0.162	0.035	0.135	**0.026**	0.107	0.034	0.124	0.670	0.541	0.047	0.155	0.041	0.141	0.032	0.126	0.974	0.780	0.510	0.493	0.101	0.231
	25%	**0.024**	**0.104**	**0.023**	**0.101**	0.096	0.229	0.093	0.206	0.080	0.193	0.052	0.166	0.032	0.119	0.046	0.144	0.689	0.553	0.063	0.180	0.044	0.144	0.042	0.146	1.032	0.807	0.518	0.500	0.106	0.235
	37.50%	**0.029**	**0.113**	**0.029**	**0.111**	0.133	0.271	0.113	0.231	0.103	0.219	0.069	0.191	**0.039**	0.131	0.057	0.161	0.737	0.581	0.079	0.200	0.052	0.158	0.063	0.182	0.999	0.792	0.516	0.499	0.116	0.246
	50%	**0.036**	**0.126**	**0.036**	**0.124**	0.186	0.323	0.134	0.255	0.132	0.248	0.089	0.218	**0.047**	0.145	0.067	0.174	0.770	0.605	0.093	0.218	0.063	0.173	0.082	0.208	0.952	0.763	0.519	0.496	0.129	0.260
	Avg	**0.027**	**0.109**	**0.027**	**0.107**	0.120	0.253	0.104	0.218	0.093	0.206	0.062	0.177	**0.036**	0.126	0.051	0.150	0.717	0.570	0.071	0.188	0.050	0.154	0.055	0.166	0.989	0.786	0.516	0.497	0.113	0.254
ETTm2	12.50%	**0.018**	**0.080**	**0.018**	**0.08**	0.108	0.239	0.034	0.127	0.062	0.166	0.056	0.159	**0.021**	**0.088**	0.023	0.092	0.394	0.470	0.133	0.270	0.103	0.229	0.108	0.228	1.013	0.805	0.307	0.441	0.150	0.298
	25%	**0.020**	**0.084**	**0.020**	**0.085**	0.164	0.294	0.042	0.143	0.085	0.196	0.080	0.195	**0.024**	0.096	0.026	0.101	0.421	0.482	0.135	0.272	0.120	0.248	0.136	0.262	1.039	0.814	0.263	0.402	0.159	0.306
	37.50%	**0.022**	**0.090**	**0.023**	**0.091**	0.237	0.356	0.051	0.159	0.106	0.222	0.110	0.231	0.027	0.103	0.030	0.108	0.478	0.521	0.155	0.293	0.138	0.260	0.175	0.300	0.917	0.744	0.250	0.396	0.180	0.321
	50%	**0.025**	**0.096**	**0.026**	**0.098**	0.323	0.421	0.059	0.174	0.131	0.247	0.156	0.276	0.030	0.108	0.035	0.119	0.568	0.560	0.200	0.333	0.117	0.247	0.211	0.329	1.140	0.835	0.246	0.389	0.210	0.353
ETTh1	12.50%	**0.055**	**0.163**	**0.057**	**0.159**	0.126	0.263	0.240	0.345	0.151	0.267	0.070	0.190	0.060	0.165	0.074	0.182	0.857	0.609	0.114	0.234	0.229	0.330	0.074	0.194	1.265	0.896	0.599	0.554	0.422	0.461
	25%	**0.064**	**0.174**	**0.069**	**0.178**	0.169	0.304	0.265	0.364	0.180	0.292	0.106	0.236	0.080	0.189	0.090	0.203	0.829	0.672	0.140	0.262	0.207	0.323	0.102	0.227	1.262	0.883	0.610	0.567	0.412	0.456
	37.50%	**0.083**	**0.195**	**0.084**	**0.196**	0.220	0.347	0.296	0.382	0.215	0.318	0.124	0.258	0.102	0.212	0.109	0.222	0.830	0.675	0.174	0.293	0.210	0.328	0.135	0.261	1.200	0.867	0.628	0.577	0.421	0.461
	50%	**0.106**	**0.217**	**0.102**	**0.215**	0.293	0.402	0.334	0.404	0.257	0.347	0.165	0.299	0.133	0.240	0.137	0.248	0.854	0.691	0.215	0.325	0.230	0.348	0.179	0.298	1.174	0.849	0.648	0.587	0.443	0.473
	Avg	**0.077**	**0.187**	**0.078**	**0.187**	0.202	0.329	0.284	0.373	0.201	0.306	0.117	0.246	0.094	**0.201**	0.103	0.214	0.842	0.682	0.161	0.279	0.219	0.332	0.122	0.245	1.225	0.873	0.621	0.571	0.424	0.481
ETTh2	12.50%	**0.040**	**0.132**	**0.040**	**0.130**	0.187	0.319	0.101	0.231	0.100	0.216	0.095	0.212	**0.042**	0.133	0.044	0.138	0.976	0.754	0.305	0.431	0.173	0.308	0.163	0.289	2.060	1.120	0.410	0.494	0.521	0.555
	25%	**0.045**	**0.140**	**0.460**	**0.141**	0.279	0.390	0.115	0.246	0.127	0.247	0.137	0.258	0.049	0.147	0.050	0.149	1.037	0.774	0.322	0.444	0.175	0.310	0.206	0.331	2.007	1.105	0.419	0.490	0.487	0.535
	37.50%	**0.049**	**0.147**	**0.052**	**0.151**	0.400	0.465	0.126	0.257	0.158	0.276	0.187	0.304	0.056	0.158	0.060	0.163	1.107	0.800	0.353	0.462	0.185	0.315	0.252	0.370	2.033	1.111	0.429	0.498	0.487	0.529
	50%	**0.056**	**0.158**	**0.060**	**0.162**	0.602	0.572	0.136	0.268	0.183	0.299	0.232	0.341	0.065	0.170	0.068	0.173	1.193	0.838	0.369	0.472	0.212	0.339	0.316	0.419	2.054	1.119	0.467	0.529	0.484	0.523
	Avg	**0.048**	**0.144**	**0.049**	**0.146**	0.367	0.436	0.119	0.250	0.142	0.259	0.163	0.279	0.053	0.152	0.055	0.156	1.079	0.792	0.337	0.452	0.186	0.318	0.234	0.352	2.039	1.114	0.431	0.503	0.495	0.475
Electricity	12.50%	**0.089**	**0.205**	**0.085**	**0.202**	0.196	0.321	0.102	0.229	0.092	0.214	0.107	0.237	0.093	0.210	0.089	0.210	0.297	0.383	0.218	0.326	0.164	0.296	0.190	0.308	0.277	0.366	0.621	0.620	0.217	0.341
	25%	**0.092**	**0.209**	**0.089**	**0.206**	0.207	0.332	0.121	0.252	0.118	0.247	0.120	0.251	0.097	0.214	0.096	0.220	0.294	0.380	0.219	0.326	0.169	0.299	0.197	0.312	0.281	0.369	0.559	0.585	0.219	0.341
	37.50%	**0.096**	**0.214**	**0.094**	**0.213**	0.219	0.344	0.141	0.273	0.144	0.276	0.136	0.266	0.102	0.220	0.104	0.229	0.296	0.381	0.222	0.328	0.178	0.305	0.203	0.315	0.275	0.364	0.567	0.588	0.223	0.343
	50%	**0.102**	**0.222**	**0.100**	**0.221**	0.235	0.357	0.160	0.293	0.175	0.305	0.158	0.284	0.108	0.228	0.113	0.239	0.299	0.383	0.228	0.331	0.187	0.312	0.210	0.319	0.273	0.361	0.581	0.597	0.229	0.347
	Avg	**0.095**	**0.213**	**0.092**	**0.210**	0.214	0.339	0.131	0.262	0.132	0.260	0.130	0.259	0.100	0.218	0.101	0.225	0.297	0.382	0.222	0.328	0.175	0.303	0.200	0.313	0.277	0.365	0.582	0.597	0.222	0.293
Weather	12.50%	0.027	0.050	**0.025**	**0.045**	0.057	0.141	0.047	0.101	0.039	0.084	0.041	0.107	0.027	0.051	**0.026**	**0.047**	0.140	0.220	0.037	0.093	0.037	0.072	0.031	0.076	0.296	0.379	0.176	0.287	0.036	0.095
	25%	0.034	0.067	**0.029**	**0.052**	0.065	0.155	0.052	0.111	0.048	0.103	0.064	0.163	0.029	0.056	**0.030**	**0.054**	0.147	0.229	0.042	0.100	0.038	0.074	0.035	0.082	0.327	0.409	0.187	0.293	0.042	0.104
	37.50%	**0.031**	**0.058**	**0.031**	**0.057**	0.081	0.180	0.058	0.121	0.057	0.117	0.107	0.229	0.033	0.062	**0.032**	0.060	0.156	0.240	0.049	0.111	0.039	0.078	0.040	0.091	0.406	0.463	0.172	0.281	0.047	0.112
	50%	**0.035**	**0.065**	**0.034**	**0.062**	0.102	0.207	0.065	0.133	0.066	0.134	0.183	0.312	0.037	0.068	0.037	0.067	0.164	0.249	0.053	0.114	0.042	0.082	0.046	0.099	0.431	0.483	0.195	0.303	0.054	0.123
	Avg	0.032	0.060	**0.030**	**0.054**	0.076	0.171	0.055	0.117	0.052	0.110	0.099	0.203	0.032	0.059	**0.031**	**0.057**	0.152	0.235	0.045	0.104	0.039	0.076	0.038	0.087	0.365	0.434	0.183	0.291	0.045	0.108
Count 1^{st}		21		32																											

Table 11: The result of imputation task. Avg is average from four mask rates.

Models		SpecAR-Net (ours)		TimesNet (2023)		ETS. (2022)		LightTS (2022)		DLinear (2023)		FED. (2022)		Stationary (2022a)		Auto. (2021)		Pyra. (2021a)		In. (2021)		LogTrans (2019)		Re. (2020)		LSTM (1997)		TCN (2019)		LSSL (2022)	
	MaskRate	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE
ETTm1	12.50%	**0.018**	**0.089**	**0.019**	**0.092**	0.067	0.188	0.075	0.180	0.058	0.162	0.035	0.135	0.026	0.107	0.034	0.124	0.67	0.541	0.047	0.155	0.041	0.141	0.032	0.126	0.974	0.780	0.510	0.493	0.101	0.231
	25%	**0.022**	**0.098**	**0.023**	**0.101**	0.096	0.229	0.093	0.206	0.080	0.193	0.052	0.166	0.032	0.119	0.046	0.144	0.689	0.553	0.063	0.180	0.044	0.144	0.042	0.146	1.032	0.807	0.518	0.500	0.106	0.235
	37.50%	**0.028**	**0.111**	**0.029**	**0.111**	0.133	0.271	0.113	0.231	0.103	0.219	0.069	0.191	0.039	**0.131**	0.057	0.161	0.737	0.581	0.079	0.200	0.052	0.158	0.063	0.182	0.999	0.792	0.516	0.499	0.116	0.246
	50%	**0.035**	**0.124**	**0.036**	**0.124**	0.186	0.323	0.134	0.255	0.132	0.248	0.089	0.218	0.047	**0.145**	0.067	0.174	0.770	0.605	0.093	0.218	0.063	0.173	0.082	0.208	0.952	0.763	0.519	0.496	0.129	0.260
	Avg	**0.026**	**0.106**	**0.027**	**0.107**	0.120	0.253	0.104	0.218	0.093	0.206	0.062	0.177	0.036	0.126	0.051	0.150	0.717	0.570	0.071	0.188	0.050	0.154	0.055	0.166	0.989	0.786	0.516	0.497	0.113	0.254
ETTm2	12.50%	**0.018**	**0.079**	**0.018**	**0.080**	0.108	0.239	0.034	0.127	0.062	0.166	0.056	0.159	**0.021**	0.088	0.023	0.092	0.394	0.470	0.133	0.270	0.103	0.229	0.108	0.228	1.013	0.805	0.307	0.441	0.150	0.298
	25%	**0.020**	**0.084**	**0.020**	**0.085**	0.164	0.294	0.042	0.143	0.085	0.196	0.080	0.195	**0.024**	0.096	0.026	0.101	0.421	0.482	0.135	0.272	0.120	0.248	0.136	0.262	1.039	0.814	0.263	0.402	0.159	0.306
	37.50%	**0.022**	**0.089**	**0.023**	**0.091**	0.237	0.356	0.051	0.159	0.106	0.222	0.110	0.231	0.027	0.103	0.030	0.108	0.478	0.521	0.155	0.293	0.138	0.260	0.175	0.300	0.917	0.744	0.250	0.396	0.180	0.321
	50%	**0.025**	**0.097**	**0.026**	**0.098**	0.323	0.421	0.059	0.174	0.131	0.247	0.156	0.276	0.030	0.108	0.035	0.119	0.568	0.560	0.20	0.333	0.117	0.247	0.211	0.329	1.140	0.835	0.246	0.389	0.210	0.353
	Avg	**0.021**	**0.087**	**0.022**	**0.089**	0.208	0.327	0.046	0.151	0.096	0.208	0.101	0.215	0.026	0.099	0.029	0.105	0.465	0.508	0.156	0.292	0.119	0.246	0.157	0.280	1.027	0.800	0.266	0.407	0.175	0.324
ETTh1	12.50%	**0.044**	**0.144**	**0.057**	**0.159**	0.126	0.263	0.240	0.345	0.151	0.267	0.070	0.190	0.060	0.165	0.074	0.182	0.857	0.609	0.114	0.234	0.229	0.330	0.074	0.194	1.265	0.896	0.599	0.554	0.422	0.461
	25%	**0.061**	**0.169**	**0.069**	**0.178**	0.169	0.304	0.265	0.364	0.180	0.292	0.106	0.236	0.080	0.189	0.090	0.203	0.829	0.672	0.140	0.262	0.207	0.323	0.102	0.227	1.262	0.883	0.610	0.567	0.412	0.456
	37.50%	**0.079**	**0.190**	**0.084**	**0.196**	0.220	0.347	0.296	0.382	0.215	0.318	0.124	0.258	0.102	0.212	0.109	0.222	0.830	0.675	0.174	0.293	0.210	0.328	0.135	0.261	1.200	0.867	0.628	0.577	0.421	0.461
	50%	**0.098**	**0.210**	**0.102**	**0.215**	0.293	0.402	0.334	0.404	0.257	0.347	0.165	0.299	0.133	0.240	0.137	0.248	0.854	0.691	0.215	0.325	0.230	0.348	0.179	0.298	1.174	0.849	0.648	0.587	0.443	0.473
	Avg	**0.071**	**0.178**	**0.078**	**0.187**	0.202	0.329	0.284	0.373	0.201	0.306	0.117	0.246	0.094	0.201	0.103	0.214	0.842	0.682	0.161	0.279	0.219	0.332	0.122	0.245	1.225	0.873	0.621	0.571	0.424	0.481
ETTh2	12.50%	**0.038**	**0.128**	**0.040**	**0.13**	0.187	0.319	0.101	0.231	0.100	0.216	0.095	0.212	0.042	0.133	0.044	0.138	0.976	0.754	0.305	0.431	0.173	0.308	0.163	0.289	2.060	1.120	0.410	0.494	0.521	0.555
	25%	**0.042**	**0.136**	**0.460**	**0.141**	0.279	0.390	0.115	0.246	0.127	0.247	0.137	0.258	0.049	0.147	0.050	0.149	1.037	0.774	0.322	0.444	0.175	0.310	0.206	0.331	2.007	1.105	0.419	0.490	0.487	0.535
	37.50%	**0.047**	**0.144**	**0.052**	**0.151**	0.400	0.465	0.126	0.257	0.158	0.276	0.187	0.304	0.056	0.158	0.060	0.163	1.107	0.800	0.353	0.462	0.185	0.315	0.252	0.370	2.033	1.111	0.429	0.498	0.487	0.529
	50%	**0.056**	**0.157**	**0.060**	**0.162**	0.602	0.572	0.136	0.268	0.183	0.299	0.232	0.341	0.065	0.170	0.068	0.173	1.193	0.838	0.369	0.472	0.212	0.339	0.316	0.419	2.054	1.119	0.467	0.529	0.484	0.523
	Avg	**0.046**	**0.141**	**0.049**	**0.146**	0.367	0.436	0.119	0.250	0.142	0.259	0.163	0.279	0.053	0.152	0.055	0.156	1.079	0.792	0.337	0.452	0.186	0.318	0.234	0.352	2.039	1.114	0.431	0.503	0.495	0.475
Electricity	12.50%	**0.086**	**0.202**	**0.085**	**0.202**	0.196	0.321	0.102	0.229	0.092	0.214	0.107	0.237	0.093	**0.210**	0.089	0.210	0.297	0.383	0.218	0.326	0.164	0.296	0.190	0.308	0.277	0.366	0.621	0.620	0.217	0.341
	25%	**0.089**	**0.206**	**0.089**	**0.206**	0.207	0.332	0.121	0.252	0.118	0.247	0.120	0.251	0.097	**0.214**	**0.096**	0.220	0.294	0.380	0.219	0.326	0.169	0.299	0.197	0.312	0.281	0.369	0.559	0.585	0.219	0.341
	37.50%	**0.094**	**0.212**	**0.094**	**0.213**	0.219	0.344	0.141	0.273	0.144	0.276	0.136	0.266	**0.102**	0.220	0.104	0.229	0.296	0.381	0.222	0.328	0.178	0.305	0.203	0.315	0.275	0.364	0.567	0.588	0.223	0.343
	50%	**0.100**	**0.220**	**0.100**	**0.221**	0.235	0.357	0.160	0.293	0.175	0.305	0.158	0.284	**0.108**	0.228	0.113	0.239	0.299	0.383	0.228	0.331	0.187	0.312	0.210	0.319	0.273	0.361	0.581	0.597	0.229	0.347
	Avg	**0.092**	**0.210**	**0.092**	**0.210**	0.214	0.339	0.131	0.262	0.132	0.260	0.130	0.259	**0.100**	**0.218**	0.101	0.225	0.297	0.382	0.222	0.328	0.175	0.303	0.200	0.313	0.277	0.365	0.582	0.597	0.222	0.293
Weather	12.50%	0.027	0.052	**0.025**	**0.045**	0.057	0.141	0.047	0.101	0.039	0.084	0.041	0.107	0.027	0.051	**0.026**	**0.047**	0.140	0.220	0.037	0.093	0.037	0.072	0.031	0.076	0.296	0.379	0.176	0.287	0.036	0.095
	25%	**0.028**	**0.052**	**0.029**	**0.052**	0.065	0.155	0.052	0.111	0.048	0.103	0.064	0.163	**0.029**	0.056	0.030	**0.054**	0.147	0.229	0.042	0.100	0.038	0.074	0.035	0.082	0.327	0.409	0.187	0.293	0.042	0.104
	37.50%	**0.031**	**0.058**	**0.031**	**0.057**	0.081	0.180	0.058	0.121	0.057	0.117	0.107	0.229	0.033	0.062	**0.032**	0.060	0.156	0.240	0.049	0.111	0.039	0.078	0.040	0.091	0.406	0.463	0.172	0.281	0.047	0.112
	50%	**0.036**	**0.066**	**0.034**	**0.062**	0.102	0.207	0.065	0.133	0.066	0.134	0.183	0.312	0.037	0.068	0.037	0.067	0.164	0.249	0.053	0.114	0.042	0.082	0.046	0.099	0.431	0.483	0.195	0.303	0.054	0.123
	Avg	**0.031**	**0.057**	**0.030**	**0.054**	0.076	0.171	0.055	0.117	0.052	0.110	0.099	0.203	0.032	0.059	**0.031**	**0.057**	0.152	0.235	0.045	0.104	0.039	0.076	0.038	0.087	0.365	0.434	0.183	0.291	0.045	0.108
Count 1^{st}		42		17																											

Table 12: The result of imputation task(order-preserving).