Supplementary

Appendix 1: Visual representation of performed experiments

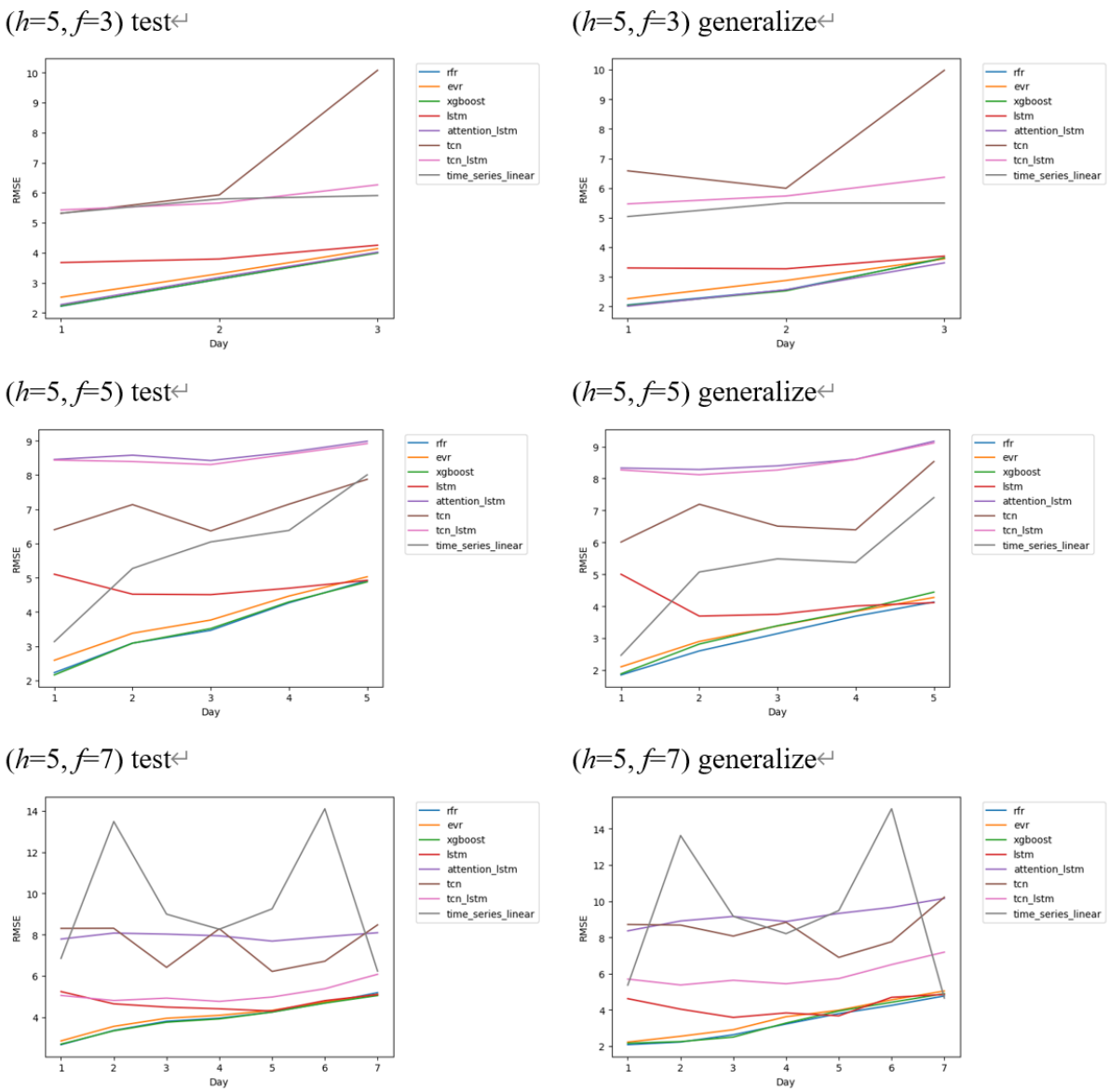

Figure S1 RMSE of models' prediction in each predicting time steps. *h*, historical data; *f*, future forecasts; RMSE, root mean square error.

https://dx.doi.org/10.21037/jmai-24-277

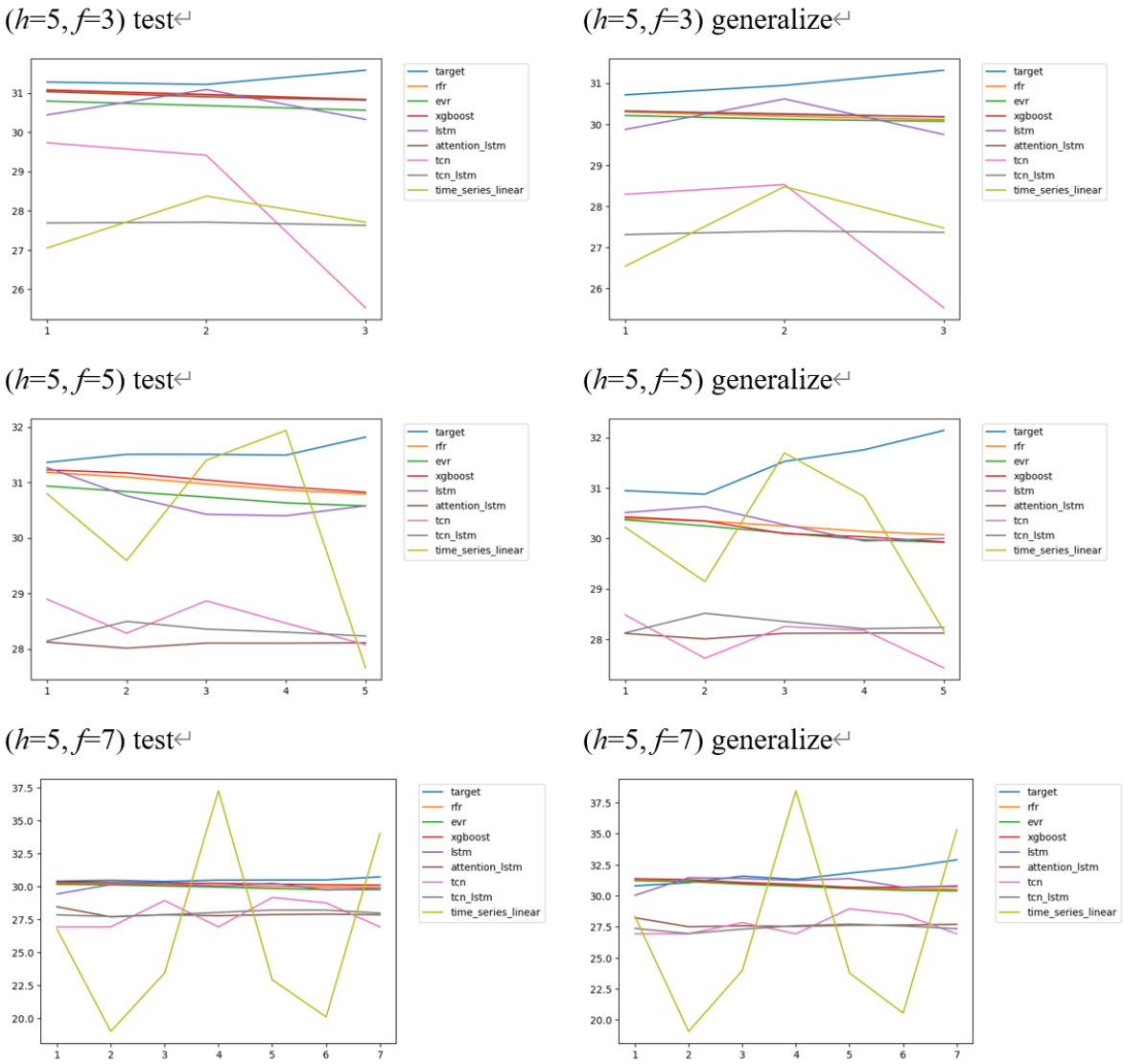

Figure S2 Average of models' prediction in each predicting time steps. The X-axis is the number of predicting days. The Y-axis is MELD score. *h*, historical data; *f*, future forecasts; MELD, Model for End-Stage Liver Disease.

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Appendix 2: Model performance

Table S1 Accuracy evaluation of models for experiment 1 (b=5, f=1)

Model name	Data set	R-square	RMSE	95% CI	MAE
RFR	Test	0.904†	2.582	20.185, 30.192	1.858
	Generalize	0.876†	2.883†	30.015, 41.206	1.914†
EVR	Test	0.892	2.740	19.462, 30.049	1.956
	Generalize	0.869	2.962	28.408, 39.822	2.089
XGBoost	Test	0.904†	2.576†	20.233, 30.223	1.842†
	Generalize	0.874	2.906	29.967, 41.264	1.950
LSTM	Test	0.876	2.936	19.844, 31.168	2.162
	Generalize	0.833	3.337	27.233, 40.079	2.336
A-L	Test	–0.079	8.658	11.649, 42.551	6.76
	Generalize	–0.2	8.956	12.942, 44.604	7.170
TCN	Test	0.082	7.986	10.318, 37.750	6.329
	Generalize	–0.037	8.326	17.554, 44.980	6.668
T-L	Test	–0.228	9.239	11.158, 43.903	7.312
	Generalize	–0.274	9.228	11.404, 43.730	7.412
LR	Test	0.693	4.621	19.834, 34.023	3.752
	Generalize	0.744	4.137	30.954, 44.445	3.300

†, best performances. h, historical data; f, future forecasts; RMSE, root mean square error; CI, confidence interval; MAE, mean absolute error; RFR, Random Forest Regression; EVR, Extra Tree Regressor; LSTM, long short-term memory; A-L, attention LSTM; TCN, temporal convolutional network; T-L, TCN LSTM; LR, linear regression.

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Table S2 Accuracy evaluation of models for experiment 2 (h=5, f=3)

Model name	Data set	R-square	RMSE	RMSE per timestep	95% CI	MAE
RFR	Test	0.840†	3.115	Day 1: 2.218	Day 1: 25.519, 32.705	2.321†
				Day 2: 3.118	Day 2: 25.531, 32.717	
				Day 3: 4.007	Day 3: 25.458, 32.6435	
	Generalize	0.876	2.749	Day 1: 2.056	Day 1: 30.958, 37.124	2.034
				Day 2: 2.564	Day 2: 30.734, 36.904	
				Day 3: 3.628	Day 3: 30.569, 36.735	
EVR	Test	0.821	3.318	Day 1: 2.517	Day 1: 24.774, 32.282	2.435
				Day 2: 3.302	Day 2: 24.819, 32.327	
				Day 3: 4.136	Day 3: 24.774, 32.282	
	Generalize	0.863	2.919	Day 1: 2.264	Day 1: 30.182, 36.645	2.182
				Day 2: 2.881	Day 2: 30.007, 36.471	
				Day 3: 3.613	Day 3: 29.919, 36.382	
XGBoost	Test	0.840	3.113†	Day 1: 2.228	Day 1: 25.4, 32.581	2.292
				Day 2: 3.121	Day 2: 25.422, 32.603	
				Day 3: 3.99	Day 3: 25.601, 32.781	
	Generalize	0.877	2.739	Day 1: 2.038	Day 1: 30.828, 37.009	2.032
				Day 2: 2.531	Day 2: 31.095, 37.277	
				Day 3: 3.649	Day 3: 31.038, 37.219	
LSTM	Test	0.759	3.906	Day 1: 3.673	Day 1: 22.292, 30.997	2.889
				Day 2: 3.793	Day 2: 24.363, 33.068	
				Day 3: 4.251	Day 3: 23.833, 32.538	
	Generalize	0.815	3.427	Day 1: 3.303	Day 1: 27.129, 34.647	2.508
				Day 2: 3.275	Day 2: 29.369, 36.887	
				Day 3: 3.703	Day 3: 28.874, 36.392	
A-L	Test	0.835	3.171	Day 1: 2.29	Day 1: 25.065, 32.357	2.351
				Day 2: 3.207	Day 2: 25.061, 32.354	
				Day 3: 4.015	Day 3: 24.998, 32.291	
	Generalize	0.882†	2.699†	Day 1: 2.046	Day 1: 30.984, 37.038	1.982†
				Day 2: 2.584	Day 2: 30.680, 36.735	
				Day 3: 3.466	Day 3: 30.600, 36.654	
TCN	Test	0.153	7.046	Day 1: 5.204	Day 1: 19.460, 34.602	5.431
				Day 2: 5.854	Day 2: 18.996, 34.138	
				Day 3: 10.08	Day 3: 17.958, 33.100	
	Generalize	0.100	7.389	Day 1: 5.847	Day 1: 23.064, 38.443	5.964
				Day 2: 6.341	Day 2: 22.814, 38.193	
				Day 3: 9.98	Day 3: 17.839, 33.219	
T-L	Test	0.510	5.569	Day 1: 5.212	Day 1: 20.063, 29.944	4.463
				Day 2: 5.482	Day 2: 21.017, 30.898	
				Day 3: 6.014	Day 3: 19.911, 29.792	
	Generalize	0.535	5.429	Day 1: 5.026	Day 1: 25.595, 34.545	4.455
				Day 2: 5.193	Day 2: 27.152, 36.103	
				Day 3: 6.069	Day 3: 26.776, 35.727	
LR	Test	0.492	5.671	Day 1: 5.317	Day 1: 19.406, 29.259	4.498
				Day 2: 5.791	Day 2: 23.620, 33.473	
				Day 3: 5.905	Day 3: 22.344, 32.197	
	Generalize	0.551	5.344	Day 1: 5.041	Day 1: 24.501, 33.703	4.300
				Day 2: 5.497	Day 2: 25.498, 34.699	
				Day 3: 5.495	Day 3: 26.046, 35.247	

†, best performances. h, historical data; f, future forecasts; RMSE, root mean square error; CI, confidence interval; MAE, mean absolute error; RFR, Random Forest Regression; EVR, Extra Tree Regressor; LSTM, long short-term memory; A-L, attention LSTM; TCN, temporal convolutional network; T-L, TCN LSTM; LR, linear regression.

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Table S3 Accuracy evaluation of models for experiment 3 (b=5, f=5)

Model name	Data set	R-square	RMSE	Daily RMSE	95% CI	MAE
RFR	Test	0.783†	3.594	Day 1: 2.227	Day 1: 22.790, 29.230	2.704
				Day 2: 3.09	Day 2: 23.092, 29.533	
				Day 3: 3.464	Day 3: 23.348, 29.789	
				Day 4: 4.267	Day 4: 23.556, 29.996	
				Day 5: 4.92	Day 5: 23.726, 30.167	
	Generalize	0.837†	3.084†	Day 1: 1.85	Day 1: 39.402, 44.589	2.264†
				Day 2: 2.602	Day 2: 38.776, 43.962	
				Day 3: 3.145	Day 3: 37.914, 43.100	
				Day 4: 3.692	Day 4: 37.182, 42.369	
				Day 5: 4.132	Day 5: 36.707, 41.894	
EVR	Test	0.755	3.845	Day 1: 2.59	Day 1: 23.975, 30.741	2.858
				Day 2: 3.379	Day 2: 24.010, 30.776	
				Day 3: 3.765	Day 3: 23.920, 30.686	
				Day 4: 4.465	Day 4: 23.891, 30.657	
				Day 5: 5.027	Day 5: 23.917, 30.683	
	Generalize	0.816	3.300	Day 1: 2.105	Day 1: 38.611, 44.089	2.473
				Day 2: 2.899	Day 2: 37.788, 43.266	
				Day 3: 3.381	Day 3: 36.693, 42.171	
				Day 4: 3.84	Day 4: 35.677, 41.155	
				Day 5: 4.276	Day 5: 34.856, 40.334	
XGBoost	Test	0.783†	3.588†	Day 1: 2.161	Day 1: 22.863, 29.312	2.700†
				Day 2: 3.088	Day 2: 23.137, 29.587	
				Day 3: 3.516	Day 3: 23.482, 29.931	
				Day 4: 4.294	Day 4: 23.585, 30.034	
				Day 5: 4.879	Day 5: 23.762, 30.212	
	Generalize	0.816	3.279	Day 1: 1.884	Day 1: 39.373, 44.901	2.441
				Day 2: 2.816	Day 2: 38.198, 43.726	
				Day 3: 3.39	Day 3: 37.157, 42.685	
				Day 4: 3.862	Day 4: 36.334, 41.862	
				Day 5: 4.443	Day 5: 36.310, 41.838	
LSTM	Test	0.637	4.750	Day 1: 5.102	Day 1: 25.934, 34.142	3.547
				Day 2: 4.52	Day 2: 25.287, 33.495	
				Day 3: 4.507	Day 3: 25.097, 33.305	
				Day 4: 4.694	Day 4: 23.953, 32.162	
				Day 5: 4.924	Day 5: 22.955, 31.163	
	Generalize	0.722	4.113	Day 1: 5.002	Day 1: 31.785, 38.765	3.146
				Day 2: 3.693	Day 2: 36.038, 43.018	
				Day 3: 3.747	Day 3: 35.863, 42.843	
				Day 4: 4.009	Day 4: 35.778, 42.758	
				Day 5: 4.113	Day 5: 36.162, 43.143	
A-L	Test	−0.187	8.600	Day 1: 8.42	Day 1: 21.189, 35.040	6.912
				Day 2: 8.54	Day 2: 21.186, 35.037	
				Day 3: 8.402	Day 3: 21.155, 35.006	
				Day 4: 8.658	Day 4: 21.220, 35.071	
				Day 5: 8.981	Day 5: 21.216, 35.067	
	Generalize	−0.182	8.537	Day 1: 8.306	Day 1: 21.413, 35.241	6.867
				Day 2: 8.209	Day 2: 21.239, 35.067	
				Day 3: 8.385	Day 3: 21.258, 35.086	
				Day 4: 8.622	Day 4: 21.330, 35.158	
				Day 5: 9.165	Day 5: 21.286, 35.114	
TCN	Test	0.153	7.260	Day 1: 7.087	Day 1: 19.268, 30.689	5.488
				Day 2: 6.892	Day 2: 19.268, 30.689	
				Day 3: 7.258	Day 3: 19.268, 30.689	
				Day 4: 6.936	Day 4: 19.268, 30.689	
				Day 5: 8.126	Day 5: 19.268, 30.689	
	Generalize	0.200	7.022	Day 1: 7.151	Day 1: 19.709, 30.248	5.557
				Day 2: 6.358	Day 2: 32.541, 43.080	
				Day 3: 6.837	Day 3: 32.142, 42.682	
				Day 4: 7.071	Day 4: 31.752, 42.291	
				Day 5: 7.695	Day 5: 31.468, 42.007	
T-L	Test	−0.175	8.558	Day 1: 8.447	Day 1: 20.581, 34.477	6.866
				Day 2: 8.415	Day 2: 21.948, 35.843	
				Day 3: 8.325	Day 3: 21.262, 35.157	
				Day 4: 8.649	Day 4: 20.860, 34.756	
				Day 5: 8.952	Day 5: 20.610, 34.505	
	Generalize	−0.171	8.499	Day 1: 8.294	Day 1: 21.382, 35.271	6.836
				Day 2: 8.09	Day 2: 21.318, 35.208	
				Day 3: 8.32	Day 3: 21.315, 35.205	
				Day 4: 8.626	Day 4: 21.248, 35.138	
				Day 5: 9.164	Day 5: 21.708, 35.598	
LR	Test	0.434	5.768	Day 1: 3.133	Day 1: 22.075, 32.337	4.522
				Day 2: 5.272	Day 2: 21.743, 32.005	
				Day 3: 6.047	Day 3: 26.865, 37.127	
				Day 4: 6.381	Day 4: 21.319, 31.581	
				Day 5: 8.006	Day 5: 23.632, 33.894	
	Generalize	0.536	5.160	Day 1: 2.465	Day 1: 37.155, 46.301	4.082
				Day 2: 5.073	Day 2: 29.740, 38.886	
				Day 3: 5.485	Day 3: 33.196, 42.342	
				Day 4: 5.371	Day 4: 33.850, 42.996	
				Day 5: 7.403	Day 5: 33.576, 42.722	

†, best performances. h, historical data; f, future forecasts; RMSE, root mean square error; CI, confidence interval; MAE, mean absolute error; RFR, Random Forest Regression; EVR, Extra Tree Regressor; LSTM, long short-term memory; A-L, attention LSTM; TCN, temporal convolutional network; T-L, TCN LSTM; LR, linear regression.

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Table S4 Accuracy evaluation of models for experiment 4 (b=5, f=7)

Model name	Data set	R-square	RMSE	Daily RMSE	95% CI	MAE
RFR	Test	0.705	3.989	Day 1: 2.668	Day 1: 29.904, 35.896	2.915
				Day 2: 3.36	Day 2: 29.711, 35.703	
				Day 3: 3.805	Day 3: 29.616, 35.608	
				Day 4: 3.956	Day 4: 29.381, 35.373	
				Day 5: 4.254	Day 5: 29.157, 35.149	
				Day 6: 4.691	Day 6: 29.020, 35.012	
				Day 7: 5.189	Day 7: 29.010, 35.002	
	Generalize	0.817†	3.284†	Day 1: 2.083	Day 1: 22.425, 27.355	2.611†
				Day 2: 2.23	Day 2: 22.663, 27.593	
				Day 3: 2.631	Day 3: 23.016, 27.946	
				Day 4: 3.222	Day 4: 23.253, 28.183	
				Day 5: 3.798	Day 5: 23.387, 28.317	
				Day 6: 4.251	Day 6: 23.668, 28.598	
				Day 7: 4.772	Day 7: 23.867, 28.797	
EVR	Test	0.692	4.091	Day 1: 2.854	Day 1: 29.136, 35.234	3.000
				Day 2: 3.555	Day 2: 29.171, 35.269	
				Day 3: 3.951	Day 3: 28.962, 35.061	
				Day 4: 4.092	Day 4: 28.796, 34.894	
				Day 5: 4.33	Day 5: 28.762, 34.860	
				Day 6: 4.743	Day 6: 28.836, 34.934	
				Day 7: 5.109	Day 7: 28.957, 35.055	
	Generalize	0.786	3.557	Day 1: 2.228	Day 1: 22.881, 28.200	2.816
				Day 2: 2.548	Day 2: 22.936, 28.254	
				Day 3: 2.909	Day 3: 23.237, 28.555	
				Day 4: 3.629	Day 4: 23.322, 28.641	
				Day 5: 3.983	Day 5: 23.365, 28.683	
				Day 6: 4.557	Day 6: 23.417, 28.735	
				Day 7: 5.046	Day 7: 23.325, 28.644	
XGBoost	Test	0.710†	3.956†	Day 1: 2.697	Day 1: 30.685, 36.638	2.901†
				Day 2: 3.34	Day 2: 31.002, 36.955	
				Day 3: 3.757	Day 3: 31.219, 37.172	
				Day 4: 3.918	Day 4: 31.013, 36.966	
				Day 5: 4.247	Day 5: 31.225, 37.178	
				Day 6: 4.682	Day 6: 31.383, 37.336	
				Day 7: 5.048	Day 7: 31.355, 37.308	
	Generalize	0.808	3.352	Day 1: 2.166	Day 1: 21.832, 26.930	2.717
				Day 2: 2.255	Day 2: 22.215, 27.313	
				Day 3: 2.504	Day 3: 22.921, 28.019	
				Day 4: 3.277	Day 4: 23.448, 28.545	
				Day 5: 3.942	Day 5: 23.364, 28.461	
				Day 6: 4.422	Day 6: 23.150, 28.247	
				Day 7: 4.898	Day 7: 24.064, 29.162	
LSTM	Test	0.602	4.712	Day 1: 5.24	Day 1: 26.489, 33.255	3.536
				Day 2: 4.647	Day 2: 27.224, 36.461	
				Day 3: 4.488	Day 3: 27.373, 35.757	
				Day 4: 4.406	Day 4: 27.198, 34.292	
				Day 5: 4.301	Day 5: 28.043, 35.080	
				Day 6: 4.804	Day 6: 27.637, 35.156	
				Day 7: 5.095	Day 7: 27.863, 34.568	
	Generalize	0.716	4.189	Day 1: 4.623	Day 1: 14.704, 21.383	3.234
				Day 2: 4.042	Day 2: 10.611, 17.290	
				Day 3: 3.59	Day 3: 13.064, 19.742	
				Day 4: 3.838	Day 4: 14.858, 21.537	
				Day 5: 3.677	Day 5: 15.501, 22.179	
				Day 6: 4.696	Day 6: 17.351, 24.029	
				Day 7: 4.854	Day 7: 18.462, 25.141	
A-L	Test	−0.107	7.876	Day 1: 7.865	Day 1: 18.807, 32.216	6.296
				Day 2: 7.847	Day 2: 11.764, 25.174	
				Day 3: 7.932	Day 3: 16.549, 29.958	
				Day 4: 7.905	Day 4: 30.869, 44.278	
				Day 5: 7.624	Day 5: 16.301, 29.710	
				Day 6: 7.854	Day 6: 11.068, 24.478	
				Day 7: 8.107	Day 7: 28.870, 42.280	
	Generalize	−0.236	8.773	Day 1: 8.2	Day 1: 18.454, 31.706	7.174
				Day 2: 8.377	Day 2: 12.148, 25.399	
				Day 3: 8.637	Day 3: 15.825, 29.077	
				Day 4: 8.481	Day 4: 27.939, 41.190	
				Day 5: 8.844	Day 5: 14.860, 28.111	
				Day 6: 9.166	Day 6: 16.617, 29.868	
				Day 7: 9.708	Day 7: 22.755, 36.006	
TCN	Test	−0.034	7.569	Day 1: 8.301	Day 1: 29.904, 35.896	5.952
				Day 2: 8.307	Day 2: 29.711, 35.703	
				Day 3: 6.566	Day 3: 29.616, 35.608	
				Day 4: 8.285	Day 4: 29.381, 35.373	
				Day 5: 6.404	Day 5: 29.157, 35.149	
				Day 6: 6.65	Day 6: 29.020, 35.012	
				Day 7: 8.473	Day 7: 29.010, 35.002	
	Generalize	−0.119	8.281	Day 1: 8.716	Day 1: 22.425, 27.355	6.759
				Day 2: 8.68	Day 2: 22.663, 27.593	
				Day 3: 6.812	Day 3: 23.016, 27.946	
				Day 4: 8.835	Day 4: 23.253, 28.183	
				Day 5: 6.846	Day 5: 23.387, 28.317	
				Day 6: 7.862	Day 6: 23.668, 28.598	
				Day 7: 10.217	Day 7: 23.867, 28.797	
T-L	Test	0.518	5.177	Day 1: 5.312	Day 1: 29.136, 35.234	4.087
				Day 2: 4.743	Day 2: 29.171, 35.269	
				Day 3: 4.669	Day 3: 28.962, 35.061	
				Day 4: 4.88	Day 4: 28.796, 34.894	
				Day 5: 5.017	Day 5: 28.762, 34.860	
				Day 6: 5.492	Day 6: 28.836, 34.934	
				Day 7: 6.129	Day 7: 28.957, 35.055	
	Generalize	0.354	6.344	Day 1: 6.017	Day 1: 22.881, 28.200	5.348
				Day 2: 5.932	Day 2: 22.936, 28.254	
				Day 3: 5.997	Day 3: 23.237, 28.555	
				Day 4: 5.935	Day 4: 23.322, 28.641	
				Day 5: 6.387	Day 5: 23.365, 28.683	
				Day 6: 6.676	Day 6: 23.417, 28.735	
				Day 7: 7.462	Day 7: 23.325, 28.644	
LR	Test	−0.794	9.595	Day 1: 6.852	Day 1: 30.685, 36.638	8.036
				Day 2: 13.48	Day 2: 31.002, 36.955	
				Day 3: 8.992	Day 3: 31.219, 37.172	
				Day 4: 8.261	Day 4: 31.013, 36.966	
				Day 5: 9.247	Day 5: 31.225, 37.178	
				Day 6: 14.098	Day 6: 31.383, 37.336	
				Day 7: 6.232	Day 7: 31.355, 37.308	
	Generalize	−0.629	9.370	Day 1: 5.368	Day 1: 21.832, 26.930	8.071
				Day 2: 13.622	Day 2: 22.215, 27.313	
				Day 3: 9.165	Day 3: 22.921, 28.019	
				Day 4: 8.208	Day 4: 23.448, 28.545	
				Day 5: 9.48	Day 5: 23.364, 28.461	
				Day 6: 15.097	Day 6: 23.150, 28.247	
				Day 7: 4.653	Day 7: 24.064, 29.162	

†, best performances. h, historical data; f, future forecasts; RMSE, root mean square error; CI, confidence interval; MAE, mean absolute error; RFR, Random Forest Regression; EVR, Extra Tree Regressor; LSTM, long short-term memory; A-L, attention LSTM; TCN, temporal convolutional network; T-L, TCN LSTM; LR, linear regression.

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Appendix 3: Model optimization hyper-parameters

This section reports the hyper-parameters of the optimized models. We don't report the parameters for which we selected the default that set by the software package that hosts the model. For example, Conv1d library in torch 2.0.1 (Pytorch) has stride parameter set default to 1, which we selected for our TCN models.

Table S5 Optimized hyper-parameters of the LSTM model in all experiments

Layer name	Parameter name	Value
(*h*=5, *f*=1)		
LSTM	Hidden_size	180
	Num_layer	2
	Drop_out	0.396
(*h*=5, *f*=3)		
LSTM	Hidden_size	630
	Num_layer	2
	Drop_out	0
(*h*=5, *f*=5)		
LSTM	Hidden_size	720
	Num_layer	2
	Drop_out	0
(*h*=5, *f*=7)		
LSTM	Hidden_size	720
	Num_layer	2
	Drop_out	0

LSTM, long short-term memory; *h*, historical data; *f*, future forecasts.

Table S6 Optimized hyper-parameters of the A-L model in all experiments

Layer name	Parameter name	Value
(*h*=5, *f*=1)		
LSTM	Hidden_size	300
	Num_layer	2
	Drop_out	0.151
MultiHeadAttention	In_feature	300
(*h*=5, *f*=3)		
LSTM	Hidden_size	420
	Num_layer	1
MultiHeadAttention	In_feature	420
(*h*=5, *f*=5)		
LSTM	Hidden_size	240
	Num_layer	5
	Drop_out	0.367
MultiHeadAttention	In_feature	240
(*h*=5, *f*=7)		
LSTM	Hidden_size	570
	Num_layer	5
	Drop_out	0.495
MultiHeadAttention	In_feature	570

A-L, attention LSTM; LSTM, long short-term memory; *h*, historical data; *f*, future forecasts.

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Table S7 Optimized hyper-parameters of the TCN model in all experiments

Layer name	Parameter name	Value
(*h*=5, *f*=1)		
Conv1d	In_channel	[5, 2, 5, 8, 3]
	Out_channel	[2, 5, 8, 3, 1]
Batchnorm1d	Eps	1e–05
	Momentum	0.1
RELU	–	–
Dropout	P	0.221
MaxPool1d	Kernel_size	1
	Stride	1
	Padding	0
	Dilation	1
(*h*=5, *f*=3)		
Conv1d	In_channel	5
	Out_channel	3
Batchnorm1d	Eps	1e–05
	Momentum	0.1
RELU	–	–
Dropout	P	0.128
MaxPool1d	Kernel_size	1
	Stride	1
	Padding	0
	Dilation	1
(*h*=5, *f*=5)		
Conv1d	In_channel	[5, 15, 15, 45, 20, 25, 35]
	Out_channel	[15, 15, 45, 20, 25, 35, 5]
Batchnorm1d	Eps	1e–05
	Momentum	0.1
RELU	–	–
Dropout	P	0.272
MaxPool1d	Kernel_size	1
	Stride	1
	Padding	0
	Dilation	1
(*h*=5, *f*=7)		
Conv1d	In_channel	[5, 35, 49, 14]
	Out_channel	[35, 49, 14, 7]
Batchnorm1d	Eps	1e–05
	Momentum	0.1
RELU	–	–
Dropout	P	0.271
MaxPool1d	Kernel_size	1
	Stride	1
	Padding	0
	Dilation	1

Since the TCN model involves stacking multiple CNN layers, we document the in_channel and out_channel of all Conv1d layers as an array. TCN, temporal convolutional network; *h*, historical data; *f*, future forecasts; RELU, rectified linear unit; CNN, convolutional neural network.

Table S8 Optimized hyper-parameters of the T-L model in all experiments

Layer name	Parameter name	Value
(*h*=5, *f*=1)		
Conv1d	In_channel	[5, 2, 5, 8, 3]
	Out_channel	[2, 5, 8, 3, 1]
Batchnorm1d	Eps	1e–05
	Momentum	0.1
RELU	–	–
Dropout	P	0.221
MaxPool1d	Kernel_size	1
	Stride	1
	Padding	0
	Dilation	1
(*h*=5, *f*=3)		
Conv1d	In_channel	5
	Out_channel	3
Batchnorm1d	Eps	1e–05
	Momentum	0.1
RELU	–	–
Dropout	P	0.128
MaxPool1d	Kernel_size	1
	Stride	1
	Padding	0
	Dilation	1
(*h*=5, *f*=5)		
Conv1d	In_channel	[5, 15, 15, 45, 20, 25, 35]
	Out_channel	[15, 15, 45, 20, 25, 35, 5]
Batchnorm1d	Eps	1e–05
	Momentum	0.1
RELU	–	–
Dropout	P	0.272
MaxPool1d	Kernel_size	1
	Stride	1
	Padding	0
	Dilation	1
(*h*=5, *f*=7)		
Conv1d	In_channel	[5, 35, 49, 14]
	Out_channel	[35, 49, 14, 7]
Batchnorm1d	Eps	1e–05
	Momentum	0.1
RELU	–	–
Dropout	P	0.271
MaxPool1d	Kernel_size	1
	Stride	1
	Padding	0
	Dilation	1

T-L, TCN LSTM; TCN, temporal convolutional network; LSTM, long short-term memory; *h*, historical data; *f*, future forecasts; RELU, rectified linear unit.

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Table S9 Optimized hyper-parameters of the RFR model in all experiments

Parameter name	Value
(*h*=5, *f*=1)	
Max_depth	5
Min_samples_leaf	4
Min_samples_split	5
(*h*=5, *f*=3)	
Max_depth	5
Min_samples_leaf	2
N_estimators	300
(*h*=5, *f*=5)	
Max_depth	5
N_estimators	300
(*h*=5, *f*=7)	
Max_depth	5
Min_samples_leaf	2
Min_samples_split	10
N_estimators	300

RFR, Random Forest Regression; *h*, historical data; *f*, future forecasts.

Table S10 Optimized hyper-parameters of the EVR model in all experiments

Parameter name	Value
(*h*=5, *f*=1)	
Criterion	Friedman_mse
Max_features	Sqrt
N_estimators	300
(*h*=5, *f*=3)	
Max_depth	10
Max_features	Log2
(*h*=5, *f*=5)	
Criterion	Absolute_error
Max_depth	10
(*h*=5, *f*=7)	
Criterion	Absolute_error
Max_depth	10
Max_features	Log2

EVR, Extra Tree Regressor; *h*, historical data; *f*, future forecasts.

Table S11 Optimized hyper-parameters of the XGBoost model in all experiments

Parameter name	Value
(*h*=5, *f*=1)	
Base_score	4.312869E−1
Booster	Gbtree
Enable_categorical	False
(*h*=5, *f*=3)	
Base_score	4.3555206E−1
Booster	Gbtree
Enable_categorical	False
(*h*=5, *f*=5)	
Base_score	4.349109E−1
Booster	Gbtree
Enable_categorical	False
(*h*=5, *f*=7)	
Base_score	4.2695358E−1
Booster	Gbtree
Enable_categorical	False

XGBoost, Extreme Gradient Boosting; *h*, historical data; *f*, future forecasts.

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Appendix 4: Configurations and packages versions

Table S12 Configurations for the optimization of Pytorch models

Parameter name	Value
Learning_rate	0.1
Gamma_rate	0.9
Num_epoch	100
Patience	15
N_trials	5

Table S13 Versions of all packages used in our paper

Package	Version
sklearn	1.2.2
optuna	3.1.1
torch	2.0.1
xgboost	2.0.3
pandas	2.0.1
seaborn	0.12.2
numpy	1.22.3
tensorflow	2.6.0
matplotlib	3.7.1

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Appendix 5: Data analysis

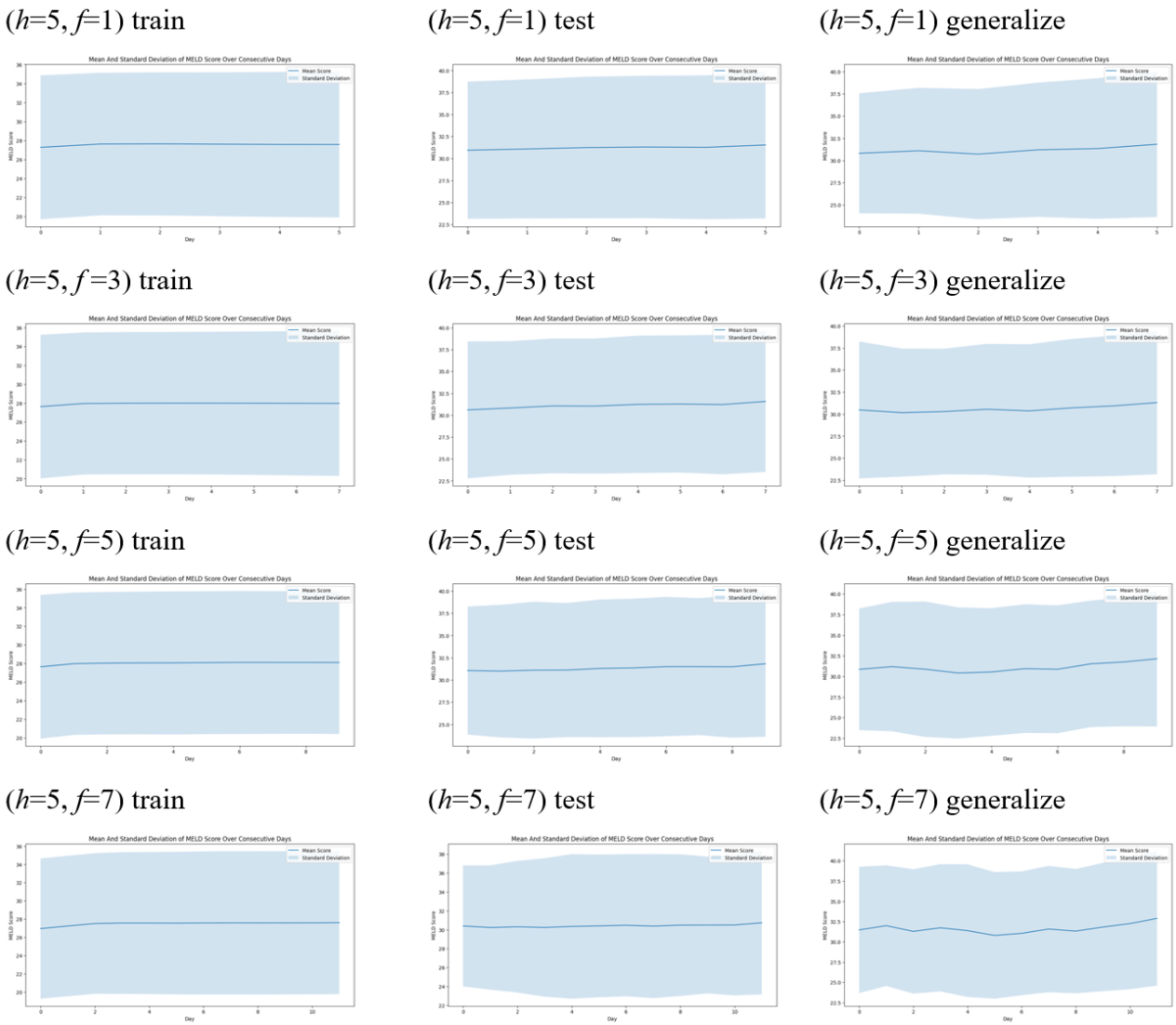

Figure S3 Daily mean and SD of the preprocessed data. *h*, historical data; *f*, future forecasts; SD, standard deviation.

Appendix 6: Comparing autoregressive *vs.* independent setup

As previously mentioned, we report the performance of LR model in two set up: autoregressive and independent. In the autoregressive setup, the LR model is applied onto the preprocessed data. The predictor variable is the past MELD score, and the response variable is the predicting MELD score. In the independent setup, the model is applied on the original data. The independent variable is the timestamp of the MELD measurement, and the dependent variable is the predicting MELD score. In the independent set up, LR model has R-square of –3,488.603 and –3,382.831 on train and test data set, respectively; and its RMSE is 82.607 and 81.97. In the autoregressive setup, the LR model achieves a significantly higher R-square of 0.693 and 0.744 (at best) on test and generalize data set, respectively; and best RMSE of 4.621 and 4.137.

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