Table 1: The prediction performance under the BC scenario.

Datasets		Higgs		Covertype		Temp		Gas	
Models		Accuracy ↑	AUC ↑	Accuracy ↑	AUC ↑	RMSE ↓	R2 ↑	RMSE ↓	R2 ↑
F-XGBoost		0.649 ± 0.003	0.707 ± 0.002	0.707 ± 0.005	0.933 ± 0.003	1.281 ± 0.016	0.730 ± 0.004	103.436 ± 2.551	0.994 ± 0.001
F-GBDT	F-Mean	0.635 ± 0.003	0.685 ± 0.001	0.692 ± 0.003	0.911 ± 0.001	1.397 ± 0.091	0.681 ± 0.023	116.968 ± 3.019	0.993 ± 0.001
	F-MIWAE	0.618 ± 0.004	0.666 ± 0.005	0.678 ± 0.003	0.897 ± 0.004	1.629 ± 0.073	0.567 ± 0.016	–	–
	F-NMIWAE	0.621 ± 0.005	0.669 ± 0.003	0.683 ± 0.001	0.901 ± 0.002	1.598 ± 0.011	0.583 ± 0.019	–	–
	F-GAIN	0.638 ± 0.000	0.689 ± 0.003	0.697 ± 0.004	0.919 ± 0.003	1.347 ± 0.031	0.687 ± 0.001	107.149 ± 5.147	0.994 ± 0.001
F-RF	F-Mean	0.619 ± 0.004	0.659 ± 0.007	0.664 ± 0.002	0.885 ± 0.003	–	–	–	–
	F-MIWAE	0.608 ± 0.004	0.646 ± 0.005	0.655 ± 0.001	0.869 ± 0.003	–	–	–	–
	F-NMIWAE	0.610 ± 0.001	0.648 ± 0.002	0.659 ± 0.003	0.874 ± 0.001	–	–	–	–
	F-GAIN	0.624 ± 0.003	0.665 ± 0.004	0.671 ± 0.001	0.894 ± 0.001	–	–	–	–
F-MLP	F-Mean	0.623 ± 0.004	0.666 ± 0.003	0.677 ± 0.003	0.894 ± 0.001	1.560 ± 0.019	0.603 ± 0.008	133.398 ± 7.269	0.990 ± 0.001
	F-MIWAE	0.617 ± 0.004	0.656 ± 0.002	0.659 ± 0.007	0.882 ± 0.002	1.695 ± 0.114	0.531 ± 0.013	–	–
	F-NMIWAE	0.621 ± 0.001	0.660 ± 0.002	0.668 ± 0.005	0.890 ± 0.003	1.679 ± 0.102	0.540 ± 0.010	–	–
	F-GAIN	0.633 ± 0.005	0.684 ± 0.005	0.683 ± 0.002	0.899 ± 0.002	1.496 ± 0.092	0.635 ± 0.008	125.699 ± 4.937	0.992 ± 0.001
F-TabNet	F-Mean	0.629 ± 0.003	0.674 ± 0.003	0.717 ± 0.002	0.937 ± 0.001	1.391 ± 0.140	0.654 ± 0.020	86.418 ± 6.841	0.995 ± 0.001
	F-MIWAE	0.623 ± 0.001	0.667 ± 0.001	0.704 ± 0.001	0.928 ± 0.002	1.482 ± 0.138	0.622 ± 0.019	–	–
	F-NMIWAE	0.624 ± 0.003	0.671 ± 0.001	0.712 ± 0.003	0.937 ± 0.002	1.449 ± 0.129	0.665 ± 0.017	–	–
	F-GAIN	0.634 ± 0.003	0.685 ± 0.004	0.728 ± 0.002	0.942 ± 0.000	1.379 ± 0.121	0.690 ± 0.019	78.175 ± 3.184	0.995 ± 0.001
F-SAINT	F-Mean	0.637 ± 0.003	0.688 ± 0.002	0.723 ± 0.002	0.941 ± 0.001	1.323 ± 0.001	0.721 ± 0.001	72.491 ± 5.497	0.996 ± 0.001
	F-MIWAE	0.625 ± 0.002	0.672 ± 0.003	0.709 ± 0.003	0.933 ± 0.004	1.364 ± 0.072	0.679 ± 0.005	–	–
	F-NMIWAE	0.627 ± 0.005	0.674 ± 0.002	0.713 ± 0.005	0.938 ± 0.003	1.347 ± 0.031	0.687 ± 0.001	–	–
	F-GAIN	0.644 ± 0.006	0.702 ± 0.004	0.734 ± 0.002	0.947 ± 0.003	1.291 ± 0.104	0.748 ± 0.011	67.198 ± 1.487	0.997 ± 0.001
Central-DARN		0.643 ± 0.001	0.700 ± 0.003	0.727 ± 0.002	0.943 ± 0.002	1.335 ± 0.033	0.693 ± 0.007	74.164 ± 7.928	0.997 ± 0.001
Local-DARN		0.639 ± 0.001	0.696 ± 0.001	0.721 ± 0.002	0.940 ± 0.003	1.362 ± 0.013	0.677 ± 0.004	71.948 ± 6.156	0.997 ± 0.001
DARN		**0.662 ± 0.001**	**0.721 ± 0.001**	**0.770 ± 0.002**	**0.967 ± 0.001**	**1.096 ± 0.012**	**0.792 ± 0.003**	**40.147 ± 2.009**	**0.999 ± 0.000**

Table 2: The prediction performance under the CC scenario.

Datasets	Higgs		Covertype		Temp		Gas	
Models	Accuracy ↑	AUC ↑	Accuracy ↑	AUC ↑	RMSE ↓	R2 ↑	RMSE ↓	R2 ↑
F-XGBoost	0.651 ± 0.005	0.710 ± 0.005	0.703 ± 0.002	0.929 ± 0.003	1.257 ± 0.019	0.738 ± 0.008	99.681 ± 4.651	0.994 ± 0.001
F-GBDT	0.640 ± 0.004	0.692 ± 0.002	0.695 ± 0.003	0.917 ± 0.005	1.313 ± 0.114	0.695 ± 0.013	111.519 ± 5.941	0.993 ± 0.001
F-RF	0.621 ± 0.001	0.662 ± 0.002	0.668 ± 0.006	0.891 ± 0.003	–	–	–	–
F-MLP	0.631 ± 0.005	0.682 ± 0.004	0.689 ± 0.003	0.902 ± 0.004	1.515 ± 0.169	0.612 ± 0.029	127.581 ± 3.654	0.992 ± 0.001
F-TabNet	0.632 ± 0.004	0.686 ± 0.003	0.721 ± 0.004	0.939 ± 0.003	1.396 ± 0.031	0.681 ± 0.001	81.651 ± 6.198	0.995 ± 0.001
F-SAINT	0.643 ± 0.003	0.701 ± 0.002	0.732 ± 0.001	0.944 ± 0.002	1.315 ± 0.016	0.714 ± 0.020	71.948 ± 4.738	0.997 ± 0.001
Central-DARN	0.641 ± 0.001	0.694 ± 0.003	0.727 ± 0.003	0.941 ± 0.004	1.323 ± 0.052	0.670 ± 0.009	68.417 ± 6.185	0.997 ± 0.001
Local-DARN	0.637 ± 0.002	0.689 ± 0.002	0.720 ± 0.003	0.939 ± 0.002	1.367 ± 0.036	0.641 ± 0.004	76.779 ± 3.617	0.997 ± 0.001
DARN	**0.658 ± 0.002**	**0.717 ± 0.001**	**0.767 ± 0.002**	**0.964 ± 0.002**	**1.183 ± 0.016**	**0.771 ± 0.003**	**45.164 ± 3.698**	**0.999 ± 0.001**

Table 3: The prediction performance under the PC scenario.

Datasets	Higgs		Covertype		Temp		Gas	
Models	Accuracy ↑	AUC ↑	Accuracy ↑	AUC ↑	RMSE ↓	R2 ↑	RMSE ↓	R2 ↑
F-XGBoost	0.649 ± 0.003	0.708 ± 0.002	0.701 ± 0.001	0.926 ± 0.002	1.279 ± 0.074	0.736 ± 0.005	107.982 ± 0.669	0.994 ± 0.001
F-GBDT	0.636 ± 0.004	0.688 ± 0.003	0.695 ± 0.002	0.915 ± 0.002	1.333 ± 0.021	0.687 ± 0.003	114.648 ± 1.233	0.994 ± 0.001
F-RF	0.622 ± 0.001	0.661 ± 0.001	0.664 ± 0.003	0.886 ± 0.001	–	–	–	–
F-MLP	0.626 ± 0.001	0.676 ± 0.001	0.684 ± 0.001	0.894 ± 0.001	1.545 ± 0.054	0.607 ± 0.004	131.495 ± 2.541	0.992 ± 0.001
F-TabNet	0.634 ± 0.005	0.684 ± 0.004	0.724 ± 0.003	0.940 ± 0.001	1.413 ± 0.140	0.676 ± 0.020	86.176 ± 2.481	0.995 ± 0.001
F-SAINT	0.636 ± 0.001	0.693 ± 0.002	0.728 ± 0.001	0.942 ± 0.002	1.328 ± 0.015	0.706 ± 0.004	73.486 ± 4.561	0.997 ± 0.001
Central-DARN	0.640 ± 0.004	0.693 ± 0.004	0.725 ± 0.003	0.941 ± 0.002	1.328 ± 0.008	0.667 ± 0.001	70.165 ± 7.169	0.997 ± 0.001
Local-DARN	0.637 ± 0.002	0.690 ± 0.003	0.714 ± 0.002	0.936 ± 0.002	1.371 ± 0.039	0.636 ± 0.005	79.146 ± 5.532	0.997 ± 0.001
DARN	**0.653 ± 0.001**	**0.713 ± 0.002**	**0.754 ± 0.001**	**0.957 ± 0.002**	**1.215 ± 0.027**	**0.765 ± 0.001**	**52.194 ± 5.024**	**0.999 ± 0.000**

Table 4: The prediction performance under the SSC scenario.

Datasets	Higgs		Covertype		Temp		Gas	
Models	Accuracy ↑	AUC ↑	Accuracy ↑	AUC ↑	RMSE ↓	R2 ↑	RMSE ↓	R2 ↑
F-XGBoost	0.646 ± 0.002	0.706 ± 0.002	0.689 ± 0.006	0.913 ± 0.005	1.284 ± 0.100	0.732 ± 0.010	109.781 ± 5.517	0.994 ± 0.001
F-GBDT	0.634 ± 0.007	0.687 ± 0.010	0.684 ± 0.005	0.913 ± 0.003	1.376 ± 0.147	0.675 ± 0.022	117.982 ± 1.981	0.993 ± 0.001
F-RF	0.618 ± 0.008	0.656 ± 0.006	0.651 ± 0.002	0.871 ± 0.003	–	–	–	–
F-MLP	0.623 ± 0.003	0.671 ± 0.002	0.673 ± 0.007	0.886 ± 0.004	1.549 ± 0.092	0.589 ± 0.008	135.714 ± 4.897	0.992 ± 0.001
F-TabNet	0.628 ± 0.003	0.675 ± 0.001	0.710 ± 0.001	0.931 ± 0.002	1.428 ± 0.084	0.676 ± 0.007	90.641 ± 3.983	0.994 ± 0.001
F-SAINT	0.638 ± 0.001	0.695 ± 0.001	0.722 ± 0.001	0.936 ± 0.002	1.346 ± 0.080	0.701 ± 0.06	76.415 ± 6.614	0.997 ± 0.001
Central-DARN	0.643 ± 0.001	0.697 ± 0.002	0.726 ± 0.004	0.941 ± 0.005	1.291 ± 0.041	0.721 ± 0.011	64.517 ± 2.148	0.998 ± 0.000
Local-DARN	0.638 ± 0.002	0.693 ± 0.003	0.717 ± 0.001	0.938 ± 0.003	1.351 ± 0.038	0.689 ± 0.005	68.492 ± 4.738	0.997 ± 0.001
DARN	**0.648 ± 0.001**	**0.707 ± 0.001**	**0.731 ± 0.001**	**0.947 ± 0.001**	**1.259 ± 0.046**	**0.754 ± 0.014**	**55.134 ± 6.517**	**0.999 ± 0.001**

Table 5: The prediction performance under the CR scenario.

Datasets	Higgs		Covertype		Temp		Gas	
Models	Accuracy ↑	AUC ↑	Accuracy ↑	AUC ↑	RMSE ↓	R2 ↑	RMSE ↓	R2 ↑
F-XGBoost	0.642 ± 0.001	0.698 ± 0.002	0.705 ± 0.003	0.929 ± 0.002	1.289 ± 0.037	0.729 ± 0.004	105.564 ± 3.477	0.994 ± 0.001
F-GBDT	0.632 ± 0.006	0.687 ± 0.02	0.696 ± 0.006	0.918 ± 0.004	1.344 ± 0.016	0.701 ± 0.002	103.189 ± 3.655	0.993 ± 0.001
F-RF	0.618 ± 0.003	0.655 ± 0.004	0.676 ± 0.001	0.901 ± 0.002	–	–	–	–
F-MLP	0.626 ± 0.004	0.673 ± 0.005	0.688 ± 0.005	0.899 ± 0.002	1.514 ± 0.062	0.621 ± 0.011	114.487 ± 7.246	0.993 ± 0.001
F-TabNet	0.631 ± 0.005	0.675 ± 0.003	0.719 ± 0.001	0.936 ± 0.003	1.352 ± 0.028	0.693 ± 0.003	82.791 ± 4.489	0.994 ± 0.001
F-SAINT	0.641 ± 0.001	0.698 ± 0.001	0.737 ± 0.002	0.948 ± 0.003	1.273 ± 0.012	0.741 ± 0.003	69.486 ± 3.332	0.997 ± 0.001
Central-DARN	0.638 ± 0.003	0.692 ± 0.002	0.733 ± 0.004	0.946 ± 0.003	1.271 ± 0.025	0.739 ± 0.008	71.912 ± 6.166	0.998 ± 0.001
Local-DARN	0.636 ± 0.004	0.688 ± 0.003	0.723 ± 0.002	0.939 ± 0.004	1.385 ± 0.072	0.671 ± 0.017	73.984 ± 8.728	0.997 ± 0.001
DARN	**0.660 ± 0.002**	**0.720 ± 0.001**	**0.773 ± 0.001**	**0.971 ± 0.001**	**1.138 ± 0.009**	**0.783 ± 0.001**	**38.624 ± 1.137**	**0.999 ± 0.000**

Table 6: The prediction performance under the MMM scenario.

Datasets	Higgs		Covertype		Temp		Gas	
Models	Accuracy ↑	AUC ↑	Accuracy ↑	AUC ↑	RMSE ↓	R2 ↑	RMSE ↓	R2 ↑
F-XGBoost	0.628 ± 0.003	0.683 ± 0.002	0.691 ± 0.004	0.914 ± 0.003	1.312 ± 0.040	0.715 ± 0.005	108.245 ± 3.500	0.993 ± 0.002
F-GBDT	0.619 ± 0.005	0.672 ± 0.003	0.682 ± 0.005	0.903 ± 0.004	1.368 ± 0.020	0.689 ± 0.003	115.892 ± 3.700	0.993 ± 0.002
F-RF	0.605 ± 0.002	0.641 ± 0.003	0.662 ± 0.003	0.886 ± 0.002	–	–	–	–
F-MLP	0.613 ± 0.003	0.659 ± 0.004	0.673 ± 0.004	0.892 ± 0.003	1.587 ± 0.065	0.605 ± 0.012	132.782 ± 7.300	0.991 ± 0.002
F-TabNet	0.621 ± 0.006	0.661 ± 0.005	0.705 ± 0.003	0.921 ± 0.003	1.452 ± 0.150	0.669 ± 0.022	87.345 ± 4.600	0.994 ± 0.002
F-SAINT	0.625 ± 0.002	0.683 ± 0.003	0.713 ± 0.002	0.931 ± 0.003	1.362 ± 0.025	0.699 ± 0.005	74.123 ± 4.800	0.996 ± 0.002
Central-DARN	0.623 ± 0.004	0.681 ± 0.004	0.709 ± 0.004	0.929 ± 0.003	1.360 ± 0.015	0.690 ± 0.003	72.345 ± 7.300	0.996 ± 0.002
Local-DARN	0.620 ± 0.003	0.678 ± 0.004	0.698 ± 0.003	0.924 ± 0.004	1.405 ± 0.075	0.660 ± 0.010	81.234 ± 8.800	0.996 ± 0.002
DARN	**0.645 ± 0.002**	**0.705 ± 0.003**	**0.758 ± 0.002**	**0.956 ± 0.003**	**1.225 ± 0.035**	**0.758 ± 0.002**	**51.456 ± 5.200**	**0.998 ± 0.001**

Table 7: The ablation study of DARN under the IID setting.

Datasets		Higgs		Covertype		Temp		Gas	
Models		Accuracy ↑	AUC ↑	Accuracy ↑	AUC ↑	RMSE ↓	R2 ↑	RMSE ↓	R2 ↑
BC	DARN	**0.662 ± 0.001**	**0.721 ± 0.001**	**0.770 ± 0.002**	**0.967 ± 0.001**	**1.096 ± 0.012**	**0.792 ± 0.003**	**40.147 ± 2.009**	**0.999 ± 0.000**
	w/o C	0.661 ± 0.004	0.718 ± 0.003	0.764 ± 0.003	0.963 ± 0.001	1.112 ± 0.032	0.789 ± 0.005	44.340 ± 3.196	0.999 ± 0.001
	w/o MAT	0.655 ± 0.002	0.713 ± 0.003	0.760 ± 0.002	0.960 ± 0.002	1.143 ± 0.001	0.776 ± 0.012	49.050 ± 7.770	0.999 ± 0.001
	w/o REC	0.650 ± 0.004	0.707 ± 0.004	0.755 ± 0.003	0.957 ± 0.002	1.181 ± 0.001	0.768 ± 0.013	54.151 ± 5.875	0.998 ± 0.001
	w/o PWC	0.640 ± 0.003	0.693 ± 0.001	0.734 ± 0.001	0.945 ± 0.003	1.274 ± 0.035	0.741 ± 0.011	67.192 ± 3.625	0.997 ± 0.000
CC	DARN	**0.658 ± 0.002**	**0.717 ± 0.001**	**0.767 ± 0.002**	**0.964 ± 0.002**	**1.183 ± 0.016**	**0.771 ± 0.003**	**45.164 ± 3.698**	**0.999 ± 0.001**
	w/o C	0.654 ± 0.002	0.712 ± 0.003	0.765 ± 0.004	0.957 ± 0.002	1.195 ± 0.013	0.768 ± 0.012	47.475 ± 5.375	0.999 ± 0.001
	w/o MAT	0.650 ± 0.001	0.708 ± 0.003	0.754 ± 0.002	0.953 ± 0.002	1.209 ± 0.019	0.761 ± 0.027	52.339 ± 5.700	0.999 ± 0.001
	w/o REC	0.647 ± 0.004	0.705 ± 0.002	0.748 ± 0.001	0.951 ± 0.001	1.222 ± 0.021	0.753 ± 0.009	61.198 ± 3.147	0.998 ± 0.001
	w/o PWC	0.644 ± 0.005	0.703 ± 0.006	0.737 ± 0.005	0.948 ± 0.003	1.270 ± 0.012	0.736 ± 0.008	69.984 ± 5.624	0.997 ± 0.001
PC	DARN	**0.653 ± 0.001**	**0.713 ± 0.002**	**0.754 ± 0.001**	**0.957 ± 0.002**	**1.215 ± 0.027**	**0.765 ± 0.001**	**52.194 ± 5.024**	**0.999 ± 0.000**
	w/o C	0.649 ± 0.002	0.711 ± 0.001	0.750 ± 0.006	0.952 ± 0.002	1.233 ± 0.016	0.759 ± 0.012	55.286 ± 1.668	0.999 ± 0.000
	w/o MAT	0.648 ± 0.001	0.703 ± 0.002	0.746 ± 0.003	0.950 ± 0.002	1.255 ± 0.041	0.743 ± 0.015	61.259 ± 7.310	0.998 ± 0.001
	w/o REC	0.644 ± 0.001	0.698 ± 0.001	0.736 ± 0.003	0.946 ± 0.006	1.272 ± 0.017	0.734 ± 0.015	67.441 ± 6.628	0.997 ± 0.001
	w/o PWC	0.640 ± 0.004	0.696 ± 0.003	0.732 ± 0.004	0.944 ± 0.002	1.296 ± 0.012	0.715 ± 0.022	74.842 ± 2.691	0.997 ± 0.000
SSC	DARN	**0.648 ± 0.001**	**0.707 ± 0.001**	**0.731 ± 0.001**	**0.947 ± 0.001**	**1.259 ± 0.046**	**0.754 ± 0.014**	**55.134 ± 6.517**	**0.999 ± 0.001**
	w/o C	0.647 ± 0.003	0.706 ± 0.003	0.727 ± 0.001	0.943± 0.002	1.273 ± 0.048	0.744 ± 0.028	58.037 ± 4.232	0.999 ± 0.001
	w/o MAT	0.644 ± 0.001	0.703 ± 0.002	0.725 ± 0.002	0.939 ± 0.003	1.295 ± 0.035	0.732 ± 0.024	64.006 ± 2.472	0.998 ± 0.000
	w/o REC	0.641 ± 0.001	0.701 ± 0.004	0.723 ± 0.006	0.938 ± 0.005	1.318 ± 0.036	0.724 ± 0.023	70.455 ± 7.768	0.997 ± 0.001
	w/o PWC	0.639 ± 0.005	0.697 ± 0.006	0.721 ± 0.007	0.935 ± 0.008	1.333 ± 0.006	0.706 ± 0.020	77.765 ± 6.363	0.997 ± 0.001
CR	DARN	**0.660 ± 0.002**	**0.720 ± 0.001**	**0.773 ± 0.001**	**0.971 ± 0.001**	**1.138 ± 0.009**	**0.783 ± 0.001**	**38.624 ± 1.137**	**0.999 ± 0.000**
	w/o C	0.655 ± 0.003	0.716 ± 0.004	0.769 ± 0.005	0.970 ± 0.003	1.158 ± 0.032	0.769 ± 0.035	42.788 ± 5.402	0.999 ± 0.001
	w/o MAT	0.651 ± 0.002	0.708 ± 0.002	0.758 ± 0.001	0.956 ± 0.003	1.186 ± 0.003	0.751 ± 0.001	41.927 ± 1.462	0.999 ± 0.000
	w/o REC	0.648 ± 0.003	0.707 ± 0.004	0.753 ± 0.003	0.948 ± 0.004	1.228 ± 0.013	0.739 ± 0.006	63.947 ± 4.481	0.997 ± 0.001
	w/o PWC	0.640 ± 0.003	0.700 ± 0.002	0.734 ± 0.002	0.942 ± 0.001	1.319 ± 0.019	0.713 ± 0.010	79.184 ± 3.838	0.997 ± 0.001