

## Appendix: Experimental Comparison and Survey of Twelve Time Series Anomaly Detection Algorithms

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Acronym	Definition
ACF	AutoCorrelation Function
AD TS	Anomaly Detection Time Series (Twitter)
AD VEC	Anomaly Detection Vector (Twitter)
AIC	Akaike Information Criterion
ROC AUC	Area Under the ROC Curve
CPC	Cost Per Clicks
CPM	Cost Per thousand iMpressions
DFT	Discrete Fourier Transform
ELBO	Evidence Lower BOund
ESD	Extreme Studentized Deviate (test)
GLiM	Generalized Linear Model
GRU	Gated Recurrent Unit
HS	Half-Space
HTM	Hierarchical Temporal Memory (network)
IVA	Intelligent Virtual Assistant
KPI	Key Performance Indicator
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
KL	Kullback-Leibler
LMS	Least Mean Squares
LSTM	Long Short-Term Memory
MAD	Median Absolute Deviation
MAP	Maximum A Posteriori
MASS	Mueen's Algorithm for Similarity Search
MCMC	Markov Chain Monte Carlo
NAB	Numenta Anomaly Benchmark (score)
PAA	Piecewise Aggregate Approximation
PP	Phillips-Perron
RLS	Recursive Least Squares
RNN	Recurrent Neural Network
ROC	Receiver Operating Characteristic
RPCA	Robust Principal Component Analysis
SARIMAX	Seasonal AutoRegressive Integrated Moving Average with eXogeneous variables
SAX	Symbolic Aggregate approXimation
SDR	Sparse Distributed Representation
SGVB	Stochastic Gradient Variational Bayes
STAMP	Scalable Time series Anytime Matrix Profile
STOMP	Scalable Time series Ordered search Matrix Profile
STL	Seasonal decomposition of Time series by Loess
VAE	Variational AutoEncoder

**Table 1:** Table of acronyms and their definitions.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.498760	0.498760	0.498760	0.498760
Prophet	0.996031	0.989618	0.987668	0.991568
GLiM	0.989581	0.952617	0.945012	0.960223
Matrix Profile	0.914971	0.629826	0.578044	0.681609
PBAD	0.621310	0.591987	0.577097	0.606878
SARIMAX	0.995287	0.992806	0.992428	0.993184
HS Tree	0.980278	0.979348	0.979089	0.979606
VAE	0.990821	0.904128	0.878781	0.929475
Windowed Gaussian	0.988837	0.948772	0.940185	0.957359
HTM	0.987100	0.987100	0.964478	1.009722

**Table 2:** ROC AUC Table for rds\_cpu\_util\_cc0c53\_f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.559989	0.559989	0.537367	0.582610
Prophet	0.747977	0.738525	0.736072	0.740979
GLiM	0.964216	0.947621	0.944335	0.950908
Matrix Profile	0.541364	0.319007	0.287005	0.351010
PBAD	0.683733	0.659919	0.651511	0.668328
SARIMAX	0.490862	0.390290	0.334298	0.446283
STL	0.863351	0.848075	0.845825	0.850324
HS Tree	0.552699	0.495818	0.469058	0.522579
Twitter	0.489955	0.489955	0.489955	0.489955
VAE	0.969657	0.816223	0.787600	0.844845
Windowed Gaussian	0.909807	0.658601	0.620412	0.696790
HTM	0.847866	0.847866	0.847866	0.847866

**Table 3:** ROC AUC Table for artificial\_cd\_2\_f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.496743	0.496743	0.496743	0.496743
Prophet	0.995005	0.832009	0.738671	0.925346
GLiM	0.990879	0.977915	0.975742	0.980089
Matrix Profile	0.853203	0.566089	0.525563	0.606615
SARIMAX	0.992182	0.728903	0.691055	0.766752
HS Tree	0.995548	0.993029	0.991400	0.994659
VAE	0.991097	0.959223	0.950860	0.967585
HTM	0.861672	0.861672	0.839051	0.884294

**Table 4:** ROC AUC Table for ex-3\_cpc\_results\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.496915	0.496915	0.496915	0.496915
Prophet	0.960518	0.833374	0.774030	0.892719
GLiM	0.994139	0.990500	0.989947	0.991052
Matrix Profile	0.890808	0.713085	0.680960	0.745209
SARIMAX	0.851789	0.664065	0.613801	0.714330
HS Tree	0.993831	0.978779	0.971182	0.986376
VAE	0.997532	0.992853	0.992124	0.993582
HTM	0.882943	0.882943	0.860321	0.905564

**Table 5:** ROC AUC Table for ex-2\_cpm\_results\_nf.

TWELVE TIME SERIES ANOMALY DETECTION ALGORITHMS

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.498867	0.498867	0.476245	0.521489
Prophet	0.604955	0.573064	0.564894	0.581235
GLiM	0.630712	0.480187	0.440090	0.520285
Matrix Profile	0.918649	0.537421	0.487266	0.587575
PBAD	0.257761	0.220281	0.199325	0.241237
SARIMAX	0.517562	0.452512	0.436283	0.468740
STL	0.610394	0.602221	0.600454	0.603987
HS Tree	0.785935	0.732132	0.707331	0.756933
Twitter	0.500000	0.500000	0.477378	0.522622
VAE	0.940781	0.718467	0.676850	0.760085
Windowed Gaussian	0.891042	0.809608	0.795013	0.824203
HTM	0.639663	0.639663	0.617042	0.662285

**Table 6:** ROC AUC Table for FARM.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.748883	0.748883	0.748883	0.748883
Prophet	0.997022	0.994094	0.993394	0.994795
GLiM	0.999504	0.997122	0.996197	0.998046
Matrix Profile	0.984864	0.824143	0.795817	0.852469
PBAD	0.893797	0.878015	0.871355	0.884675
SARIMAX	0.965261	0.953797	0.951102	0.956491
HS Tree	0.999690	0.997612	0.995596	0.999627
Twitter	0.499876	0.499876	0.499876	0.499876
VAE	0.999194	0.998757	0.998660	0.998853
Windowed Gaussian	0.999504	0.999404	0.999378	0.999431
HTM	1.000000	1.000000	0.977378	1.022622

**Table 7:** ROC AUC Table for cpu\_util\_5f5533.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.498760	0.498760	0.498760	0.498760
Prophet	0.960804	0.941305	0.936476	0.946134
GLiM	0.991813	0.982114	0.979940	0.984287
Matrix Profile	0.497147	0.445299	0.427308	0.463290
PBAD	0.927934	0.899206	0.885241	0.913171
SARIMAX	0.155545	0.141355	0.137996	0.144713
STL	0.975688	0.964326	0.959283	0.969370
HS Tree	0.962788	0.954329	0.948039	0.960619
Twitter	0.490077	0.490077	0.467455	0.512698
VAE	0.996899	0.996333	0.996199	0.996468
Windowed Gaussian	0.098115	0.068544	0.062467	0.074620
HTM	0.953734	0.953734	0.953734	0.953734

**Table 8:** ROC AUC Table for art\_daily\_flatmiddle.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.830900	0.830900	0.808279	0.853522
Prophet	0.992295	0.978751	0.975474	0.982028
GLiM	0.991281	0.978305	0.975484	0.981126
Matrix Profile	0.787916	0.482459	0.414791	0.550128
PBAD	0.479015	0.456995	0.442906	0.471084
SARIMAX	0.976683	0.788970	0.745659	0.832281
HS Tree	0.997161	0.995975	0.995422	0.996529
VAE	0.988848	0.942897	0.932716	0.953079
Windowed Gaussian	0.995945	0.993593	0.993034	0.994152
HTM	0.869627	0.869627	0.869627	0.869627

**Table 9:** ROC AUC Table for ex-3\_cpc\_results.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.997266	0.997266	0.997266	0.997266
Prophet	0.999089	0.998724	0.998639	0.998810
GLiM	0.999089	0.998724	0.998659	0.998789
Matrix Profile	0.997570	0.870693	0.844587	0.896798
PBAD	0.489976	0.385358	0.327688	0.443029
SARIMAX	0.998177	0.997388	0.997177	0.997598
HS Tree	1.000000	1.000000	1.000000	1.000000
VAE	0.998481	0.997691	0.997523	0.997860
Windowed Gaussian	0.999089	0.999089	0.999089	0.999089
HTM	0.980255	0.980255	0.957634	1.002877

**Table 10:** ROC AUC Table for ex-3\_cpm\_results.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.496747	0.496747	0.474125	0.519368
Prophet	0.999349	0.892778	0.831589	0.953968
GLiM	0.999349	0.998699	0.998567	0.998831
Matrix Profile	0.973975	0.744886	0.719039	0.770733
SARIMAX	0.997072	0.994340	0.993408	0.995271
HS Tree	1.000000	1.000000	0.977378	1.022622
VAE	0.999024	0.996884	0.996141	0.997626
HTM	0.932010	0.932010	0.932010	0.932010

**Table 11:** ROC AUC Table for ex-3\_cpm\_results\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.493695	0.493695	0.493695	0.493695
Prophet	0.866330	0.801850	0.765008	0.838691
GLiM	0.993695	0.991593	0.991288	0.991898
Matrix Profile	0.905422	0.599142	0.545383	0.652902
SARIMAX	0.759563	0.699538	0.679545	0.719530
STL	0.524170	0.515679	0.514326	0.517032
HS Tree	0.609710	0.513493	0.467340	0.559646
VAE	0.978983	0.911076	0.883164	0.938988
HTM	0.824926	0.824926	0.802305	0.847548

**Table 12:** ROC AUC Table for artificial\_cd\_1\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.465035	0.465035	0.465035	0.465035
Prophet	0.996503	0.996503	0.996503	0.996503
GLiM	0.996503	0.996503	0.996503	0.996503
Matrix Profile	0.986014	0.929510	0.908345	0.950676
PBAD	0.993007	0.980420	0.972670	0.988169
SARIMAX	0.993007	0.993007	0.972911	1.013103
STL	0.993007	0.993007	0.972911	1.013103
HS Tree	0.363636	0.363636	0.341015	0.386258
Twitter	1.000000	1.000000	0.977378	1.022622
VAE	0.996503	0.995105	0.994439	0.995771
Windowed Gaussian	0.993007	0.993007	0.993007	0.993007

**Table 13:** ROC AUC Table for airline.f.

TWELVE TIME SERIES ANOMALY DETECTION ALGORITHMS

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.499684	0.499684	0.499684	0.499684
Prophet	0.930010	0.874957	0.861684	0.888231
GLiM	0.987175	0.978443	0.975625	0.981260
Matrix Profile	0.500000	0.500000	0.479904	0.520096
PBAD	0.494728	0.432431	0.404882	0.459981
SARIMAX	0.982589	0.970146	0.964509	0.975783
STL	0.883050	0.870612	0.867583	0.873640
HS Tree	0.978367	0.975826	0.973918	0.977734
Twitter	0.740087	0.740087	0.740087	0.740087
VAE	0.975833	0.950254	0.942137	0.958370
Windowed Gaussian	0.978793	0.957237	0.947878	0.966597
HTM	0.905709	0.905709	0.905709	0.905709

**Table 14:** ROC AUC Table for Twitter\_GOOG\_f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.498760	0.498760	0.498760	0.498760
Prophet	0.295460	0.107566	0.077369	0.137763
GLiM	0.995907	0.990747	0.990006	0.991487
Matrix Profile	0.970479	0.743247	0.698794	0.787700
PBAD	0.978541	0.946390	0.927177	0.965604
SARIMAX	0.678740	0.613942	0.601972	0.625912
STL	0.051104	0.031754	0.028801	0.034707
HS Tree	0.394071	0.236145	0.162754	0.309536
Twitter	0.490077	0.490077	0.467455	0.512698
VAE	0.855619	0.615837	0.574219	0.657456
Windowed Gaussian	0.515505	0.292037	0.241975	0.342099
HTM	0.432027	0.432027	0.409405	0.454648

**Table 15:** ROC AUC Table for art\_daily\_nojump\_f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.499312	0.499312	0.476690	0.521933
Prophet	0.996008	0.863441	0.791872	0.935010
GLiM	0.992085	0.984074	0.981626	0.986523
Matrix Profile	0.500000	0.500000	0.479904	0.520096
SARIMAX	0.654921	0.636999	0.631005	0.642994
STL	0.671025	0.657027	0.654322	0.659731
HS Tree	0.997901	0.993964	0.990917	0.997012
VAE	0.998004	0.980793	0.975881	0.985704
HTM	0.989745	0.989745	0.989745	0.989745

**Table 16:** ROC AUC Table for amb\_temp\_sys\_fail\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.498759	0.498759	0.498759	0.498759
Prophet	0.996340	0.983002	0.979449	0.986556
GLiM	0.989578	0.952605	0.944998	0.960213
Matrix Profile	0.889578	0.736648	0.707344	0.765951
SARIMAX	0.995285	0.992829	0.992423	0.993235
HS Tree	0.979653	0.979318	0.979233	0.979402
VAE	0.982072	0.908251	0.881104	0.935397
HTM	0.986476	0.986476	0.986476	0.986476

**Table 17:** ROC AUC Table for rds\_cpu\_util\_cc0c53\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.496917	0.496917	0.496917	0.496917
Prophet	0.991985	0.968557	0.964102	0.973012
GLiM	0.997534	0.996054	0.995789	0.996319
Matrix Profile	0.959309	0.564630	0.524703	0.604557
SARIMAX	0.971640	0.945623	0.937618	0.953627
HS Tree	0.983970	0.976480	0.971861	0.981098
VAE	0.998459	0.994223	0.993426	0.995020
HTM	0.561344	0.561344	0.538722	0.583966

**Table 18:** ROC AUC Table for ex-2\_cpc\_results\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.493726	0.493726	0.493726	0.493726
Prophet	0.854454	0.835132	0.832357	0.837907
GLiM	0.993726	0.991719	0.991431	0.992007
Matrix Profile	0.799247	0.547072	0.495761	0.598383
PBAD	0.704517	0.690213	0.681256	0.699171
SARIMAX	0.442493	0.352614	0.302084	0.403144
STL	0.431200	0.415056	0.412362	0.417750
HS Tree	0.603304	0.536930	0.496297	0.577564
Twitter	0.500000	0.500000	0.477378	0.522622
VAE	0.985780	0.848908	0.806371	0.891446
Windowed Gaussian	0.923881	0.762024	0.736773	0.787276
HTM	0.777499	0.777499	0.754877	0.800121

**Table 19:** ROC AUC Table for artificial\_cd\_1.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.999747	0.999747	0.999747	0.999747
Prophet	0.998484	0.998130	0.998032	0.998229
GLiM	0.998516	0.998156	0.998037	0.998274
Matrix Profile	0.802634	0.556123	0.523789	0.588457
PBAD	0.472112	0.358224	0.292644	0.423805
SARIMAX	0.998421	0.997915	0.997679	0.998152
STL	0.998484	0.998181	0.998120	0.998241
HS Tree	1.000000	1.000000	0.977378	1.022622
Twitter	0.990083	0.990083	0.967461	1.012704
VAE	0.998421	0.997525	0.997229	0.997822
Windowed Gaussian	0.998516	0.998156	0.998014	0.998297
HTM	0.999810	0.999810	0.977189	1.022432

**Table 20:** ROC AUC Table for Twitter\_FB.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.496964	0.496964	0.496964	0.496964
Prophet	0.992107	0.988828	0.988281	0.989375
GLiM	0.997571	0.995507	0.995148	0.995866
Matrix Profile	0.986642	0.575628	0.534040	0.617217
PBAD	0.096236	0.034305	0.009188	0.059421
SARIMAX	0.992714	0.966606	0.957073	0.976139
HS Tree	0.982999	0.977869	0.975234	0.980504
VAE	0.997571	0.993892	0.993174	0.994610
Windowed Gaussian	0.993321	0.971342	0.968184	0.974499
HTM	0.630844	0.630844	0.608222	0.653466

**Table 21:** ROC AUC Table for ex-2\_cpc\_results.f.

TWELVE TIME SERIES ANOMALY DETECTION ALGORITHMS

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.620468	0.620468	0.597847	0.643090
Prophet	0.843907	0.753625	0.702692	0.804559
GLiM	0.992447	0.992044	0.991971	0.992118
Matrix Profile	0.830312	0.679152	0.655814	0.702489
SARIMAX	0.804129	0.633182	0.608293	0.658072
HS Tree	0.752644	0.712513	0.698915	0.726111
VAE	0.948389	0.841586	0.817916	0.865256
HTM	0.630287	0.630287	0.607665	0.652909

**Table 22:** ROC AUC Table for artificial\_cd\_3\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.998884	0.998884	0.998884	0.998884
Prophet	0.993550	0.988837	0.987205	0.990468
GLiM	0.998139	0.995435	0.994438	0.996433
Matrix Profile	0.926569	0.683815	0.631138	0.736493
SARIMAX	0.996775	0.995485	0.995300	0.995670
HS Tree	0.979161	0.974994	0.968708	0.981279
VAE	0.989705	0.968645	0.964085	0.973206
HTM	0.992682	0.992682	0.970060	1.015303

**Table 23:** ROC AUC Table for cpu\_util\_ac20cd\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.498917	0.498917	0.476296	0.521539
Prophet	0.988848	0.981226	0.978558	0.983893
GLiM	0.979320	0.907110	0.889203	0.925017
Matrix Profile	0.749206	0.410333	0.362158	0.458509
PBAD	0.599502	0.558965	0.536722	0.581207
SARIMAX	0.973582	0.950830	0.943001	0.958660
STL	0.971344	0.952014	0.946112	0.957915
HS Tree	0.946297	0.940053	0.936778	0.943329
Twitter	0.656814	0.656814	0.656814	0.656814
VAE	0.961022	0.856199	0.841076	0.871321
Windowed Gaussian	0.979789	0.965548	0.961647	0.969449
HTM	0.939079	0.939079	0.916457	0.961701

**Table 24:** ROC AUC Table for grok\_asg\_anomaly\_f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.748886	0.748886	0.726264	0.771507
Prophet	0.935178	0.915342	0.912368	0.918315
GLiM	0.951895	0.922870	0.918512	0.927229
Matrix Profile	0.978826	0.407789	0.321796	0.493781
PBAD	0.380510	0.318685	0.283906	0.353464
SARIMAX	0.959262	0.931402	0.927385	0.935418
STL	0.968673	0.959931	0.958577	0.961284
HS Tree	0.970654	0.961132	0.957217	0.965047
Twitter	0.744676	0.744676	0.722054	0.767297
VAE	0.971273	0.712864	0.678259	0.747469
Windowed Gaussian	0.968611	0.953975	0.951746	0.956203
HTM	0.928616	0.928616	0.928616	0.928616

**Table 25:** ROC AUC Table for req\_count\_8c0756\_f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.496962	0.496962	0.496962	0.496962
Prophet	0.992558	0.990826	0.990546	0.991107
GLiM	0.993013	0.989368	0.988814	0.989922
Matrix Profile	0.876974	0.693657	0.665802	0.721513
PBAD	0.921628	0.914338	0.911390	0.917285
SARIMAX	0.969623	0.855772	0.829548	0.881995
HS Tree	0.989672	0.982579	0.978678	0.986480
VAE	0.996962	0.993676	0.993153	0.994199
Windowed Gaussian	0.991495	0.983536	0.982153	0.984918
HTM	0.905225	0.905225	0.905225	0.905225

**Table 26:** ROC AUC Table for ex-2-cpm\_results.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.498761	0.498761	0.476140	0.521383
Prophet	0.992815	0.986373	0.984059	0.988686
GLiM	0.998637	0.995714	0.994803	0.996624
Matrix Profile	0.991824	0.296724	0.196334	0.397114
PBAD	0.009539	0.007161	0.005912	0.008409
SARIMAX	0.997151	0.995168	0.994884	0.995453
HS Tree	0.979187	0.977106	0.972398	0.981814
Twitter	0.490089	0.490089	0.467468	0.512711
VAE	0.990956	0.969316	0.964615	0.974017
Windowed Gaussian	0.989594	0.970565	0.965620	0.975510
HTM	0.998142	0.998142	0.998142	0.998142

**Table 27:** ROC AUC Table for cpu\_util\_ac20cd.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.748883	0.748883	0.748883	0.748883
Prophet	0.989268	0.970645	0.965849	0.975441
GLiM	0.990447	0.980955	0.978730	0.983181
Matrix Profile	0.903412	0.645864	0.590737	0.700990
PBAD	0.643672	0.576526	0.535595	0.617458
SARIMAX	0.995161	0.992903	0.992526	0.993280
HS Tree	0.961725	0.960471	0.960103	0.960840
VAE	0.996650	0.992730	0.992152	0.993307
Windowed Gaussian	0.987965	0.959057	0.953693	0.964421
HTM	0.995409	0.995409	0.995409	0.995409

**Table 28:** ROC AUC Table for rds\_cpu\_util\_e47b3b.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.496573	0.496573	0.473951	0.519195
Prophet	0.981494	0.947910	0.941521	0.954298
GLiM	0.570939	0.390679	0.355305	0.426052
Matrix Profile	0.912611	0.444448	0.366795	0.522101
PBAD	0.759767	0.625154	0.555719	0.694589
SARIMAX	0.919808	0.896230	0.890235	0.902225
HS Tree	0.233036	0.171419	0.133599	0.209239
VAE	0.883482	0.438012	0.377963	0.498062
Windowed Gaussian	0.459561	0.228444	0.183714	0.273175
HTM	0.078478	0.078478	0.055857	0.101100

**Table 29:** ROC AUC Table for ibm-stock.f.



TWELVE TIME SERIES ANOMALY DETECTION ALGORITHMS

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.494980	0.494980	0.494980	0.494980
Prophet	0.823042	0.820080	0.818895	0.821266
GLiM	0.992470	0.992068	0.991995	0.992142
Matrix Profile	0.852159	0.733818	0.712947	0.754688
PBAD	0.721888	0.692871	0.682865	0.702878
SARIMAX	0.635040	0.503012	0.430856	0.575169
HS Tree	0.744227	0.699272	0.681611	0.716934
Twitter	0.500000	0.500000	0.477378	0.522622
VAE	0.951807	0.785439	0.752411	0.818468
Windowed Gaussian	0.908133	0.862048	0.850695	0.873401
HTM	0.821160	0.821160	0.798538	0.843781

**Table 30:** ROC AUC Table for artificial\_cd\_3.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.624716	0.624716	0.602094	0.647337
Prophet	0.998578	0.997757	0.997443	0.998071
GLiM	0.998768	0.997793	0.997485	0.998102
Matrix Profile	0.603273	0.497731	0.488759	0.506703
PBAD	0.483604	0.381072	0.341378	0.420766
SARIMAX	0.994219	0.970648	0.962791	0.978505
STL	0.995332	0.982707	0.980564	0.984850
HS Tree	0.999163	0.999081	0.999024	0.999139
Twitter	0.996399	0.996399	0.996399	0.996399
VAE	0.995925	0.970931	0.963249	0.978613
Windowed Gaussian	0.998642	0.997008	0.996435	0.997581
HTM	0.976504	0.976504	0.976504	0.976504

**Table 31:** ROC AUC Table for Twitter\_AMZN.f.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.999007	0.999007	0.999007	0.999007
Prophet	0.919417	0.910620	0.908079	0.913162
GLiM	0.952543	0.922767	0.918310	0.927223
Matrix Profile	0.797333	0.455929	0.409459	0.502400
SARIMAX	0.960918	0.935186	0.931329	0.939043
STL	0.969107	0.959975	0.958556	0.961394
HS Tree	0.968610	0.961464	0.958178	0.964750
VAE	0.954901	0.694913	0.667587	0.722240
HTM	0.941625	0.941625	0.941625	0.941625

**Table 32:** ROC AUC Table for req.count\_8c0756.nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.499431	0.499431	0.476809	0.522052
Prophet	0.799264	0.744160	0.730704	0.757616
GLiM	0.944805	0.906510	0.887207	0.925813
Matrix Profile	0.768781	0.529183	0.499984	0.558383
PBAD	0.365050	0.336112	0.320589	0.351635
SARIMAX	0.958433	0.945693	0.941328	0.950059
STL	0.953081	0.944372	0.942168	0.946577
HS Tree	0.963899	0.960825	0.958935	0.962714
Twitter	0.823483	0.823483	0.800861	0.846104
VAE	0.831264	0.724287	0.711806	0.736767
Windowed Gaussian	0.948184	0.905895	0.883233	0.928558
HTM	0.796720	0.796720	0.774099	0.819342

**Table 33:** ROC AUC Table for gift\_certificates.f.

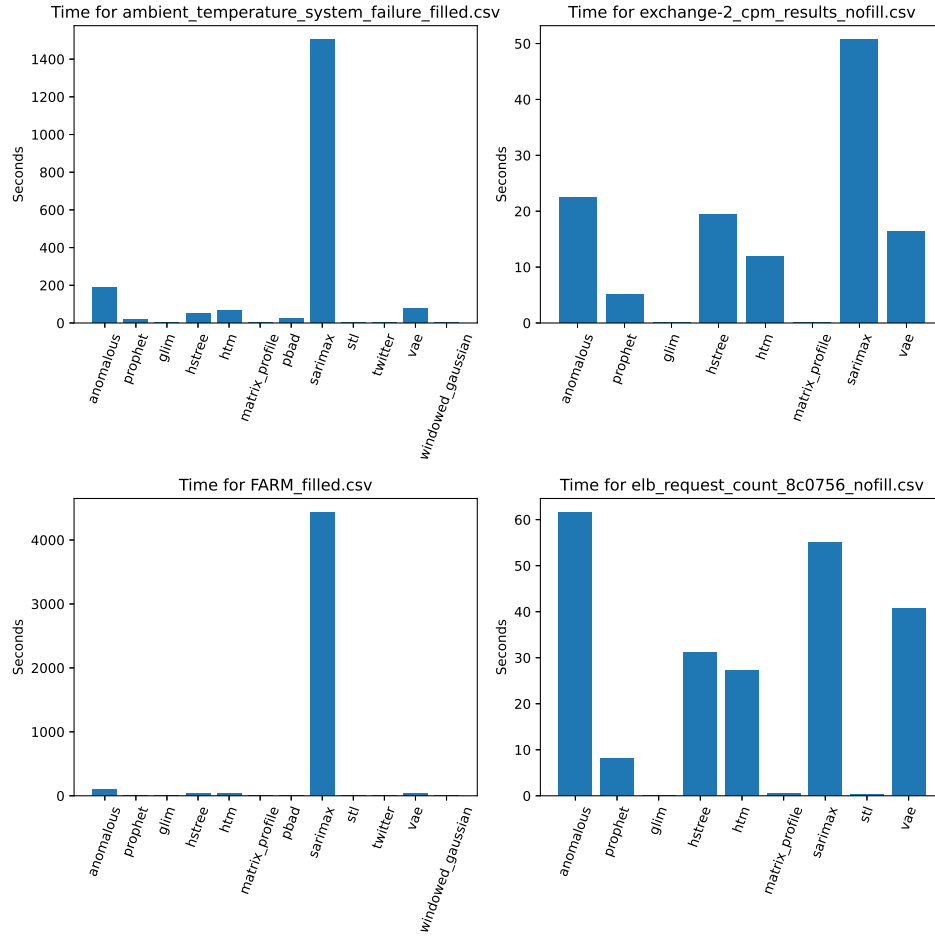


Figure 1: Times of anomaly detection methods.

TWELVE TIME SERIES ANOMALY DETECTION ALGORITHMS

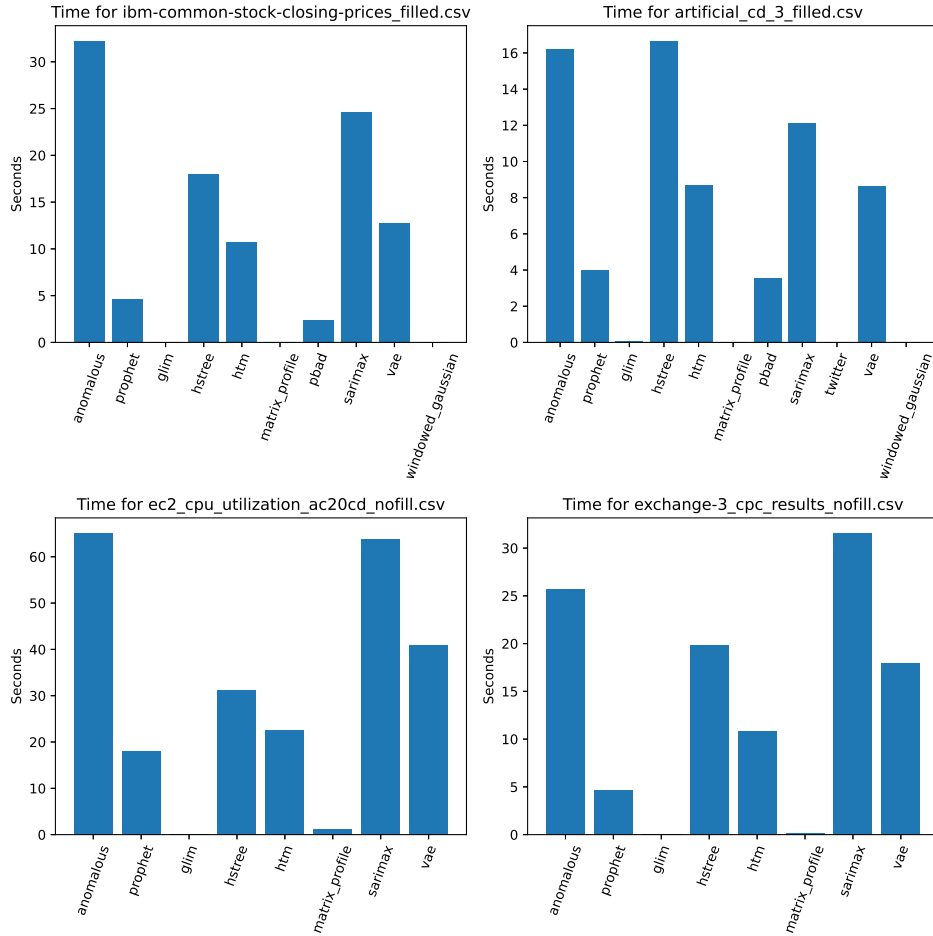
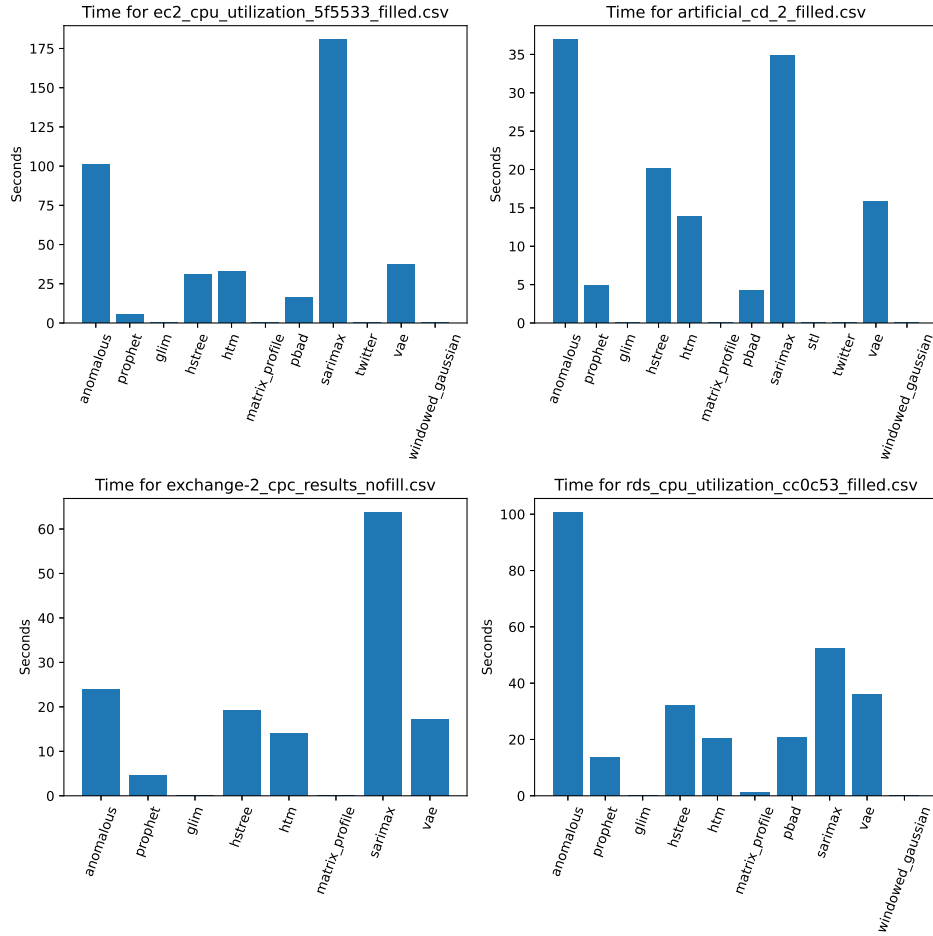
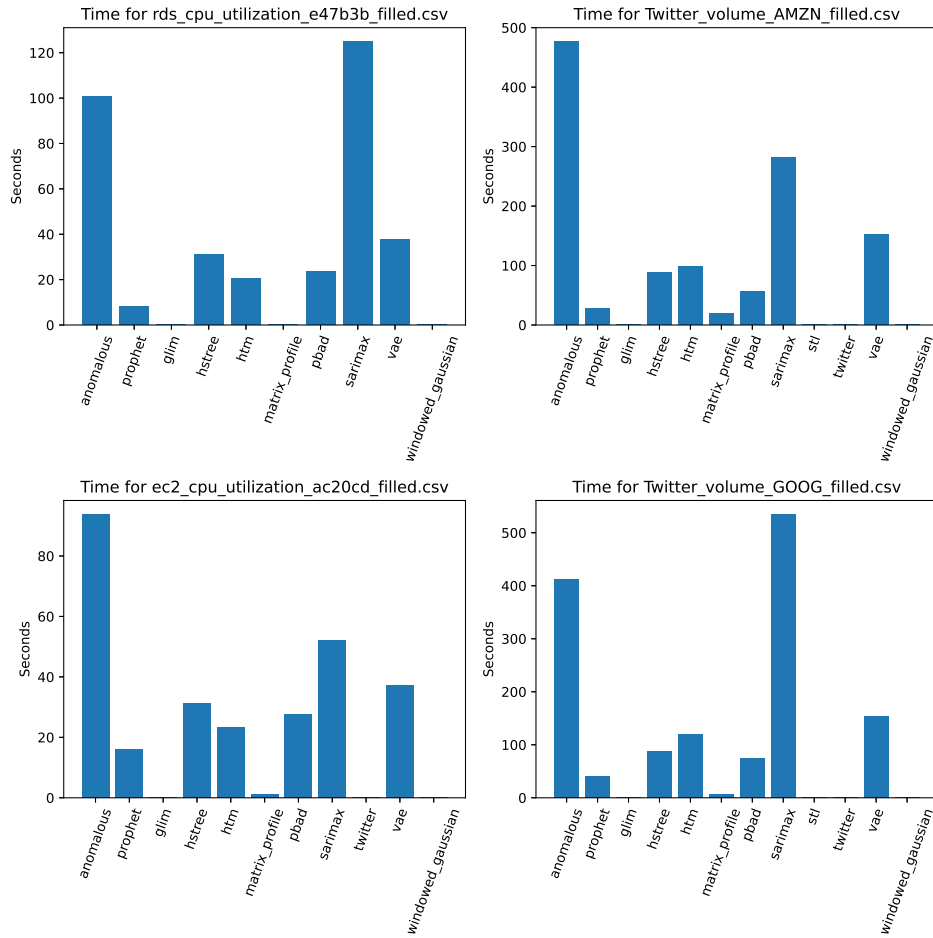


Figure 2: Times of anomaly detection methods.



**Figure 3:** Times of anomaly detection methods

## TWELVE TIME SERIES ANOMALY DETECTION ALGORITHMS



**Figure 4:** Times of anomaly detection methods.

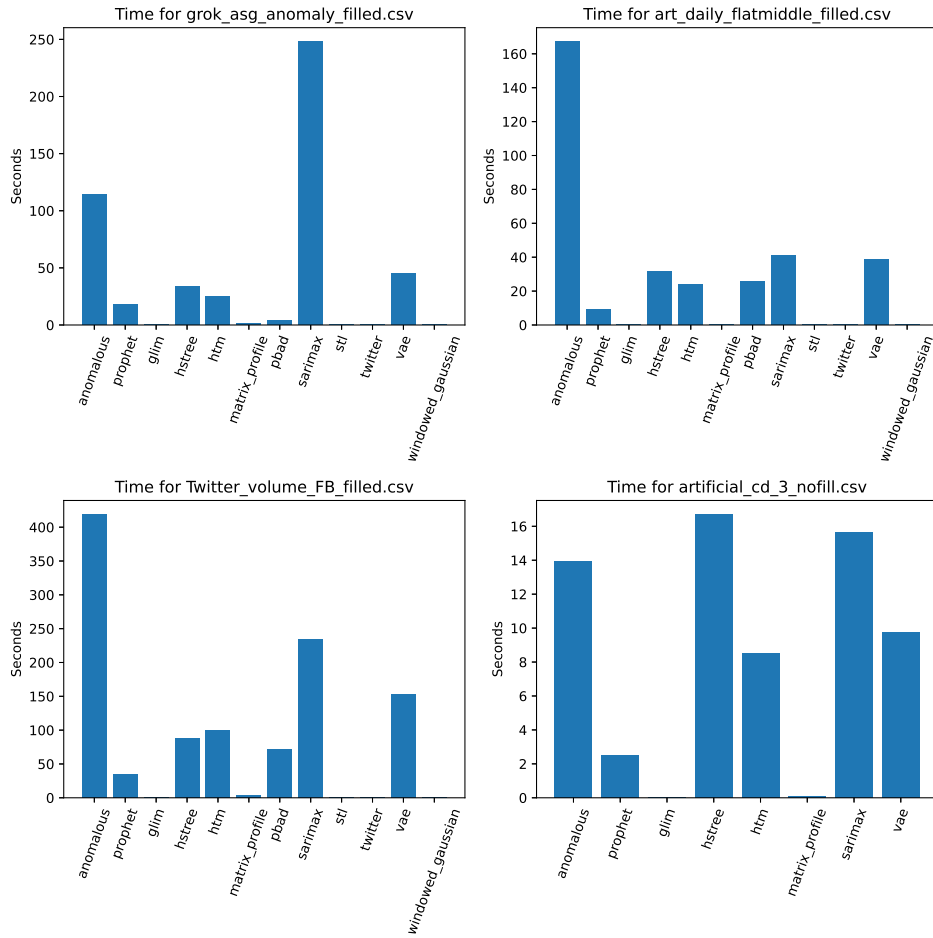


Figure 5: Times of anomaly detection methods.

TWELVE TIME SERIES ANOMALY DETECTION ALGORITHMS

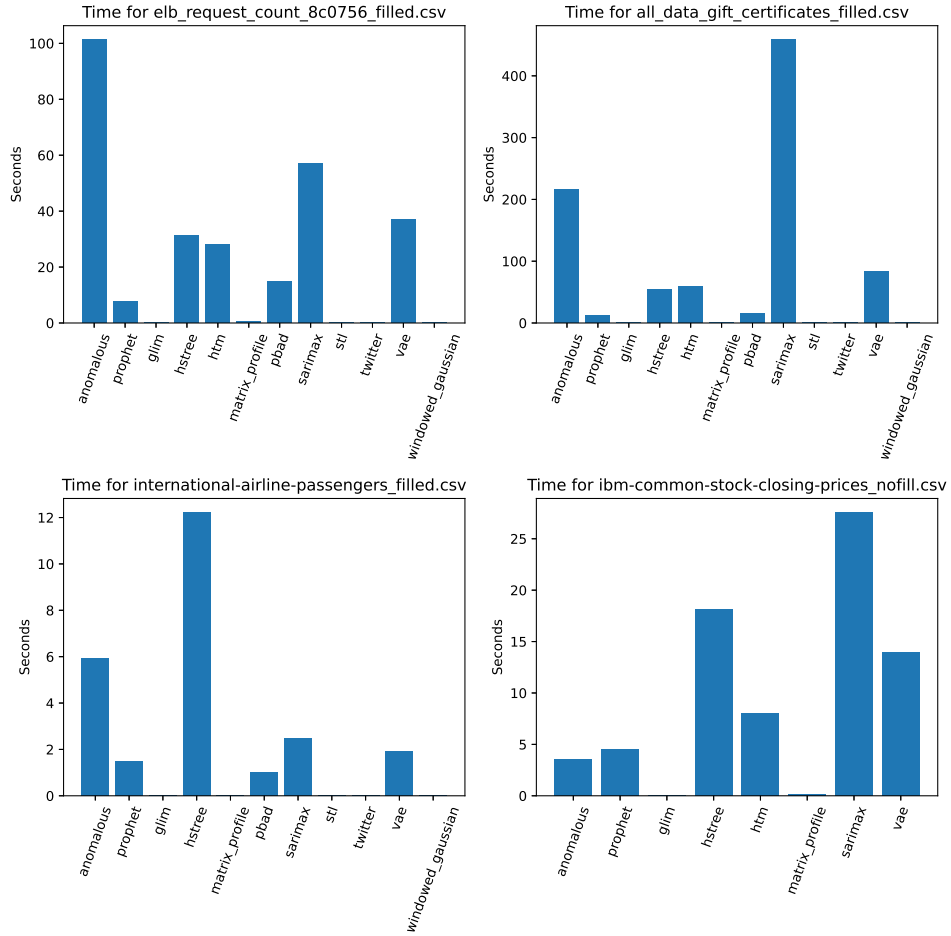


Figure 6: Times of anomaly detection methods.

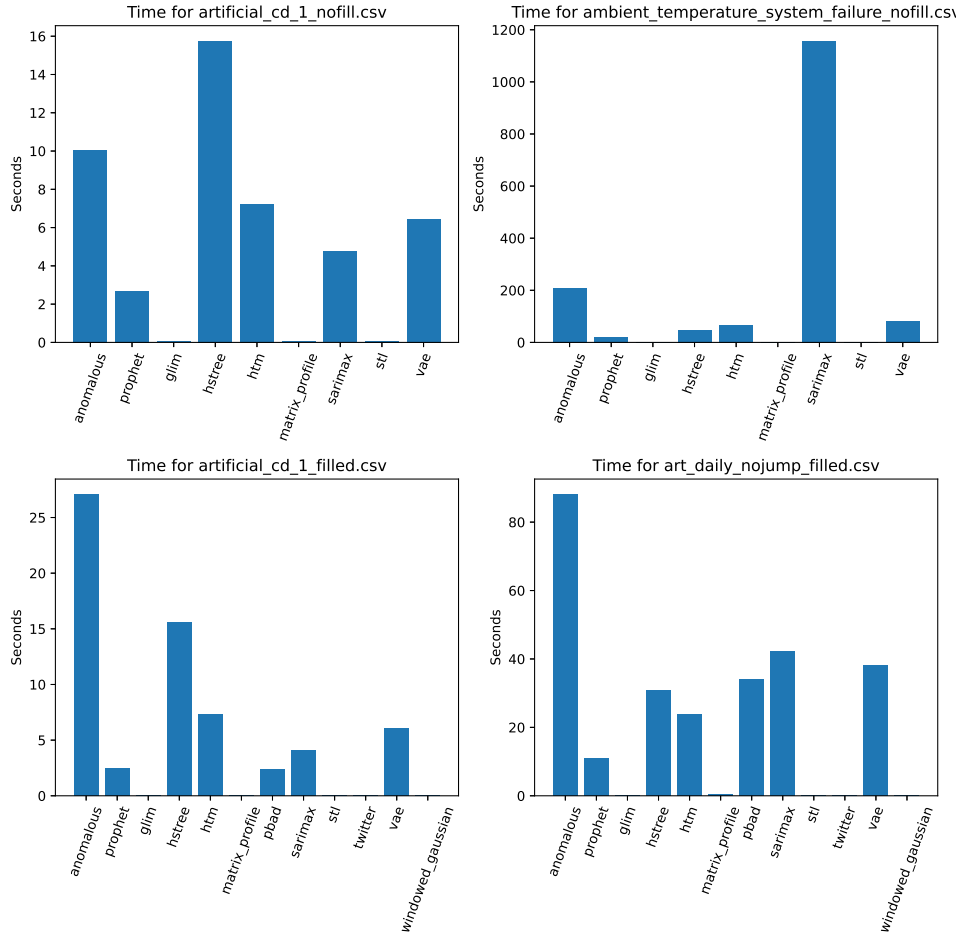
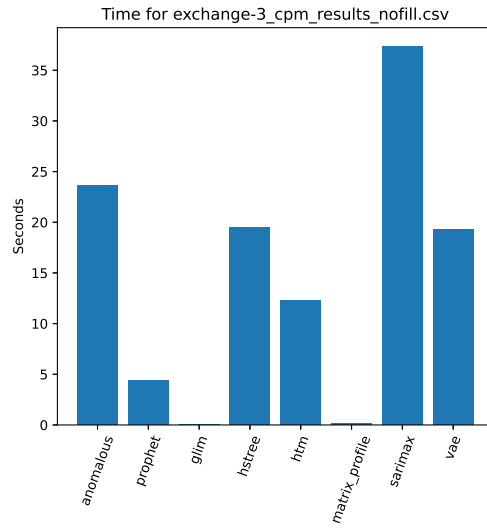


Figure 7: Times of anomaly detection methods.





**Figure 8:** Times of anomaly detection methods.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.500000	0.500000	0.477378	0.522622
Prophet	0.961271	0.620258	0.558172	0.682344
GLiM	0.261172	0.167428	0.151005	0.183851
Matrix Profile	0.966236	0.404945	0.323048	0.486843
SARIMAX	0.816286	0.666137	0.637439	0.694835
HS Tree	0.259186	0.178550	0.139354	0.217746
VAE	0.882820	0.479146	0.392159	0.566133
HTM	0.192651	0.192651	0.170030	0.215273

**Table 34:** ROC AUC Table for ibm-stock\_nf.

Anomaly Detection Method	Best ROC AUC	Mean ROC AUC	Lower	Upper
Anomalous	0.499366	0.499366	0.499366	0.499366
Prophet	0.996196	0.992582	0.991364	0.993799
GLiM	0.995879	0.990718	0.989615	0.991821
Matrix Profile	0.969947	0.807409	0.780991	0.833827
PBAD	0.005009	0.004039	0.003728	0.004349
SARIMAX	0.625666	0.606898	0.602554	0.611243
STL	0.716396	0.674563	0.665583	0.683542
HS Tree	0.999398	0.997543	0.995756	0.999331
Twitter	0.500000	0.500000	0.477378	0.522622
VAE	0.995308	0.982182	0.979614	0.984750
Windowed Gaussian	0.999620	0.994490	0.993222	0.995759
HTM	0.991504	0.991504	0.991504	0.991504

**Table 35:** ROC AUC Table for amb\_temp\_sys\_fail\_f.

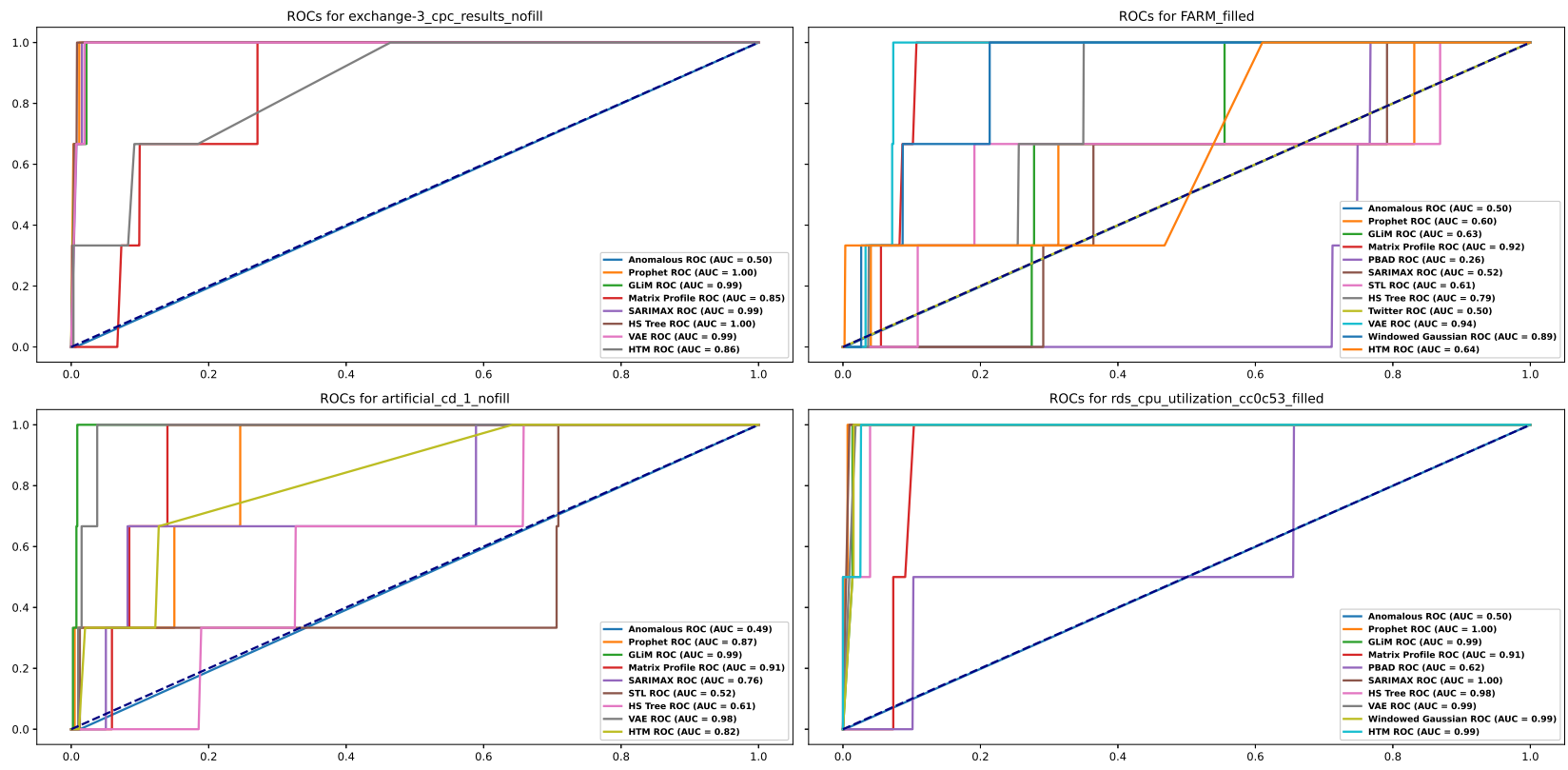


Figure 9: ROCs of anomaly detection methods.

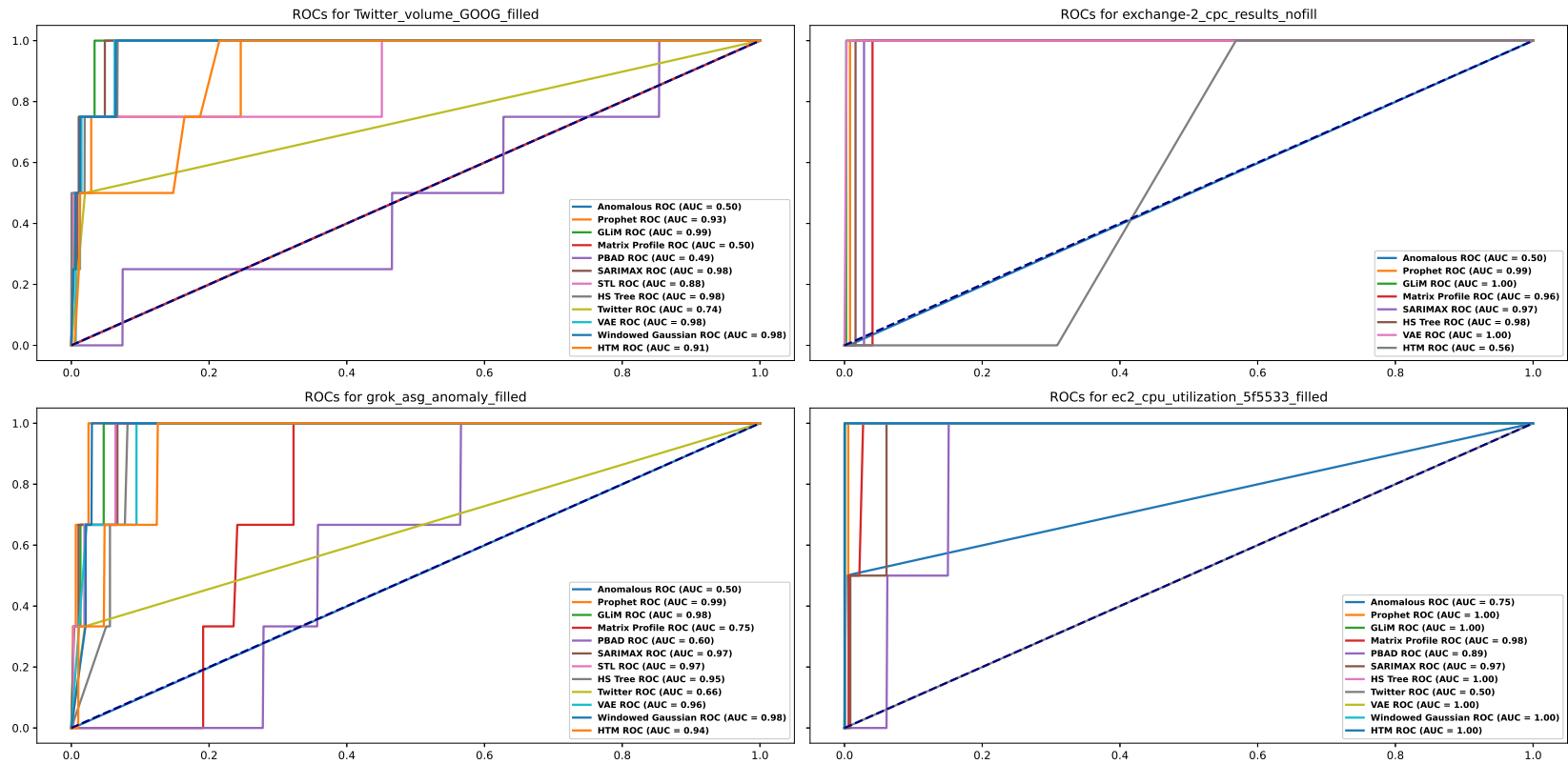


Figure 10: ROCs of anomaly detection methods.

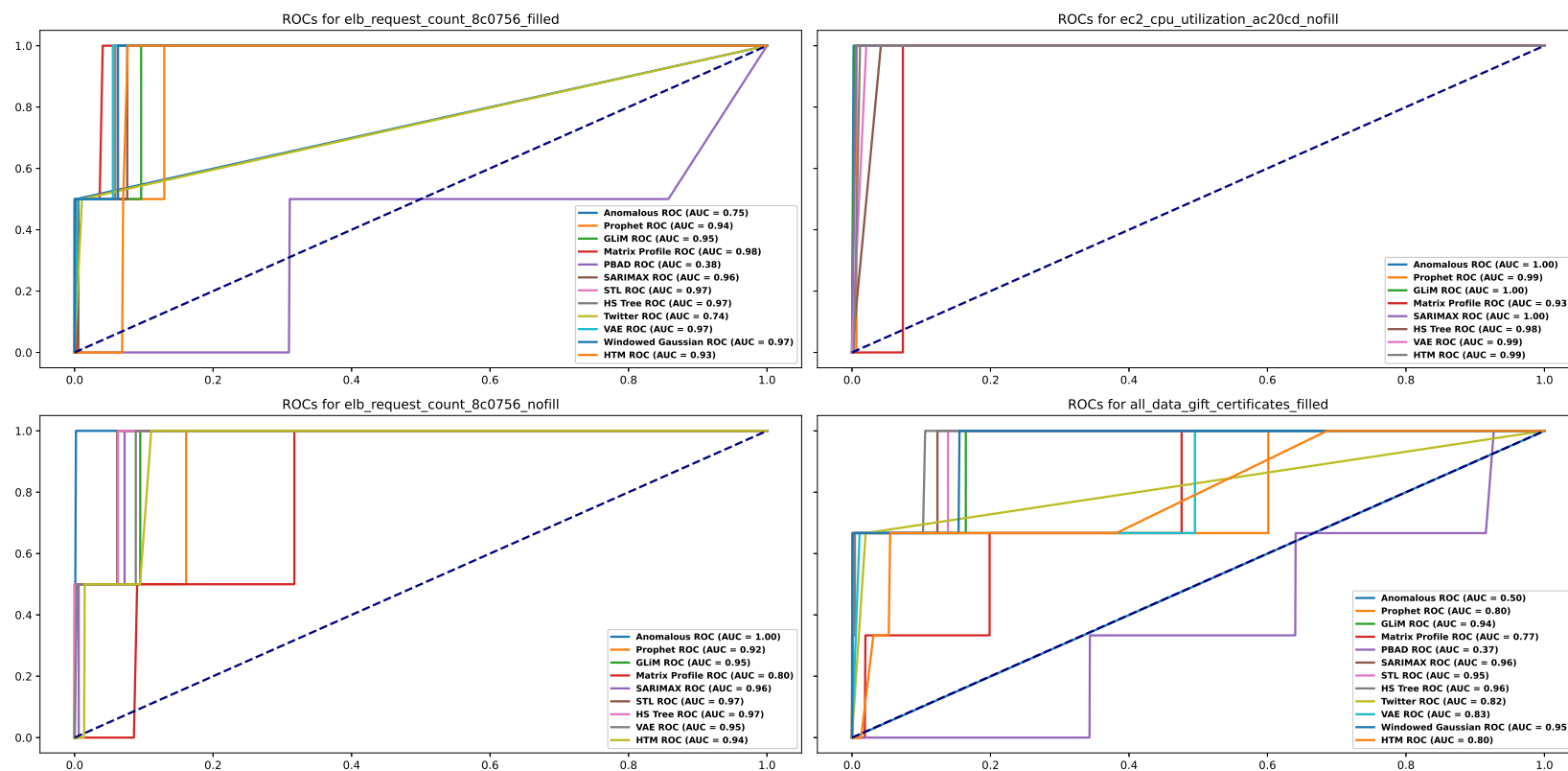


Figure 11: ROCs of anomaly detection methods

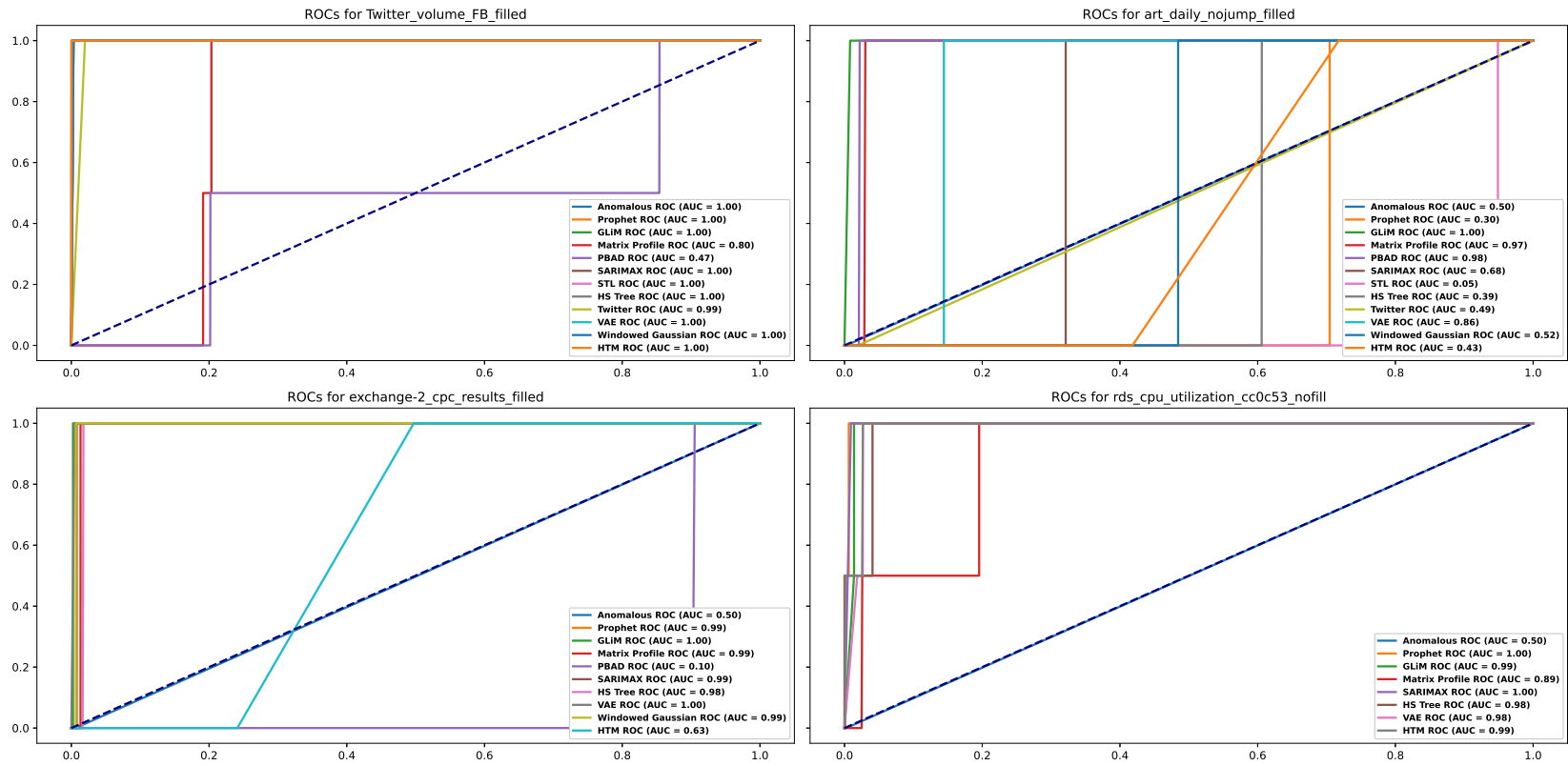


Figure 12: ROCs of anomaly detection methods.

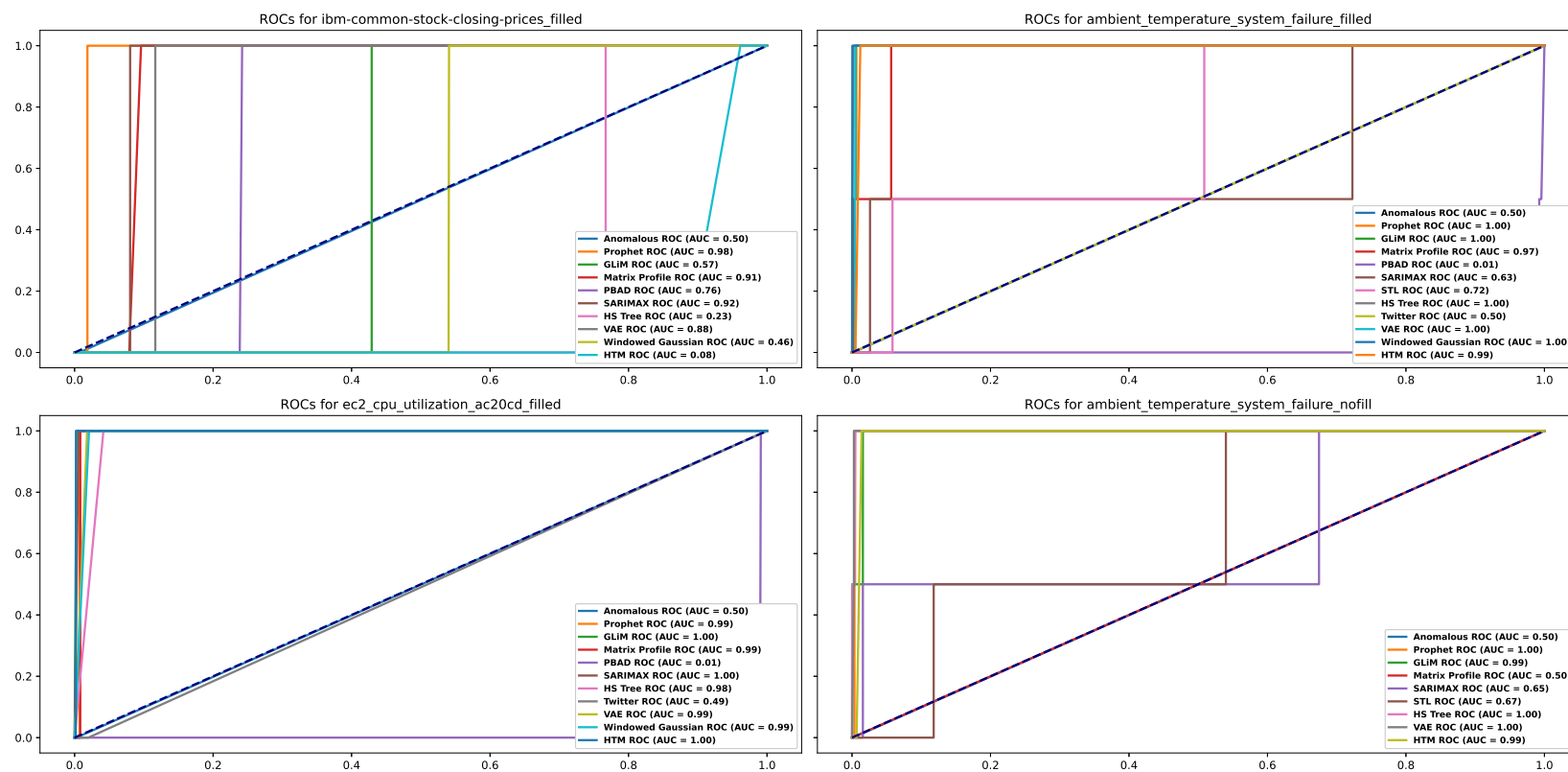


Figure 13: ROCs of anomaly detection methods.

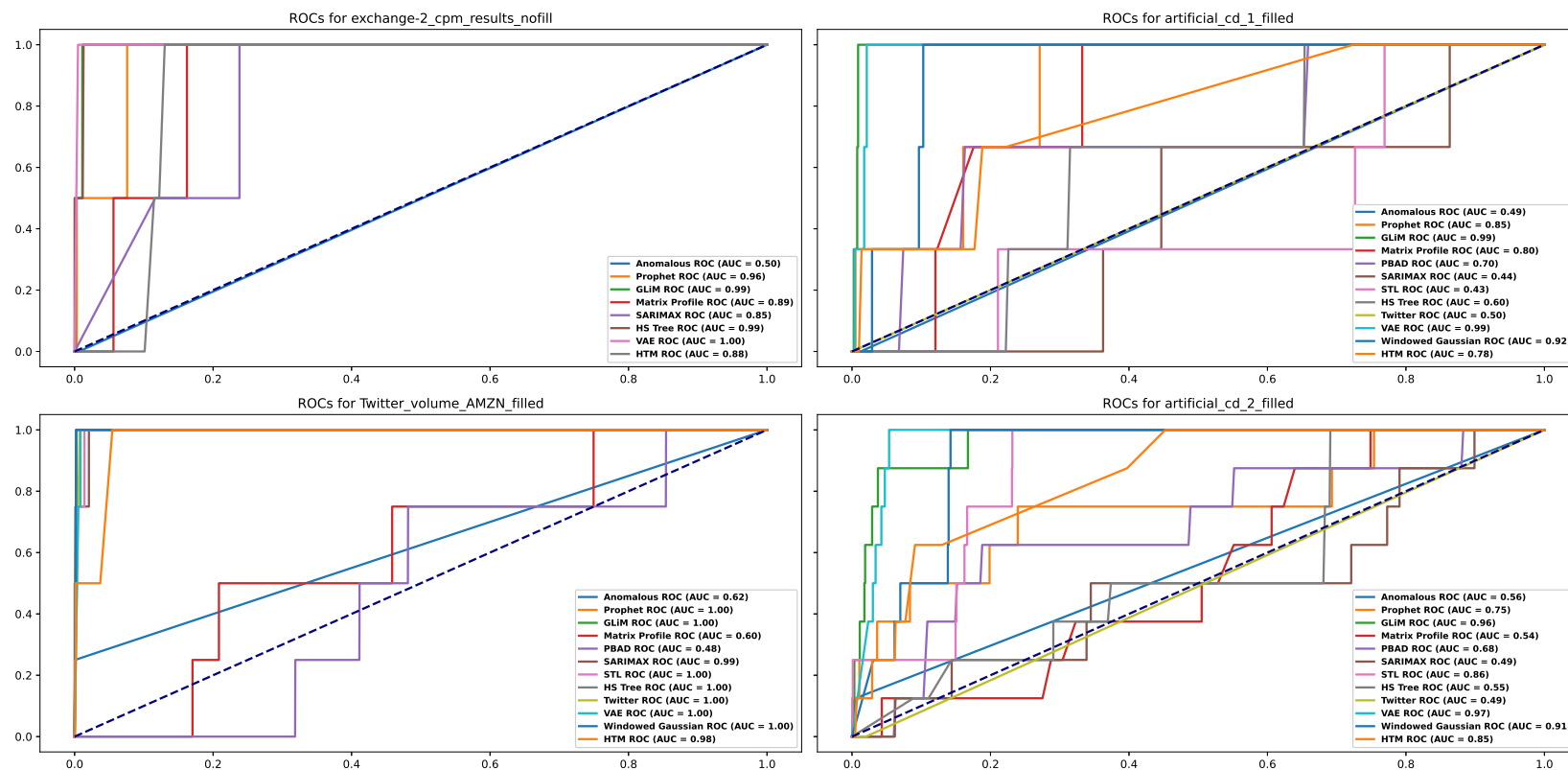


Figure 14: ROCs of anomaly detection methods.



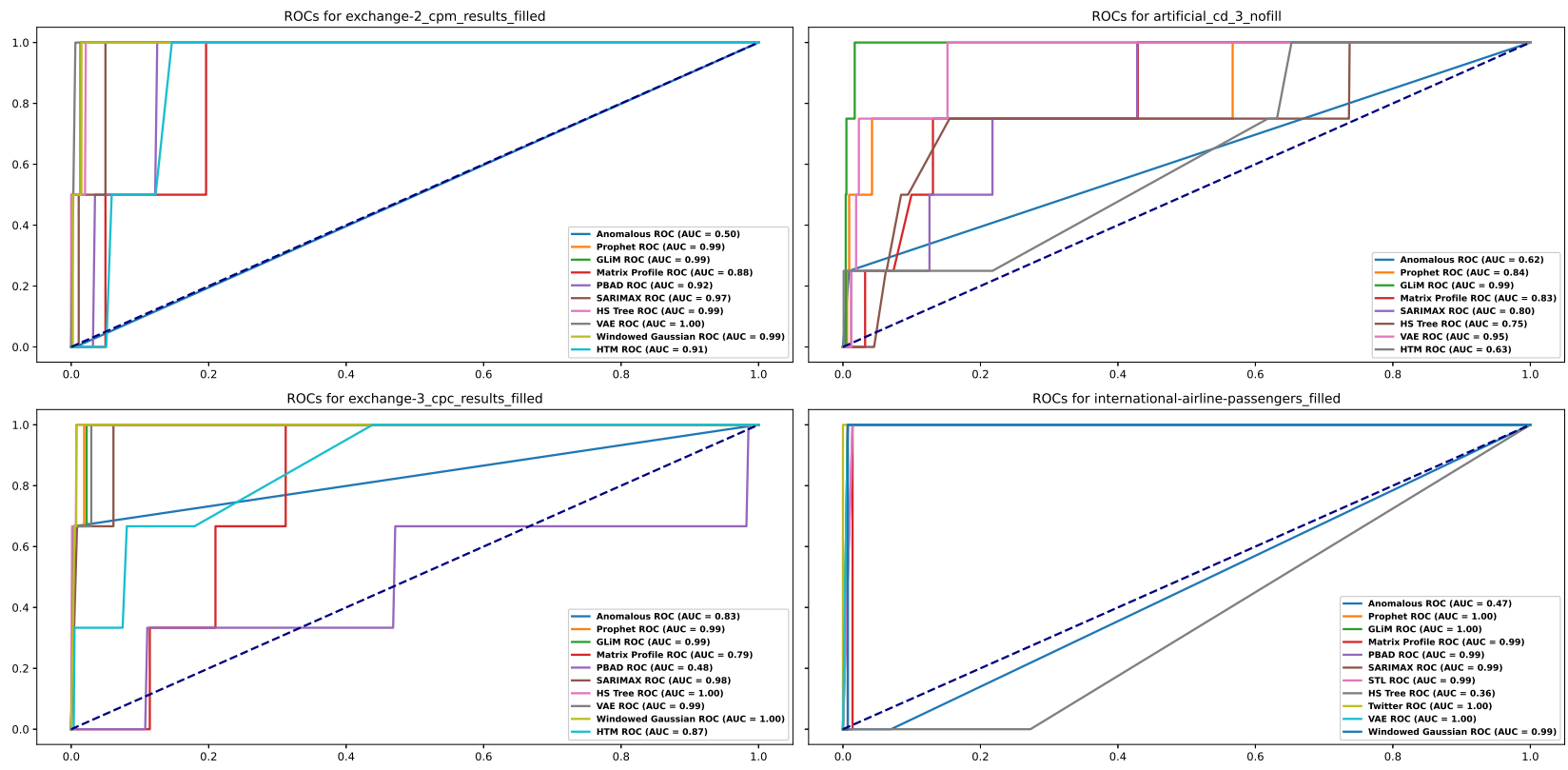


Figure 15: ROCs of anomaly detection methods.

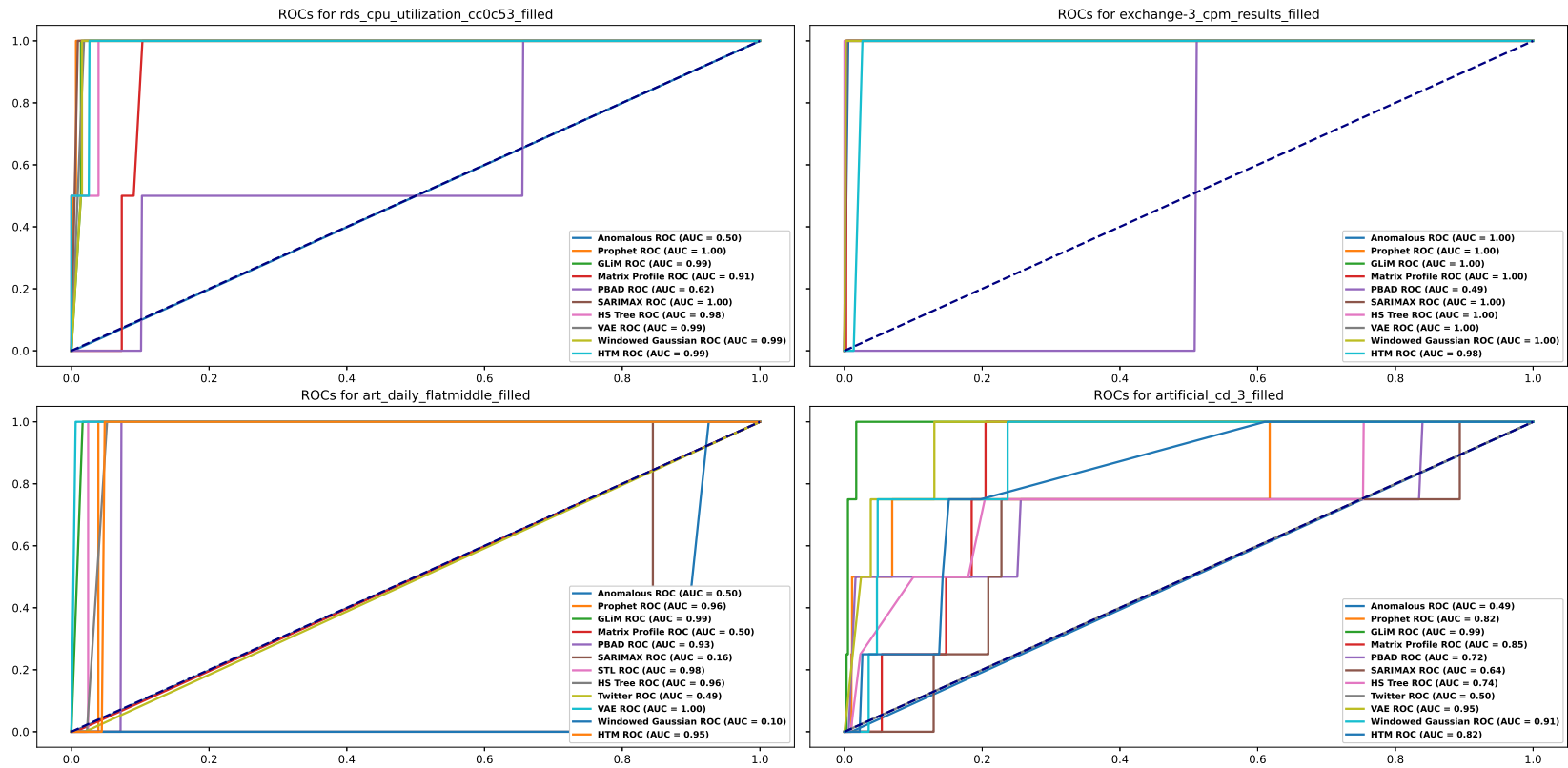


Figure 16: ROCs of anomaly detection methods.

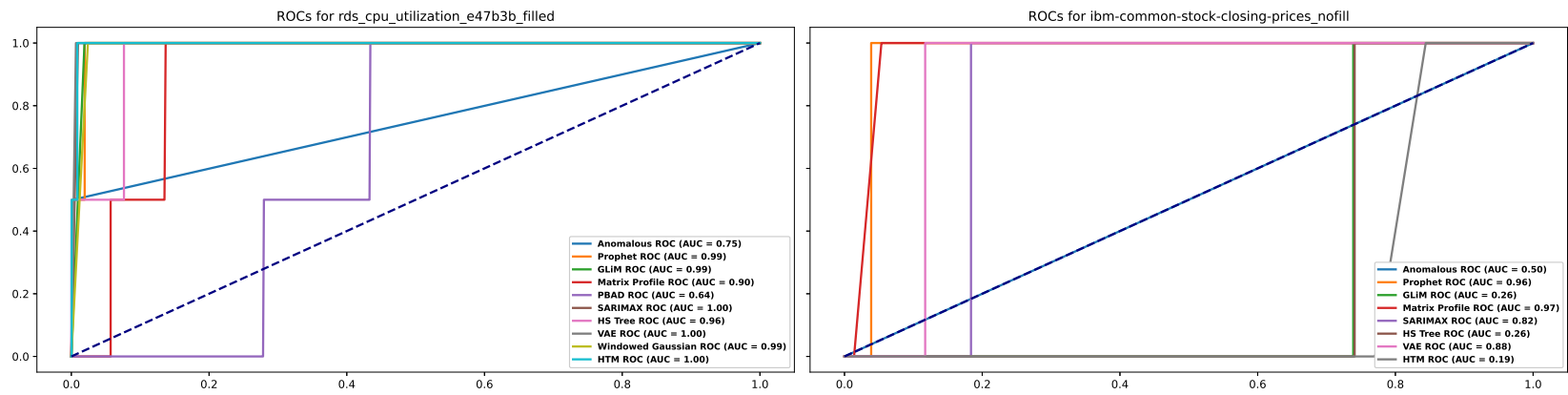


Figure 17: ROCs of anomaly detection methods.