Structural Break Analysis Results

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Executive Summary

Study Overview:

- **Simulation Design:** Monte Carlo experiments with 300 replications per scenario
- **Time Series Length:** T = 400 observations, break point Tb = 200
- **Break Types Analyzed:** Variance, Mean, and Parameter breaks
- **Innovation Types:** 3, 5, Gaussian
- **Persistence Levels:** 0.90, 0.95, 0.99
- **Total Scenarios:** 154 forecast results across 3 break types

Key Findings:

- **Best Overall Method:** Rolling SARIMA achieves lowest RMSE of 0.9106
- **Mean Break Performance:** Best RMSE = 0.9789 (Gaussian)
- **Parameter Break Performance:** Best RMSE = 0.9106 (Unknown)
- **Variance Break Performance:** Best RMSE = 1.4787 (Unknown)
- **Persistence p0.90:** Best RMSE = 1.0318
- **Persistence p0.95:** Best RMSE = 1.0778
- **Persistence p0.99:** Best RMSE = 1.0318
- **Predictive Performance:** Average Coverage@95%: 0.8930, Average LogScore: -2.1926

1 Mean Break

1.1 Single Break

Table 1: Mean Single Break (Gaussian): 300 simulations

Method	RMSE	MAE	Bias	Var(error)
SARIMA + Break Dummy (oracle Tb)	0.9789	0.7607	0.1568	0.9336
Simple Exp. Smoothing (SES)	1.0598	0.8488	0.0644	1.1190
Holt-Winters (additive)	1.0979	0.8643	0.0266	1.2047
SARIMA Rolling	1.1424	0.9059	0.1833	1.2715
SARIMA Global	1.1482	0.8985	0.3800	1.1741

Table 2: Mean Single Break (Student-t df=3): 300 simulations

Method	RMSE	MAE	Bias	Var(error)
SARIMA + Break Dummy (oracle Tb)	1.1056	0.7405	0.1655	1.1950
Simple Exp. Smoothing (SES)	1.1328	0.7774	0.0644	1.2790
Holt-Winters (additive)	1.1371	0.8046	0.0457	1.2910
SARIMA Rolling	1.2195	0.8434	0.2114	1.4424
SARIMA Global	1.2284	0.8695	0.3984	1.3502

Table 3: Mean Single Break (Student-t df=5): 300 simulations

Method	RMSE	MAE	Bias	Var(error)
SARIMA + Break Dummy (oracle Tb)	1.0610	0.7785	0.1451	1.1046
Simple Exp. Smoothing (SES)	1.1278	0.8284	0.0363	1.2707
Holt-Winters (additive)	1.1599	0.8561	-0.0054	1.3454
SARIMA Rolling	1.2033	0.8659	0.2105	1.4037
SARIMA Global	1.2419	0.9227	0.3903	1.3899

1.2 Recurring Break

Table 4: Mean Recurring: 300 simulations

Method	RMSE	MAE	Bias	Var(error)
SARIMA + Midpoint Dummy (proxy Tb)	1.0957	0.8906	0.0287	1.1997
SARIMA Global	1.1253	0.9019	0.1931	1.2290
SARIMA Rolling	1.1504	0.9285	0.1919	1.2867
Simple Exp. Smoothing (SES)	1.1548	0.9101	0.0267	1.3329
Holt-Winters (additive)	1.1798	0.9235	0.0114	1.3918

2 Parameter Break

2.1 Single Break

Table 5: Parameter Single Break (Gaussian): 300 simulations

Method	RMSE	MAE	Bias	Variance
MS AR	1.0735	0.8456	0.0353	1.1512
Rolling SARIMA	1.0950	0.8651	0.0433	1.1971
Global SARIMA	1.1702	0.9297	0.0288	1.3685

Table 6: Parameter Single Break (Student-t df=3): 300 simulations

Method	RMSE	MAE	Bias	Variance
Rolling SARIMA	0.9106	0.6792	0.0212	0.8287
MS AR	1.0502	0.7118	-0.0138	1.1027
Global SARIMA	1.0931	0.7951	0.0526	1.1921

Table 7: Parameter Single Break (Student-t df=5): 300 simulations

Method	RMSE	MAE	Bias	Variance
MS AR	0.9653	0.7309	0.0408	0.9302
Rolling SARIMA	0.9781	0.7510	0.0143	0.9565
Global SARIMA	1.0476	0.8032	0.0124	1.0973

2.2 Persistence Results

Table 8: Parameter Recurring (p=09): 300 simulations

Method	RMSE	MAE	Bias	Variance
MS AR	1.1426	0.8922	0.0253	1.3049
Global SARIMA	1.1695	0.9117	0.0041	1.3676
Rolling SARIMA	1.1875	0.9257	0.0059	1.4100

Table 9: Parameter Recurring (p=095): 300 simulations

Method	RMSE	MAE	Bias	Variance
MS AR	1.0778	0.8570	0.0408	1.1600
Rolling SARIMA	1.1215	0.8990	-0.0027	1.2578
Global SARIMA	1.1238	0.8952	-0.0114	1.2627

Table 10: Parameter Recurring (p=099): 300 simulations

Method	RMSE	MAE	Bias	Variance
MS AR	1.0318	0.8043	-0.0102	1.0645
Rolling SARIMA	1.0668	0.8408	-0.0122	1.1380
Global SARIMA	1.0974	0.8515	-0.0582	1.2009

3 Variance Break

3.1 Single Break

Table 11: Variance Single Break (Gaussian): 300 simulations

Method	RMSE	MAE	Bias	Variance	LogScore
SARIMA Global	2.0476	1.6263	0.2020	4.1516	-2.4465
SARIMA Avg-Window	2.0518	1.6331	0.1884	4.1746	-2.2981
GARCH	2.0535	1.6338	0.2024	4.1759	-2.2569
SARIMA Rolling	2.0678	1.6504	0.1789	4.2439	-2.2809

Table 12: Variance Single Break (Student-t df=3): 300 simulations

Method	RMSE	MAE	Bias	Variance	LogScore
GARCH	2.0311	1.3335	0.2884	4.0423	-2.1884
SARIMA Global	2.0378	1.3493	0.2924	4.0670	-2.3866
SARIMA Avg-Window	2.0576	1.3688	0.2856	4.1520	-2.2049
SARIMA Rolling	2.0948	1.4147	0.2680	4.3164	-2.1916

Table 13: Variance Single Break (Student-t df=5): 300 simulations

Method	RMSE	MAE	Bias	Variance	LogScore
SARIMA Global	2.2351	1.5565	0.1890	4.9598	-2.6418
SARIMA Avg-Window	2.2381	1.5678	0.1849	4.9751	-2.4155
GARCH	2.2438	1.5575	0.1922	4.9975	-2.3550
SARIMA Rolling	2.2703	1.6086	0.1681	5.1258	-2.3994

3.2 Recurring Break

Table 14: Variance Recurring: 300 simulations

Method	RMSE	MAE	Bias	Variance	LogScore
MS AR(1)	1.4787	1.1691	-0.2057	2.1443	-1.9859
SARIMA Rolling	1.4826	1.1731	-0.1803	2.1655	-1.8035
SARIMA Avg-Window	1.4876	1.1766	-0.1820	2.1799	-1.7950
SARIMA Global	1.4960	1.1795	-0.1978	2.1990	-1.8202