

# The Serverless Application Analytics Framework: Performance Modeling

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TABLE I. *PERFORMANCE MODEL RESULTS SCNMT2 WORKLOADS*

SCNMT2 Model	Mean Runtime (ms)	STDEV (ms)	Training CV	Test CV	RMSE (ms)	MAE (ms)	MAPE	df
256MB a1 → a2	15833.57	3768.92	0.24	0.238	96.74	78.62	0.51	127
256MB a1 → a3	15837.56	3938.33	0.2479	0.2487	90.94	67.29	0.42	151
256MB a2 → a3	18033.93	4025.3	0.2218	0.2232	71.39	55.17	0.3	127
512MB a1 → a2	7189.17	792.02	0.1167	0.1102	48.68	38.45	0.53	58
512MB a1 → a3	7668.96	1779.75	0.2322	0.2321	99.28	77.89	1.07	414
512MB a2 → a3	8552.5	1041.81	0.1207	0.1218	15.38	9.99	0.11	58
1024MB a1 → a2	3756.67	842.68	0.2426	0.2243	22.78	18.31	0.51	28
1024MB a1 → a3	4051.24	813.88	0.2105	0.2009	81.02	62.24	1.53	406
1024MB a2 → a3	4117	1179.58	0.2858	0.2865	3.88	3.34	0.09	28
2048MB a1 → a2	2432.35	551.93	0.2254	0.2269	10.82	8.87	0.37	155
2048MB a1 → a3	2422	446.54	0.1833	0.1844	12.12	9.31	0.37	265
2048MB a2 → a3	2409.12	501.7	0.2069	0.2083	12.61	9.99	0.41	155
256MB → 512MB a1	10110.96	2020.35	0.2017	0.1998	167.67	131.81	1.3	414
256MB → 1024MB a1	5115.29	1088.94	0.205	0.2129	90.91	70.7	1.43	406
256MB → 2048MB a1	2327.66	514.18	0.2257	0.2209	13.99	11.48	0.5	265
256MB → 512MB a2	8940.83	1079.02	0.1234	0.1207	27.83	20.51	0.21	58
256MB → 1024MB a2	4842	682.47	0.1418	0.1409	15.61	14.17	0.29	28
256MB → 2048MB a2	2389.93	548.66	0.2309	0.2296	12.61	9.68	0.39	127
256MB → 512MB a3	7681.75	1628.22	0.2184	0.212	38.33	25.62	0.33	151
256MB → 1024MB a3	3746.88	920.34	0.2487	0.2456	14.29	11.84	0.34	151
256MB → 2048MB a3	2344.06	563.16	0.2472	0.2402	14.38	8.68	0.33	151

TABLE II. *PERFORMANCE MODEL RESULTS SCMT2 WORKLOADS*

SCMT2 Model	Mean Runtime (ms)	STDEV (ms)	Training CV	Test CV	RMSE (ms)	MAE (ms)	MAPE	df
256MB a1 → a2	45382.43	10384.19	0.2242	0.2288	206.29	139.2	0.28	127
256MB a1 → a3	47245.12	11071.88	0.2298	0.2343	227.68	149.02	0.29	151
256MB a2 → a3	52646.21	12233.77	0.2309	0.2324	202.5	154.28	0.3	127
512MB a1 → a2	20433.5	6351.5	0.3055	0.3108	103.98	74.95	0.38	58
512MB a1 → a3	25927.89	5230.08	0.2847	0.2017	2416.4	1865.71	6.98	414
512MB a2 → a3	21201.5	3450.42	0.17	0.1627	57.75	54.18	0.26	58
1024MB a1 → a2	11235.33	3290.99	0.2958	0.2929	26	21.47	0.23	28
1024MB a1 → a3	11860.51	2642.17	0.2665	0.2228	1224.3	968.58	7.83	406
1024MB a2 → a3	11447.33	3093.38	0.2731	0.2702	77.95	72.98	0.61	28
2048MB a1 → a2	6756.94	1305.3	0.1993	0.1932	95.69	70.14	1.03	157
2048MB a1 → a3	6982.93	1441.66	0.2691	0.2065	641.39	503.28	6.95	266
2048MB a2 → a3	7445	1712.71	0.2138	0.23	361.19	265.22	3.33	157
256MB → 512MB a1	42047.54	10166.27	0.2437	0.2418	3691.45	3336.12	8.15	414
256MB → 1024MB a1	20077.02	5005.32	0.2163	0.2493	1499.13	1114.89	5.52	406
256MB → 2048MB a1	7719.97	1796.84	0.1811	0.2328	826.25	658.51	8.28	266
256MB → 512MB a2	21162.5	5850.52	0.274	0.2765	82.91	63.71	0.28	58
256MB → 1024MB a2	11167.33	879.6	0.0797	0.0788	51.02	35.88	0.3	28
256MB → 2048MB a2	6528.36	1185.74	0.19	0.1816	125.79	89.54	1.32	127
256MB → 512MB a3	23795.12	5203.18	0.2214	0.2187	164.3	124.04	0.47	151
256MB → 1024MB a3	11584.31	2590.41	0.2253	0.2236	135.75	112.13	1	151
256MB → 2048MB a3	6531.5	1601.19	0.2276	0.2451	300.37	216.48	2.98	151

TABLE III. PERFORMANCE MODEL RESULTS SCSMT2 WORKLOADS

SCSMT2 Model	Mean Runtime (ms)	STDEV (ms)	Training CV	Test CV	RMSE (ms)	MAE (ms)	MAPE	df
256MB a1 → a2	42759.24	12110.69	0.3004	0.2832	1218.04	1005.45	2.96	1414
256MB a1 → a3	45520.71	14542.2	0.3335	0.3195	1024MB .36	807.56	2.36	1613
256MB a2 → a3	48747.47	13743.09	0.2736	0.2819	774.98	605.46	1.59	1414
512MB a1 → a2	19662.67	5470.98	0.3086	0.2782	695.99	550.55	3.13	652
512MB a1 → a3	21686.42	6899.5	0.4	0.3181	2816.69	2375.5	11.52	4572
512MB a2 → a3	20933.28	6800.99	0.3164	0.3249	355.31	293.07	1.53	652
1024MB a1 → a2	9240.53	2650.33	0.3529	0.2868	462.33	316.33	3.7	325
1024MB a1 → a3	10122	3399.21	0.4252	0.3358	1217.9	998.88	10.54	4478
1024MB a2 → a3	10202.69	3612.71	0.3421	0.3541	266.27	214.37	2.25	325
2048MB a1 → a2	4603.39	1666.14	0.4171	0.3619	223.25	168.85	4.14	1739
2048MB a1 → a3	5299.21	1915.1	0.4361	0.3614	707.18	566.92	11.86	2938
2048MB a2 → a3	5114.97	1763.12	0.3188	0.3447	376.45	284.65	5.91	1739
256MB → 512MB a1	36500.36	14527.64	0.3622	0.398	4988.16	3771.51	10.58	4572
256MB → 1024MB a1	15135.99	6353.93	0.3429	0.4198	2555.22	1757.67	16.31	4478
256MB → 2048MB a1	5527.18	2443.87	0.3141	0.4422	1250.25	927.67	19.82	2938
256MB → 512MB a2	19789.62	5966.73	0.2928	0.3015	363.15	272.99	1.62	652
256MB → 1024MB a2	9806.22	3354.23	0.3172	0.3421	534.8	441.12	6.04	325
256MB → 2048MB a2	4654.28	1538.04	0.2832	0.3305	570.48	485.56	11.31	1414
256MB → 512MB a3	20654.36	6668.28	0.3157	0.3229	645.61	515.38	3.02	1613
256MB → 1024MB a3	9505.2	3255.82	0.3157	0.3425	743.93	572.47	7.43	1613
256MB → 2048MB a3	4865.45	1853.49	0.3157	0.3809	770.51	590.92	14.15	1613

TABLE IV. PERFORMANCE MODEL RESULTS SCNMT2 AWS→IBM

SCNMT2 IBM Model	Mean Runtime (ms)	STDEV (ms)	Training CV	Test CV	RMSE (ms)	MAE (ms)	MAPE	df
256MB a1 → i3	28887.68	4278.86	0.1511	0.1481	1074.34	880.92	3.14	171
256MB a1 → i4	26141.55	6081.51	0.2159	0.2326	1695.29	1297.76	4.79	200
512MB a1 → i1	17206.62	2922.44	0.1638	0.1698	762.88	602.94	3.51	142
512MB a1 → i2	15023.95	2813.67	0.1966	0.1873	1217.56	884.35	5.95	369
512MB a1 → i3	13412.55	2239.53	0.1409	0.167	620.17	388.37	2.75	99
512MB a1 → i4	12466.22	920.66	0.0911	0.0739	759.72	575.13	4.47	85
1024MB a1 → i1	8320.35	1668.79	0.2002	0.2006	371.95	288.18	3.68	236
1024MB a1 → i2	7427.39	1729.31	0.2201	0.2328	434.56	292.84	3.98	395
1024MB a1 → i3	7326	443.16	0.0684	0.0605	173.89	164.48	2.21	49
1024MB a1 → i4	6700	1067.37	0.1622	0.1593	448.36	274.36	3.91	70
2048MB a1 → i1	4038.53	1163.06	0.2616	0.288	164.59	110.56	3.44	139
2048MB a1 → i2	3566.34	787.34	0.1994	0.2208	185.11	131.21	3.67	265
2048MB a1 → i3	2855.5	661.97	0.2061	0.2318	34.7	30.67	1.17	42
2048MB a1 → i4	2403	347.9	0.1673	0.1448	74.87	59.14	2.29	24

**Legend:**

Mean Runtime – Average runtime for workload in ms  
STDEV – Standard deviation of workload in ms  
Training CV – Coefficient of Variation for training dataset  
Test CV – Coefficient of Variation for test dataset  
RMSE – Root Mean Squared Error in ms  
MAE – Mean Absolute Error in ms  
MAPE – Mean Absolute Percent Error  
df – Degrees of Freedom

Platform	Intel Xeon CPU	VM	Alias
AWS	E5-2680v2 @ 2.8 GHz, 10 core	c3	a1
AWS	E5-2676v3 @ 2.4 GHz, 12 core	m4	a2
AWS	E5-2686v4 @ 2.3 GHz, 18 core	r4	a3
IBM	E5-2683v3 @ 2.0 GHz, 14 core	unseen	i1
IBM	E5-2683v4 @ 2.1 GHz, 16 core	bl2/b1/m1	i2
IBM	E5-2650v4 @ 2.2 GHz, 12 core	u1	i3
IBM	E5-2690v4 @ 2.6 GHz, 14 core	c1	i4
IBM	Gold 6140 @ 2.3 GHz, 18 core	unseen	i5