

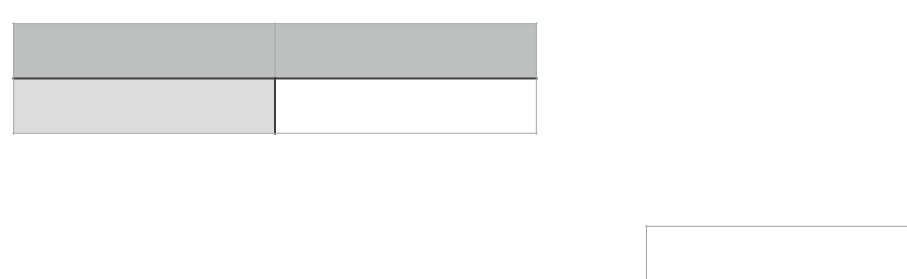
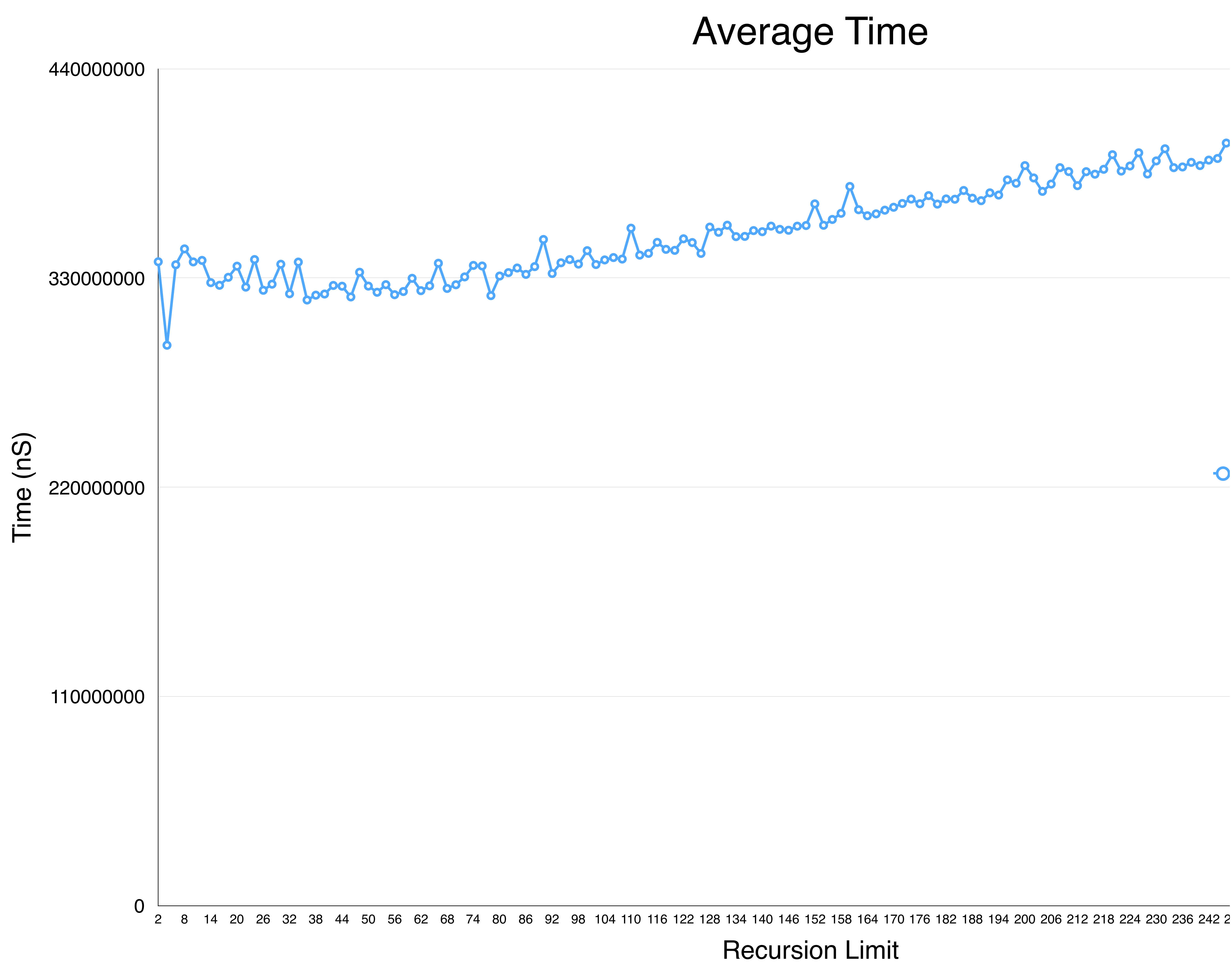
Table 1

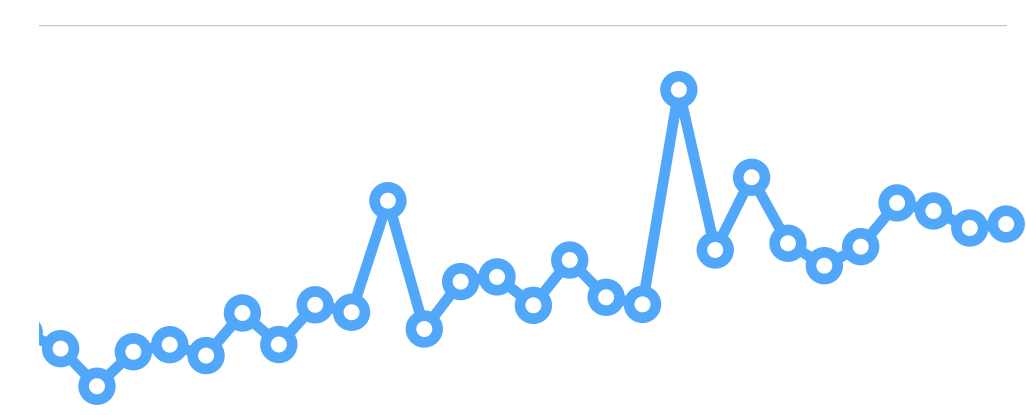
Recursion Limit	Array Size: 2000	Array Size: 10000	Array Size: 50000	Array Size: 250000	Array Size: 1250000	Array Size: 6250000	Average Time
2	2436770	1689948	28477654	34209401	245388995	1719002119	338534147.833333
4	554008	1665488	24864547	36726525	257875981	1740766032	294636083
6	484457	1587209	25432463	35647831	244732036	1713803876	336947978.666667
8	510084	1561813	24242617	34418626	258587144	1752516244	345306088
10	659029	1578440	10406607	37602294	236020282	1744419124	338447629.333333
12	501735	1512224	11193434	32859970	260847678	1728499012	339235675.5
14	481756	1478353	9618321	32856597	253319305	1667494158	327541415
16	457082	1456979	9308413	32660584	245618979	1667432157	326155699
18	448230	2092189	9280459	32290117	239042230	1698900518	330342290.5
20	557774	1721459	11097249	30479088	244970393	1728366328	336198715.166667
22	520087	1462834	9413043	39418955	246465297	1653872663	325192146.5
24	460953	1412642	9355925	33186491	245597579	1748099086	339685446
26	510233	1487240	10840809	32828923	246014940	1649475293	323526239.666667
28	350224	2267875	8248774	32840129	254756685	1661976781	326740078
30	399558	2136875	10109232	31824864	248117810	1730775365	337227284
32	452000	1994194	6886324	35581319	248345555	1636917902	321696215.666667
34	397905	2193653	8677374	32169674	237027825	1749699859	338361048.333333
36	368166	2134669	9397198	32247972	244368281	1621958012	318412383
38	310090	1732993	10034816	32358741	252471861	1628848569	320959511.666667
40	309973	1400406	11891931	31864437	233618059	1650229242	321552341.333333
42	318591	1428352	13266917	32251446	260894087	1648254244	326068939.5
44	813673	1410763	14514449	32517184	248843890	1655895996	325665992.5
46	1125763	1404494	10019838	32466671	247356026	1627837846	320035106.333333
48	1021354	1386694	8334591	32363614	239700246	1715277739	333014039.666667
50	1171579	1402819	6774540	37108994	241738974	1666197454	325732393.333333
52	1189075	1392151	7666861	32971312	245000806	1646683322	322483921.166667
54	1041204	1622301	9398004	33628598	250695306	1662456396	326473634.833333
56	1284453	1565946	8191677	33322804	242740455	1640179302	321214106.166667
58	1134101	1435960	9148721	33478920	238448607	1653641516	322881304.166667
60	1115701	2412948	6125305	38246640	241522325	1689515050	329822994.833333
62	1117238	4541183	7024888	33230902	251172710	1642866941	323325643.666667
64	1350327	1423082	8707348	31879665	259254138	1652629810	325874061.666667
66	1481311	1607436	8507069	33043014	249020288	1732793511	337742104.833333
68	1267668	1757273	7842396	33364740	249386407	1653358073	324496092.833333
70	1358449	2722760	6252085	33382532	246512455	1668344788	326428844.833333
72	1554818	2198901	8376777	33435557	258595246	1679223927	330564204.333333
74	1394561	2982053	8022954	33821226	247214205	1726222344	336609557.166667
76	1779937	2075785	8071629	42560311	261107026	1702237389	336305346.166667
78	1944683	3013560	7280971	34705864	241353104	1636021748	320719988.333333
80	1990631	1516564	10178093	37411980	259058029	1676030950	331031041.166667
82	1355291	1451033	7862081	34640501	240606584	1710984548	332816673
84	1442551	1914132	7428902	34222379	259108209	1707303989	335236693.666667
86	1209444	2248127	8374134	37961750	249845499	1691670041	331884832.5
88	1675396	1451971	6184159	38394601	250477419	1717648371	335971986.166667
90	2085155	1624168	6230400	35342485	252093247	1804100605	350246010
92	1053862	2265437	6190376	34809544	248047636	1701733343	332350033
94	1112255	2258464	6198801	35091781	262942682	1720308986	337985494.833333
96	1252679	2253374	6174163	35035620	255283685	1738124904	339687404.166667
98	988516	2343470	7134830	35042910	255098866	1723203845	337302072.833333
100	865960	2225610	7229415	33865160	250560032	1771442866	344364840.5
102	1141196	2210851	6354258	39046985	259055659	1714626010	337072493.166667
104	1158639	1443585	8156631	39267340	248501382	1738426442	339492336.5
106	1085143	1457569	6841235	35623944	266170064	1733227013	340734161.333333
108	990800	1445306	6397108	35712038	261361082	1733766011	339945390.833333
110	827422	1425741	6421345	35662276	258619684	1834175617	356188680.833333
112	385935	1425122	6471980	39659032	254115573	1750079943	342022930.833333
114	380338	1428582	6136191	37464302	261528971	1750602735	342923519.833333
116	406740	1421184	6140929	40023032	283716351	1760655655	348727315.166667
118	343320	1422956	6117561	36200509	256320514	1769928762	345055603.666667
120	431593	1506355	6141696	36667326	271424891	1750935181	344517840.333333

Recursion Limit	Array Size: 2000	Array Size: 10000	Array Size: 50000	Array Size: 250000	Array Size: 1250000	Array Size: 6250000	Average Time
122	547951	1436969	6305754	36789613	260707590	1797835055	350603822
124	430312	1471833	6240569	36816502	266210414	1780568080	348622951.666667
126	431692	1463607	6360802	36989318	274023357	1738151524	342903383.333333
128	324024	1512063	6378840	48244812	276561485	1807493376	356752433.333333
130	333043	1800959	6351485	37190777	268527727	1809927798	354021964.833333
132	319058	1726595	6384676	38444077	268046118	1831541507	357743671.833333
134	275252	1543590	6447965	38236507	273332165	1790657227	351748784.333333
136	230740	1540237	6474105	41468923	253945221	1807462080	351853551
138	242699	1548167	6491846	37902866	277670325	1805605041	354910157.333333
140	236340	1442036	6683929	38249443	282158373	1797239807	354334988
142	247746	1485922	6696892	37441209	267669381	1830057495	357266440.833333
144	269986	1520659	6445594	36384910	266930136	1821855820	355567850.833333
146	234168	1488200	6567205	39780201	270953852	1811548344	355095328.333333
148	240573	1445105	6621634	38419751	279594572	1817125834	357241244.833333
150	241533	1538669	6634253	38658104	260400657	1838033738	357584492.333333
152	313194	1520607	6680165	43053066	286017238	1876162991	368957876.833333
154	327044	1445084	6740963	39152080	277595707	1821024611	357714248.166667
156	386871	1454050	6917054	39455634	276143988	1840251877	360768245.666667
158	405098	1519604	12010685	39380813	290663584	1840009137	363998153.5
160	384538	1515355	7082821	42529938	273604508	1943639816	378126162.666667
162	417176	1525263	7106879	39641231	289884428	1856775501	365891746.333333
164	407018	1481082	6966702	40143674	284349576	1843033685	362730289.5
166	400061	1458855	6880171	39816797	278353757	1855339830	363708245.166667
168	385570	1577528	6788615	43277790	288997093	1852829270	365642644.333333
170	251229	1579015	6999932	38502789	277621656	1878123514	367179689.166667
172	252548	1476206	7149976	38417387	286304725	1881396231	369166178.833333
174	250362	1562511	7249016	48818227	286224594	1884839290	371490666.666667
176	263679	1565208	7113550	44503500	287446056	1873248964	369023492.833333
178	291142	1650381	7219823	41613063	287259203	1901803305	373306152.833333
180	314310	1566873	7277258	41508908	298504646	1863913337	368847555.333333
182	258691	2667834	7274250	47338840	292206877	1879626814	371562217.666667
184	247363	1732934	7282513	45669095	294251204	1879255680	371406464.833333
186	262099	1582904	7421387	42599243	284501077	1919614552	375996877
188	368884	1598655	7433249	41223483	286210871	1894938418	371962260
190	464019	1663170	7438012	41658219	274723623	1897956579	370650603.666667
192	454046	1577842	7418968	41976142	306872338	1890254779	374759019.166667
194	429196	1498662	7512147	41810554	286470792	1903928660	373608335.166667
196	430822	1552616	7488626	51658083	293230060	1935163355	381587260.333333
198	424653	1594272	7503925	42247865	300138882	1926844610	379792367.833333
200	420949	1527560	7514666	42552790	287321183	1995157050	389082366.333333
202	465603	1628322	7389808	42690310	296179605	1947275250	382604816.333333
204	435593	1622862	7449991	48666309	282462700	1912624868	375543720.5
206	446053	1627907	7466356	43280900	293562741	1929855559	379373252.666667
208	404909	1604181	8938311	43445932	321075579	1952583555	388008744.5
210	379318	1597956	7779033	43706888	296631341	1965617583	385952019.833333
212	272086	1680421	7946742	43331114	289298542	1928762753	378548609.666667
214	434483	1662024	7756614	43168005	307321516	1955042682	385897554
216	440955	1701937	7540219	44436053	291218108	1962114680	384575325.333333
218	287264	1753886	7571835	51509446	307023826	1954723421	387144946.333333
220	300004	1722093	7718189	45093342	303949038	2010194359	394829504.166667
222	277533	1792655	7718910	45140619	300121425	1962149637	386200129.833333
224	275295	1686365	10034798	49475016	319875810	1951962302	388884931
226	265790	1619270	8777907	44594259	308984492	2010637845	395813260.5
228	281219	1639299	7842618	44718129	304956026	1948564864	384667025.833333
230	279503	1714889	7895636	45101185	313704657	1980633557	391554904.5
232	283553	1682468	7769823	45096476	302842764	2029994794	397944979.666667
234	286195	1736912	7827387	45013383	303466125	1969736453	388011075.833333
236	269188	1683715	7996444	45033336	304968001	1970273309	388370665.5
238	274448	1786587	7919801	51312896	297375746	1986076628	390791017.666667
240	299691	1824968	8089310	45802987	315842783	1962741525	389100210.666667
242	290516	1724655	10355476	45687956	320340738	1973508059	391984566.666667

Recursion Limit	Array Size: 2000	Array Size: 10000	Array Size: 50000	Array Size: 250000	Array Size: 1250000	Array Size: 6250000	Average Time
244	308779	1679378	8150021	50753046	302534798	1993654139	392846693.5
246	276979	1726674	8064420	46539553	315895543	2033116161	400936555
248	274667	2861386	8236426	46046389	315622669	2020757630	398966527.833333
250	265795	1748974	8293614	46269456	298122721	2010541624	394207030.666667
252	284309	1889753	8543245	50177477	326675123	2003891181	398576848
254	282362	1804671	8608064	47032555	320252779	2018835607	399469339.666667
256	484112	1702745	8540663	47103518	306642093	2024056300	398088238.5
258	291978	1742529	8464775	56725581	322299756	2031398216	403487139.166667
260	417774	1652732	8503760	50493789	311306517	2024559834	399489067.666667
262	442852	1690668	8429707	52001550	309833416	2054702790	404516830.5
264	405716	1754625	8712999	57233268	320052387	2033280324	403573219.833333
266	303374	1839794	8660297	48728966	316184629	2130497091	417702358.5
268	292596	1746716	8562296	48670301	322795712	2026661143	401454794
270	306462	1801620	8689943	47986136	332662499	2053295397	407457009.5
272	289142	1798221	8649049	51177813	321702138	2064700099	408052743.666667
274	290581	1714486	9399017	48997257	312920364	2053376466	404449695.166667
276	306191	1725062	11084479	53115401	333734544	2061165467	410188524
278	283311	1755654	9365571	46624245	326378142	2048400209	405467855.333333
280	275789	1767589	8595064	49115474	316635544	2051052221	404573613.5
282	300702	1859122	8840471	51564009	339041824	2188981366	431764582.333333
284	302149	1832181	8768822	53222441	325305202	2079335971	411461127.666667
286	274137	1837331	8948326	53209255	327283090	2132443258	420665899.5
288	295656	1762625	8800930	49506827	334530689	2078983488	412313369.166667
290	297011	1753317	8817206	49489599	335214817	2061242417	409469061.166667
292	314317	1973361	9015190	47226334	330098200	2082671446	411883141.333333
294	291330	1865781	8974525	56303589	336773109	2100329520	417422975.666667
296	303753	1870472	8722384	52635748	333052134	2096945778	416453368.833333
298	310114	1952414	9152415	5157765	33478911	212405611	424450133.333333
300	287778	2000000	9000000	5000000	3000000	2000000	2000000.000000

Looking at the data it would appear the best recursion limit is somewhere between 40 and 80. There was an odd drop at recursion limit 4 but the overall data shows the lowest average times somewhere between the 40 and 80 limit. There was always a large difference between 2 and 4-8 limit. With the recursion limit only being 2 the insertion sort had to do a lot of the work and that caused the time to be higher. The smaller arrays showed a more consistent time because there is less sorting to be done with them. Over 150 recursion limit almost all graphs show and increase in time and thus inefficiency.





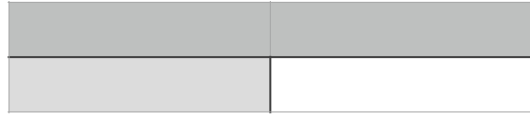
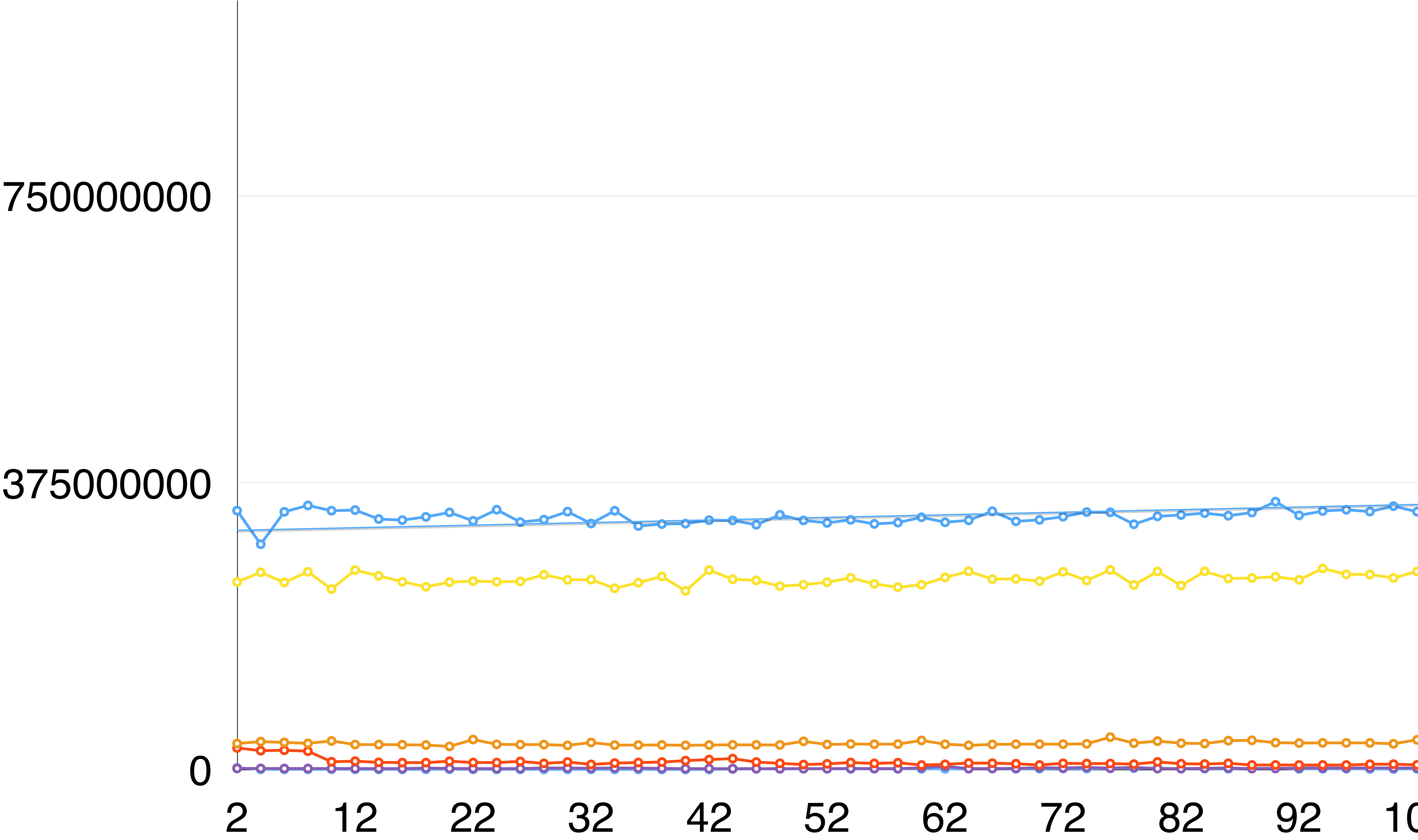
▪ Average Time

48 254 260 266 272 278 284 290 296

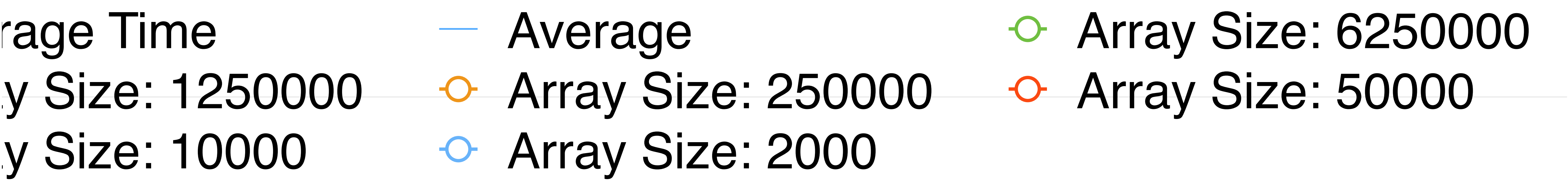
Time in NanSec

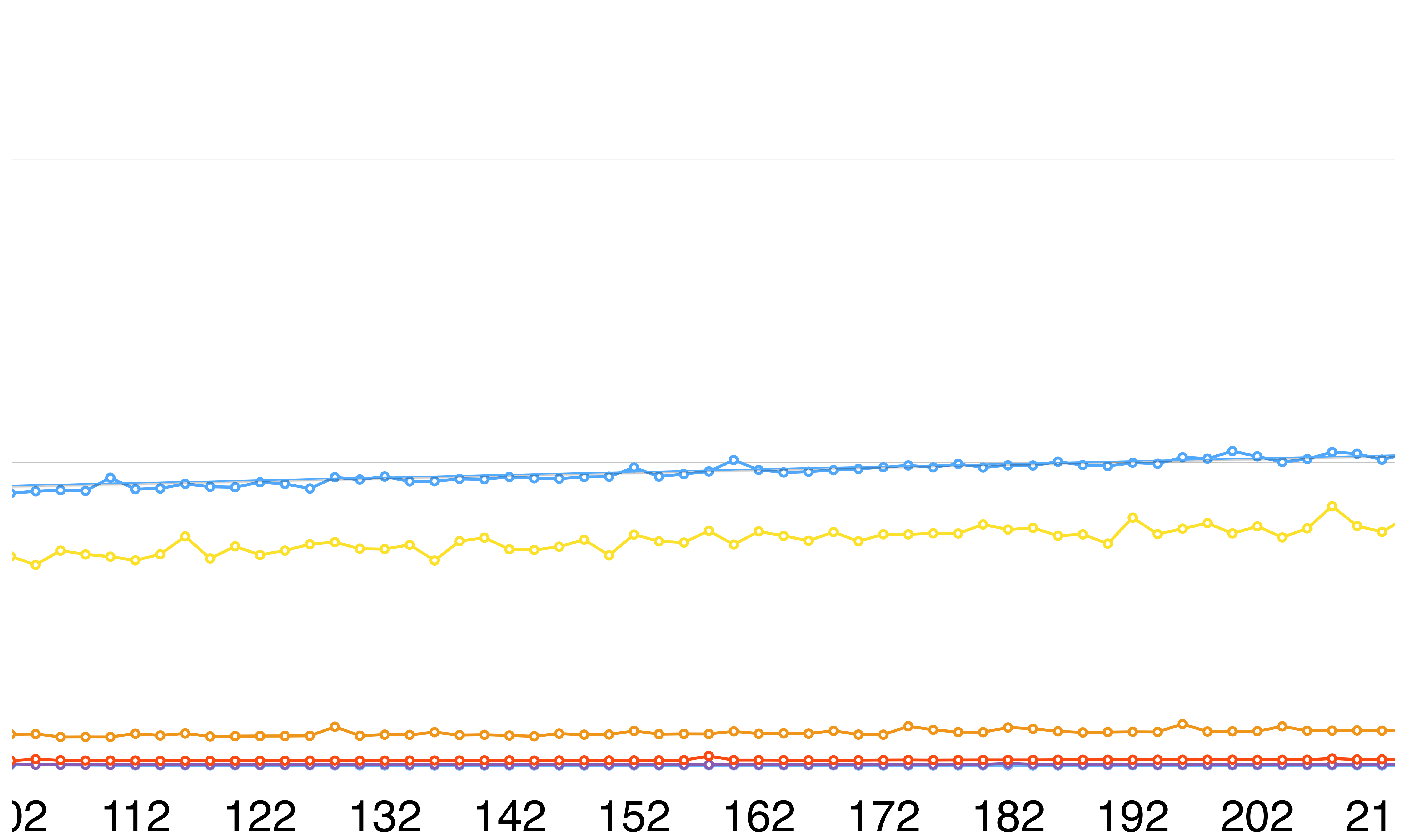
3000000000
2625000000
2250000000
1875000000
1500000000
1125000000

Avei
Arra
Arra

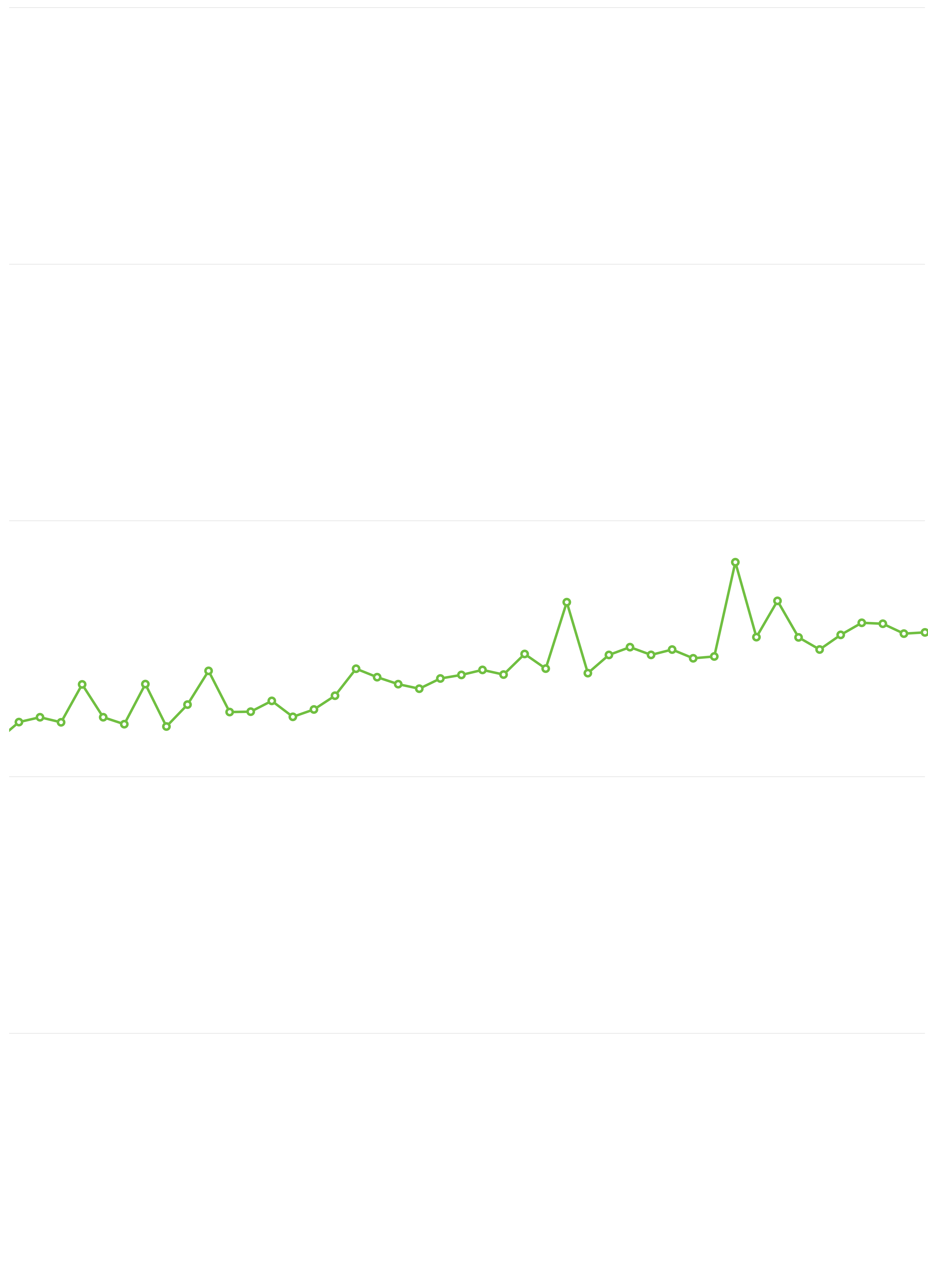


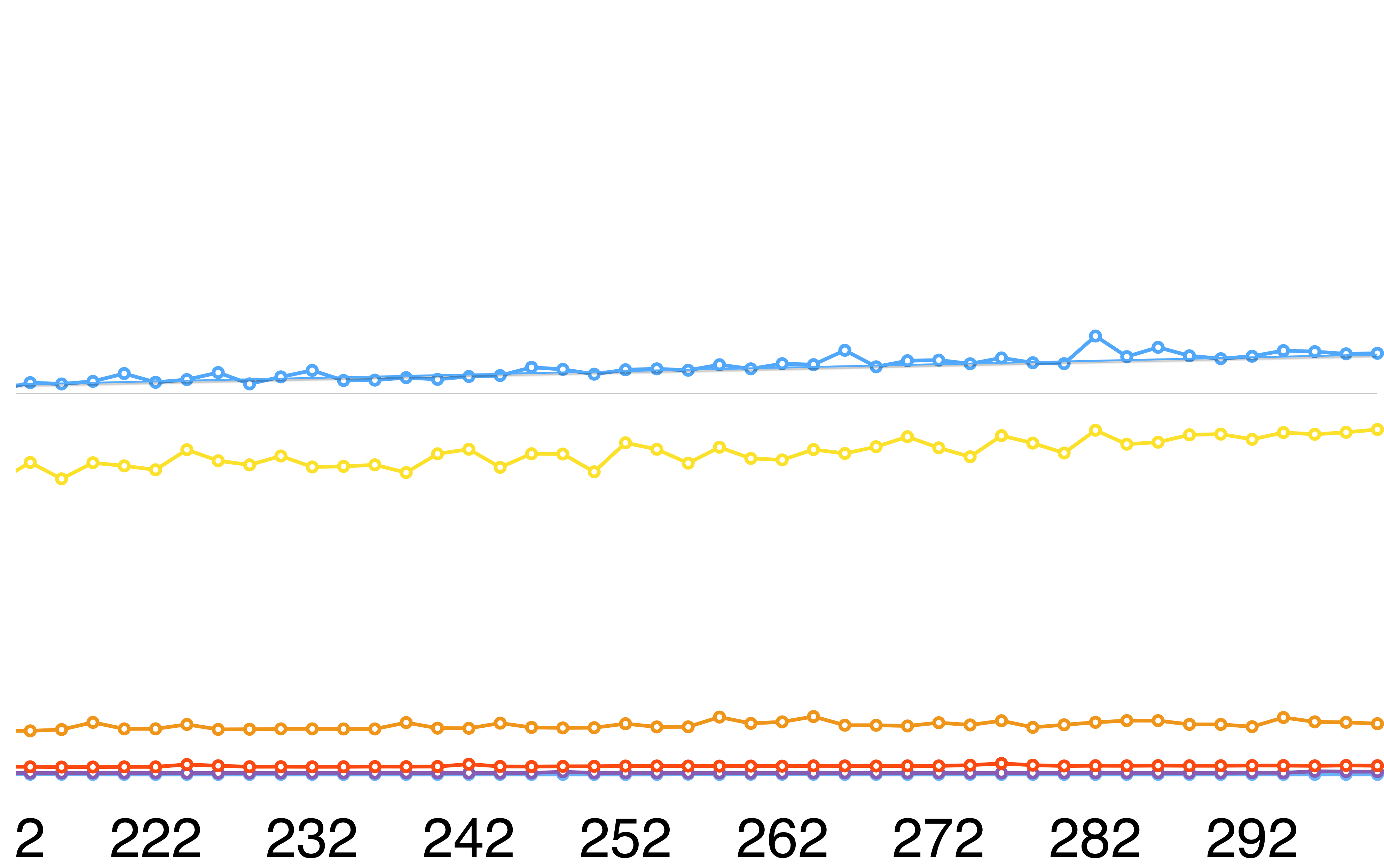
Analysis of Limiting QuickSort Recursion Limit



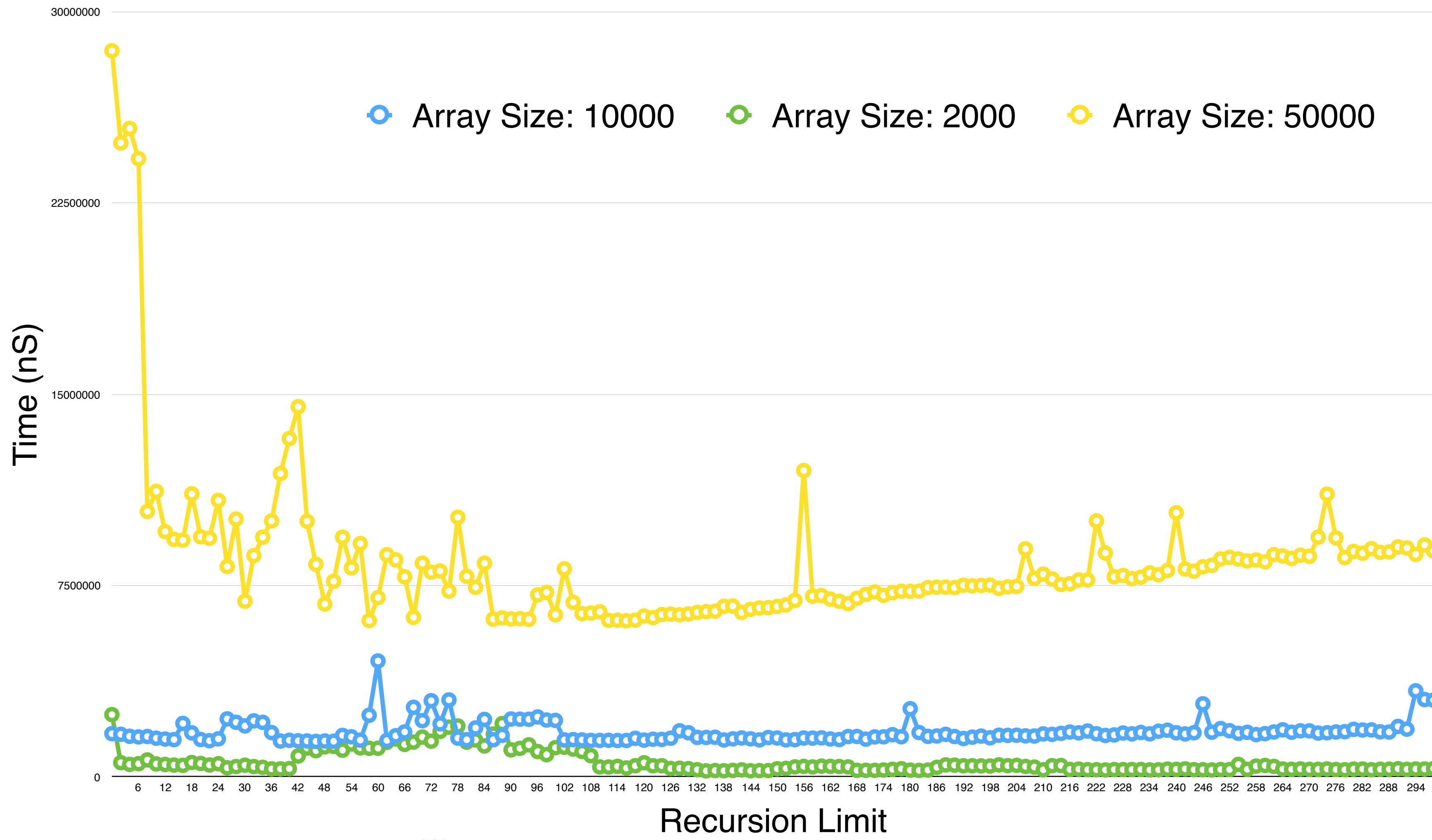


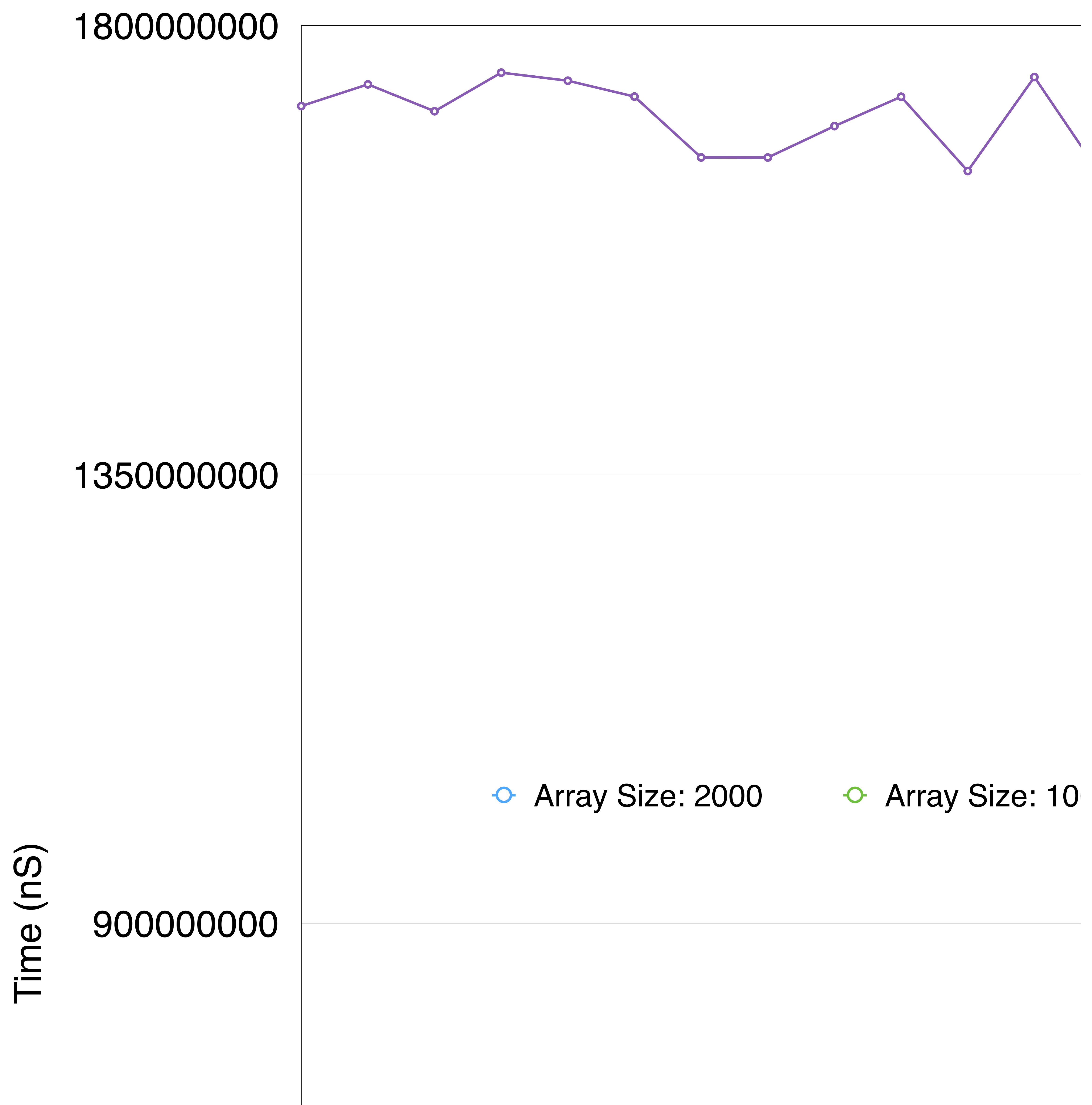
Recursion Limit





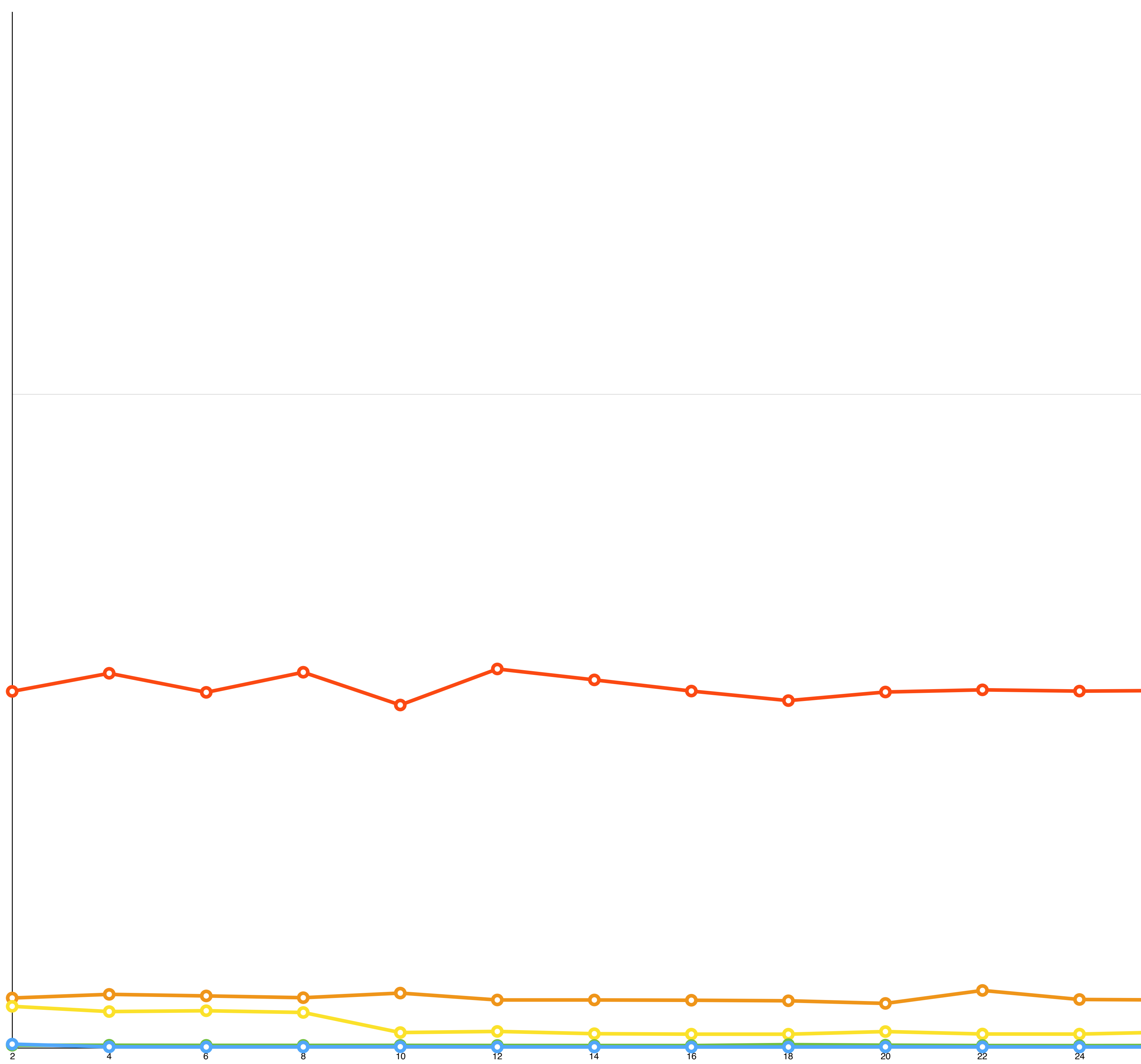
Smaller Arrays





450000000

0



The line graph illustrates the population aged 65 and over in the United Kingdom from 1980 to 2010. The population starts at approximately 5.5 million in 1980, rises to about 6.5 million by 1985, dips slightly to 6.3 million in 1990, and then continues a general upward trend, reaching approximately 7.5 million by 2010. The population growth is relatively steady, with a slight acceleration in the early 1980s and a slight dip in the early 1990s.

Year	Population (millions)
1980	5.5
1981	5.8
1982	6.0
1983	6.2
1984	6.4
1985	6.5
1986	6.3
1987	6.1
1988	6.3
1989	6.4
1990	6.3
1991	6.4
1992	6.4
1993	6.5
1994	6.4
1995	6.6
1996	6.8
1997	6.6
1998	6.5
1999	6.6
2000	6.5
2001	6.6
2002	6.7
2003	6.8
2004	6.9
2005	7.0
2006	7.1
2007	7.2
2008	7.3
2009	7.4
2010	7.5

000  Array Size: 50000  Array Size: 250000  Array Size: 1250000

🔗 Array Size: 250000

○ Array Size: 12500

