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Number of calculations in a numerical method

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Abstract. We evaluate the number of calculations in the recently introduced numerical method. We may use the approximate value of the number of calculations in order to evaluate the complexity of the method provided the parameters are selected.

Keywords: number of calculations, numerical method.

In the recently introduced in this journal numerical method (see also [1]), we calculate values of a function of one or more variables. Here we evaluate the number of calculations. We may use the approximate value of the number of calculation in order to evaluate the complexity of the method provided the parameters are selected.

We begin with an initial interval. At each step we divide the interval by N. At each next step we take interval whose length is n times smaller than the length of the interval in the previous step. We use s steps in order to receive d true digits in the answer.

Since $n^s = 10^d$, we obtain for the number of steps $s = \frac{d.\ln 10}{\ln n}$. At each step we perform $(N+1)^v$ calculations, where v is the number of arguments of the function. Hence, if we want to receive d true digits in the answer, we perform $c(v) = \frac{d \ln 10}{\ln n}(N+1)^v$ calculations.

The tables below give the rounded values of the numbers of calculations for some d, n and v. (Here we take $N = 2n$). If the number of calculations is less than 10,000 we receive the answer instantly. Note that if the number of calculations is less than 100,000, we still could use the method without problems.

In the examples given in previous papers we take n = 10, but in many cases it is suitable we to take $n \leq 10$. Also, we see that the method is suitable for functions of one, two or three arguments.

d = 1

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	4	3	2	2	2	2	1	1
c(1)	20	21	18	22	26	34	21	25
c(2)	100	147	162	242	338	578	441	625
c(3)	500	1029	1458	2662	4394	9826	9261	15625
c(4)	2500	7203	13122	29282	57122	167042	194481	390625

d = 2

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	7	5	4	3	3	3	2	2
c(1)	35	35	36	33	39	51	42	50
c(2)	175	245	324	363	507	867	882	1250
c(3)	875	1715	2916	3993	6591	14739	18522	31250
c(4)	4375	12005	26244	43923	85683	250563	388962	781250

d = 3

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	10	7	5	5	4	4	3	3
c(1)	50	49	45	55	52	68	63	75
c(2)	250	343	405	605	676	1156	1323	1875
c(3)	1250	2401	3645	6655	8788	19652	27783	46875
c(4)	6250	16807	32805	73205	114244	334084	583443	1171875

d = 4

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	14	9	7	6	6	5	4	4
c(1)	70	63	63	66	78	85	84	100
c(2)	350	441	567	726	1014	1445	1764	2500
c(3)	1750	3087	5103	7986	13182	24565	37044	62500
c(4)	8750	21609	45927	87846	171366	417605	777924	1562500

d = 5

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	17	11	9	8	7	6	5	5
c(1)	85	77	81	88	91	102	105	125
c(2)	425	539	729	968	1183	1734	2205	3125
c(3)	2125	3773	6561	10648	15379	29478	46305	78125
c(4)	10625	26411	59049	117128	199927	501126	972405	1953125

d = 6

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	20	13	10	9	8	7	6	6
c(1)	100	91	90	99	104	119	126	150
c(2)	500	637	810	1089	1352	2023	2646	3750
c(3)	2500	4459	7290	11979	17576	34391	55566	93750
c(4)	12500	31213	65610	131769	228488	584647	1166886	2343750

d = 7

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	24	15	12	11	9	8	7	7
c(1)	120	105	108	121	117	136	147	175
c(2)	600	735	972	1331	1521	2312	3087	4375
c(3)	3000	5145	8748	14641	19773	39304	64827	109375
c(4)	15000	36015	78732	161051	257049	668168	1361367	2734375

d = 8

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	27	17	14	12	11	9	8	8
c(1)	135	119	126	132	143	153	168	200
c(2)	675	833	1134	1452	1859	2601	3528	5000
c(3)	3375	5831	10206	15972	24167	44217	74088	125000
c(4)	16875	40817	91854	175692	314171	751689	1555848	3125000

d = 9

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	30	19	15	13	12	10	9	9
c(1)	150	133	135	143	156	170	189	225
c(2)	750	931	1215	1573	2028	2890	3969	5625
c(3)	3750	6517	10935	17303	26364	49130	83349	140625
c(4)	18750	45619	98415	190333	342732	835210	1750329	3515625

d = 10

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	34	21	17	15	13	12	10	10
c(1)	170	147	153	165	169	204	210	250
c(2)	850	1029	1377	1815	2197	3468	4410	6250
c(3)	4250	7203	12393	19965	28561	58956	92610	156250
c(4)	21250	50421	111537	219615	371293	1002252	1944810	3906250

d = 11

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	37	24	19	16	15	13	11	11
c(1)	185	168	171	176	195	221	231	275
c(2)	925	1176	1539	1936	2535	3757	4851	6875
c(3)	4625	8232	13851	21296	32955	63869	101871	171875
c(4)	23125	57624	124659	234256	428415	1085773	2139291	4296875

d = 12

n	2	3	4	5	6	8	10	12
N = 2n	4	6	8	10	12	16	20	24
s	40	26	20	18	16	14	12	12
c(1)	200	182	180	198	208	238	252	300
c(2)	1000	1274	1620	2178	2704	4046	5292	7500
c(3)	5000	8918	14580	23958	35152	68782	111132	187500
c(4)	25000	62426	131220	263538	456976	1169294	2333772	4687500

References

1. Deko Dekov, A numerical method for solving the horizontal resection problem in Surveying, Journal of Geodetic Science (to appear)

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