

Numerical Experiments with a Gradient Descent Method using an Anticipative Scalar Approximation of Hessian for Unconstrained Optimization

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In this work we present the numerical results with ASA package (Anticipative Scalar Approximation) which implements a gradient descent algorithm with backtracking. The corresponding algorithm selects the steplength, according to a backtracking procedure, along the negative gradient, in which the initial stepsize is determined using a new scalar approximation of the Hessian of the minimizing function. This approximation is based only on the function values and its gradient in two successive points along the iterations. Like other gradient descent algorithms, this one also is linear convergent. The main advantage of this computational scheme is that at every iteration we generate a positive, occasionally greater than 1, initial stepsize in the backtracking procedure, this giving us the possibility to continue and accelerate the convergence of the algorithm. The numerical experience shows that the algorithm compares favourable with the Barzilai-Borwein approach.

A number of 400 unconstrained optimization problems have been considered in this experiment. The Fortran code is authored by Andrei.

The criteria for stopping the iterations are: $\|\mathbf{g}_{k+1}\|_{\infty} \leq \varepsilon_g$ or $t_{k+1} |\mathbf{g}_{k+1}^T \mathbf{g}_{k+1}| \leq \varepsilon_f |f_{k+1}|$, where $\varepsilon_g = 10^{-6}$ and $\varepsilon_f = 10^{-20}$. The code considers backtracking using Armijo line search implemented in the following manner:

Step 1. Set: $t = \bar{t}_{k+1}$ and $f_{\min} = \min\{f(x_j), j = 0, 1, \dots, k+1\}$.

Step 2. While $f(x_{k+1} - t\mathbf{g}_{k+1}) > f_{\min} - \alpha t \mathbf{g}_{k+1}^T \mathbf{g}_{k+1}$, set $t = t\beta$.

Step 3. Set $t_{k+1} = t$.

in which $\alpha = 0.0001$ and $\beta = 0.8$. Here $\bar{t}_{k+1} = \frac{1}{\gamma_{k+1}}$, where $\gamma_{k+1} = \frac{2}{\mathbf{g}_k^T \mathbf{g}_k} \frac{1}{t_k^2} [f(x_{k+1}) - f(x_k) + t_k \mathbf{g}_k^T \mathbf{g}_k]$.

The following tables give the results of ASA package, where:

n	dimension of the problem (number of variables),
iter	number of iterations,
fgcnt	number of function and its gradient evaluations,
time(c)	cpu time in centeseconds,
fxnew	function value in (local) optimal point, $f(x^*)$,
ginf	infinite norm of the gradient in optimal point, $\ \nabla f(x^*)\ _\infty$,
ngama	number of negative γ_{k+1} ,
stepinimin	$\min\{\bar{t}_k, k = 0, 1, \dots, iter\}$
stepinimax	$\max\{\bar{t}_k, k = 0, 1, \dots, iter\}$

1 New Gradient Algorithm: Extended Freudenstein & Roth

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	25	194	22	.5503076402906E-15	.2526382658630E-08	.2269962984566E-03	.3447924218341E+00	
2000	25	194	50	.2090239184863E-14	.3481602561806E-08	.2269962984567E-03	.3447985549264E+00	
3000	25	194	71	.4750588380691E-15	.1355200396347E-08	.2269962984567E-03	.3447849023407E+00	
4000	25	194	99	.1088560992873E-16	.1776392366537E-09	.2269962984567E-03	.3447773404826E+00	
5000	25	194	121	.2485237610176E-14	.2401012721975E-08	.2269962984567E-03	.3447916175944E+00	
6000	25	194	148	.2593671985818E-13	.7080702246753E-08	.2269962984566E-03	.3448216653654E+00	
7000	25	194	171	.9991685968359E-14	.4068796854995E-08	.2269962984566E-03	.3448023279152E+00	
8000	25	194	192	.1649196107615E-13	.4889727733826E-08	.2269962984566E-03	.3448075966437E+00	
9000	25	194	225	.3368985268126E-13	.6589012002678E-08	.2269962984565E-03	.3448185127370E+00	
10000	25	194	247	.2208693067712E-14	.1600534815793E-08	.2269962984565E-03	.3447864766849E+00	
TOTAL	250	1940	13.46(seconds)					

2 New Gradient Algorithm: Extended Trigonometric

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	40	141	55	.1097242118862E-12	.5961495609152E-06	.6380737559397E-05	.6161844935984E+01	
2000	35	135	104	.1086144214804E-10	.7945807642933E-06	.1507530037943E-05	.4508934408255E+01	
3000	30	122	143	.1893721118397E-11	.3855354629158E-06	.7328031392263E-06	.1118503188052E+01	
4000	29	122	192	.8391597371406E-11	.3761095086435E-06	.4803877620206E-06	.5133463956696E+00	
5000	30	126	248	.5164615678794E-11	.2372879280187E-06	.3072120456288E-06	.5179993367883E+00	
6000	34	135	318	.9106172808732E-10	.7596658120546E-06	.1731399832022E-06	.1185351645069E+01	
7000	31	131	363	.1269387026414E-10	.3656270355298E-06	.1554853665029E-06	.5170515412512E+00	
8000	32	134	423	.2142159313200E-13	.4417489107379E-07	.1098927214905E-06	.5008771993091E+00	
9000	32	135	477	.4942562593303E-11	.5023641040992E-06	.8514370241044E-07	.5460597764656E+00	
10000	33	138	544	.1416147658278E-14	.1254615872039E-07	.7030804836222E-07	.5008231552306E+00	
TOTAL	326	1319	28.67(seconds)					

3 New Gradient Algorithm: Extended Rosenbrock				Function				
n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	234	1914	379	.5167075141981E-10	.2299872431605E-06		.5233249875407E-03	.5580956403427E+01
2000	80	675	269	.4748378666544E-16	.1644906541705E-09		.5233249875407E-03	.5580956396847E+01
3000	253	2071	1220	.4562579777450E-09	.4487708694131E-06		.5233249875407E-03	.5580956398414E+01
4000	138	1159	917	.2175806953274E-10	.8327942411200E-07		.5233249875407E-03	.5580956396679E+01
5000	247	1976	1983	.3511744619294E-08	.9114189111867E-06		.5233249875408E-03	.5580956398036E+01
6000	91	769	928	.9464437985354E-12	.1478834470246E-07		.5233249875407E-03	.5580956402300E+01
7000	86	722	1016	.2746491071165E-09	.2232279846213E-06		.5233249875407E-03	.5580956394805E+01
8000	161	1365	2197	.7071727358865E-14	.4577076291804E-08		.5233249875407E-03	.5580956406722E+01
9000	81	694	1263	.1731699731198E-11	.1737651044104E-07		.5233249875407E-03	.5580956414811E+01
10000	91	779	1577	.2542612282049E-11	.1944041753748E-07		.5233249875407E-03	.5580956425591E+01
TOTAL	1462	12124	117.49(seconds)					

4 New Gradient Algorithm: Extended White & Holst				Function				
n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	79	702	137	.7050418081442E-09	.7279874013832E-06		.3780680475714E-03	.5004448001508E+01
2000	69	615	247	.2531961686044E-08	.9863472459257E-06		.3780680475714E-03	.5004412490703E+01
3000	144	1289	769	.2492706819863E-08	.7573771131303E-06		.3780680475714E-03	.5004446626491E+01
4000	127	1130	901	.5412180047087E-08	.9918858484342E-06		.3780680475714E-03	.5004338988673E+01
5000	114	1033	1033	.7612613832374E-08	.9893303915681E-06		.3780680475714E-03	.5004361990516E+01
6000	224	1999	2400	.8491185458557E-08	.9769454863140E-06		.3780680475714E-03	.5004326969773E+01
7000	164	1472	2065	.9173814521895E-08	.9540839564031E-06		.3780680475714E-03	.5004285350377E+01
8000	114	1026	1648	.1127513698215E-07	.9829239143639E-06		.3780680475714E-03	.5004307213485E+01
9000	102	914	1659	.1404948469621E-07	.9930300509404E-06		.3780680475714E-03	.5004393457529E+01
10000	82	730	1466	.1403975191586E-07	.9990916945428E-06		.3780680475714E-03	.5004397143504E+01
TOTAL	1219	10910	123.25(seconds)					

5 New Gradient Algorithm: Extended Beale				Function				
n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	60	303	28	.1931803938571E-10	.1416174098165E-06		.2041600806168E-01	.3310189857718E+01
2000	60	303	54	.3868061887393E-10	.1416973080402E-06		.2041600867026E-01	.3310188999295E+01
3000	60	303	77	.5844907113521E-10	.1422086752319E-06		.2041601254332E-01	.3310183509202E+01
4000	60	303	110	.7734727737241E-10	.1416847884997E-06		.2041600857507E-01	.3310189133789E+01
5000	60	303	132	.9287918984209E-10	.1389386820205E-06		.2041598711251E-01	.3310218738599E+01
6000	60	303	159	.1143438264146E-09	.1406799120810E-06		.2041600085170E-01	.3310199942943E+01
7000	60	303	193	.1333648118064E-09	.1406612193538E-06		.2041600070668E-01	.3310200144284E+01
8000	60	303	219	.1590431943227E-09	.1436266473310E-06		.2041602308871E-01	.3310168321167E+01
9000	60	303	242	.1788682434359E-09	.1436047686663E-06		.2041602292820E-01	.3310168555150E+01
10000	60	303	275	.1941877986612E-09	.1419786193363E-06		.2041601080563E-01	.3310185978250E+01
TOTAL	600	3030	14.89(seconds)					

6 New Gradient Algorithm: Extended Penalty**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	51	205	38	.8831940750670E+03	.4873789942691E-06		.6987746485119E-09	.6961190296391E-01
2000	50	209	71	.1814063664869E+04	.1522153363562E-06		.8226724247928E-10	.4185205973487E-01
3000	50	216	121	.2755973749503E+04	.7642664662828E-06		.1960361988051E-10	.5316423037217E-01
4000	57	303	209	.3704070534948E+04	.1633022448313E-06	3	.8717509521452E-11	.9521510577206E+01
5000	54	226	203	.4656333923744E+04	.3231469398221E-06		.4464343805100E-11	.1366443259335E+00
6000	60	347	368	.5611676659140E+04	.3780400298355E-05	2	.3272869989429E-11	.5038086747522E+01
7000	58	245	313	.6569428560737E+04	.5129179464021E-06		.2078747903081E-11	.5253136421903E-01
8000	61	279	401	.7529139638522E+04	.3064935264209E-06	1	.1357871102349E-11	.5030669955295E+01
9000	61	320	511	.8490489281458E+04	.1146580701515E-07	3	.8007302570503E-12	.6043655264292E+01
10000	62	273	489	.9453238852842E+04	.8408792424799E-06	1	.6952407078957E-12	.6268848830182E+01
TOTAL	564	2623	27.24(seconds)					

7 New Gradient Algorithm: Perturbed Quadratic**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	1263	6769	664	.2079195374296E-12	.9151068305042E-06		.5027965347180E-03	.4944422581186E+00
2000	2827	14985	2950	.2454704957031E-12	.9953814074931E-06		.2515271918670E-03	.4873084185634E+00
3000	3825	21315	6300	.2467204907664E-12	.9978807416046E-06		.1673143444082E-03	.4926440157696E+00
4000	5182	29215	11556	.2410955457121E-12	.9864487214753E-06		.1255977731813E-03	.4920044757907E+00
5000	6650	37239	18510	.2447176441757E-12	.9938262632093E-06		.1003610802568E-03	.4929047293949E+00
6000	7564	43360	25996	.2444899567092E-12	.9929340385406E-06		.8362214698878E-04	.4944859320598E+00
7000	9493	52917	37130	.2439205419933E-12	.9910615168862E-06		.7174887237940E-04	.4912404390389E+00
8000	10597	59673	48027	.2453152475623E-12	.9950198822912E-06		.6284645240368E-04	.4892007062491E+00
9000	11659	66519	60352	.2462860416898E-12	.9969390762050E-06		.5578355612261E-04	.4912567613110E+00
10000	13540	75790	76681	.2458483961508E-12	.9960573939978E-06		.5019464955083E-04	.4945033985295E+00
TOTAL	72600	407782	2881.66(seconds)					

8 New Gradient Algorithm: Raydan 1**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	691	3665	451	.5005000000000E+05	.1362157504579E-04	5	.2066640036538E-05	.9908690152027E+01
2000	1207	6378	1587	.2001000000000E+06	.3276229695320E-04	8	.1552784767975E-05	.2466014626238E+02
3000	1368	7408	2757	.4501500000000E+06	.2491682259193E-04	9	.5937211612660E-05	.9970582035886E+01
4000	1489	7971	3966	.8002000000000E+06	.8384379117502E-04	12	.5961207445778E-06	.9919937018767E+01
5000	1901	9895	6201	.1250250000000E+07	.1501763829575E-03	5	.4595961000866E-06	.1765912505380E+02
6000	1866	10037	7574	.1800300000000E+07	.1663708593367E-03	6	.5715496325202E-06	.1083121782406E+03
7000	2360	12752	11254	.2450350000001E+07	.3356343650558E-03	6	.1755796455230E-06	.8414238400840E+01
8000	2281	12582	12738	.3200400000000E+07	.2389754444458E-03	6	.3054865098498E-06	.1209781819517E+02
9000	2325	12703	14522	.4050450000000E+07	.2016547244741E-03	6	.9262576855022E-06	.8923620464607E+01
10000	2317	12767	16329	.5000500000001E+07	.4153874719465E-03	5	.2440656797202E-06	.2305213234446E+02
TOTAL	17805	96158	773.79(seconds)					

9 New Gradient Algorithm: Raydan 2**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	8	18	0	.1000000000000E+04	.1173470375070E-08		.6049986753983E+00	.1844559122419E+01
2000	8	18	6	.2000000000000E+04	.1170084744969E-08		.6049986753983E+00	.1844559122421E+01
3000	8	18	11	.3000000000000E+04	.1173076062124E-08		.6049986753983E+00	.1844559122418E+01
4000	8	18	5	.4000000000000E+04	.1179091457392E-08		.6049986753983E+00	.1844559122418E+01
5000	8	18	17	.5000000000000E+04	.1170364812280E-08		.6049986753983E+00	.1844559122429E+01
6000	8	18	11	.6000000000000E+04	.1177194277171E-08		.6049986753982E+00	.1844559122436E+01
7000	8	18	16	.7000000000000E+04	.1168803352334E-08		.6049986753982E+00	.1844559122437E+01
8000	8	18	22	.8000000000000E+04	.1178922564389E-08		.6049986753983E+00	.1844559122419E+01
9000	8	18	22	.9000000000000E+04	.1177070895180E-08		.6049986753983E+00	.1844559122397E+01
10000	8	18	22	.1000000000000E+05	.1172152445364E-08		.6049986753983E+00	.1844559122360E+01
TOTAL	80	180	1.32(seconds)					

14 New Gradient Algorithm: Generalized Tridiagonal 1**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	26	81	22	.9972103074860E+03	.8758677796372E-06		.2035872441076E-01	.1603392701481E+00
2000	26	80	49	.1997210307486E+04	.6325991996903E-06		.1956054868782E-01	.1603400300573E+00
3000	29	104	99	.2997210307486E+04	.7330260143323E-06	1	.2083567491923E-01	.5040534958212E+01
4000	26	80	105	.3997210307486E+04	.2394245997017E-06		.2051829325774E-01	.1627747942483E+00
5000	28	97	154	.4997210307486E+04	.9407618120072E-06	1	.1955532151625E-01	.5227065656970E+01
6000	34	259	477	.5997210307486E+04	.2175821904427E-05	3	.2245579379992E-05	.5095110418457E+01
7000	35	162	357	.6997210307486E+04	.1636257036086E-05	1	.9713050486010E-06	.5161507008653E+01
8000	26	80	204	.7997210307486E+04	.7019324705926E-06		.2117312822497E-01	.1603406218508E+00
9000	33	173	483	.8997210307486E+04	.3543318671806E-06	3	.1518098863846E-01	.5266963475935E+01
10000	35	153	483	.9997210307486E+04	.9423922280316E-06	2	.1088592232500E-02	.5758729458622E+01
TOTAL	298	1269	24.33(seconds)					

15 New Gradient Algorithm: Extended Tridiagonal 1**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	81	467	72	.6062837704574E-06	.8430970275983E-06		.8491501907650E-01	.1052587962891E+04
2000	196	1353	428	.1406901586257E-05	.9617201399216E-06		.8491501907650E-01	.1047409636148E+04
3000	84	499	236	.1756307962895E-05	.8129928448481E-06		.8491501907650E-01	.8104410237981E+03
4000	154	1019	648	.2767745503790E-05	.9728753471800E-06		.8491501907650E-01	.1014183323013E+04
5000	79	459	374	.1823081986702E-05	.5656149918110E-06		.8491501907650E-01	.7321332679103E+03
6000	81	468	456	.4405397365442E-05	.9919212962661E-06		.8491501907650E-01	.8334576837274E+03
7000	86	508	577	.3013403079900E-05	.6586637802104E-06		.8491501907650E-01	.1084818624002E+04
8000	200	1409	1823	.6060818274010E-05	.9804771823664E-06		.8491501907650E-01	.1013233927306E+04
9000	174	1184	1730	.5948464996675E-05	.9220984819223E-06		.8491501907650E-01	.9868731268441E+03
10000	194	1338	2175	.6859570782071E-05	.9917061802159E-06		.8491501907650E-01	.1028012026896E+04
TOTAL	1329	8704	85.19(seconds)					

16 New Gradient Algorithm: Extended Three Expo Terms

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	12	43	11	.1279633348329E+04	.8123927974779E-08		.6804806860618E-01	.3907363595065E+00
2000	12	43	22	.2559266696658E+04	.1900149415590E-07		.6804806860615E-01	.3907363420464E+00
3000	12	43	28	.3838900044987E+04	.7972040005910E-07		.6804806860613E-01	.3907362656973E+00
4000	12	43	38	.5118533393317E+04	.1099835837959E-06		.6804806860617E-01	.3907363824972E+00
5000	12	43	50	.6398166741646E+04	.1278744097277E-06		.6804806860619E-01	.3907364399064E+00
6000	12	43	60	.7677800089975E+04	.1399356870380E-06		.6804806860620E-01	.3907365162650E+00
7000	12	43	71	.8957433438304E+04	.1040185209078E-06		.6804806860619E-01	.3907364597706E+00
8000	12	43	83	.1023706678663E+05	.5128998159520E-07		.6804806860617E-01	.3907365178415E+00
9000	12	43	88	.1151670013496E+05	.9822594737585E-08		.6804806860616E-01	.3907365682867E+00
10000	12	43	104	.1279633348329E+05	.2375623608941E-07		.6804806860615E-01	.3907365886605E+00
TOTAL	120	430	5.55(seconds)					

17 New Gradient Algorithm: generalized Tridiagonal 2

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	112	409	132	.4471761704532E-12	.9866718458095E-06		.9792983659115E-03	.5480671412679E-01
2000	95	452	296	.5406844829960E-12	.6610377590089E-06	5	.5317859586320E-03	.5003279222776E+01
3000	87	351	346	.5323206455425E-12	.7423322796409E-06	2	.4595314433393E-03	.5364857255600E+01
4000	68	249	330	.2033983649052E-14	.1957525653092E-06	1	.3926328530696E-03	.5005046702201E+01
5000	125	543	901	.1114854332625E+01	.6278007758098E-06	2	.3690962175684E-03	.5104210842830E+01
6000	998	5266	10007	.3439074037830E+01	.8979075234866E-06	3	.3582822064809E-03	.7818722894180E+02
7000	1241	6687	14797	.2123937494288E+01	.5521723660806E-06	6	.3524312843571E-03	.2171870024917E+02
8000	431	2025	5218	.1438823445608E+02	.8677209755170E-06	3	.3488718292109E-03	.5004895618049E+01
9000	69	231	676	.2510297029352E+01	.2786659631937E-06		.1760114771017E-03	.1612475134620E+00
10000	62	247	802	.2146531164762E+01	.6230906016115E-06	1	.1780337694693E-03	.5000467756801E+01
TOTAL	3288	16460	335.05(seconds)					

20 New Gradient Algorithm: Extended Himmelblau

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	14	49	0	.2352869280683E-11	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
2000	14	49	11	.4705738561365E-11	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
3000	14	49	11	.7058607842048E-11	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
4000	14	49	22	.9411477122731E-11	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
5000	14	49	22	.1176434640341E-10	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
6000	14	49	28	.1411721568410E-10	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
7000	14	49	27	.1647008496478E-10	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
8000	14	49	38	.1882295424546E-10	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
9000	14	49	39	.2117583036409E-10	.4515170077961E-06		.1028203171083E-01	.3888658213034E-01
10000	14	49	44	.2352869280683E-10	.4515169402946E-06		.1028203171083E-01	.3888658213034E-01
TOTAL	140	490	2.42(seconds)					

21 New Gradient Algorithm: Generalized PSC1**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	635	3628	2905	.9987220420199E+03	.5748086805424E-06	10	.6710006326168E-02	.1638434729421E+04
2000	586	3567	5652	.1998722043876E+04	.8277431761969E-06	21	.6708979804950E-02	.8998556038893E+04
3000	510	2823	6833	.2998722043002E+04	.6225124739283E-06	13	.6708638250119E-02	.1884602640587E+05
4000	710	4050	13012	.3998722047697E+04	.9967453885063E-06	55	.6708467588493E-02	.4622587253398E+04
5000	845	4743	19015	.4998722045467E+04	.9895754193856E-06	66	.6708365228538E-02	.2526170408002E+06
6000	482	2585	12342	.5998722050790E+04	.9933165028851E-06	34	.6708297003985E-02	.8986906662524E+03
7000	851	4772	26924	.6998722043162E+04	.9932613279627E-06	58	.6708248279711E-02	.2913932721389E+04
8000	487	2595	16961	.7998722050807E+04	.9210901210626E-06	34	.6708211740632E-02	.1508035574925E+04
9000	438	2445	17686	.8998722052221E+04	.9558552119815E-06	16	.6708183323795E-02	.1655751734755E+04
10000	584	3134	25261	.9998722056549E+04	.9701270448441E-06	52	.6708160591865E-02	.4115389306183E+04
TOTAL	6128	34342	1465.91(seconds)					

22 New Gradient Algorithm: Extended PSC1**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	11	39	16	.3865995282465E+03	.2129899840941E-06		.1388533437120E-01	.4634585774807E+00
2000	11	39	44	.7731990564929E+03	.2121720777959E-06		.1388533437120E-01	.4634585775419E+00
3000	11	39	60	.1159798584739E+04	.2214661425359E-06		.1388533437120E-01	.4634585776104E+00
4000	11	39	83	.1546398112986E+04	.2392587027389E-06		.1388533437120E-01	.4634585775741E+00
5000	11	39	99	.1932997641232E+04	.2498959634223E-06		.1388533437120E-01	.4634585774495E+00
6000	11	39	126	.2319597169479E+04	.2569200622804E-06		.1388533437120E-01	.4634585774708E+00
7000	11	39	143	.2706196697725E+04	.2619764584710E-06		.1388533437120E-01	.4634585775674E+00
8000	11	39	165	.3092796225972E+04	.2657643618509E-06		.1388533437120E-01	.4634585775461E+00
9000	11	39	181	.3479395754218E+04	.2687080393748E-06		.1388533437120E-01	.4634585775264E+00
10000	11	39	203	.3865995282465E+04	.2710611038959E-06		.1388533437120E-01	.4634585774751E+00
TOTAL	110	390	11.20(seconds)					

24 New Gradient Algorithm: Extended Block-Diagonal BD1**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	36	180	22	.1859928651189E-10	.2670882875406E-06	5	.4434567214950E-01	.5363315389197E+01
2000	36	180	55	.3719846704412E-10	.2670878583688E-06	5	.4434567214950E-01	.5363315393300E+01
3000	36	180	72	.5579754529869E-10	.2670874397566E-06	5	.4434567214950E-01	.5363315397523E+01
4000	36	180	104	.7439679808280E-10	.2670875831186E-06	5	.4434567214950E-01	.5363315396022E+01
5000	36	180	126	.9299696663207E-10	.2670891515614E-06	5	.4434567214949E-01	.5363315380683E+01
6000	36	180	154	.1115943109283E-09	.2670863880844E-06	5	.4434567214949E-01	.5363315407848E+01
7000	36	180	181	.1301922058494E-09	.2670850511094E-06	5	.4434567214949E-01	.5363315421091E+01
8000	36	180	209	.1487947382578E-09	.2670887383501E-06	5	.4434567214949E-01	.5363315384759E+01
9000	36	180	231	.1673947702535E-09	.2670893584473E-06	5	.4434567214949E-01	.5363315378601E+01
10000	36	180	258	.1859944056281E-09	.2670895335234E-06	5	.4434567214949E-01	.5363315376901E+01
TOTAL	360	1800	14.12(seconds)					

25 New Gradient Algorithm: Extended Maratos

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	56	296	27	-.5003121103477E+03	.1574082321607E-05	3	.3122423616423E-08	.5003880693896E+01
2000	28	191	33	-.1000624220697E+04	.3310556073721E-06	1	.1098359185823E-02	.5001711952673E+01
3000	66	394	99	-.1500936331044E+04	.1016748718667E-05	5	.5660256690376E-08	.5006419327877E+01
4000	70	372	132	-.2001248441391E+04	.1540031342815E-05	5	.3309977408264E-08	.5005440172476E+01
5000	27	195	82	-.2501560551742E+04	.1916394919421E-06	2	.7617525374499E-03	.5002759584725E+01
6000	51	272	143	-.3001872662076E+04	.3095038925842E-05	3	.9743794939295E-09	.5005838868170E+01
7000	55	282	176	-.3502184772420E+04	.3263347972251E-05	3	.6078118644742E-09	.5002715164757E+01
8000	49	232	159	-.4002496882782E+04	.1494612172563E-05	1	.3235415737499E-08	.5005214839228E+01
9000	36	275	220	-.4502808993133E+04	.9992245918506E-06	4	.4553780051145E-03	.5020272652522E+01
10000	59	319	280	-.5003121103473E+04	.2032968847474E-05	4	.1238792390760E-08	.5003234698029E+01
TOTAL	497	2828	13.51(seconds)					

27 New Gradient Algorithm: Quadratic Diagonal Perturbed

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	2110	19928	2055	.5998424766393E-10	.9695695735167E-06		.4975058375411E-03	.4120967466825E+02
2000	3169	31854	6585	.5125572998693E-10	.8746192858547E-06		.2487535375512E-03	.4061763988276E+02
3000	6399	66353	20597	.7640079151928E-10	.9873266153839E-06		.1658358292081E-03	.3996689342368E+02
4000	6655	68974	28644	.7035200317503E-10	.9909687167650E-06		.1243769234714E-03	.4039685173586E+02
5000	8757	91864	47906	.6943522487008E-10	.9458363339624E-06		.9950156352850E-04	.4012797974542E+02
6000	10037	104089	65389	.6407084964023E-10	.9137513140649E-06		.8291798335786E-04	.4059644299407E+02
7000	10568	111677	82163	.7290245176459E-10	.9808353295690E-06		.7107256558272E-04	.4005276386120E+02
8000	12528	134358	113459	.6862701289270E-10	.9138755056045E-06		.6218850040975E-04	.4023987853598E+02
9000	16229	175211	166836	.6394609554862E-10	.9889891307353E-06		.5527867085055E-04	.4048437291872E+02
10000	15883	171443	181595	.7418335834163E-10	.9478173409284E-06		.4975080651565E-04	.3988566896279E+02
TOTAL	92335	975751	7152.29(seconds)					

28 New Gradient Algorithm: Extended Wood

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	1174	8024	1901	.4195132231815E-09	.9842928440915E-06	1	.1822689236783E-03	.5082835828289E+01
2000	1106	7393	3504	.7267870812144E-09	.9180357274758E-06	1	.1822689236783E-03	.5082835724372E+01
3000	1000	6714	4779	.1214226667387E-08	.9663459526666E-06	1	.1822689236783E-03	.5082835803861E+01
4000	1015	6848	6525	.1273333929635E-08	.9286592572027E-06	1	.1822689236783E-03	.5082836164717E+01
5000	1080	7308	8689	.2050948296659E-08	.9722907424801E-06	1	.1822689236783E-03	.5082836531485E+01
6000	1041	7128	10233	.2524154669659E-08	.9949177891905E-06	1	.1822689236783E-03	.5082836811964E+01
7000	1140	7871	13182	.2949164140395E-08	.9935167933808E-06	1	.1822689236783E-03	.5082836862427E+01
8000	1015	6857	13193	.3350892329484E-08	.9892640162312E-06	1	.1822689236783E-03	.5082837560820E+01
9000	1117	7572	16428	.3937772163272E-08	.9950787322882E-06	1	.1822689236783E-03	.5082837164085E+01
10000	1051	7178	17247	.3896792916951E-08	.9989913394408E-06	1	.1822689236783E-03	.5082837179097E+01
TOTAL	10739	72893	956.81(seconds)					

29 New Gradient Algorithm: Extended Hiebert

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	2980	30620	2488	.1113114354812E-16	.5684341886166E-10	1	.1922365973740E-03	.1300463413879E+02
2000	4102	41775	6794	.6476783128614E-08	.9687598967773E-06	1	.1922413222227E-03	.1300476959963E+02
3000	896	9020	2208	.4013870980334E-11	.1989292296741E-07	1	.1922365995071E-03	.1300163098944E+02
4000	2756	28447	9266	.1542195010955E-07	.9918213006803E-06	1	.1922388569872E-03	.1300475387752E+02
5000	5816	59049	24123	.1617302761193E-07	.9752923439892E-06	1	.1922417222035E-03	.1300472889136E+02
6000	3786	38754	19070	.2376739762175E-07	.9967814625576E-06	1	.1922482428794E-03	.1300472247050E+02
7000	3842	39588	22943	.2236473937468E-07	.9905434355975E-06	1	.1922439143095E-03	.1300477537028E+02
8000	3065	31248	20751	.1417859541581E-13	.7264588931779E-09	1	.1922365969228E-03	.1300419431387E+02
9000	4484	45653	34421	.2950785044346E-07	.9738553436761E-06	1	.1922439028040E-03	.1300472966620E+02
10000	5304	54048	45462	.2899979085649E-07	.9273949176762E-06	1	.1922538042684E-03	.1300478366427E+02
TOTAL	37031	378202	1875.26(seconds)					

30 New Gradient Algorithm: Quadratic QF1

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	1483	7414	44	-.4999999995033E-03	.9966142785672E-06		.1006093003554E-02	.9946272187306E+00
2000	2719	14744	280	-.2499999995466E-03	.9522375925139E-06		.5021721342801E-03	.9946597044513E+00
3000	3897	22272	835	-.16666666661809E-03	.9856261282141E-06		.3350450878439E-03	.9945661811573E+00
4000	5110	28954	1532	-.1249999995030E-03	.9969811031983E-06		.2509755149998E-03	.9988183195044E+00
5000	6831	38206	2664	-.9999999950047E-04	.9995128858996E-06		.2013845960910E-03	.9894305776237E+00
6000	7879	43953	3653	-.8333333284200E-04	.9912921837604E-06		.1674678176116E-03	.9899009319995E+00
7000	9242	52373	5338	-.7142857093946E-04	.9886708827216E-06		.1434904345857E-03	.9898287889531E+00
8000	10574	59865	7201	-.62499999950355E-04	.9964437140694E-06		.1255062153982E-03	.9773031072803E+00
9000	11677	66725	9167	-.5555555505657E-04	.9989441668718E-06		.1113835011918E-03	.9997749374894E+00
10000	13351	75693	11650	-.4999999950072E-04	.9992525432330E-06		.1004916677812E-03	.9904526764817E+00
TOTAL	72763	410199	423.64(seconds)					

31 New Gradient Algorithm: Extended Quadratic Penalty QP1

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	23	230	16	.3990006250000E+04	.4353800951444E-05	3	.2334894712847E-03	.1719172177586E+02
2000	20	84	17	.7990003125000E+04	.2481637704776E-06		.1182613745772E-03	.1250720107895E+00
3000	17	214	60	.1199000208333E+05	.5264205883398E-05	3	.5583587981965E-04	.1259895610224E+02
4000	27	259	94	.1599000156250E+05	.1253189458417E-04	3	.5864567139773E-04	.7065004265303E+01
5000	22	89	44	.1999000125000E+05	.6384435639328E-06		.4690462812040E-04	.1249747225841E+00
6000	25	292	159	.2399000104166E+05	.1065548638544E-04	4	.3904571592670E-04	.7635990552700E+01
7000	20	91	60	.2799000089285E+05	.2625075076756E-06		.2562257478190E-04	.1250195148976E+00
8000	23	95	77	.3199000078125E+05	.9816315558464E-06		.2734200262235E-04	.1249735353645E+00
9000	19	280	231	.3599000069444E+05	.2848468807513E-05	3	.1905463923496E-04	.1995572036273E+02
10000	24	116	110	.3999000062500E+05	.9694621050382E-06	1	.2187112266452E-04	.5280678761402E+01
TOTAL	220	1750	8.68(seconds)					

32 New Gradient Algorithm: Extended Quadratic Penalty QP2 Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	53	409	94	.2277336432736E-11	.9549065839729E-07	4	.2053589804541E-03	.6386031297277E+01
2000	118	876	411	.1879825176273E-09	.8475137746249E-06	8	.8767245891119E-04	.2969198408066E+02
3000	54	414	292	.1365484598354E-10	.1349538055279E-06	6	.5982188830403E-04	.4911471298117E+02
4000	50	354	329	.1230659997551E-09	.3508516204825E-06	3	.6048879158932E-04	.8177739641989E+01
5000	60	421	500	.1282199287712E-10	.3191814812580E-06	5	.4829185282936E-04	.7318576983739E+01
6000	101	771	1093	.7254068861397E-10	.2199284876989E-06	10	.3927341584003E-04	.4621967053694E+02
7000	173	1162	1939	.1159665921752E-08	.8141006288999E-06	6	.2648998950980E-04	.1096723059038E+02
8000	66	463	873	.2655107243500E-14	.1152267150652E-08	3	.2851625000238E-04	.6681846793529E+01
9000	64	451	967	.1152081428109E-11	.2262947427928E-07	2	.1950438392650E-04	.5064497872937E+01
10000	34	244	577	.5832103586938E-13	.1348075784313E-06	3	.2261434518886E-04	.1408872389645E+02
TOTAL	773	5565	70.75(seconds)					

33 New Gradient Algorithm: Quadratic QF2 Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	1493	7895	1686	-.1000124968766E+01	.6361950198759E-06	4	.2282587505891E-03	.5000285811074E+01
2000	2881	15241	6415	.9999374921856E+00	.8832037752898E-06	3	.1209930491421E-03	.5000133956865E+01
3000	2143	12714	8052	-.1000041663195E+01	.2939918534087E-08		.7757379372189E-04	.3106247626936E+00
4000	5332	29617	24920	.9999687480467E+00	.4300023813180E-06	4	.6009855727001E-04	.5000292872906E+01
5000	6609	36034	37937	.9999749987499E+00	.3417546612929E-06	3	.4802086058212E-04	.5000256409258E+01
6000	7195	39428	49400	-.1000020832465E+01	.9881005873741E-06	10	.2250272855058E-04	.5000242909341E+01
7000	8300	46133	67498	-.1000017856505E+01	.1325687457128E-05	7	.3107318464770E-08	.5000233686242E+01
8000	7547	43110	72502	.9999843745117E+00	.2608462590569E-06	5	.2988049947190E-04	.5000227044882E+01
9000	11003	61165	115343	-.1000013888503E+01	.4848644274885E-06		.2634709801147E-04	.3282584366899E+00
10000	12845	70945	149754	.9999874996875E+00	.5757521996580E-06	5	.2482780823300E-04	.5000412819975E+01
TOTAL	65348	362282	5335.07(seconds)					

34 New Gradient Algorithm: Extended EP1 Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	4	35	0	.7931762881473E+04	.1480591510540E-06		.2143078035335E-02	.2182505949335E-02
2000	4	35	5	.1586352576295E+05	.1480402398828E-06		.2143078035333E-02	.2182505949344E-02
3000	4	35	6	.2379528864442E+05	.1480334555111E-06		.2143078035332E-02	.2182505949348E-02
4000	4	35	11	.3172705152589E+05	.1480300633218E-06		.2143078035332E-02	.2182505949349E-02
5000	4	35	11	.3965881440736E+05	.1480280054054E-06		.2143078035332E-02	.2182505949369E-02
6000	4	35	16	.4759057728884E+05	.1480266711325E-06		.2143078035332E-02	.2182505949384E-02
7000	4	35	17	.5552234017031E+05	.1480256439472E-06		.2143078035332E-02	.2182505949394E-02
8000	4	35	16	.6345410305178E+05	.1480249256294E-06		.2143078035331E-02	.2182505949402E-02
9000	4	35	22	.7138586593325E+05	.1480532914946E-06		.2143078035331E-02	.2182505949392E-02
10000	4	35	22	.7931762881473E+05	.1480853584167E-06		.2143078035331E-02	.2182505949378E-02
TOTAL	40	350	1.26(seconds)					

35 New Gradient Algorithm: Extended Tridiagonal 2

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	35	126	11	.3893393944764E+03	.5148119573972E-06		.1354897366210E+00	.4751941913998E+01
2000	35	123	22	.7790685180765E+03	.9318623560572E-06	3	.1354668077703E+00	.5438518204085E+01
3000	32	117	33	.1168797641676E+04	.8746693778705E-06	1	.1354591741892E+00	.5212522473041E+01
4000	34	128	44	.1558526765277E+04	.7083485223935E-06	2	.1354553591530E+00	.6255291939363E+01
5000	37	129	55	.194825588877E+04	.9574992466399E-06	2	.1259149028664E+00	.5300089896913E+01
6000	38	140	77	.2337985012477E+04	.9580126296427E-06		.1354515452856E+00	.7782301616211E+02
7000	38	131	77	.2727714136076E+04	.9033844373396E-06		.1354504558238E+00	.4789864581589E+01
8000	42	181	126	.3117443259676E+04	.6436640775098E-06	2	.1057248097190E+00	.5432308183755E+02
9000	34	130	104	.3507172383276E+04	.9273994271974E-06	1	.1168521979691E+00	.5575400957542E+01
10000	40	139	127	.3896901506876E+04	.5321991278229E-06	2	.1354484950328E+00	.5184271311277E+01

TOTAL	365	1344	6.76(seconds)					

36 New Gradient Algorithm: BDQRTIC (CUTE)

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	518	3812	2043	.3983817950577E+04	.3970712292301E-04	12	.1611365021565E-08	.5000860165086E+01
2000	847	7084	7564	.7989427682544E+04	.2785430473815E-03	31	.3448797173871E-09	.5000063458445E+01
3000	792	6820	10968	.1199503741451E+05	.1064893106810E-02	25	.6835160670959E-10	.5000865121249E+01
4000	471	4408	9480	.1600064714651E+05	.4108764055773E-03	28	.6311412499225E-06	.8415752436991E+01
5000	660	5960	16017	.2000625687857E+05	.1554406417728E-02	31	.4548617693317E-10	.5000043036690E+01
6000	471	4593	14808	.2401186661046E+05	.5106796325058E-03	29	.4232274705145E-08	.5000056646914E+01
7000	379	3348	12770	.2801747634266E+05	.1149795166210E-02	15	.5282070617686E-09	.5000022037745E+01
8000	455	3975	17208	.3202308607442E+05	.6147606559206E-03	12	.2718867042382E-09	.5000027227583E+01
9000	683	6074	29572	.3602869580630E+05	.1375990589996E-02	31	.4892455656665E-09	.5000163796148E+01
10000	534	4460	24200	.4003430553971E+05	.3699314721168E-02	19	.2514313188422E-11	.5000034447439E+01

TOTAL	5810	50534	1446.30(seconds)					

38 New Gradient Algorithm: ARWHEAD (CUTE)

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	39	313	171	.1083117970313E-15	.5552939692538E-05		.2663959087899E-25	.8350874110068E-01
2000	18	164	181	.6314942373273E-10	.8680806917738E-06	2	.6116346364344E-04	.5000598145528E+01
3000	24	208	346	.5965015233058E-10	.6900972833179E-06	2	.4032241831546E-04	.5000341699336E+01
4000	28	264	588	.1021895575971E-09	.7849714034336E-06	3	.3074637153834E-04	.5000229548909E+01
5000	39	376	1032	.4091936229959E-10	.4458188724854E-06	4	.2459598825023E-04	.5000270508410E+01
6000	19	162	544	.2274841823702E-09	.9536746419236E-06	1	.2029226118218E-04	.5000290682778E+01
7000	112	946	3669	.1691363097755E-09	.7630184373220E-06	4	.1487464449128E-04	.5000537023148E+01
8000	50	482	2126	.2946974472719E-09	.9416232535919E-06	6	.1518481560768E-04	.5000270949304E+01
9000	34	334	1664	.9254848883783E-10	.4922767677940E-06	3	.1337025566931E-04	.5000030662778E+01
10000	22	224	1247	.1557712630759E-09	.6074421516900E-06	2	.1214688903753E-04	.5000061852003E+01

TOTAL	385	3473	115.68(seconds)					

41 New Gradient Algorithm: DQDRTIC (CUTE)**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	109	588	137	.2868347741180E-12	.8948388068217E-06		.2487576307259E-02	.4998001901975E+00
2000	143	729	351	.5023139375421E-13	.8050899190582E-06		.2487569237429E-02	.4999637074059E+00
3000	99	519	374	.1469670593637E-14	.6922324696541E-06		.2487566885592E-02	.4999121303992E+00
4000	98	545	522	.2867061844764E-13	.3384364071239E-06		.2487565710566E-02	.4999864693599E+00
5000	134	690	829	.2138718054712E-12	.9248507123764E-06		.2487565005836E-02	.4999600357852E+00
6000	127	671	972	.2493835592445E-12	.9987428946437E-06		.2487564536135E-02	.4999683617807E+00
7000	108	522	896	.1248863464082E-12	.7065018221264E-06		.2487564200692E-02	.4999987342357E+00
8000	122	632	1224	.5706319271068E-13	.4766344798001E-06		.2487563949142E-02	.4999262198980E+00
9000	108	560	1209	.2165069557619E-12	.9302252236741E-06		.2487563753511E-02	.4999977432434E+00
10000	135	700	1691	.1025308561052E-12	.6404060105705E-06		.2487563597018E-02	.4999994331193E+00
TOTAL	1183	6156	82.05(seconds)					

42 New Gradient Algorithm: EG2 (CUTE)**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	150	2365	352	-.9989999999132E+03	.3528571696401E-03	24	.7427993302119E-10	.5000009463189E+01
2000	107	1449	428	-.1998999754143E+04	.5312850033936E-02	11	.3478228692540E-12	.5000024801138E+01
3000	135	2519	1121	-.2998998543499E+04	.1789624275301E-02	27	.1758298888399E-11	.5000006859266E+01
4000	75	1353	796	-.3998978158001E+04	.2549863079563E-01	13	.5733746562974E-13	.2777582330502E+05
5000	118	2268	1692	-.499899923803E+04	.2029972025753E-01	23	.7503559393072E-13	.7489243369037E+01
6000	94	960	868	-.5998988257561E+04	.1103337052666E-01	10	.1440151359531E-12	.2649512433755E+03
7000	101	1370	1439	-.6999499766358E+04	.1899314742779E-01	14	.1452158377908E-12	.9213856525780E+02
8000	130	2168	2598	-.7999499701603E+04	.5280073456485E-01	23	.2187250766356E-13	.5618166714177E+04
9000	52	1148	1543	-.8998998870998E+04	.4227200361429E+00	12	.4809815209579E-15	.3639496846075E+03
10000	44	250	368	-.9683383689438E+04	.4548806162511E-01	1	.2514039256448E-15	.500000006546E+01
TOTAL	1006	15850	112.05(seconds)					

43 New Gradient Algorithm: DIXMAANA (CUTE)**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	8	26	22	.1000000000005E+01	.2356812284034E-06		.7871192271658E-01	.5022642914581E+00
2000	8	26	44	.1000000000009E+01	.2338503740348E-06		.7875466150468E-01	.5013454832758E+00
3000	8	26	66	.1000000000014E+01	.2348942005230E-06		.7880140655750E-01	.5022643918505E+00
4000	8	26	88	.1000000000018E+01	.2350912803571E-06		.7877899877881E-01	.5022643890336E+00
5000	8	26	104	.1000000000023E+01	.2344824743187E-06		.7878269945533E-01	.5018883811750E+00
6000	8	26	132	.1000000000028E+01	.2348942005828E-06		.7880140655750E-01	.5022643918867E+00
7000	8	26	154	.1000000000032E+01	.2350068141753E-06		.7878859910119E-01	.5022643920870E+00
8000	8	26	176	.1000000000037E+01	.2346377629539E-06		.7878971319885E-01	.5020280990005E+00
9000	8	26	197	.1000000000041E+01	.2348942008499E-06		.7880140655752E-01	.5022643923155E+00
10000	8	26	220	.1000000000046E+01	.2349729869264E-06		.7879244049462E-01	.5022643927468E+00
TOTAL	80	260	12.03(seconds)					

44 New Gradient Algorithm: DIXMAANB (CUTE)

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	8	28	22	.1000000000004E+01	.1978383626815E-06		.4203577022949E-01	.5146271690895E+00
2000	8	28	50	.1000000000006E+01	.3834567508899E-06		.4202747596959E-01	.5148661639476E+00
3000	8	28	71	.1000000000016E+01	.2589737151004E-06		.4202654947371E-01	.5131695081417E+00
4000	8	28	93	.1000000000021E+01	.2692418952694E-06		.4202514723361E-01	.5130826588351E+00
5000	8	28	116	.1000000000023E+01	.2694008011458E-06		.4202395784393E-01	.5136893551762E+00
6000	8	28	142	.1000000000033E+01	.2742270506220E-06		.4202408155298E-01	.5127510155110E+00
7000	8	28	165	.1000000000038E+01	.2811885352042E-06		.4202363326460E-01	.5127570656642E+00
8000	8	28	187	.1000000000041E+01	.2631530149864E-06		.4202307932798E-01	.5132281716564E+00
9000	8	28	209	.1000000000051E+01	.2794850736335E-06		.4202325944706E-01	.5125953221705E+00
10000	8	28	236	.1000000000056E+01	.2860921768289E-06		.4202302792846E-01	.5126174591489E+00

TOTAL	80	280	12.91(seconds)					

45 New Gradient Algorithm: DIXMAANC (CUTE)

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	11	37	33	.1000000000000E+01	.8554024622268E-07		.2338255197146E-01	.5136143751680E+00
2000	11	37	60	.1000000000000E+01	.1174677675030E-06		.2337708535621E-01	.5065255035539E+00
3000	11	37	94	.1000000000000E+01	.1250380386194E-06		.2337675542162E-01	.5052475688630E+00
4000	11	37	126	.1000000000000E+01	.1320081452930E-06		.2337630124421E-01	.5034264856744E+00
5000	11	37	154	.1000000000000E+01	.1398952595529E-06		.2337536734231E-01	.5015704168789E+00
6000	11	37	186	.1000000000000E+01	.1404897603311E-06		.2337548901654E-01	.5018172866075E+00
7000	11	37	220	.1000000000000E+01	.1433140216754E-06		.2337541058254E-01	.5010487587692E+00
8000	11	37	247	.1000000000000E+01	.1468983037273E-06		.2337493838058E-01	.5000744466265E+00
9000	11	37	280	.1000000000000E+01	.1467785283015E-06		.2337506717353E-01	.5003320117730E+00
10000	11	37	314	.1000000000000E+01	.1482832363228E-06		.2337505447837E-01	.4999081160137E+00

TOTAL	110	370	17.14(seconds)					

46 New Gradient Algorithm: DIXMAANE (CUTE)

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	314	1690	1499	.1000000000246E+01	.9743969522549E-06		.8901727489673E-01	.4955654994403E+03
2000	523	2887	5114	.1000000000501E+01	.9969410919705E-06		.8911661265600E-01	.9581786480704E+03
3000	662	3762	10002	.1000000000753E+01	.9923131284756E-06		.8915128726978E-01	.1286053961048E+04
4000	675	3694	13121	.1000000001026E+01	.9950965043823E-06		.8912519414200E-01	.1767316211767E+04
5000	762	4200	18675	.1000000001312E+01	.9977542038704E-06		.89143429224614E-01	.1736692257211E+04
6000	1072	5548	30017	.1000000001627E+01	.9980728808816E-06		.8915628470086E-01	.1573302871002E+04
7000	1050	5717	36119	.1000000001838E+01	.9679354721747E-06		.8914065372414E-01	.1770754100317E+04
8000	1096	5858	42584	.1000000002323E+01	.9986760855287E-06		.8915012668343E-01	.2030421154368E+04
9000	1035	5807	47241	.1000000002724E+01	.9972345906431E-06		.8915795072617E-01	.2628651172897E+04
10000	1113	6039	55074	.1000000003190E+01	.9984610512543E-06		.8914684054384E-01	.2729991968090E+04

TOTAL	8302	45202	2594.46(seconds)					

48 New Gradient Algorithm: Broyden Tridiagonal**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	88	347	0	.7125279095862E+00	.8477209370759E-06		.5450239091291E-02	.3587814340600E+00
2000	101	402	11	.7125279095863E+00	.7158967051391E-06		.5393431770833E-02	.3619271478336E+00
3000	106	442	16	.3460153919730E+01	.9315790958642E-06	1	.5495208101266E-02	.5006816534542E+01
4000	124	524	28	.6614865279836E+00	.9866977999096E-06	2	.2831481925131E-02	.5007057395448E+01
5000	73	278	22	.8809135203575E+00	.7841237406048E-06	1	.2800937193491E-02	.5002807283125E+01
6000	102	400	38	.9719272667376E+00	.8306283720838E-06	1	.2787356629649E-02	.5002794408287E+01
7000	307	1422	149	.8735911285536E+00	.9925086139062E-06	1	.2782908551209E-02	.5002790450500E+01
8000	183	769	93	.3970671034877E+00	.5806418048593E-06	1	.2102587007603E-02	.5002791861931E+01
9000	144	661	93	.7125279095865E+00	.9956085251783E-06	5	.2541540812666E-02	.5199701165967E+01
10000	138	577	94	.3970671034880E+00	.9683173128883E-06	1	.2115441485866E-02	.5002804072179E+01
TOTAL	1366	5822	5.44(seconds)					

49 New Gradient Algorithm: Almost Perturbed Quadratic**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	1369	7193	55	.2369557947036E-12	.9766521184534E-06		.5030882739016E-03	.4930103522703E+00
2000	2485	13696	225	.2452687121710E-12	.9954100956139E-06		.2514902598952E-03	.4936115997261E+00
3000	4150	22572	917	.2474791276031E-12	.9999043395153E-06		.1674081995393E-03	.4943455586548E+00
4000	5203	29756	1692	.2466101922924E-12	.9981409429085E-06		.1254913234514E-03	.4932463025044E+00
5000	6659	37377	2845	.2456894173037E-12	.9961708646842E-06		.1005326076508E-03	.4916125577181E+00
6000	7879	43927	4048	.2472402654700E-12	.9993819692909E-06		.8367998510270E-04	.4934360794637E+00
7000	8566	49201	5635	.2454742220018E-12	.9957708022820E-06		.7161834956299E-04	.4911567459510E+00
8000	10502	58949	7679	.2461538882770E-12	.9971086065725E-06		.6279443048603E-04	.4896280582720E+00
9000	11616	66173	9722	.2476002760162E-12	.9999034829535E-06		.5579027570319E-04	.4911873965146E+00
10000	12940	73412	11748	.2474740073299E-12	.9998942477844E-06		.5021256029719E-04	.4929842660590E+00
TOTAL	71369	402256	445.66(seconds)					

50 New Gradient Algorithm: Tridiagonal Perturbed Quadratic**Function**

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	1368	7072	621	.2354550565453E-12	.9685840414640E-06		.4998587253416E-03	.4977052343734E+00
2000	2774	14751	3087	.2496801163326E-12	.9990578120609E-06		.2508495905717E-03	.4974010134199E+00
3000	4163	22230	9084	.2343599432359E-12	.9644321286013E-06		.1670642130990E-03	.4934940082193E+00
4000	5196	29242	17390	.2490489081582E-12	.9979071788064E-06		.1253075964699E-03	.4966557911953E+00
5000	6274	35766	27342	.2493551833550E-12	.9982983419167E-06		.1002567613788E-03	.4978336359877E+00
6000	8140	46343	41232	.2495600293857E-12	.9990004074471E-06		.8363609025913E-04	.4986094365158E+00
7000	9469	52797	53602	.2462865374014E-12	.9923877510086E-06		.7164232551483E-04	.4947640566131E+00
8000	10327	58947	67196	.2487957838163E-12	.9973297225616E-06		.6254478786443E-04	.5000431974586E+00
9000	11758	67530	85986	.2451831888809E-12	.9902280884552E-06		.5577143286491E-04	.4964871743737E+00
10000	13569	76023	105501	.2488116337872E-12	.9974039717741E-06		.5019382499075E-04	.4888828642982E+00
TOTAL	73038	410701	4110.41(seconds)					

55 New Gradient Algorithm: ARGLINB (CUTE)

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	8	270	16	.4634146341463E+01	.2833075996023E-04	1	.1381809227046E-12	.5000000000044E+01
2000	12	161	22	.4634146341463E+01	.1266512321308E-02		.4080127547633E-16	.6528204076214E-13
3000	16	321	66	.4634146341463E+01	.2308925140824E-02	1	.5545339388242E-17	.5000000000000E+01
4000	14	173	49	.4634146341463E+01	.2502147326595E-02		.3466042892721E-17	.8163314808463E-14
5000	16	180	61	.4634146341463E+01	.5470383242937E-02		.4660779210229E-18	.4179930606209E-14
6000	10	327	137	.4634146341463E+01	.1230002089869E-03	1	.3972659575942E-15	.5000000000000E+01
7000	18	188	93	.4634146341463E+01	.1594856250449E-01		.4239425405970E-19	.1523428881250E-14
8000	19	192	110	.4634146341463E+01	.2055094228126E-01		.3018431411944E-19	.1020605666792E-14
9000	20	198	121	.4634146341463E+01	.3767812805017E-01		.6980382986107E-20	.7168189120716E-15
10000	20	197	143	.4634146341463E+01	.3528675719281E-01		.7591047510203E-20	.5225696955565E-15

TOTAL	153	2207	8.18(seconds)					

59 New Gradient Algorithm: DIXMAANF (CUTE)

Function

n	iter	fgcnt	time(c)	fxnew	ginf	ngama	stepinimin	stepinimax
1000	133	423	379	.9819931272236E+00	.1121965713610E-01	1	.2475349058540E-17	.5000000000000E+01
2000	136	304	549	.9798870439923E+00	.1536869886319E-01		.4556962522809E-18	.1740182769274E+01
3000	155	338	923	.9657861617138E+00	.1535949597864E-01		.1910761171540E-18	.1741161520958E+01
4000	158	473	1703	.8996706286923E+00	.1077613435093E-01	1	.7512764865348E-18	.5000000000000E+01
5000	144	315	1428	.9381597060047E+00	.1536356360668E-01		.1144170268119E-18	.1741645864371E+01
6000	142	306	1675	.9244375825871E+00	.1536526931764E-01		.1014996430743E-18	.1741404277407E+01
7000	153	458	2889	.8203927551838E+00	.1078391039866E-01	1	.2586308921565E-18	.5000000000000E+01
8000	145	452	3252	.7940999815108E+00	.1078606442219E-01	1	.2950019527277E-18	.5000000000000E+01
9000	155	474	3844	.7678468469460E+00	.1078756871790E-01	1	.2831292649265E-18	.5000000000000E+01
10000	150	457	4114	.7416125859788E+00	.1078868950195E-01	1	.1575555705079E-18	.5000000000000E+01

TOTAL	1471	4000	207.56(seconds)					

March 21, 2005

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