

Boys' Function Computed by Gauss-Jacobi Quadrature

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Boys' Function $F_m(z)$ that appears in the quantum mechanics of Gaussian Type Orbitals is a special case of Kummer's confluent hypergeometric function. We evaluate its integral representation of a product of a power and an exponential function over the unit interval with the numerical Gauss-Jacobi quadrature. We provide an implementation in C for real values of the argument z which basically employs a table of the weights and abscissae of the quadrature rule for integer quantum numbers $m \leq 129$.

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I. BOYS' FUNCTION

We define Boys' Function $F_m(z)$ for small non-negative integer m and non-negative real argument z as usual by its integral representation and power series (confluent hypergeometric function) [1–11]:

$$F_m(z) \equiv \int_0^1 u^{2m} e^{-zu^2} du = \frac{1}{2} \int_0^1 v^{m-1/2} e^{-zv} dv = \frac{1}{2m+1} {}_1F_1\left(m + \frac{1}{2}; m + \frac{3}{2}; -z\right). \quad (1)$$

For large z we compute the confluent hypergeometric function at $a = m + 1/2$ with [12, (13.5.1)][13]

$${}_1F_1(a; a+1; -z) = \Gamma(1+a) \left(\frac{1}{z}\right)^a - ae^{-z} \frac{1}{z} \sum_{n \geq 0} \frac{(1-a)_n}{(-z)^n}. \quad (2)$$

This is merely an asymptotic expansion and does not converge if z is approximately larger than the number of digits demanded in the numerical result [14]. Figure 1 illustrates this intrinsic limit for a relative error equivalent to 15 digits in precision. It also illustrates that the number of terms needed for a given relative error increases as a function of the index m . The implementation proposed here does not re-expand (2) in a Padé series to improve on the region of convergence [15–18].

II. GAUSS-JACOBI QUADRATURE

A. Basic Theory

This work provides a C program which is inspired by the small number of abscissa required for a Gauss-Jacobi quadrature of (1) to achieve fast convergence at small z [14, Fig. 7][19]. The evaluation approximates the integral (1) by the discrete sampling

$$F_m(z) \approx \frac{1}{2} \sum_{j=1}^N w_{j,m} e^{-zv_{j,m}} \quad (3)$$

where weights w and abscissae v are defined by the zeros of the Jacobi Polynomials $P_N^{(m-1/2,0)}(1-2v)$ [12, 22.5.42, 25.4.33]:

$$P_N^{(\alpha,0)}(x) = \frac{1}{2^N} \sum_{j=0}^N \binom{N+\alpha}{j} \binom{N}{j} (x-1)^{N-j} (x+1)^j. \quad (4)$$

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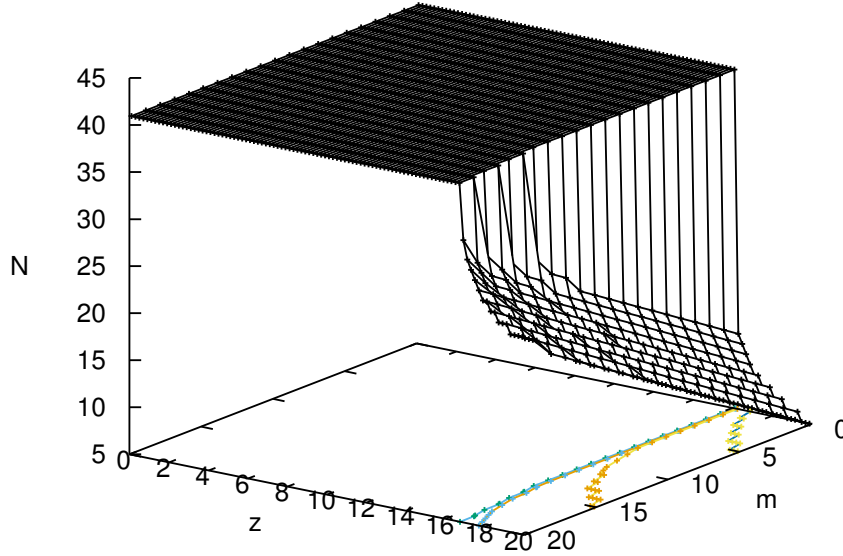


FIG. 1. The upper limit on n to reach a relative error of 10^{-15} in (2). The plateau at level $N \approx 40$ indicates that the series over n does not converge in this region of m and z .

j	$v_{j,m}$	$w_{j,m}$
1	0.0569391159670073532371751168	0.9358278691453820947797406880
2	0.4371978527510939418006878729	0.7215231460962772151396670277
3	0.8694993949182623413257733739	0.3426489847583406900805922843

TABLE I. Abscissae and weights for $m = 0$, $N = 3$.

$$P_N^{(m-1/2,0)}(1 - 2v_{j,m}) = 0. \quad (5)$$

$$w_{j,m} = \frac{1}{\sum_{i=0}^{N-1} [m - 1/2 + 2i + 1] \left(P_i^{(m-1/2,0)}(1 - 2v_{j,m}) \right)^2}. \quad (6)$$

Some basic examples for $m = 0$ and $m = 1$ are:

$$P_3^{(0-1/2,0)}(x) = \frac{1}{128}(19 - 147x - 63x^2 + 231x^3); \quad (7)$$

$$P_4^{(0-1/2,0)}(x) = \frac{1}{1024} \left(\frac{611}{2} + 486x - 2871x^2 - 858x^3 + \frac{6435}{2}x^4 \right); \quad (8)$$

$$P_5^{(0-1/2,0)}(x) = \frac{1}{8192}(-943 + 11825x + 10010x^2 - 52910x^3 - 12155x^4 + 46189x^5); \quad (9)$$

$$P_3^{(1-1/2,0)}(x) = \frac{1}{128}(-23 - 225x + 99x^2 + 429x^3). \quad (10)$$

Tables I–V show examples of $(v_{j,m}, w_{j,m})$; many more can be extracted from the variables `gj_m_N` in the program listing in Appendix A 5.

The number of abscissae needed to achieve a relative error in the result equivalent to double-precision numerics grows with z and (essentially) drops with m , see Figure 2, opposite to the tendency of the asymptotic high- z series.

j	$v_{j,m}$	$w_{j,m}$
1	0.0336482680675068532985540048	0.7253675667567239659303008986
2	0.2761843138724644405463052852	0.6274132917557745746759244040
3	0.6346774762346366440178864668	0.4447620689067489410887119889
4	0.9221566084920587288039209099	0.2024570725807525183050627086

TABLE II. Abscissae and weights for $m = 0$, $N = 4$, $j = 1..N$.

j	$v_{j,m}$	$w_{j,m}$
1	0.0221635688072176383248335645	0.5910484494295057403477859893
2	0.1878315676524455103763869130	0.5385334386199927101824538431
3	0.4615973614962667094116573193	0.4381727250319640879910698685
4	0.7483346283872804764262410271	0.2989026983011611862915526793
5	0.9484939262883686128293022287	0.1333426886173762751871376198

TABLE III. Abscissae and weights for $m = 0$, $N = 5$.

B. Implementation

The strategy followed in the program is to move the boundary of switching between the Gauss-Jacobi numerics at small z to the asymptotic series at high z when the number of Gauss-Jacobi samples is approximately a fourth of the number of terms in the series (given the parameter m and a target relative error of 1.1×10^{-16}). This is a kind of load-balancing as if the speed of evaluating an exponential functions in the Gauss-Jacobi samples was typically four times slower than evaluating a single term of the asymptotic series. The maximum z that is computed with the Gauss-Jacobi algorithm grows from $z \approx 15$ at $m = 0$ to $z \approx 100$ at $m \approx 110$.

A further decision has been made to compute only each third m explicitly and to relay the others by the well-known recurrence

$$F_m(z) = \frac{1}{2m+1} [e^{-z} + 2zF_{m+1}(z)] \quad (11)$$

to m which are larger by one or two. This is merely a policy to reduce the printout and the code size of the compiled library to a third of its volume.

The maximum quantum number m supported by the function was set to a large but arbitrary value of $m \leq 129$. Larger m are computed with Kummer's transform

$${}_1F_1(a; a+1; -z) = e^{-z} {}_1F_1(1; a+1; z). \quad (12)$$

The right hand side is equivalent to the iteration of (11); it is evaluated by its power series (which is essentially a series in z/m).

Another implementation detail is that the number N of samples for the Gauss-Jacobi algorithm (3) was tuned in steps of 2 to the number needed for a specific pair of m and z . Again this merely aims at reducing the size of the code by one half. There is a (small) run-time overhead because the exponential in the integral kernel may sometimes be sampled by one more abscissa point than strictly necessary (at the required accuracy).

j	$v_{j,m}$	$w_{j,m}$
1	0.1647102868965424215227963860	0.1257826743288388479536492876
2	0.5498684992164435639085994626	0.3076023676819127355061813001
3	0.9008058292716293991839887668	0.2332816246559150832068360790

TABLE IV. Abscissae and weights for $m = 1$, $N = 3$.

j	$v_{j,m}$	$w_{j,m}$
1	0.1051402825890897841204817515	0.0656805198917241921395509113
2	0.3762245144531748949762019367	0.1960962654309963349126189502
3	0.6989480124178008184946440925	0.2525273457292041411760263506
4	0.9373342493634639141733781017	0.1523625356147419984384704546

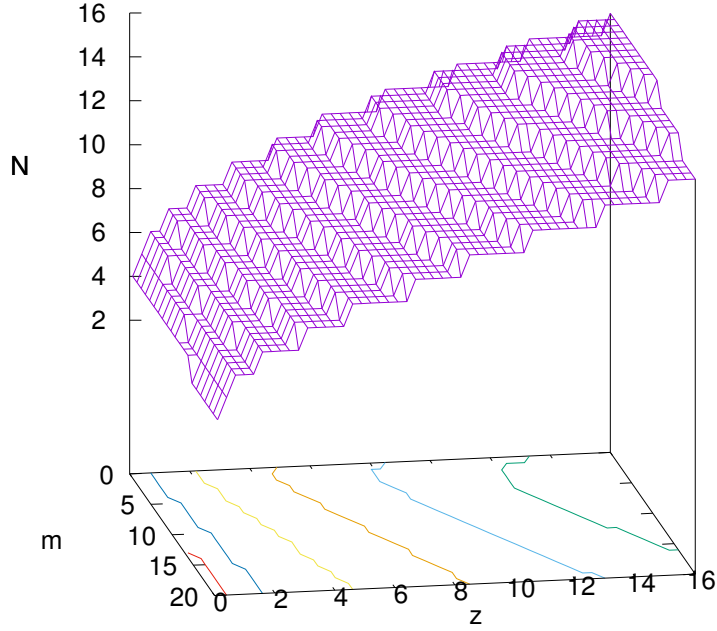
TABLE V. Abscissae and weights for $m = 1$, $N = 4$.

FIG. 2. The minimum number N of abscissae needed to achieve a relative error of 10^{-15} with a Gauss-Jacobi quadrature (3). The iso-altitude lines projected on the floor of the graph show where $N = 4, 6, 8, 10, 12$ and 14 abscissae are required.

Appendix A: C Program

1. Compilation

The source code files are printed in the appendices A 2–A 6. The LGPLv3 license applies. If the GNU autotools are available, the program is compiled with

```
autoreconf -i -s
./configure
make
make check
```

If not, compiler calls similar to

```
gcc -O2 -c boysGaussJacobi.c
gcc -O2 -c boysGaussJacobiTst.c
gcc -O2 -o boysGaussJacobiTst boysGaussJacobiTst.o boysGaussJacobi.o -lm
```

can be used to create the main library function and the test program.

Calling the test program `boysGaussJacobiTst` should reveal a largest relative error near 1.7×10^{-15} over the 175 pairs of m and z that are calculated.

2. File `configure.ac`

```
#                                     -*- Autoconf -*-
# Process this file with autoconf to produce a configure script.

AC_PREREQ([2.68])
AC_INIT([boysGaussJacobi], [1.0], [mathar@mpia.de])
AC_CONFIG_SRCDIR([boysGaussJacobi.c])
AM_INIT_AUTOMAKE([foreign])

LT_INIT

AC_PROG_CC
AC_PROG_CPP
AC_PROG_INSTALL

AC_CHECK_LIB(m,exp)

AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile])

AC_OUTPUT
```

3. File `Makefile.am`

```
AUTOMAKE_OPTIONS =

lib_LTLIBRARIES = libboysGaussJacobi.la

libboysGaussJacobi_la_SOURCES = boysGaussJacobi.c boysGaussJacobiData.h
libboysGaussJacobi_la_LIBADD = -lm

check_PROGRAMS = boysGaussJacobiTst

boysGaussJacobiTst_SOURCES = boysGaussJacobiTst.c
boysGaussJacobiTst_LDFLAGS =
boysGaussJacobiTst_LDADD = -lm -lboysGaussJacobi
boysGaussJacobiTst_DEPENDENCIES = libboysGaussJacobi.la

TESTS = boysGaussJacobiTst
```

4. File `boysGaussJacobi.c`

```
#include <math.h>
#include <stdio.h>
```

```

/** Square root of Pi = 3.14159
 * Would for example be defined in gsl/gsl_math.h .
 */
#define M_SQRTPI 1.77245385090551602729816748334

/*****
 * @brief Compute Boys' function  $F_m(z)$  via the asymptotic high- $z$  expansion.
 * @param m The non-negative integer index.
 * The function supports only the range  $0 < m \leq 128$ .
 * @param z The non-negative radial distance
 * @param N The number of terms in the  $1/z$  expansion.
 * @return  $F_m(z)$  with approximately double precision accuracy.
 * @author Richard J. Mathar
 * @since 2017-09-17 Richard J. Mathar
 */
static double boysHighz(int m, double z, int N)
{
    double a=m+0.5 ;
    double f= 1.0 ;
    double fn= 1.0 ;
    double gam= M_SQRTPI ;
    int n=1 ;
    for(; n <= N ; n++)
    {
        fn *= (a-n)/z ;
        f += fn ;
    }

    f *= -a*exp(-z)/z ;
    /* add  $\Gamma(1+a)/z^a$ , where  $\Gamma(1/2)=\sqrt{\pi}$ 
    */
    int j=0 ;
    for( ; j <= m ; j++)
        gam *= j+0.5 ;
    f += gam/pow(z,a) ;

    /* divide through  $2m+1$  to convert  $1F_1(a,a+1,-z)$  to  $F_m(z)$  */
    return f/(2*a) ;
}
#undef M_SQRTPI

/*****
 * @brief Compute Boys' function  $F_m(z)$  via Gauss-Jacobi quadrature.
 * @param m The non-negative integer index.
 * The function supports only the range  $0 < m \leq 128$ .
 * @param z The non-negative radial distance
 * @return  $F_m(z)$  with approximately double precision accuracy.
 * If  $m$  or  $z$  are outside the range of supported values, 0 is returned.
 * @author Richard J. Mathar
 * @since 2017-09-17 Richard J. Mathar
 */
double boysGaussJacobi(int m, double z)
{
#include "boysGaussJacobiData.h"
    /* if gj is not assigned here, either m is not
     * in the supported range or z is outside the region of convergence
     */
    if ( gj && N >0)
    {
        double F=0.0 ;
        /* N abscissae are in gj[0,2,4...] and N weights in gj[1,3,5...]
        */
        int i=0 ;
        for( ; i < N; i++)
            F += gj[1+2*i]*exp(-z*gj[2*i]) ;

        /* gather the factor 1/2 left over from the u->v substitution
        */
        return F/2.0 ;
    }
    else if ( N >0 )
    {
        /* call the high- $z$  expansion with N terms of the Laurent series */
        return boysHighz(m,z,N) ;
    }
    else
    {
        /* large m: Kummer transformation assuming  $z/m$  is small.
         *  $1F_1(a,a+1,-z) = \exp(-z) * 1F_1(1;a+1;z)$  */
        double a=m+0.5 ;
        double f=1.0 ;
        double fn=1.0 ;

```

```

int n=1 ;
for( ; ; n++)
{
    fn *= z/(a+n) ;
    f += fn ;
    if ( fabs(fn/f) < 1.1e-16)
        break ;
}
/* Kummer's factor exp(z). Factor 1/(2m+1) to get F_m
*/
return f*exp(-z)/(2*a) ;
}
} /* boysGaussJacobi */

```

5. File boysGaussJacobiData.h

```

static double gj_0_5[10] = { 2.21635688072176383e-02,5.91048449429505740e-01,
1.87831567652445510e-01,5.38533438619992710e-01, 4.61597361496266709e-01,4.38172725031964088e-01,
7.48334628387280476e-01,2.98902698301161186e-01, 9.48493926288368613e-01,1.33342688617376275e-01
};
static double gj_0_7[14] = { 1.16758719401466697e-02,4.30527706926315580e-01,
1.01832704002769622e-01,4.10396927442591208e-01, 2.65481157268937311e-01,3.71076794955875627e-01,
4.72371537004484544e-01,3.14406334316387069e-01, 6.84262015653148613e-01,2.43037141375806369e-01,
8.61991333203393291e-01,1.60316174319520420e-01, 9.72755751297490319e-01,7.02389206635037261e-02
};
static double gj_0_9[18] = { 7.18680283622639041e-03,3.38284765926287184e-01,
6.34466706931120502e-02,3.28552967491665446e-01, 1.69539018965999915e-01,3.09369350252530490e-01,
3.13343383321217907e-01,2.81285829341301302e-01, 4.78430965537574913e-01,2.45110413422956920e-01,
6.45941661077025065e-01,2.01884088212574331e-01, 7.96739163197520116e-01,1.52851460509778113e-01,
9.13599422574265919e-01,9.94290977899395929e-02, 9.83201483225629154e-01,4.32320270529666206e-02
};
static double gj_0_11[22] = { 4.86356624316291964e-03,2.78503745711263987e-01,
4.32059569830094156e-02,2.73082996692030343e-01, 1.16920105609143503e-01,2.62347009574124741e-01,
2.20294902652250910e-01,2.46504753621024849e-01, 3.45321243833765875e-01,2.25864592161078437e-01,
4.82312558728528795e-01,2.0082828885761930e-01, 6.20655319783281317e-01,1.71883212434135455e-01,
7.49631419738670764e-01,1.39592936849040976e-01, 8.59248857503664399e-01,1.04586670305366572e-01,
9.41017369460719822e-01,6.75498031696283096e-02, 9.88621722719616233e-01,2.92559905965444014e-02
};
static double gj_0_13[26] = { 3.50820396764517155e-03,2.36642830558524553e-01,
3.12790423380307537e-02,2.33320886970593164e-01, 8.52668262832194511e-02,2.26723633092639333e-01,
1.62450717308122770e-01,2.16943681057153181e-01, 2.58511960491254348e-01,2.04118322188850846e-01,
3.68075538406975335e-01,1.88427600711828297e-01, 4.85010929056046975e-01,1.70091788626970478e-01,
6.02775141526185769e-01,1.49368299531319492e-01, 7.14778842177532265e-01,1.26548092659149671e-01,
8.14755109887600986e-01,1.01951650594295624e-01, 8.97110297559489659e-01,7.59247665887255279e-02,
9.57238080859442618e-01,4.88357021852638176e-02, 9.91788329746297036e-01,2.11027452346860143e-02
};
static double gj_0_15[30] = { 2.64935057603941371e-03,2.05705305787117681e-01,
2.36759503139129642e-02,2.03524779496811009e-01, 6.48399641682313848e-02,1.99186841173590534e-01,
1.24400623411812063e-01,1.92737474349288519e-01, 1.99839191107433427e-01,1.84245044475572257e-01,
2.87965476369148519e-01,1.73799574402165960e-01, 3.85052743775199316e-01,1.61511790458840431e-01,
4.86995313083275678e-01,1.47511949475410413e-01, 5.89482185249480997e-01,1.31948459764360990e-01,
6.88179354117703759e-01,1.14986312435238133e-01, 7.78913099337555102e-01,9.68053456611881058e-02,
8.57846527857990011e-01,7.75983851392540992e-02, 9.21641981217227263e-01,5.75694157666467387e-02,
9.67602976756699955e-01,3.69329366221819183e-02, 9.93796618590493537e-01,1.59363849923332112e-02
};
static double gj_3_5[10] = { 1.73024726379620134e-01,2.42009307449806675e-03,
3.92448914604073735e-01,2.28639767733012688e-02, 6.30351882433045053e-01,7.26454100023257706e-02,
8.36622243175757269e-01,1.11916573284960152e-01, 9.67552233407503809e-01,7.58682325792004563e-02
};
static double gj_3_7[14] = { 1.05181317037617586e-01,4.35381396702159452e-04,
2.47940810997027490e-01,4.93858248523642194e-03, 4.21143760068189706e-01,2.08761789564955702e-02,
6.02980397398135101e-01,5.03659154534107254e-02, 7.70325900920945401e-01,7.95281269986563146e-02,
9.01865053344953835e-01,8.30756196984737968e-02, 9.80865790536161184e-01,4.64944808253107259e-02
};
static double gj_3_9[18] = { 7.04163406993479154e-02,1.08273811457137782e-04,
1.69131170737618556e-01,1.33978869115792608e-03, 2.95078625208354852e-01,6.44358790505250680e-03,
4.37758199071399942e-01,1.86505532687699850e-02, 5.8511278169267390e-01,3.81056485440004756e-02,
7.24656557455043598e-01,5.88248924467002746e-02, 8.44567374860804630e-01,6.98265219049807331e-02,
9.34681113761966564e-01,6.11706860451258754e-02, 9.87379827841074601e-01,3.12443330970407999e-02
};
static double gj_3_11[22] = { 5.03536316167007538e-02,3.37201417873900784e-05,
1.22223941627299672e-01,4.37939694264674508e-04, 2.16450431221879747e-01,2.259464444638604587e-03,
3.27466960339298169e-01,7.19519332299061497e-03, 4.48595324347242177e-01,1.66832776714960294e-02,
5.72528086119417481e-01,3.04652974280135084e-02, 6.91783025899679125e-01,4.55633299731946703e-02,
7.99158549728471351e-01,5.66327300674592078e-02, 8.88170061069532643e-01,5.79339203818342033e-02,
9.53443276254284220e-01,4.61208458563698121e-02, 9.91051201572113029e-01,2.23885667304895576e-02
};
static double gj_3_13[26] = { 3.77619107654517483e-02,1.23705234625033071e-05,
9.2258666522367071e-02,1.65509782397501914e-04, 1.64892937787566354e-01,8.91128464402642604e-04,
2.52475145970049549e-01,3.00412287316989864e-03, 3.51067597173932536e-01,7.49587331358246902e-03,

```

```
4.56221432739848760e-01,1.5023720882338673e-02, 5.63187311549463030e-01,2.52923665130554394e-02,
6.67132537065693955e-01,3.66601216839628218e-02, 7.633603051953711988e-01,4.62694213244278239e-02,
8.47522338757503067e-01,5.07900371067124284e-02, 9.15815707955323091e-01,4.75669808402068339e-02,
9.65155625858786539e-01,3.57315149307374553e-02, 9.93323921215264693e-01,1.68111174758295288e-02
};
static double gj_3_15[30] = { 2.93534729797357505e-02,5.13774234146609820e-06,
7.20249036070567424e-02,7.00995039108448194e-05, 1.29512254273169924e-01,3.88109076613139982e-04,
1.99870793675025233e-01,1.35754187221434367e-03, 2.80648338016069594e-01,3.54964254110226707e-03,
3.69016826925514701e-01,7.53989046557788941e-03, 4.61878925171753011e-01,1.36330109992117531e-02,
5.55978566998535186e-01,2.15772680246624274e-02, 6.48015796848897311e-01,3.03957002930587030e-02,
7.34762768384436092e-01,3.84410445770998449e-02, 8.13177082917009181e-01,4.37097128462122624e-02,
8.80508588798239866e-01,4.43530023886402823e-02, 9.34395995602699263e-01,3.923843863754449811e-02,
9.72950373202142390e-01,2.83771036525717736e-02, 9.94828389522792679e-01,1.30785830935237355e-02
};
static double gj_3_17[34] = { 2.34648983590652876e-02,2.35129962002271935e-06,
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1.61811335281495721e-01,6.58515804566644148e-04, 2.28744676762306714e-01,1.77754950922541587e-03,
3.03209167827440276e-01,3.92589949676313918e-03, 3.83120918051693062e-01,7.44080174961063632e-03,
4.66242590524208861e-01,1.24616805289931748e-02, 5.50246564805146978e-01,1.87892639457930906e-02,
6.32780325404497706e-01,2.58067057962445544e-02, 7.11532439287688158e-01,3.25051376197262231e-02,
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9.03938708932647301e-01,3.84120347333592040e-02, 9.47464635288458482e-01,3.26828428490417757e-02,
9.78396743033047956e-01,2.30244686127161440e-02, 9.95875802449869192e-01,1.04608707342532482e-02
};
static double gj_6_5[10] = { 2.98330383094752414e-01,2.80648374167677368e-04,
5.15700170362842876e-01,5.60713523280134348e-03, 7.17907368112375734e-01,3.00242452318158548e-02,
8.78849435844537390e-01,6.50196810620459855e-02, 9.76309416779039974e-01,5.29144439453229850e-02
};
static double gj_6_7[14] = { 1.98593521429324903e-01,2.08533069398670124e-05,
3.56869477099068752e-01,5.66597363646764238e-04, 5.22271548071248462e-01,4.62178691236278782e-03,
6.81161044152944799e-01,1.82481323012759772e-02, 8.19227804209531773e-01,4.11532350461609855e-02,
9.23802739303032234e-01,5.45194248759964847e-02, 9.85253352914336257e-01,3.47161240397709797e-02
};
static double gj_6_9[18] = { 1.41084333477058442e-01,2.31326267182443333e-06,
2.58798403862855112e-01,7.37268821791503155e-05, 3.88755530790825589e-01,7.40808868058367085e-04,
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7.74421313906270253e-01,2.71371288873909332e-02, 8.74058644810456116e-01,4.1721854617538859e-02,
9.47471565363175205e-01,4.35139594747481768e-02, 9.89893042638411473e-01,2.44496805103757178e-02
};
static double gj_6_11[22] = { 1.05178223150463991e-01,3.47642773349493989e-07,
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4.09014968398686718e-01,3.31580000712218320e-04, 5.23348173247385354e-01,3.24249898532500202e-03,
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9.61535945999000713e-01,3.47080799892674573e-02, 9.92625514290675397e-01,1.81272543603810501e-02
};
static double gj_6_13[26] = { 8.13419137574761781e-02,6.59932883208441273e-08,
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3.25921515752910048e-01,1.99050982667562167e-04, 4.23051994568002063e-01,8.71327131305468803e-04,
5.22424922481231174e-01,2.79229748904086896e-03, 6.20370787234027705e-01,6.94871333319042513e-03,
7.13257756374882090e-01,1.39043092945975820e-02, 7.97635084794387177e-01,2.27926216437043794e-02,
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9.70595268329500155e-01,2.80195951911794544e-02, 9.94375571103039078e-01,1.39676793270309316e-02
};
static double gj_6_15[30] = { 6.47418936934928356e-02,1.50581764986806044e-08,
1.21843045429842567e-01,5.83744529598220735e-07, 1.88997326066703363e-01,7.52379680334369465e-06,
2.64745422150707696e-01,5.31175251688424218e-05, 3.46989861129142207e-01,2.51020647618320180e-04,
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7.69068142389114097e-01,1.73654111034331083e-02, 8.38154775361973676e-01,2.43240252411628505e-02,
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9.76780575974143974e-01,2.29585021917397498e-02, 9.95565836155443983e-01,1.10886648721895274e-02
};
static double gj_6_17[34] = { 5.27315360575251795e-02,3.98458178112226840e-09,
9.96250285356225226e-02,1.59066243623271880e-07, 1.55279874729885386e-01,2.12693905216427144e-06,
2.18783725345586614e-01,1.57047240770194108e-05, 2.88725009886934758e-01,7.83013937170749033e-05,
3.63467393480777581e-01,2.92793188011246021e-04, 4.41235860744722327e-01,8.73937790942106312e-04,
5.20173096795370522e-01,2.16693616552452659e-03, 5.98389168198133505e-01,4.58330941681760163e-03,
6.74009089792251532e-01,8.41757977329059406e-03, 7.45218898040408713e-01,1.35759842678289085e-02,
8.10309761098227459e-01,1.93388614334549601e-02, 8.67719328224059268e-01,2.43286879143865356e-02,
9.16069451878731660e-01,2.68061799078029472e-02, 9.54199479787389781e-01,2.52623811404613013e-02,
9.81194653837869897e-01,1.90884314924407436e-02, 9.96412947363971650e-01,9.01477524752071226e-03
};
static double gj_9_5[10] = { 3.94137970574141808e-01,7.90832605450092431e-05,
5.97680718735037821e-01,2.39978733782428095e-03, 7.17199517709576873e-01,1.71750928838053905e-02,
9.03687545718295080e-01,4.50076428182372881e-02, 9.81342895911597066e-01,4.06015515943248733e-02
};
static double gj_9_7[14] = { 2.79336774172479642e-01,3.18866546074755861e-06,
4.39475919806581807e-01,1.45648922878385521e-04, 5.93357969328295091e-01,1.75749179553622795e-03,
7.33461894305063875e-01,9.33960790477323832e-03, 8.50879030660627408e-01,2.61804820639645874e-02,
9.37707050713763437e-01,4.01466421399581879e-02, 9.88003583235410962e-01,2.76900964021654675e-02
};
static double gj_9_9[18] = { 2.07378414653953240e-01,1.94416154775628482e-07,
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3.33102808230524903e-01,1.11260600495133409e-05, 4.60958067645175137e-01,1.76782840766832421e-04,
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9.56065776363007633e-01,3.35478340517795738e-02, 9.91571314023612757e-01,2.00783468843862541e-02
};
static double gj_9_11[22] = { 1.59700661316505602e-01,1.65761960956341529e-08,
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8.55812856045160456e-01,1.94784215382527346e-02, 9.20648837945675567e-01,2.77697811514968706e-02,
9.67228372904115565e-01,2.77064470243084119e-02, 9.93728684260593034e-01,1.52267333786973900e-02
};
static double gj_9_13[26] = { 1.26615883274872173e-01,1.85083457259609461e-09,
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3.86729262114773017e-01,2.90374820551583729e-05, 4.80709228181815349e-01,1.86174246960633499e-04,
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};
static double gj_9_15[30] = { 1.02772121815037431e-01,2.57324977925345203e-10,
1.69702572434332600e-01,1.97955094919741211e-08, 2.42569337961708483e-01,4.46995092963231364e-07,
3.20672266575040808e-01,5.07859449332949749e-06, 4.02377015452250989e-01,3.61260455761598643e-05,
4.85760837770747670e-01,1.80523118037153474e-04, 5.6878793537895597e-01,6.78803912989500082e-04,
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9.79659648484601257e-01,1.92397729234810485e-02, 9.96119191985834549e-01,9.62373792820574904e-03
};
static double gj_9_17[34] = { 8.50442362587906004e-02,4.28693769762357776e-11,
1.41052223073337190e-01,3.4564559959033693e-09, 2.02657205789482795e-01,8.2460159446272776e-08,
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9.83350373335140960e-01,1.62788676409895715e-02, 9.96826283244941196e-01,7.91959540864448353e-03
};
static double gj_12_5[10] = { 4.68142302046837272e-01,3.35566328888716166e-05,
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};
static double gj_12_7[14] = { 3.47358946607025868e-01,8.64052304034689302e-07,
5.03783041728021086e-01,5.62465925693047729e-05, 6.46052865957287760e-01,8.84494311353402192e-04,
7.70966156203720564e-01,5.74660582269246958e-03, 8.73067743738488835e-01,1.86680526266241509e-02,
9.47313572846298999e-01,3.16177740597747832e-02, 9.89889045468176495e-01,2.30259625346818546e-02
};
static double gj_12_9[18] = { 2.66783981956407152e-01,3.31968250619783235e-08,
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9.62240107274524239e-01,2.72072240656043169e-02, 9.92771514161633165e-01,1.70313447124100206e-02
};
static double gj_12_11[22] = { 2.10857605193180721e-01,1.79808340927840410e-09,
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7.18158279073601360e-01,1.97784665222387759e-03, 8.01974224571478114e-01,6.17544395301296546e-03,
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9.71451530216239471e-01,2.30034462785791550e-02, 9.94544708052148954e-01,1.31254923983020886e-02
};
static double gj_12_13[26] = { 1.70632025990511112e-01,1.29719066673978472e-10,
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7.75230570124756090e-01,3.87303692721415569e-03, 8.42941611901253674e-01,8.796106718135444636e-03,
9.00185160563118302e-01,1.53640011778453449e-02, 9.45463114116739479e-01,2.03959754471238235e-02,
9.77588077697455253e-01,1.94467180730505989e-02, 9.95722936325926163e-01,1.04349397755649206e-02
};
static double gj_12_15[30] = { 1.40805223485574383e-01,1.18892951954164784e-11,
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3.69147006556864992e-01,8.39192090851201510e-07, 4.49257970561324591e-01,8.10266015294815991e-06,
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6.82637577096418523e-01,9.02219918670029354e-04, 7.52713340851976997e-01,2.55843875703559838e-03,
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9.81902998793562952e-01,1.65384400568692423e-02, 9.96549747066092769e-01,8.50040406075214138e-03
};
static double gj_15_5[10] = { 5.26557705567159593e-01,1.78957009805135171e-05,
6.99648033287298213e-01,8.64518501125389459e-04, 8.34811150701185486e-01,8.50246856447675577e-03,
9.31669087081993566e-01,2.74369171056991772e-02, 9.86905860097057019e-01,2.76943291599762286e-02
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static double gj_15_7[14] = { 4.04638676927045534e-01,3.26907700513378790e-07,

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5.5509184969627425e-01,2.75925039261343104e-05, 6.86670298783368637e-01,5.26007883965657447e-04,
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};
static double gj_15_9[18] = { 3.19277377429921821e-01,8.69847097479311356e-09,
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};
static double gj_15_11[22] = { 2.57772997917075018e-01,3.24943799737593054e-10,
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};
static double gj_15_13[26] = { 2.12205249069590622e-01,1.62599100042088379e-11,
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9.79968969305822350e-01,1.68382253312151061e-02, 9.96180414361850310e-01,9.2629945098357932e-03
};
static double gj_15_15[30] = { 1.77596135076662655e-01,1.04454116139447057e-12,
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4.11441490470406691e-01,1.9996381662357607e-07, 4.89416115129808120e-01,2.45280960066693194e-06,
5.66037106827686127e-01,1.96936445632346413e-05, 6.40025218470404087e-01,1.11843325151222083e-04,
7.10076997881556190e-01,4.72317876836557017e-04, 7.74924857577448350e-01,1.53299060809199993e-03,
8.33377809555753040e-01,3.90530306728793560e-03, 8.84352754595391916e-01,7.89421631483868494e-03,
9.26899912420565219e-01,1.265844085903050565e-02, 9.60223781848443562e-01,1.58154113000542279e-02,
9.83700374595419622e-01,1.44915181810438567e-02, 9.96894299737047970e-01,7.61173150008577902e-03
};
static double gj_18_5[10] = { 5.73666582094099541e-01,1.10061339737464522e-05,
7.33469386822230545e-01,6.14115924685988845e-04, 8.54837134065790391e-01,6.65574944592125101e-03,
9.40331421419568997e-01,2.28794174860540231e-02, 9.88604566507401435e-01,2.38937650634190447e-02
};
static double gj_18_7[14] = { 4.53203619960351909e-01,1.53275134669685429e-07,
5.96909064775802721e-01,1.57947434046710022e-05, 7.18932329711328130e-01,3.48706837260777976e-04,
8.2121410596700655e-01,2.92782392908651282e-03, 9.02151005532160091e-01,1.14774316193001563e-02,
9.59727298035691128e-01,2.20634522641325106e-02, 9.92307020468409810e-01,1.72206913857347556e-02
};
static double gj_18_9[18] = { 3.65539030504206795e-01,3.02354161449967844e-09,
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9.70521639323890380e-01,1.96611926074935043e-02, 9.94373712305511027e-01,1.30640763292093033e-02
};
static double gj_18_11[22] = { 3.00404812653053576e-01,8.28512447559750535e-11,
4.08180816096238492e-01,1.59905007883021057e-08, 5.08425492475779310e-01,7.03826636628112954e-07,
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9.77299871476880832e-01,1.71197069489700264e-02, 9.95671181142283388e-01,1.02855050657398521e-02
};
static double gj_18_13[26] = { 2.50931382628521793e-01,3.03783110127569709e-12,
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9.81892305088562847e-01,1.48373685432941925e-02, 9.96549477013175301e-01,8.32755332935867136e-03
};
static double gj_18_15[30] = { 2.12576176025490228e-01,1.43599868400540280e-13,
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};
static double gj_21_5[10] = { 6.12386274084669150e-01,7.44899392724986767e-06,
7.60456468928629932e-01,4.64899171818288252e-04, 8.70528757262881272e-01,5.43072919619170569e-03,
9.47043273292783130e-01,1.95987448511330799e-02, 9.89913095283495531e-01,2.10098056939064205e-02
};
static double gj_21_7[14] = { 4.94746788375590368e-01,8.32577951341860981e-08,
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8.38875847751161370e-01,2.28302245478872224e-03, 9.12202266393081209e-01,9.53826813306421728e-03,
9.63970381183134915e-01,1.91387668597534286e-02, 9.93128605000865948e-01,1.52922112955268901e-02
};
static double gj_21_9[18] = { 4.06387742466988518e-01,1.28090360563862530e-09,

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5.28076097582919277e-01,2.33854113013592795e-07, 6.34890216602022593e-01,9.09405398378230734e-06,
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};
static double gj_21_11[22] = { 3.39028081214934248e-01,2.69968545300139554e-11,
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};
static double gj_21_13[26] = { 2.86767119260892782e-01,7.57467903441520999e-13,
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5.50675482528097126e-01,3.94380418436866164e-07, 6.29208249192731437e-01,5.71099895397681944e-06,
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};
static double gj_21_15[30] = { 2.45524469574103645e-01,2.74026243974488375e-14,
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4.81457746566477646e-01,2.31139132452785663e-08, 5.54552007865132366e-01,4.04031630686763722e-07,
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7.52762027156826365e-01,1.75345400470606703e-04, 8.09152148132466490e-01,6.95804435478160314e-04,
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9.86401143231042884e-01,1.16018804484503901e-02, 9.97411315048998924e-01,6.29518957572555134e-03
};
static double gj_24_5[10] = { 6.44737763424800424e-01,5.39528775439772776e-06,
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9.52397092634893806e-01,1.71291685919604953e-02, 9.90952039215305017e-01,1.87466969290376004e-02
};
static double gj_24_7[14] = { 5.30608243136176803e-01,5.02748909338805272e-08,
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9.67404151772515673e-01,1.68891807074096163e-02, 9.93791624827272846e-01,1.37519359145831675e-02
};
static double gj_24_9[18] = { 4.42597080378005426e-01,6.27102160561860094e-10,
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7.51276041255731843e-01,9.99661917417174981e-05, 8.27887465728737678e-01,8.29201783656300940e-04,
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9.75822428828214746e-01,1.53533559794583331e-02, 9.95394478444991957e-01,1.05950756003201284e-02
};
static double gj_24_11[22] = { 3.74021523812067123e-01,1.05521411640968721e-11,
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9.81158551680087622e-01,1.36057100730091638e-02, 9.96412036628262441e-01,8.45537928403510819e-03
};
static double gj_24_13[26] = { 3.19834434589802607e-01,2.34594055310846877e-13,
4.13486024958998696e-01,8.59239176562935494e-11, 4.98891442015135775e-01,6.60889082320885988e-09,
5.78976113263870515e-01,2.05260833163552006e-07, 6.53974835011005325e-01,3.34960134789015886e-06,
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};
static double gj_24_15[30] = { 2.76402617490419116e-01,6.70733533963846214e-15,
3.59693346193848488e-01,2.91286728627114201e-12, 4.36921762027340638e-01,2.67093042922182100e-10,
5.10701429980561983e-01,1.00135417148817124e-08, 5.81309039520515756e-01,2.00440053584760313e-07,
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9.43352842239441758e-01,7.54717338057605051e-03, 9.69281209243987267e-01,1.06113285525761423e-02,
9.87441459669956330e-01,1.05458531069523653e-02, 9.97610228011187419e-01,5.79403950321637411e-03
};
static double gj_27_5[10] = { 6.72153363158332645e-01,4.10834039060132011e-06,
8.00811789868054390e-01,3.01813837949002916e-04, 8.93539058911246158e-01,3.92871069972059947e-03,
9.56767347486577760e-01,1.52054841509287506e-02, 9.91796933726473979e-01,1.69235193346474093e-02
};
static double gj_27_7[14] = { 5.61834532318273326e-01,3.28533032214704732e-08,
6.85822798425150514e-01,5.02610511283861677e-06, 7.85278200277019861e-01,1.47911833631162222e-04,
8.65449035902730304e-01,1.54074352552665210e-03, 9.27160846515077595e-01,7.06943700965481348e-03,
9.70240096349402551e-01,1.51070711439776833e-02, 9.94337947002469307e-01,1.24934138924299925e-02
};
static double gj_27_9[18] = { 4.74843316584021567e-01,3.42486420389178393e-10,
5.8901773475538191e-01,8.42716410635787727e-08, 6.85792765777608331e-01,4.10762812343236237e-06,
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static double gj_27_11[22] = { 4.05777470656056447e-01,4.74039067596220263e-12,
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};
static double gj_27_13[26] = { 3.50325350835544546e-01,8.59152878209313187e-14,
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};
static double gj_27_15[30] = { 3.05267179973729250e-01,1.99385502960222196e-15,
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};
static double gj_30_5[10] = { 6.95671718377287394e-01,3.24998754810204357e-06,
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};
static double gj_30_7[14] = { 5.89243672297458668e-01,2.28115483874481030e-08,
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};
static double gj_30_9[18] = { 5.03699791266231341e-01,2.03612750800888805e-10,
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};
static double gj_30_11[22] = { 4.34664993897358561e-01,2.37511641830208188e-12,
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};
static double gj_30_13[26] = { 3.78454680940723315e-01,3.59282595338308836e-14,
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};
static double gj_30_15[30] = { 3.32221939255998305e-01,6.92095114938686444e-16,
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static double gj_33_5[10] = { 7.16062236157218731e-01,2.64882653327981531e-06,
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};
static double gj_33_7[14] = { 6.13479234081890347e-01,1.66132640097557745e-08,
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};
static double gj_33_9[18] = { 5.29646733510380440e-01,1.29480691058590866e-10,
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};
static double gj_33_11[22] = { 4.61016716219828901e-01,1.29861884395073836e-12,
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static double gj_33_13[26] = { 4.04436718257986505e-01,1.67213563006548750e-14,
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};
static double gj_33_15[30] = { 3.57391458518661315e-01,2.72481785743381681e-16,
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};
static double gj_36_5[10] = { 7.33905992905790325e-01,2.21096560255613514e-06,
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};
static double gj_36_7[14] = { 6.35051995782217227e-01,1.25713652262109687e-08,
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};
static double gj_36_9[18] = { 5.53084979255612285e-01,8.69414752241632341e-11,
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static double gj_36_11[22] = { 4.85126181483587701e-01,7.62335268176222948e-13,
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static double gj_36_13[26] = { 4.28474199504512370e-01,8.49557630758468920e-15,
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};
static double gj_36_15[30] = { 3.80906408460952450e-01,1.19022118678466813e-16,
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};
static double gj_39_5[10] = { 7.49649507789485051e-01,1.88165956971846133e-06,
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};
static double gj_39_7[14] = { 6.54371198580402803e-01,9.81467276994730820e-09,
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};
static double gj_39_9[18] = { 5.74349370719487053e-01,6.10424492795940801e-11,
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};
static double gj_39_11[22] = { 5.07249769878840846e-01,4.74569306634085182e-13,
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};
static double gj_39_13[26] = { 4.50753639991175301e-01,4.64256443697146389e-15,
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static double gj_39_15[30] = { 4.02895542093744191e-01,5.67046452030540724e-17,
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};
static double gj_42_5[10] = { 7.63641273530603848e-01,1.62731047330695648e-06,
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static double gj_42_7[14] = { 6.71767852639521074e-01,7.86317984206428186e-09,
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};
static double gj_42_9[18] = { 5.93720478625507170e-01,4.44790918833844982e-11,
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static double gj_42_11[22] = { 5.27610354100210307e-01,3.10289235150161405e-13,
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};
static double gj_42_13[26] = { 4.71443970394687735e-01,2.69728262839604989e-15,
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static double gj_42_15[30] = { 4.23481478714036053e-01,2.90714884529349128e-17,
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};
static double gj_45_5[10] = { 7.76157094208135248e-01,1.42639784496692723e-06,
8.67709396393189296e-01,1.35903804545821755e-04, 9.30554340975650243e-01,2.09767328679811393e-03,
9.72121076037721888e-01,9.05664838877476203e-03, 9.94742496055028127e-01,1.06863701000583134e-02
};
static double gj_45_7[14] = { 6.87512153963421609e-01,6.43772653453678544e-09,
7.82227715956208288e-01,1.45901196550035253e-06, 8.54152594939004753e-01,5.68820393031554926e-05,
9.09970501116606096e-01,7.30278358768619749e-04, 9.51790025884081941e-01,3.89972161223241943e-03,
9.80445774616853931e-01,9.22534699406341929e-03, 9.96294395916985776e-01,8.06432752396232917e-03
};
static double gj_45_9[18] = { 6.11434392499140988e-01,3.34381330757314239e-11,
7.04288637961378320e-01,1.37401518270850443e-08, 7.78575156458585039e-01,9.82452003587430365e-07,
8.40283996599143644e-01,2.43500806677328792e-05, 8.91277707638091746e-01,2.73904771509445958e-04,
9.32267531412501253e-01,1.59244485877204419e-03, 9.63529823645382187e-01,5.06101388869344374e-03,
9.85159637246816034e-01,8.64928695545158557e-03, 9.97183116538960789e-01,6.37602519733417808e-03
};
static double gj_45_11[22] = { 5.46401397125266352e-01,2.11471365074336730e-13,
6.35187992634738998e-01,1.34823447878175596e-10, 7.08570006308682004e-01,1.49350562182855466e-08,
7.71938084103956335e-01,5.86861047359958907e-07, 8.26952943755914797e-01,1.08695571241551929e-05,
8.74229267367439655e-01,1.09847216473639306e-04, 9.13980600011721679e-01,6.57852334666866870e-04,
9.46248170511611880e-01,2.43977466954030979e-03, 9.71000949936665869e-01,5.66285773950145433e-03,
9.88185616297562285e-01,7.88636895099762609e-03, 9.97756099765989019e-01,5.20984957857942896e-03
};
static double gj_45_13[26] = { 4.90696845518589473e-01,1.65079513229489778e-15,
5.74513744266993565e-01,1.47686215009112191e-12, 6.45362094553463032e-01,2.28309151401649837e-10,
7.081172125690989672e-01,1.26724977353135184e-08, 7.64276288084021604e-01,3.38534902381776377e-07,
8.14384665350529628e-01,5.0755283075730162e-06, 8.58617486431631491e-01,4.67854156900962716e-05,
8.96985892034095958e-01,2.80668430608515734e-04, 9.29427421020681531e-01,1.13411209877259679e-03,
9.55851479605260194e-01,3.13533124094400308e-03, 9.76164493478179411e-01,5.88881079782853135e-03,
9.90284877134897646e-01,7.12520669287204973e-03, 9.98154379385190907e-01,4.36168031128764634e-03
};

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static double gj_45_15[30] = { 4.42778683934832596e-01,1.58672496182690847e-17,
5.21369787105269229e-01,1.8527385998230468e-14, 5.88906631887786416e-01,3.73582973865965952e-12,
6.49819105399208601e-01,2.71548176467982450e-10, 7.05469085042858568e-01,9.62395220387977068e-09,
7.56350892595699968e-01,1.94766880925949266e-07, 8.02617662801474173e-01,2.47605570909236007e-06,
8.44267829409222124e-01,2.10369078889947942e-05, 8.81225747266525024e-01,1.24502143826436550e-04,
9.13384836038660411e-01,5.27416602596902215e-04, 9.40628506967543712e-01,1.62421604076335280e-03,
9.62844918778583102e-01,3.64777753075241129e-03, 9.79935492638409664e-01,5.88350704960614026e-03,
9.91820747570583391e-01,6.42648716649851006e-03, 9.98446044375423556e-01,3.72039781424440305e-03
};
static double gj_48_5[10] = { 7.87418001417246433e-01,1.26462896131688452e-06,
8.74723470003975389e-01,1.23738242830735286e-04, 9.34357688691022272e-01,1.94316157123248770e-03,
9.73678662734495621e-01,8.48251855908436134e-03, 9.95039368457608111e-01,1.00678736989220266e-02
};
static double gj_48_7[14] = { 7.01826581716410955e-01,5.36837709218454990e-09,
7.92835312321724578e-01,1.2680609950111316e-06, 8.61554688188750910e-01,5.09091100455860845e-05,
9.14674972116130741e-01,6.67915834327860994e-04, 9.54361429436250259e-01,3.6230344761913066e-03,
9.81502872652938209e-01,8.66105343232459108e-03, 9.96496176088119551e-01,7.61437041883165572e-03
};
static double gj_48_9[18] = { 6.27690725391744975e-01,2.58140963903869023e-11,
7.17530343575812739e-01,1.12110038021242264e-08, 7.88969859157530733e-01,8.35134030582217792e-07,
8.4805179107190780e-01,2.13741634837094917e-05, 8.96710148622453132e-01,2.46604358847848152e-04,
9.35721681470247675e-01,1.46221510155493635e-03, 9.6541756334040121e-01,4.71553123370629895e-03,
9.85935482916934088e-01,8.13919869813943744e-03, 9.9733118293999995e-01,6.03278677445021672e-03
};
static double gj_48_11[22] = { 5.63790910701211976e-01,1.49319320305967864e-13,
6.50234391660550358e-01,1.01919728037349491e-10, 7.21230567679396520e-01,1.18906865030257670e-08,
7.82250266920864508e-01,4.87248786855490880e-07, 8.35029830066015496e-01,9.34191714655579802e-06,
8.40250259263132654e-01,9.71341649586870399e-05, 9.18182176521569574e-01,5.95317975443032042e-04,
9.48914850081649172e-01,2.24851639246041129e-03, 9.72456297091001401e-01,5.29095456432983921e-03,
9.88783175674320480e-01,7.43780754635526595e-03, 9.97870080095683544e-01,4.93898489879473026e-03
};
static double gj_48_13[26] = { 5.08647751022978164e-01,1.05640862316887005e-15,
5.90715484257721590e-01,1.02376283382460360e-12, 6.59639826691465844e-01,1.68354139209920798e-10,
7.20393154925962839e-01,9.83405160204180282e-09, 7.74547654498227260e-01,2.74285766366980484e-07,
8.22711508512232849e-01,4.26586536735004239e-06, 8.65114056337324662e-01,4.05631060148038738e-05,
9.01813432811109669e-01,2.49764045810468397e-04, 9.32787562329197114e-01,1.03108538274912177e-03,
9.57979840163172626e-01,2.8953856645379058e-03, 9.77324316726783122e-01,5.51655034181192202e-03,
9.90760611970177466e-01,6.73406349307424820e-03, 9.98245071862490333e-01,4.14244161055229547e-03
};
static double gj_48_15[30] = { 4.60892712158682938e-01,9.13981237549691031e-18,
5.38238311015893879e-01,1.17187324673394268e-14, 6.04273192225329110e-01,2.52902326149746149e-12,
6.63543435973812153e-01,1.95078594619397275e-10, 7.17456235418878684e-01,7.27568664853487841e-09,
7.66590812215918837e-01,1.53906115477764848e-07, 8.11440762365075879e-01,2.03331335504074543e-06,
8.51147661750874160e-01,1.78602396057563377e-05, 8.86574687299019137e-01,1.08765980265324215e-04,
9.17348189367093781e-01,4.72028037773937887e-04, 9.43380776056382411e-01,1.48300790485652725e-03,
9.64585093306408944e-01,3.38435881116522292e-03, 9.80882500229852902e-01,5.52522932358564479e-03,
9.92208833677536605e-01,6.08569610396050978e-03, 9.98519990487627677e-01,3.53941560704146214e-03
};
static double gj_51_5[10] = { 7.97603148947318246e-01,1.13221221849594608e-06,
8.81031454508473889e-01,1.13452037207351735e-04, 9.37766000396438884e-01,1.80934585282456094e-03,
9.75071750232357485e-01,7.97650251975347692e-03, 9.95304505419543728e-01,9.51704310615145426e-03
};
static double gj_51_7[14] = { 7.14895827261464793e-01,4.54756664901788933e-09,
8.02459388283153397e-01,1.11495113134859047e-06, 8.68241839489283648e-01,4.59579023920945133e-05,
9.18912046891160633e-01,6.14803927469712361e-04, 9.56672337255990850e-01,3.38214508532873254e-03,
9.82451522700338740e-01,8.16148611446401722e-03, 9.9667711563798785e-01,7.21196319980278557e-03
};
static double gj_51_9[18] = { 6.42659097685787093e-01,2.03874071689098352e-11,
7.29642560215330578e-01,9.30879512951698438e-09, 7.98433691384881484e-01,7.19564862829526349e-07,
8.55099035231491784e-01,1.89573803614237365e-05, 9.01625290881612427e-01,2.23775913328117188e-04,
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9.86634225609550639e-01,7.68564178665967127e-03, 9.97464460471276502e-01,5.72460939863415254e-03
};
static double gj_51_11[22] = { 5.79925039565865639e-01,1.08697952645751245e-13,
6.64100250064035348e-01,7.89361688234797881e-11, 7.32840947150583233e-01,9.65232310517288186e-09,
7.91671160418177047e-01,4.10838966435828824e-07, 8.42386201842441732e-01,8.12712740476221301e-06,
8.85720722346640836e-01,8.67058583997194074e-05, 9.21992132489941171e-01,5.42622188116511625e-04,
9.51329298930811900e-01,2.08355730594118034e-03, 9.73772500458676914e-01,4.96386113901947536e-03,
9.89323188944036192e-01,7.03729284601078803e-03, 9.97973040547410678e-01,4.69488869292849505e-03
};
static double gj_51_13[26] = { 5.25417439071397407e-01,7.02607419635952974e-16,
6.05747710851414880e-01,7.3237759752088009e-13, 6.72820778580013551e-01,1.27405127150172205e-10,
7.31681229153040595e-01,7.79556387487320966e-09, 7.83961880134422506e-01,2.26114503553586122e-07,
8.30323005077930405e-01,3.63567430131081050e-06, 8.71039293006013867e-01,3.55592681110203331e-05,
9.06208341131757881e-01,2.24188141821621210e-04, 9.35842024221054197e-01,9.43648485158503164e-04,
9.59912311654750311e-01,2.69499260419119047e-03, 9.78376468188015599e-01,5.1875938671858629e-03,
9.91191923611260117e-01,6.38343913478057521e-03, 9.98327268521543064e-01,3.94418457686689634e-03
};
static double gj_51_15[30] = { 4.77920163971354089e-01,5.51661901672283847e-18,
5.53986299390016961e-01,7.68418296131557633e-15, 6.18546458828724418e-01,1.76924982237724927e-12,
6.76222327173105168e-01,1.44070063711350285e-10, 7.28508135401501722e-01,5.62897754213349172e-09,
7.76005052009966998e-01,1.23969436103524096e-07, 8.18957771762787919e-01,1.69615867861370726e-06,
8.57444841415319703e-01,1.53570350950440303e-05, 8.91462046218839149e-01,9.59846786601920047e-05,

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9.20964321694476182e-01,4.25816960367053655e-04, 9.45888969862676033e-01,1.36237177896074194e-03,
9.66169466949213242e-01,3.15460618903489106e-03, 9.81744115004196436e-01,5.20721725663610643e-03,
9.92561755821958310e-01,5.77907393719511276e-03, 9.98587218595242551e-01,3.37522199026693532e-03
};
static double gj_54_5[10] = { 8.06859245117665534e-01,1.02225693849611460e-06,
8.86734828129218280e-01,1.04655449542822756e-04, 9.40837793076034558e-01,1.69239247331598482e-03,
9.76324608680796640e-01,7.52720228417629057e-03, 9.95542737594710184e-01,9.02335138923741491e-03
};
static double gj_54_7[14] = { 7.26874388255221716e-01,3.90487363807020279e-09,
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9.22748103996050084e-01,5.69093055552537899e-04, 9.58760436014409242e-01,3.17063403741326174e-03,
9.83307601279840140e-01,7.71615455513817927e-03, 9.96840284826240341e-01,6.84994786430562282e-03
};
static double gj_54_9[18] = { 6.56484372653840822e-01,1.64218101848147969e-11,
7.40763150987808146e-01,7.84725263404666016e-09, 8.07086164038092424e-01,6.27296566797078407e-07,
8.61521547016824072e-01,1.69660625750011597e-05, 9.06093698823649367e-01,2.04458333860752792e-04,
9.41670451634977515e-01,1.25394523307100336e-03, 9.68661606100790257e-01,4.14648916846633485e-03,
9.87266816422334604e-01,7.27974702427828867e-03, 9.97585059454549926e-01,5.44638278071838703e-03
};
static double gj_54_11[22] = { 5.94931201531839883e-01,8.12483368824621625e-14,
6.76917772648330977e-01,6.24346892166949008e-11, 7.43526089608435364e-01,7.96841379526241610e-09,
8.00311412314326471e-01,3.51092987216359209e-07, 8.49114376923328447e-01,7.14553989486809359e-06,
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9.53525705538198215e-01,1.93999148076943574e-03, 9.74968610744951966e-01,4.67405859128054853e-03,
9.89813587992269702e-01,6.67752593961705911e-03, 9.98066505596087533e-01,4.47378024417214878e-03
};
static double gj_54_13[26] = { 5.41113444382464662e-01,4.83246343416994860e-16,
6.19730205471965508e-01,5.38485589607444631e-13, 6.85025598857246303e-01,9.86176233961972393e-11,
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9.91584757494848064e-01,6.06737006123429391e-03, 9.98402109765060577e-01,3.76403518498073488e-03
};
static double gj_54_15[30] = { 4.93949034757114981e-01,3.46849785904061706e-18,
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9.92884086663573865e-01,5.50174492034074601e-03, 9.98648604429344966e-01,3.22558477018923997e-03
};
static double gj_57_5[10] = { 8.15307555638519995e-01,9.29798714320730332e-07,
8.91916518067562632e-01,9.70571407574035658e-05, 9.43620568290705508e-01,1.58934906500454476e-03,
9.7745754582377216e-01,7.12562103860247518e-03, 9.95757962555378998e-01,8.57834730474734272e-03
};
static double gj_57_7[14] = { 7.37892429661894953e-01,3.39281760607929600e-09,
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9.26237517395335868e-01,5.29385192499020921e-04, 9.60656475326537343e-01,2.98351321907791999e-03,
9.84084029681063413e-01,3.1671216191709263e-03, 9.96988179046559865e-01,6.52253430103942442e-03
};
static double gj_57_9[18] = { 6.69290885693766374e-01,1.34565233697863520e-11,
7.51008545624163644e-01,6.70309874772845466e-09, 8.15027198437185918e-01,5.52486530260408861e-07,
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};
static double gj_57_11[22] = { 6.08920789690965358e-01,6.21503696876287266e-14,
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8.08264102196502048e-01,3.03582428167496721e-07, 8.55291544059477089e-01,6.3411118008042161e-06,
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9.90260910841200629e-01,6.35261064402930610e-03, 9.98151730915385450e-01,4.27255870514452747e-03
};
static double gj_57_13[26] = { 5.55831553425059073e-01,3.42292057724141156e-16,
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};
static double gj_57_15[30] = { 5.09059262703229496e-01,2.26046367766995543e-18,
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static double gj_60_5[10] = { 8.23049173964267475e-01,8.51186180424857250e-07,

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static double gj_60_7[14] = { 7.48060347780792805e-01,2.97854729474142288e-09,
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static double gj_60_9[18] = { 6.81185868850155088e-01,1.11938995137891887e-11,
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static double gj_60_15[30] = { 5.23323363023906224e-01,1.52066706532004985e-18,
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static double gj_63_5[10] = { 8.30169037602714396e-01,7.83683992590047095e-07,
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static double gj_63_9[18] = { 6.92262233631178607e-01,9.43621569822489274e-12,
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};
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};
static double gj_63_13[26] = { 5.82666527529716738e-01,1.85077506996090762e-16,
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};
static double gj_63_15[30] = { 5.36807082575449334e-01,1.05224594317085628e-18,
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};
static double gj_63_17[34] = { 4.95930396002442781e-01,7.08584664977802261e-21,
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};
static double gj_66_5[10] = { 8.36739024134765999e-01,7.25209181059770118e-07,
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};
static double gj_66_7[14] = { 7.66209320133719882e-01,2.35679484836231930e-09,
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};
static double gj_66_9[18] = { 7.02600841946458677e-01,8.0488167258067135e-12,
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};
static double gj_66_11[22] = { 6.45709627648234702e-01,3.11414351669546979e-14,
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};
static double gj_66_13[26] = { 5.94927821196407138e-01,1.40512039180950623e-16,
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static double gj_66_15[30] = { 5.49570037668050041e-01,7.46682197912734417e-19,
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};
static double gj_66_17[34] = { 5.0898096905680805e-01,4.67766687062577930e-21,
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static double gj_69_5[10] = { 8.42820363235238807e-01,6.74152057844287359e-07,
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};
static double gj_69_7[14] = { 7.74341033169694159e-01,2.12014762445583223e-09,
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};
static double gj_69_9[18] = { 7.12272367837463826e-01,6.93793249491959907e-12,
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static double gj_69_11[22] = { 6.56499943062768941e-01,2.55105854726774213e-14,
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static double gj_69_13[26] = { 6.06502136711791344e-01,1.08650189988385146e-16,
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};
static double gj_69_15[30] = { 5.61666315207249123e-01,5.41953572599346072e-19,
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};
static double gj_69_17[34] = { 5.21395842941131567e-01,3.17231719398426803e-21,
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};
static double gj_72_5[10] = { 8.48465534302342169e-01,6.29252057308172920e-07,
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};
static double gj_72_7[14] = { 7.81928030357274940e-01,1.91961752569773650e-09,
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};
static double gj_72_9[18] = { 7.21338830999148761e-01,6.03694230843523759e-12,
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static double gj_72_11[22] = { 6.66659632986538157e-01,2.11669571567551463e-14,
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static double gj_72_13[26] = { 6.17444315245310697e-01,8.54080537376911990e-17,
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static double gj_72_15[30] = { 5.73145027730541557e-01,4.01439938570241910e-19,
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};
static double gj_72_17[34] = { 5.33218071980589535e-01,2.20439888823256137e-21,
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static double gj_75_5[10] = { 8.53719773005574460e-01,5.89510061850526053e-07,
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static double gj_75_7[14] = { 7.89023070077518428e-01,1.74818319952533378e-09,
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};
static double gj_75_9[18] = { 7.29854866013676377e-01,5.29764913242935531e-12,
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};
static double gj_75_11[22] = { 6.76241690404265499e-01,1.77664853321815291e-14,
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};
static double gj_75_13[26] = { 6.27803689365805783e-01,6.81427653048342224e-17,
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};
static double gj_75_15[30] = { 5.84050819105472714e-01,3.02874569608897578e-19,
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};
static double gj_75_17[34] = { 5.44487213407759346e-01,1.56593168375748623e-21,
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static double gj_75_19[38] = { 5.08649561275047090e-01,9.40816227726638613e-24,
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};
static double gj_78_5[10] = { 8.58622277474618723e-01,5.54125448721310725e-07,
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};
static double gj_78_7[14] = { 7.95672337421097641e-01,1.60044109742663746e-09,
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};
static double gj_78_9[18] = { 7.37868777841499372e-01,4.68460659331915228e-12,
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static double gj_78_11[22] = { 6.85293426846942350e-01,1.50685154378591089e-14,
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};
static double gj_78_13[26] = { 6.37624728216596460e-01,5.51041190394810161e-17,
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};
static double gj_78_15[30] = { 5.94424321251272085e-01,2.32352398730960459e-19,
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};
static double gj_78_17[34] = { 5.55239623467056874e-01,1.13488191645619781e-21,
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};
static double gj_78_19[38] = { 5.19642715532534732e-01,6.41869748480837583e-24,
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static double gj_81_5[10] = { 8.63207181620224345e-01,5.22450194129787469e-07,
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};
static double gj_81_7[14] = { 8.01916432637433584e-01,1.47218103885533952e-09,
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};
static double gj_81_9[18] = { 7.45423423661245902e-01,4.17135222364796921e-12,
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};
static double gj_81_11[22] = { 6.93857198790053133e-01,1.29016859135255157e-14,
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};
static double gj_81_13[26] = { 6.46947599990765379e-01,4.51084692953416349e-17,
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};
static double gj_81_15[30] = { 6.04302564238662610e-01,1.80976590825535027e-19,
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};
static double gj_81_17[34] = { 5.65508735107405837e-01,8.37634715489510863e-22,

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static double gj_81_19[38] = { 5.30170581917510375e-01,4.47388857578832562e-24,
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static double gj_84_5[10] = { 8.67504346317309433e-01,4.93954943575074281e-07,
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static double gj_84_7[14] = { 8.07791187252206926e-01,1.36008534616320864e-09,
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};
static double gj_84_9[18] = { 7.52556952976722095e-01,3.73785789446356018e-12,
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};
static double gj_84_11[22] = { 7.01971028252361381e-01,1.11419657556410986e-14,
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};
static double gj_84_13[26] = { 6.55808662420832131e-01,3.73398231694449391e-17,
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};
static double gj_84_15[30] = { 6.13719343133675680e-01,1.42926982025422618e-19,
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};
static double gj_84_17[34] = { 5.75325315382199083e-01,6.28644346832793737e-22,
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};
static double gj_84_19[38] = { 5.40260720103551035e-01,3.18005872282005265e-24,
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};
static double gj_87_5[10] = { 8.71540006952518471e-01,4.68203605527680725e-07,
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};
static double gj_87_7[14] = { 8.13328341738754641e-01,1.26151233414780742e-09,
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};
static double gj_87_9[18] = { 7.59303431507225722e-01,3.36877346993700273e-12,
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};
static double gj_87_11[22] = { 7.09669134518030547e-01,9.69822613409349770e-15,
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};
static double gj_87_13[26] = { 6.64240890830594081e-01,3.12256621055801358e-17,
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};
static double gj_87_15[30] = { 6.22705545368602231e-01,1.14317862542789075e-19,
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};
static double gj_87_17[34] = { 5.84717702111489199e-01,4.79069536965014185e-22,
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static double gj_87_19[38] = { 5.49938713890552751e-01,2.30143877095063892e-24,
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};
static double gj_87_21[42] = { 5.18052413346795623e-01,1.26561337556011166e-26,
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static double gj_90_5[10] = { 8.75337306823617758e-01,4.44834101727799314e-07,
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static double gj_90_7[14] = { 8.18556111264734501e-01,1.17433832691600454e-09,
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};
static double gj_90_9[18] = { 7.65693369348023628e-01,3.05219716381875354e-12,
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};
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};
static double gj_90_13[26] = { 6.72274252136141836e-01,2.63577448263390240e-17,
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};
static double gj_90_15[30] = { 6.31289442488649154e-01,9.25060304120366366e-20,
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};
static double gj_90_17[34] = { 5.93712020243788199e-01,3.70252634922706457e-22,
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};
static double gj_90_19[38] = { 5.59228321698373509e-01,1.69338525021140693e-24,
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};
static double gj_90_21[42] = { 5.27543053549834669e-01,8.84150253686840172e-27,
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};
static double gj_93_5[10] = { 8.78916739166566450e-01,4.23543622378714103e-07,
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static double gj_93_7[14] = { 8.23499660412940917e-01,1.09684089533573283e-09,
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};
static double gj_93_9[18] = { 7.71754169923014994e-01,2.77880171029686138e-12,
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};
static double gj_93_11[22] = { 7.23938719186276534e-01,7.50382005626958094e-15,
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};
static double gj_93_13[26] = { 6.79936032095561261e-01,2.24405955168053131e-17,
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};
static double gj_93_15[30] = { 6.39496949987457424e-01,7.56621951235887784e-20,
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};
static double gj_93_17[34] = { 6.02332378873869310e-01,2.89883729965321575e-22,
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static double gj_93_19[38] = { 5.68151617895256240e-01,1.26516493710534321e-24,
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};
static double gj_93_21[42] = { 5.36678699533884781e-01,6.28665421248097958e-27,
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static double gj_96_5[10] = { 8.82296515543089040e-01,4.04077217308455268e-07,
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};
static double gj_96_7[14] = { 8.28181503451541000e-01,1.02761153091988049e-09,
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9.90081333541749319e-01,4.36984967807366258e-03, 9.98127530855787704e-01,4.02274914702857280e-03
};
static double gj_96_9[18] = { 7.77510513113733678e-01,2.54120476507269036e-12,
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static double gj_96_11[22] = { 7.30563428596816667e-01,6.66284004893449366e-15,
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};
static double gj_96_13[26] = { 6.87251122122690813e-01,1.92573855480411110e-17,
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};
static double gj_96_15[30] = { 6.47351858702124489e-01,6.24999974860878094e-20,
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};
static double gj_96_17[34] = { 6.10601050154619967e-01,2.29691705280258956e-22,
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};
static double gj_96_19[38] = { 5.76729124529698149e-01,9.58679248691555624e-25,
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};
static double gj_96_21[42] = { 5.45478021188176109e-01,4.54372224876188407e-27,
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};
static double gj_99_5[10] = { 8.85492874499270083e-01,3.86218885070498925e-07,
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static double gj_99_7[14] = { 8.32621843381279297e-01,9.65489612557467328e-10,
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};
static double gj_99_9[18] = { 7.82984683455151710e-01,2.33350943709570900e-12,
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};
static double gj_99_11[22] = { 7.36879512161536640e-01,5.94946871790699930e-15,
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};
static double gj_99_13[26] = { 6.94242271108580021e-01,1.66469525798688612e-17,
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};
static double gj_99_15[30] = { 6.54876040946361143e-01,5.21013959136790968e-20,
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};
static double gj_99_17[34] = { 6.18538631469174999e-01,1.84024500370849451e-22,
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static double gj_99_19[38] = { 5.84979933449147873e-01,7.36010104937151760e-25,
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};
static double gj_99_21[42] = { 5.53958492193208731e-01,3.33417742088365952e-27,
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static double gj_102_5[10] = { 8.88520341484823718e-01,3.69784551909068127e-07,
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};
static double gj_102_7[14] = { 8.36838860377970369e-01,9.09511960421266299e-10,
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9.90624804063044511e-01,4.11457863524420074e-03, 9.98230512713516059e-01,3.79875802679203024e-03
};
static double gj_102_9[18] = { 7.88196852298523610e-01,2.15096496826189438e-12,
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static double gj_102_11[22] = { 7.42907902467629275e-01,5.34018138930129260e-15,
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};
static double gj_102_13[26] = { 7.00930306932742504e-01,1.44880779792843188e-17,
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static double gj_102_15[30] = { 6.62089634253654349e-01,4.38021472341330337e-20,
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static double gj_102_17[34] = { 6.26164192260135058e-01,1.48958715138527253e-22,
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};
static double gj_102_19[38] = { 5.92921819055740432e-01,5.71967800294536618e-25,
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static double gj_102_21[42] = { 5.62136472463703993e-01,2.48133531009940602e-27,
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static double gj_102_23[46] = { 5.33595580078816480e-01,1.21470050778002196e-29,
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static double gj_105_5[10] = { 8.91391948773373388e-01,3.54616494394107831e-07,
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static double gj_105_7[14] = { 8.40848958202082748e-01,8.58873927946875876e-10,
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static double gj_105_9[18] = { 7.93165321246248993e-01,1.98971335211802840e-12,
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};
static double gj_105_11[22] = { 7.48667695324720233e-01,4.81646338711123488e-15,
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};
static double gj_105_13[26] = { 7.07334331686997213e-01,1.26885727371331250e-17,
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};
static double gj_105_15[30] = { 6.69011205301128824e-01,3.71154576499136620e-20,
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static double gj_105_17[34] = { 6.33495406882830464e-01,1.21730835031723932e-22,
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};
static double gj_105_19[38] = { 6.00571342114061747e-01,4.49539895248292015e-25,
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};
static double gj_105_21[42] = { 5.70027285823672183e-01,1.87102854783110383e-27,
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static double gj_108_5[10] = { 8.94119422379227162e-01,3.40578874867600256e-07,
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static double gj_108_7[14] = { 8.44666975532337261e-01,8.12899123841215963e-10,
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static double gj_108_11[22] = { 7.54176345135359740e-01,4.36361395089093493e-15,
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static double gj_108_13[26] = { 7.13471894067302486e-01,1.11775979780923628e-17,
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static double gj_108_15[30] = { 6.75657896300464401e-01,3.16802968124745414e-20,
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static double gj_108_19[38] = { 6.07943945120660006e-01,3.57058366774603670e-25,
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static double gj_111_11[22] = { 7.59449836105373084e-01,3.96986386910791974e-15,
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static double gj_111_13[26] = { 7.19359141902559186e-01,9.90019260404750363e-18,
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static double gj_111_15[30] = { 6.82045555880353303e-01,2.72259044000254800e-20,
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static double gj_114_7[14] = { 8.51779364866290721e-01,7.32737320107104158e-10,
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9.91550715958718730e-01,3.6840448485248142e-03, 9.98405861098794056e-01,3.41810705299544710e-03
};
static double gj_114_9[18] = { 8.06767733854993476e-01,1.60481901876742672e-12,
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9.26593486572892263e-01,4.72747873670773195e-06, 9.50789055022563261e-01,6.98154207684589774e-05,
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9.93458466030339614e-01,3.53518246313443502e-03, 9.98762367943423746e-01,2.76168712369051143e-03
};
static double gj_114_11[22] = { 7.64502832666340471e-01,3.62571773097003300e-15,
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9.94690595850458577e-01,3.29718120549978937e-03, 9.98994129608548069e-01,2.30370836842503963e-03
};
static double gj_114_13[26] = { 7.25010957373307996e-01,8.81332723377108875e-18,
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};
static double gj_114_15[30] = { 6.88188856247734490e-01,2.35470880277650713e-20,
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};
static double gj_114_17[34] = { 6.53881235651167882e-01,6.99098092705549792e-23,
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9.96676029554644287e-01,2.58387301412053630e-03, 9.99369369965879905e-01,1.50670375040648466e-03
};
static double gj_114_19[38] = { 6.21915087243007969e-01,2.31853206899155087e-25,
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};
static double gj_114_21[42] = { 5.92115916509940947e-01,8.60573923135530329e-28,
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9.97375417229983943e-01,2.20849564100512652e-03,9.99501915871278844e-01,1.20799193281488538e-03
};
static double gj_114_23[46] = { 5.64315551794732061e-01,3.57451157774089036e-30,
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};
static double gj_117_5[10] = { 9.01537901860915067e-01,3.04147566838075731e-07,
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};
static double gj_117_7[14] = { 8.55097106304613422e-01,6.97648665713724452e-10,
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};
static double gj_117_9[18] = { 8.10913845809142153e-01,1.50219915960038888e-12,
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9.93613730258374419e-01,3.44642232038256610e-03,9.98791817861441107e-01,2.69525549763034372e-03
};
static double gj_117_11[22] = { 7.69348811963162840e-01,3.32345880103469321e-15,
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};
static double gj_117_13[26] = { 7.30441077117832693e-01,7.88302692429474198e-18,
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};
static double gj_117_15[30] = { 6.94101398202520030e-01,2.04868144622264884e-20,
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};
static double gj_117_17[34] = { 6.60187880795446378e-01,5.89978965185626813e-23,
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};

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};
static double gj_117_19[38] = { 6.28539671420652168e-01,1.89314787584180344e-25,
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9.97127067271504468e-01,2.33030652567264524e-03, 9.99454861143164214e-01,1.31296011773077843e-03
};
static double gj_117_21[42] = { 5.98993026298950878e-01,6.78368025136070889e-28,
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};
static double gj_117_23[46] = { 5.71389156073426901e-01,2.71481787921588785e-30,
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};
static double gj_120_5[10] = { 9.03785106108218230e-01,2.93598323962334148e-07,
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9.88756028178864574e-01,3.35590734638031120e-03, 9.97893728074263176e-01,4.21388591601973980e-03
};
static double gj_120_7[14] = { 8.58269760907726425e-01,6.65392944401354284e-10,
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static double gj_120_9[18] = { 8.14886207002622717e-01,1.40964922832927517e-12,
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};
static double gj_120_11[22] = { 7.74000180826921332e-01,3.05677286826066129e-15,
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};
static double gj_120_13[26] = { 7.35662199119707103e-01,7.08225115968670865e-18,
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static double gj_120_15[30] = { 6.99795805391650981e-01,1.79237953200451143e-20,
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static double gj_120_17[34] = { 6.66271453344273774e-01,5.01282478351150652e-23,
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static double gj_120_21[42] = { 6.05646429119113812e-01,5.39796158822198660e-28,
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};
static double gj_120_25[50] = { 5.52583961795022280e-01,8.96253321818883908e-33,
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static double gj_123_5[10] = { 9.05932072004459518e-01,2.83723584391374851e-07,
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};
static double gj_123_7[14] = { 8.61306629603557840e-01,6.35662427573833149e-10,
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};
static double gj_123_9[18] = { 8.18695486774191381e-01,1.32589499664838384e-12,
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9.93903148806444054e-01,3.28161913312573547e-03, 9.98846704059967073e-01,2.57153977860752835e-03
};
static double gj_123_11[22] = { 7.78468379291707920e-01,2.82045999665910405e-15,
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};
static double gj_123_13[26] = { 7.40686078011664676e-01,6.38931636264229587e-18,
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static double gj_123_15[30] = { 7.05283809021385410e-01,1.57635356250676379e-20,
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};
static double gj_123_17[34] = { 6.72143417112132490e-01,4.28642057269821108e-23,
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static double gj_123_19[38] = { 6.41125797643453301e-01,1.29250365114117287e-25,
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};
static double gj_123_21[42] = { 6.12086597742768512e-01,4.33346758850056526e-28,
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};
static double gj_123_23[46] = { 5.84884069186668298e-01,1.61647606287426611e-30,
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};
static double gj_123_25[50] = { 5.59382961936556412e-01,6.70388289374812018e-33,
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};
static double gj_126_5[10] = { 9.07985356836082166e-01,2.74462601796705074e-07,
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};
static double gj_126_7[14] = { 8.64216236046998516e-01,6.08190518880307730e-10,
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};
static double gj_126_9[18] = { 8.22351500886205523e-01,1.24985570794013214e-12,
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};

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};
static double gj_126_11[22] = { 7.82763972411286774e-01,2.61021182510576366e-15,
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};
static double gj_126_13[26] = { 7.45523610209229807e-01,5.78671115834174183e-18,
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};
static double gj_126_15[30] = { 7.10576324099750935e-01,1.39318114655695287e-20,
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};
static double gj_126_17[34] = { 6.77814477420964541e-01,3.68728534133053682e-23,
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};
static double gj_126_19[38] = { 6.47108698957302246e-01,1.07968748029813884e-25,
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};
static double gj_126_21[42] = { 6.18323383298500034e-01,3.50797374635901143e-28,
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};
static double gj_126_23[46] = { 5.91324522650647747e-01,1.26572250218449835e-30,
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};
static double gj_126_25[50] = { 5.65983656527200061e-01,5.06900402576301338e-33,
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9.98021703220499784e-01,1.74945273352585992e-03, 9.99624540889822929e-01,9.19194329335526072e-04
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};
static double gj_129_7[14] = { 8.67006406037961530e-01,5.82745310161902224e-10,
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};
static double gj_129_9[18] = { 8.25863294953218863e-01,1.18061023051850240e-12,
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};
static double gj_129_11[22] = { 7.86896731877138404e-01,2.42243817782342578e-15,
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};
static double gj_129_13[26] = { 7.50184910098169786e-01,5.26019878066107572e-18,
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};
static double gj_129_15[30] = { 7.15683518152044492e-01,1.23698704595390779e-20,
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};
static double gj_129_17[34] = { 6.83294641387046862e-01,3.18981258054833195e-23,
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9.97017043593379961e-01,2.30533171837326986e-03, 9.99434142894621387e-01,1.35045751617711022e-03
};
static double gj_129_19[38] = { 6.52897963518842275e-01,9.07987867229067891e-26,
7.01280706234701582e-01,6.72605985831145462e-22, 7.40498257226061709e-01,6.21296592026509133e-19,
7.74503266205473947e-01,1.75500040491366180e-16, 8.04768300048466928e-01,2.16862304766119736e-14,
8.32028414677921213e-01,1.41671099960868842e-12, 8.56706402057490596e-01,5.49170077234782494e-11,
8.79069250858411715e-01,1.36371707337743086e-09, 8.99293635509528212e-01,2.28892517796249956e-08,
9.17501823184356798e-01,2.69964484615588254e-07, 9.33780631853297615e-01,2.30247701591610220e-06,
9.48192898770773495e-01,1.45015419947031662e-05, 9.60784692850360236e-01,6.84547392466689026e-05,
9.71590039719963359e-01,2.44418207261231678e-04, 9.80634114977460829e-01,6.62027075020005221e-04,
9.87935451284093153e-01,1.35256136780984172e-03, 9.93507489260991874e-01,2.03980956569607499e-03,
9.97359713143491063e-01,2.13212298365335471e-03, 9.99499050850145234e-01,1.20551548850087586e-03
};
static double gj_129_21[42] = { 6.24366058447049929e-01,2.86209112272702265e-28,
6.72070880615205983e-01,2.81232920364365693e-24, 7.11032331727122895e-01,3.35797377338912783e-21,
7.45076244982533353e-01,1.21575601027928797e-18, 7.75625644993742326e-01,1.92202683127772416e-16,
8.03389678347361520e-01,1.60934100283810115e-14, 8.28776694947236704e-01,8.02964667018774986e-13,
8.52042996556374121e-01,2.58215671083973005e-11, 8.73358760237732067e-01,5.65622289660169288e-10,
8.92841426898983348e-01,8.78867352553850319e-09, 9.10574278589944915e-01,9.98588846202978866e-08,
9.26617524208123116e-01,8.49112918133087944e-07, 9.41015281732324800e-01,5.49902773140768896e-06,
9.53800167046217107e-01,2.74782733071050766e-05, 9.64996413264458798e-01,1.06889475308486640e-04,
9.74622047916432840e-01,3.25206441962959818e-04, 9.82690442965605595e-01,7.73525078856913638e-04,
9.89211433616453144e-01,1.42662446871357423e-03, 9.94192135649386618e-01,1.99280098548176053e-03,
9.97637579841566102e-01,1.97694489592196147e-03, 9.99551713486525950e-01,1.08608072198416573e-03
};
static double gj_129_23[46] = { 5.97572187763693727e-01,1.00005026931614326e-30,
6.44457807864534973e-01,1.26367632535241115e-26, 6.82994493578860957e-01,1.89472491068033199e-23,
7.16883031441639255e-01,8.54332754376031259e-21, 7.47497995234373574e-01,1.67814071139612066e-18,
7.75523596654419232e-01,1.74720827651923673e-16, 8.01353401387660759e-01,1.0870212667474240e-14,
8.25234146717915337e-01,4.37773694146317064e-13, 8.47329435220419706e-01,1.207652938988789e-11,
8.67751976335754056e-01,2.37914954688333020e-10, 8.86581519478522789e-01,3.45473993333051604e-09,
9.03875555214128874e-01,3.78905128418374455e-08, 9.19676058657057580e-01,3.19922876544202250e-07,
9.34013927096385880e-01,2.11064124084835577e-06, 9.46912004278856054e-01,1.10048597136416003e-05,
9.58387200820592430e-01,4.57260241153936278e-05, 9.68452015139119163e-01,1.52211698396996413e-04,

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9.77115643832162129e-01,4.06693176137198704e-04, 9.84384802698483157e-01,8.69956635286904662e-04,
9.90264338927983705e-01,1.47520172201465744e-03, 9.94757692852179247e-01,1.93458131219332256e-03,
9.97867279655074993e-01,1.83810739204319500e-03, 9.99595264508348613e-01,9.86052742295939572e-04
};
static double gj_129_25[50] = { 5.72394292473765993e-01,3.87216771389295552e-33,
6.18362431439129113e-01,6.13100058273714705e-29, 6.56350963860113382e-01,1.12692118331519744e-25,
6.89938385591676968e-01,6.17997722411808459e-23, 7.20452220772506330e-01,1.47249442003629002e-20,
7.48552601529633701e-01,1.85990536326373146e-18, 7.74618883864983436e-01,1.40644528734425863e-16,
7.98888649425299434e-01,6.90610125780669090e-15, 8.21519226744481480e-01,2.33255895175263474e-13,
8.42618816208333411e-01,5.65477468363507018e-12, 8.62263794939929216e-01,1.01643470405553392e-10,
8.80509040760626629e-01,1.38935254903933844e-09, 8.97394438235172108e-01,1.47334786900224037e-08,
9.12949162160387800e-01,1.23165109154752080e-07, 9.27194600103603794e-01,8.22023179494141704e-07,
9.40146405816859539e-01,4.42431676028424042e-06, 9.51815977422911421e-01,1.93504296463495484e-05,
9.62211542867556625e-01,6.91428734879045931e-05, 9.71338969708419177e-01,2.02444135886272043e-04,
9.79202376478006600e-01,4.85730254289254116e-04, 9.85804597931524424e-01,9.51188164832788462e-04,
9.91147540951889652e-01,1.50362813828449338e-03, 9.95232460744234201e-01,1.87026298257354886e-03,
9.98060206013938153e-01,1.71374888290042038e-03, 9.99631853730927779e-01,9.01126124687968830e-04
};
/* rel error 1.100000e-16 */
int N=0 ;
double * gj =0 ;
if ( m % 3 )
    return (exp(-z)+2*z*boysGaussJacobi(m+1,z))/(2*m+1) ;
switch (m) {
case 0:
    if ( z <= 0.443 ) { N=5 ; gj=gj_0_5 ;}
    else if ( z <= 1.744 ) { N=7 ; gj=gj_0_7 ;}
    else if ( z <= 4.070 ) { N=9 ; gj=gj_0_9 ;}
    else if ( z <= 7.439 ) { N=11 ; gj=gj_0_11 ;}
    else if ( z <= 11.836 ) { N=13 ; gj=gj_0_13 ;}
    else if ( z <= 17.234 ) { N=15 ; gj=gj_0_15 ;}
    else N=16 ;
    break ;
case 3:
    if ( z <= 0.519 ) { N=5 ; gj=gj_3_5 ;}
    else if ( z <= 1.894 ) { N=7 ; gj=gj_3_7 ;}
    else if ( z <= 4.116 ) { N=9 ; gj=gj_3_9 ;}
    else if ( z <= 7.087 ) { N=11 ; gj=gj_3_11 ;}
    else if ( z <= 10.800 ) { N=13 ; gj=gj_3_13 ;}
    else if ( z <= 15.276 ) { N=15 ; gj=gj_3_15 ;}
    else if ( z <= 20.513 ) { N=17 ; gj=gj_3_17 ;}
    else N=9 ;
    break ;
case 6:
    if ( z <= 0.641 ) { N=5 ; gj=gj_6_5 ;}
    else if ( z <= 2.224 ) { N=7 ; gj=gj_6_7 ;}
    else if ( z <= 4.643 ) { N=9 ; gj=gj_6_9 ;}
    else if ( z <= 7.691 ) { N=11 ; gj=gj_6_11 ;}
    else if ( z <= 11.297 ) { N=13 ; gj=gj_6_13 ;}
    else if ( z <= 15.498 ) { N=15 ; gj=gj_6_15 ;}
    else if ( z <= 20.334 ) { N=17 ; gj=gj_6_17 ;}
    else N=12 ;
    break ;
case 9:
    if ( z <= 0.767 ) { N=5 ; gj=gj_9_5 ;}
    else if ( z <= 2.575 ) { N=7 ; gj=gj_9_7 ;}
    else if ( z <= 5.235 ) { N=9 ; gj=gj_9_9 ;}
    else if ( z <= 8.464 ) { N=11 ; gj=gj_9_11 ;}
    else if ( z <= 12.136 ) { N=13 ; gj=gj_9_13 ;}
    else if ( z <= 16.257 ) { N=15 ; gj=gj_9_15 ;}
    else if ( z <= 20.893 ) { N=17 ; gj=gj_9_17 ;}
    else N=15 ;
    break ;
case 12:
    if ( z <= 0.895 ) { N=5 ; gj=gj_12_5 ;}
    else if ( z <= 2.934 ) { N=7 ; gj=gj_12_7 ;}
    else if ( z <= 5.849 ) { N=9 ; gj=gj_12_9 ;}
    else if ( z <= 9.296 ) { N=11 ; gj=gj_12_11 ;}
    else if ( z <= 13.106 ) { N=13 ; gj=gj_12_13 ;}
    else if ( z <= 17.253 ) { N=15 ; gj=gj_12_15 ;}
    else N=29 ;
    break ;
case 15:
    if ( z <= 1.024 ) { N=5 ; gj=gj_15_5 ;}
    else if ( z <= 3.296 ) { N=7 ; gj=gj_15_7 ;}
    else if ( z <= 6.473 ) { N=9 ; gj=gj_15_9 ;}
    else if ( z <= 10.153 ) { N=11 ; gj=gj_15_11 ;}
    else if ( z <= 14.136 ) { N=13 ; gj=gj_15_13 ;}
    else if ( z <= 18.372 ) { N=15 ; gj=gj_15_15 ;}
    else N=25 ;
    break ;
case 18:
    if ( z <= 1.152 ) { N=5 ; gj=gj_18_5 ;}

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else if ( z <= 3.660 ) { N=7 ; gj=gj_18_7 ;}
else if ( z <= 7.102 ) { N=9 ; gj=gj_18_9 ;}
else if ( z <= 11.024 ) { N=11 ; gj=gj_18_11 ;}
else if ( z <= 15.198 ) { N=13 ; gj=gj_18_13 ;}
else if ( z <= 19.557 ) { N=15 ; gj=gj_18_15 ;}
else N=26 ;
break ;
case 21:
if ( z <= 1.281 ) { N=5 ; gj=gj_21_5 ;}
else if ( z <= 4.024 ) { N=7 ; gj=gj_21_7 ;}
else if ( z <= 7.734 ) { N=9 ; gj=gj_21_9 ;}
else if ( z <= 11.901 ) { N=11 ; gj=gj_21_11 ;}
else if ( z <= 16.278 ) { N=13 ; gj=gj_21_13 ;}
else if ( z <= 20.782 ) { N=15 ; gj=gj_21_15 ;}
else N=28 ;
break ;
case 24:
if ( z <= 1.411 ) { N=5 ; gj=gj_24_5 ;}
else if ( z <= 4.389 ) { N=7 ; gj=gj_24_7 ;}
else if ( z <= 8.367 ) { N=9 ; gj=gj_24_9 ;}
else if ( z <= 12.783 ) { N=11 ; gj=gj_24_11 ;}
else if ( z <= 17.368 ) { N=13 ; gj=gj_24_13 ;}
else if ( z <= 22.030 ) { N=15 ; gj=gj_24_15 ;}
else N=30 ;
break ;
case 27:
if ( z <= 1.540 ) { N=5 ; gj=gj_27_5 ;}
else if ( z <= 4.754 ) { N=7 ; gj=gj_27_7 ;}
else if ( z <= 9.002 ) { N=9 ; gj=gj_27_9 ;}
else if ( z <= 13.668 ) { N=11 ; gj=gj_27_11 ;}
else if ( z <= 18.465 ) { N=13 ; gj=gj_27_13 ;}
else if ( z <= 23.295 ) { N=15 ; gj=gj_27_15 ;}
else N=32 ;
break ;
case 30:
if ( z <= 1.669 ) { N=5 ; gj=gj_30_5 ;}
else if ( z <= 5.120 ) { N=7 ; gj=gj_30_7 ;}
else if ( z <= 9.637 ) { N=9 ; gj=gj_30_9 ;}
else if ( z <= 14.555 ) { N=11 ; gj=gj_30_11 ;}
else if ( z <= 19.567 ) { N=13 ; gj=gj_30_13 ;}
else if ( z <= 24.570 ) { N=15 ; gj=gj_30_15 ;}
else N=34 ;
break ;
case 33:
if ( z <= 1.799 ) { N=5 ; gj=gj_33_5 ;}
else if ( z <= 5.486 ) { N=7 ; gj=gj_33_7 ;}
else if ( z <= 10.273 ) { N=9 ; gj=gj_33_9 ;}
else if ( z <= 15.444 ) { N=11 ; gj=gj_33_11 ;}
else if ( z <= 20.673 ) { N=13 ; gj=gj_33_13 ;}
else if ( z <= 25.851 ) { N=15 ; gj=gj_33_15 ;}
else N=36 ;
break ;
case 36:
if ( z <= 1.929 ) { N=5 ; gj=gj_36_5 ;}
else if ( z <= 5.852 ) { N=7 ; gj=gj_36_7 ;}
else if ( z <= 10.909 ) { N=9 ; gj=gj_36_9 ;}
else if ( z <= 16.334 ) { N=11 ; gj=gj_36_11 ;}
else if ( z <= 21.781 ) { N=13 ; gj=gj_36_13 ;}
else if ( z <= 27.140 ) { N=15 ; gj=gj_36_15 ;}
else N=39 ;
break ;
case 39:
if ( z <= 2.058 ) { N=5 ; gj=gj_39_5 ;}
else if ( z <= 6.218 ) { N=7 ; gj=gj_39_7 ;}
else if ( z <= 11.546 ) { N=9 ; gj=gj_39_9 ;}
else if ( z <= 17.225 ) { N=11 ; gj=gj_39_11 ;}
else if ( z <= 22.890 ) { N=13 ; gj=gj_39_13 ;}
else if ( z <= 28.431 ) { N=15 ; gj=gj_39_15 ;}
else N=42 ;
break ;
case 42:
if ( z <= 2.187 ) { N=5 ; gj=gj_42_5 ;}
else if ( z <= 6.585 ) { N=7 ; gj=gj_42_7 ;}
else if ( z <= 12.184 ) { N=9 ; gj=gj_42_9 ;}
else if ( z <= 18.115 ) { N=11 ; gj=gj_42_11 ;}
else if ( z <= 24.001 ) { N=13 ; gj=gj_42_13 ;}
else if ( z <= 29.725 ) { N=15 ; gj=gj_42_15 ;}
else N=44 ;
break ;
case 45:
if ( z <= 2.317 ) { N=5 ; gj=gj_45_5 ;}
else if ( z <= 6.951 ) { N=7 ; gj=gj_45_7 ;}
else if ( z <= 12.821 ) { N=9 ; gj=gj_45_9 ;}

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else if ( z <= 19.007 ) { N=11 ; gj=gj_45_11 ;}
else if ( z <= 25.114 ) { N=13 ; gj=gj_45_13 ;}
else if ( z <= 31.022 ) { N=15 ; gj=gj_45_15 ;}
else N=47 ;
break ;
case 48:
if ( z <= 2.447 ) { N=5 ; gj=gj_48_5 ;}
else if ( z <= 7.317 ) { N=7 ; gj=gj_48_7 ;}
else if ( z <= 13.459 ) { N=9 ; gj=gj_48_9 ;}
else if ( z <= 19.899 ) { N=11 ; gj=gj_48_11 ;}
else if ( z <= 26.227 ) { N=13 ; gj=gj_48_13 ;}
else if ( z <= 32.320 ) { N=15 ; gj=gj_48_15 ;}
else N=50 ;
break ;
case 51:
if ( z <= 2.576 ) { N=5 ; gj=gj_51_5 ;}
else if ( z <= 7.683 ) { N=7 ; gj=gj_51_7 ;}
else if ( z <= 14.096 ) { N=9 ; gj=gj_51_9 ;}
else if ( z <= 20.791 ) { N=11 ; gj=gj_51_11 ;}
else if ( z <= 27.341 ) { N=13 ; gj=gj_51_13 ;}
else if ( z <= 33.621 ) { N=15 ; gj=gj_51_15 ;}
else N=52 ;
break ;
case 54:
if ( z <= 2.706 ) { N=5 ; gj=gj_54_5 ;}
else if ( z <= 8.049 ) { N=7 ; gj=gj_54_7 ;}
else if ( z <= 14.734 ) { N=9 ; gj=gj_54_9 ;}
else if ( z <= 21.684 ) { N=11 ; gj=gj_54_11 ;}
else if ( z <= 28.455 ) { N=13 ; gj=gj_54_13 ;}
else if ( z <= 34.922 ) { N=15 ; gj=gj_54_15 ;}
else N=55 ;
break ;
case 57:
if ( z <= 2.836 ) { N=5 ; gj=gj_57_5 ;}
else if ( z <= 8.417 ) { N=7 ; gj=gj_57_7 ;}
else if ( z <= 15.372 ) { N=9 ; gj=gj_57_9 ;}
else if ( z <= 22.577 ) { N=11 ; gj=gj_57_11 ;}
else if ( z <= 29.570 ) { N=13 ; gj=gj_57_13 ;}
else if ( z <= 36.224 ) { N=15 ; gj=gj_57_15 ;}
else N=58 ;
break ;
case 60:
if ( z <= 2.964 ) { N=5 ; gj=gj_60_5 ;}
else if ( z <= 8.783 ) { N=7 ; gj=gj_60_7 ;}
else if ( z <= 16.010 ) { N=9 ; gj=gj_60_9 ;}
else if ( z <= 23.469 ) { N=11 ; gj=gj_60_11 ;}
else if ( z <= 30.685 ) { N=13 ; gj=gj_60_13 ;}
else if ( z <= 37.526 ) { N=15 ; gj=gj_60_15 ;}
else if ( z <= 44.004 ) { N=17 ; gj=gj_60_17 ;}
else N=58 ;
break ;
case 63:
if ( z <= 3.094 ) { N=5 ; gj=gj_63_5 ;}
else if ( z <= 9.149 ) { N=7 ; gj=gj_63_7 ;}
else if ( z <= 16.647 ) { N=9 ; gj=gj_63_9 ;}
else if ( z <= 24.363 ) { N=11 ; gj=gj_63_11 ;}
else if ( z <= 31.800 ) { N=13 ; gj=gj_63_13 ;}
else if ( z <= 38.830 ) { N=15 ; gj=gj_63_15 ;}
else if ( z <= 45.465 ) { N=17 ; gj=gj_63_17 ;}
else N=61 ;
break ;
case 66:
if ( z <= 3.224 ) { N=5 ; gj=gj_66_5 ;}
else if ( z <= 9.516 ) { N=7 ; gj=gj_66_7 ;}
else if ( z <= 17.285 ) { N=9 ; gj=gj_66_9 ;}
else if ( z <= 25.255 ) { N=11 ; gj=gj_66_11 ;}
else if ( z <= 32.915 ) { N=13 ; gj=gj_66_13 ;}
else if ( z <= 40.134 ) { N=15 ; gj=gj_66_15 ;}
else if ( z <= 46.926 ) { N=17 ; gj=gj_66_17 ;}
else N=64 ;
break ;
case 69:
if ( z <= 3.354 ) { N=5 ; gj=gj_69_5 ;}
else if ( z <= 9.882 ) { N=7 ; gj=gj_69_7 ;}
else if ( z <= 17.923 ) { N=9 ; gj=gj_69_9 ;}
else if ( z <= 26.149 ) { N=11 ; gj=gj_69_11 ;}
else if ( z <= 34.031 ) { N=13 ; gj=gj_69_13 ;}
else if ( z <= 41.438 ) { N=15 ; gj=gj_69_15 ;}
else if ( z <= 48.388 ) { N=17 ; gj=gj_69_17 ;}
else N=66 ;
break ;
case 72:
if ( z <= 3.483 ) { N=5 ; gj=gj_72_5 ;}

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else if ( z <= 10.249 ) { N=7 ; gj=gj_72_7 ;}
else if ( z <= 18.561 ) { N=9 ; gj=gj_72_9 ;}
else if ( z <= 27.042 ) { N=11 ; gj=gj_72_11 ;}
else if ( z <= 35.148 ) { N=13 ; gj=gj_72_13 ;}
else if ( z <= 42.743 ) { N=15 ; gj=gj_72_15 ;}
else if ( z <= 49.849 ) { N=17 ; gj=gj_72_17 ;}
else if ( z <= 56.543 ) { N=19 ; gj=gj_72_19 ;}
else N=66 ;
break ;

case 75:
if ( z <= 3.613 ) { N=5 ; gj=gj_75_5 ;}
else if ( z <= 10.616 ) { N=7 ; gj=gj_75_7 ;}
else if ( z <= 19.199 ) { N=9 ; gj=gj_75_9 ;}
else if ( z <= 27.935 ) { N=11 ; gj=gj_75_11 ;}
else if ( z <= 36.264 ) { N=13 ; gj=gj_75_13 ;}
else if ( z <= 44.047 ) { N=15 ; gj=gj_75_15 ;}
else if ( z <= 51.313 ) { N=17 ; gj=gj_75_17 ;}
else if ( z <= 58.138 ) { N=19 ; gj=gj_75_19 ;}
else N=68 ;
break ;

case 78:
if ( z <= 3.743 ) { N=5 ; gj=gj_78_5 ;}
else if ( z <= 10.982 ) { N=7 ; gj=gj_78_7 ;}
else if ( z <= 19.837 ) { N=9 ; gj=gj_78_9 ;}
else if ( z <= 28.829 ) { N=11 ; gj=gj_78_11 ;}
else if ( z <= 37.380 ) { N=13 ; gj=gj_78_13 ;}
else if ( z <= 45.353 ) { N=15 ; gj=gj_78_15 ;}
else if ( z <= 52.777 ) { N=17 ; gj=gj_78_17 ;}
else if ( z <= 59.734 ) { N=19 ; gj=gj_78_19 ;}
else N=71 ;
break ;

case 81:
if ( z <= 3.872 ) { N=5 ; gj=gj_81_5 ;}
else if ( z <= 11.349 ) { N=7 ; gj=gj_81_7 ;}
else if ( z <= 20.476 ) { N=9 ; gj=gj_81_9 ;}
else if ( z <= 29.722 ) { N=11 ; gj=gj_81_11 ;}
else if ( z <= 38.496 ) { N=13 ; gj=gj_81_13 ;}
else if ( z <= 46.659 ) { N=15 ; gj=gj_81_15 ;}
else if ( z <= 54.241 ) { N=17 ; gj=gj_81_17 ;}
else if ( z <= 61.332 ) { N=19 ; gj=gj_81_19 ;}
else N=73 ;
break ;

case 84:
if ( z <= 4.002 ) { N=5 ; gj=gj_84_5 ;}
else if ( z <= 11.715 ) { N=7 ; gj=gj_84_7 ;}
else if ( z <= 21.114 ) { N=9 ; gj=gj_84_9 ;}
else if ( z <= 30.616 ) { N=11 ; gj=gj_84_11 ;}
else if ( z <= 39.613 ) { N=13 ; gj=gj_84_13 ;}
else if ( z <= 47.964 ) { N=15 ; gj=gj_84_15 ;}
else if ( z <= 55.706 ) { N=17 ; gj=gj_84_17 ;}
else if ( z <= 62.929 ) { N=19 ; gj=gj_84_19 ;}
else N=76 ;
break ;

case 87:
if ( z <= 4.132 ) { N=5 ; gj=gj_87_5 ;}
else if ( z <= 12.082 ) { N=7 ; gj=gj_87_7 ;}
else if ( z <= 21.752 ) { N=9 ; gj=gj_87_9 ;}
else if ( z <= 31.510 ) { N=11 ; gj=gj_87_11 ;}
else if ( z <= 40.730 ) { N=13 ; gj=gj_87_13 ;}
else if ( z <= 49.270 ) { N=15 ; gj=gj_87_15 ;}
else if ( z <= 57.171 ) { N=17 ; gj=gj_87_17 ;}
else if ( z <= 64.527 ) { N=19 ; gj=gj_87_19 ;}
else if ( z <= 71.442 ) { N=21 ; gj=gj_87_21 ;}
else N=74 ;
break ;

case 90:
if ( z <= 4.261 ) { N=5 ; gj=gj_90_5 ;}
else if ( z <= 12.449 ) { N=7 ; gj=gj_90_7 ;}
else if ( z <= 22.390 ) { N=9 ; gj=gj_90_9 ;}
else if ( z <= 32.403 ) { N=11 ; gj=gj_90_11 ;}
else if ( z <= 41.846 ) { N=13 ; gj=gj_90_13 ;}
else if ( z <= 50.576 ) { N=15 ; gj=gj_90_15 ;}
else if ( z <= 58.637 ) { N=17 ; gj=gj_90_17 ;}
else if ( z <= 66.127 ) { N=19 ; gj=gj_90_19 ;}
else if ( z <= 73.152 ) { N=21 ; gj=gj_90_21 ;}
else N=76 ;
break ;

case 93:
if ( z <= 4.391 ) { N=5 ; gj=gj_93_5 ;}
else if ( z <= 12.816 ) { N=7 ; gj=gj_93_7 ;}
else if ( z <= 23.028 ) { N=9 ; gj=gj_93_9 ;}
else if ( z <= 33.297 ) { N=11 ; gj=gj_93_11 ;}
else if ( z <= 42.963 ) { N=13 ; gj=gj_93_13 ;}

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else if ( z <= 51.882 ) { N=15 ; gj=gj_93_15 ;}
else if ( z <= 60.102 ) { N=17 ; gj=gj_93_17 ;}
else if ( z <= 67.726 ) { N=19 ; gj=gj_93_19 ;}
else if ( z <= 74.864 ) { N=21 ; gj=gj_93_21 ;}
else N=79 ;
break ;
case 96:
if ( z <= 4.520 ) { N=5 ; gj=gj_96_5 ;}
else if ( z <= 13.182 ) { N=7 ; gj=gj_96_7 ;}
else if ( z <= 23.666 ) { N=9 ; gj=gj_96_9 ;}
else if ( z <= 34.190 ) { N=11 ; gj=gj_96_11 ;}
else if ( z <= 44.080 ) { N=13 ; gj=gj_96_13 ;}
else if ( z <= 53.188 ) { N=15 ; gj=gj_96_15 ;}
else if ( z <= 61.568 ) { N=17 ; gj=gj_96_17 ;}
else if ( z <= 69.326 ) { N=19 ; gj=gj_96_19 ;}
else if ( z <= 76.577 ) { N=21 ; gj=gj_96_21 ;}
else N=81 ;
break ;
case 99:
if ( z <= 4.650 ) { N=5 ; gj=gj_99_5 ;}
else if ( z <= 13.548 ) { N=7 ; gj=gj_99_7 ;}
else if ( z <= 24.305 ) { N=9 ; gj=gj_99_9 ;}
else if ( z <= 35.084 ) { N=11 ; gj=gj_99_11 ;}
else if ( z <= 45.197 ) { N=13 ; gj=gj_99_13 ;}
else if ( z <= 54.495 ) { N=15 ; gj=gj_99_15 ;}
else if ( z <= 63.034 ) { N=17 ; gj=gj_99_17 ;}
else if ( z <= 70.926 ) { N=19 ; gj=gj_99_19 ;}
else if ( z <= 78.290 ) { N=21 ; gj=gj_99_21 ;}
else N=83 ;
break ;
case 102:
if ( z <= 4.779 ) { N=5 ; gj=gj_102_5 ;}
else if ( z <= 13.915 ) { N=7 ; gj=gj_102_7 ;}
else if ( z <= 24.943 ) { N=9 ; gj=gj_102_9 ;}
else if ( z <= 35.977 ) { N=11 ; gj=gj_102_11 ;}
else if ( z <= 46.313 ) { N=13 ; gj=gj_102_13 ;}
else if ( z <= 55.801 ) { N=15 ; gj=gj_102_15 ;}
else if ( z <= 64.501 ) { N=17 ; gj=gj_102_17 ;}
else if ( z <= 72.527 ) { N=19 ; gj=gj_102_19 ;}
else if ( z <= 80.003 ) { N=21 ; gj=gj_102_21 ;}
else if ( z <= 87.040 ) { N=23 ; gj=gj_102_23 ;}
else N=81 ;
break ;
case 105:
if ( z <= 4.909 ) { N=5 ; gj=gj_105_5 ;}
else if ( z <= 14.282 ) { N=7 ; gj=gj_105_7 ;}
else if ( z <= 25.581 ) { N=9 ; gj=gj_105_9 ;}
else if ( z <= 36.872 ) { N=11 ; gj=gj_105_11 ;}
else if ( z <= 47.430 ) { N=13 ; gj=gj_105_13 ;}
else if ( z <= 57.108 ) { N=15 ; gj=gj_105_15 ;}
else if ( z <= 65.966 ) { N=17 ; gj=gj_105_17 ;}
else if ( z <= 74.128 ) { N=19 ; gj=gj_105_19 ;}
else if ( z <= 81.717 ) { N=21 ; gj=gj_105_21 ;}
else if ( z <= 88.850 ) { N=23 ; gj=gj_105_23 ;}
else N=83 ;
break ;
case 108:
if ( z <= 5.039 ) { N=5 ; gj=gj_108_5 ;}
else if ( z <= 14.649 ) { N=7 ; gj=gj_108_7 ;}
else if ( z <= 26.219 ) { N=9 ; gj=gj_108_9 ;}
else if ( z <= 37.766 ) { N=11 ; gj=gj_108_11 ;}
else if ( z <= 48.547 ) { N=13 ; gj=gj_108_13 ;}
else if ( z <= 58.414 ) { N=15 ; gj=gj_108_15 ;}
else if ( z <= 67.433 ) { N=17 ; gj=gj_108_17 ;}
else if ( z <= 75.729 ) { N=19 ; gj=gj_108_19 ;}
else if ( z <= 83.433 ) { N=21 ; gj=gj_108_21 ;}
else if ( z <= 90.661 ) { N=23 ; gj=gj_108_23 ;}
else N=85 ;
break ;
case 111:
if ( z <= 5.168 ) { N=5 ; gj=gj_111_5 ;}
else if ( z <= 15.015 ) { N=7 ; gj=gj_111_7 ;}
else if ( z <= 26.857 ) { N=9 ; gj=gj_111_9 ;}
else if ( z <= 38.659 ) { N=11 ; gj=gj_111_11 ;}
else if ( z <= 49.664 ) { N=13 ; gj=gj_111_13 ;}
else if ( z <= 59.721 ) { N=15 ; gj=gj_111_15 ;}
else if ( z <= 68.900 ) { N=17 ; gj=gj_111_17 ;}
else if ( z <= 77.331 ) { N=19 ; gj=gj_111_19 ;}
else if ( z <= 85.147 ) { N=21 ; gj=gj_111_21 ;}
else if ( z <= 92.472 ) { N=23 ; gj=gj_111_23 ;}
else N=87 ;
break ;
case 114:

```

```

if ( z <= 5.298 ) { N=5 ; gj=gj_114_5 ;}
else if ( z <= 15.382 ) { N=7 ; gj=gj_114_7 ;}
else if ( z <= 27.496 ) { N=9 ; gj=gj_114_9 ;}
else if ( z <= 39.553 ) { N=11 ; gj=gj_114_11 ;}
else if ( z <= 50.781 ) { N=13 ; gj=gj_114_13 ;}
else if ( z <= 61.028 ) { N=15 ; gj=gj_114_15 ;}
else if ( z <= 70.367 ) { N=17 ; gj=gj_114_17 ;}
else if ( z <= 78.932 ) { N=19 ; gj=gj_114_19 ;}
else if ( z <= 86.863 ) { N=21 ; gj=gj_114_21 ;}
else if ( z <= 94.283 ) { N=23 ; gj=gj_114_23 ;}
else N=90 ;
break ;
case 117:
if ( z <= 5.428 ) { N=5 ; gj=gj_117_5 ;}
else if ( z <= 15.748 ) { N=7 ; gj=gj_117_7 ;}
else if ( z <= 28.134 ) { N=9 ; gj=gj_117_9 ;}
else if ( z <= 40.446 ) { N=11 ; gj=gj_117_11 ;}
else if ( z <= 51.898 ) { N=13 ; gj=gj_117_13 ;}
else if ( z <= 62.335 ) { N=15 ; gj=gj_117_15 ;}
else if ( z <= 71.833 ) { N=17 ; gj=gj_117_17 ;}
else if ( z <= 80.535 ) { N=19 ; gj=gj_117_19 ;}
else if ( z <= 88.580 ) { N=21 ; gj=gj_117_21 ;}
else if ( z <= 96.096 ) { N=23 ; gj=gj_117_23 ;}
else N=92 ;
break ;
case 120:
if ( z <= 5.557 ) { N=5 ; gj=gj_120_5 ;}
else if ( z <= 16.115 ) { N=7 ; gj=gj_120_7 ;}
else if ( z <= 28.772 ) { N=9 ; gj=gj_120_9 ;}
else if ( z <= 41.341 ) { N=11 ; gj=gj_120_11 ;}
else if ( z <= 53.016 ) { N=13 ; gj=gj_120_13 ;}
else if ( z <= 63.641 ) { N=15 ; gj=gj_120_15 ;}
else if ( z <= 73.301 ) { N=17 ; gj=gj_120_17 ;}
else if ( z <= 82.137 ) { N=19 ; gj=gj_120_19 ;}
else if ( z <= 90.295 ) { N=21 ; gj=gj_120_21 ;}
else if ( z <= 97.908 ) { N=23 ; gj=gj_120_23 ;}
else if ( z <= 105.087 ) { N=25 ; gj=gj_120_25 ;}
else N=89 ;
break ;
case 123:
if ( z <= 5.687 ) { N=5 ; gj=gj_123_5 ;}
else if ( z <= 16.482 ) { N=7 ; gj=gj_123_7 ;}
else if ( z <= 29.411 ) { N=9 ; gj=gj_123_9 ;}
else if ( z <= 42.234 ) { N=11 ; gj=gj_123_11 ;}
else if ( z <= 54.132 ) { N=13 ; gj=gj_123_13 ;}
else if ( z <= 64.949 ) { N=15 ; gj=gj_123_15 ;}
else if ( z <= 74.768 ) { N=17 ; gj=gj_123_17 ;}
else if ( z <= 83.739 ) { N=19 ; gj=gj_123_19 ;}
else if ( z <= 92.013 ) { N=21 ; gj=gj_123_21 ;}
else if ( z <= 99.721 ) { N=23 ; gj=gj_123_23 ;}
else if ( z <= 106.982 ) { N=25 ; gj=gj_123_25 ;}
else N=91 ;
break ;
case 126:
if ( z <= 5.817 ) { N=5 ; gj=gj_126_5 ;}
else if ( z <= 16.849 ) { N=7 ; gj=gj_126_7 ;}
else if ( z <= 30.049 ) { N=9 ; gj=gj_126_9 ;}
else if ( z <= 43.128 ) { N=11 ; gj=gj_126_11 ;}
else if ( z <= 55.249 ) { N=13 ; gj=gj_126_13 ;}
else if ( z <= 66.255 ) { N=15 ; gj=gj_126_15 ;}
else if ( z <= 76.235 ) { N=17 ; gj=gj_126_17 ;}
else if ( z <= 85.341 ) { N=19 ; gj=gj_126_19 ;}
else if ( z <= 93.729 ) { N=21 ; gj=gj_126_21 ;}
else if ( z <= 101.536 ) { N=23 ; gj=gj_126_23 ;}
else if ( z <= 108.878 ) { N=25 ; gj=gj_126_25 ;}
else N=93 ;
break ;
case 129:
if ( z <= 5.947 ) { N=5 ; gj=gj_129_5 ;}
else if ( z <= 17.215 ) { N=7 ; gj=gj_129_7 ;}
else if ( z <= 30.687 ) { N=9 ; gj=gj_129_9 ;}
else if ( z <= 44.022 ) { N=11 ; gj=gj_129_11 ;}
else if ( z <= 56.367 ) { N=13 ; gj=gj_129_13 ;}
else if ( z <= 67.563 ) { N=15 ; gj=gj_129_15 ;}
else if ( z <= 77.702 ) { N=17 ; gj=gj_129_17 ;}
else if ( z <= 86.944 ) { N=19 ; gj=gj_129_19 ;}
else if ( z <= 95.446 ) { N=21 ; gj=gj_129_21 ;}
else if ( z <= 103.350 ) { N=23 ; gj=gj_129_23 ;}
else if ( z <= 110.774 ) { N=25 ; gj=gj_129_25 ;}
else N=95 ;
break ;
}

```

6. File boysGaussJacobiTst.c

```

#include <math.h>
#include <stdio.h>

extern double boysGaussJacobi(int m, double z) ;

/*****
 * @brief compute a value with the program and compare it with a correct one.
 * @param[in] m The integer index of Boys function.
 * @param[in] z The argument of Boys function.
 * @param[in] value The correct (expected) value.
 * @param[in] errMarg A relative error margin to produce verbose output.
 * @return 0 if the computed value is within 3 times the error margin.
 * So this is considered a test passed.
 * Otherwise 1.
 */
static int boysGaussJacobiComp(int m, double z, double value, double errMarg)
{
    /* value generated by theprogram
    */
    double F = boysGaussJacobi(m,z) ;
    /* relative error
    */
    double err = fabs(1.-F/value) ;
    if ( err > errMarg)
        printf("m=%d z=%f %.17e expected %.17e rel err %.3e\n",m,z,F,value,err) ;
    return ( err > 3*errMarg) ? 1 : 0 ;
}

/*****
 * @brief Test main function for the boysGaussJacobi subroutine.
 * For 175 pairs of m and z we compute the numerical value and
 * compare it with a known result that was obtained with high precision.
 * @param[in] argc Number of arguments in the command line.
 * Dummy parameter. Not used.
 * @param[in] argv The vector of command line arguments.
 * Dummy parameter. Not used.
 * @since 2017-09-17
 * @author Richard J. Mathar
 */
int main(int argc,char *argv[])
{
    /* print results if the relative error in the computed value exceeds this number
    */
    double errMarg = 1.e-15 ;
    int err = 0 ;

    /* m = 0 .. 10, z= 0.000000e+00 .. 5.000000e+00 */
    err += boysGaussJacobiComp(3,1.10185120525508566e+00,6.18766542175746446e-02,errMarg) ;
    err += boysGaussJacobiComp(2,1.76577119262604747e+00,6.11825639426621793e-02,errMarg) ;
    err += boysGaussJacobiComp(4,3.23037524963850408e+00,9.12059472487586327e-03,errMarg) ;
    err += boysGaussJacobiComp(0,3.08608408426085971e+00,4.97929773714634554e-01,errMarg) ;
    err += boysGaussJacobiComp(0,4.69364098297121447e+00,4.08169033593379339e-01,errMarg) ;
    err += boysGaussJacobiComp(9,4.59060542843920716e-01,3.47709144661698761e-02,errMarg) ;
    err += boysGaussJacobiComp(1,1.05782425556418974e+00,1.83784360820336149e-01,errMarg) ;
    err += boysGaussJacobiComp(7,1.16240645029399288e-01,6.01724161273037453e-02,errMarg) ;
    err += boysGaussJacobiComp(0,4.69364098297121447e+00,4.08169033593379339e-01,errMarg) ;
    err += boysGaussJacobiComp(7,1.67085426805529170e+00,1.55179557273704668e-02,errMarg) ;
    err += boysGaussJacobiComp(5,4.39642388637500865e+00,2.72813318450120458e-03,errMarg) ;
    err += boysGaussJacobiComp(9,4.59060542843920716e-01,3.47709144661698761e-02,errMarg) ;
    err += boysGaussJacobiComp(0,1.56064093021955635e+00,6.54583832433497471e-01,errMarg) ;
    err += boysGaussJacobiComp(4,9.11886468618789914e-01,5.32214686889205691e-02,errMarg) ;
    err += boysGaussJacobiComp(1,2.81084401770867673e+00,8.16601636195038075e-02,errMarg) ;
    err += boysGaussJacobiComp(7,2.81363558170664424e+00,5.85296951907279933e-03,errMarg) ;
    err += boysGaussJacobiComp(1,3.51776621659429321e+00,6.24073761837337416e-02,errMarg) ;
    err += boysGaussJacobiComp(6,2.54481034876241880e+00,8.91456880247929484e-03,errMarg) ;
    err += boysGaussJacobiComp(2,1.71097775420966734e-02,1.97571934031116749e-01,errMarg) ;
    err += boysGaussJacobiComp(0,2.62990041558805845e+00,5.34555136098613369e-01,errMarg) ;
    err += boysGaussJacobiComp(0,2.78853346207363049e+00,5.21052265143433045e-01,errMarg) ;
    err += boysGaussJacobiComp(0,4.93413454710710736e+00,3.98298389255380287e-01,errMarg) ;
    err += boysGaussJacobiComp(3,3.20655684117901929e+00,1.42860523385369159e-02,errMarg) ;
    err += boysGaussJacobiComp(3,6.40894462299422263e-01,8.73622913508490626e-02,errMarg) ;
    err += boysGaussJacobiComp(7,4.93617748799008009e+00,1.01619982345831285e-03,errMarg) ;
    err += boysGaussJacobiComp(0,1.18165384269143953e+00,7.13995613900412723e-01,errMarg) ;
    err += boysGaussJacobiComp(7,2.55090351987942377e+00,7.31067587218400585e-03,errMarg) ;
    err += boysGaussJacobiComp(6,1.43808078860566576e+00,2.24575690498485180e-02,errMarg) ;
    err += boysGaussJacobiComp(1,4.35417133561288676e+00,4.71400052658071444e-02,errMarg) ;
    err += boysGaussJacobiComp(1,1.67247487969853155e+00,1.34919268673417994e-01,errMarg) ;
    err += boysGaussJacobiComp(6,2.44572821278028255e-01,6.22559783625824615e-02,errMarg) ;
    err += boysGaussJacobiComp(4,2.14843573474138502e+00,2.03351671820967326e-02,errMarg) ;
    err += boysGaussJacobiComp(8,2.50113793296766264e+00,6.47719310910455897e-03,errMarg) ;
    err += boysGaussJacobiComp(8,2.01268788057210367e+00,9.91151761669940898e-03,errMarg) ;
    err += boysGaussJacobiComp(3,4.85494664062866054e+00,5.23515888992428097e-03,errMarg) ;

```

```

err += boysGaussJacobiComp(2,4.94472597757495695e+00,1.12662528797242100e-02, errMarg) ;
/* m = 10 .. 90, z= 0.000000e+00 .. 5.000000e+00 */
err += boysGaussJacobiComp(17,4.12310997736165195e+00,5.93024056274768668e-04, errMarg) ;
err += boysGaussJacobiComp(28,1.98260147027554227e-01,1.44860444295897823e-02, errMarg) ;
err += boysGaussJacobiComp(15,2.2570044590700971e+00,3.90584744716254340e-03, errMarg) ;
err += boysGaussJacobiComp(17,2.15090246014902853e+00,3.75932258163156043e-03, errMarg) ;
err += boysGaussJacobiComp(14,1.25940467381241843e+00,1.06475929028584714e-02, errMarg) ;
err += boysGaussJacobiComp(55,3.00725393541662858e+00,4.70297867669921504e-04, errMarg) ;
err += boysGaussJacobiComp(22,2.91371146222695857e+00,1.37569333191435058e-03, errMarg) ;
err += boysGaussJacobiComp(19,3.16525550726132215e-02,2.48805453513582370e-02, errMarg) ;
err += boysGaussJacobiComp(12,2.09417587700846377e+00,5.81858736736084268e-03, errMarg) ;
err += boysGaussJacobiComp(15,2.87551358544984288e+00,2.19750412249902217e-03, errMarg) ;
err += boysGaussJacobiComp(11,3.74357652003135060e-01,3.08223366525322295e-02, errMarg) ;
err += boysGaussJacobiComp(53,2.97673095480940332e-01,6.97777200019610124e-03, errMarg) ;
err += boysGaussJacobiComp(65,4.90397348342779461e+00,6.11207175631414014e-05, errMarg) ;
err += boysGaussJacobiComp(54,4.17423983260431233e-01,6.08929296295050040e-03, errMarg) ;
err += boysGaussJacobiComp(62,4.39994423618739994e-01,5.18826594624253255e-03, errMarg) ;
err += boysGaussJacobiComp(29,1.57948604933454441e+00,3.68331536266984844e-03, errMarg) ;
err += boysGaussJacobiComp(77,1.81879063121180401e+00,1.07140877845038293e-03, errMarg) ;
err += boysGaussJacobiComp(23,4.63625162127909347e+00,2.53872610366915764e-04, errMarg) ;
err += boysGaussJacobiComp(51,4.87568421409986594e-01,6.01819053619613609e-03, errMarg) ;
err += boysGaussJacobiComp(73,2.84196161837828456e+00,4.12398185135804522e-04, errMarg) ;
err += boysGaussJacobiComp(85,4.06475152021454688e+00,1.05340615181350278e-04, errMarg) ;
err += boysGaussJacobiComp(78,2.13142635325963588e+00,7.76662065115703828e-04, errMarg) ;
err += boysGaussJacobiComp(14,2.01830152382404778e-01,2.85519604234165442e-02, errMarg) ;
err += boysGaussJacobiComp(50,7.29043849884289609e-01,4.84450142459049873e-03, errMarg) ;
err += boysGaussJacobiComp(24,1.47664189263935161e+00,4.94711045443220289e-03, errMarg) ;
err += boysGaussJacobiComp(53,4.16172462051881343e+00,1.57633019307205248e-04, errMarg) ;
err += boysGaussJacobiComp(22,4.42623931680481501e+00,2.18867058696143604e-03, errMarg) ;
err += boysGaussJacobiComp(13,1.10565025449478208e+00,1.32653211100037921e-02, errMarg) ;
err += boysGaussJacobiComp(49,2.93905358850750125e+00,5.67490889243916638e-04, errMarg) ;
err += boysGaussJacobiComp(65,2.22552675391620917e+00,8.53041455156413569e-04, errMarg) ;
err += boysGaussJacobiComp(88,3.63491225768344867e+00,1.55382545424575028e-04, errMarg) ;
err += boysGaussJacobiComp(52,7.29165391695675117e-01,4.65689551703295511e-03, errMarg) ;
err += boysGaussJacobiComp(12,4.14640028555270438e+00,9.02549877393784755e-04, errMarg) ;
err += boysGaussJacobiComp(20,3.990678428485876298e+00,5.52451856943125083e-04, errMarg) ;
err += boysGaussJacobiComp(16,4.22737818308918280e+00,5.79955569122797833e-04, errMarg) ;
/* m = 0 .. 10, z= 5.000000e+00 .. 3.000000e+01 */
err += boysGaussJacobiComp(7,2.65299030717728560e+01,1.96373873064420139e-08, errMarg) ;
err += boysGaussJacobiComp(7,1.27105157249199337e+01,4.67820545465691176e-06, errMarg) ;
err += boysGaussJacobiComp(9,1.11230584738534261e+01,4.99433178569089635e-06, errMarg) ;
err += boysGaussJacobiComp(8,5.37129458692201611e+00,5.69739758450416983e-04, errMarg) ;
err += boysGaussJacobiComp(1,1.56312886945312452e+01,7.17005428497372215e-03, errMarg) ;
err += boysGaussJacobiComp(4,1.07145123323015585e+01,1.33348833937758246e-04, errMarg) ;
err += boysGaussJacobiComp(1,1.91059645713545582e+01,5.30592958078778906e-03, errMarg) ;
err += boysGaussJacobiComp(2,2.08588016336415864e+01,3.34489731491456038e-04, errMarg) ;
err += boysGaussJacobiComp(3,2.40110717976441027e+01,2.4496598555732651e-05, errMarg) ;
err += boysGaussJacobiComp(2,1.05760917718943296e+01,1.82584453104787371e-03, errMarg) ;
err += boysGaussJacobiComp(4,1.07517634824251921e+01,1.31319923018956300e-04, errMarg) ;
err += boysGaussJacobiComp(6,1.00358282923656341e+01,4.03172678289962034e-05, errMarg) ;
err += boysGaussJacobiComp(0,5.47892906868342847e+00,3.78261480395963582e-01, errMarg) ;
err += boysGaussJacobiComp(0,1.36097073739555537e+01,2.40226253436670254e-01, errMarg) ;
err += boysGaussJacobiComp(5,5.78760718891000480e+00,1.01117939674783074e-03, errMarg) ;
err += boysGaussJacobiComp(2,2.37105717448630061e+01,2.42801371668631682e-04, errMarg) ;
err += boysGaussJacobiComp(3,8.61958659153599469e+00,8.69711577833474938e-04, errMarg) ;
err += boysGaussJacobiComp(1,1.75161748481979937e+01,6.04443880924752762e-03, errMarg) ;
err += boysGaussJacobiComp(7,1.78005408144260599e+01,3.90819942959252242e-07, errMarg) ;
err += boysGaussJacobiComp(4,1.60309583027948742e+01,2.19893399718623621e-05, errMarg) ;
err += boysGaussJacobiComp(1,5.81891629977826995e+00,3.12926689388285139e-02, errMarg) ;
err += boysGaussJacobiComp(2,2.23206874068650339e+01,2.82382177734836615e-04, errMarg) ;
err += boysGaussJacobiComp(3,2.1111773917220969e+01,3.84372594790543070e-05, errMarg) ;
err += boysGaussJacobiComp(5,1.78385193363418439e+01,3.42981096851515732e-06, errMarg) ;
err += boysGaussJacobiComp(0,2.98533710073760069e+01,1.62199029584505578e-01, errMarg) ;
err += boysGaussJacobiComp(1,1.37043093906448141e+01,8.73428007209458796e-03, errMarg) ;
err += boysGaussJacobiComp(0,2.39053812214143036e+01,1.81257966648478835e-01, errMarg) ;
err += boysGaussJacobiComp(8,9.33114880537891119e+00,2.60490669849565536e-05, errMarg) ;
err += boysGaussJacobiComp(0,1.04258048892890095e+01,2.74465643391503084e-01, errMarg) ;
err += boysGaussJacobiComp(9,1.65377357672650522e+01,1.54776455775331250e-07, errMarg) ;
err += boysGaussJacobiComp(2,2.19722029227043184e+01,2.93712338162186753e-04, errMarg) ;
err += boysGaussJacobiComp(5,2.64168048956758169e+01,3.95808484621800808e-07, errMarg) ;
err += boysGaussJacobiComp(8,2.52388894296045645e+01,8.48304110900746019e-09, errMarg) ;
err += boysGaussJacobiComp(0,9.98875844810448816e+00,2.80405018534803785e-01, errMarg) ;
err += boysGaussJacobiComp(1,2.23679305265493216e+01,4.18867087312500282e-03, errMarg) ;
/* m = 10 .. 90, z= 5.000000e+00 .. 3.000000e+01 */
err += boysGaussJacobiComp(70,1.92245328618759941e+01,4.33400554688531631e-11, errMarg) ;
err += boysGaussJacobiComp(10,9.89181912066122254e+00,9.34026818696273425e-06, errMarg) ;
err += boysGaussJacobiComp(30,8.17974671103959913e+00,6.18389295694653863e-06, errMarg) ;
err += boysGaussJacobiComp(24,7.52007969252186202e+00,1.55939418218495283e-05, errMarg) ;
err += boysGaussJacobiComp(89,2.54189905423002868e+01,7.08442441366052987e-14, errMarg) ;
err += boysGaussJacobiComp(32,1.06376081356388596e+01,5.37769175151009233e-07, errMarg) ;
err += boysGaussJacobiComp(73,2.61650738841696614e+01,4.52485888428729547e-14, errMarg) ;
err += boysGaussJacobiComp(30,1.92700054813983659e+01,1.70373988628827959e-10, errMarg) ;
err += boysGaussJacobiComp(42,1.26468300154490580e+01,5.31803587334539247e-08, errMarg) ;

```

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err += boysGaussJacobiComp(86, 2.97716788006918767e+01, 1.02714044786350082e-15, errMarg) ;
err += boysGaussJacobiComp(74, 2.76356818783211442e+01, 1.04931031070858934e-14, errMarg) ;
err += boysGaussJacobiComp(67, 1.6211612301056519e+01, 8.82570259643614001e-10, errMarg) ;
err += boysGaussJacobiComp(63, 1.03306569323112328e+01, 3.05644793556233076e-07, errMarg) ;
err += boysGaussJacobiComp(29, 6.17715921556351228e+00, 4.40421493459611961e-05, errMarg) ;
err += boysGaussJacobiComp(70, 1.76084179953994054e+01, 2.11690286808927728e-10, errMarg) ;
err += boysGaussJacobiComp(11, 5.97799067324183133e+00, 2.01532348445969970e-04, errMarg) ;
err += boysGaussJacobiComp(27, 5.8518329777326192e+00, 6.56271926777048995e-05, errMarg) ;
err += boysGaussJacobiComp(20, 1.6840476322987917e+01, 4.21895070541460645e-09, errMarg) ;
err += boysGaussJacobiComp(67, 6.05435081778860514e+00, 1.90732660307018927e-05, errMarg) ;
err += boysGaussJacobiComp(72, 1.23100354484967509e+01, 3.73100224549654081e-08, errMarg) ;
err += boysGaussJacobiComp(83, 1.25057752602362257e+01, 2.60316364186279509e-08, errMarg) ;
err += boysGaussJacobiComp(59, 6.33316826874109368e+00, 1.66693696353589451e-05, errMarg) ;
err += boysGaussJacobiComp(24, 2.90446124234768099e+01, 7.42119974291119758e-14, errMarg) ;
err += boysGaussJacobiComp(57, 6.69112892994784952e+00, 1.21902576280553909e-05, errMarg) ;
err += boysGaussJacobiComp(62, 2.07665413465024307e+01, 1.13440730876788935e-11, errMarg) ;
err += boysGaussJacobiComp(41, 1.70068185735957695e+01, 8.18101391457461557e-10, errMarg) ;
err += boysGaussJacobiComp(70, 2.69520487045060350e+01, 2.23374125592427837e-14, errMarg) ;
err += boysGaussJacobiComp(65, 1.11632755299639244e+01, 1.30055731097039240e-07, errMarg) ;
err += boysGaussJacobiComp(31, 6.09577719352733688e+00, 4.39375873039425086e-05, errMarg) ;
err += boysGaussJacobiComp(18, 1.64570399155563417e+01, 7.98505124997823672e-09, errMarg) ;
err += boysGaussJacobiComp(11, 2.43251147381966542e+01, 6.82754680869066021e-10, errMarg) ;
err += boysGaussJacobiComp(41, 5.21502235033788227e+00, 7.45982800292774695e-05, errMarg) ;
err += boysGaussJacobiComp(20, 2.45659220513966159e+01, 6.98414431764812995e-12, errMarg) ;
err += boysGaussJacobiComp(50, 9.75586608161083425e+00, 7.07177649909072579e-07, errMarg) ;
err += boysGaussJacobiComp(11, 7.23138483724284237e+00, 6.81896973412850151e-05, errMarg) ;
/* m = 90 .. 200, z = 0.000000e+00 .. 3.000000e+01 */
err += boysGaussJacobiComp(108, 6.5555005167576446e+00, 6.97102008917135754e-06, errMarg) ;
err += boysGaussJacobiComp(138, 6.66759831436095616e+00, 4.82038227900499749e-06, errMarg) ;
err += boysGaussJacobiComp(112, 1.14988413593726942e+01, 5.01506867491939310e-08, errMarg) ;
err += boysGaussJacobiComp(116, 4.56796400550042503e+00, 4.63465315929140115e-05, errMarg) ;
err += boysGaussJacobiComp(139, 6.38578709196594329e+00, 6.32817193540230137e-06, errMarg) ;
err += boysGaussJacobiComp(160, 7.37446306022909160e+00, 2.04690726067200503e-06, errMarg) ;
err += boysGaussJacobiComp(106, 1.46404149411062849e+01, 2.38150680413150456e-09, errMarg) ;
err += boysGaussJacobiComp(159, 1.66660991508910510e+01, 2.02205146218256831e-10, errMarg) ;
err += boysGaussJacobiComp(114, 2.03525525968990355e+01, 7.67677644208968252e-12, errMarg) ;
err += boysGaussJacobiComp(196, 6.40048424486130103e+00, 4.36734520934262999e-06, errMarg) ;
err += boysGaussJacobiComp(118, 5.23602228046214460e+00, 2.34815673000039485e-05, errMarg) ;
err += boysGaussJacobiComp(163, 1.06074954538447118e+01, 8.08372430578271002e-08, errMarg) ;
err += boysGaussJacobiComp(94, 2.14515757471513257e+01, 3.29118466761506144e-12, errMarg) ;
err += boysGaussJacobiComp(97, 8.96303687444297643e+00, 7.22367583152890804e-07, errMarg) ;
err += boysGaussJacobiComp(124, 1.02727051007033680e+01, 1.51175936003237791e-07, errMarg) ;
err += boysGaussJacobiComp(99, 1.02296009351812653e+01, 2.01861592793258461e-07, errMarg) ;
err += boysGaussJacobiComp(98, 2.64192406530599626e+01, 2.31882622144869504e-14, errMarg) ;
err += boysGaussJacobiComp(132, 2.25883086312445769e+01, 7.03310720988087134e-13, errMarg) ;
err += boysGaussJacobiComp(146, 1.36934767097831084e+01, 4.25025708748869363e-09, errMarg) ;
err += boysGaussJacobiComp(100, 3.17317419895544135e+00, 2.15031217342827884e-04, errMarg) ;
err += boysGaussJacobiComp(109, 2.82247755365686974e+01, 3.38324192002785972e-15, errMarg) ;
err += boysGaussJacobiComp(123, 1.40925053172813733e+01, 3.46035305938193238e-09, errMarg) ;
err += boysGaussJacobiComp(109, 1.23992480930093206e+01, 2.11962423349140964e-08, errMarg) ;
err += boysGaussJacobiComp(126, 3.27921757293449336e+00, 1.52773121743971348e-04, errMarg) ;
err += boysGaussJacobiComp(167, 1.07110916453745925e+00, 1.02931379543230710e-03, errMarg) ;
err += boysGaussJacobiComp(114, 2.88366489749167010e+00, 2.50485688367471183e-04, errMarg) ;
err += boysGaussJacobiComp(98, 2.54578724506953317e+01, 5.98634516854993775e-14, errMarg) ;
err += boysGaussJacobiComp(110, 2.21544084158236273e+00, 5.03695964233241741e-04, errMarg) ;
err += boysGaussJacobiComp(145, 1.73317578758603899e+01, 1.15784193417679468e-10, errMarg) ;
err += boysGaussJacobiComp(170, 7.85351293212905868e+00, 1.19360309611942457e-06, errMarg) ;
err += boysGaussJacobiComp(128, 7.42899264236361151e+00, 2.45098867135004395e-06, errMarg) ;
err += boysGaussJacobiComp(176, 1.59979455797387281e+01, 3.51076933075999839e-10, errMarg) ;
err += boysGaussJacobiComp(100, 2.15376165876964989e+00, 5.89861110120164300e-04, errMarg) ;
err += boysGaussJacobiComp(186, 2.14998208547183632e+01, 1.39280972402024329e-12, errMarg) ;
err += boysGaussJacobiComp(140, 3.26552015899235240e+00, 1.39070383439031829e-04, errMarg) ;
return err;
} /* main */

```

Appendix B: Recurrence for $z/(2+N)$

One may sum the first N terms of the power series of the exponential factor in the integral kernel (1), and gather the series of the remainder to express $F_m(z)$ as a series over terms $F_{m+n+j}(\frac{z}{N+2})$:

$$\begin{aligned}
e^{-zu^2} &= \sum_{i=0}^N \frac{(-zu^2)^i}{i!} + \frac{(-zu^2)^{N+1}}{(N+1)!} + \frac{(-zu^2)^{N+2}}{(N+2)!} + \dots \\
&= \sum_{i=0}^N \frac{(-zu^2)^i}{i!} + \frac{(-zu^2)^{N+1}}{(N+1)!} \left(1 + \frac{-zu^2}{N+2} + \frac{(-zu^2)^2}{(N+2)(N+3)} \dots \right)
\end{aligned}$$

$$\begin{aligned}
&= \sum_{i=0}^N \frac{(-zu^2)^i}{i!} + \frac{(-zu^2)^{N+1}}{(N+1)!} \exp\left(-\frac{zu^2}{N+2}\right) \left(1 + \frac{z^2(N+1)}{2(N+3)(N+2)^2} u^4 - \frac{z^3 N(N+1)}{3(N+2)^3(N+3)(N+4)} u^6 \right. \\
&\quad \left. + \frac{z^4(N+1)(3N^2+5N+4)}{8(N+2)^4(N+3)(N+4)(N+5)} u^8 + \dots \right) \\
&= \sum_{i=0}^N \frac{(-zu^2)^i}{i!} + \frac{(-z)^{N+1}}{(N+1)!} \exp\left(-\frac{zu^2}{N+2}\right) \left(u^{2N+2} + \frac{z^2(N+1)}{2(N+3)(N+2)^2} u^{2N+6} - \frac{z^3 N(N+1)}{3(N+2)^3(N+3)(N+4)} u^{2N+8} \right. \\
&\quad \left. + \frac{z^4(N+1)(3N^2+5N+4)}{8(N+2)^4(N+3)(N+4)(N+5)} u^{2N+10} + \dots \right). \tag{B1}
\end{aligned}$$

Integrating both sides over $u^{2m} du$ gives

$$\begin{aligned}
F_m(z) &= \sum_{i=0}^N \frac{(-z)^i}{(2i+2m+1)i!} + \frac{(-z)^{N+1}}{(N+1)!} \left(F_{m+N+1}\left(\frac{z}{N+2}\right) + \frac{N+1}{2(N+3)} \left(\frac{z}{N+2}\right)^2 F_{m+N+3}\left(\frac{z}{N+2}\right) \right. \\
&\quad - \frac{N(N+1)}{3(N+3)(N+4)} \left(\frac{z}{N+2}\right)^3 F_{m+N+4}\left(\frac{z}{N+2}\right) \\
&\quad + \frac{(N+1)(3N^2+5N+4)}{8(N+3)(N+4)(N+5)} \left(\frac{z}{N+2}\right)^4 F_{m+N+5}\left(\frac{z}{N+2}\right) \\
&\quad - \frac{N(N+1)(11N^2+27N+22)}{30(N+3)(N+4)\dots(N+6)} \left(\frac{z}{N+2}\right)^5 F_{m+N+6}\left(\frac{z}{N+2}\right) \\
&\quad + \frac{(N+1)(53N^4+186N^3+259N^2+174N+72)}{144(N+3)(N+4)\dots(N+7)} \left(\frac{z}{N+2}\right)^6 F_{m+N+7}\left(\frac{z}{N+2}\right) \\
&\quad \left. - \frac{N(N+1)(309N^4+1390N^3+2555N^2+2330N+976)}{840(N+3)(N+4)\dots(N+8)} \left(\frac{z}{N+2}\right)^7 F_{m+N+8}\left(\frac{z}{N+2}\right) \right. \\
&\quad \left. + \dots \right). \tag{B2}
\end{aligned}$$

The right hand side defines expansion coefficients $f_j(N, z)$

$$F_m(z) - \sum_{i=0}^N \frac{(-z)^i}{(2i+2m+1)i!} = \sum_{j=0}^{\infty} f_j(N, z) F_{m+N+j+1}\left(\frac{z}{N+2}\right), \tag{B3}$$

starting with

$$f_0(N, z) = \frac{(-z)^{N+1}}{(N+1)!}; \tag{B4}$$

$$f_1(N, z) = 0; \tag{B5}$$

$$f_2(N, z) = \frac{N+1}{2(N+3)} \left(\frac{z}{N+2}\right)^2 \frac{(-z)^{N+1}}{(N+1)!}; \tag{B6}$$

$$f_3(N, z) = -\frac{N(N+1)}{3(N+3)(N+4)} \left(\frac{z}{N+2}\right)^3 \frac{(-z)^{N+1}}{(N+1)!}, \tag{B7}$$

and creates an upper triangular matrix operator that translates $F(z)$ to $F(\frac{z}{N+2})$:

$$\begin{aligned}
&\begin{pmatrix} f_0(N, z) & 0 & f_2(N, z) & f_3(N, z) & f_4(N, z) & f_5(N, z) & f_6(N, z) & \dots \\ 0 & f_0(N, z) & 0 & f_2(N, z) & f_3(N, z) & f_4(N, z) & f_5(N, z) & \dots \\ 0 & 0 & f_0(N, z) & 0 & f_2(N, z) & f_3(N, z) & f_4(N, z) & \dots \\ \vdots & \ddots & \ddots & \ddots & & & \vdots & \ddots \end{pmatrix} \cdot \begin{pmatrix} F_{m+N+1}(z/(N+2)) \\ F_{m+N+2}(z/(N+2)) \\ F_{m+N+3}(z/(N+2)) \\ \vdots \end{pmatrix} \\
&= \begin{pmatrix} F_m(z) - \sum_{i=0}^N \frac{(-z)^i}{(2i+2m+1)i!} \\ F_{m+1}(z) - \sum_{i=0}^N \frac{(-z)^i}{(2i+2m+3)i!} \\ F_{m+2}(z) - \sum_{i=0}^N \frac{(-z)^i}{(2i+2m+5)i!} \\ \vdots \end{pmatrix}. \tag{B8}
\end{aligned}$$

This format is not helpful: the representation of the small value at z by summation over larger values at smaller argument $z/(N+2)$ suffers from cancellation of digits. One would rather like to have a kind of matrix-inverse of Eq. (B8) that would start from large z to obtain values at moderate z .

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