Technical White Paper for the Ulysses-HISCALE Background Rate Software

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Abstract

This software is provided to the HISCALE Team for the purpose of determining the background levels in the MFSA and RATE data for the M, F, M' and F' detectors. The background rates provided by this software are the result of the application of a technique demonstrated by Patterson and Armstrong [2001] of using the IMP-8 data to determine the GCR contribution to the overall background rates. A data quality flag is included in the software to warn the user. The normalization factors for the model spectrum used to determine the background rates is provided in a separate file. The team will be provided with updated normalizations as more data are made available.

1 Introduction

In previous studies, the background rates for the HISCALE detectors were determined by searching the data time-series for minimum counts and assuming that the background rates were time invariant [*Simnett*, 1994]. Other studies made the assumption that the background rates varied with heliolatitude [*Tappin*, 1994]. These earlier attempts dismissed the possibility of a time-varying background rate. With the over 10 years of data now collected by HISCALE, a time-varying trend in the GCR-induced background rates was noticed [*Patterson*, 2001]. The trend was only noticed as a result of the simultaneous investigation of the data from IMP-8 and Ulysses. The results of our method to determine a rough value for the HISCALE backgrounds were noticed to bear a strong resemblance to the IMP-8 P11 time-series. It was then realized that the correlation between the two could be made. The process of utilizing the IMP-8 data to model the HISCALE background is presented in a report by *Patterson* [2001] to the HISCALE team. Details about the computational methods and models can be found in Patterson's report. This document focuses on the application of the results of the model. The other component to the total HISCALE background rates are the rates induced by the RTG gamma rays. Many experimental measurements and numerical simulations have been done to determine the contribution to the total background rates by the RTG. A preflight measurement was taken with the RTG and the HISCALE package in the same relative positions they now have on the spacecraft [*Gold*, 1984], and a numerical simulation of the response was done by *Gomez* [1996]. The RTG-induced rates used in the ULYBKGR.FOR subroutine are those obtained by the *Patterson* [2001] study.

2 Structure

The tabular data accessed by ULYBKGR.FOR is provided via a series of DATA statements rather than reading the data from a file on disc. The drawback is that the subroutine must be recompiled at each update to the available data, whereas the advantage is the increase in the speed of the software. Disc I/O is slow and with the large quantity of data used by ULYBKGR.FOR the access time will be high. With the data compiled into the object file, the access time is greatly reduced, thereby reducing the amount of costly CPU time required. All of the time-invariant data are contained within the ULYBKGR.FOR file, but the time-varying normalization factors are contained in a separate file, SCALE.INC. This is done to allow for easy updates to the software as more data are made available. Upon taking the day-of-mission (DOM) as an input from the user, the subroutine loads the tabular data required. These data include the energy thresholds for the MFSA and RATE channels, the RTG contribution to the background, the parameters for the modeled MFSA background spectrum, and the time-varying normalization of the background spectrum, and then the midpoint energies for the MFSA channels are computed. The DOM is compared to the available range of days in the current data set. If the DOM is within the available range, then the program continues with no changes. If the DOM requested by the user is outside the available range, then the last day of data available is used instead and the data quality flag is set to a value of two, indicating an estimated result. Once the normalization data for the requested day are acquired, the GCR contribution to the MFSA background are computed using the following model:

$$R_{GCR-background}(E,t) = A(t) \cdot \left[\frac{a}{(E-b)^c \cdot exp\left(\frac{d}{E-b}\right) - e} - f \right].$$

The parameters a though f are defined in the software as the array FIT. A in the equation above is the normalization factor for the requested DOM. The resulting GCR-induced rates are then added, channel-by-channel, to the RTG-induced rates to yield the total background rates in the MFSA channels. In order to obtain the background rates for the RATE channels, the MFSA data were integrated over the individual RATE channel energy passbands. As an example, here is how the background rate for P3 is determined:

```
        ratebkgr(1,3)=
     +        ((mfsaeng(13)-rateeng(1,3))/(mfsaeng(12)-mfsaeng(13)))*
     +        mfsabkgr(1,12)+mfsabkgr(1,13)+mfsabkgr(1,14)+
     +        ((rateeng(1,4)-mfsaeng(15))/(mfsaeng(15)-mfsaeng(16)))*
     +        mfsabkgr(1,15)
```

Similar methods are used for the other RATE channels. With the background rates now determined for the MFSA and RATE channels, the values and the data quality flag are returned to the user.

3 Usage

This software is a FORTRAN77 subroutine which accepts from the user the day-of-mission (DOM) and returns two arrays containing the MFSA and RATE block background rates and a data quality flag. The two data arrays contain the background rates in the 32 MFSA channels of the M, F, M', and F' detectors, the eight RATE channels for M and M' (P1 to P8), and the seven RATE channels for F and F' (E1 to FP7). Here is a sample calling statement:

```
CALL ULYBKGR(DOM,RATEBKGR,MFSABKGR,DQF)
```

where the arguments are declared in the following manner:

```
INTEGER*2 DOM
REAL*4 RATEBKGR(4,8)
REAL*4 MFSABKGR(4,32)
INTEGER*2 DQF
```

The day-of-mission numbering begins with day 318 of 1990 as day 1. All other days are numbered sequentially from that initial date with no gap. The first coordinate for the data arrays indicates the detector where 1=M, 2=F', 3=M', and 4=F. The second coordinate indicates the energy channel. For the F and F' portions of the RATEBKGR array, the eighth element is unused and set to zero. Therefore, the background rate for P5' would be stored in RATEBKGR(3,5). The data quality flag, DQF, has the value 1 if the data are good and without availability errors. DQF has a value of 2 if the DOM requested is outside the bounds of the current version of the software. When this occurs, the last value of the normalization factor is used.

4 Applying Updates

The initial version of the SCALE.INC file contains data up to and including the 3644^{th} day of the mission. As more IMP-8 data and HISCALE data are made available, this file will be updated and distributed to the HISCALE team. To apply the updates, simply remove or rename the previous copy of the SCALE.INC file and place the new version in the same directory as the ULYBKGR.FOR source code. The version number for the SCALE.INC file can be found at the top of the file within the header block. With the new version of the include file in place, recompile the ULYBKGR.FOR code so that the new data are incorporated in the object file.

References

[1] Gold, R. E., RTG radiation background tests, memo to the HISCALE Instrument Team, 1984.

[2] Gomez, J., Monte Carlo simulation of MFSA response to RTG gamma rays, internal document, Fundamental Technologies, 1996.

[3] Patterson, J. D., and Armstrong, T. P., Determination of HISCALE MFSA background rates using IMP-8 monitored omnidirectional galactic cosmic rays, internal document, Fundamental Technologies, 2001.

[4] Simnett, G. M., Background analysis for the high latitude cosmic ray study, University of Birmingham, 1994.

[5] Tappin, S. J., HISCALE backgrounds, a new look, HISCALE internal document, 1994.

Appendix A: ULYBKGR.FOR Source Code

This is the FORTRAN77 source code for the ULYBKGR.FOR subroutine. This code was written for an i586 machine running RedHat Linux 7.0, but there is no platform-specific code involved. The code should compile as-is, without modification, on any architecture-OS combination.

```
c*********************************************************************
c
c     The program ULYBKGR.FOR uses the results of a study by
c     J. D. Patterson and T. P. Armstrong on the sources of background
c     counts produced in the M, F, M' and F' detectors of EPAM and
c     HISCALE.  This program takes as its input a requested time
c     in the form of day-of-mission (DOM) and returns the background
c     rates in MFSA and RATE channels of the M, F, M' and F' detectors
c     of the HISCALE instrument.   Variable definitions are given
c     in the variable declaration section of the following code.
c     Please direct any questions about this software or the study
c     that made this software possible to Doug Patterson at
c     dpatter@ulysses.ftecs.com.   Fundamental Technologies, LLC owns
c     the copyright to this software.  Modifications or unauthorized
c     distribution of this software is prohibited.
c
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c
c*********************************************************************
c
      subroutine ulybkgr(dom,mfsabkgr,ratebkgr,domflag)
c
      implicit none
c
c*********************************************************************
c
c     ** Variable Declarations and Definitions **
c
      character*365 header   !text variable to skip file headers
      character*80 gcrfile   !filename containing GCR rates
c
      integer i,j,k,q        !dummy iindicies
      integer dom            !day-of-mission time from driver
      integer domflag        !data availibility flag
                                !1=dom is within availible range
                                !2=dom is outside availible range
      integer year,day       !year and day for data from GCR file
c
      real fit(6)            !Fit parameters for modeled background
      real rtgbkgr(4,32)     !RTG-induced rates (detector,MFSA channel)
                                !detector, 1=M, 2=F', 3=M', 4=F
      real inputgcr(32)      !GCR-induced rates per record (channel)
      real gcrbkgr(32)       !GCR-induced rates (MFSA channel)
      real mfsaeng(33)       !MFSA energy thresholds (channel)
```

```
      real mfsamid(32)       !MFSA mid-point energies (channel)
      real rateeng(4,9)      !RATE energy thresholds (detector,channel)
                                !detector, 1=M, 2=F', 3=M', 4=F
      real mfsabkgr(4,32)    !MFSA background rates (detector,channel)
                                !detector, 1=M, 2=F', 3=M', 4=F
      real ratebkgr(4,32)    !RATE background rates (detector,channel)
                                !detector, 1=M, 2=F', 3=M', 4=F
c
      include 'scale.inc'
c
c*******************************************************************
c
c     ** Define MFSA and RATE Energy Thresholds **
c
      data mfsaeng/ 13.6330,16.5094,19.9929,24.2124 ,29.3237,35.5157,
     +     43.0174,52.1064,63.1193,76.4646,92.6376,112.239,135.999,
     +     164.801,199.720,242.061,293.407,355.682,431.224,522.872,
     +     634.081,769.048,932.881,1131.79,1373.35,1666.76,2023.25,
     +     2456.48,2983.13,3623.52,4402.47,5350.28,6503.03/
c
      do i=1,32
         mfsamid(i)=sqrt(mfsaeng(i)*mfsaeng(i+1))
      end do
c
c                LEMS30 LEFS60 LEMS120 LEFS150
      data rateeng/ 56.00, 42.00, 61.00, 40.00,
     +              78.00, 64.00, 77.00, 65.00,
     +              130.0, 112.0, 127.0, 107.00,
     +              214.0, 178.0, 207.0, 170.0,
     +              337.0, 290.0, 336.0, 280.0,
     +              594.0, 546.0, 601.0, 540.0,
     +              1073., 761.0, 1123., 765.0,
     +              1802., 1223., 1874., 1223.,
     +              4752., 4974., 4752., 4942./
c
c*******************************************************************
c
c     ** Define RTG and GCR-Induced Background Rates **
c
c                  LEMS30    LEFS60   LEMS120   LEFS150
      data rtgbkgr/ 1.67E-01, 4.76E-01, 8.94E-03, 0.00E+00,
     +              9.23E-02, 2.45E-01, 1.39E-02, 1.48E-03,
     +              5.78E-02, 1.09E-01, 3.39E-02, 1.07E-02,
     +              5.94E-02, 9.71E-02, 8.48E-02, 3.47E-02,
     +              8.06E-02, 1.43E-01, 1.56E-01, 6.53E-02,
     +              8.54E-02, 1.54E-01, 2.05E-01, 7.06E-02,
     +              9.46E-02, 1.87E-01, 3.01E-01, 7.28E-02,
     +              1.27E-01, 2.39E-01, 3.27E-01, 8.92E-02,
     +              1.47E-01, 2.68E-01, 3.87E-01, 9.89E-02,
     +              1.51E-01, 2.72E-01, 4.06E-01, 1.06E-01,
     +              1.43E-01, 2.45E-01, 3.84E-01, 9.98E-02,
     +              1.32E-01, 2.16E-01, 3.55E-01, 9.00E-02,
     +              1.11E-01, 1.79E-01, 3.20E-01, 7.73E-02,
     +              9.20E-02, 1.59E-01, 2.80E-01, 6.67E-02,
     +              7.80E-02, 1.23E-01, 2.37E-01, 4.94E-02,
     +              6.60E-02, 9.58E-02, 1.96E-01, 3.89E-02,
     +              4.00E-02, 5.28E-02, 1.29E-01, 2.11E-02,
```

```
     +              2.40E-02, 2.28E-02, 7.15E-02, 1.00E-02,
     +              1.14E-02, 2.25E-03, 3.18E-02, 2.38E-03,
     +              6.40E-03, 0.00E+00, 1.17E-02, 0.00E+00,
     +              4.00E-04, 0.00E+00, 3.67E-04, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00,
     +              0.00E+00, 0.00E+00, 0.00E+00, 0.00E+00/
c
      data fit/ 5000,-12.8,1.74,209,-0.698,-0.002/
c
      if (dom.gt.nscl) then
         dom=nscl
         domflag=2
      else
         domflag=1
      end if
c
      do j=1,32
         gcrbkgr(j)=scle(dom)*(fit(1)/(((mfsamid(j)-fit(2))**fit(3))
     +        *exp(fit(4)/(mfsamid(j)-fit(2)))-fit(5))-fit(6))
      end do
c
c*******************************************************************
c
c     ** Determine the MFSA and RATE Background Rates **
c     **         for the Given Day-Of-Mission         **
c
c
c     ** MFSA Rates **
 10   do i=1,4
         do j=1,32
            mfsabkgr(i,j)=gcrbkgr(j)+rtgbkgr(i,j)
         end do
      end do
c
c     ** M and M' Rates **
      do i=1,3,2
         ratebkgr(i,1)=
     +        ((mfsaeng(9)-rateeng(i,1))/(mfsaeng(8)-mfsaeng(9)))*
     +        mfsabkgr(i,8)+mfsabkgr(i,9)+
     +        ((rateeng(i,2)-mfsaeng(10))/(mfsaeng(10)-mfsaeng(11)))*
     +        mfsabkgr(i,10)
         ratebkgr(i,2)=
     +        ((mfsaeng(11)-rateeng(i,2))/(mfsaeng(10)-mfsaeng(11)))*
     +        mfsabkgr(i,10)+mfsabkgr(i,11)+
     +        ((rateeng(i,3)-mfsaeng(12))/(mfsaeng(12)-mfsaeng(13)))*
     +        mfsabkgr(i,12)
         ratebkgr(i,3)=
     +        ((mfsaeng(13)-rateeng(i,3))/(mfsaeng(12)-mfsaeng(13)))*
```

```
     +        mfsabkgr(i,12)+mfsabkgr(i,13)+mfsabkgr(i,14)+
     +        ((rateeng(i,4)-mfsaeng(15))/(mfsaeng(15)-mfsaeng(16)))*
     +        mfsabkgr(i,15)
         ratebkgr(i,4)=
     +        ((mfsaeng(16)-rateeng(i,4))/(mfsaeng(15)-mfsaeng(16)))*
     +        mfsabkgr(i,15)+mfsabkgr(i,16)+
     +        ((rateeng(i,5)-mfsaeng(17))/(mfsaeng(17)-mfsaeng(18)))*
     +        mfsabkgr(i,17)
         ratebkgr(i,5)=
     +        ((mfsaeng(18)-rateeng(i,5))/(mfsaeng(17)-mfsaeng(18)))*
     +        mfsabkgr(i,17)+mfsabkgr(i,18)+mfsabkgr(i,19)+
     +        ((rateeng(i,6)-mfsaeng(20))/(mfsaeng(20)-mfsaeng(21)))*
     +        mfsabkgr(i,20)
         ratebkgr(i,6)=
     +        ((mfsaeng(21)-rateeng(i,6))/(mfsaeng(20)-mfsaeng(21)))*
     +        mfsabkgr(i,20)+mfsabkgr(i,21)+mfsabkgr(i,22)+
     +        ((rateeng(i,7)-mfsaeng(23))/(mfsaeng(23)-mfsaeng(24)))*
     +        mfsabkgr(i,23)
         ratebkgr(i,7)=
     +        ((mfsaeng(24)-rateeng(i,7))/(mfsaeng(23)-mfsaeng(24)))*
     +        mfsabkgr(i,23)+mfsabkgr(i,24)+mfsabkgr(i,25)+
     +        ((rateeng(i,8)-mfsaeng(26))/(mfsaeng(26)-mfsaeng(27)))*
     +        mfsabkgr(i,26)
         ratebkgr(i,8)=
     +        ((mfsaeng(27)-rateeng(i,8))/(mfsaeng(26)-mfsaeng(27)))*
     +        mfsabkgr(i,26)+mfsabkgr(i,27)+mfsabkgr(i,28)+
     +        mfsabkgr(i,29)+mfsabkgr(i,30)+
     +        ((rateeng(i,9)-mfsaeng(31))/(mfsaeng(31)-mfsaeng(32)))*
     +        mfsabkgr(i,31)
      end do
c
c     ** F and F' Rates **
      do i=2,4,2
         ratebkgr(i,1)=
     +        ((mfsaeng(7)-rateeng(i,1))/(mfsaeng(7)-mfsaeng(6)))*
     +        mfsabkgr(i,6)+mfsabkgr(i,7)+mfsabkgr(i,8)+
     +        ((rateeng(i,2)-mfsaeng(9))/(mfsaeng(10)-mfsaeng(9)))*
     +        mfsabkgr(i,9)
         ratebkgr(i,2)=
     +        ((mfsaeng(10)-rateeng(i,2))/(mfsaeng(10)-mfsaeng(9)))*
     +        mfsabkgr(i,9)+mfsabkgr(i,10)+
     +        (rateeng(i,3)-(mfsaeng(11))/(mfsaeng(12)-mfsaeng(11)))*
     +        mfsabkgr(i,11)
         ratebkgr(i,3)=
     +        ((mfsaeng(12)-rateeng(i,3))/(mfsaeng(12)-mfsaeng(11)))*
     +        mfsabkgr(i,11)+mfsabkgr(i,12)+mfsabkgr(i,13)+
     +        ((rateeng(i,4)-mfsaeng(14))/(mfsaeng(15)-mfsaeng(14)))*
     +        mfsabkgr(i,14)
         ratebkgr(i,4)=
     +        ((mfsaeng(15)-rateeng(i,4))/(mfsaeng(15)-mfsaeng(14)))*
     +        mfsabkgr(i,14)+mfsabkgr(i,15)+
     +        ((rateeng(i,5)-mfsaeng(16))/(mfsaeng(17)-mfsaeng(16)))*
     +        mfsabkgr(i,16)
         ratebkgr(i,5)=
     +        ((mfsaeng(21)-rateeng(i,6))/(mfsaeng(21)-mfsaeng(20)))*
     +        mfsabkgr(i,20)+
     +        ((rateeng(i,7)-mfsaeng(21))/(mfsaeng(22)-mfsaeng(21)))*
```

```
     +        mfsabkgr(i,21)
        ratebkgr(i,6)=
     +        ((mfsaeng(22)-rateeng(i,7))/(mfsaeng(21)-mfsaeng(22)))*
     +        mfsabkgr(i,21)+mfsabkgr(i,22)+mfsabkgr(i,23)+
     +        ((rateeng(i,8)-mfsaeng(24))/(mfsaeng(25)-mfsaeng(24)))*
     +        mfsabkgr(i,24)
        ratebkgr(i,7)=
     +        ((mfsaeng(25)-rateeng(i,8))/(mfsaeng(25)-mfsaeng(24)))*
     +        mfsabkgr(i,24)+mfsabkgr(i,25)+mfsabkgr(i,26)+
     +        mfsabkgr(i,27)+mfsabkgr(i,28)+mfsabkgr(i,29)+
     +        mfsabkgr(i,30)+
     +        ((rateeng(i,9)-mfsaeng(31))/(mfsaeng(32)-mfsaeng(31)))*
     +        mfsabkgr(i,31)
        ratebkgr(i,8)=0.00
      end do
c
      return
      end
```

Appendix B: SCALE.INC Source Code

This is the file which contains the normalization factors for the HISCALE background model. Each new update to the software will include a current SCALE.INC file that contains the latest results. This file also will update the size of the SCLE vector as more data are included.

```
c*********************************************************************
c
c     SCALE.INC is part of the ULYBKGR.FOR subroutine for determining
c     the background rates for the M, F, M', and F' detectors of the
c     HISCALE instrument on board Ulysses.   The data contained here
c     are the time-varying normalization factors for the modeled GCR
c     contribution to the total MFSA background rates.
c
c     Please direct any questions about this software or the study
c     that made this software possible to Doug Patterson at
c     dpatter@ulysses.ftecs.com.   Fundamental Technologies, LLC owns
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c                                 fax.  (785) 840-0808
c
c*********************************************************************
c
      real scle(3644)        !Normalization of GCR-induced background
      integer nscl           !No.  of elements in SCLE vector
c
      nscl=3644
c
      data scle/ .524, .527, .529, .533, .536,
     +     .539, .542, .542, .542, .542,
     +     .543, .544, .545, .545, .547,
     +     .546, .544, .540, .540, .544,
     +     .550, .554, .551, .543, .533,
     +     .522, .519, .520, .526, .535,
     +     .542, .548, .545, .541, .536,
     +     .532, .529, .525, .526, .531,
     +     .538, .541, .539, .540, .545,
     +     .550, .554, .554, .554, .554,
     +     .553, .552, .552, .555, .558,
     +     .560, .564, .567, .567, .565,
     +     .563, .565, .567, .569, .566,
     +     .564, .562, .559, .559, .559,
     +     .559, .560, .571, .599, .637,
     +     .686, .704, .711, .701, .678,
     +     .648, .606, .579, .570, .577,
     +     .593, .602, .598, .585, .576,
     +     .570, .573, .577, .582, .585,
     +     .588, .588, .589, .589, .589,
     +     .589, .590, .596, .604, .609,
```

```
     +     .612, .611, .610, .606, .600,
     +     .592, .582, .578, .578, .577,
     +     .576, .569, .573, .592, .623,
     +     .660, .658, .634, .590, .552,
     +     .532, .526, .529, .532, .535,
     +     .535, .535, .535, .535, .535,
     +     .535, .557, .624, .738, .898,
     +     .997,1.010, .928, .776, .655,
     +     .574, .540, .534, .532, .530,
     +     .530, .530, .533, .538, .545,
     +     .550, .552, .552, .552, .556,
     +     .556, .547, .535, .528, .534,
     +     .544, .553, .556, .560, .568,
     +     .577, .585, .577, .565, .556,
     +     .557, .566, .579, .579, .575,
     +     .565, .555, .544, .545, .545,
     +     .564, .599, .654, .698, .729,
     +     .745, .738, .723, .695, .663,
     +     .632, .612, .619, .653, .711,
     +     .786, .838, .869, .879, .879,
     +     .879, .879, .879, .879, .879,
     +     .879, .879, .879, .879, .875,
     +     .863, .844, .806, .760, .706,
     +     .644, .609, .592, .596, .613,
     +     .625, .633, .636, .636, .636,
     +     .636, .636, .636, .636, .636,
     +     .636, .636, .625, .592, .539,
     +     .467, .422, .406, .415, .438,
     +     .454, .461, .456, .446, .435,
     +     .428, .426, .427, .431, .437,
     +     .442, .443, .443, .441, .441,
     +     .443, .444, .446, .449, .450,
     +     .451, .452, .453, .453, .460,
     +     .467, .473, .480, .481, .476,
     +     .465, .453, .449, .464, .483,
     +     .500, .514, .514, .506, .494,
     +     .483, .482, .483, .489, .493,
     +     .496, .502, .506, .510, .511,
     +     .512, .513, .515, .516, .519,
     +     .524, .527, .531, .534, .533,
     +     .534, .533, .532, .534, .536,
     +     .540, .540, .540, .538, .537,
     +     .537, .538, .540, .541, .541,
     +     .541, .543, .550, .558, .566,
     +     .576, .583, .589, .592, .594,
     +     .592, .584, .572, .557, .547,
     +     .543, .546, .554, .563, .576,
     +     .591, .609, .631, .646, .655,
     +     .653, .639, .618, .589, .576,
     +     .574, .580, .586, .585, .579,
     +     .574, .571, .566, .564, .566,
     +     .572, .581, .591, .592, .591,
     +     .588, .585, .585, .586, .592,
     +     .603, .615, .626, .630, .631,
     +     .628, .621, .616, .612, .612,
     +     .612, .612, .611, .608, .605,
     +     .598, .591, .584, .579, .575,
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+     .575, .579, .588, .600, .611,
+     .616, .615, .614, .616, .622,
+     .635, .653, .674, .688, .692,
+     .681, .663, .663, .663, .642,
+     .633, .633, .630, .626, .617,
+     .609, .603, .599, .594, .590,
+     .587, .589, .596, .604, .613,
+     .616, .620, .624, .632, .641,
+     .646, .650, .648, .650, .648,
+     .648, .651, .652, .645, .632,
+     .618, .607, .604, .605, .606,
+     .605, .599, .592, .592, .600,
+     .605, .612, .617, .620, .623,
+     .621, .614, .607, .600, .598,
+     .604, .611, .612, .604, .591,
+     .578, .572, .572, .573, .574,
+     .577, .579, .586, .590, .599,
+     .617, .640, .668, .679, .677,
+     .668, .668, .655, .641, .625,
+     .612, .611, .615, .625, .633,
+     .643, .656, .666, .677, .679,
+     .679, .675, .665, .654, .646,
+     .643, .644, .645, .647, .647,
+     .650, .654, .655, .656, .654,
+     .654, .656, .660, .669, .680,
+     .691, .700, .706, .707, .709,
+     .710, .707, .699, .688, .676,
+     .669, .665, .663, .661, .658,
+     .655, .654, .655, .653, .650,
+     .644, .639, .637, .637, .641,
+     .649, .662, .676, .685, .696,
+     .698, .706, .709, .708, .706,
+     .699, .697, .701, .703, .706,
+     .703, .695, .688, .687, .690,
+     .691, .692, .690, .690, .691,
+     .694, .694, .701, .705, .708,
+     .711, .713, .717, .722, .722,
+     .723, .719, .715, .716, .718,
+     .722, .719, .718, .716, .716,
+     .717, .717, .719, .724, .732,
+     .744, .750, .750, .753, .751,
+     .749, .749, .750, .752, .748,
+     .743, .737, .738, .742, .755,
+     .763, .770, .774, .773, .769,
+     .758, .748, .740, .741, .745,
+     .755, .761, .767, .772, .778,
+     .787, .793, .796, .792, .784,
+     .774, .767, .758, .749, .744,
+     .740, .743, .748, .754, .760,
+     .762, .763, .764, .767, .765,
+     .758, .745, .735, .731, .743,
+     .764, .785, .800, .807, .809,
+     .813, .820, .827, .827, .816,
+     .801, .785, .772, .757, .739,
+     .716, .698, .694, .702, .720,
+     .720, .737, .753, .765, .773,
+     .782, .790, .800, .815, .827,
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     +     .840, .848, .848, .848, .838,
     +     .827, .817, .815, .819, .826,
     +     .837, .845, .848, .838, .814,
     +     .790, .776, .767, .765, .764,
     +     .764, .769, .775, .785, .785,
     +     .802, .821, .838, .849, .852,
     +     .850, .845, .843, .842, .845,
     +     .849, .852, .853, .853, .853,
     +     .853, .853, .853, .853, .853,
     +     .850, .841, .826, .806, .790,
     +     .785, .785, .788, .788, .787,
     +     .790, .796, .801, .809, .816,
     +     .819, .820, .813, .813, .822,
     +     .832, .843, .852, .860, .868,
     +     .873, .872, .865, .865, .856,
     +     .848, .843, .840, .838, .838,
     +     .838, .843, .847, .854, .859,
     +     .861, .861, .861, .860, .858,
     +     .856, .854, .857, .863, .870,
     +     .870, .865, .854, .854, .854,
     +     .849, .847, .843, .841, .836,
     +     .831, .833, .835, .838, .838,
     +     .838, .844, .849, .852, .858,
     +     .861, .865, .865, .860, .855,
     +     .850, .848, .846, .845, .844,
     +     .848, .851, .853, .855, .854,
     +     .851, .849, .853, .862, .876,
     +     .880, .883, .881, .875, .869,
     +     .863, .860, .860, .858, .861,
     +     .862, .867, .875, .872, .861,
     +     .842, .822, .815, .812, .816,
     +     .822, .831, .840, .849, .859,
     +     .862, .864, .851, .838, .824,
     +     .808, .792, .786, .796, .814,
     +     .833, .833, .824, .818, .827,
     +     .849, .871, .890, .886, .875,
     +     .856, .835, .823, .819, .819,
     +     .826, .829, .825, .816, .810,
     +     .808, .808, .810, .815, .827,
     +     .842, .847, .848, .840, .834,
     +     .833, .834, .838, .841, .849,
     +     .858, .868, .875, .873, .870,
     +     .869, .868, .868, .867, .865,
     +     .869, .872, .871, .865, .865,
     +     .856, .850, .857, .865, .870,
     +     .871, .868, .863, .859, .854,
     +     .848, .840, .841, .850, .865,
     +     .876, .886, .894, .901, .904,
     +     .900, .888, .874, .865, .858,
     +     .858, .869, .875, .888, .900,
     +     .907, .908, .899, .885, .872,
     +     .872, .872, .872, .866, .863,
     +     .864, .869, .875, .884, .891,
     +     .896, .904, .909, .909, .909,
     +     .916, .926, .938, .946, .949,
     +     .942, .935, .929, .922, .907,
     +     .893, .893, .893, .882, .878,
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     +     .880, .883, .885, .888, .889,
     +     .894, .900, .910, .918, .926,
     +     .933, .944, .948, .949, .946,
     +     .940, .936, .935, .942, .955,
     +     .970, .978, .970, .956, .938,
     +     .925, .919, .916, .918, .920,
     +     .925, .932, .936, .936, .934,
     +     .932, .930, .930, .933, .933,
     +     .929, .922, .917, .920, .924,
     +     .930, .936, .943, .949, .953,
     +     .951, .946, .937, .931, .929,
     +     .934, .940, .944, .944, .941,
     +     .935, .931, .929, .933, .942,
     +     .949, .952, .947, .946, .944,
     +     .950, .956, .958, .961, .967,
     +     .967, .967, .967, .969, .974,
     +     .973, .965, .965, .951, .933,
     +     .920, .919, .920, .930, .938,
     +     .943, .946, .946, .937, .932,
     +     .931, .930, .941, .953, .970,
     +     .988,1.000,1.020,1.030,1.040,
     +     1.040,1.030,1.030,1.010, .998,
     +     .979, .961, .949, .944, .946,
     +     .951, .957, .962, .964, .960,
     +     .954, .943, .936, .935, .939,
     +     .949, .958, .968, .975, .986,
     +     .986, .995,1.000,1.000, .998,
     +     .994, .986, .982, .983, .985,
     +     .989, .992, .991, .990, .987,
     +     .983, .981, .977, .972, .965,
     +     .957, .952, .952, .956, .962,
     +     .965, .968, .972, .981, .993,
     +     1.010,1.010,1.010,1.000, .993,
     +     .987, .980, .975, .969, .966,
     +     .964, .963, .967, .971, .974,
     +     .974, .974, .978, .978, .987,
     +     .998,1.010,1.010,1.020,1.020,
     +     1.020,1.030,1.020,1.010, .998,
     +     .987, .983, .984, .989, .995,
     +     1.000,1.000,1.010,1.010,1.010,
     +     1.010,1.020,1.010,1.010,1.020,
     +     1.020,1.020,1.020,1.010,1.010,
     +     1.010,1.010,1.010, .993, .969,
     +     .951, .942, .942, .946, .952,
     +     .955, .960, .965, .969, .973,
     +     .971, .974, .975, .975, .970,
     +     .959, .946, .941, .941, .949,
     +     .962, .971, .978, .975, .967,
     +     .963, .953, .942, .930, .925,
     +     .923, .924, .927, .930, .932,
     +     .931, .927, .926, .928, .936,
     +     .948, .961, .972, .983, .999,
     +     1.020,1.040,1.040,1.020, .999,
     +     .981, .974, .969, .968, .967,
     +     .964, .955, .946, .940, .939,
     +     .934, .933, .933, .936, .938,
     +     .937, .934, .923, .910, .901,
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+     .901, .918, .937, .950, .960,
+     .962, .961, .961, .962, .964,
+     .966, .966, .963, .957, .946,
+     .938, .933, .932, .931, .925,
+     .923, .926, .934, .945, .952,
+     .956, .956, .952, .951, .954,
+     .958, .966, .974, .978, .974,
+     .965, .956, .962, .967, .975,
+     .977, .972, .966, .956, .945,
+     .939, .936, .938, .940, .940,
+     .943, .945, .952, .958, .959,
+     .959, .960, .966, .978, .992,
+     1.000, .999, .987, .974, .970,
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+     .973, .969, .972, .978, .989,
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+     1.040,1.030,1.020,1.000, .992,
+     .990, .995,1.010,1.020,1.020,
+     1.030,1.030,1.020,1.020,1.030,
+     1.020,1.020,1.010, .997, .991,
+     .990, .991, .997,1.010,1.010,
+     1.020,1.030,1.040,1.040,1.040,
+     1.040,1.040,1.030,1.030,1.030,
+     1.030,1.040,1.040,1.040,1.040,
+     1.040,1.050,1.060,1.060,1.050,
+     1.050,1.040,1.050,1.050,1.050,
+     1.060,1.060,1.070,1.070,1.070,
+     1.070,1.060,1.050,1.030,1.030,
+     1.030,1.040,1.050,1.060,1.050,
+     1.040,1.020,1.010,1.020,1.030,
+     1.050,1.060,1.060,1.070,1.070,
+     1.070,1.080,1.080,1.080,1.080,
+     1.080,1.080,1.070,1.050,1.040,
+     1.030,1.040,1.040,1.040,1.050,
+     1.040,1.040,1.040,1.040,1.030,
+     1.030,1.030,1.040,1.050,1.060,
+     1.070,1.060,1.050,1.040,1.040,
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+     1.040,1.030,1.030,1.030,1.030,
+     1.030,1.030,1.040,1.040,1.050,
+     1.060,1.060,1.050,1.040,1.040,
+     1.030,1.030,1.040,1.050,1.050,
+     1.060,1.070,1.080,1.090,1.090,
+     1.090,1.080,1.060,1.050,1.040,
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+     1.060,1.060,1.060,1.070,1.070,
+     1.070,1.070,1.060,1.060,1.060,
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+     1.050,1.060,1.070,1.080,1.090,
+     1.080,1.080,1.070,1.070,1.070,
+     1.080,1.080,1.090,1.090,1.100,
+     1.100,1.100,1.110,1.100,1.100,
```

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+       1.090,1.090,1.080,1.070,1.070,
+       1.060,1.060,1.060,1.060,1.060,
+       1.070,1.070,1.070,1.080,1.080,
+       1.080,1.080,1.080,1.090,1.100,
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+       1.110,1.110,1.110,1.110,1.100,
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+       1.040,1.040,1.050,1.060,1.070,
+       1.080,1.070,1.060,1.050,1.040,
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+       1.070,1.080,1.080,1.080,1.080,
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+       1.080,1.070,1.070,1.080,1.080,
+       1.090,1.100,1.110,1.110,1.110,
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+       1.080,1.080,1.080,1.080,1.090,
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+       1.120,1.110,1.110,1.100,1.090,
+       1.080,1.080,1.080,1.090,1.090,
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+       1.150,1.140,1.130,1.120,1.110,
+       1.120,1.130,1.130,1.130,1.130,
+       1.130,1.140,1.140,1.150,1.140,
+       1.140,1.130,1.120,1.110,1.120,
+       1.120,1.120,1.130,1.130,1.140,
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     +       1.140,1.140,1.130,1.130,1.120,
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     +       1.180,1.160,1.150,1.130,1.130,
     +       1.130,1.130,1.140,1.150,1.150,
     +       1.150,1.160,1.160,1.170,1.170,
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     +       1.170,1.190,1.190,1.190,1.190,
     +       1.180,1.180,1.180,1.180,1.180,
     +       1.180,1.180,1.180,1.190,1.200,
     +       1.210,1.210,1.200,1.200,1.190,
     +       1.190,1.190,1.190,1.190,1.180,
     +       1.180,1.180,1.180,1.190,1.190,
     +       1.190,1.190,1.190,1.190,1.190,
     +       1.190,1.190,1.190,1.190,1.200,
     +       1.190,1.190,1.180,1.180,1.180,
     +       1.190,1.190,1.190,1.200,1.200,
     +       1.210,1.210,1.210,1.210,1.220,
     +       1.220,1.210,1.210,1.200,1.200,
     +       1.200,1.200,1.200,1.210,1.210,
     +       1.210,1.210,1.210,1.210,1.210,
     +       1.210,1.200,1.200,1.200,1.200,
     +       1.200,1.210,1.210,1.220,1.230,
     +       1.230,1.220,1.220,1.210,1.200,
     +       1.190,1.180,1.170,1.170,1.170,
     +       1.180,1.180,1.190,1.200,1.200,
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```
+     1.210,1.210,1.200,1.190,1.190,
+     1.180,1.180,1.180,1.180,1.180,
+     1.190,1.200,1.220,1.230,1.230,
+     1.230,1.200,1.170,1.170,1.170,
+     1.170,1.150,1.130,1.130,1.140,
+     1.150,1.160,1.170,1.180,1.180,
+     1.180,1.180,1.180,1.190,1.190,
+     1.190,1.190,1.190,1.200,1.200,
+     1.210,1.210,1.210,1.200,1.190,
+     1.190,1.180,1.170,1.160,1.150,
+     1.140,1.140,1.140,1.140,1.150,
+     1.150,1.160,1.170,1.180,1.190,
+     1.190,1.180,1.160,1.150,1.150,
+     1.160,1.170,1.180,1.180,1.170,
+     1.160,1.150,1.150,1.140,1.140,
+     1.120,1.110,1.110,1.120,1.120,
+     1.120,1.130,1.130,1.130,1.130,
+     1.140,1.140,1.150,1.160,1.160,
+     1.170,1.180,1.180,1.190,1.200,
+     1.200,1.200,1.190,1.180,1.170,
+     1.170,1.170,1.170,1.160,1.150,
+     1.150,1.140,1.140,1.130,1.130,
+     1.130,1.130,1.140,1.140,1.150,
+     1.150,1.160,1.160,1.160,1.170,
+     1.170,1.180,1.180,1.190,1.200,
+     1.200,1.200,1.200,1.190,1.180,
+     1.170,1.160,1.160,1.160,1.160,
+     1.160,1.160,1.160,1.160,1.160,
+     1.160,1.150,1.160,1.160,1.170,
+     1.170,1.180,1.180,1.190,1.200,
+     1.210,1.210,1.210,1.210,1.210,
+     1.210,1.210,1.200,1.190,1.170,
+     1.160,1.150,1.140,1.140,1.140,
+     1.150,1.150,1.160,1.150,1.160,
+     1.170,1.170,1.180,1.180,1.180,
+     1.190,1.210,1.230,1.240,1.240,
+     1.240,1.240,1.230,1.230,1.220,
+     1.220,1.210,1.210,1.200,1.200,
+     1.190,1.180,1.160,1.150,1.150,
+     1.160,1.160,1.160,1.170,1.180,
+     1.200,1.210,1.230,1.240,1.240,
+     1.230,1.220,1.210,1.200,1.190,
+     1.180,1.180,1.190,1.200,1.200,
+     1.210,1.210,1.210,1.210,1.200,
+     1.190,1.180,1.180,1.180,1.180,
+     1.180,1.190,1.190,1.200,1.210,
+     1.220,1.220,1.220,1.200,1.170,
+     1.150,1.150,1.160,1.170,1.170,
+     1.170,1.170,1.160,1.160,1.160,
+     1.160,1.170,1.190,1.190,1.190,
+     1.200,1.200,1.200,1.200,1.200,
+     1.210,1.210,1.220,1.220,1.230,
+     1.230,1.240,1.230,1.220,1.210,
+     1.200,1.190,1.180,1.170,1.160,
+     1.170,1.180,1.190,1.190,1.200,
+     1.200,1.190,1.180,1.180,1.180,
+     1.190,1.200,1.200,1.210,1.210,
```

```
     +      1.210,1.220,1.230,1.230,1.230,
     +      1.230,1.220,1.210,1.200,1.200,
     +      1.200,1.190,1.190,1.190,1.200,
     +      1.200,1.210,1.210,1.210,1.200,
     +      1.200,1.200,1.190,1.190,1.180,
     +      1.190,1.190,1.200,1.200,1.210,
     +      1.210,1.220,1.220,1.220,1.220,
     +      1.220,1.220,1.210,1.190,1.180,
     +      1.180,1.180,1.180,1.180,1.180,
     +      1.180,1.180,1.190,1.200,1.210,
     +      1.210,1.220,1.220,1.220,1.220,
     +      1.220,1.230,1.240,1.250,1.250,
     +      1.250,1.240,1.220,1.210,1.210,
     +      1.220,1.220,1.230,1.220,1.220,
     +      1.210,1.210,1.200,1.200,1.210,
     +      1.210,1.220,1.220,1.230,1.230,
     +      1.230,1.220,1.220,1.220,1.230,
     +      1.230,1.240,1.230,1.230,1.230,
     +      1.230,1.230,1.220,1.220,1.220,
     +      1.210,1.220,1.230,1.230,1.230,
     +      1.230,1.230,1.230,1.230,1.230,
     +      1.230,1.230,1.230,1.220,1.220,
     +      1.210,1.210,1.220,1.220,1.230,
     +      1.240,1.230,1.220,1.210,1.200,
     +      1.190,1.190,1.180,1.170,1.170,
     +      1.180,1.190,1.200,1.200,1.180,
     +      1.170,1.150,1.140,1.150,1.170,
     +      1.190,1.200,1.210,1.220,1.220,
     +      1.220,1.220,1.210,1.190,1.170,
     +      1.140,1.130,1.130,1.140,1.150,
     +      1.170,1.180,1.190,1.200,1.200,
     +      1.200,1.190,1.190,1.190,1.190,
     +      1.200,1.200,1.210,1.230,1.230,
     +      1.240,1.230,1.210,1.200,1.180,
     +      1.160,1.140,1.120,1.110,1.100,
     +      1.090,1.090,1.100,1.110,1.130,
     +      1.160,1.180,1.200,1.200,1.200,
     +      1.200,1.200,1.190,1.170,1.170,
     +      1.160,1.160,1.150,1.150,1.150,
     +      1.170,1.190,1.190,1.190,1.190,
     +      1.180,1.170,1.160,1.150,1.150,
     +      1.150,1.160,1.170,1.180,1.190,
     +      1.190,1.180,1.170,1.160,1.160,
     +      1.170,1.170,1.180,1.180,1.180,
     +      1.170,1.170,1.170,1.180,1.190,
     +      1.200,1.200,1.200,1.190,1.190,
     +      1.180,1.170,1.160,1.150,1.140,
     +      1.140,1.150,1.160,1.170,1.170,
     +      1.170,1.160,1.160,1.150,1.160,
     +      1.170,1.170,1.180,1.180,1.180,
     +      1.170,1.170,1.160,1.160,1.150,
     +      1.160,1.160,1.160,1.160,1.160,
     +      1.160,1.160,1.150,1.160,1.160,
     +      1.170,1.170,1.180,1.180,1.180,
     +      1.180,1.180,1.170,1.170,1.180,
     +      1.190,1.190,1.200,1.200,1.200,
     +      1.190,1.190,1.180,1.180,1.180,
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     +      1.180,1.190,1.190,1.200,1.210,
     +      1.220,1.220,1.210,1.200,1.180,
     +      1.170,1.160,1.160,1.150,1.150,
     +      1.160,1.170,1.180,1.200,1.210,
     +      1.210,1.200,1.200,1.180,1.170,
     +      1.150,1.130,1.110,1.090,1.080,
     +      1.080,1.080,1.080,1.080,1.080,
     +      1.070,1.070,1.060,1.060,1.060,
     +      1.070,1.100,1.150,1.210,1.210,
     +      1.200,1.180,1.170,1.190,1.200,
     +      1.220,1.220,1.220,1.220,1.220,
     +      1.220,1.220,1.200,1.180,1.140,
     +      1.120,1.100,1.080,1.060,1.050,
     +      1.040,1.030,1.030,1.030,1.020,
     +      1.010, .998, .992, .992, .996,
     +      1.010,1.020,1.030,1.030,1.050,
     +      1.050,1.050,1.040,1.040,1.030,
     +      1.030,1.020,1.020,1.020,1.030,
     +      1.040,1.040,1.040,1.030,1.030,
     +      1.030,1.030,1.020,1.000, .990,
     +      .985, .983, .983, .979, .974,
     +      .976, .989,1.010,1.020,1.030,
     +      1.030,1.030,1.020,1.020,1.010,
     +      .994, .987, .992,1.010,1.030,
     +      1.040,1.050,1.060,1.050,1.050,
     +      1.050,1.050,1.040,1.050,1.040,
     +      1.040,1.040,1.030,1.030,1.030,
     +      1.040,1.040,1.050,1.050,1.060,
     +      1.060,1.060,1.060,1.060,1.060,
     +      1.060,1.050,1.040,1.030,1.030,
     +      1.030,1.040,1.040,1.040,1.040,
     +      1.050,1.050,1.060,1.080,1.090,
     +      1.100,1.080,1.050,1.020, .999,
     +      .991, .987, .980, .972, .963,
     +      .963, .972, .986,1.000,1.020,
     +      1.030,1.040,1.050,1.060,1.060,
     +      1.060,1.070,1.080,1.080,1.080,
     +      1.070,1.070,1.070,1.060,1.050,
     +      1.040,1.040,1.040,1.040,1.040,
     +      1.030,1.010, .973, .960, .957,
     +      .963, .971, .980, .996,1.020,
     +      1.050,1.060,1.080,1.080,1.080,
     +      1.080,1.070,1.070,1.070,1.060,
     +      1.060,1.060,1.060,1.060,1.070,
     +      1.070,1.070,1.050,1.040,1.030,
     +      1.020,1.030,1.040,1.050,1.060,
     +      1.070,1.070,1.080,1.090,1.100,
     +      1.110,1.110,1.100,1.070,1.040,
     +      .992, .967, .965, .978, .997,
     +      1.010,1.020,1.020,1.030,1.050,
     +      1.080,1.090,1.100,1.100,1.100,
     +      1.100,1.100,1.090,1.060,1.030,
     +      .998, .974, .964, .961, .963,
     +      .964, .965, .968, .973, .977,
     +      .979, .981, .979, .974, .964,
     +      .954, .951, .962, .979, .995,
     +      1.000,1.010,1.000,1.000, .991,
```

```
     +     .983, .975, .973, .971, .971,
     +     .971, .969, .972, .974, .982,
     +     .987, .991, .994,1.000,1.000,
     +     1.000,1.000,1.000,1.000, .996,
     +     .983, .967, .951, .943, .940,
     +     .943, .948, .951, .963, .985,
     +     1.010,1.040,1.020, .986, .945,
     +     .915, .905, .901, .906, .914,
     +     .926, .943, .961, .977, .990,
     +     .997,1.000,1.010,1.010,1.010,
     +     .998, .984, .968, .950, .929,
     +     .906, .884, .868, .864, .872,
     +     .885, .896, .905, .910, .916,
     +     .921, .926, .935, .945, .953,
     +     .955, .951, .944, .937, .939,
     +     .941, .944, .945, .945, .945,
     +     .949, .954, .960, .960, .955,
     +     .945, .932, .925, .923, .923,
     +     .921, .921, .924, .924, .926,
     +     .928, .930, .933, .932, .935,
     +     .939, .941, .946, .951, .957,
     +     .965, .969, .969, .970, .968,
     +     .966, .965, .957, .951, .943,
     +     .935, .930, .922, .915, .908,
     +     .905, .906, .915, .937, .948,
     +     .953, .948, .944, .944, .947,
     +     .952, .956, .960, .957, .949,
     +     .935, .926, .923, .921, .928,
     +     .931, .937, .943, .947, .950,
     +     .951, .952, .953, .953, .949,
     +     .938, .924, .917, .927, .952,
     +     .977, .982, .969, .948, .931,
     +     .922, .919, .918, .921, .926,
     +     .933, .942, .945, .955, .965,
     +     .983, .998,1.010,1.010,1.010,
     +     1.010, .994, .984, .971, .962,
     +     .953, .940, .928, .912, .899,
     +     .884, .871, .866, .873, .887,
     +     .897, .906, .915, .928, .942,
     +     .955, .962, .963, .965, .966,
     +     .971, .978, .988,1.000,1.010,
     +     1.010,1.010,1.000, .995, .991,
     +     .992, .988, .980, .969, .958,
     +     .950, .941, .931, .924, .927,
     +     .936, .950, .958, .963, .967,
     +     .968, .963, .957, .952, .954,
     +     .962, .972, .982, .986, .985,
     +     .979, .969, .955, .937, .915,
     +     .889, .869, .853, .844, .848,
     +     .858, .870, .881, .891, .901,
     +     .914, .922, .929, .932, .928,
     +     .921, .911, .900, .894, .892,
     +     .891, .890, .885, .876, .867,
     +     .862, .862, .864, .868, .865,
     +     .857, .848, .845, .851, .863,
     +     .872, .876, .871, .862, .851,
     +     .848, .846, .848, .850, .849,
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+     .847, .844, .847, .853, .860,
+     .865, .866, .863, .852, .839,
+     .821, .806, .793, .784, .778,
+     .775, .775, .779, .788, .798,
+     .805, .807, .811, .813, .812,
+     .806, .799, .794, .795, .799,
+     .804, .807, .809, .808, .807,
+     .804, .802, .795, .785, .772,
+     .763, .762, .769, .778, .786,
+     .776, .765, .752, .748, .751,
+     .756, .759, .758, .759, .757,
+     .754, .754, .752, .754, .755,
+     .754, .752, .750, .754, .759,
+     .766, .765, .754, .734, .721,
+     .711, .716, .728, .741, .751,
+     .753, .752, .748, .743, .738,
+     .734, .736, .743, .743, .754,
+     .764, .759, .748, .733, .725,
+     .721, .722, .721, .716, .714,
+     .713, .721, .731, .738, .742,
+     .740, .736, .734, .735, .740,
+     .747, .750, .749, .740, .728,
+     .715, .706, .703, .704, .707,
+     .710, .712, .718, .725, .733,
+     .740, .743, .740, .734, .723,
+     .719, .717, .716, .715, .709,
+     .695, .678, .667, .666, .674,
+     .685, .692, .697, .698, .695,
+     .690, .686, .688, .694, .702,
+     .705, .704, .701, .699, .696,
+     .704, .704, .707, .711, .705,
+     .701, .695, .686, .678, .670,
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+     .659, .661, .664, .666, .670,
+     .670, .665, .659, .653, .655,
+     .656, .658, .658, .656, .656,
+     .656, .655, .653, .648, .638,
+     .630, .623, .622, .625, .631,
+     .639, .648, .656, .660, .664,
+     .667, .668, .668, .665, .662,
+     .658, .656, .657, .662, .668,
+     .675, .680, .683, .683, .680,
+     .677, .679, .685, .694, .696,
+     .684, .671, .662, .658, .660,
+     .664, .667, .670, .671, .673,
+     .675, .675, .674, .665, .652,
+     .636, .616, .599, .587, .584,
+     .589, .595, .603, .607, .608,
+     .612, .613, .615, .613, .609,
+     .603, .599, .597, .598, .601,
+     .601, .598, .584, .576, .577,
+     .588, .603, .614, .619, .616,
+     .612, .615, .620, .626, .622,
+     .618, .615, .617, .620, .623,
+     .625, .629, .633, .640, .646,
+     .653, .648, .643, .635, .626,
+     .614, .602, .593, .588, .587,
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     +     .587, .587, .587, .592, .609,
     +     .633, .657, .658, .636, .608,
     +     .587, .579, .577, .576, .572,
     +     .571, .573, .577, .582, .585,
     +     .583, .578, .570, .564, .555,
     +     .547, .538, .530, .526, .524,
     +     .525, .530, .538, .551, .563,
     +     .575, .584, .592, .595, .597,
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     +     .571, .574, .578, .581, .576,
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     +     .592, .586, .579, .575, .574,
     +     .578, .586, .598, .607, .609,
     +     .609, .610, .615, .621, .620,
     +     .616, .612, .612, .615, .617,
     +     .621, .624, .627, .624, .613,
     +     .599, .584, .578, .572, .567,
     +     .563, .561, .557, .553, .542,
     +     .530, .521, .516, .515/
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