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program numerosaleatorios

! Projeto 1 - Introdução à Programação
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    implicit none

    real*8 gamma5b2, gamma3, gamma7b2
    real*8 gamma,c0,c1,c2,c3,c4,c5,c6,funcaogamma,somacoefic
    real*8 i,n, dif3, dif4, dif5
    real*8 piexp, pi
    real*8 gamma5b2piexp, gamma3piexp, gamma7b2piexp
    real*8 volumeesfera3, volumeesfera4, volumeesfera5
    real*8 volumeesfera3exp, volumeesfera4exp, volumeesfera5exp
    real*8 volume3d, volume4d, volume5d

    piexp = 3.1415664179483276

    c0 = 1.000000000190015d0
    c1 = 76.18009172947146d0
    c2 = -86.50532032941677d0
    c3 = 24.01409824083091d0
    c4 = -1.231739572450155d0
    c5 = 0.1208650973866179/100d0
    c6 = -0.5395239384953/100000d0
    gamma = 5

    i = 0.5d0
    n = 5
    pi = piexp

    do while(i.LE.n)
        if (i.EQ.(2d0)) then
            gamma5b2 = funcaogamma
        endif

        if (i.EQ.(2.5d0)) then
            gamma3 = funcaogamma
        endif

        if (i.EQ.(3d0)) then
            gamma7b2 = funcaogamma
        end if


        somacoefic = (c0 + (c1/(i+1d0)) + (c2/(i+2d0)) + (c3/(i+3d0)) + (c4/(i+4d0)) +
        (c5/(i+5d0)) + (c6/(i+6d0)) )
        funcaogamma = (i+gamma+0.5d0)**(i+0.5d0) * EXP(-(i+gamma+0.5d0)) * SQRT(2d0*pi)
        * somacoefic
        i = i+0.5d0

    enddo
    write(*,*)"Valores de gamma usando pi obtido pelo metodo de monte carlo:"

    write(*,*)"Gamma 5b2 = ",gamma5b2
    write(*,*)"Gamma 3 = ",gamma3
    write(*,*)"Gamma 7b2 = ",gamma7b2

    write(*,*)"Valores de gamma exatos:"

    gamma5b2piexp   = gamma5b2      !
    gamma3piexp     = gamma3        ! Armazeno os gammas calculados com pi pelo metodo
    de monte carlo
    gamma7b2piexp   = gamma7b2      !


    gamma5b2 = 1.3293403881791370   !
    gamma3 = 2.0000000000000000     ! Estes são os valores de gamma exatos
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      gamma7b2 = 3.3233509704488425   !


      write(*,*)"Gamma 5b2 = ",gamma5b2
      write(*,*)"Gamma 3 = ",gamma3
      write(*,*)"Gamma 7b2 = ",gamma7b2

      ! Agora estamos munidos de gamma exato e gamma calculado usando pi obtido pelo
      método de monte carlo,
      ! podemos prosseguir para o calculo do volume das esferas em d = 3, 4 e 5

      write(*,*)"O volume das esferas:"

      i = 3
      n = 5

      do while(i.LE.n)
          if (i.EQ.(3)) then
              volumeesfera3exp = piexp**(3d0/2d0) / gamma5b2piexp
              volumeesfera3 = pi**(3d0/2d0) / gamma5b2
          else if (i.EQ.(4)) then
              volumeesfera4exp = piexp**(2d0) / gamma3piexp
              volumeesfera4 = pi**(2d0) / gamma3
          else
              volumeesfera5exp = piexp**(5d0/2d0) / gamma7b2piexp
              volumeesfera5 = pi**(5d0/2d0) / gamma7b2
          end if
      i = i+1

      enddo

      write(*,*)"Volume 3d = ",volumeesfera3exp,"(pi monte carlo)"
      write(*,*)"Volume 4d = ",volumeesfera4exp,"(pi monte carlo)"
      write(*,*)"Volume 5d = ",volumeesfera5exp,"(pi monte carlo)"


      dif3 = abs(volumeesfera3 - volumeesfera3exp)
      dif4 = abs(volumeesfera4 - volumeesfera4exp)
      dif5 = abs(volumeesfera5 - volumeesfera5exp)

      write(*,*)"Volume 3d = ",volumeesfera3
      write(*,*)"Volume 4d = ",volumeesfera4
      write(*,*)"Volume 5d = ",volumeesfera5

      write(*,*)"As diferencas nos valores:"
      write(*,*)"3d:",dif3
      write(*,*)"4d:",dif4
      write(*,*)"5d:",dif5

      volume3d = (4*atan(1.d0))**(3.d0/2.d0) /  1.32934038817913
      volume4d = (4*atan(1.d0))**(2.d0) /  2.d0
      volume5d = (4*atan(1.d0))**(5.d0/2.d0) /  3.32335097044784
      write(*,*)"Volume exato:"
      write(*,*)"Volume 3d = ",volume3d
      write(*,*)"Volume 4d = ",volume4d
      write(*,*)"Volume 5d = ",volume5d
      dif3 = abs(volumeesfera3 - volume3d)
      dif4 = abs(volumeesfera4 - volume4d)
      dif5 = abs(volumeesfera5 - volume5d)
      write(*,*)"As diferencas nos valores (exercicio 3):"
      write(*,*)"3d:",dif3
      write(*,*)"4d:",dif4
      write(*,*)"5d:",dif5
      dif3 = abs(volumeesfera3exp - volume3d)
      dif4 = abs(volumeesfera4exp - volume4d)
      dif5 = abs(volumeesfera5exp - volume5d)
      write(*,*)"As diferencas nos valores (pi monte carlo):"
      write(*,*)"3d:",dif3
      write(*,*)"4d:",dif4
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135       write(*,*)"5d:",dif5
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139   end program numerosaleatorios
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