Final program, debugged and running:

```
!find_runs_length_N.f90
! Program to generate run of heads and tails, and then compute how many runs of heads are of length
!  1, 2, 3,
    integer itoss(1000001),icount(500)
    write(6,'("Enter lenght of run, less than or equal to 1,000,000")')
    read(5,*)irun
! Generate a run, using random numbers equally likely in [0,1]
    k=1
```

Replacing the line above, after the run below:

```
    write(6,'("Enter the seed of the random number generator (integer)")')
    read(5,*)k
    itot0=0
    do  i=1,irun
     x=ran(k)
     itoss(i)=0
     if(x.gt.0.5)then
       itoss(i)=1
       itot0=itot0+1
     endif
    enddo
    write(6,'(50i1)')(itoss(i),i=1,50)
    write(6,'("Total number of heads = ",i6)')itot0
!    do  istart=1,10
!      do  j=1,20
!       if((itoss(istart).eq.0).and.(itoss(istart+j).eq.0))then
!         write(6,'("Test")')
!       endif
!      enddo
!    enddo
! Go through each entry (I could make this more efficient; after finding a run end, start search
!    later) - say, line i
!   If it's a zero (tails; next entry might start a run of heads)
!     If next entry is a 1 (yes, this starts a run)
!       Find next 0 - say, line i+n
!         This ends a run; the run was of length n-1 (from line i+1 to i+[n-1])
!         Increment the count of runs of length n-1 by 1
    istart=1   ! Start searching on line 1
    jmax=0  ! Length of longest run found
    do  kruns=1,irun  ! Max. number of runs of any length likely to be found
!       write(6,'("This is test number ",i4," and istart=",i5)')kruns,istart
!       write(6,'("  itoss(istart)=",i1," and itoss(istart+1)=",i2)')itoss(istart),itoss(istart+1)
      if((itoss(istart).eq.0).and.(itoss(istart+1).eq.1))then  ! We've found the beginning of a run
!         write(6,'("Found beg. of run at istart=",i5)')istart
!         pause
        istartorig=istart
        if(istart.ge.irun-2)goto 100
```

```fortran
        do  jlen=2,500 ! biggest run length (of heads) expected - same as for tails
!         write(6,'("  Testing jlen=",i4)')jlen
!          pause
          if(itoss(istart+jlen).eq.0)then ! We're just past the end of the run of heads
            ! Run length was j-1
!           write(6,'("  Found the end at jlen=",i4)')jlen
!            pause
            icount(jlen-1)=icount(jlen-1)+1
            istart=istart+2  ! Begin the next search here
            if(istart.gt.irun)goto 100
            jmax=max(jmax,jlen-1)  ! Update the length of the longest run found
!            if(jmax.gt.3)then
!              write(6,'("jmax>3 at istart=",i5)')istart
!              pause
!            endif
!            write(6,'("Found a run beginning at number ",i4," and of length ",i3)')istartorig,jlen-1
!            pause
            goto 50  ! Don't test any more jlen values!
          endif
        enddo   ! End of loop over possible length of run of heads
       else
        istart=istart+1
        if(istart.gt.irun)goto 100
       endif

   50 continue
     enddo  ! End of run of possible runs
  100 continue !  Have to correct for possibility that final itoss completes a run; not done yet
!   Aha - easy
     itot=0
     do  j=1,jmax
       write(6,'("Number of runs of length ",i4," = ",i6)')j,icount(j)
       itot=itot+j*icount(j)
     enddo
     write(6,'("Total number of heads=",i6)')itot
     irunlast=itot0-itot
     write(6,'("Add 1 to icount(",i4,")")')irunlast
     stop
     end
```

Enter lenght of run, less than or equal to 1,000,000
1000000
0010110010100001101010000110100010100111100001010111
Total number of heads = 500019
Number of runs of length   1 = 125043
Number of runs of length   2 = 62299
Number of runs of length   3 = 31008
Number of runs of length   4 = 15550

Number of runs of length   5 = 7726
Number of runs of length   6 = 4052
Number of runs of length   7 = 2019
Number of runs of length   8 =   970
Number of runs of length   9 =   483
Number of runs of length 10 =   292
Number of runs of length 11 =   116
Number of runs of length 12 =   63
Number of runs of length 13 =   35
Number of runs of length 14 =   21
Number of runs of length 15 =   9
Number of runs of length 16 =   4
Number of runs of length 17 =   2
Number of runs of length 18 =   1
Number of runs of length 19 =   0
Number of runs of length 20 =   1
Total number of heads=500019
Add 1 to icount(0)
Press any key to continue