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**Project 5**

CODE:

import math

#parameters in the question

seed=123457

a=7\*\*5

c=0

m=(2\*\*31)-1

randomNumbers=[]

#function to create random numbers

def generateRandom():

    global seed

    seed=(a\*seed+c)%m

    return round(seed/m,3)

for i in range(100):

    randomNumbers.append(generateRandom())

copyrandomNumbers=randomNumbers.copy()

randomNumbers.sort()

print(randomNumbers)

#this part here is for kolmogrov-smirnov test

dpluses=[]                                                          #array to store all d+ values

dnegatives=[]                                                       #array to store all d- values

for i in range(len(randomNumbers)):

    dpluses.append(((i+1)/len(randomNumbers))-randomNumbers[i])     #i in the for loop starts from 0 thats why i need +1 here

    dnegatives.append(randomNumbers[i]-((i)/len(randomNumbers)))    #i in the for loop starts from 0 thats why i dont need -1 here

dpluses.sort()                                                      #sorting the array so we can get the max

dnegatives.sort()                                                   #sorting the array so we can get the max

dplus = dpluses[len(randomNumbers)-1]                               #getting the max

dnegative = dnegatives[len(randomNumbers)-1]                        #getting the max

d=max(dplus,dnegative)                                              #getting the max

dalpha=1.36/math.sqrt(len(randomNumbers))                           #alpha value

if(dalpha>d):

    print("numbers are uniform for alpha level of 0.05")

else:

    print("numbers are not uniform for alpha level of 0.05")

print("d𝛼 = ",dalpha)

print("d = ",d)

#this part is for runs up and runs down test

currentRunType=None

runCount=0

#loop for counting runs

for i in range(1,len(copyrandomNumbers)):

    num=copyrandomNumbers[i]

    if currentRunType!=None:                #if it is not the first 2 elements this block runs

        if (num>copyrandomNumbers[i-1]):    #checks if the current element is greater than the previous element

            if(currentRunType=="-"):        #then checks if it runs down if it runs down it means now its running up

                currentRunType="+"          #thats why we change the run type

                runCount+=1                 #and increment the run count

            #there is not a else block because

            #if current run type is up we are continuing the run and there is no change in the run type

        else:                               #if previous number is greater than the current element

            if(currentRunType=="+"):        #if it is running up that means now it started to run down

                currentRunType="-"          #so we change the run type and increment the counter

                runCount+=1

            #there is not a else block because

            #if current run type is down we are continuing the run and there is no change in the run type

    else:                                   # if we are checking the first 2 elements then this else block runs

        if(num>copyrandomNumbers[i-1]):

            currentRunType="+"

        else:

            currentRunType="-"

        runCount+=1

meana=((2\*len(randomNumbers))-1)/3          #mean of a

vara=((16\*len(randomNumbers))-29)/90        #variance of a

z=1.96                                      #z value that we need to compare with

z0=(runCount-meana)/math.sqrt(vara)

if (z0>-z and z0<z):

    print("numbers are independent for alpha level of 0.05")

else:

    print("numbers are not independent for alpha level of 0.05")

print("z = ",z)

print("z0 = ",z0)

random numbers generated with these parameters(𝑋0 = 123457 ,𝑎 = 75,𝑐 = 0,𝑚 = 231 − 1):

0.662, 0.212, 0.396, 0.317, 0.85, 0.786, 0.731, 0.977, 0.926, 0.004, 0.009, 0.312, 0.394, 0.587, 0.97, 0.379, 0.882, 0.927, 0.31, 0.221, 0.407, 0.927, 0.127, 0.192, 0.72, 0.88, 0.819, 0.772, 0.078, 0.769, 0.057, 0.547, 0.805, 0.122, 0.404, 0.144, 0.699, 0.424, 0.052, 0.067, 0.056, 0.159, 0.683, 0.253, 0.332, 0.592, 0.379, 0.226, 0.726, 0.12, 0.158, 0.872, 0.469, 0.913, 0.688, 0.295, 0.306, 0.829, 0.318, 0.72, 0.854, 0.317, 0.021, 0.541, 0.792, 0.314, 0.226, 0.838, 0.467, 0.175, 0.456, 0.219, 0.047, 0.858, 0.651, 0.489, 0.799, 0.034, 0.378, 0.117, 0.921, 0.956, 0.74, 0.196, 0.257, 0.529, 0.49, 0.715, 0.715, 0.932, 0.701, 0.824, 0.842, 0.775, 0.322, 0.917, 0.321, 0.266, 0.217, 0.484

3)

numbers are uniform for alpha level of 0.05

d𝛼 = 0.136

d = 0.09100000000000003



4)

numbers are independent for alpha level of 0.05

z = 1.96

z0 = 0.8776161218256837

