Aral Açıkalın 20161701036

Project 5

CODE:

```python
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 sto
re all d+ values
dnegatives=[]                                       #array to sto
re 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 ne
ed -1 here
```

```python
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 th
is 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
```

```python
            #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 t
he current element

            if(currentRunType=="+"):           #if it is running up that means now i
t 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 n
o change in the run type

    else:                                      # if we are checking the first 2 elem
ents 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

$d\alpha$ = 0.136

d = 0.09100000000000003

```
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

```
numbers are independent for alpha level of 0.05
z =  1.96
z0 =  0.8776161218256837
```