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CmpE 343: Introduction to Probability and Statistics for Computer Engineers (Fall 2019)
Bonus Homework
SOLUTIONS

1) *Generating a random sample of* π *values* ;

Random.py (~/Desktop/cmpe343) - gedit

Open

```
def get_pi_values(numberofsamples):
#Monte Carlo Experiment
        counter = 0
        for i in range(numberofsamples):
            # Generating uniform random number in the interval [A,B]
            A = -1
            B = +1
            x = (B-A)*np.random.rand() + A
            y = (B-A)*np.random.rand() + A
            if (x**2 + y**2) < 1:
                counter += 1
        return (4*(float(counter)/float(numberofsamples)))
pi_values=[]
numberofpi=input("Enter number of pi : ")
numberofsamples=input("Enter number of samples (X,Y) : ")
for i in range(numberofpi):
        pi_values.append(get_pi_values(numberofsamples)) #add pi_values
print("Random sample of pi values: " + str(pi_values))

#find sample mean
sum_m = 0
for i in range(numberofpi):
        sum_m = sum_m + pi_values[i]
sample_mean=sum_m/numberofpi
print("Sample mean : %f" % sample_mean)

#find sample variance
sum_v = 0
for i in range(numberofpi):
        sum_v = sum_v + ((pi_values[i]-sample_mean)**2)
sample_variance=sum_v/(numberofpi-1)
print("Sample variance : %f" % sample_variance)
```

```
alibatir@alibatir-UX330UAK:~/Desktop/cmpe343$ python Random.py
Enter number of pi : 5
Enter number of samples (X,Y) : 100000
Random sample of pi values: [3.15072, 3.1374, 3.14292, 3.13996, 3.1352]
Sample mean : 3.141240
Sample variance : 0.000036
```

2)

Let take , the number of sample (X,Y) is 100,000.

If the number of sample of π values is 5 and samples of π values = [3.15072 , 3.1374 , 3.14292 , 3.13996 , 3.1352], then the **sample mean** of π values;

$$\overline{\mathrm{X}} = \frac{1}{n}\sum_{i=1}^{5} X_i = \frac{3.15072 + 3.1374 + 3.14292 + 3.13996 + 3.1352}{5} = 3.14124$$

The **sample variance** of π values;

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{5}(X_i - \overline{\mathrm{X}})^2$$

$$= \frac{(0.00948)^2 - (0.00384)^2 + (0.000168)^2 - (0.00128)^2 - (0.00604)^2}{4}$$

$$= 0.000036$$

3)

Hypothesis Testing

Null hypothesis → H_0 : $\mu = 3.2$

Alternative hypothesis → H_1 : $\mu \neq 3.2$

$S = \sqrt{S^2} = \sqrt{0.000036} = 0.006$ $n = 5$ $v = n - 1 = 4$

Find the critical region ; $t > t_{\alpha/2}$ $t < -t_{\alpha/2}$

$\alpha = 0.05$ $\alpha/2 = 0.025$ $t_{0.025} = 2.776$ *and* $-t_{0.025} = -2.776$

Test statistic ;

$$t = \frac{\bar{X} - \mu}{s/\sqrt{n}} = \frac{3.14124 - 3.2}{0.006/\sqrt{5}} = -21.898$$

Since the value of test statistic is smaller than -2.776, we reject null hypothesis.

We do not accept the claim because we reject H_o.