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Math 855 - Prob w/ Applications

HW4

In [ ]:
```
from scipy.stats import norm, expon
from numpy.random import rand
from numpy import log
```

1. A line segment of length 1 is cut once at random.

What is the probability that the longer piece is more than twice the length of the shorter piece?

In [ ]:
```
class String():
    def __init__(self):
        self.len1 = rand()
        self.len2 = 1 - self.len1
        self.pieces = [self.len1, self.len2]
        self.longer = max(self.pieces)
        self.shorter = min(self.pieces)

    def compare(self):
        if (self.longer / 2) > self.shorter:
            return True
        else:
            return False

    def next(self):
        self.__init__()
        return self.compare()

class Experiment:
    def __init__(self, object, iter_per_round, rounds_per_exp):
        self.object = object()
        self.iter_per_round = iter_per_round
        self.rounds_per_exp = rounds_per_exp

    def round(self):
        # object executes iter of exp in list
        results = [self.object.next() for i in range(self.iter_per_round)]

        # results are bools, so should sum
        n_success = sum(results)

        # prop of successes
        return n_success / self.iter_per_round

    def do_exp(self):
        rounds = [self.round() for j in range(self.rounds_per_exp)]
        return sum(rounds) / self.rounds_per_exp

exp = Experiment(String, 1000, 100)
```

In [ ]:
```
# 37 is also solved on "paper"
exp.do_exp()
```

Out[ ]:
```
0.6652499999999999
```

1. Suppose that the lifetime of an electronic component follows an exponential distribution with λ = .1.

a. Find the probability that the lifetime is less than 10.

b. Find the probability that the lifetime is between 5 and 15.

c. Find t such that the probability that the lifetime is greater than t is .01.

In [ ]:
```
# defining terms
λ = 0.1
expon_45a = 10
expon_45b = [5, 15]

# the exponential function in scipy uses 1 / λ as the scale term for this funct
# for reference see https://docs.scipy.org/doc/scipy/reference/generated/scipy.
scale = 1 / λ
```

In [ ]:
```
expon_45a_cdf = expon.cdf(10, scale=scale)
expon_45b_cdf = expon.cdf(15, scale=scale) - expon.cdf(5, scale=scale)

lim = 0.01
t_scale = 10000
# I honed in on the value using larger steps and manually changed the range for

print(f"45a | The prob that t is less than {expon_45a} is {round(expon_45a_cdf,
print(f"45b | The prob that t is between {expon_45b} is {round(expon_45b_cdf, 4


for i in range(45 * t_scale, 50 * t_scale):
    t = i / t_scale
    t_prob_less = expon.cdf(t, scale=scale)
    t_prob_more = 1 - t_prob_less
    if t_prob_more < lim:
        print(f"45c | The prob of lifetime greater than {lim} occurs when t = {
        break
```

```
45a | The prob that t is less than 10 is 0.6321
45b | The prob that t is between [5, 15] is 0.3834
45c | The prob of lifetime greater than 0.01 occurs when t = 46.0518
```

1. T is an exponential random variable, and P(T < 1) = .05. What is λ?

In [ ]:
```
# please see written submission for work
λ = -log(0.95)
print("46 | λ =", λ)
```

```
46 | λ = 0.05129329438755058
```

1. Suppose that in a certain population,individuals' heights are approximately normally

distributed with parameters μ = 70 and σ = 3 in. a. What proportion of the population is over 6 ft. tall? b. What is the distribution of heights if they are expressed in centimeters? In meters?

In [ ]:
```
print("We've got ourselves a classic normal distribution problem!")
mean = 70
stddev = 3
units_in = [mean, stddev]
units_cm = [x * 2.54 for x in units_in]
units_m = [y / 100 for y in units_cm]

prop_under_72 = norm.cdf(72, loc=mean, scale=stddev)
prop_over_72 = 1 - prop_under_72
prop_over_72

# the distribution of heights is the same but with converted units
print(f"52a | The prop of the pop over 6ft tall is {round(prop_over_72, 4)}")
print(f"52b | The distribution expressed in cm is N({units_cm})")
print(f"52b | The distribution expressed in m is N({units_m})")
```

```
We've got ourselves a classic normal distribution problem!
52a | The prop of the pop over 6ft tall is 0.2525
52b | The distribution expressed in cm is N([177.8, 7.62])
52b | The distribution expressed in m is N([1.778, 0.0762])
```