Assignment #9

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10/24/2021

# Problem 1

The price of one share of stock in the Pilsdorff Beer Company (see Exercise 8.2.12) is given by on the th day of the year. Finn observes that the differences appear to be independent random variables with a common distribution having mean and variance . If , estimate the probability that is

## A) 100

# Data  
y\_1 <- 100  
mu <- 0  
var <- 1/4  
sd <- sqrt(var)  
y\_365 <- 100  
x\_a <- (y\_365 - y\_1) / sqrt(365-1)  
  
a\_result <- pnorm(x\_a, mean = mu, sd = sd, lower.tail=F)  
a\_result

## [1] 0.5

## B) 110

y\_365 <- 110  
x\_b <- (y\_365 - y\_1) / sqrt(365-1)  
b\_result <- pnorm(x\_b, mean = mu, sd = sd, lower.tail=F)  
b\_result

## [1] 0.1472537

## C) 120

y\_365 <- 120  
x\_c <- (y\_365 - y\_1) / sqrt(365-1)  
c\_result <- pnorm(x\_c, mean = mu, sd = sd, lower.tail=F)  
c\_result

## [1] 0.01801584

## Problem 2

Calculate the expected value and variance of the binomial distribution using the moment generating function.

### Binomial Random Variable

The mean and the variance of a random variable X with a binomial probability distribution can be difficult to calculate directly. Although it can be clear what needs to be done in using the definition of the expected value of X and X2, the actual execution of these steps is a tricky juggling of algebra and summations. An alternate way to determine the mean and variance of a binomial distribution is to use the moment generating function for X.

Start with the random variable X and describe the probability distribution more specifically.

Perform n independent Bernoulli trials, each of which has probability of success p and probability of failure 1 - p.

Thus the probability mass function is

Here the term denotes the number of combinations of n elements taken at a time, and x can take the values 0, 1, 2, 3, . . ., n.

### MGF - Moment Generating FUnction

Use this probability mass function to obtain the moment generating function of X:

Let X ~ Binom(n,p) then,

where np = u and t = 0

Second derivative to obtain

### Variance

Thus,