

ECE 341 - Homework #8

Gamma, Poisson, & Normal Distributions. Summer 2024

Gamma Distributions

Let A be an exponential distribution with a mean of 30 seconds

The time until the next customer arrives

Let B be the time until three customers arrive (B has a gamma distribution)

1) Determine the pdf for B using LaPlace transforms.

- From your results, determine the pdf at $B=20$

2) Determine the pdf of B using convolution

- From your results, determine the pdf at $B = 20$

Poisson Distributions

3) Determine the probability that 3 customers will arrive within 60 seconds ($0 < t < 60$)

- Using moment generating functions
- Using convolution

4) In D&D, you do double damage (critical hit) if you roll a natural 20 on a 20-sided die ($p = 5\%$).

- Using a binomial pdf, determine the probability of rolling a natural 20 ten times in thirty rolls
- Using a Poisson approximation, determine the probability rolling a natural 20 ten times in thirty rolls.

Normal Distribution

- Let x be a random number from a normal distribution with a mean of 15 and a standard deviation of 5
- Let y be a random number from a normal distribution with a mean of 10 and a standard deviation of 6
- Let z be a random number from a normal distribution with a mean of 5 and a standard deviation of 7

5) Let $F = x + y$. Determine the probability that $F > 30$

- a) Using a z-score
- b) Using a Monte-Carlo simulation with 100,000 samples of F

6) Let $G = x + y + z$. Determine the probability that $G > 40$

- a) Using a z-score
- b) Using a Monte-Carlo simulation with 100,000 samples of G

In Matlab: use `randn` (standard normal). multiply by the standard deviation, add the mean

```
x = randn*5 + 15;  
y = randn*6 + 10;  
z = randn*7 + 5;  
F = x + y;  
G = x + y + z;
```