Tutorial 2

Here's an extended tutorial with example problems and detailed solutions for each topic using MATLAB.

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1. Binomial Distribution Problem

Problem: A fair die is rolled 10 times. What is the probability of getting exactly 3 sixes?

Solution

The probability of rolling a six on a fair die is p=1/6, the number of trials n=10, and the desired number of successes k=3.

MATLAB Code:

matlab

```
n = 10; % Number of trials

p = 1/6; % Probability of rolling a six

k = 3; % Number of successes


% Calculate the probability using binopdf

probability = binopdf(k, n, p);

disp(['Probability of getting exactly 3 sixes: ', num2str(probability)]);
```

Explanation:

- binopdf(k, n, p) computes the probability of getting k successes in n trials.

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2. Gaussian (Normal) Distribution Problem

Problem: The height of adult males in a certain region is normally distributed with a mean of 175 cm and a standard deviation of 10 cm. What is the probability that a randomly selected male is taller than 180 cm?

Solution

We need to find P(X>180), where X is a normal random variable with mean μ=175 and standard deviation σ=10.

MATLAB Code:

matlab

```
mu = 175; % Mean
```

sigma = 10; % Standard deviation

x = 180; % Value to compare

% Calculate the probability using normcdf

probability = 1 - normcdf(x, mu, sigma);

disp(['Probability of being taller than 180 cm: ', num2str(probability)]);

Explanation:

- normcdf(x, mu, sigma) computes the cumulative probability up to x, so we subtract from 1 to get P(X>180).

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3. Poisson Distribution Problem

Problem: A call centre receives an average of 5 calls per hour. What is the probability of receiving exactly 8 calls in an hour?

Solution

Here, the average rate λ=5, and we want to calculate the probability of 8 calls.

MATLAB Code:

matlab

lambda = 5; % Average rate of calls per hour

k = 8; % Number of calls

% Calculate the probability using poisspdf

probability = poisspdf(k, lambda);

disp(['Probability of receiving exactly 8 calls: ', num2str(probability)]);

Explanation:

- poisspdf(k, lambda) gives the probability of observing k events in a given interval when the average rate is λ.

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4. Bernoulli Distribution Problem

Problem: Suppose the probability of a light bulb being defective is 0.02. If you test 100 light bulbs, what is the probability that none of them are defective?

Solution

We use the Bernoulli distribution with p=0.02 for 100 independent trials.

MATLAB Code:

matlab

```
p = 0.02; % Probability of a bulb being defective
n = 100; % Number of bulbs

% Calculate the probability of no defective bulbs using the binomial formula
probability = binopdf(0, n, p);
disp(['Probability that none of the bulbs are defective: ', num2str(probability)]);
```

Explanation:

- binopdf(0, n, p) computes the probability of 0 successes in 100 trials with a success probability of 0.02.

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5. Probability Mass Function (PMF), PDF, and CDF Problem

Problem: Simulate and plot the PMF and CDF for a binomial distribution with n=5 and p=0.3.

Solution

We generate the PMF and CDF using MATLAB functions and plot them.

MATLAB Code:

matlab

```
n = 5; % Number of trials
p = 0.3; % Probability of success
k = 0:n; % Possible outcomes

% Calculate PMF and CDF
pmf = binopdf(k, n, p);
cdf = binocdf(k, n, p);

% Plot PMF
figure;
subplot(1, 2, 1);
stem(k, pmf, 'filled');
```

```
title('Binomial PMF');
xlabel('Number of Successes');
ylabel('Probability');

% Plot CDF
subplot(1, 2, 2);
stairs(k, cdf);
title('Binomial CDF');
xlabel('Number of Successes');
ylabel('Cumulative Probability');
```

Explanation:

- binopdf() computes the PMF, and binocdf() computes the CDF.
- stem() creates a stem plot for discrete probabilities, and stairs() plots the CDF.
