Student Information

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Answer 1

a)

In this question, our goal is to create a list which includes random variables with given distributions using rand function, and then find some probabilities and estimations. Actually, we are generating some random variables by using rand function, and implementing its variables correctly such as lambda, alpha. Our α is $1 - 0.98 = 0.02$, and we use $\alpha/2 = 0.01$ to calculate N:
So here

$$N \geq 2.3263 \cdot \frac{2.3263}{0.03 \cdot 0.03} \cdot 0.25 \rightarrow N \geq 1503.3$$

So we can choose N as 1504.

```
N = 1504;
lambda1 = 50;
lambda2 = 40;
lambda3 = 25;
TotalWeight = zeros(N,1);
for k=1:N;
    U = rand;
    i = 0;
    F = exp(-lambda1);
    while (U >= F);
    i = i + 1;
    F = F + exp(-lambda1) *lambda1 ^i/gamma(i+1);
    end;
    Y=i;
    weight = 0;
    for s=1:Y;
        X = sum( -1/0.1 *log(rand(60,1)) );
        weight += X;
    end;

    U = rand;
    i = 0;
    F = exp(-lambda2);
    while (U >= F);
```

```
    i = i + 1;
    F = F + exp(-lambda2) *lambda2 ^i/gamma(i+1);
    end;
    Y=i;
    for s=1:Y;
        X = sum( -1/0.05 *log(rand(100,1)) );
        weight += X;
    end;

    U = rand;
    i = 0;
    F = exp(-lambda3);
    while (U >= F);
    i = i + 1;
    F = F + exp(-lambda3) * lambda3 ^i/gamma(i+1);
    end;
    Y=i;
    for s=1:Y;
        X = sum( -1/0.02 * log(rand(120,1)) );
        weight += X;
    end;
    TotalWeight(k) = weight;
end;
p_est = mean(TotalWeight>300000);
weightEst = mean(TotalWeight);
stdWeight = std(TotalWeight);
fprintf('Estimated probability = %d\n', p_est);
fprintf('Expected weigh = %d\n', weightEst);
fprintf('Standard deviation = %d\n', stdWeight);
```

And, here is the results:

```
Estimated probability = 0.107119
Expected weigh = 258604
Standard deviation = 32485.1
```

b)

In this section we used mean function in Octave which is used for calculating mean. It sums all elements in the list, and then divides this by length of the list.

Also, we can calculate it as: Expected number of bulk carriers=50
Expected cargo per each bulk carrier= $\dfrac{60}{0.1} = 600\text{tons}$

$$50 * 600 = 30000$$

Expected number of container ships=40

Expected cargo per each container ship=$\frac{100}{0.05} = 2000$

$$40 * 2000 = 80000$$

Expected number of oil tankers=25

Expected cargo per each bulk carrier = $\frac{120}{0.02} = 6000$

$$25 * 6000 = 150000$$

260000 is the calculated total weight. It is approximately the same as our estimation value.

c)

Code estimation, Std(X)=32485.
Due to the high standard deviation compared to the mean, this estimation can be seen as not accurate. As the standard deviation increases, the range of possible values also increases, resulting in decreased accuracy. In this case, since our standard deviation is high, we cannot make a precise estimation for a day. It can be vary significantly from day to day.

Comments

In a Monte Carlo study, we simulate the distributions mentioned in the question: Poisson and gamma distributions. The number of simulations is determined by the variable N, which represents the count of the outer loop.

First, we generate a random variable Y from the Poisson distribution, which represents the number of ships. Then, for each type of ship, we generate another random variable from the gamma distribution with the given parameters (alpha and lambda), representing the cargo weight.

We repeat this process for all three types of ships and sum up the weights in a variable called "weight." Finally, we store these weights in a list to calculate probabilities and make estimations. The purpose of this study is to generate a large number of random variables and simulate real-life scenarios.