Stat 235

Lab 3

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Lab EL12

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1

As λ increases, the distribution shifts to the right, since λ is the mean value of the distribution. We also see that as this distibution shifts to the right, the curve flattens as a result of the mean probability decreasing while the spread increases. Since Poisson distributions measure the number of successes in an interval, and in this case a "success" is a flaw in a plastic panel, we can clearly see that as λ increases, the number of flaws in the plastic panels also increase.

2

2.a

Assuming $\lambda = 0.5$, the probability that there are no flaws in a randomly selected panel is $P(X = 0)$. Using the *Poisson Probabilities* worksheet, we find this number to be 0.6065, or 60.65% of the panels are in perfect condition

2.b

The percentage of panels with 2 or more flaws can be found as shown below:

$$P(X \geq 2) = 1 - P(X < 2) = 1 - P(X \leq 1)$$

Using the *Poisson Probabilities* worksheet, we find $P(X \leq 1) = 0.9098$, so

$$P(X \geq 2) = 1 - 0.9098 = 0.0902$$

So, 9.02% of the panels would need to be scrapped.

2.c

From 2.b, we know the probability of a single panel not being defective is $P(X \leq 1) = 0.9098$. For ten panels,

$$P(X \leq 1)^{10} = 0.9098^{10} = 0.38856110447...$$

Therefore, the probability that a random sample of 10 panels not containing a defective panel is approximately 0.389.

3

From in-class notes, the Central Limit Theorem states the following:

Central Limit Theorem. *When n is sufficiently large, the sampling distibution of $\bar{x}$ is well approximated by a normal curve, even when the population distibution is not itself normal. The Central Limit Theorem can safely be applied if n is at least 30.*

Note: For Question 3, $\lambda = 0.5$

3.a

Referring to the Central Limit Theorem as defined above, we cannot safely assume that the sampling distribution of the average number of flaws in a random sample of 10 panels follows approximately a normal distribution. The Central Limit Theorem states that it can only be safely applied when the sample size is greater than or equal to 30.

If we were to assume that the Central Limit Theorem does apply, however, the probability that the average number of flaws in a random sample of 10 panels does not exceed 0.3 is found as follows:

$$\sigma^2 = \lambda \Rightarrow \sigma = \sqrt{\lambda} = \sqrt{0.5} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{1/\sqrt{2}}{\sqrt{10}} = \frac{1}{\sqrt{20}} \approx 0.2236$$

Plugging in λ, and $\sigma_{\bar{x}}$ into the *Normal Probabilities Sheet*, we find that $P(X \leq 0.30) = 0.1855$.

3.b

We can safely assume that the sampling distribution of the average number of flaws in a random sample of 30 panels follows approximately a normal distribution, because a sample size of 30 satisfies the condition in the Central Limit Theorem which requires a sample size greater than or equal to 30.

Assuming that the Central Limit Theorem does applies, the probability that the average number of flaws in a random sample of 30 panels does not exceed 0.3 is found as follows:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{1/\sqrt{2}}{\sqrt{30}} = \frac{1}{\sqrt{60}} \approx 0.129$$

Plugging in λ, and $\sigma_{\bar{x}}$ into the *Normal Probabilities Sheet*, we find that $P(X \leq 0.30) = 0.0607$.

4 CHECK TO SEE IF YOUR RANDOM NUMBERS ARE GOOD

4.a

Using the built in COUNTIF function, we find the number of perfect panels to be 382. So, the percentage of perfect panels can be found as follows:

$$\frac{362}{600} \times 100 = 0.60333333...\%$$

Therefore, about 60.33% of the panels are in perfect condition. Compared with the value obtained in 2.a (60.65%), it is pretty close. However, it would be unrealistic to expect that these two values are identical, since the value obtained in 2.a is a theoretical value for an infinite number of trials, while the number obtained here is for a finite amount of plastic panels.

4.b

Using the built in COUNTIF function, we find the number of non defective panels to be 230. So, the percentage of perfect panels can be found as follows:

$$\frac{230}{600} \times 100 = 0.38333333...\%$$

Therefore, about 38.33% of the panels are not defective. Compared with the value obtained in 2.c (38.86%), it is pretty close. However, it would be unrealistic to expect that these two values are identical, since the value obtained in 2.c is a theoretical value for an infinite number of trials, while the number obtained here is for a finite amount of plastic panels.

4.c

q4.png

Figure 1: INSERT CAPTION HERE

4.d

5

5.a

q5.png

Figure 2: INSERT CAPTION HERE

5.b