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| Power Supply Efficiency |

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A PC parts store is interested in buying 2 power supplies for comparison and will then decide which one they will go to build PCs with. Their local retailer carries two brands with 3 coming from ASUS and 2 coming from Corsair. This subset contains all the different options available.

These power supplies though, are all made differently. The store leans more towards those that are more power efficient. A1 has the highest average efficiency compared to the other two skews of the same brand, and C2 being a similar case. As a result, they are leaning more towards these two, but the price associated with such efficiency makes it a difficult choice. As a result, power supplies A2, A3, and C2 have all gone down 2% with A1 and C2 going up 3% each

The store has decided to go with the more power efficient ones of the five, A1 and C2. They have found that Corsair offers better warranty coverage, but at a higher cost. Asus power supply, on the other hand, offers better efficiency at idle as it is quieter than the one offered by corsair. As a result, they have decided to offer the choice to the consumer. When building a computer with their store, the consumer has an additional option to choose either A1 or C2. After a couple of months, they noticed that they needed to order more A1 power supplies than C2. As a result, when ordering parts, the store orders A1 50% of the time, while C2 orders 30% of the time, with the store needing to order both 10% of the time. The probability of the store needing to order A1 power supplies given that they have already ordered a supply of C2 power supplies is.

On the opposite, the store ordering C2 power supplies given they have already ordered A1 power supplies, using the same conditional probability formula, being 20%. Additionally, the probability of the store orders either or both power supplies is.

We can subtract 100% from this and conclude that the probability the store does not order any power supplies is 30%.

Only open on weekdays has offered to their customers to rent a power supply to evaluate whether they would like to commit to a specific model or brand. This option is not all too popular, but their customers are incredibly pleased with the option. After a couple of months with this option, it was found that on any given day, the chance that a power supply is rented is 1 in 5 or 20%. The retailer asked for a probability distribution of the number of days between a pair of rentals for their own information. The sequence of which can be represented with the following.

R = rental

N = no rental

Number of days between a pair of rentals = {(RR), (RNR), (RNNR),(RNNNR)}

We can then create a formula based on this information, which is the following:

Plugging in for numbers from 0 – 3 (days between rentals), we get the following.

The probability that several days between rentals moves downwards.

The store has a total of 10 different power supplies, each of which suit a different customer needs. Mainly, they keep 3 platinum efficient, 5 gold efficient, and 2 bronze efficient power supplies. Given that two customers walk into the store and purchase a power supply each, the store wants a joint probability function of them choosing either a gold (Y1) or platinum (Y2) efficient power supply. We could use the following equation to find the probability for each event occurring for (Y1, Y2)

|  |  |  |  |
| --- | --- | --- | --- |
| Y2/Y1->  |  v | 0 | 1 | 2 |
| 0 | 1/45 | 10/45 | 10/45 |
| 1 | 6/45 | 15/45 | 0 |
| 2 | 3/45 | 0 | 0 |

With the marginal distribution for Y1 being:

|  |  |  |  |
| --- | --- | --- | --- |
| Y1=y1 | 0 | 1 | 2 |
| PY1(y1) | 10/45 | 25/45 | 10/45 |

And Y2 being.

|  |  |  |  |
| --- | --- | --- | --- |
| Y2=y2 | 0 | 1 | 2 |
| PY2(y2) | 21/45 | 21/45 | 3/45 |

Using these numbers, we can check for dependency.

Where P (y1=0, y2=0) = P(y1=0) + P(y2=0)

So, they are dependent.

The shop has decided to run their own promotion for power supplies, where 3 platinum, 5 gold, and 7 bronze efficient power supplies are put into a bin and can be chosen at random to receive a 15% off discount. A guest can have a total of three tries, so the shop wants to find the probability that all three of the chosen power supplies are platinum efficient.

Using Hypergeometric

Thus the probability that a guest getting all three platinum in a row is 1/455 or .0022%

After running discount promotions and allowing customers to test power supplies, they have noticed that more customers have started visiting their stores. Before, customers would come and go, after 5 months though, the average went up to 7 and as a result, they have had to hire more staff to manage customers. The owner of the store wants to know the probability of at most 5 customers arriving at the check out, at least 2 customers arrive, and exactly 4 customers come to checkout, to plan staff accordingly.

As there has been a rise in customers, the power supplies the shop keeps in stock need to increase. The amount of power supplies sold in one day is a total of 5. Since the suppliers intend to go on strike for better wages, the shop needs information on how much they should stock up on power supplies so that the chance of running out of product is only .03.

Using Gamma Probability Distribution with:

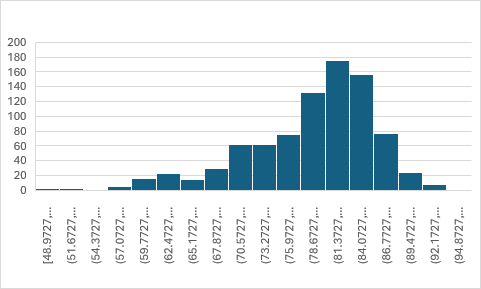
Corsair plans to introduce 5 newer model power supplies for the year 2024. To boast their performance, they have sent out review samples to other tech companies and those who specialize in tech to review and rate their performance. Using Cybenetic Labs database on power supply companies and their power supply performance (ignoring anything that scores below a 70% on total score), there is a 10% chance that a power supply scores around 86.77. With 5 new power supplies on their way, Sea sonic wanted to find the probability that 2 of their power supplies scored around 86.47. Using Binomial Distribution we receive the following:

Thus, the likelihood that two of the five power supplies they release will receive a score around 86.77 is 7.29%.

Going into 2025, Corsair plans to renew their previous power supplies for the new year. If the likely hood of a power supply receiving a score of around 81.37 is 23%, The company would like to know if their first power supply to receive this score would be their third power supply in the lineup. This can be solved using Geometric Distribution, as the equation goes:

As the probability of a power supply receiving a score of around 84 is 21%, Corsair is interested in the probability that the first power supply to receive this score would be found in their second power supply. Using Negative Binomial Distribution:

Cybenetics, the company responsible for creating the database of power supply efficiency, is interested in finding the mean, variance, standard deviation, and histogram for power supplies whose scores are above 70. Based on their findings we can create this histogram which outlines the total number of power supplies and their scores.



For the mean, we would just add all the scores above 70.

As for Variance

And Standard Deviation being the square root of variance, so:

With this information, Cybenetics wishes to know what percentage of power supplies fall between the 81.37 and 89.47 range.

Using the previous information, we can solve for k which is:

Now that we have solved for k, we can plug it into Tchebysheff’s theorem:

So, at minimum, 84% of the total data lies between scores of 81.37 and 89.47.

The company wanted similar data on noise rating, where noise can range from 9 and 51 dB(A). They want to calculate the probability that a randomly selected power supply has a noise rating between 12 and 24.

Using Uniform Probability Distribution to solve this:

Given a randomly selected power supply, the probability that it has a noise rating between 12 and 24 is .29 or 29%.

Sources:

<https://www.cybenetics.com/index.php?option=psu-performance-database>

Dennis D. Wackerly, W. M. I., &. Richard L. Scheaffer. (2002). *Mathematical statistics with applications*. Duxbury/Thomson Learning.