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CORE CONCEPT OF

BUSINESS MATHMATICS & STATISTICS

1. What is the Chebyshev's Theorem?
2. Briefly illustrate Empirical Rule?
3. What is the Cyclical Fluctuation?
4. Illustrate the Seasonal Variation.
5. Briefly describe the Trend or Secular Trend.

Chebyshev's Theorem and the Empirical Rule

It allows us to estimate the answers for intervals that are symmetrical about the mean. (That means the same distance on both sides of the mean, like the donut example, but not like the phone call example.).

Chebyshev's Theorem tells us that no matter what the distribution looks like, the probability that a randomly selected values is in the interval

$$\mu \pm k\sigma$$

is at least _

$$[100(1-1/k^2)]\ \%$$

Example:

Suppose a distribution has mean $\mu = 17.4$ and standard deviation $\sigma = 3.2$.

What does Chebyshev's Theorem tell us about the probability a randomly selected value is between 12.6 and 22.2 ?

Answer:

The values $x = 12.6$ and $x = 22.2$ correspond to $z = -1.5$ and $z = 1.5$. So the

interval can be written as $\mu - 1.5\sigma$ to $\mu + 1.5\sigma$, or as $\mu \pm 1.5\sigma$.

Chebyshev's Theorem now tells us that the probability is at least

$$[100(1-1/k^2)]\ \%$$

$$[100(1-1/1.5^2)]\ \% = 55.56\%$$

Example:

Suppose a distribution has mean $\mu = 111$ and standard deviation $\sigma = 7.6$. If

Chebyshev's Theorem tells us that 81.1% of the values are between a and b (symmetrical about the mean), then what are these limits?

Answer:

First we note that:

$$[100(1-1/k^2)]\ \% = 81.1\%$$

and if we solve this for k we get k = 2.3. That means the limits are 2.3 standard deviations below the mean to 2.3 standard deviations above the mean.

$$a = 111 - 2.3 \cdot 7.6 = 93.52$$

$$b = 111 + 2.3 \cdot 7.6 = 128.48$$

Finally, the **Empirical Rule** applies only **when the distribution is bell shaped**. Because we have more information about the shape of the distribution, we can be more certain of our predictions and the percentages are higher than Chebyshev's Theorem gives us.

The **Empirical Rule** tells us that for a bell-shaped distribution approximately 68% of

the values will be within 1 standard deviation, 95% will be within 2 standard deviations and 99.7% will be within 3 standard deviations of the mean.