


Methods for Describing Sets of Data

2.6 Chebyshev's Theorem

1. In 1997, the Bureau of Labor Statistics conducted a survey which revealed that the average annual expenditure on eating out was \$1,477 per family. The standard deviation was approximately \$520. In 1997, what was the minimum percent of families who spent between \$450 and \$2504?
2. In July of 2011, the average age of cars on the road in the US was a record high of 11.1 years old. The standard deviation of car ages was 3.2 years old. If nothing is known about the shape of the distribution, give an interval of car ages that will contain the ages of at least 88.9% of car ages.  [VS](#)
3. Using the same information from the US auto problem above, find the percent of cars on US roads in July of 2011 that were under 3 years old (recall: $\mu = 11.1$ and $\sigma = 3.2$).
4. A study conducted by LifeStyles Condoms found an average penis length of 5.9 in (14.9 cm) with a standard deviation of 0.8 in (2.1 cm) (measured by staff). The purpose of this study was to ensure properly sized condoms were available. Based on the data, what can you say about the percent of the male population with a penis length longer than 7 inches?
5. Penile circumference was measured in the Cancún LifeStyle study, in which the circumference of the shaft was measured at three points (base, mid-shaft, and just below the head) and then averaged. They found an average of 4.972 inches (12.63 cm) with a standard deviation of 0.5 in (1.3 cm). What is the maximum percent of men with a penis circumference less than 3 inches?

Answers:

1. $K = 1.975$, so **at least 74.4%** of the families would have spent between \$450 and \$2504.
2. Solve $1 - \frac{1}{k^2} = 0.889$ for K to get $K = 3$, then fill in $[\mu - 3\sigma, \mu + 3\sigma] = [1.5 \text{ yrs}, 20.7 \text{ yrs}]$

3. Since 3 is 8.1 from the mean 11.1, we add 8.1 to 11.1 to get 19.2. Our interval is then $[3, 19.2]$ using our formula for k we get $k = 2.53125$, so 84.4% is inside the interval. That means **at most** $100\% - 84.4\% = 15.6\%$ are under 3 yrs old.

4. Seven is 1.1 inch above average, so the interval $[4.8, 7]$ is symmetric around the mean. K is 1.375 for this interval, so at least 47% of men are within this span. Therefore, **at most 53%** are outside of that range (note: here we see the limitations of Chebyshev's THM. At most 53% is anywhere from 0 to 53%. Assuming normality applies, the actual percentage would be close to 8.5%).

5. Three inches is 1.972 below average so adding that amount to the mean gives us an interval surrounding the mean of $[3, 6.944]$. This interval would capture at least 93.6% of men. That leaves **at most 6.4%** less than 3 inches in circumference (or simply outside of the interval).