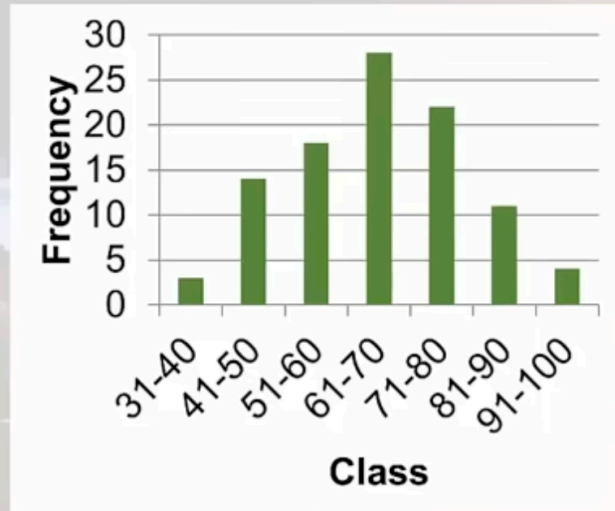


## 7.1 Normal Distribution and Empirical rule

### Normal Distribution

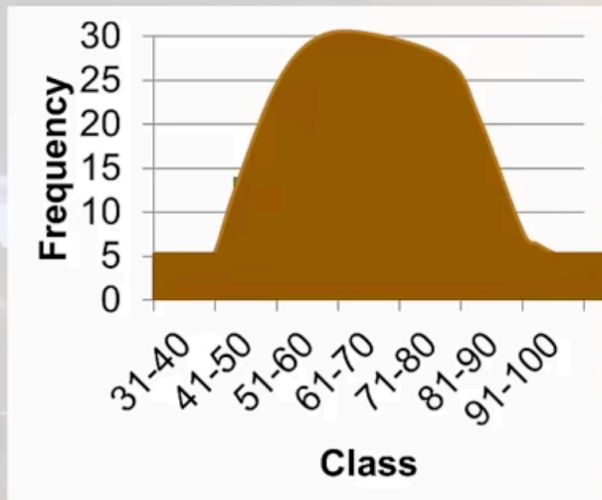
#### Remember the Normal Distribution?

- Imagine a large class ( $n=100$ ) takes a very difficult test
- The test is worth 100 points, but it's so hard, no one actually gets 100 points
- Instead, the mode is near a C grade



#### Properties of the Normal Curve

1. The curve is bell-shaped, with the highest point over the mean.
2. The curve is symmetrical around a vertical line through the mean.
3. The curve approaches the horizontal axis but never touches or crosses it.
4. The inflection (transition) points between cupping upward and downward occur at about mean  $\pm 1$  sd
5. The area under the entire curve is 1 (think: 100%).



### Empirical Rule

# Remember Chebyshev?

- Intervals have boundaries, or limits: lower limit and upper limit.
- Remember Chebyshev Intervals?
  - They say, “At least \_\_\_\_% of the data fall in the interval.”
  - When lower limit was  $\mu - 2\sigma$ , and upper limit was  $\mu + 2\sigma$ , at least 75% of the data were in the interval.
- Imagine  $n=100$  students,  $\mu$  score on test 65.5,  $\sigma = 14.5$ 
  - Lower limit:  $65.5 - (2 \times 14.5) = 36.5$
  - Upper limit:  $65.5 + (2 \times 14.5) = 94.5$
  - So if you had 100 data points, *at least* 75 would be between 36.5 and 94.5.

## Chebyshev vs. Empirical Rule

### Chebyshev's Theorem

1. Applies to any distribution
2. Says “at least”
  - between  $\mu \pm 2\sigma$ , there are **AT LEAST** 75% of the data
  - between  $\mu \pm 3\sigma$  is at least 88.9%
  - between  $\mu \pm 4\sigma$  is at least 93.8%

### Empirical Rule

1. Applies to **ONLY** the normal distribution
2. Says “approximately”
  - 68% of the data are in interval  $\mu \pm 1\sigma$
  - 95% in interval  $\mu \pm 2\sigma$
  - 99.7% (almost all) in interval  $\mu \pm 3\sigma$

# Empirical Rule Diagram

