



# Section 7.2 – How Close are Sample Means to Population Means?

The Sampling Distribution for Means

# Review: Section 7.1

- How do we summarize categorical data?
  - With proportions.
- Recall that sample proportions vary in a predictable way.
  - The sampling distribution of  $\hat{p}$  is
    - Normally distributed
    - Mean is  $p$
    - Standard error is  $\sqrt{\frac{p(1-p)}{n}}$

# Main Idea of Section 7.2

- How do we summarize quantitative data?
  - Typically with a mean.
- How do sample means vary in repeated samples?
  - TBD

# Sample Means

- When working with a quantitative variables the most common statistic computed is the *sample mean*.
- We will denote the **sample mean** by  $\bar{x}$  (read "x bar").
- The **mean for the population** will be denoted by  $\mu$  ("mu").
- The **standard deviation for the population** will be denoted by  $\sigma$  ("sigma").

# Practice with Notation

**Example:** Suppose that the average age of all Ship undergraduates is 20.6 years. You randomly sample 25 students and find that their average age is 19.2 years.

- What is the variable of interest?
- Is it quantitative or categorical?
- What is the appropriate symbol for 20.6?  
19.2?

# Central Limit Theorem

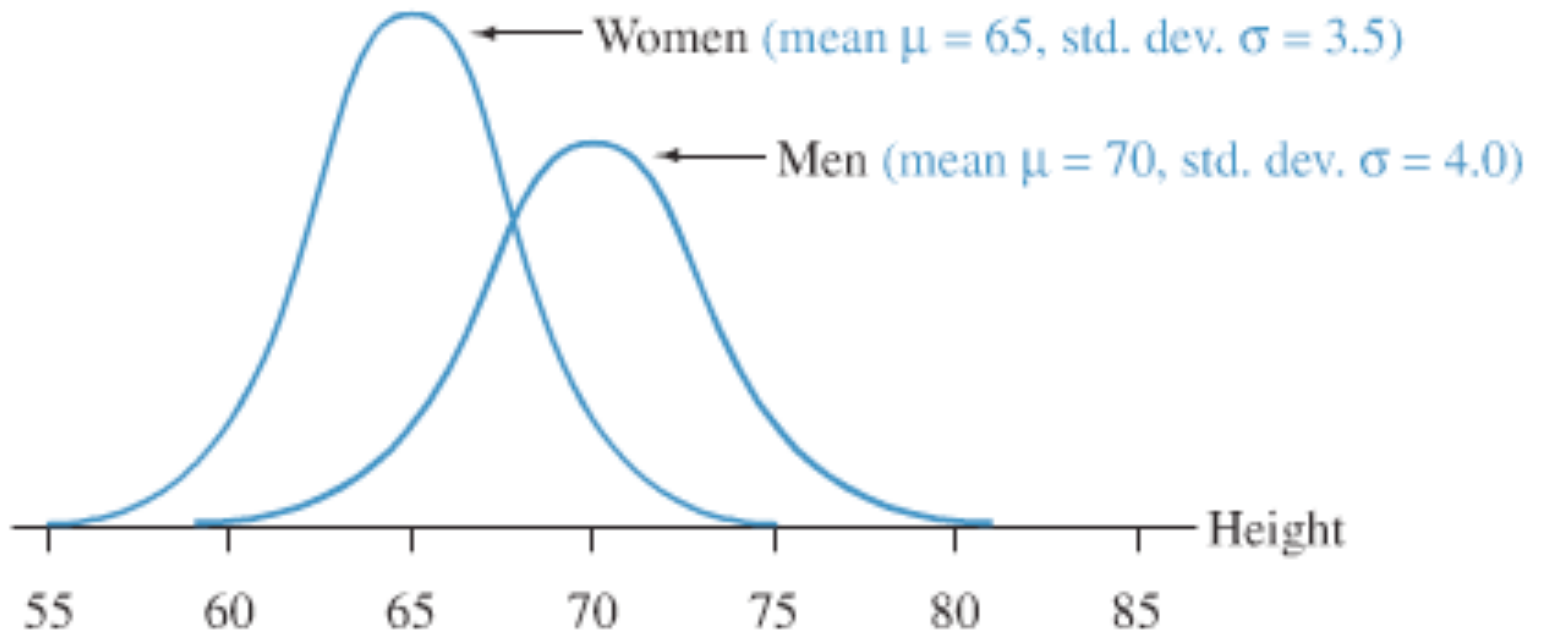
- If our sample size is  $n$  and the population mean is  $\mu$  and population standard deviation  $\sigma$ , then provided  $n > 30$ ,
  - the **sampling distribution for the sample means**,  $\bar{x}$ , is normal with mean  $\mu$  and standard deviation  $\frac{\sigma}{\sqrt{n}}$
- The standard deviation for the sampling distribution is known as the **standard error**.
- The larger the sample, the less variability we will have.

# Example 1

Suppose that you know that the average age of all Ship undergraduates is 20.8 with a standard deviation of 1.5. What's the probability that a random sample of 35 SU undergrads will have a ...

- ... mean age of no more than 20?
- ... mean age of 23 or greater?

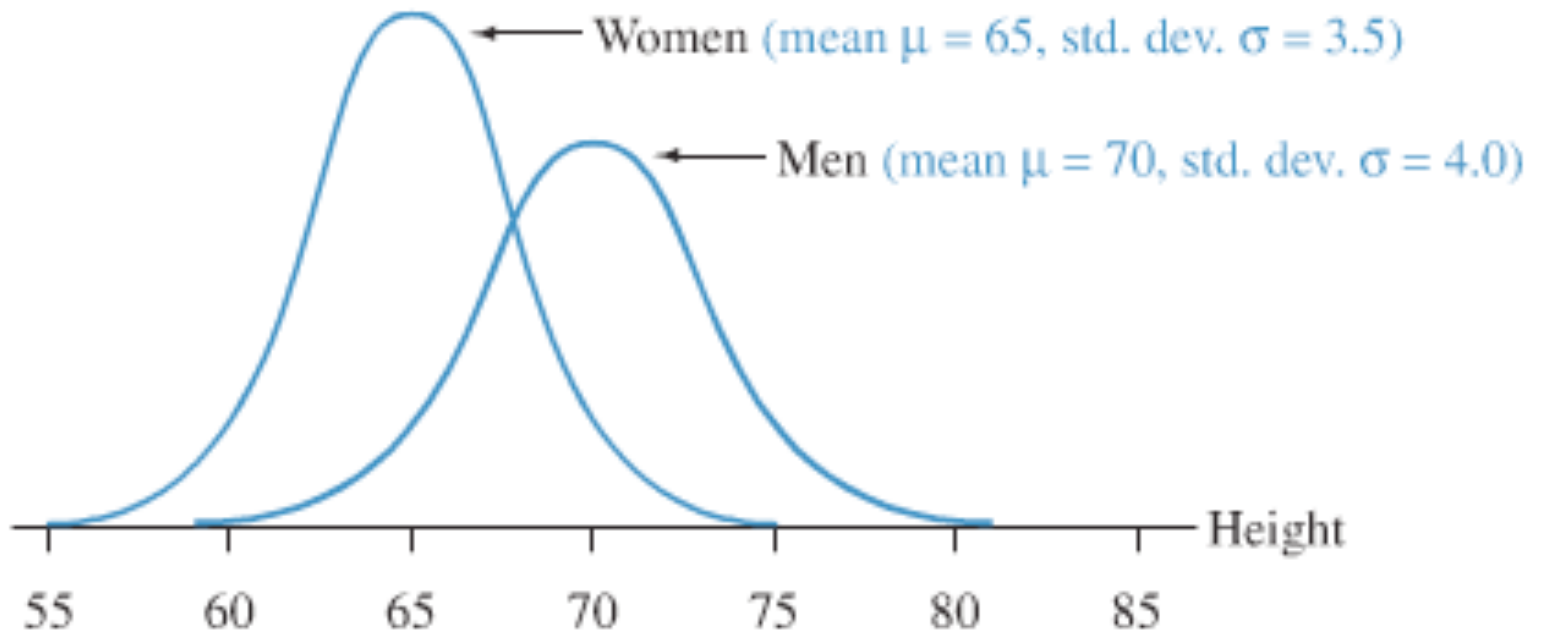
# Example 2



What's the probability that a random sample of 100 men will have a mean height of over 72 inches tall?



# Example 3



What's the probability that a random sample of 50 women will have a mean height of less than 60 inches?