Standard Deviation!

Let's say we randomly select 9 men and 9 women and ask their GPAs and get these data:

MEN	WOMEN
0.90	1.50
2.00	3.00
1.40	3.00
2.00	2.50
3.00	3.00
2.00	3.00
3.00	4.00
4.00	3.00
3.70	2.00

MEAN GPA FOR:

MEN: 2.44

WOMEN: 2.78

Can we conclude that the average GPA of ALL women at Skyline is higher than the average of ALL men?

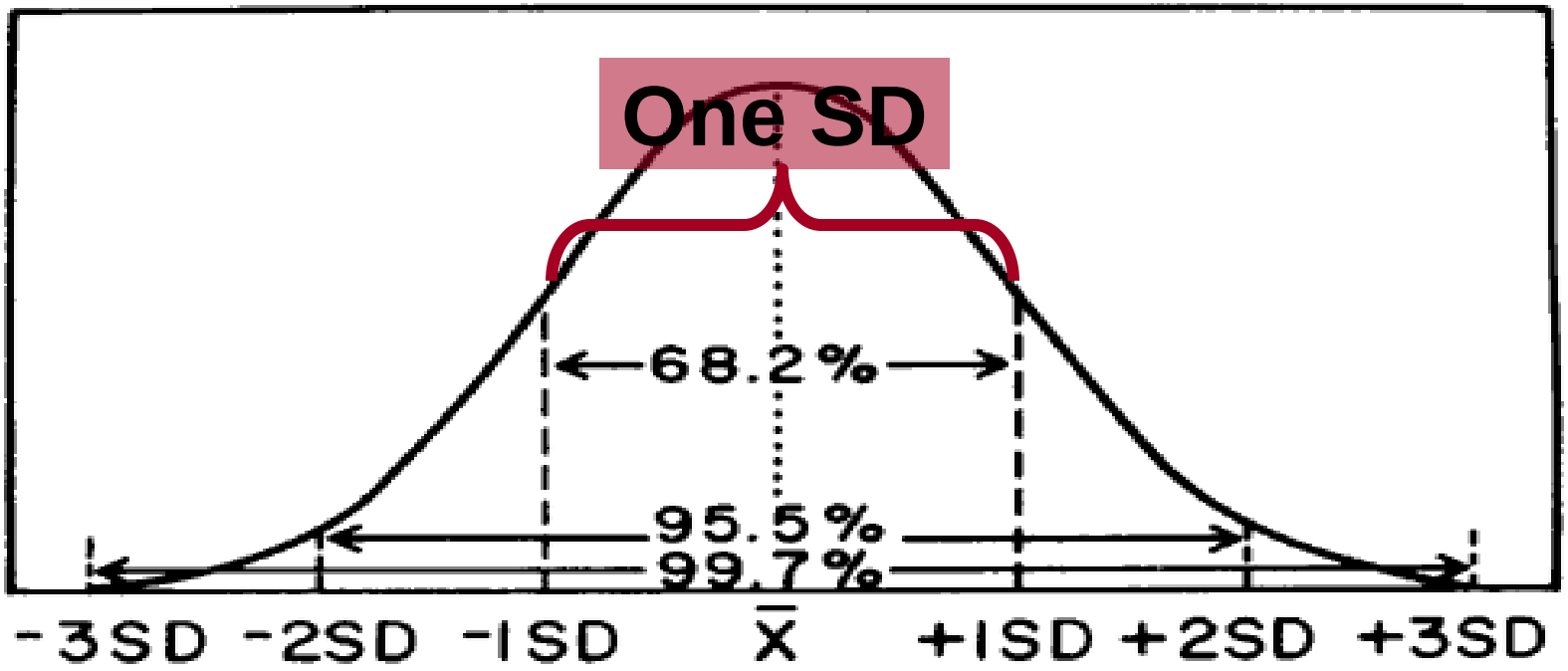
Standard Deviation

- **The standard deviation is a measure the degree each data point in the set of data points varies (or deviates) from the mean**

- **The wider the spread of scores, the larger the standard deviation.**

Standard Deviation

- **For data that has a normal distribution, 68% of the data lies within one standard deviation of the mean.**



How to calculate the standard deviation:

1. Calculate the mean (M) of a set of data

$$S = \sqrt{\frac{\sum (X - M)^2}{n - 1}}$$

MEAN GPA FOR:

MEN: 2.44

WOMEN: 2.78

How to calculate the standard deviation:

2. Subtract the mean from each point of data to determine (X-M)

MEN		WOMEN	
0.90 – 2.44 =	-1.54	1.50 – 2.78 =	-1.28
2.00 – 2.44 =	-0.44	3.00 – 2.78 =	0.22
1.40 – 2.44 =	-1.04	3.00 – 2.78 =	0.22
2.00 – 2.44 =	-0.44	2.50 – 2.78 =	-0.28
3.00 – 2.44 =	0.56	3.00 – 2.78 =	0.22
2.00 – 2.44 =	-0.44	3.00 – 2.78 =	0.22
3.00 – 2.44 =	0.56	4.00 – 2.78 =	1.22
4.00 – 2.44 =	1.56	3.00 – 2.78 =	0.22
3.70 – 2.44 =	1.26	2.00 – 2.78 =	-0.78

$$s = \sqrt{\frac{\sum (X-M)^2}{n-1}}$$

How to calculate the standard deviation:

3. Square each of the resulting numbers to determine $(X-M)^2$

$$s = \sqrt{\frac{\sum (X-M)^2}{n-1}}$$

MEN		WOMEN	
$(-1.54)^2 =$	**2.37**	$(-1.28)^2 =$	**1.64**
$(-0.44)^2 =$	**0.19**	$(0.22)^2 =$	**0.05**
$(-1.04)^2 =$	**1.08**	$(0.22)^2 =$	**0.05**
$(-0.44)^2 =$	**0.19**	$(-0.28)^2 =$	**0.08**
$(0.56)^2 =$	**0.31**	$(0.22)^2 =$	**0.05**
$(-0.44)^2 =$	**0.19**	$(0.22)^2 =$	**0.05**
$(0.56)^2 =$	**0.31**	$(1.22)^2 =$	**1.49**
$(1.56)^2 =$	**2.43**	$(0.22)^2 =$	**0.05**
$(1.26)^2 =$	**1.59**	$(-0.78)^2 =$	**0.61**

How to calculate the standard deviation:

4. Add the values from the previous step together to get $\sum(X-M)^2$

$$s = \sqrt{\frac{\sum(X-M)^2}{n-1}}$$

MEN	WOMEN
2.37	1.64
0.19	0.05
1.08	0.05
0.19	0.08
0.31	0.05
0.19	0.05
0.31	1.49
2.43	0.05
1.59	0.61
8.68	4.06

How to calculate the standard deviation:

5. Calculate (n-1) by subtracting 1 from your sample size. Your sample size is the total number of data points you collected.

$$s = \sqrt{\frac{\sum (X - M)^2}{n - 1}}$$

N-1 for men = 9-1 = 8

N-1 for women = 9-1 = 8

How to calculate the standard deviation:

6. Divide the answer from $\sum(X-M)^2$ by the answer from (n-1) to find $\frac{\sum(X-M)^2}{n-1}$

$$s = \sqrt{\frac{\sum(X-M)^2}{n-1}}$$

Men
8.68 / 8 = 1.09

Women
4.06 / 8 = 0.51

How to calculate the standard deviation:

7. Calculate the square root of your previous answer to determine the standard deviation

$$s = \sqrt{\frac{\sum (X-M)^2}{n-1}}$$

Men

$\sqrt{1.09}$ = 1.04

Women

$\sqrt{0.51}$ = 0.71

This means that…

- In men, 68% of all students sampled have a GPA that falls within 1.04 grade points of the mean.
  - MEAN PLUS 1.04 = 3.49
  - MEAN MINUS 1.04 = 1.40

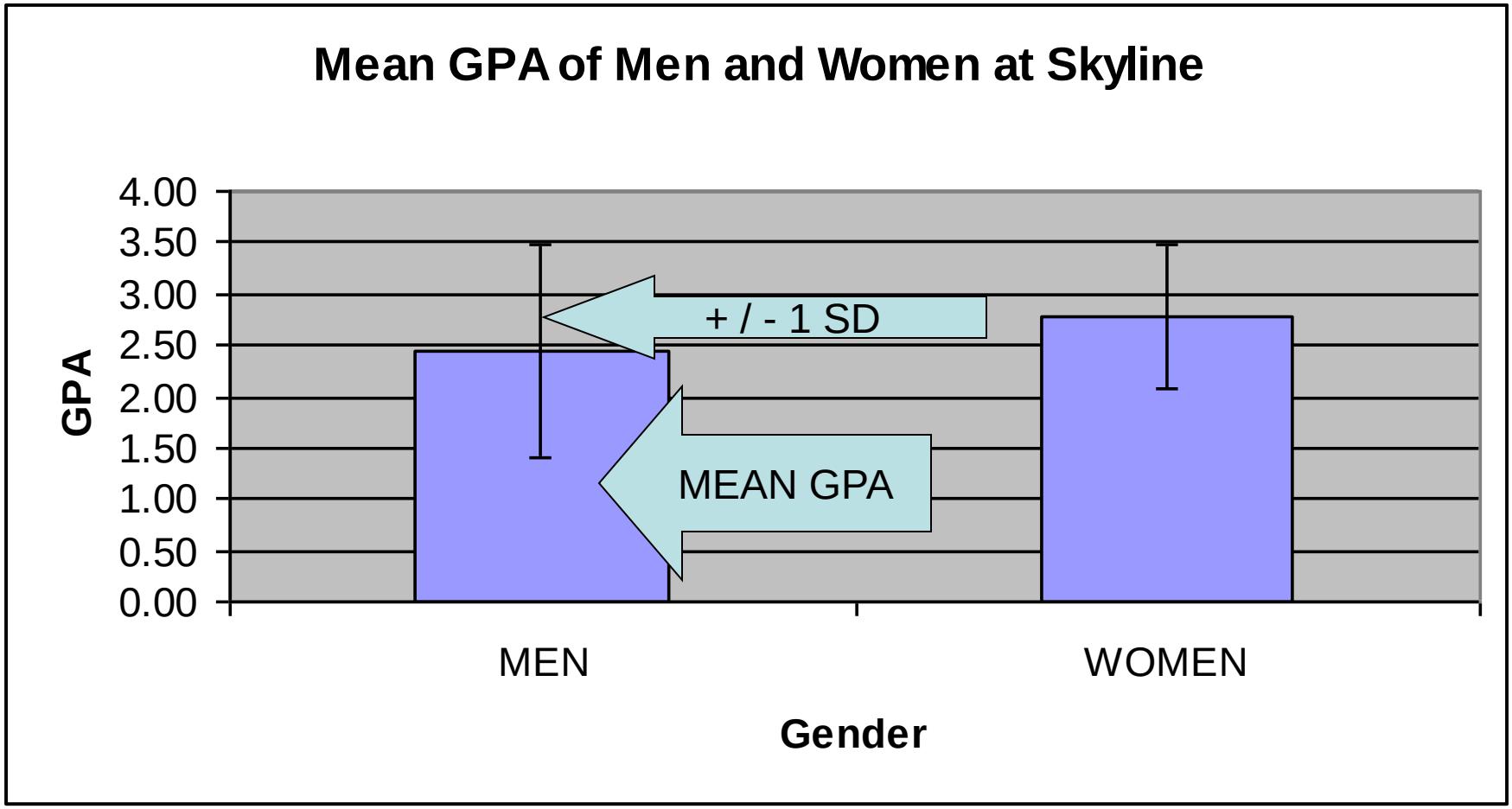
68% of men have a GPA between these values

- In women, 68% of all students sampled have a GPA that falls within 0.71 grade points of the mean.
  - MEAN PLUS 0.71 = 3.49
  - MEAN MINUS 0.71 = 2.07

68% of women have a GPA between these values

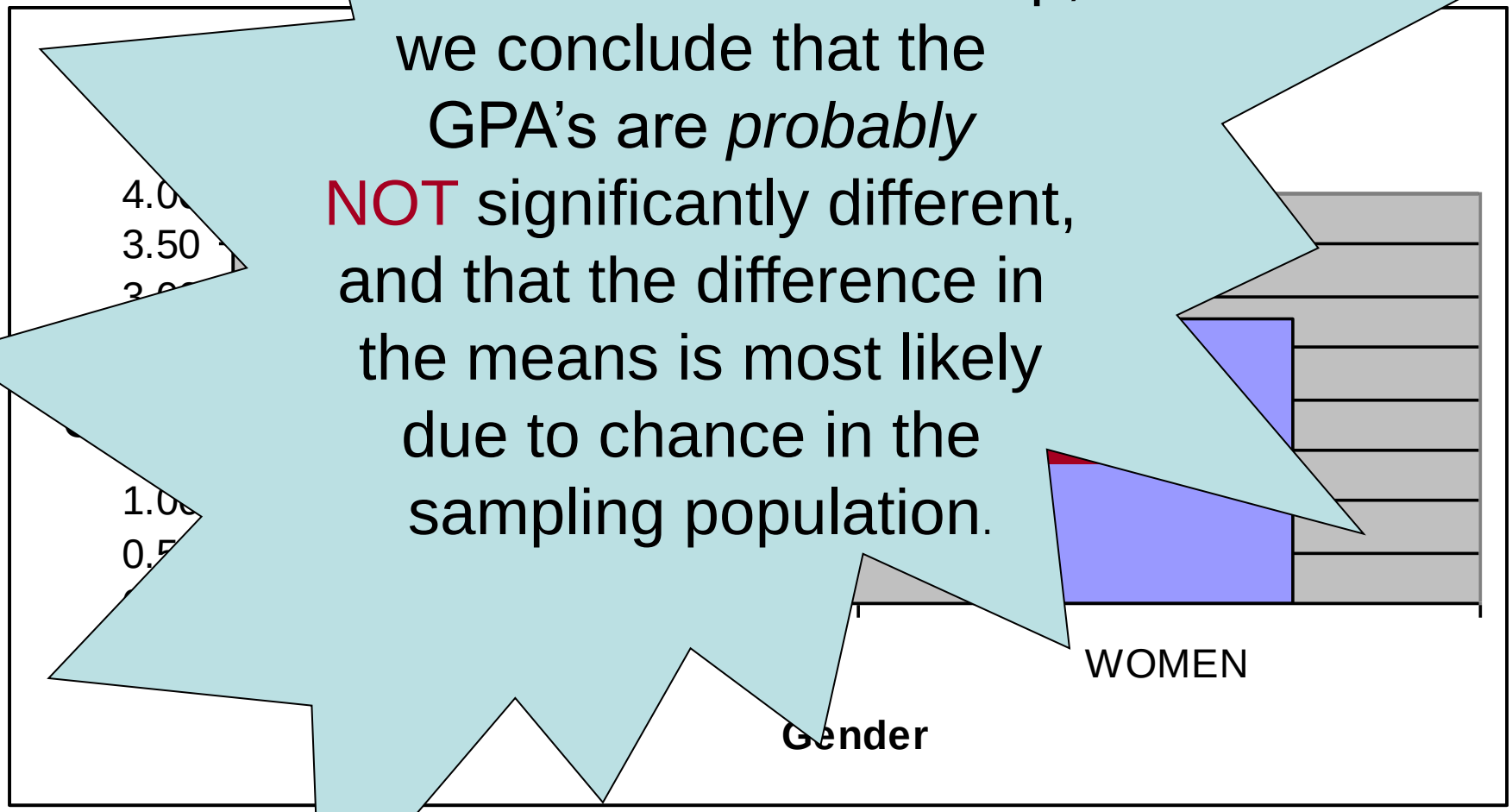
So, are women smarter?

Graph results to find out:



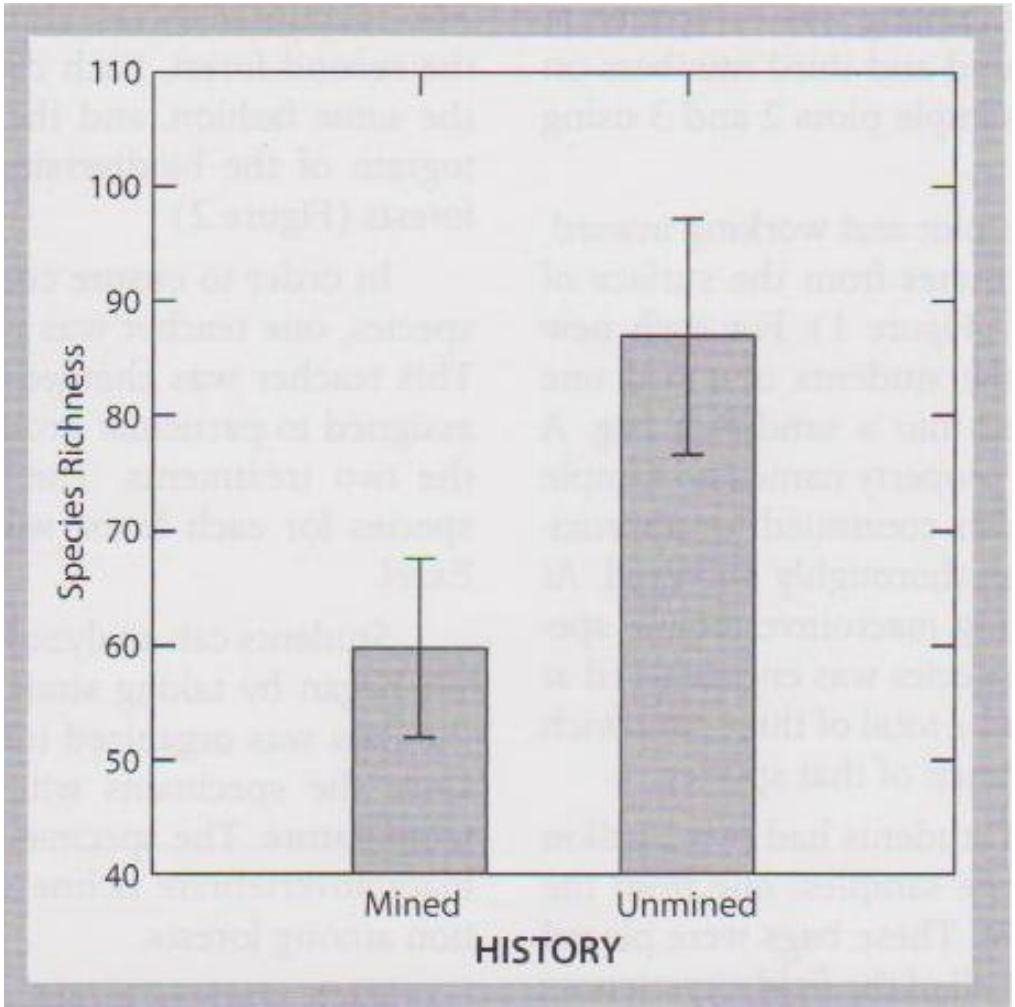
So are we [illegible] arter?

Graph resu



Since the SD bars overlap, we conclude that the GPA's are *probably* NOT significantly different, and that the difference in the means is most likely due to chance in the sampling population.

Since the SD bars DO NOT overlap, we conclude that the populations are *probably* significantly different, and that the difference in the means is most likely due to something MORE THAN CHANCE.



Using Tools to Calculate Standard Deviation

- Excel 2003
- TI-83
- Excel 2007 (doc)
- TI-nspire (external link)

PRACTICE PROBLEMS