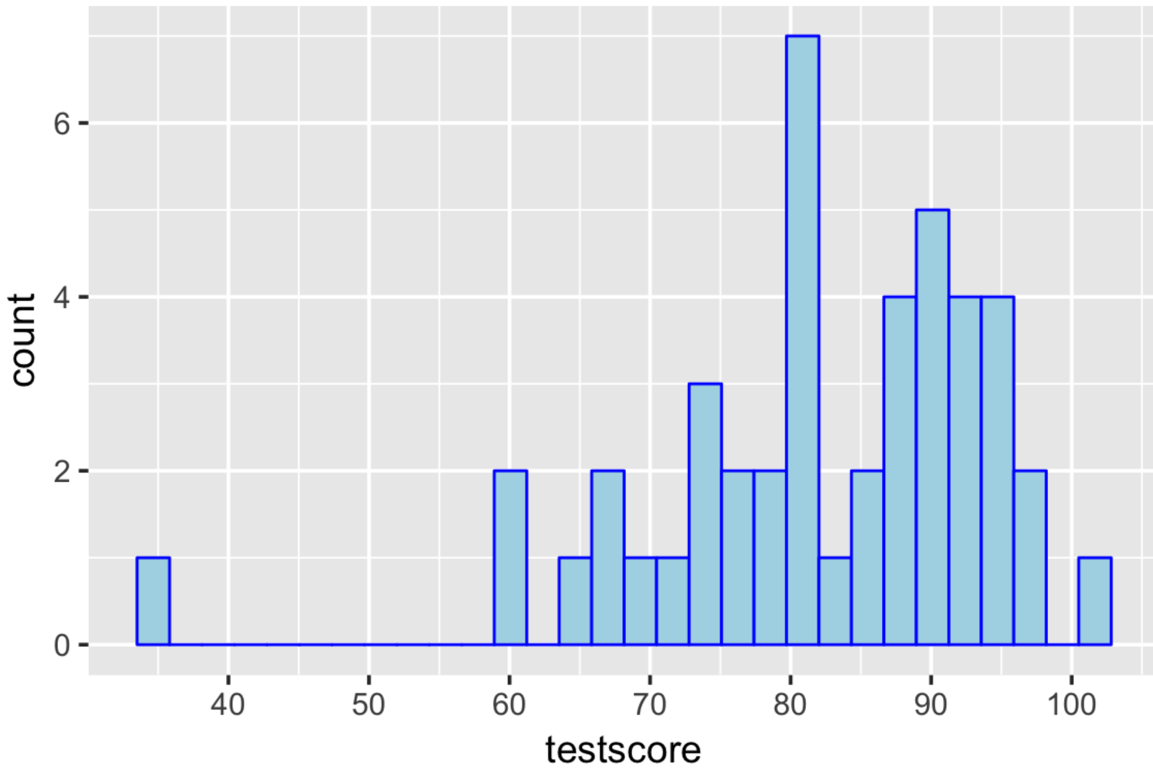
Five number summary

1. min
2. lower fourth
3. median
4. upper fourth
5. max

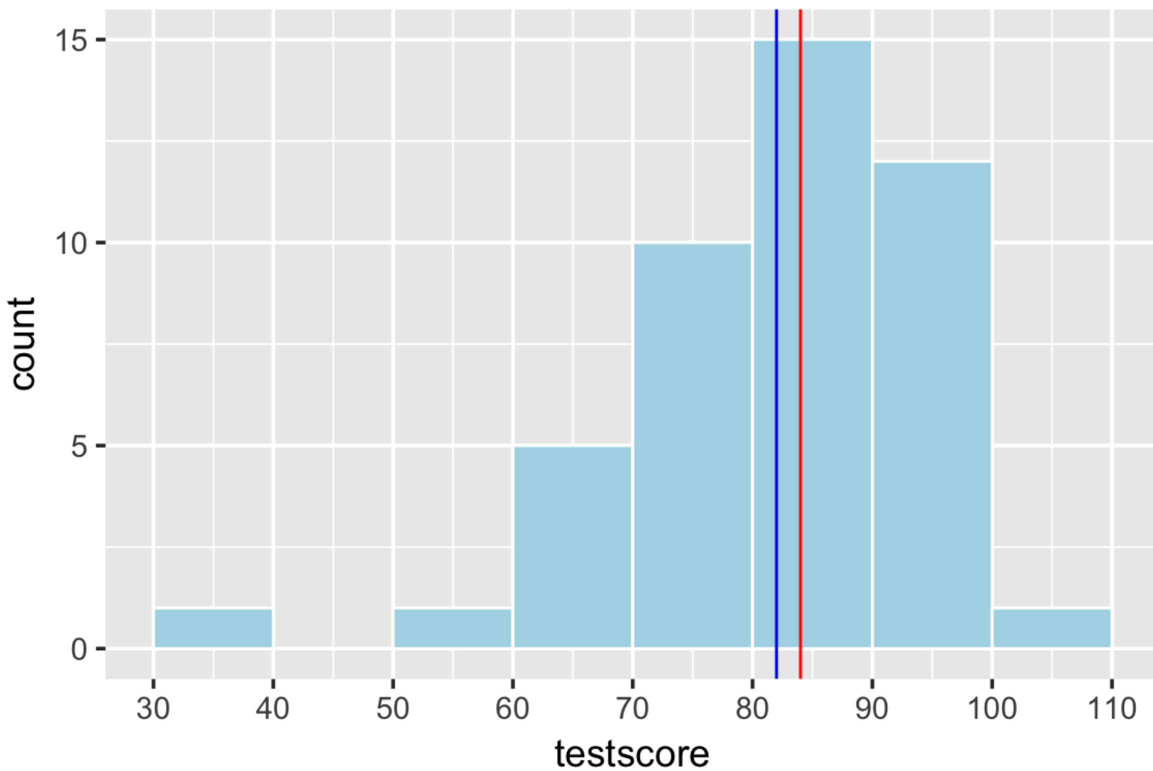
```
summary(prices)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     379     506     572     593     699     799
```

Test score data



Fewer bins



Test score dataset

Original data set of scores:
35, 59, 61, 64, 66, 66, 70, 72, 73, 74, 75, 76, 76, 78, 79, 80, 80, 81, 81, 82, 82, 82, 84, 86, 86, 88, 88, 88, 88, 89, 89, 90, 91, 91, 92, 92, 92, 92, 94, 94, 94, 94, 96, 98, 102

Mean: 82

Median: 84

Trimmed dataset (min and max removed):
59, 61, 64, 66, 66, 70, 72, 73, 74, 75, 76, 76, 78, 79, 80, 80, 81, 81, 82, 82, 82, 84, 86, 86, 88, 88, 88, 88, 89, 89, 90, 91, 91, 92, 92, 92, 92, 94, 94, 94, 94, 96, 98

Mean: 82.63

Median: 84

How much was trimmed? $\frac{1}{45}$ = 2.22%

Trimmed means

Suppose we want to **trim 15%**.

.15 x 45 = 6.75 values

Trim 6:

$\frac{6}{45}$ = 0.133

$\overline{x}_{tr(13.33)}$ = 83.667

Trim 7:

$\frac{7}{45}$ = 0.156

$\overline{x}_{tr(15.56)}$ = 83.774

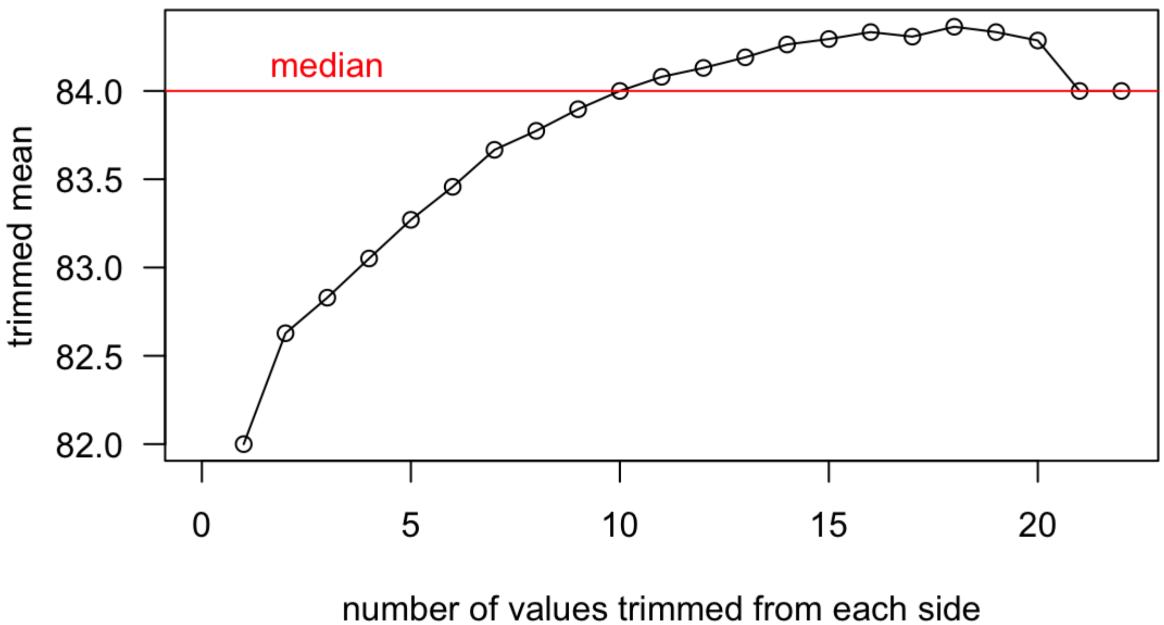
Interpolate:

83.667 + .75 * (difference) =

83.667 + .75 * (83.774 - 83.667) =

83.667 + .75 * (.107) = **83.747**

Median vs. trimmed mean



Sample and population means

population mean: μ = sum of N population values / N

sample mean: $\bar{x} = \frac{x_1+x_2+\ldots+x_n}{n} = \frac{\sum_{i=1}^{n} x_i}{n}$

population median: $\tilde{\mu}$

sample median: $\tilde{x}$

Measures of variability

deviations from the mean

$$x_1 - \bar{x},\ x_2 - \bar{x},\ etc.$$

Data: 3, 8, 11, 14
Mean: 9

$value$	$deviation$	$deviation^2$
3	-6	36
8	-1	1
11	2	4
14	5	25

Sum of squared deviations

S_{xx}: 36 + 1 + 4 + 25 = 66

Population variance

σ^2 = 66/4 = 16.5

$$\sigma^2 = \sum_{i=1}^{N} (x_i - \mu)^2 / N$$

Sample variance

Sum of squared deviations:

S_{xx}: 36 + 1 + 4 + 25 = 66

Sample variance:

s^2 = 66 / **3** = 22

$$s^2 = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}$$

Why n-1?

Short answer: using **n** would result in an underestimation, since the values in the sample are closer to the sample mean than to the true population mean (which we don't know)

Standard deviation

Square root of variance

- Population s.d. = $\sqrt{\sigma^2}$
- Sample s.d. = $\sqrt{s^2}$
- *same units as original values*
- Variance of test scores: 156.636
- Standard deviation of test scores: 12.515

EXERCISE (p. 47, #62)

Consider the following information on ultimate tensile strength (lb/in^2) for a sample of $n = 4$ hard zirconium copper wire specimens:

$\overline{x} = 76{,}831$
$s = 180$
smallest $x_i = 76{,}683$
largest $x_i = 77{,}048$

Set up equations to determine the values of the two middle sample observations. *Do not solve.*

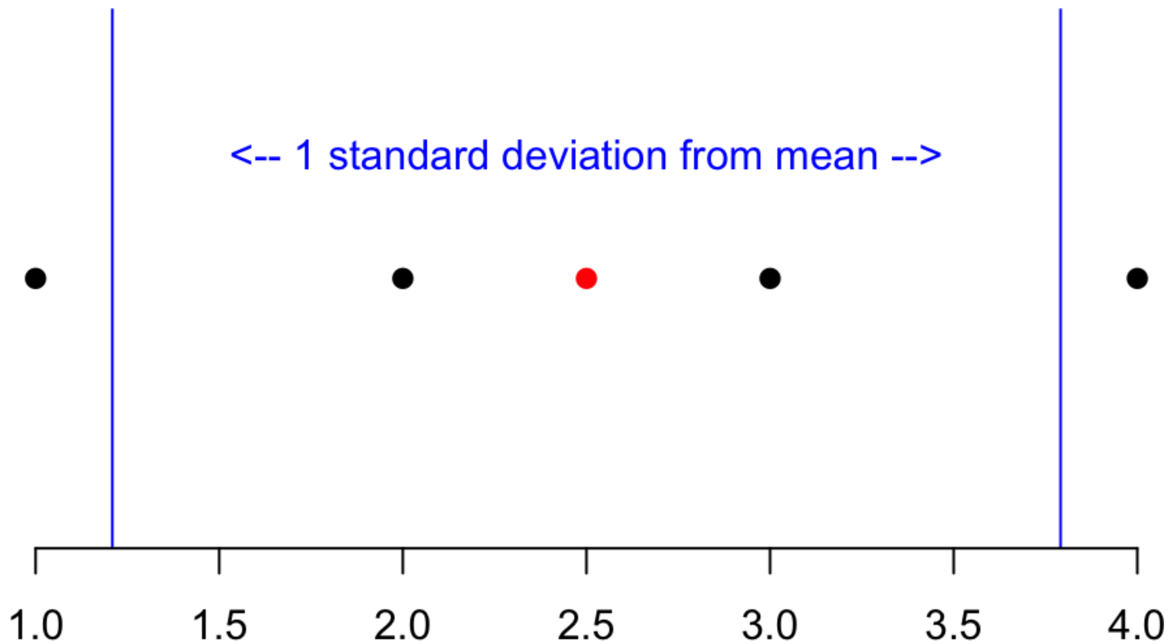
EXERCISE: sd for n = 3

Find the sample mean, variance, and standard deviation:

X1	**X2**	**X3**	**mean**	**var**	**sd**
1	2	3			
2	4	6			
0	5	10			
99	100	101			
-8	-5	-2			

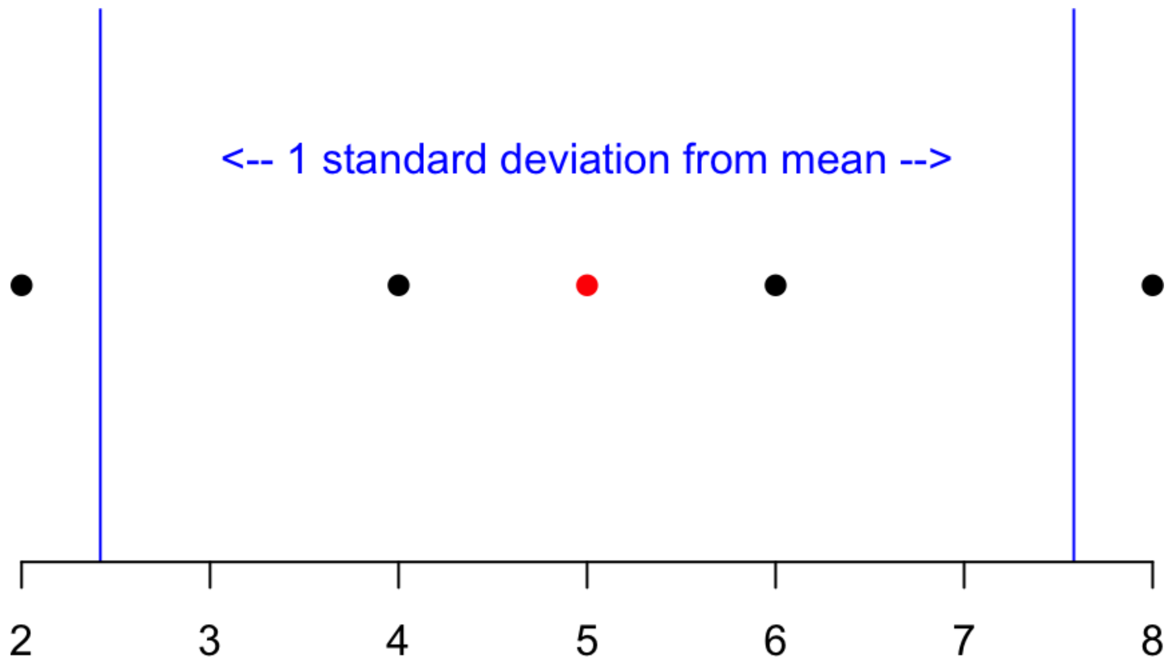
Standard deviation, n = 4

	X1	**X2**	**X3**	**X4**	**mean**	**var**	**sd**
set1	1	2	3	4	2.5	1.67	1.29



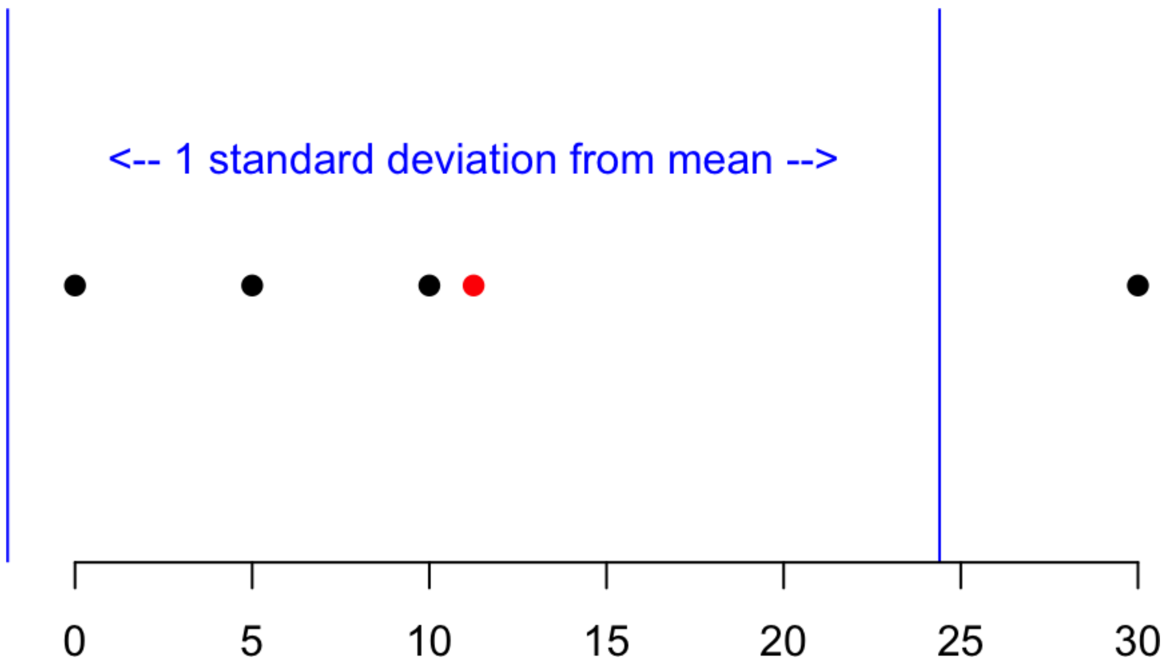
Standard deviation, n = 4

	X1	**X2**	**X3**	**X4**	**mean**	**var**	**sd**
set2	2	4	6	8	5	6.67	2.58



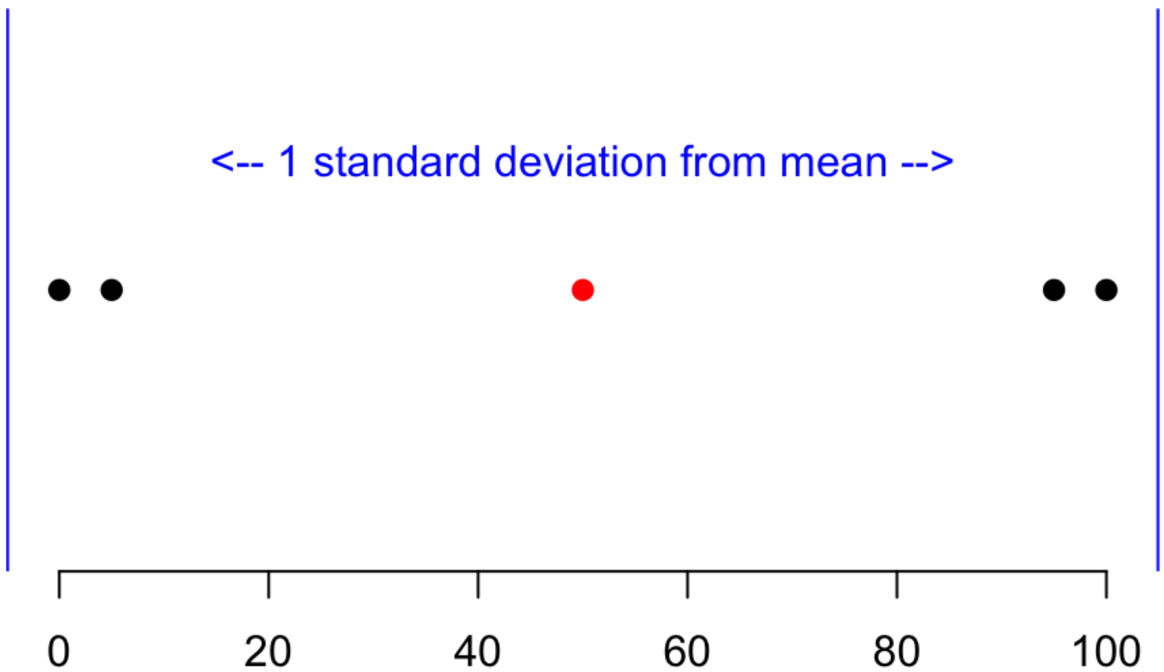
Standard deviation, n = 4

	X1	**X2**	**X3**	**X4**	**mean**	**var**	**sd**
set3	0	5	10	30	11.2	173	13.2



Standard deviation, n = 4

	X1	X2	X3	X4	mean	var	sd
set4	0	5	95	100	50	3017	54.9



STAT UN1201 – Chapter 2

Prof. Joyce Robbins

Probability

In 1654, writer Antoine Gombaud “Chevalier de Méré” wanted to know if the following bets are profitable:

- getting at least one six on 4 dice rolls
- getting at least one double-six on 24 dice rolls

Vocabulary (2.1)

- **experiment** – process whose outcome is subject to uncertainty (ex. rolling a die)
- **sample space** – set of all possible outcomes of an experiment
  S = {1, 2, 3, 4, 5, 6}

Experiment with an infinite sample space

- ex. flip a coin until you get tails
- **sample space**
  S = {T, HT, HHT, HHHT, …}
- **event**
  you get tails in less than 8 flips
  A = {T, HT, HHT, HHHT, HHHHT, HHHHHT, HHHHHHT}

Vocabulary (2.1)

- **event** – *collection* of outcomes contained in the sample space
- **simple event** – one outcome (ex. getting a 5)
  A = {5}
- **compound event** – more than one outcome (ex. rolling > 3)
  B = {4, 5, 6}

Set theory 1

- **complement** of an event – all outcomes in the sample space that are *not* in the event
  S = {1, 2, 3, 4, 5, 6}
  A = {1, 3}
  A' ("not A") = {2, 4, 5, 6}

Set theory 2

- **union** of two events: all outcomes in *either* event or in *both* $A \cup B$ ("A *or* B")
  $A = \{1, 3\}$
  $B = \{3, 5\}$
  $A \cup B = \{1, 3, 5\}$

Set theory 3

- **intersection** of two events: all outcomes in *both* events
  $A \cap B$ ("A *and* B")
  $A = \{1, 3\}$
  $B = \{3, 5\}$
  $A \cap B = \{3\}$