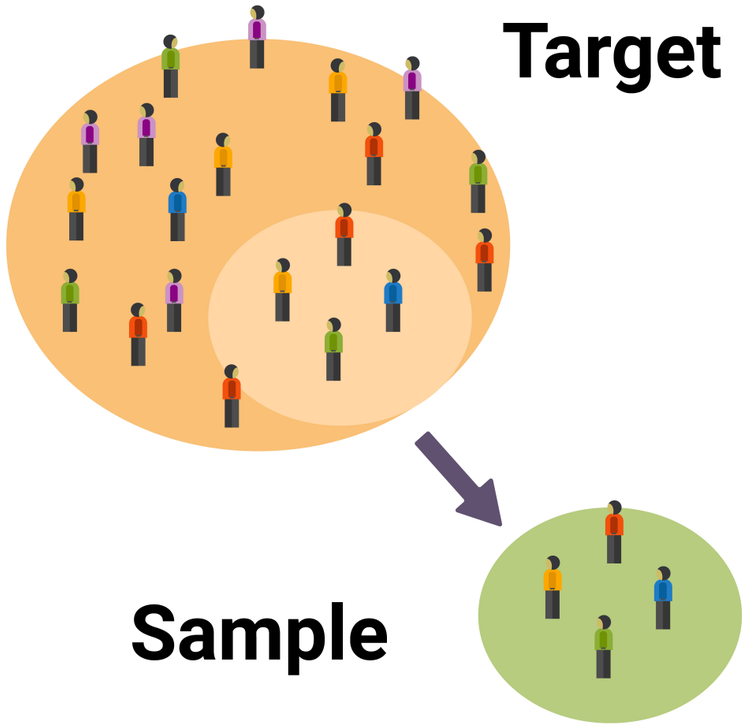
# Introduction to statistics

## INTRODUCTION TO STATISTICS IN SPREADSHEETS

**Ted Kwartler**
Data Dude

# Sometimes it's ok to be mean (average)!




- Averages reduce information

# What it takes to be mean (average)?

- Mean = Sum of all observations / Number of observations

# Let's calculate an average

| Person | Age |
|---|---|
| 1 | 40 |
| 2 | 2 |
| 3 | 47 |
| 4 | 48 |
| 5 | 35 |
| 6 | 26 |
| 7 | 76 |
| 8 | 55 |
| 9 | 48 |
| 10 | 96 |

- Sum of all observations: 473
- Number of observations: 10
- Mean: `47.3`

# Let's calculate another average

| Person | Age |
|---|---|
| 1 | 15 |
| 2 | 17 |
| 3 | 21 |
| 4 | 13 |
| 5 | 10 |
| 6 | 16 |
| 7 | 12 |
| 8 | 21 |
| 9 | 19 |
| 10 | 14 |

- Sum of all observations: 158
- Number of observations: 10
- Mean: `15.8`

# Median averages

| Person | Age |
|---|---|
| 2 | 2 |
| 7 | 26 |
| 6 | 35 |
| 1 | 40 |
| 3 | 47 |
| 4 | 48 |
| 5 | 48 |
| 9 | 55 |
| 8 | 76 |
| 10 | 96 |

- Middle number of a dataset
- Half the numbers are less than the median
- Half the numbers are above the median

# Median averages

| Person | Age |
|---|---|
| ~~2~~ | 2 |
| ~~7~~ | 26 |
| ~~6~~ | 35 |
| ~~1~~ | 40 |
| 3 | **47** |
| 4 | **48** |
| ~~5~~ | 48 |
| ~~9~~ | 55 |
| ~~8~~ | 76 |
| ~~10~~ | 96 |

- Middle number of a dataset
- Half the numbers are less than the median
- Half the numbers are above the median

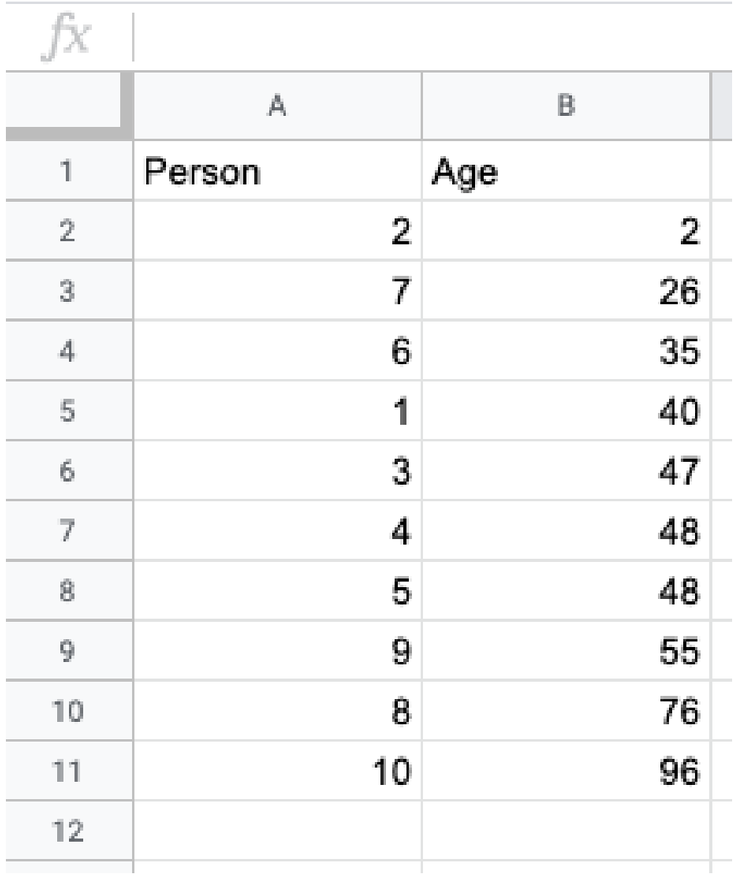
# Modal average

| Person | Age |
|---|---|
| 1 | 40 |
| 2 | 2 |
| 3 | 47 |
| **4** | **48** |
| 5 | 35 |
| 6 | 26 |
| 7 | 76 |
| 8 | 55 |
| **9** | **48** |
| 10 | 96 |

- Person 4 & 9 are both 48
- All other observations occur only once

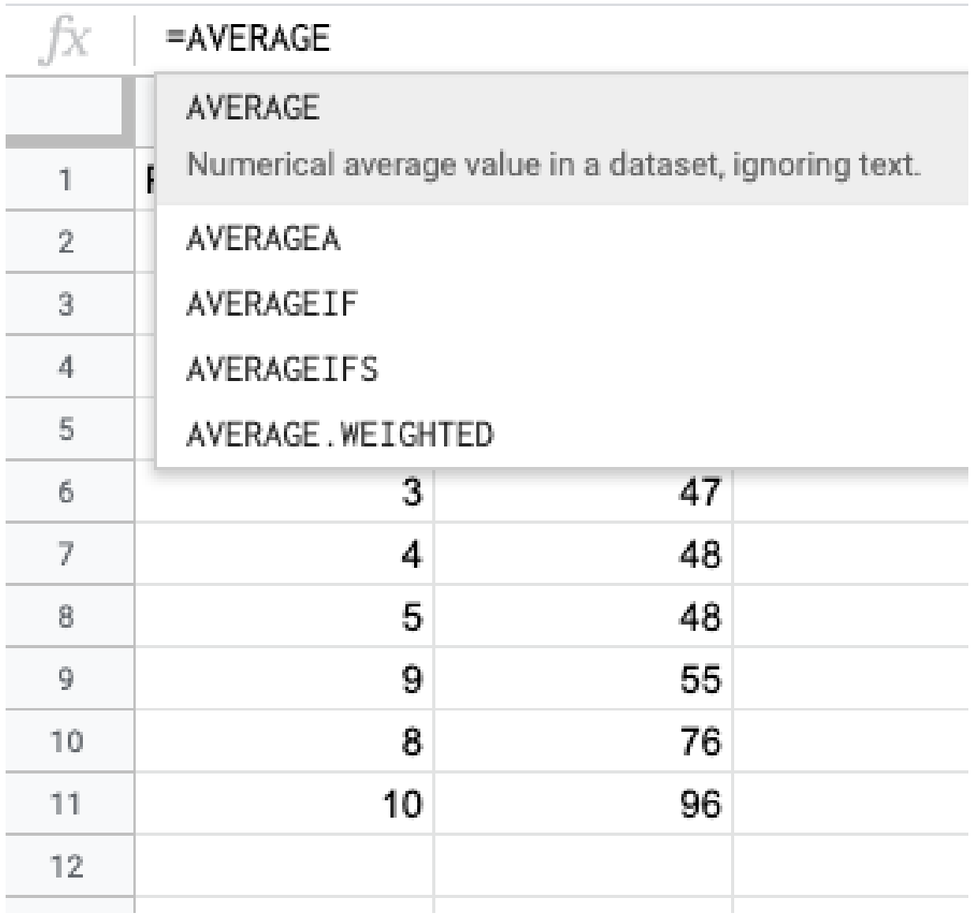
**Therefore the mode is 48**

# Mean average in Spreadsheets

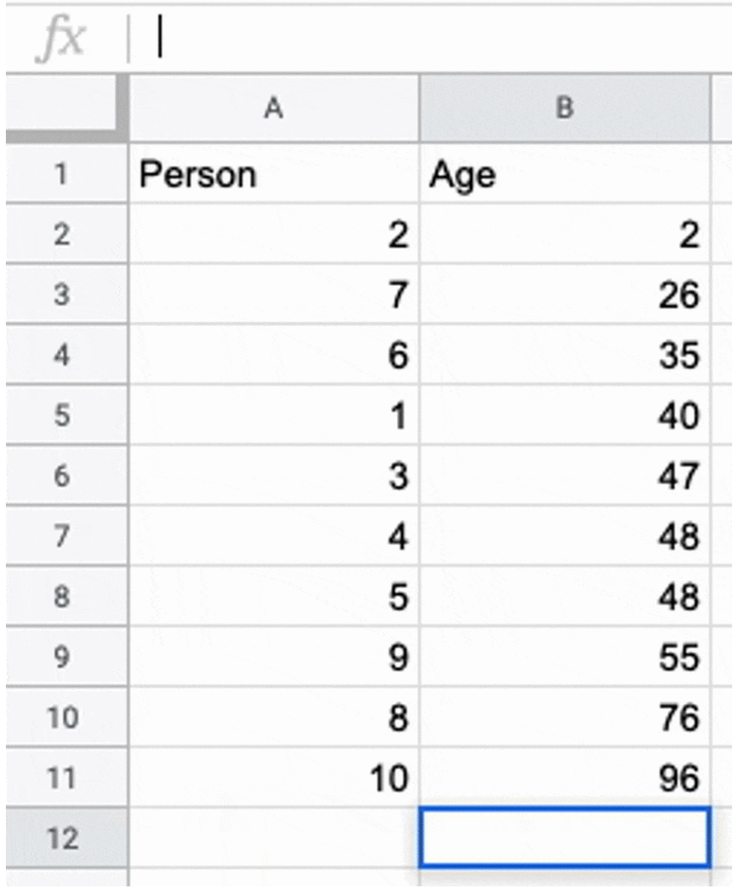


| | A | B |
|---|---|---|
| 1 | Person | Age |
| 2 | 2 | 2 |
| 3 | 7 | 26 |
| 4 | 6 | 35 |
| 5 | 1 | 40 |
| 6 | 3 | 47 |
| 7 | 4 | 48 |
| 8 | 5 | 48 |
| 9 | 9 | 55 |
| 10 | 8 | 76 |
| 11 | 10 | 96 |
| 12 | | |

# Mean average in Spreadsheets



# Mean average in Spreadsheets



| | A | B |
|---|---|---|
| 1 | Person | Age |
| 2 | 2 | 2 |
| 3 | 7 | 26 |
| 4 | 6 | 35 |
| 5 | 1 | 40 |
| 6 | 3 | 47 |
| 7 | 4 | 48 |
| 8 | 5 | 48 |
| 9 | 9 | 55 |
| 10 | 8 | 76 |
| 11 | 10 | 96 |
| 12 | | |

# Median and Mode in Spreadsheets

fx =MEDIAN(B2:B11)

| | A | B |
|---|---|---|
| 1 | Person | Age |
| 2 | 2 | 2 |
| 3 | 7 | 26 |
| 4 | 6 | 35 |
| 5 | 1 | 40 |
| 6 | 3 | 47 |
| 7 | 4 | 48 |
| 8 | 5 | 48 |
| 9 | 9 | 55 |
| 10 | 8 | 76 |
| 11 | 10 | 96 |
| 12 | | 47.5 |

fx =MODE(B2:B11)

| | A | B |
|---|---|---|
| 1 | Person | Age |
| 2 | 2 | 2 |
| 3 | 7 | 26 |
| 4 | 6 | 35 |
| 5 | 1 | 40 |
| 6 | 3 | 47 |
| 7 | 4 | 48 |
| 8 | 5 | 48 |
| 9 | 9 | 55 |
| 10 | 8 | 76 |
| 11 | 10 | 96 |
| 12 | | 48 |

# Let's practice some averages!

INTRODUCTION TO STATISTICS IN SPREADSHEETS

# How far from average?

INTRODUCTION TO STATISTICS IN SPREADSHEETS

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Data Dude

# All aboard!

# First stop, Variance Station

- Measures how dispersed a dataset is
- Smaller variance indicates a dataset is less spread
- Large differences between data points increase the variance

# First stop, Variance Station

| A |
|---|
| 347 |
| 347 |
| 347 |
| 347 |

# First stop, Variance Station

| A |
|---|
| 347 |
| 347 |
| 347 |
| 347 |

- Column A Variance: **0**

# First stop, Variance Station

| A | B |
|---|---|
| 347 | 10 |
| 347 | **14** |
| 347 | 10 |
| 347 | 10 |

- Column A Variance: **0**

# First stop, Variance Station

| A | B |
|---|---|
| 347 | 10 |
| 347 | 14 |
| 347 | 10 |
| 347 | 10 |

- Column A Variance: **0**
- Column B Variance: **3**

# First stop, Variance Station

| A | B | C |
|---|---|---|
| 347 | 10 | 10 |
| 347 | 14 | 14 |
| 347 | 10 | **100** |
| 347 | 10 | 10 |

- Column A Variance: **0**
- Column B Variance: **3**

# First stop, Variance Station

| A | B | C |
|---|---|---|
| 347 | 10 | 10 |
| 347 | 14 | 14 |
| 347 | 10 | 100 |
| 347 | 10 | 10 |

- Column A Variance: **0**
- Column B Variance: **3**
- Column C Variance: **1476.75**

# Calculating Variance: Step 1

fx | =AVERAGE(B2:B5)

| | A | B | C | D |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | 10 | | |
| 3 | | 14 | | |
| 4 | | 10 | | |
| 5 | | 10 | | |
| 6 | Mean: | 11 | | |

# Calculating Variance: Step 2

fx

| | A | B | C | D |
|---|---|---|---|---|
| 1 | | | Subtract Mean from Each Value | |
| 2 | | 10 | -1 | |
| 3 | | 14 | 3 | |
| 4 | | 10 | -1 | |
| 5 | | 10 | -1 | |
| 6 | Mean: | 11 | | |

# Calculating Variance: Step 3

fx

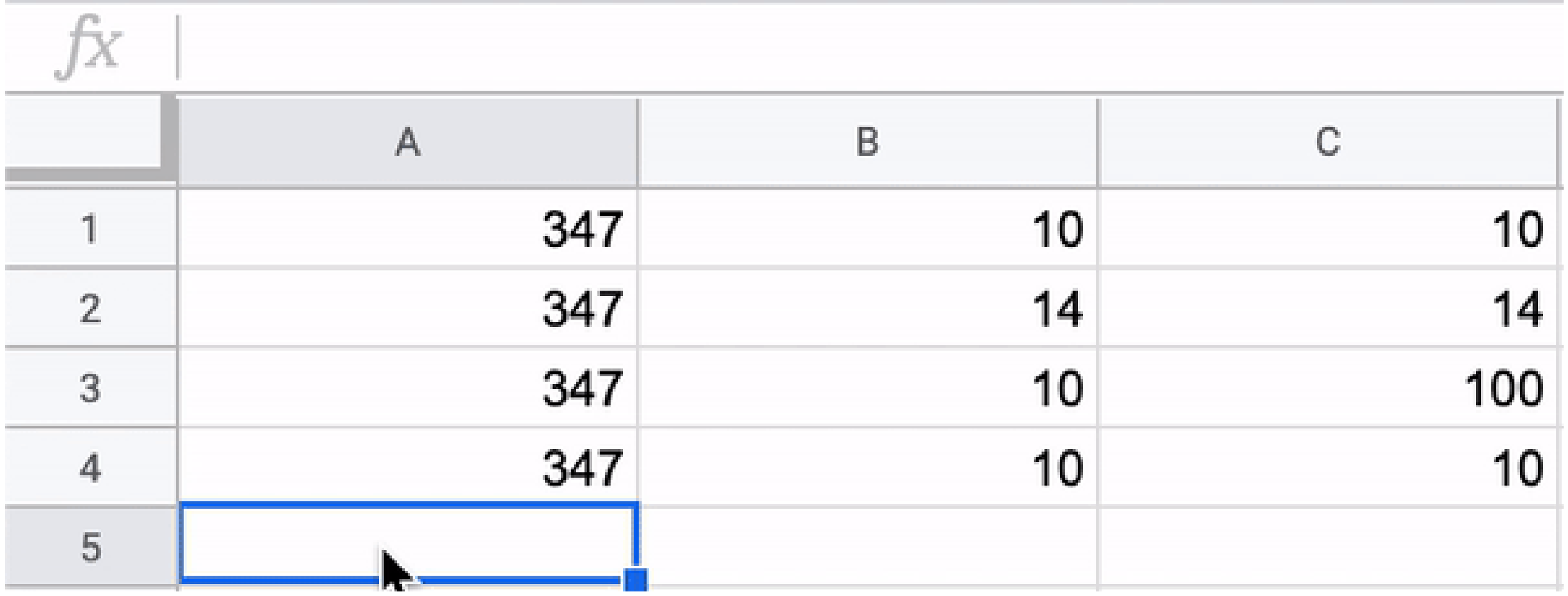
| | A | B | C | D |
|---|---|---|---|---|
| 1 | | | Subtract Mean from Each Value | Square the Differences |
| 2 | | 10 | -1 | 1 |
| 3 | | 14 | 3 | 9 |
| 4 | | 10 | -1 | 1 |
| 5 | | 10 | -1 | 1 |
| 6 | Mean: | 11 | | |

# Calculating Variance: Step 4

fx =AVERAGE(D2:D5)

| | A | B | C | D |
|---|---|---|---|---|
| 1 | | | Subtract Mean from Each Value | Square the Differences |
| 2 | | 10 | -1 | 1 |
| 3 | | 14 | 3 | 9 |
| 4 | | 10 | -1 | 1 |
| 5 | | 10 | -1 | 1 |
| 6 | Mean: | 11 | | 3 |

# Calculating variance in spreadsheets



| | A | B | C |
|---|---|---|---|
| 1 | 347 | 10 | 10 |
| 2 | 347 | 14 | 14 |
| 3 | 347 | 10 | 100 |
| 4 | 347 | 10 | 10 |
| 5 | | | |

# Pulling into, Standard Deviation!

# Standard Deviation

## Manual Standard Deviation:

fx =SQRT(B5)

| | A | B |
|---|---|---|
| 1 | | 10 |
| 2 | | 14 |
| 3 | | 10 |
| 4 | | 10 |
| 5 | Variance | 3 |
| 6 | Standard Deviation | 1.732050808 |

## Spreadsheets Standard Deviation:

fx =STDEVP(B1:B4)

| | A | B |
|---|---|---|
| 1 | | 10 |
| 2 | | 14 |
| 3 | | 10 |
| 4 | | 10 |
| 5 | Variance | 3 |
| 6 | Standard Deviation | 1.732050808 |

# Standard Deviation as a unit of measure

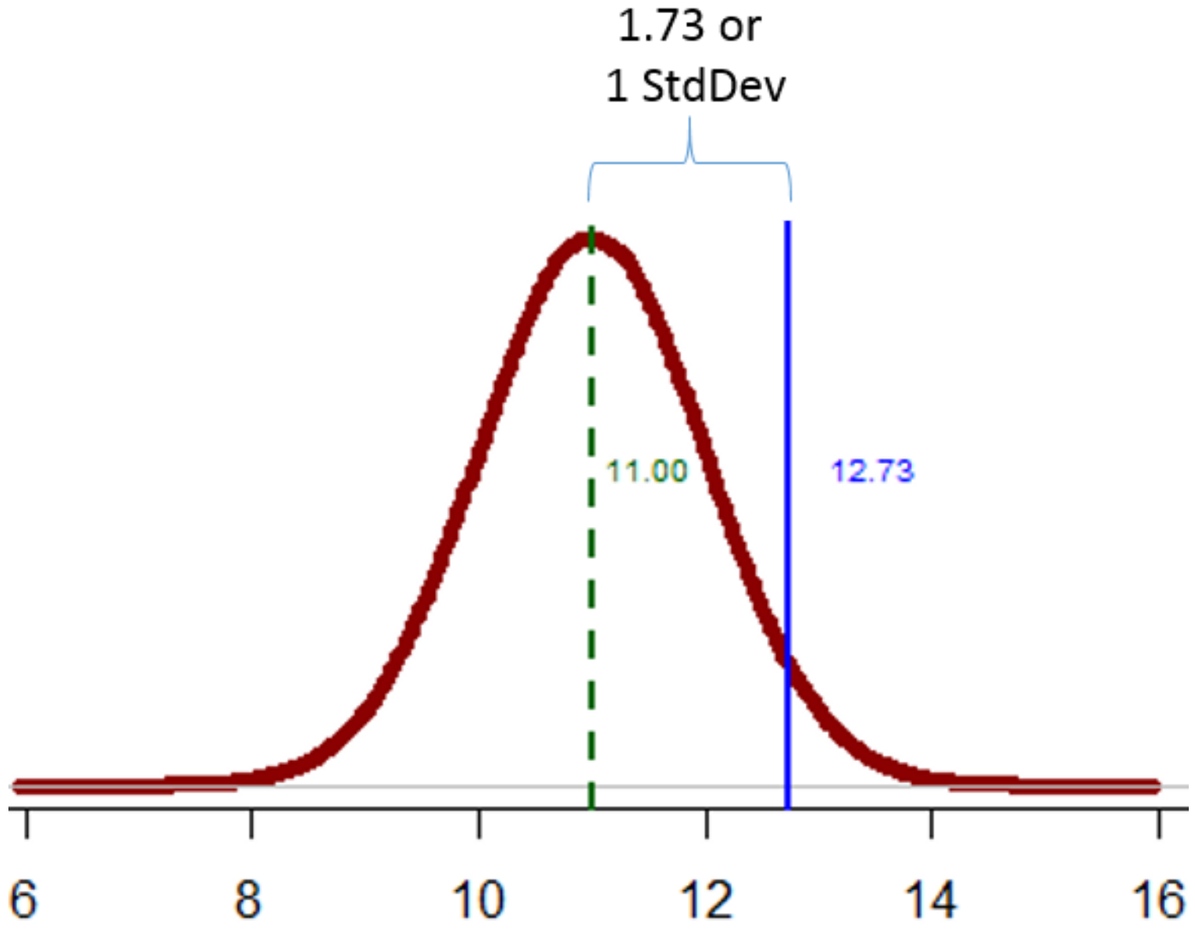
Sample average & standard deviation

```
=AVERAGE(10,14,10,10) = 11
```

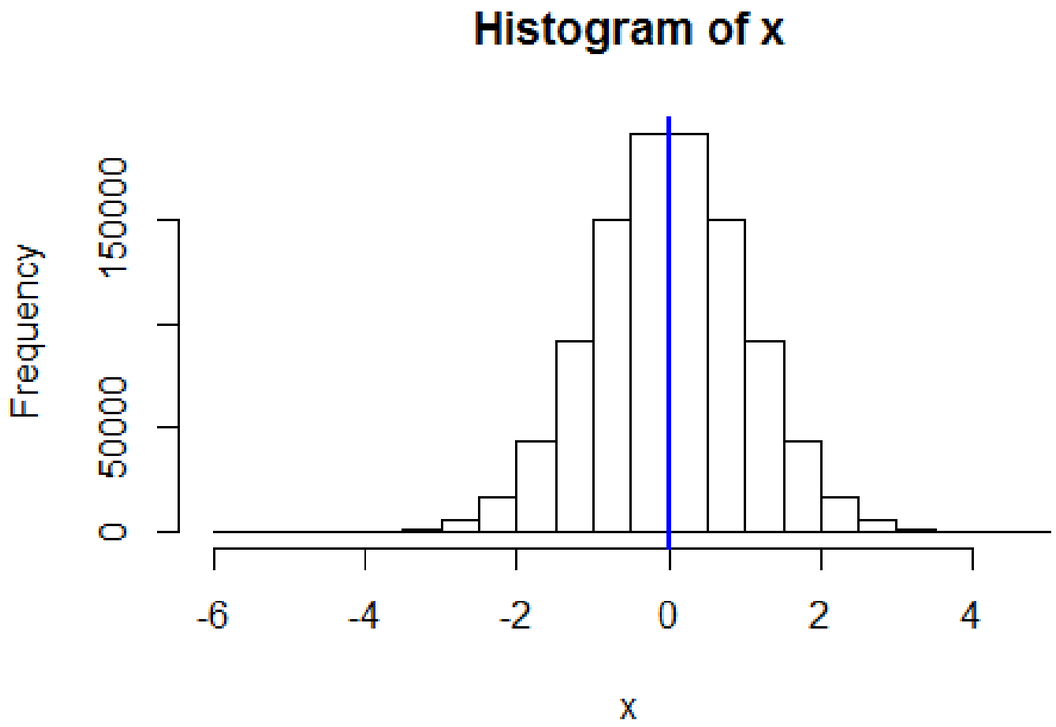
```
=STDEVP(10,14,10,10) = 1.73
```

New Data Point: 12.73

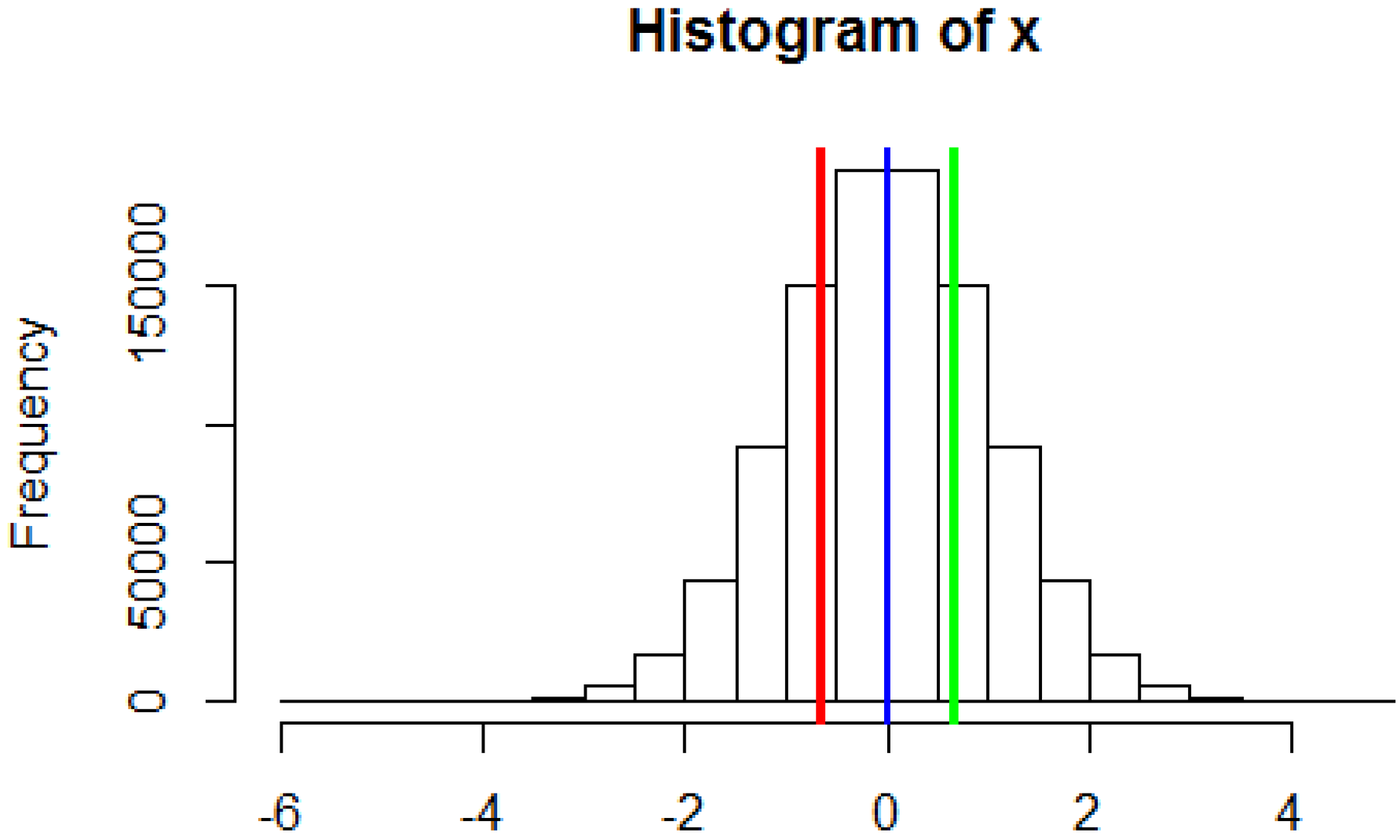
```
12.73 - 1.73 = 11
```



# Last distribution stop on the stats train: quartiles




- Percentile: % of values below a specific point
- 50th percentile: Splits the data evenly
- Here, 0 is the 50th percentile


Histogram of x
Frequency
0
50000
150000
-6
-4
-2
0
2
4

=QUARTILE(B1:B5, 1)

| | A | B |
|---|---|---|
| 1 | | 123 |
| 2 | | 456 |
| 3 | | 789 |
| 4 | | 234 |
| 5 | | 567 |
| 6 | First Quartile | 234 |

=QUARTILE(B1:B5, 2)

| | A | B |
|---|---|---|
| 1 | | 123 |
| 2 | | 456 |
| 3 | | 789 |
| 4 | | 234 |
| 5 | | 567 |
| 6 | Second Quartile | 456 |

=QUARTILE(B1:B5, 3)

| | A | B |
|---|---|---|
| 1 | | 123 |
| 2 | | 456 |
| 3 | | 789 |
| 4 | | 234 |
| 5 | | 567 |
| 6 | Third Quartile | 567 |

=QUARTILE(B1:B5, 4)

| | A | B |
|---|---|---|
| 1 | | 123 |
| 2 | | 456 |
| 3 | | 789 |
| 4 | | 234 |
| 5 | | 567 |
| 6 | Fourth Quartile | 789 |

# Let's practice!

INTRODUCTION TO STATISTICS IN SPREADSHEETS

# Standardizing data

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**Ted Kwartler**
Data Dude

# Why standardize?

- Variables are sometimes measured on different scales
- Makes it harder to compare
- Easier to misinterpret variable importance
- Solution: standardize your data
- All variables on the same scale

fx

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | Data | | | |
| 2 | | 1 | | | |
| 3 | | 2 | | | |
| 4 | | 3 | | | |
| 5 | | | | | |
| 6 | | | | | |

=AVERAGE(B2:B4)

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | Data | | | |
| 2 | | 1 | | | |
| 3 | | 2 | | | |
| 4 | | 3 | | | |
| 5 | Mean: | 2 | | | |
| 6 | | | | | |

=STDEVP(B2:B4)

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | Data | | | |
| 2 | | 1 | | | |
| 3 | | 2 | | | |
| 4 | | 3 | | | |
| 5 | Mean: | 2 | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | |

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | Data | Mean | Std. Deviation | |
| 2 | | 1 | 2 | 0.8164965809 | |
| 3 | | 2 | 2 | 0.8164965809 | |
| 4 | | 3 | 2 | 0.8164965809 | |
| 5 | Mean: | 2 | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | |

fx =(B2-C2)/D2

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | Data | Mean | Std. Deviation | Z-Score |
| 2 | | 1 | 2 | 0.8164965809 | -1.224744871 |
| 3 | | 2 | 2 | 0.8164965809 | |
| 4 | | 3 | 2 | 0.8164965809 | |
| 5 | Mean: | 2 | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | |

fx =(B3-C3)/D3

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | Data | Mean | Std. Deviation | Z-Score |
| 2 | | 1 | 2 | 0.8164965809 | -1.224744871 |
| 3 | | 2 | 2 | 0.8164965809 | 0 |
| 4 | | 3 | 2 | 0.8164965809 | |
| 5 | Mean: | 2 | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | |

fx =(B4-C4)/D4

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | Data | Mean | Std. Deviation | Z-Score |
| 2 | | 1 | 2 | 0.8164965809 | -1.224744871 |
| 3 | | 2 | 2 | 0.8164965809 | 0 |
| 4 | | 3 | 2 | 0.8164965809 | 1.224744871 |
| 5 | Mean: | 2 | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | |

=STANDARDIZE()

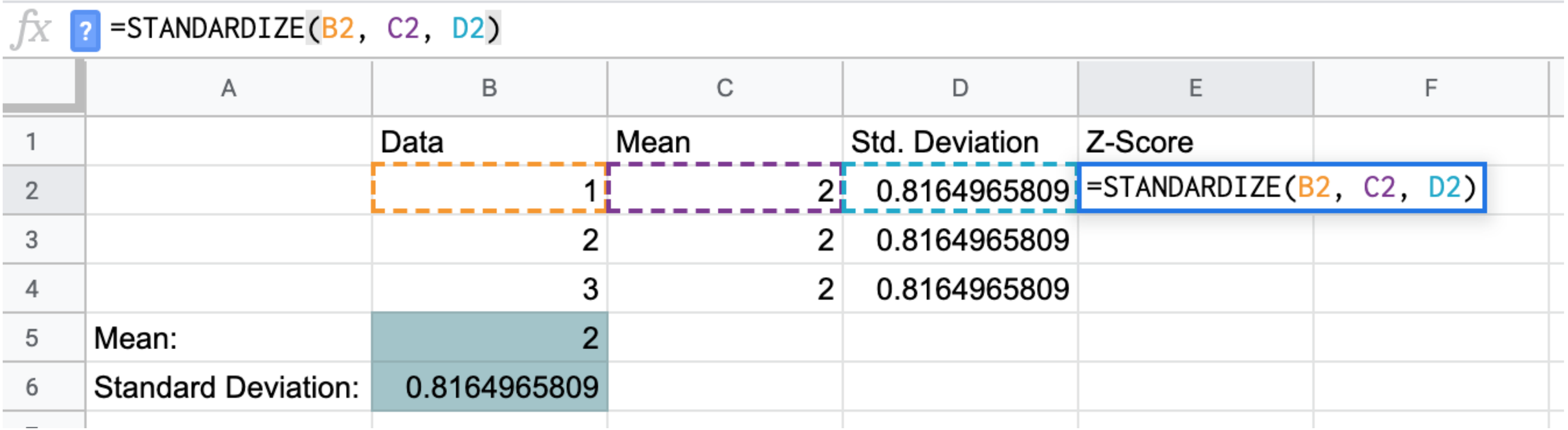
| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Data | Mean | Std. Deviation | Z-Score | |
| 2 | | 1 | 2 | 0.8164965809 | =STANDARDIZE( ) | |
| 3 | | 2 | 2 | 0.8164965809 | | |
| 4 | | 3 | 2 | 0.8164965809 | | |
| 5 | Mean: | 2 | | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | | |

=STANDARDIZE(B2)

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Data | Mean | Std. Deviation | Z-Score | |
| 2 | | 1 | 2 | 0.8164965809 | =STANDARDIZE(B2) | |
| 3 | | 2 | 2 | 0.8164965809 | | |
| 4 | | 3 | 2 | 0.8164965809 | | |
| 5 | Mean: | 2 | | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | | |

=STANDARDIZE(B2, C2)

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Data | Mean | Std. Deviation | Z-Score | |
| 2 | | 1 | 2 | 0.8164965809 | =STANDARDIZE(B2, C2) | |
| 3 | | 2 | 2 | 0.8164965809 | | |
| 4 | | 3 | 2 | 0.8164965809 | | |
| 5 | Mean: | 2 | | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | | |


=STANDARDIZE(B2, C2, D2)
A
B
C
D
E
F
1
Data
Mean
Std. Deviation
Z-Score
2
1
2
0.8164965809
=STANDARDIZE(B2, C2, D2)
3
2
2
0.8164965809
4
3
2
0.8164965809
5
Mean:
2
6
Standard Deviation:
0.8164965809

=STANDARDIZE(B2, C2, D2)

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Data | Mean | Std. Deviation | Z-Score | |
| 2 | | 1 | 2 | 0.8164965809 | -1.224744871 | |
| 3 | | 2 | 2 | 0.8164965809 | | |
| 4 | | 3 | 2 | 0.8164965809 | | |
| 5 | Mean: | 2 | | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | | |

fx

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Data | Z-Score | | Data | |
| 2 | | 1 | -1.224744871 | | 10 | |
| 3 | | 2 | 0 | | 20 | |
| 4 | | 3 | 1.224744871 | | 30 | |
| 5 | Mean: | 2 | | | | |
| 6 | Standard Deviation: | 0.8164965809 | | | | |

fx

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Data | Z-Score | | Data | |
| 2 | | 1 | -1.224744871 | | 10 | |
| 3 | | 2 | 0 | | 20 | |
| 4 | | 3 | 1.224744871 | | 30 | |
| 5 | Mean: | 2 | | | 20 | |
| 6 | Standard Deviation: | 0.8164965809 | | | 8.164965809 | |

fx

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Data | Z-Score | | Data | Z-Score |
| 2 | | 1 | -1.224744871 | | 10 | -1.224744871 |
| 3 | | 2 | 0 | | 20 | 0 |
| 4 | | 3 | 1.224744871 | | 30 | 1.224744871 |
| 5 | Mean: | 2 | | | 20 | |
| 6 | Standard Deviation: | 0.8164965809 | | | 8.164965809 | |

# Almost there, let's standardize!

INTRODUCTION TO STATISTICS IN SPREADSHEETS