V0G Create Sampling Distribution of a Single Die using COUNTIF in Excel 2013 1

Create Sampling Distributions from a Single Die in Excel 2013

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Slides at: www.StatLit.org/pdf/ Excel2013-Sampling-1Die-Demo-Slides.pdf

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The Goal and Approach

Goal: to create the sampling distribution from a single die with various sample sizes using Excel 2013.

A preformatted data spreadsheet is at www.StatLit.org/xls/Excel2013-Sampling-1Die-Data.xlsx

This step-by-step demo is at www.StatLit.org/pdf/
- Excel2013-Sampling-1Die-Demo-Slides.pdf

A picture of the output is at www.StatLit.org/pdf/ Excel2013-Sampling-1Die-Demo-Output.pdf

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Steps in Creating Sampling Distributions for a single die

Access Pre-formatted Data Worksheet:

1. Insert RandBetween(1, 6) to simulate throw of die.
2. Create row averages: samples of 4, 16, 25, 50, 200.
3. Calculate population statistics for a single die.
4. Calculate summary sample statistics by sample size.
5. Group row averages into frequency bins.
6. Create line-graph histograms by sample size.

Upload completed worksheet.

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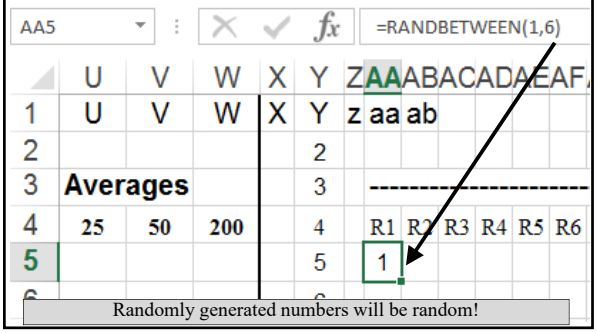
1a: Insert RandBetween(1,6) Function in AA5



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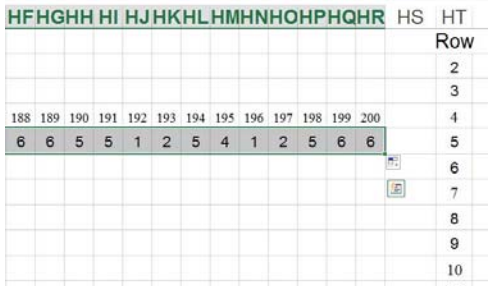
1b: Drag over 200 columns to the right to HR5



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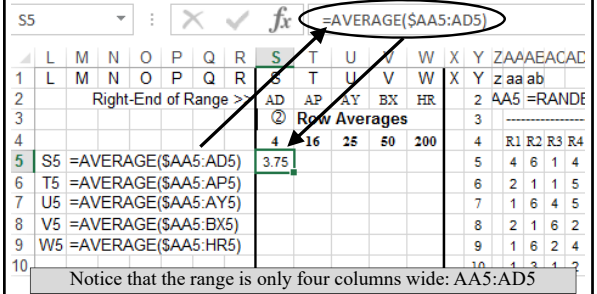
2a: In S5, create row average with sample size four



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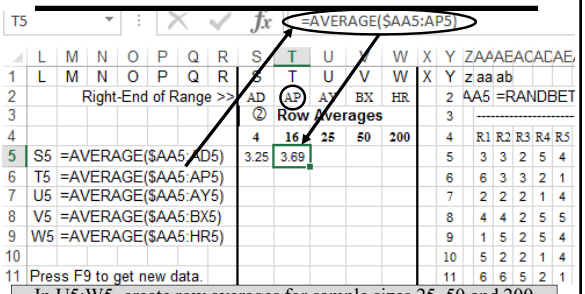
2b: In T5, create row average with sample size of 16



In U5:W5, create row averages for sample sizes 25, 50 and 200

Right-end of ranges are shown in S2:W2

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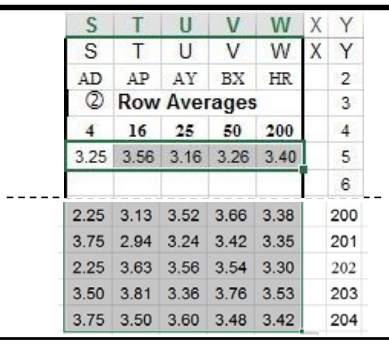
2d: Drag First Row Averages, S5:W5, down to Row 204.



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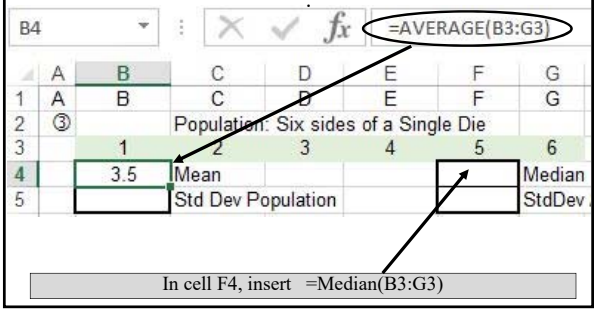
3a: Generate mean (average) [and median] for a six-sided die



In cell F4, insert =Median(B3:G3)

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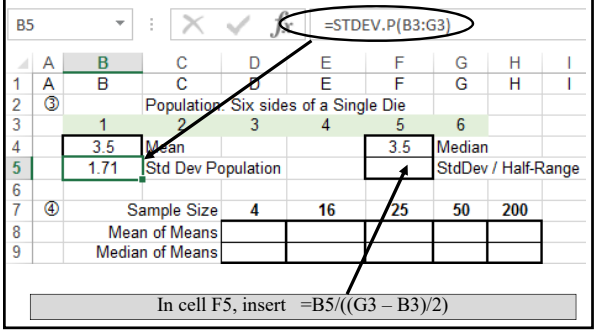
3b: Generate population std. deviation for a fair die



In cell F5, insert =B5/((G3 – B3)/2)

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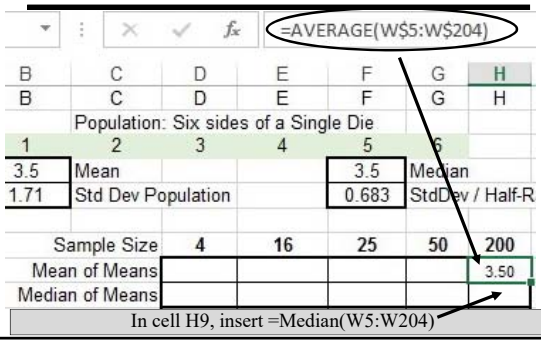
4a: Generate Mean [& Median] of Row Means for Sample Size 200



In cell H9, insert =Median(W5:W204)

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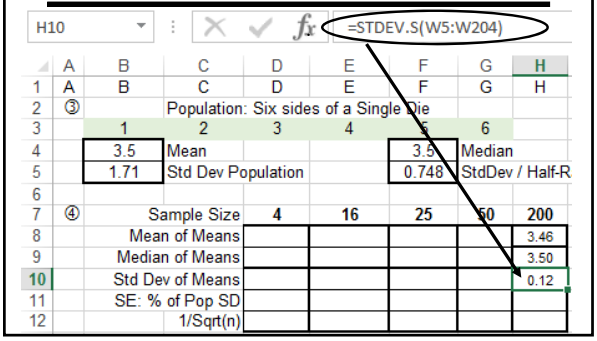
4b: Generate Sample Std.Dev of Row Means for Size 200



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4c: H11 Ratio of Std. Error to Population Std. Deviation

H11 =H10/$B5

	A	B	C	D	E	F	G	H
1	A	B	C	D	E	F	G	H
2	③		Population: Six sides of a Single Die					
3		1	2	3	4	5	6	
4		3.5	Mean			3.5	Median	
5		1.71	Std Dev Population			0.748	StdDev / Half-R	
6								
7	④	Sample Size	4	16	25	50	200	
8		Mean of Means					3.47	
9		Median of Means					3.50	
10		Std Dev of Means					0.12	
11		SE: % of Pop SD					7%	
12		1/Sqrt(n)						

Insert =1/SQRT(H7) into cell H12

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4d: Drag H8:H12 column left-ward to fill out the table

D11 =D10/$B5

	A	B	C	D	E	F	G	H
1	A	B	C	D	E	F	G	H
2	③		Population: Six sides of a Single Die					
3		1	2	3	4	5	6	
4		3.5	Mean			3.5	Median	
5		1.71	Std Dev Population			0.748	StdDev / Half-R	
6								
7	④	Sample Size	4	16	25	50	200	
8		Mean of Means	3.52	3.51	3.52	3.53	3.52	
9		Median of Means	3.50	3.53	3.52	3.52	3.51	
10		Std Dev of Means	0.85	0.41	0.34	0.24	0.12	
11		SE: % of Pop SD	50%	24%	20%	14%	7%	
12		1/Sqrt(n)	50%	25%	20%	14%	7%	

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5a: Insert COUNTIF function in H17

H17 =COUNTIF(W$5:W$204, "<="&$C17)

	A	B	C	D	E	F	G	H	I
13									
14	⑤		Rolling a Single Six-Sided Die						
15			------ Distribution of Averages by Sample size ----						
16		Midpoint	Max	4	16	25	50	200	
17		2.10	2.00					0	
18		2.10	2.20						
19		2.30	2.40						
20		2.50	2.60						
21		2.70	2.80						
22		2.90	3.00						
23		3.10	3.20						
24		3.30	3.40						

Insert $ sign in before Column in range; before Row in single cell!

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5b: Insert "=CountIF() –Sum()" function in 2nd row: H18

=COUNTIF(W$5:W$204,"<="&$C18)-SUM(H$17:H17)

	C	D	E	F	G	H	I	J
	Rolling a Single Six-Sided Die							
	------ Distribution of Averages by Sample size ----							
	Max	4	16	25	50	200		
	2.00					0		
	2.20					0		
	2.40							
	2.60							
	2.80							
	3.00							
	3.20							
	3.40							
	3.60							

H18: Equivalent to =COUNTIF(W$5:W$204, "<="&$C18) - COUNTIF(W$5:W$204, "<="&$C17)

Insert single $ sign in Sum function before first row.

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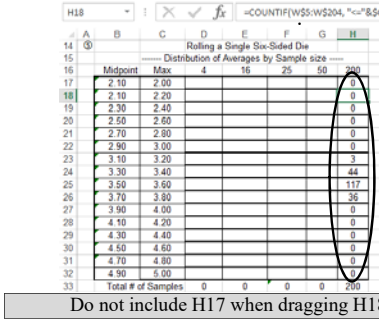
5c: Drag H18, =CountIF() –Sum(), formula down to bottom row



Midpoint	Max	4	16	25	50	200
2.10	2.00					0
2.10	2.20					0
2.30	2.40					0
2.50	2.60					0
2.70	2.80					0
2.90	3.00					0
3.10	3.20					3
3.30	3.40					44
3.50	3.60					117
3.70	3.80					36
3.90	4.00					0
4.10	4.20					0
4.30	4.40					0
4.50	4.60					0
4.70	4.80					0
4.90	5.00					0
Total # of Samples		0	0	0	0	200

Drag entire right column (H17:H32) left-ward to fill out frequency table.

Insert SUM at bottom of each column.

May be different from 200.

Do not include H17 when dragging H18 downward!!!

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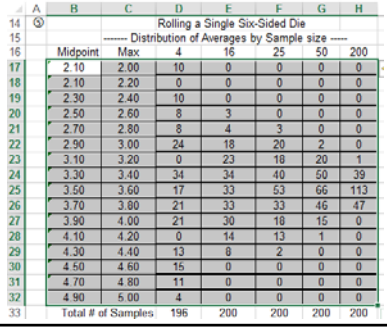
6a: Select Data (B17:H32) to use in Histogram



Midpoint	Max	4	16	25	50	200
2.10	2.00	10	0	0	0	0
2.10	2.20	0	0	0	0	0
2.30	2.40	10	0	0	0	0
2.50	2.60	8	3	0	0	0
2.70	2.80	8	4	3	0	0
2.90	3.00	24	18	20	2	0
3.10	3.20	0	23	18	20	1
3.30	3.40	34	34	40	50	39
3.50	3.60	17	33	53	66	113
3.70	3.80	21	33	33	46	47
3.90	4.00	21	30	18	15	0
4.10	4.20	0	14	13	1	0
4.30	4.40	13	8	2	0	0
4.50	4.60	15	0	0	0	0
4.70	4.80	11	0	0	0	0
4.90	5.00	4	0	0	0	0
Total # of Samples		196	200	200	200	200

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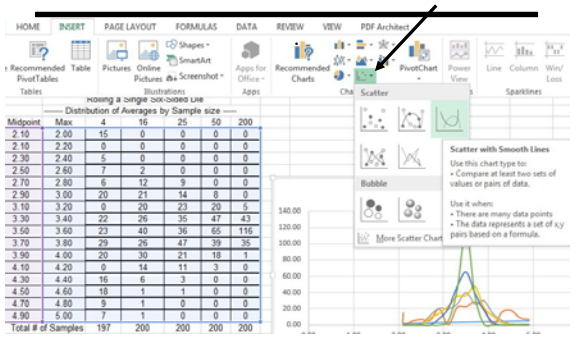
6b: Insert X-Y Scatter Plot



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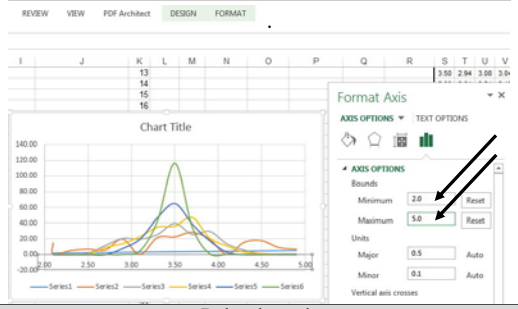
6c: Format Horizontal Axis: Change Min and Max



Delete legend.

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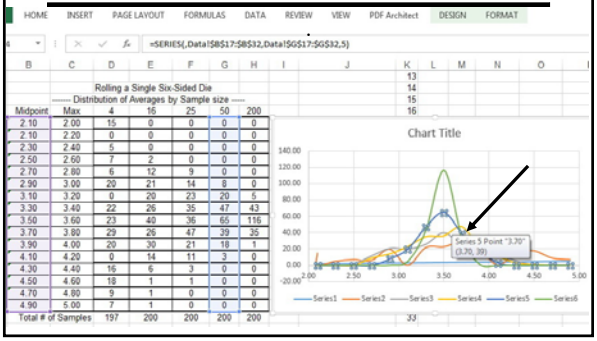
6d: Select/delete Series 5 (size 50), 3 (size 16) and 1 (Max).



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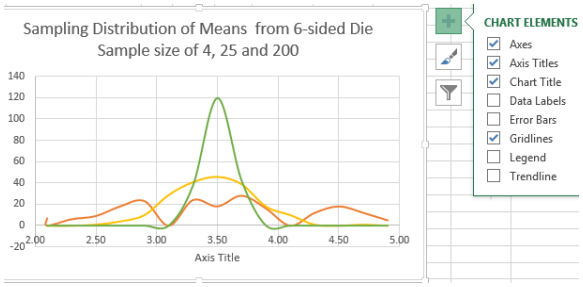
6e: Insert Title and Horizontal Axis Text



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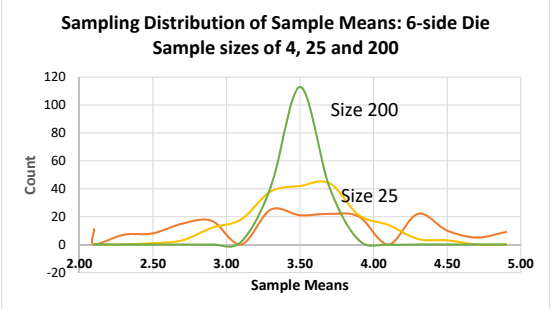
6f: Insert legends in text boxes. Final Result



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Summary

When sampling from a process, the population "size" is "infinite". That doesn't influence the standard deviation.

Notice as sample size increases, the standard error (the std. deviation of the sample means) quickly decreases – as a percentage of the population standard deviation.

A sample of size 4 is expected to have a standard error that is only a half of the population standard deviation: a sample of 25 has a fifth, a sample of 100 has a tenth and a sample of 10,000 has a hundredth.

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This step-by-step demo is at www.StatLit.org/pdf/

- Excel2013-Sampling-1Die-Demo-Slides.pdf

A picture of the output is at www.StatLit.org/pdf/Excel2013-Sampling-1Die-Demo-Output.pdf

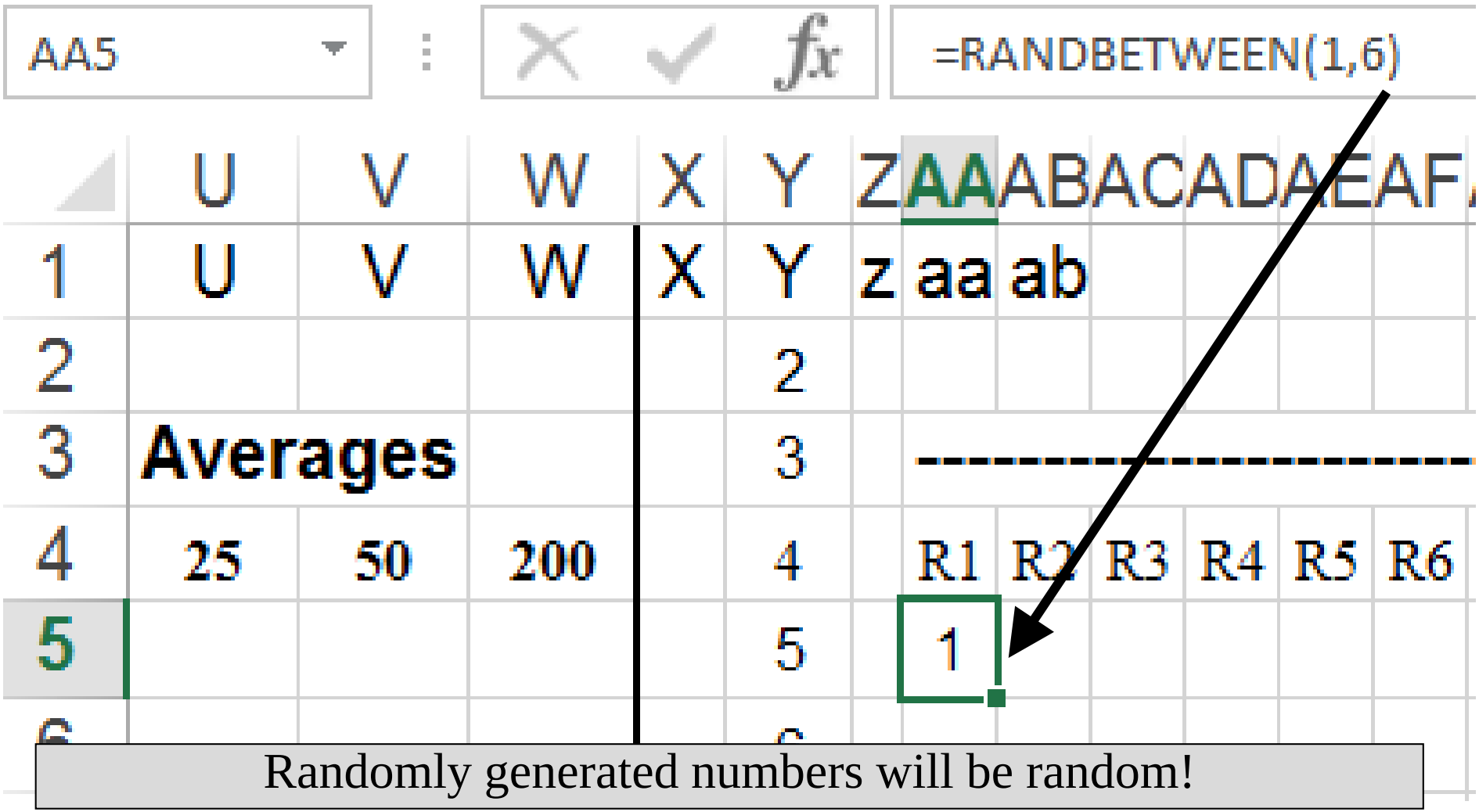
Steps in Creating Sampling Distributions for a single die

Access Pre-formatted Data Worksheet:

1. Insert RandBetween(1, 6) to simulate throw of die.
2. Create row averages: samples of 4, 16, 25, 50, 200.
3. Calculate population statistics for a single die.
4. Calculate summary sample statistics by sample size.
5. Group row averages into frequency bins.
6. Create line-graph histograms by sample size.

Upload completed worksheet.

1a: Insert RandBetween(1,6) Function in AA5



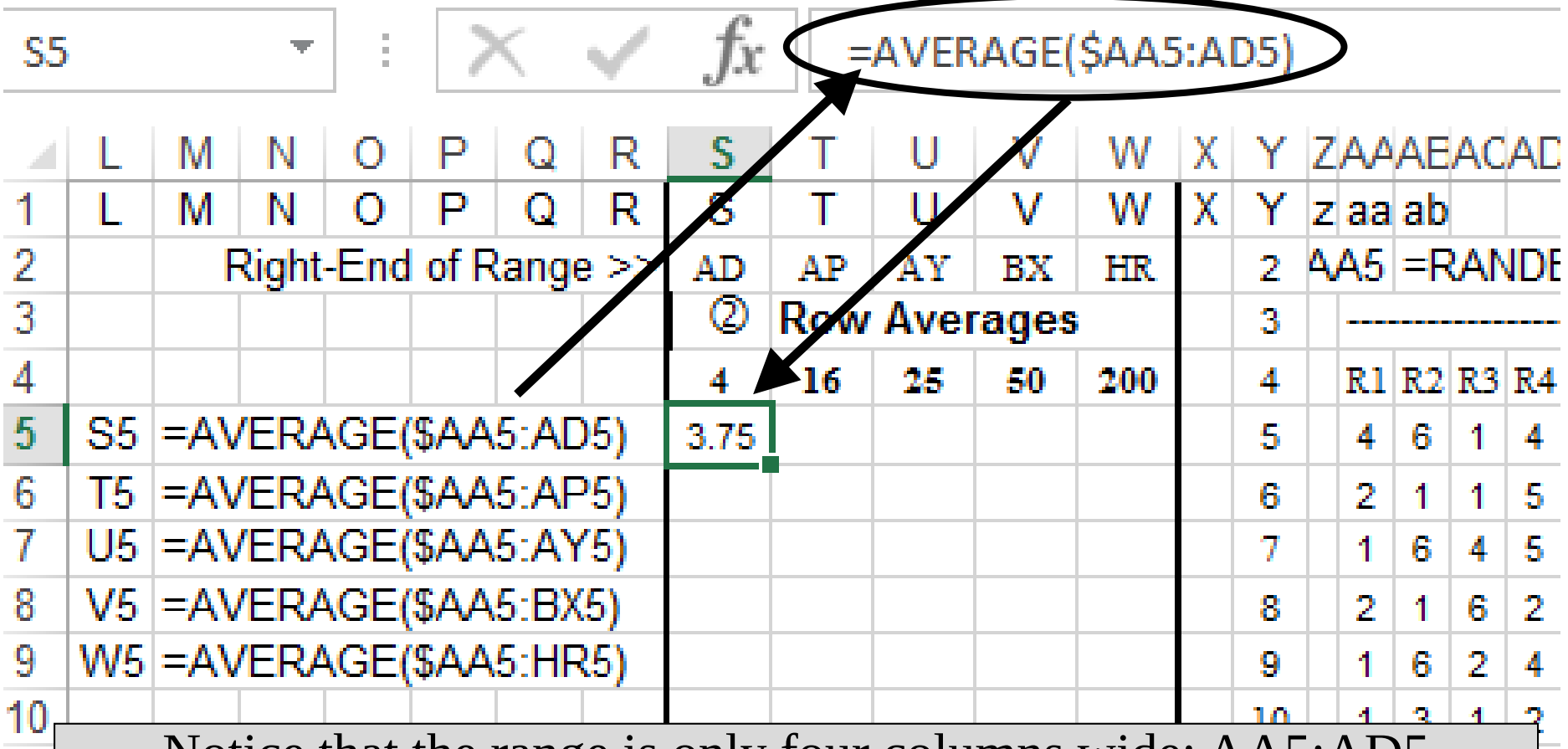
Randomly generated numbers will be random!

1b: Drag over 200 columns to the right to HR5

HF	HG	HH	HI	HJ	HK	HL	HM	HN	HO	HP	HQ	HR	HS	HT
														Row
														2
														3
188	189	190	191	192	193	194	195	196	197	198	199	200		4
6	6	5	5	1	2	5	4	1	2	5	6	6		5
														6
														7
														8
														9
														10

Drag this first row of random numbers down 200 rows to Row 204

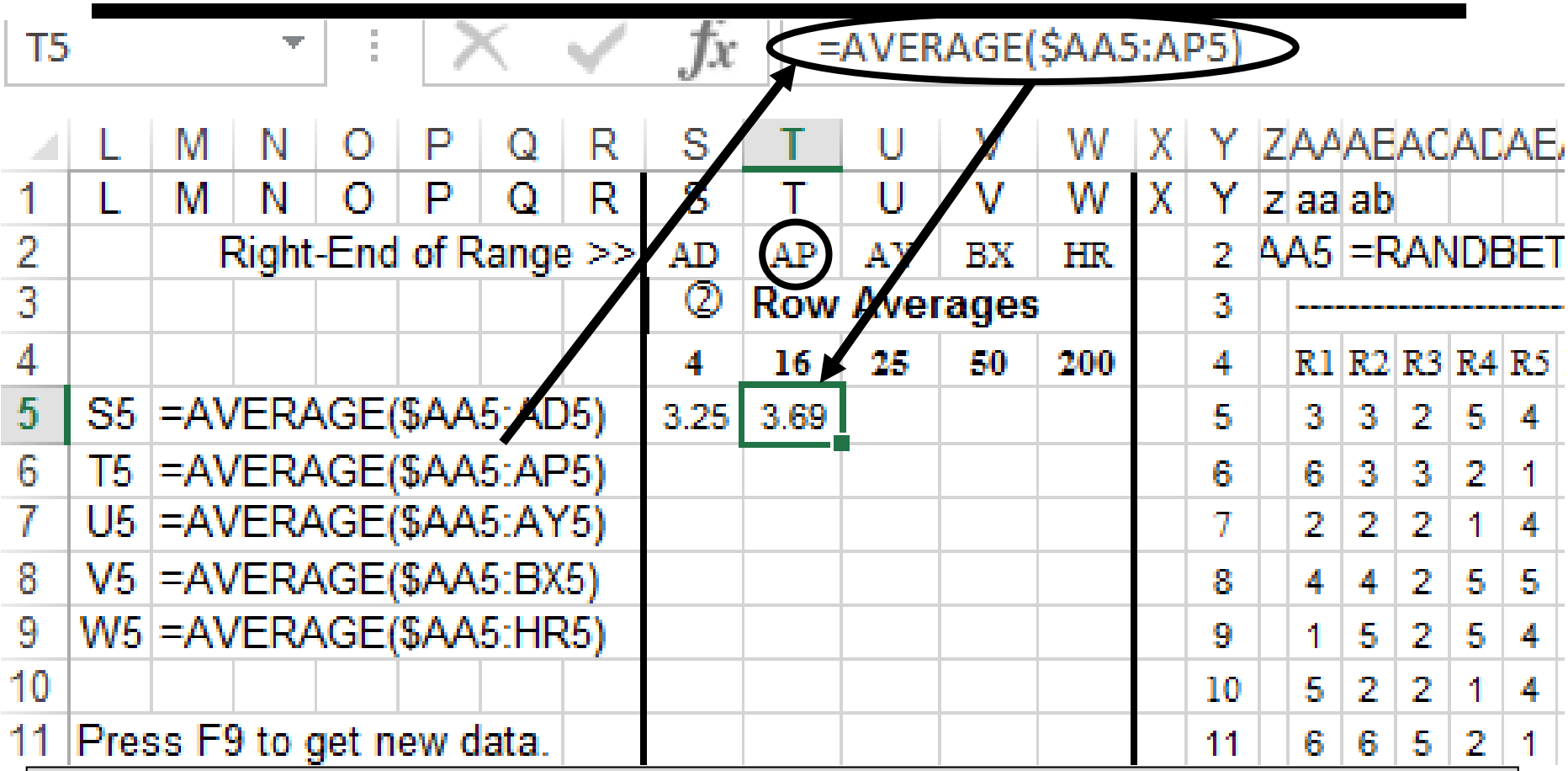
2a: In S5, create row average with sample size four



Notice that the range is only four columns wide: AA5:AD5

Averages of random numbers will be random!

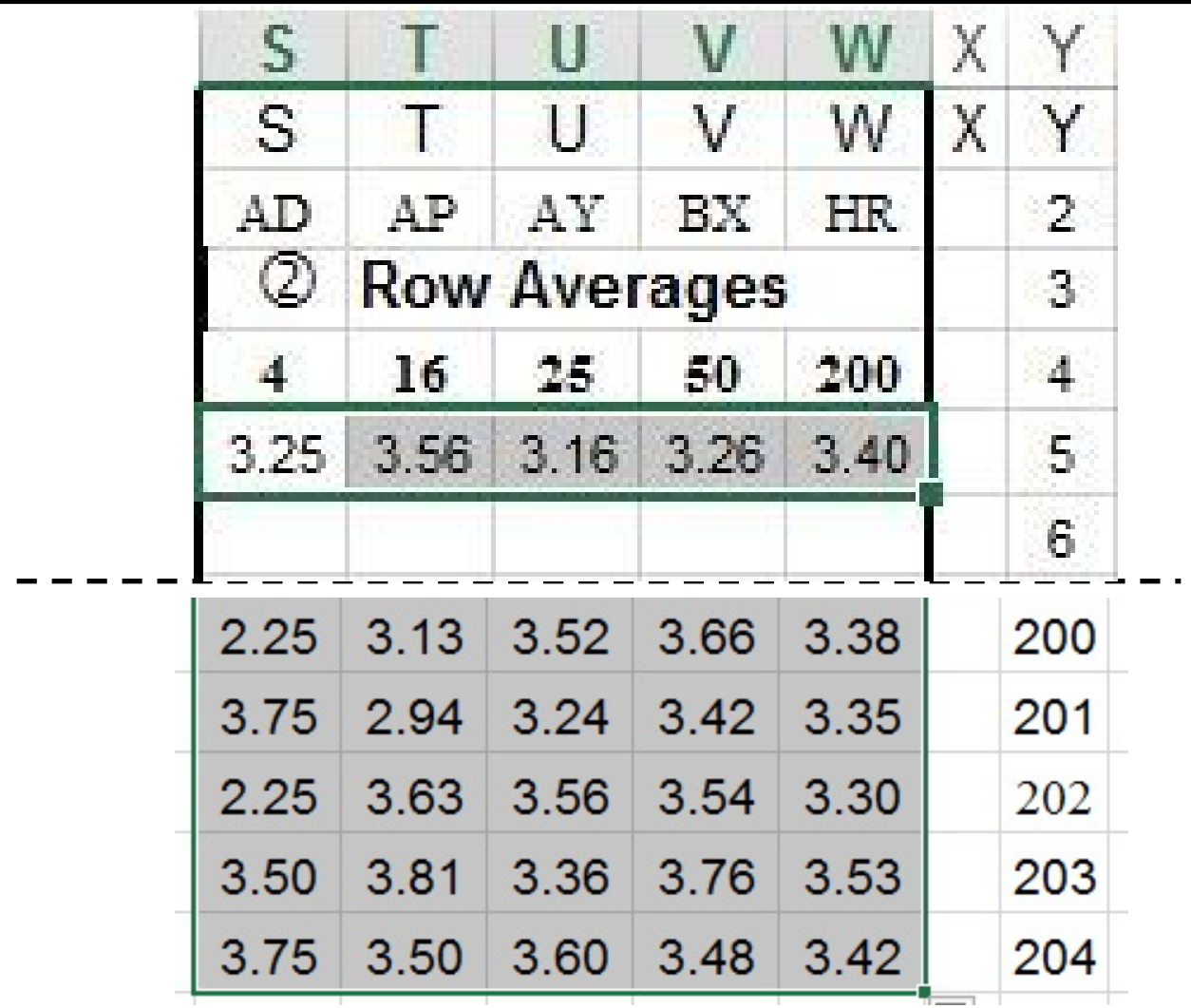
2b: In T5, create row average with sample size of 16



In U5:W5, create row averages for sample sizes 25, 50 and 200

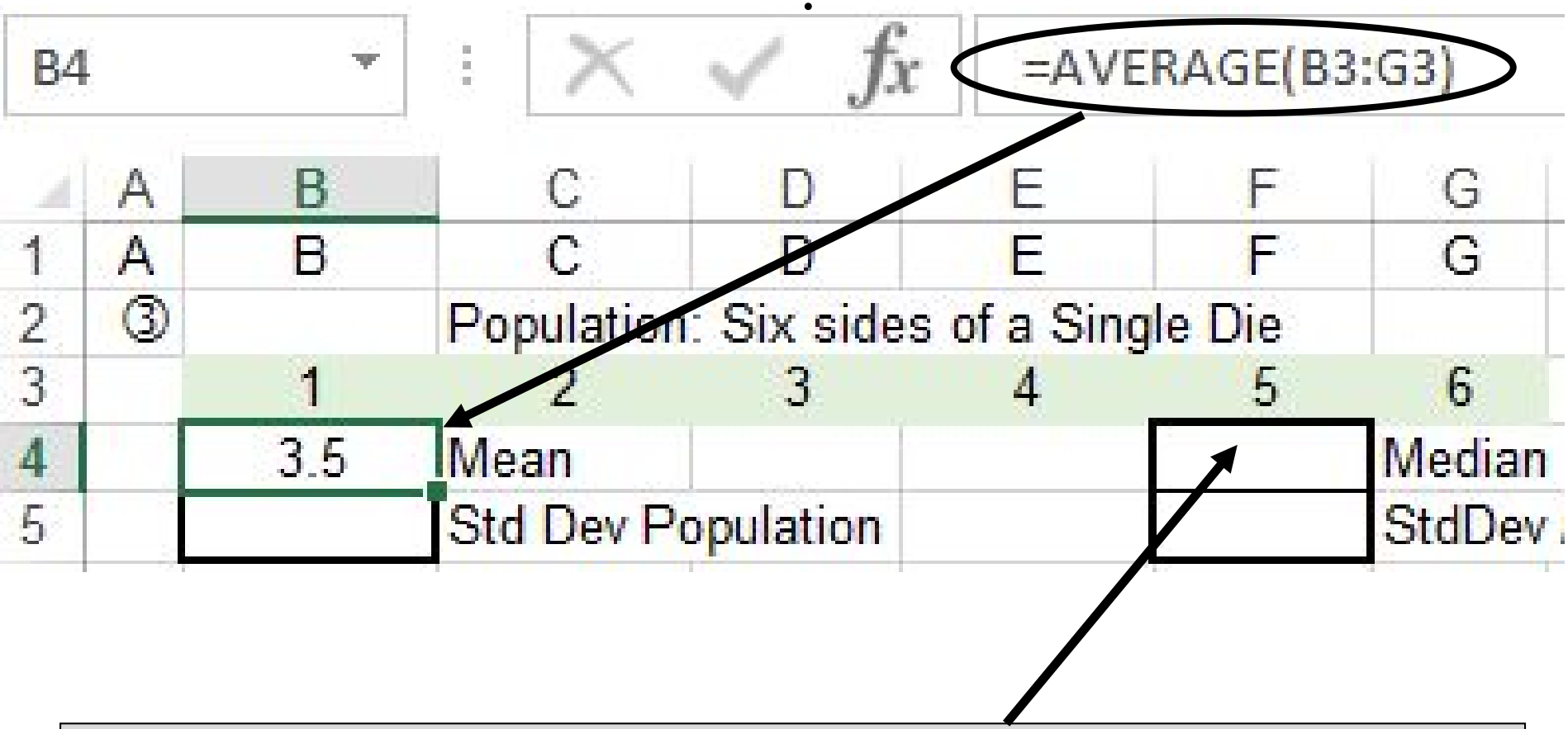
Right-end of ranges are shown in S2:W2

2d: Drag First Row Averages, S5:W5, down to Row 204.



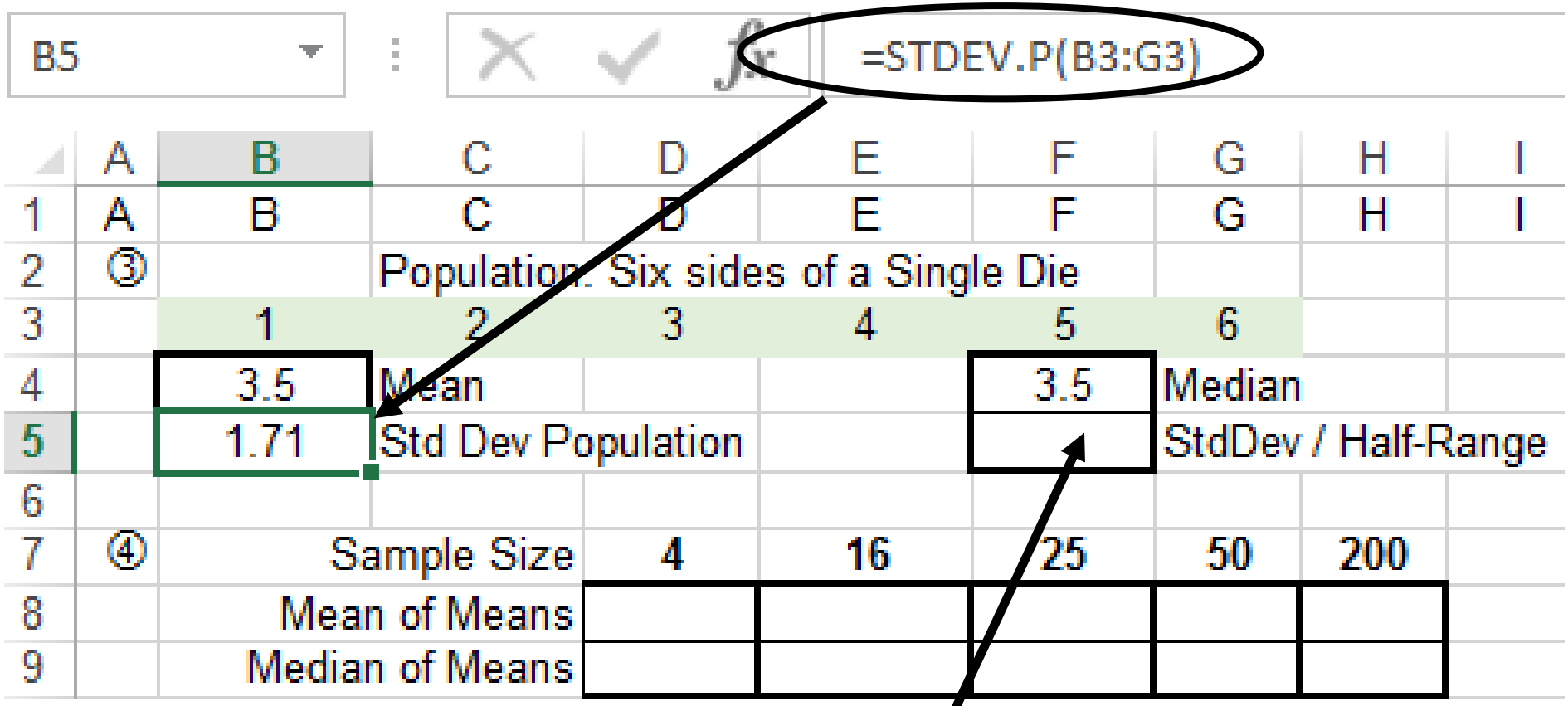
S	T	U	V	W	X	Y
S	T	U	V	W	X	Y
AD	AP	AY	BX	HR		2
②	Row Averages					3
4	16	25	50	200		4
3.25	3.56	3.16	3.26	3.40		5
						6
2.25	3.13	3.52	3.66	3.38		200
3.75	2.94	3.24	3.42	3.35		201
2.25	3.63	3.56	3.54	3.30		202
3.50	3.81	3.36	3.76	3.53		203
3.75	3.50	3.60	3.48	3.42		204

3a: Generate mean (average) [and median] for a six-sided die



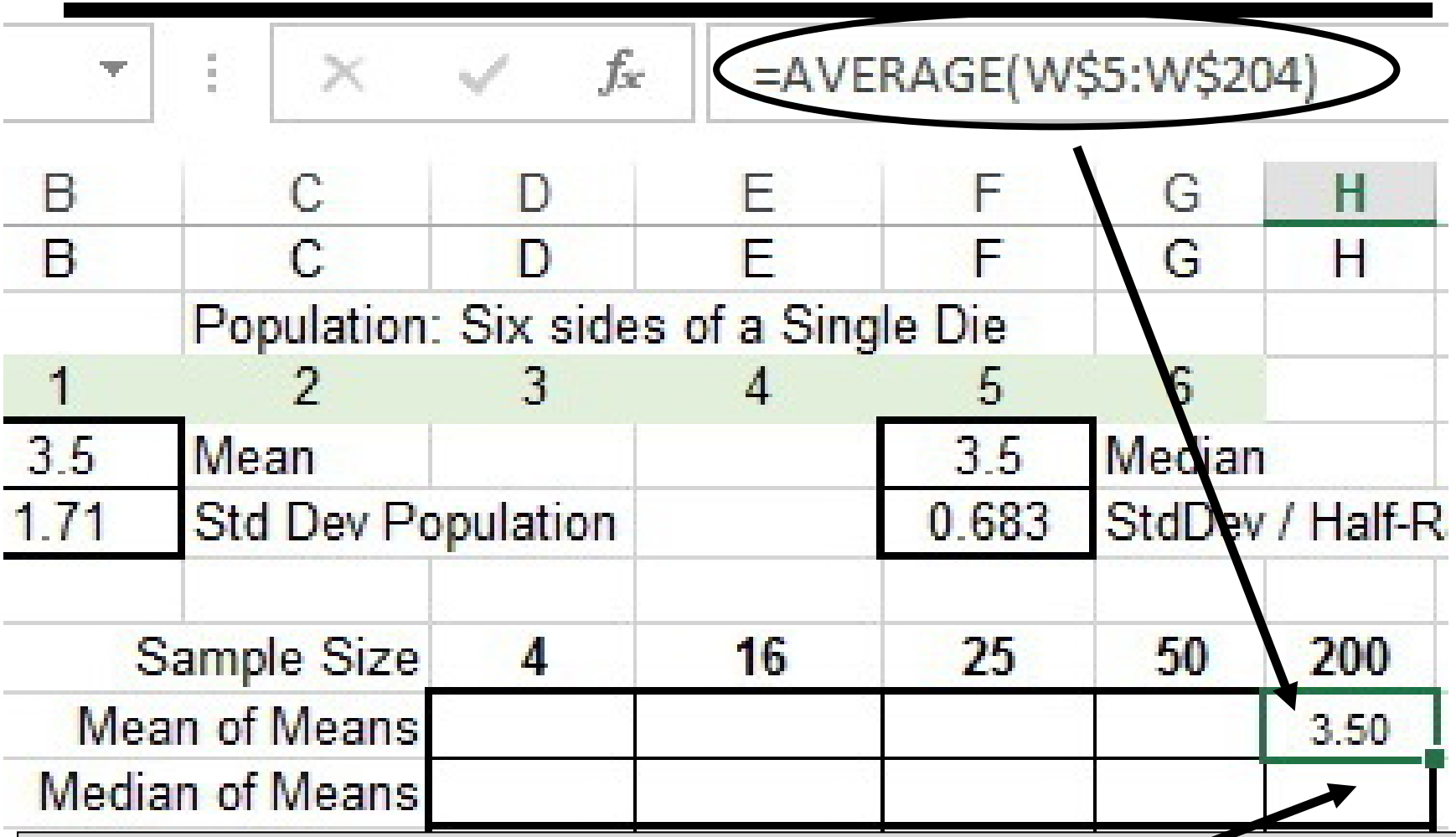
In cell F4, insert =Median(B3:G3)

3b: Generate population std. deviation for a fair die



In cell F5, insert =B5/((G3 – B3)/2)

4a: Generate Mean [& Median] of Row Means for Sample Size 200

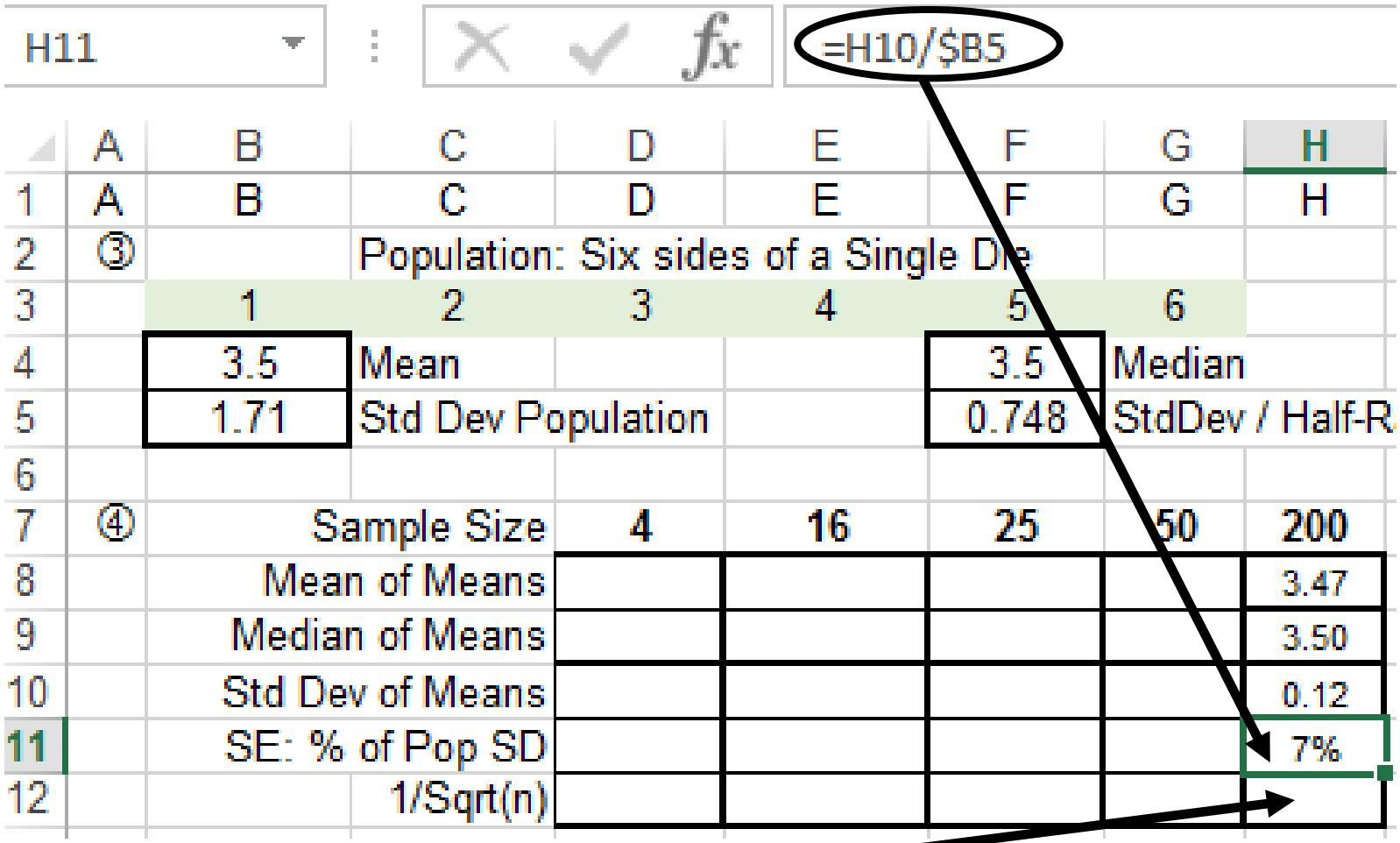


4b: Generate Sample Std.Dev of Row Means for Size 200

H10 =STDEV.S(W5:W204)

	A	B	C	D	E	F	G	H
1	A	B	C	D	E	F	G	H
2	③		Population: Six sides of a Single Die					
3		1	2	3	4	5	6	
4		3.5	Mean			3.5	Median	
5		1.71	Std Dev Population			0.748	StdDev / Half-R	
6								
7	④	Sample Size	4	16	25	50	200	
8		Mean of Means					3.46	
9		Median of Means					3.50	
10		Std Dev of Means					0.12	
11		SE: % of Pop SD						
12		1/Sqrt(n)						

4c: H11 Ratio of Std. Error to Population Std. Deviation



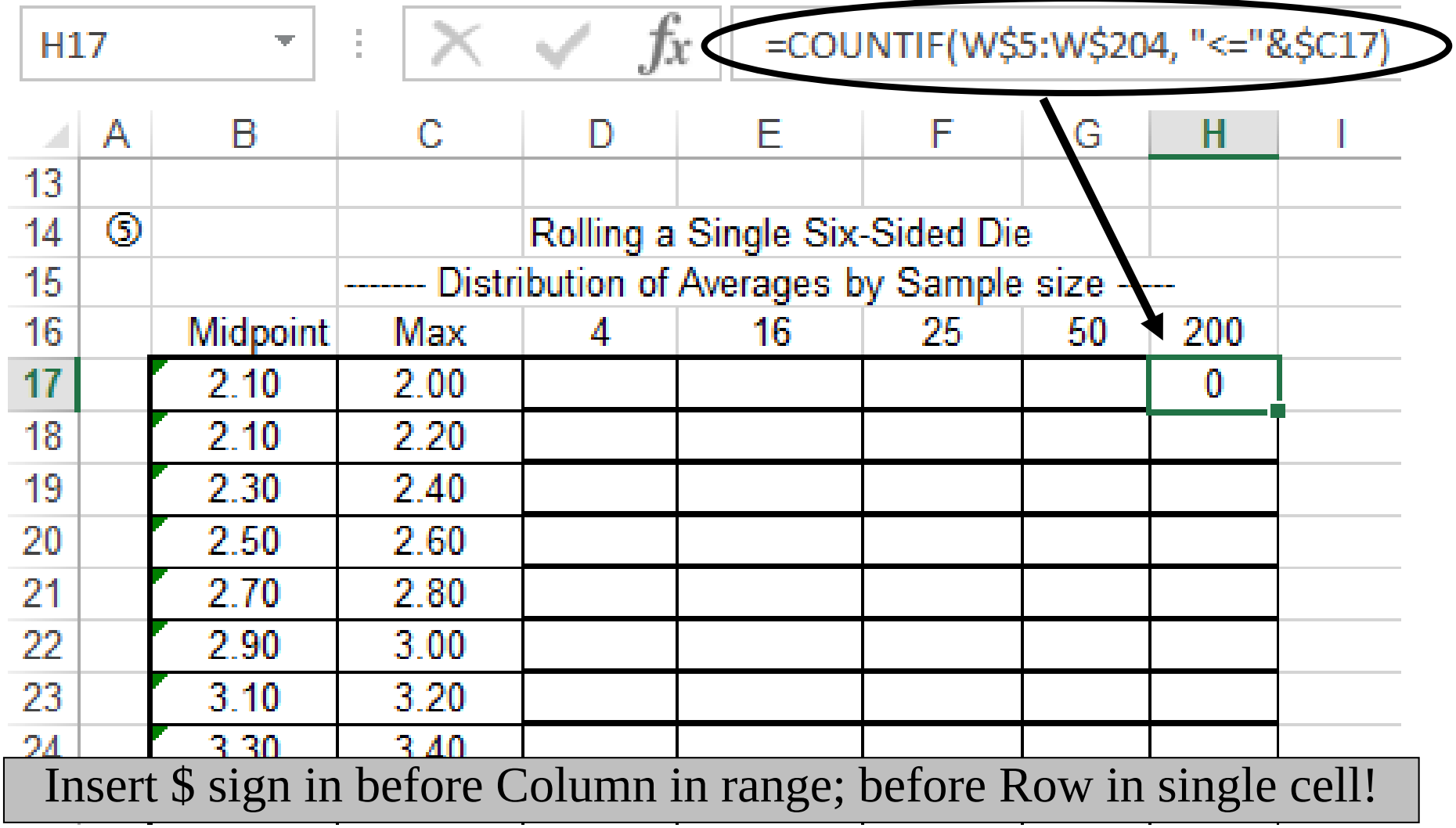
Insert =1/SQRT(H7) into cell H12

4d: Drag H8:H12 column left-ward to fill out the table

D11 =D10/$B5

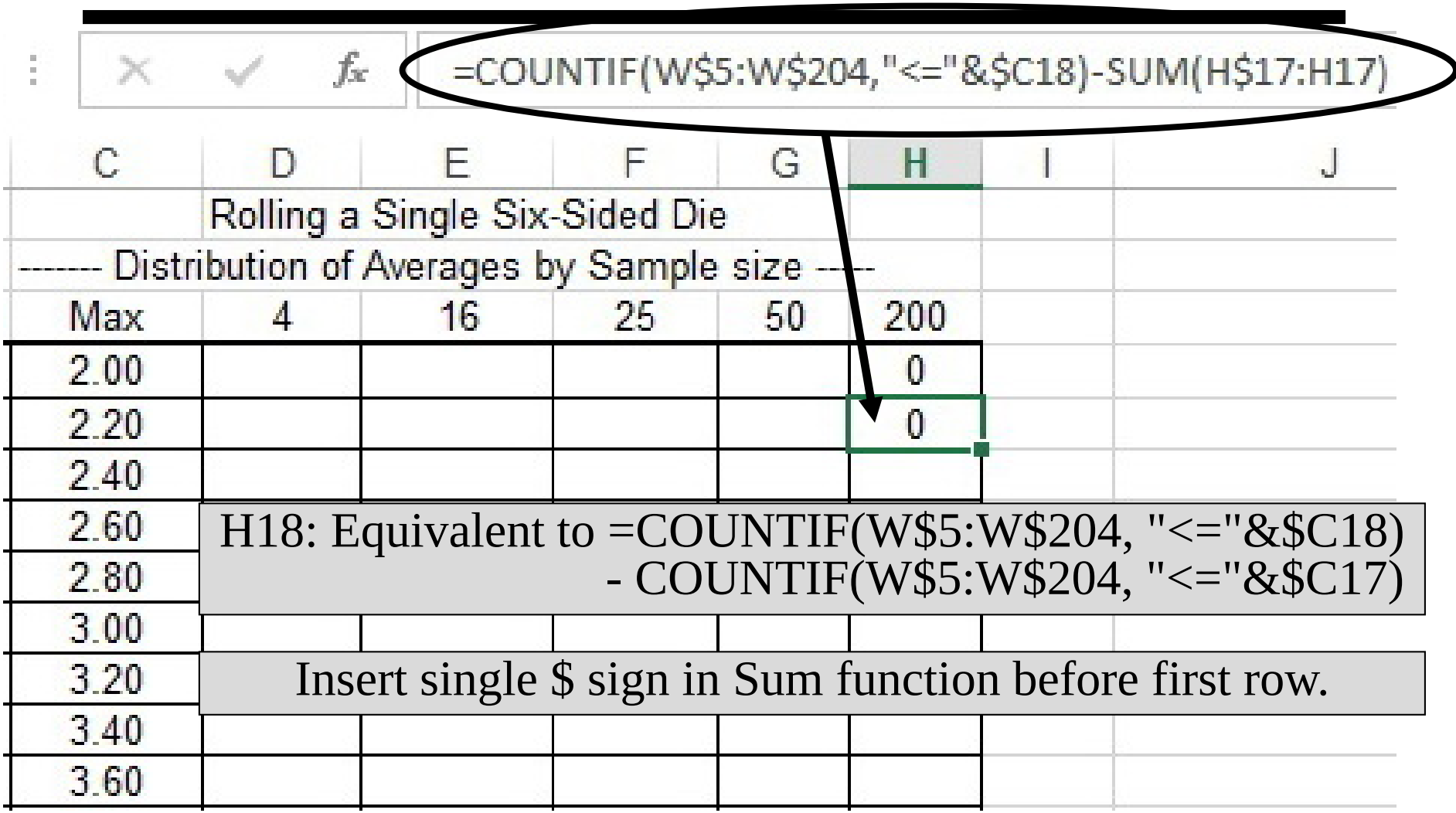
	A	B	C	D	E	F	G	H
1	A	B	C	D	E	F	G	H
2	③		Population: Six sides of a Single Die					
3		1	2	3	4	5	6	
4		3.5	Mean			3.5	Median	
5		1.71	Std Dev Population			0.748	StdDev / Half-R	
6								
7	④	Sample Size		4	16	25	50	200
8		Mean of Means		3.52	3.51	3.52	3.53	3.52
9		Median of Means		3.50	3.53	3.52	3.52	3.51
10		Std Dev of Means		0.85	0.41	0.34	0.24	0.12
11		SE: % of Pop SD		50%	24%	20%	14%	7%
12		1/Sqrt(n)		50%	25%	20%	14%	7%

5a: Insert COUNTIF function in H17



Insert $ sign in before Column in range; before Row in single cell!

5b: Insert "=CountIF() –Sum()" function in 2nd row: H18



5c: Drag H18, =CountIF() –Sum(), formula down to bottom row

H18 =COUNTIF(W$5:W$204, "<="&$C18)-SUM(H$17:H17)

	A	B	C	D	E	F	G	H	I	J
14	⑤			Rolling a Single Six-Sided Die						
15			------- Distribution of Averages by Sample size -----							
16		Midpoint	Max	4	16	25	50	200		
17		2.10	2.00					0		
18		2.10	2.20					0		
19		2.30	2.40					0		
20		2.50	2.60					0		
21		2.70	2.80					0		
22		2.90	3.00					0		
23		3.10	3.20					3		
24		3.30	3.40					44		
25		3.50	3.60					117		
26		3.70	3.80					36		
27		3.90	4.00					0		
28		4.10	4.20					0		
29		4.30	4.40					0		
30		4.50	4.60					0		
31		4.70	4.80					0		
32		4.90	5.00					0		
33		Total # of Samples		0	0	0	0	200		

Drag entire right column (H17:H32) left-ward to fill out frequency table.

Insert SUM at bottom of each column.

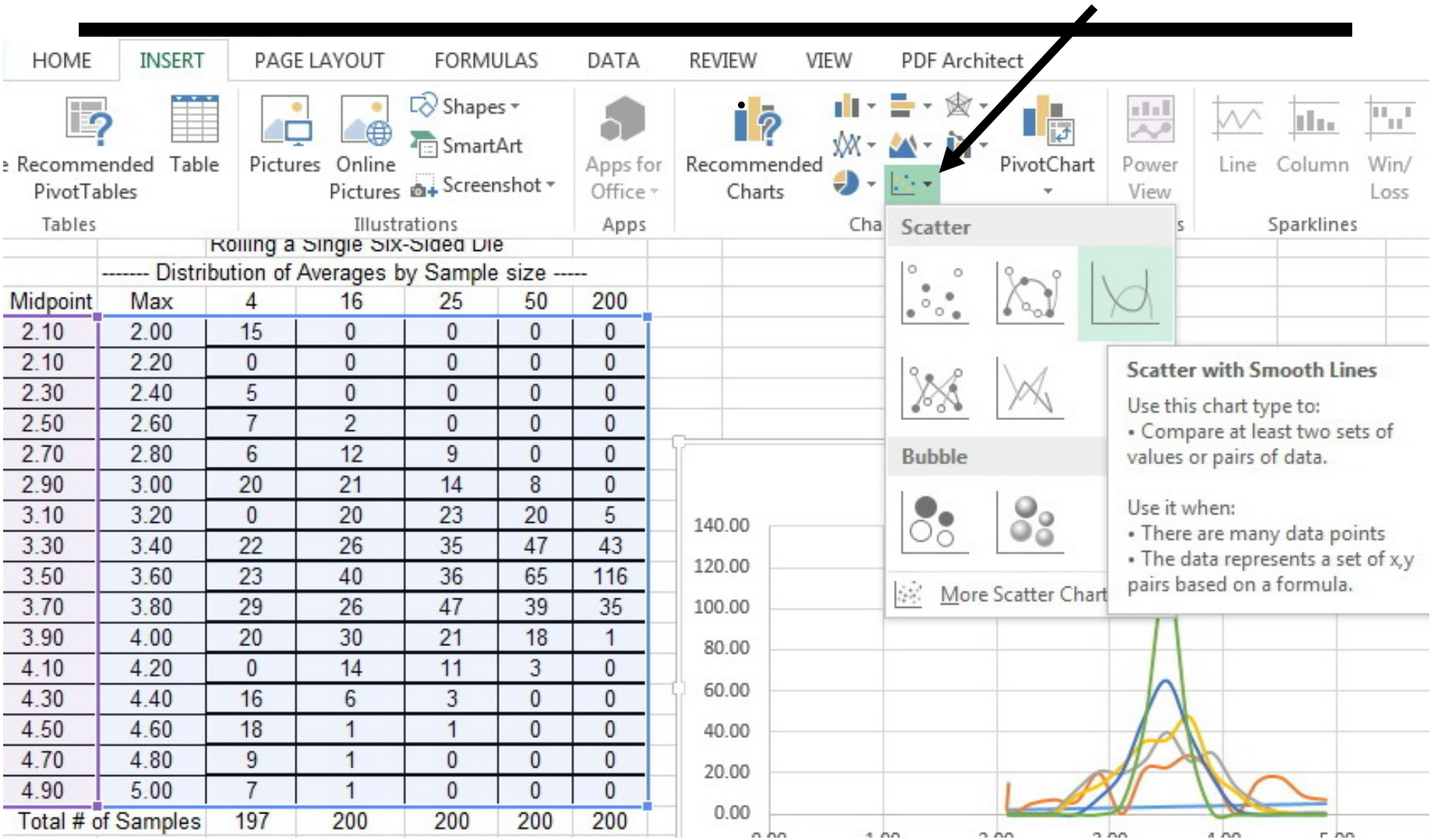
May be different from 200.

Do not include H17 when dragging H18 downward!!!

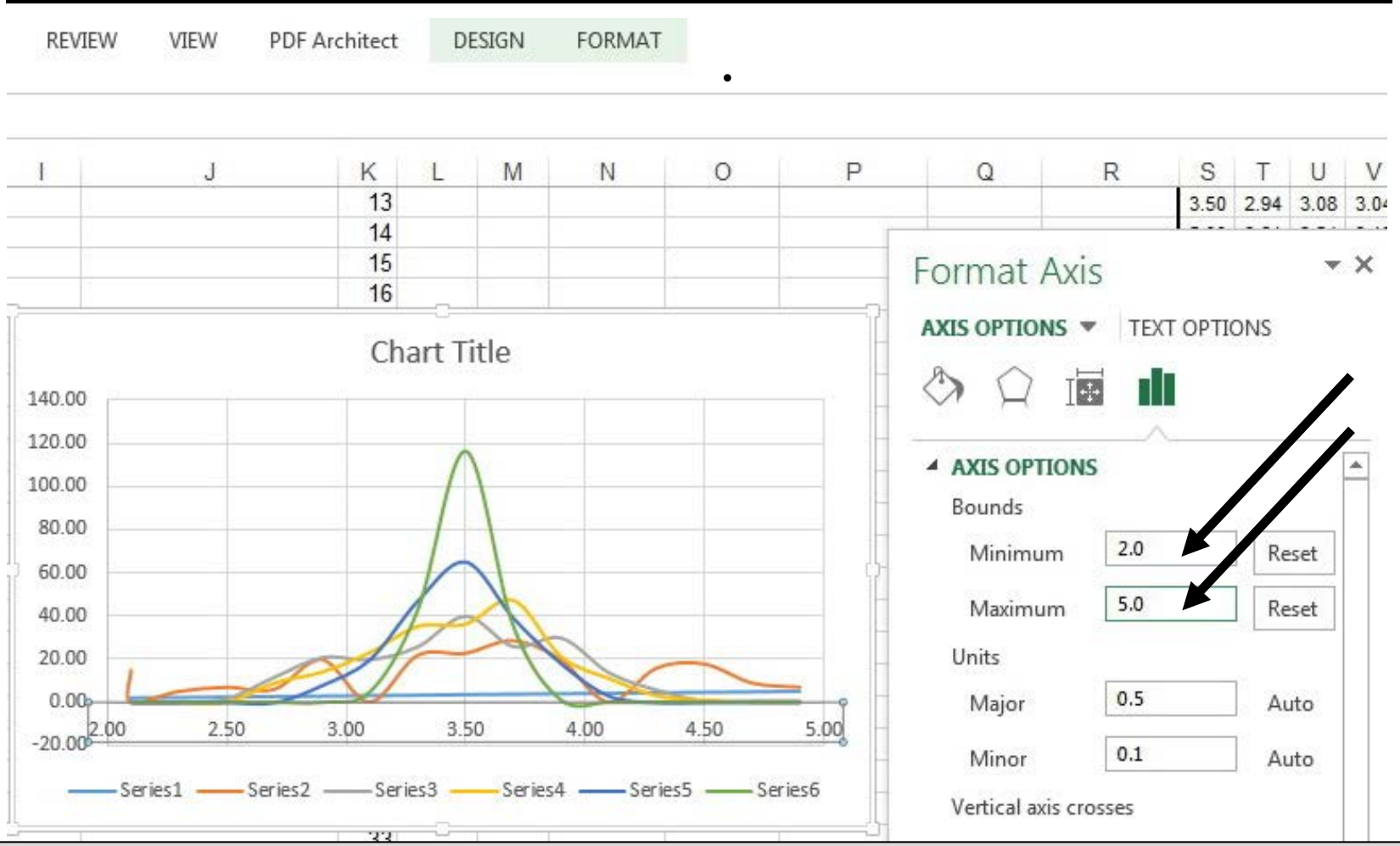
6a: Select Data (B17:H32) to use in Histogram

	A	B	C	D	E	F	G	H
14	⑤			Rolling a Single Six-Sided Die				
15				------- Distribution of Averages by Sample size -----				
16		Midpoint	Max	4	16	25	50	200
17		2.10	2.00	10	0	0	0	0
18		2.10	2.20	0	0	0	0	0
19		2.30	2.40	10	0	0	0	0
20		2.50	2.60	8	3	0	0	0
21		2.70	2.80	8	4	3	0	0
22		2.90	3.00	24	18	20	2	0
23		3.10	3.20	0	23	18	20	1
24		3.30	3.40	34	34	40	50	39
25		3.50	3.60	17	33	53	66	113
26		3.70	3.80	21	33	33	46	47
27		3.90	4.00	21	30	18	15	0
28		4.10	4.20	0	14	13	1	0
29		4.30	4.40	13	8	2	0	0
30		4.50	4.60	15	0	0	0	0
31		4.70	4.80	11	0	0	0	0
32		4.90	5.00	4	0	0	0	0
33		Total # of Samples		196	200	200	200	200

6b: Insert X-Y Scatter Plot



6c: Format Horizontal Axis: Change Min and Max



Delete legend.

6d: Select/delete Series 5 (size 50), 3 (size 16) and 1 (Max).

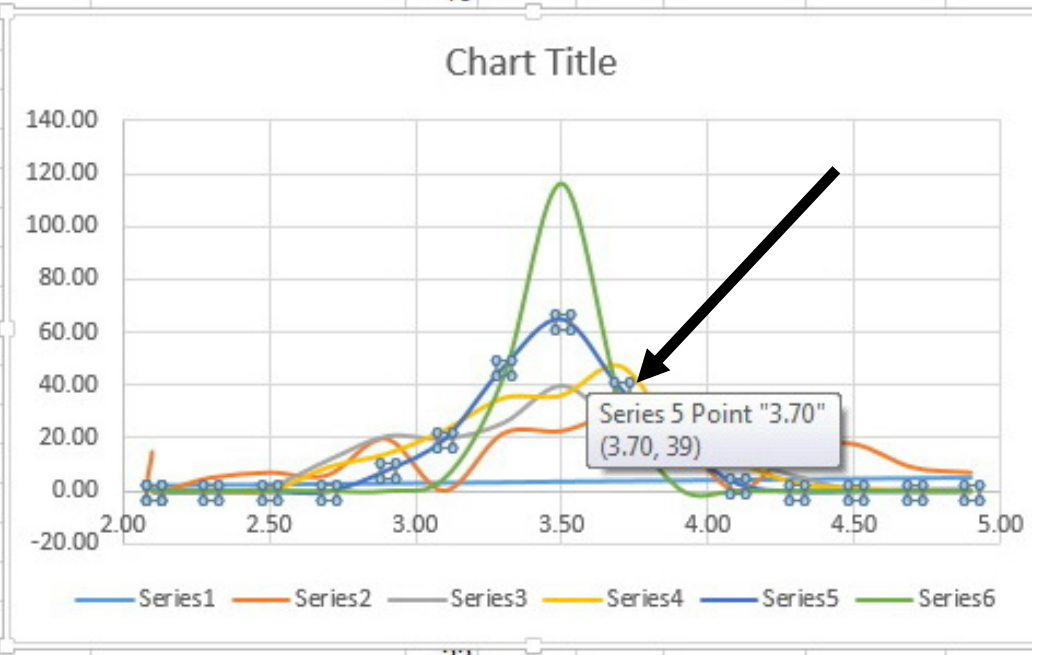
HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW PDF Architect DESIGN FORMAT

=SERIES(,Data!$B$17:$B$32,Data!$G$17:$G$32,5)

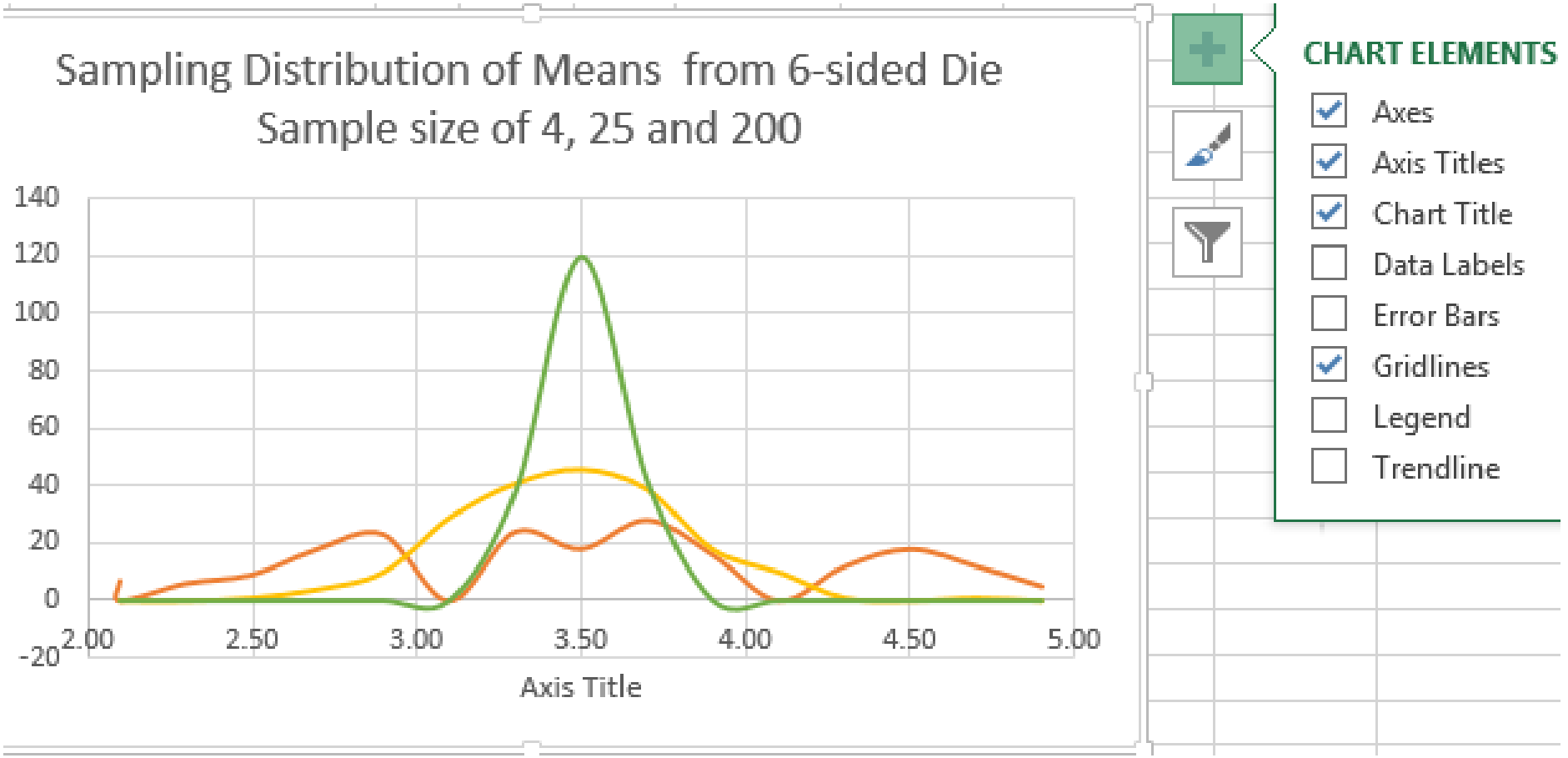
Rolling a Single Six-Sided Die

------- Distribution of Averages by Sample size -----

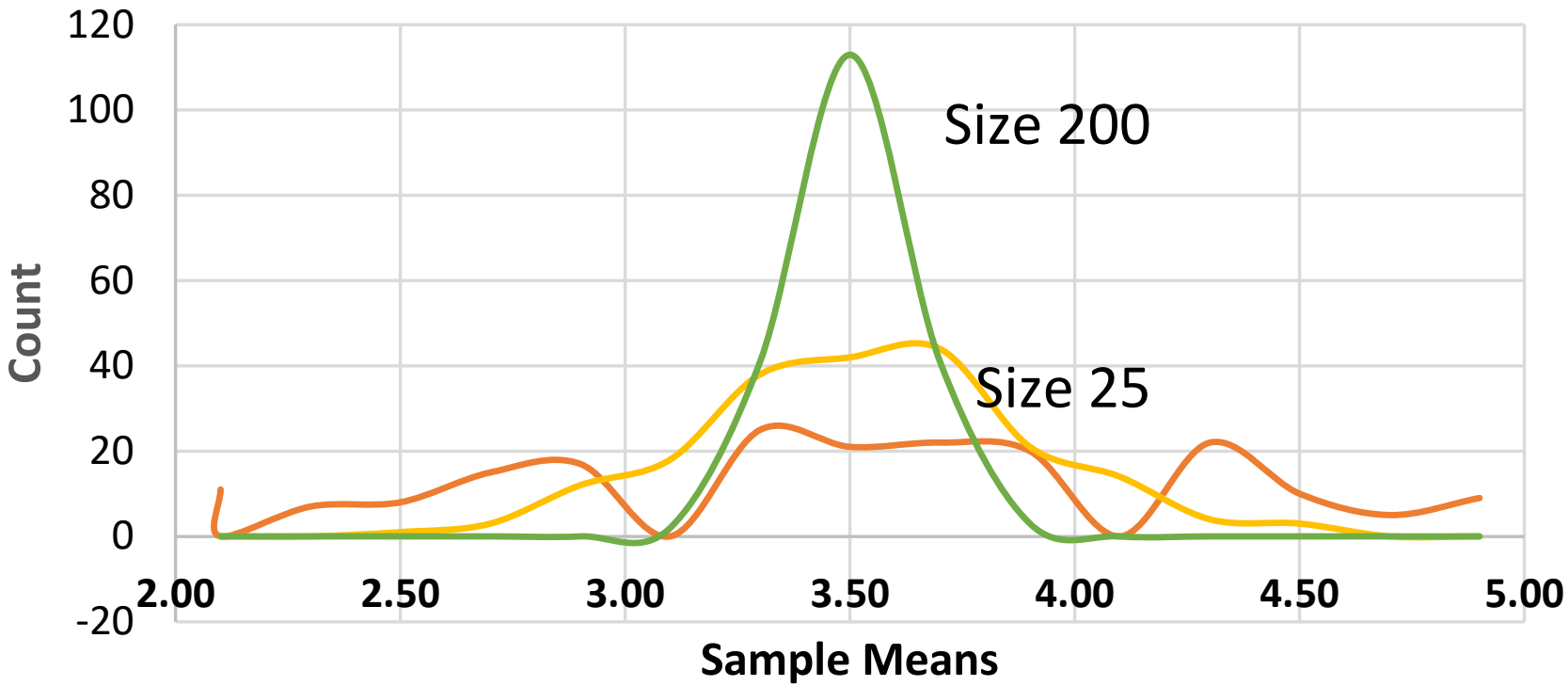
Midpoint	Max	4	16	25	50	200
2.10	2.00	15	0	0	0	0
2.10	2.20	0	0	0	0	0
2.30	2.40	5	0	0	0	0
2.50	2.60	7	2	0	0	0
2.70	2.80	6	12	9	0	0
2.90	3.00	20	21	14	8	0
3.10	3.20	0	20	23	20	5
3.30	3.40	22	26	35	47	43
3.50	3.60	23	40	36	65	116
3.70	3.80	29	26	47	39	35
3.90	4.00	20	30	21	18	1
4.10	4.20	0	14	11	3	0
4.30	4.40	16	6	3	0	0
4.50	4.60	18	1	1	0	0
4.70	4.80	9	1	0	0	0
4.90	5.00	7	1	0	0	0
Total # of Samples		197	200	200	200	200



6e: Insert Title and Horizontal Axis Text



6f: Insert legends in text boxes. Final Result



Summary

When sampling from a process, the population "size" is "infinite". That doesn't influence the standard deviation.

Notice as sample size increases, the standard error (the std. deviation of the sample means) quickly decreases – as a percentage of the population standard deviation.

A sample of size 4 is expected to have a standard error that is only a half of the population standard deviation: a sample of 25 has a fifth, a sample of 100 has a tenth and a sample of 10,000 has a hundredth.