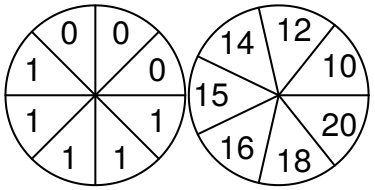
Spinner homework

Homework due Feb 11th

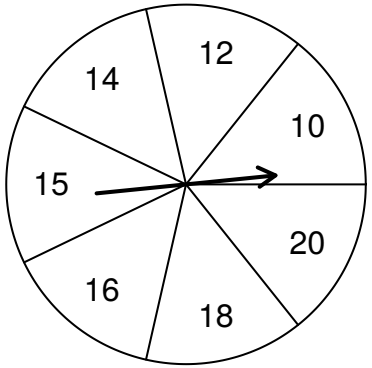
- Pick a spinner or other random number generator (X)
  - Show or describe the spinner in the report
- Plot a running average with at least 10 spins
  - Also, make a table showing the spins and calculations
  - Also, **describe** what you think the running average would do if you continued with more spins.
- Sample from $X + X + X$ at least 10 times; determine sample mean and sample standard deviation.
  - Also, make a table showing the measurements and calculations
- Sample from $3X$ at least 10 times; determine the sample mean and sample standard deviation.
  - Also, make a table showing the measurements and calculations
- In your own words, explain why $X + X + X$ has a smaller standard deviation than $3X$.
- Combine all work, with descriptions/explanations, into a report. Staple the pages together.

Pick a spinner (or any random number generator)

- Pick a spinner or some other random number generator
- Some options (pick one):
  - Make your own spinner
  - Use a die (or dice) (directly or with a transformation table)
  - Use a provided spinner
  - Use a computer's random number generator
    - Spreadsheets have `rand()` function, which generates standard uniform measurements
    - R has various functions: `sample()`, `rnorm()`, `runif()`, `rgeom()`, ...
- Examples:



Example with equally sized wedges



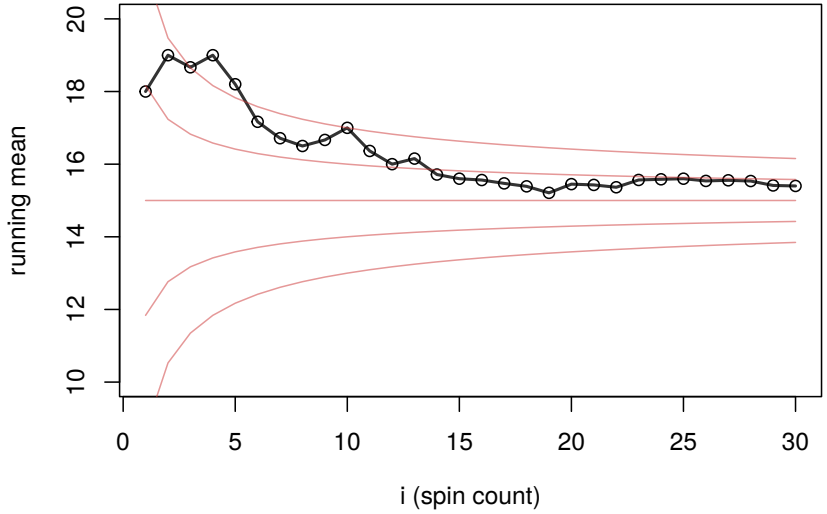
$$\mu = \frac{\sum X}{N} = 15$$

$$\sigma = \sqrt{\frac{\sum (X - \mu)^2}{N}} = 3.1623$$

Running average table

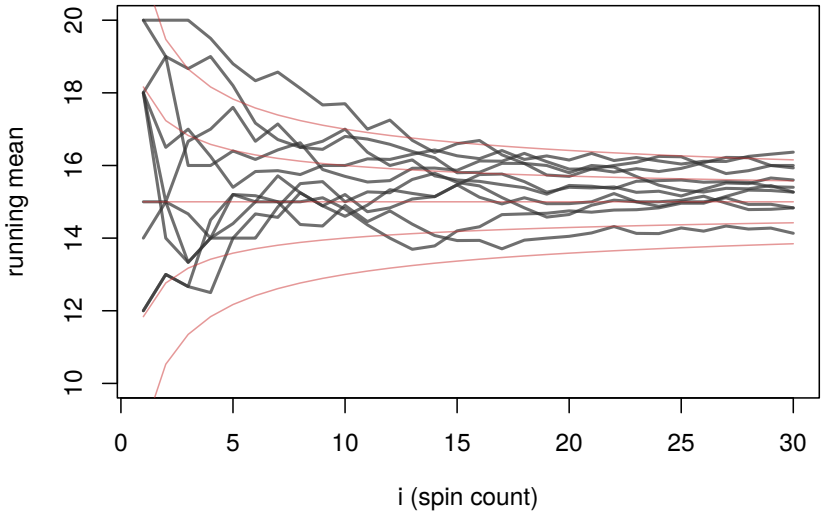
i	x	$\sum x$	$\bar{x} = \frac{\sum x}{i}$
1	18	18	18
2	20	38	19
3	18	56	18.6666667
4	20	76	19
5	15	91	18.2
6	12	103	17.1666667
7	14	117	16.7142857
8	15	132	16.5
9	18	150	16.6666667
10	20	170	17
11	10	180	16.3636364
⋮	⋮	⋮	⋮

Running-averages plot



The smooth curves represent $\mu \pm 2\frac{\sigma}{\sqrt{i}}$ and $\mu \pm \frac{\sigma}{\sqrt{i}}$ and μ. You do not need to draw them, but you can.

Overlay of multiple running-averages



This is a **lot** of work by hand. Feel free to overlay multiple running averages if you use a computer. You can just show work for one.

Sample from $X + X + X$

Each measurement takes three spins.

x_1	x_2	x_3	$x_1 + x_2 + x_3$
10	14	14	38
16	15	16	47
16	20	16	52
16	12	14	42
16	14	14	44
16	20	20	56
12	15	14	41
12	16	10	38
15	12	12	39
14	20	12	46
=====	=====	=====	=====
			total = 443
			mean = 44.3
			stdev = 6.0562181

Sample from $3X$

Each measurement takes three spins.

x	$3x$
14	42
18	54
18	54
16	48
10	30
10	30
20	60
18	54
15	45
20	60
=====	=====
	total = 477
	mean = 47.7
	stdev = 10.9954536

Theory (linear combination of random variables)

- If X and Y represent two random variables, and a and b represent two constants, then:

$$SD(aX + bY) = \sqrt{a^2 SD(X)^2 + b^2 SD(Y)^2}$$

$$SD(X + Y) = \sqrt{SD(X)^2 + SD(Y)^2}$$

$$SD(X+X) = \sqrt{SD(X)^2 + SD(X)^2} = \sqrt{2SD(X)^2} = \sqrt{2}SD(X)$$

$$SD(X + X + X) = \sqrt{SD(X)^2 + SD(X)^2 + SD(X)^2}$$

$$SD(aX) = \sqrt{a^2 SD(X)^2} = a \cdot SD(X)$$