An Overview of Distributions and How to Describe Them

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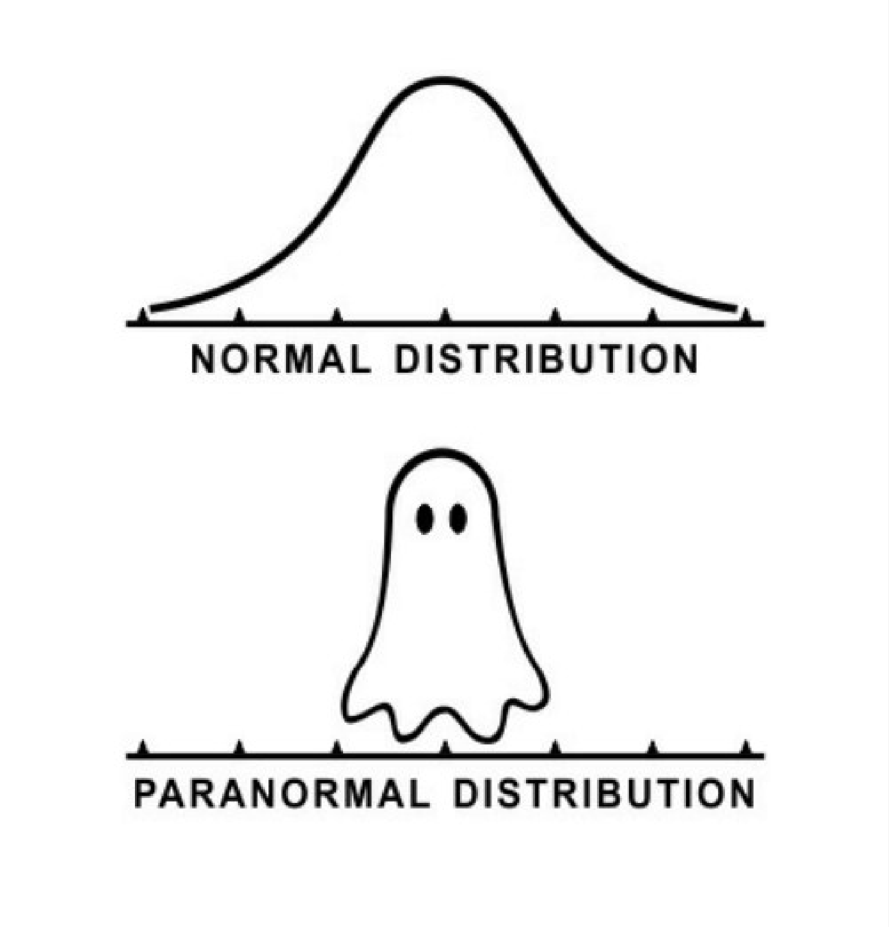
Two Topics will be covered

- Overview of different types of distributions of data

- Some metrics to describe them

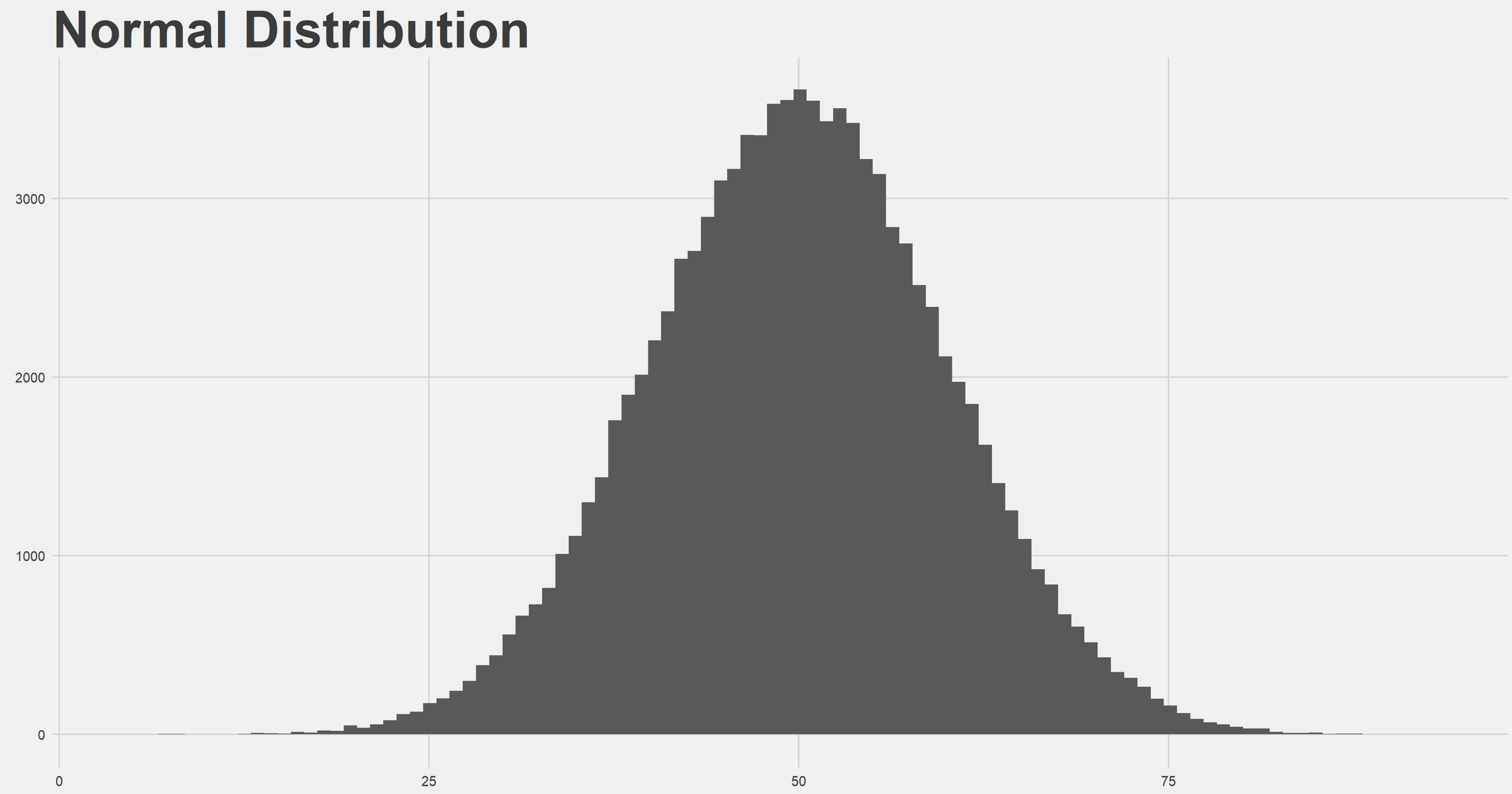
What’s in a name….



What’s in a name

- A distribution is the form and frequency that the data take
  - What is its measure of central tendency
    - Mean
    - Median
    - Mode
  - How “spread out” is it
    - Range
    - Standard Deviation
  - How “peaky” is the distribution
    - Kurtosis

Our friend the normal distribution



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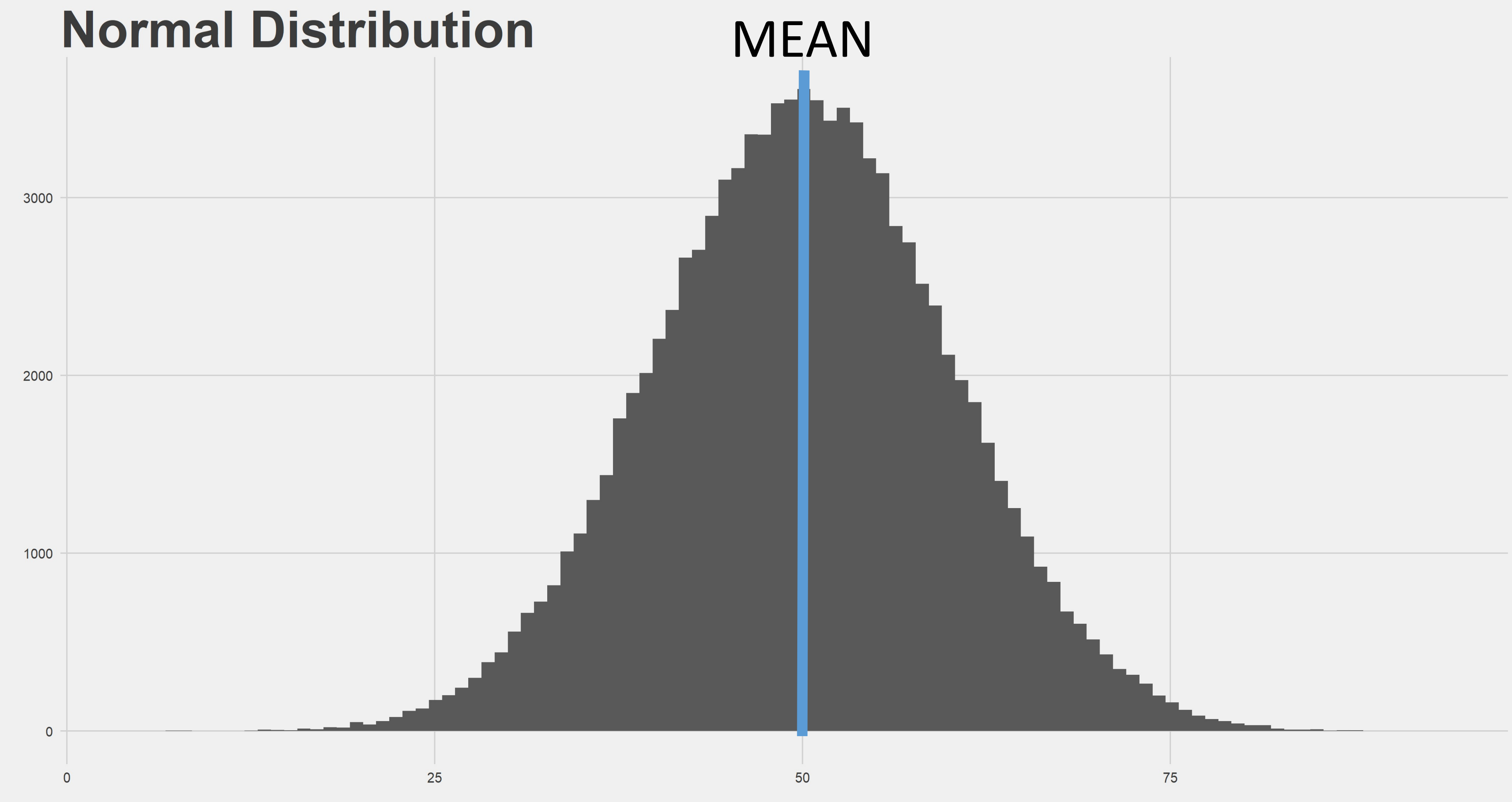

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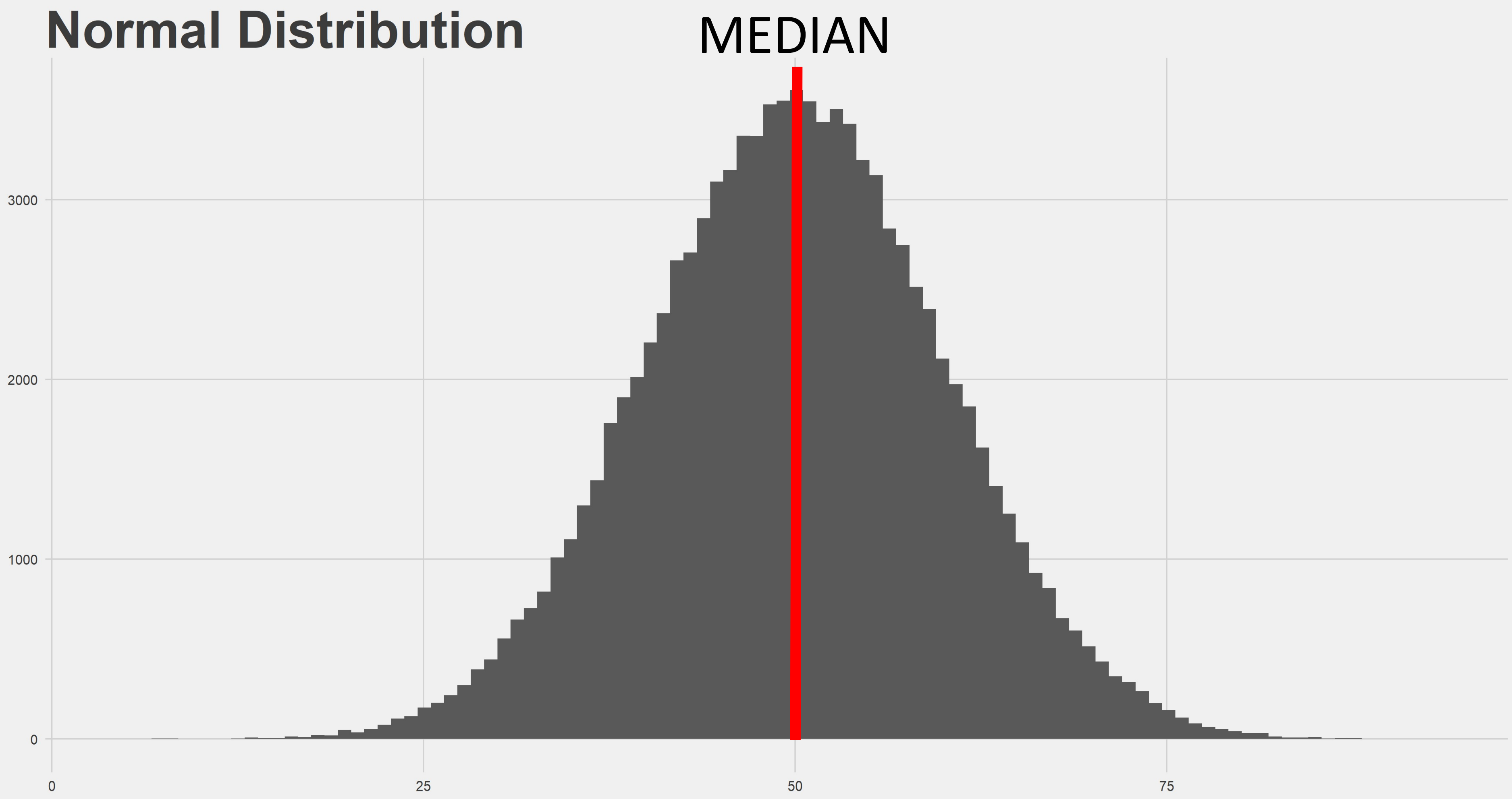

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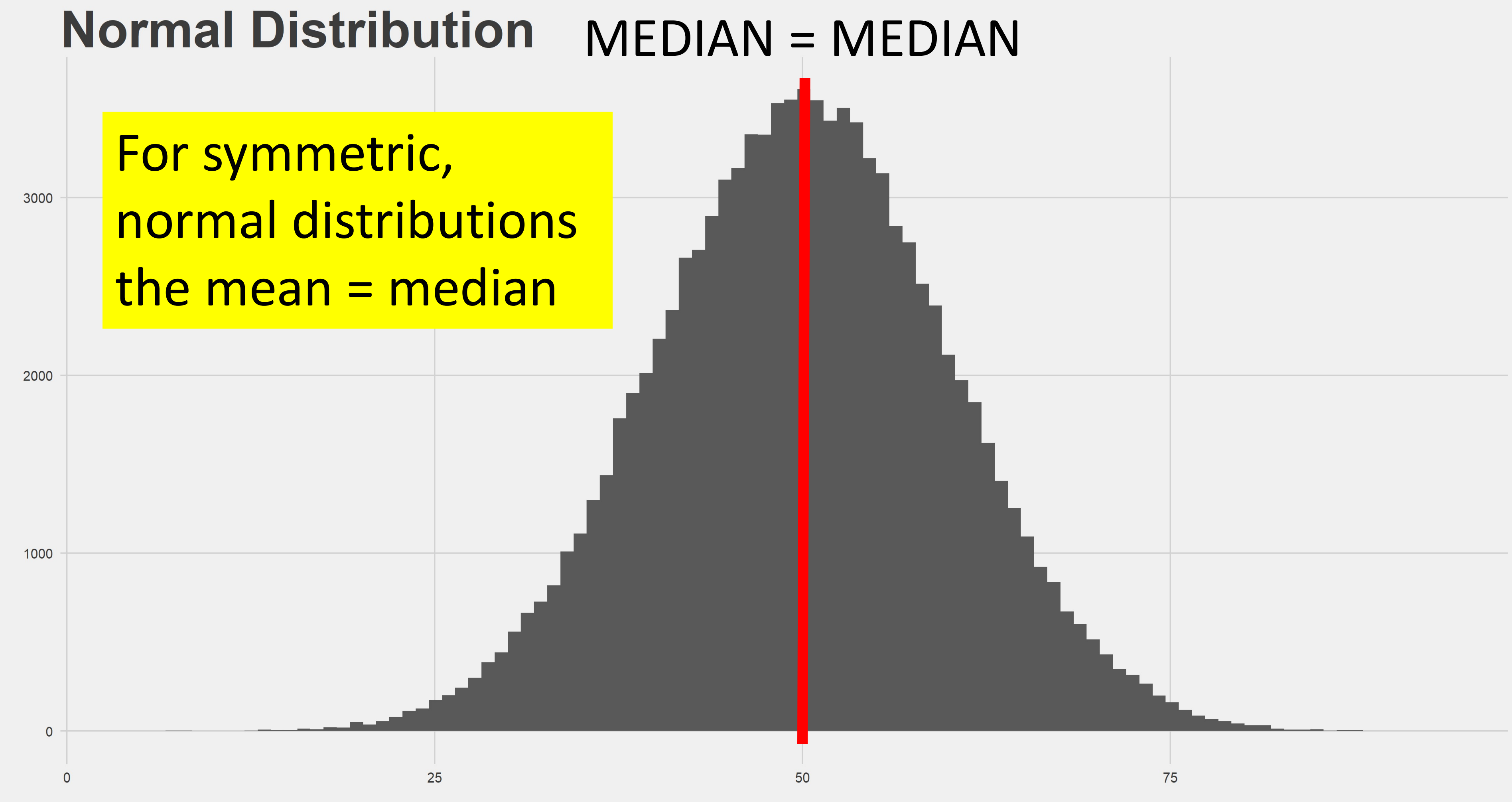
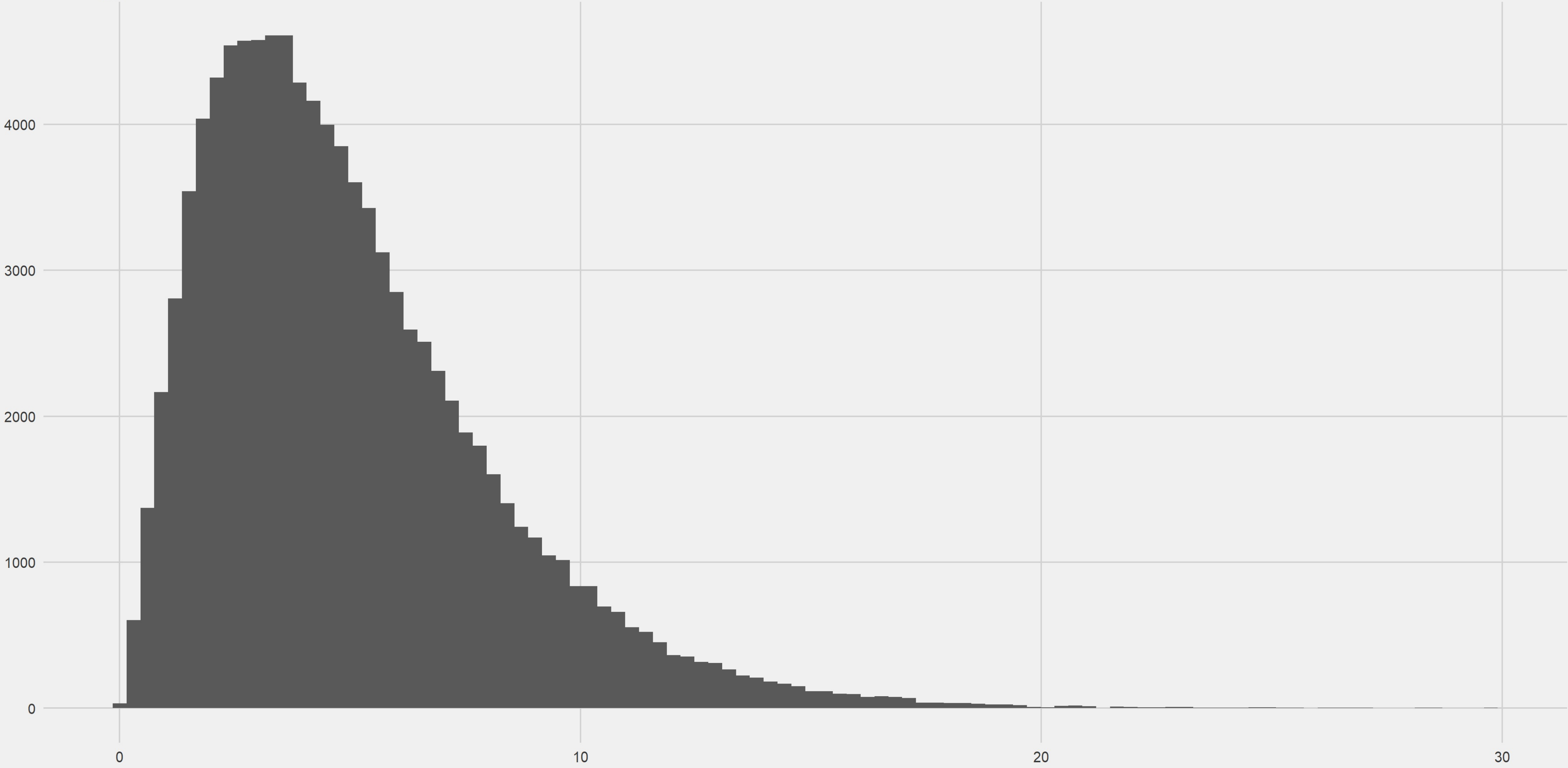


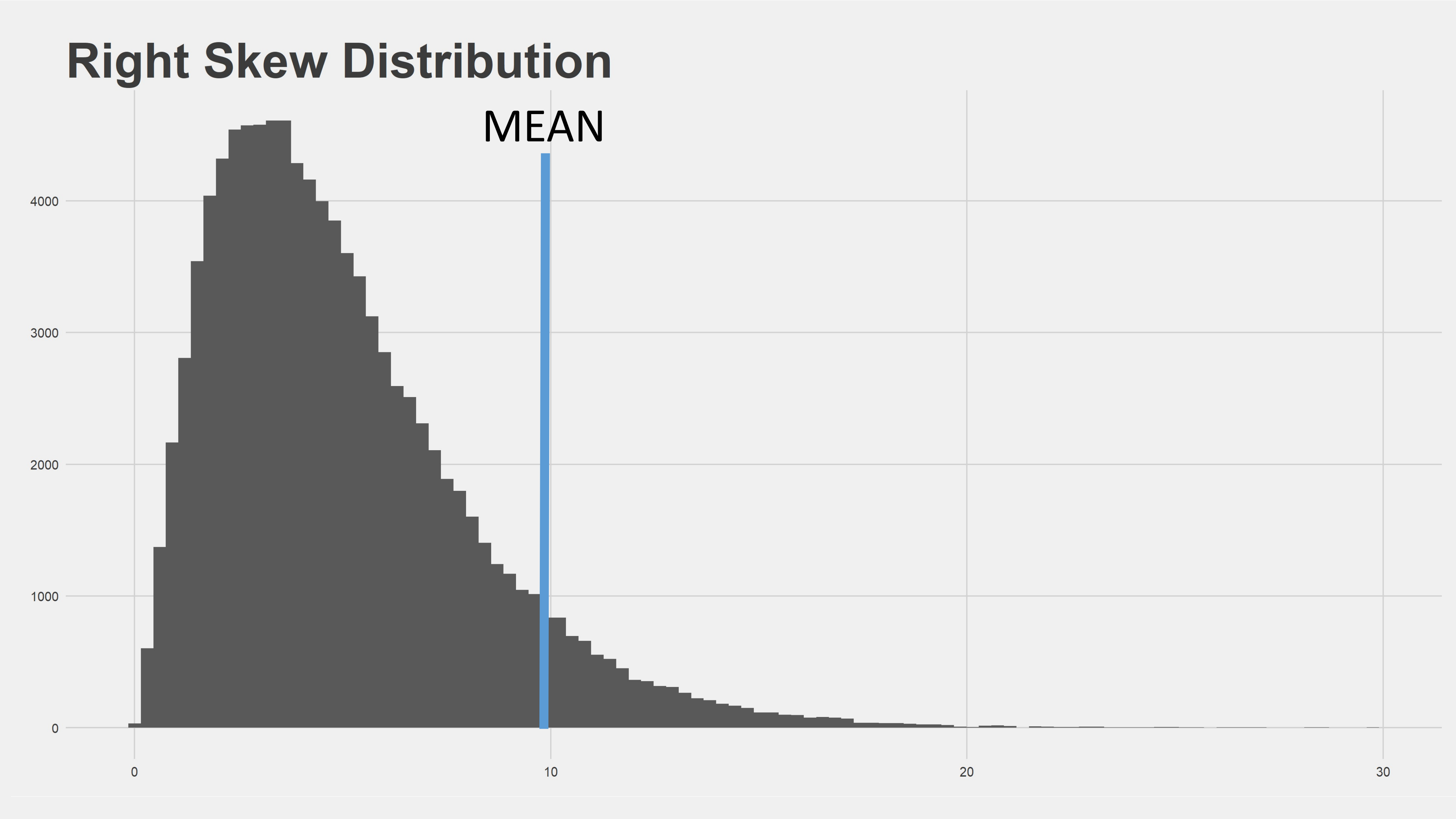
Normal Distribution

MEDIAN = MEDIAN

For symmetric, normal distributions the mean = median

Right Skew Distribution





Right Skew Distribution

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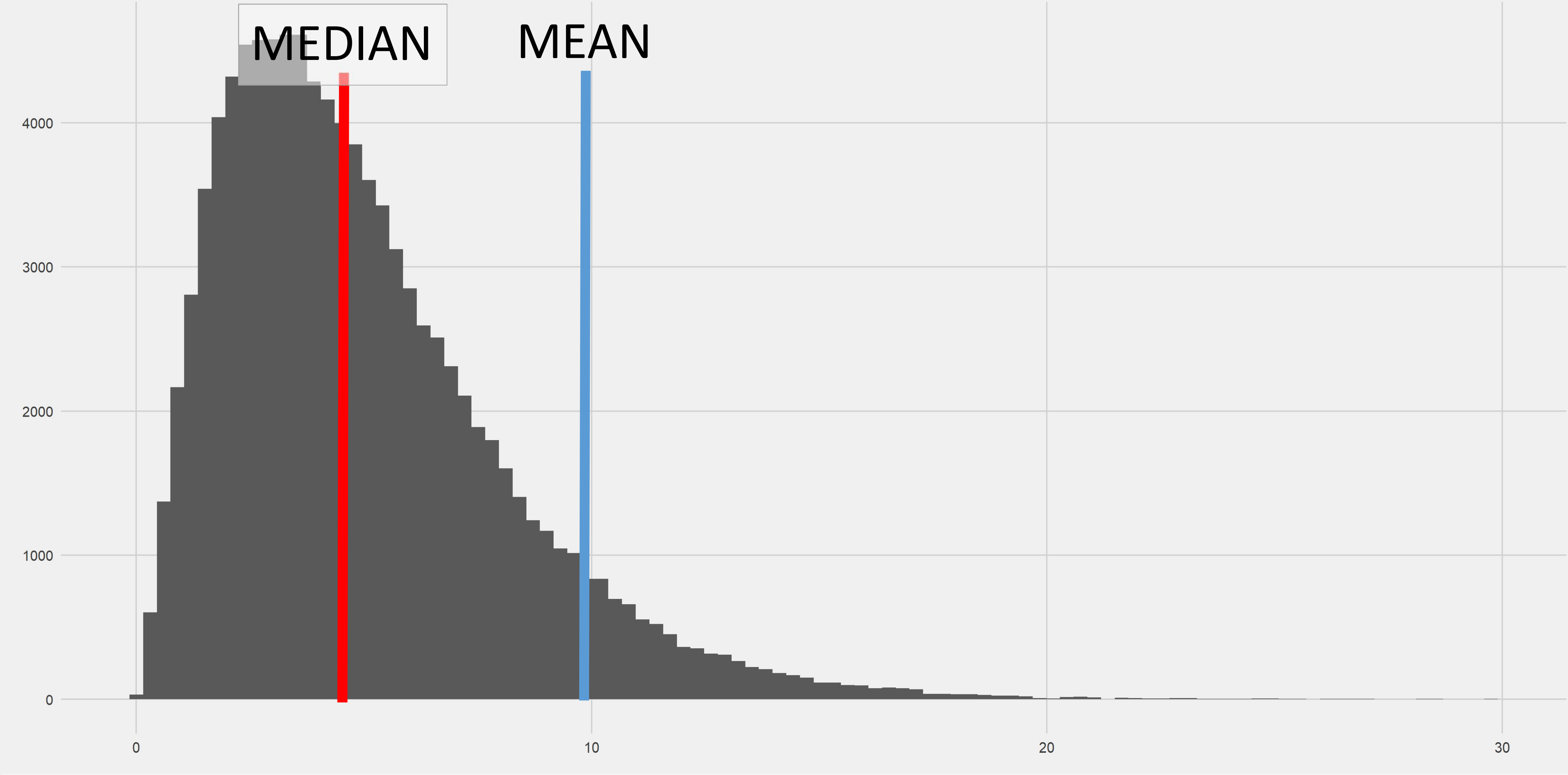

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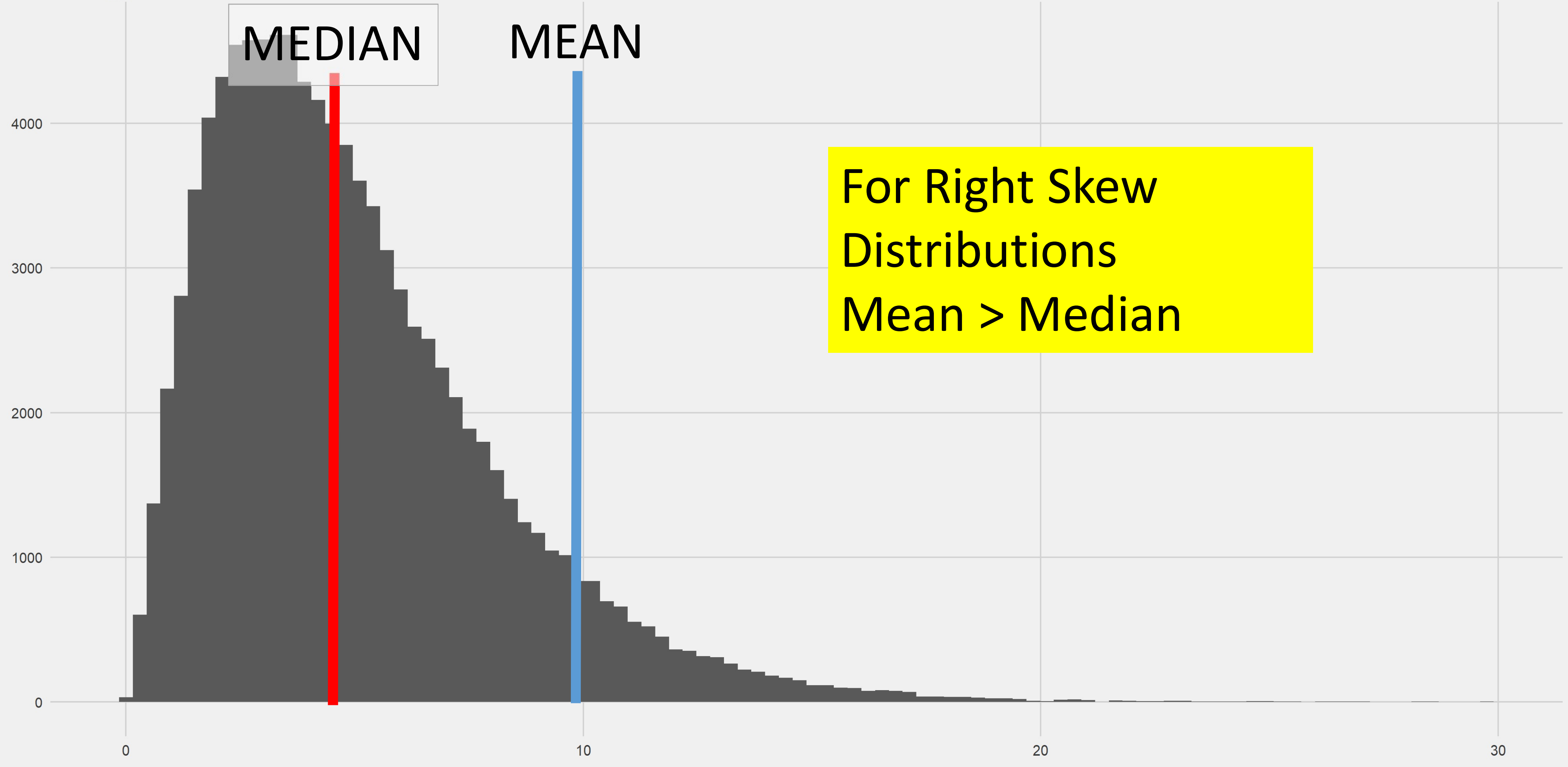
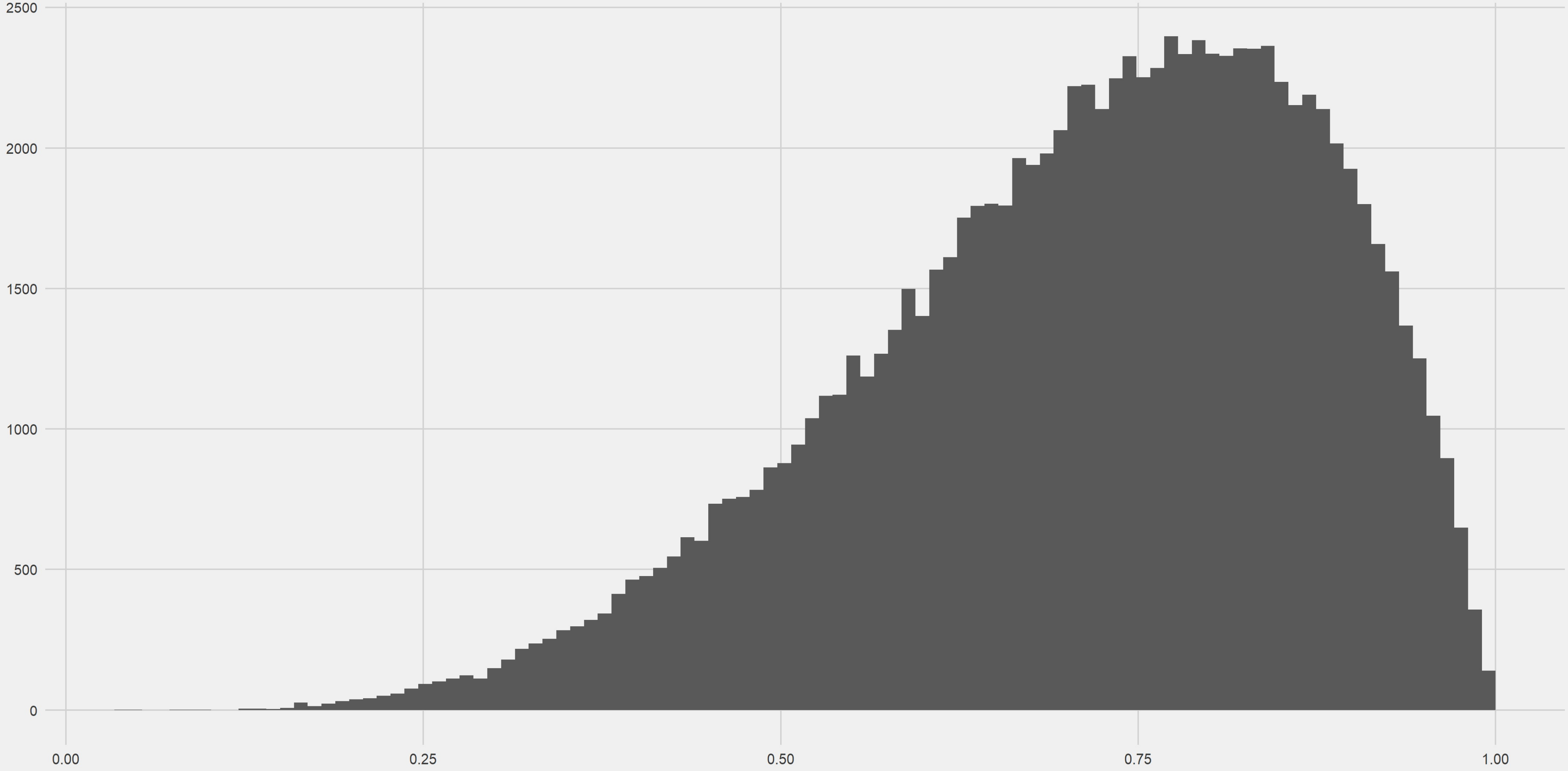
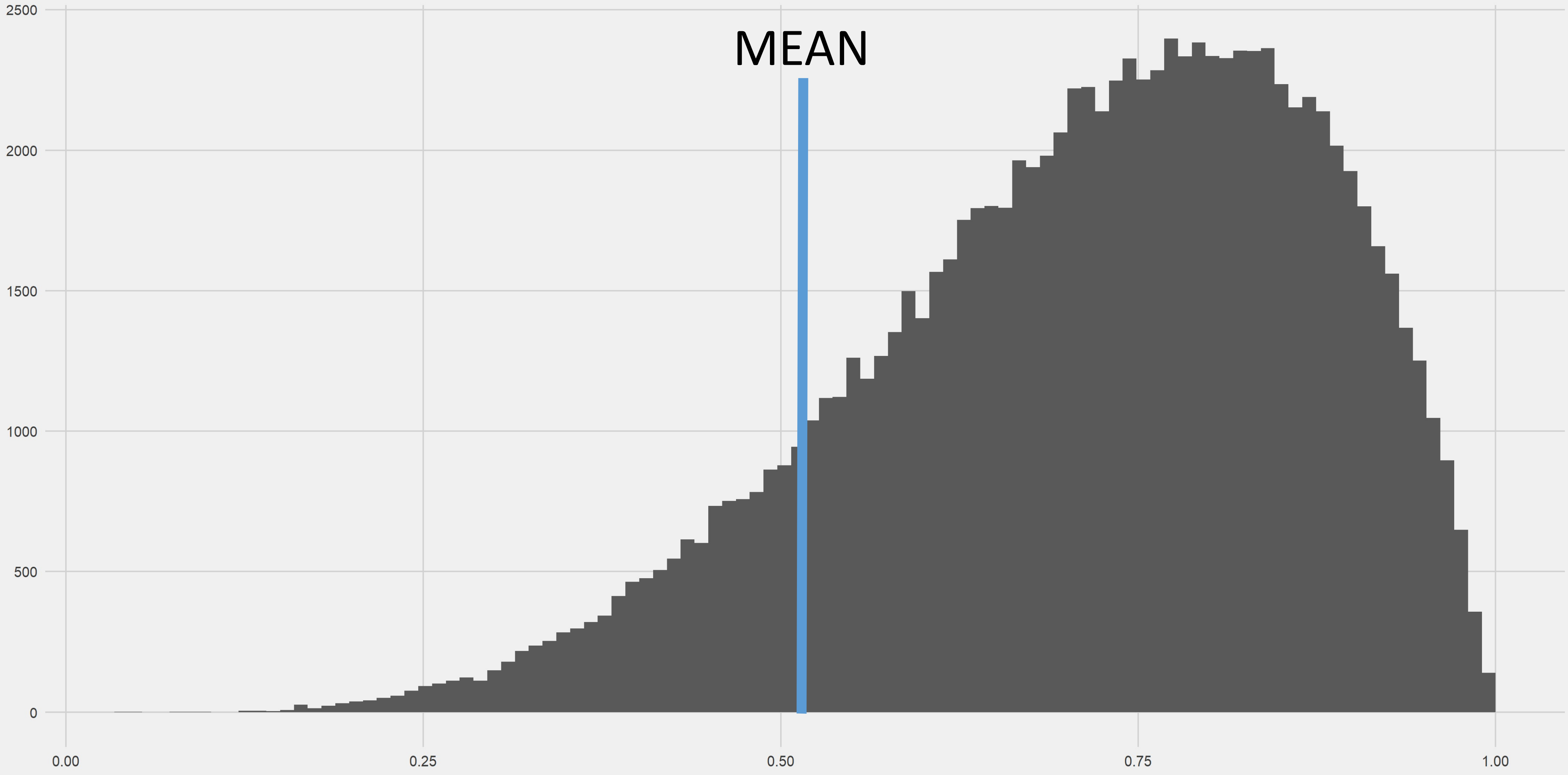


For Right Skew
Distributions
Mean > Median

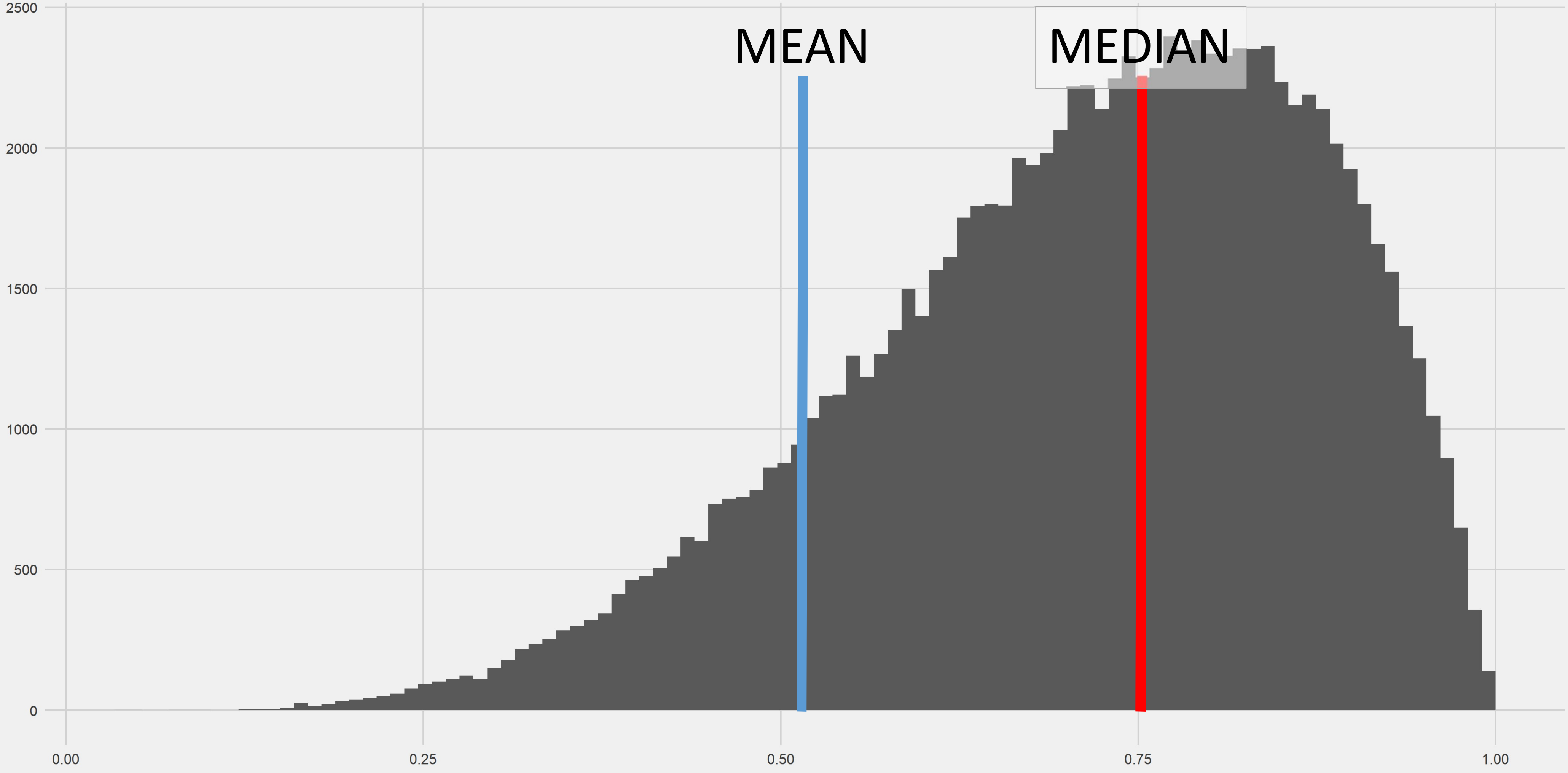
Left Skew Distribution



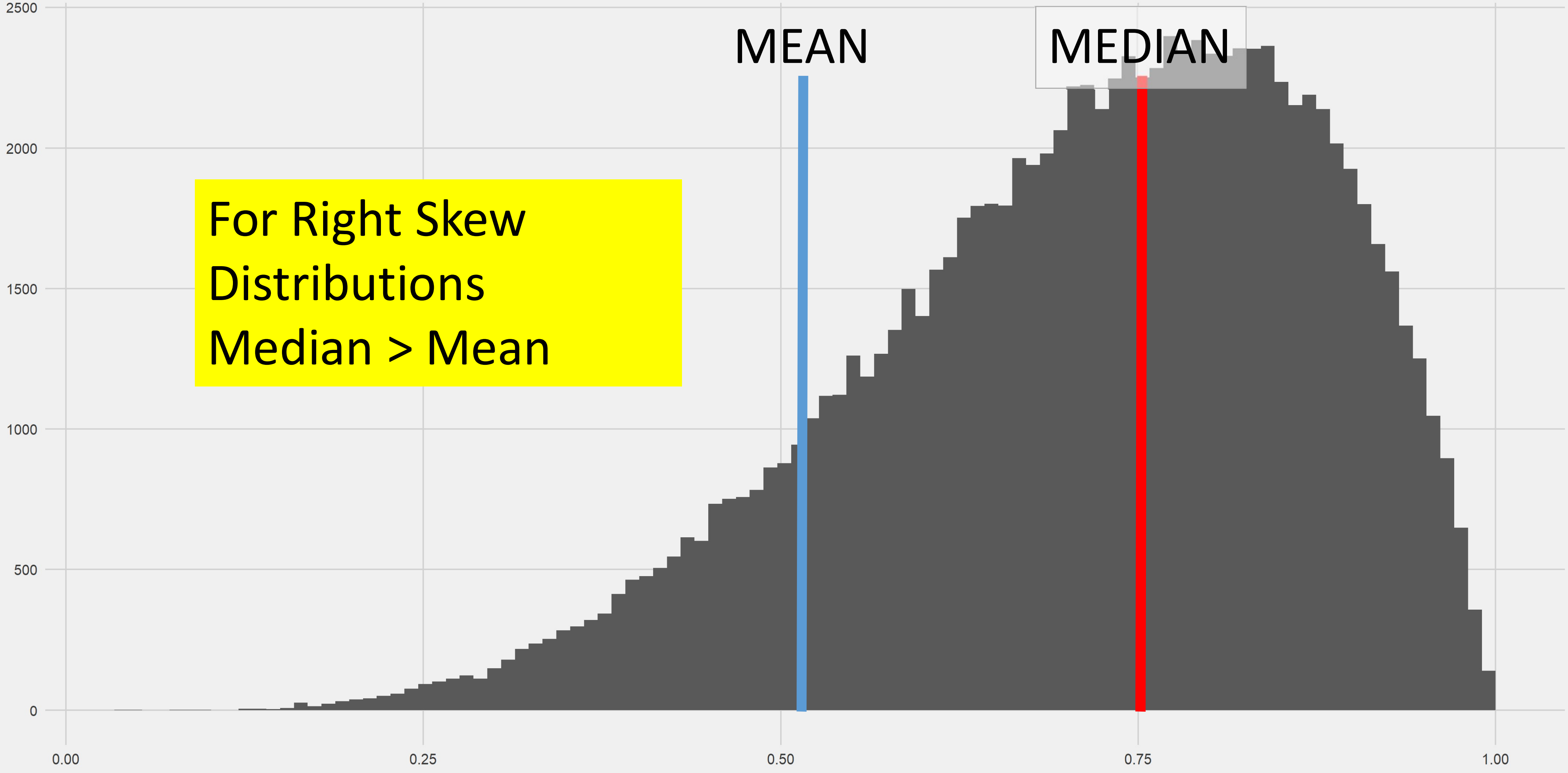
Left Skew Distribution



Left Skew Distribution



Left Skew Distribution



For Right Skew Distributions

Median > Mean

But what about spread?

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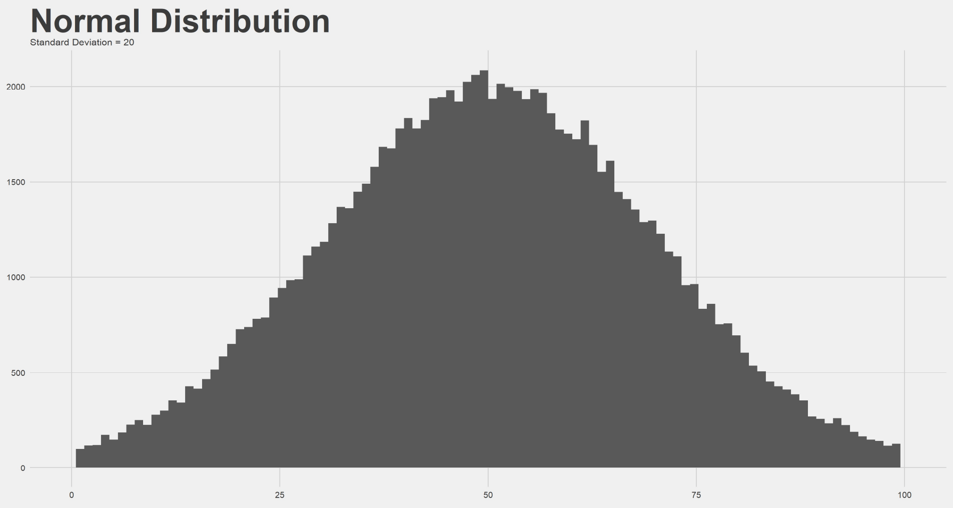
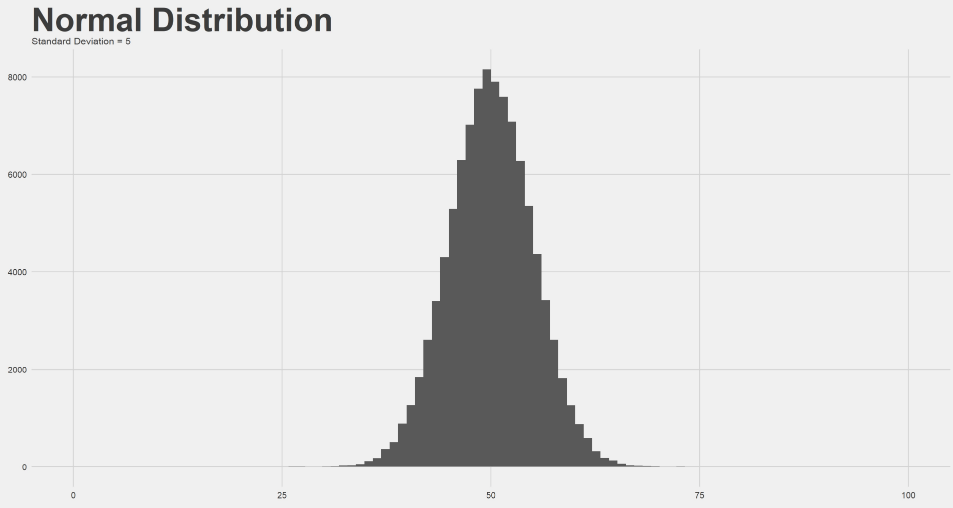
But what about spread?

- Standard Deviation
  - Typically only appropriate for normal distribution which gives these nice guidelines
    - 68% of the data is within 1 standard deviation of the mean
    - 95% of the data is within 2 standard deviations of the mean
    - 99.97% of the data is within 3 standard deviation of the mean
- Range
  - Maximum Value – Minimum Value
  - Can be used to describe all kinds of distributions

Remind me of standard deviation….



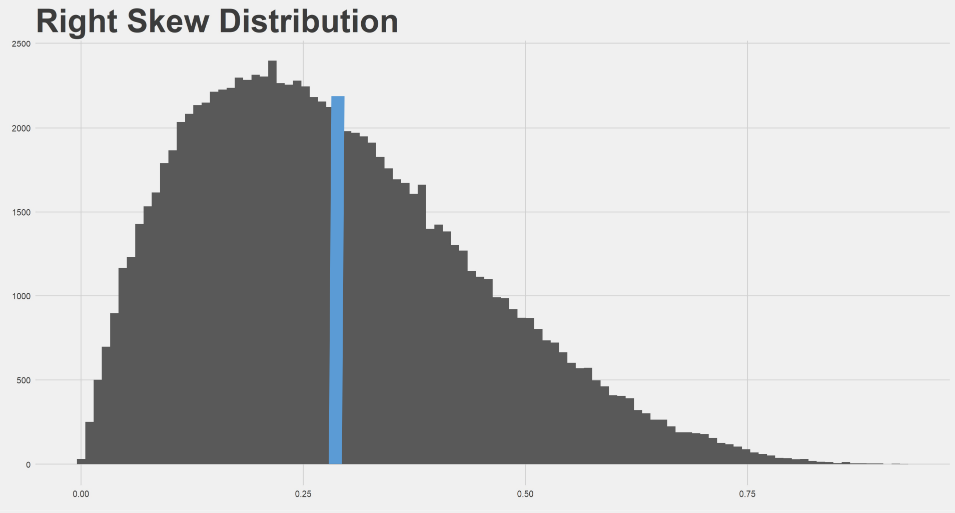
Standard deviation = 20

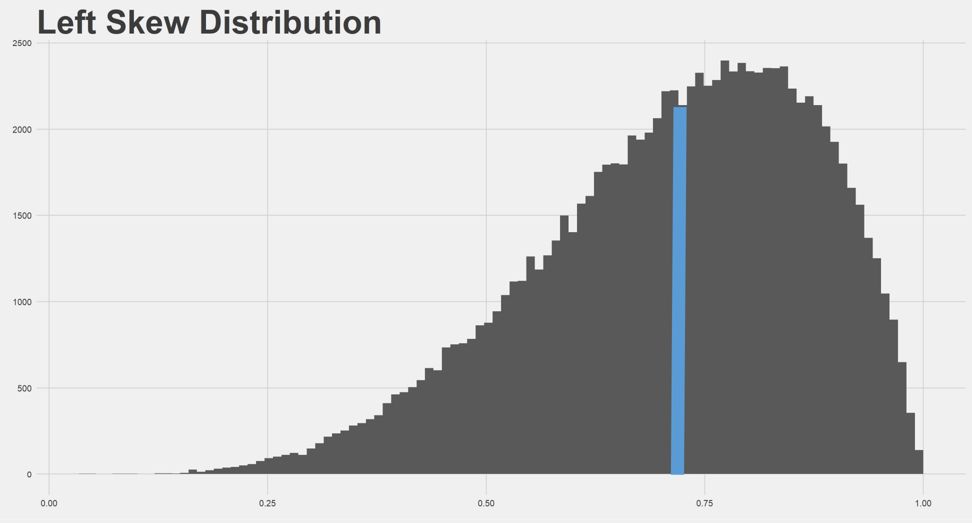


Standard deviation = 5

Same mean, but standard deviation is 4x greater on right than left distribution

So why only normal distributions?





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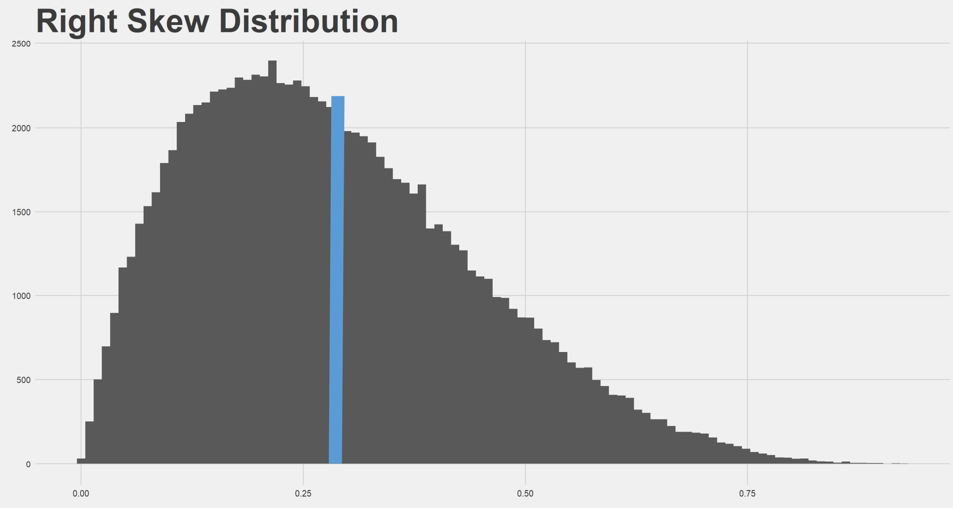
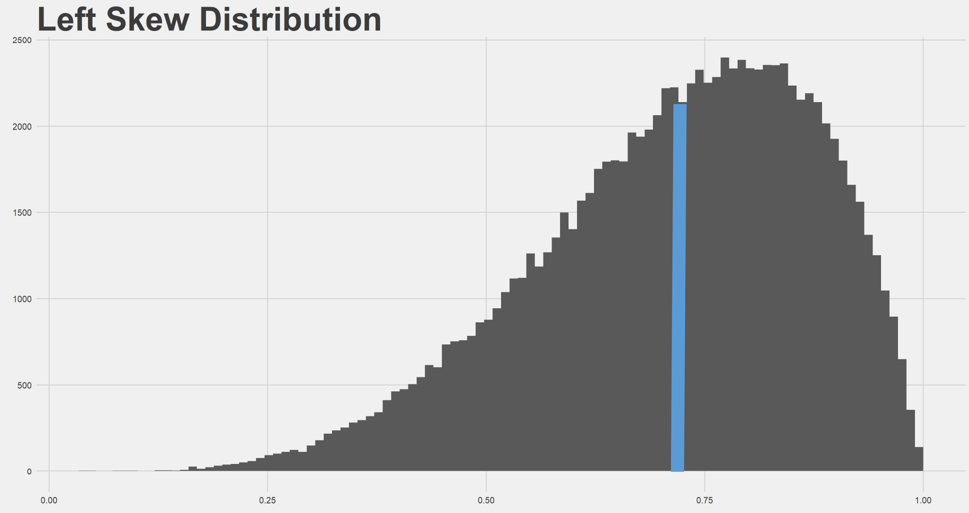


Right Skew Distribution



Left Skew Distribution

95% of the data is between
-1.8 StdDev to +1.4 StdDev

95% of the data is between
-1.4 StdDev to + 1.8 StdDev

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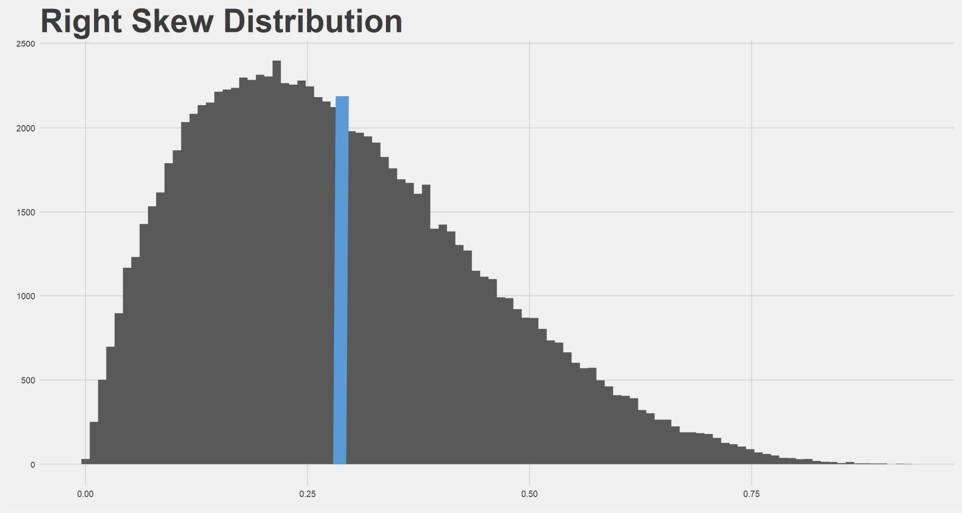

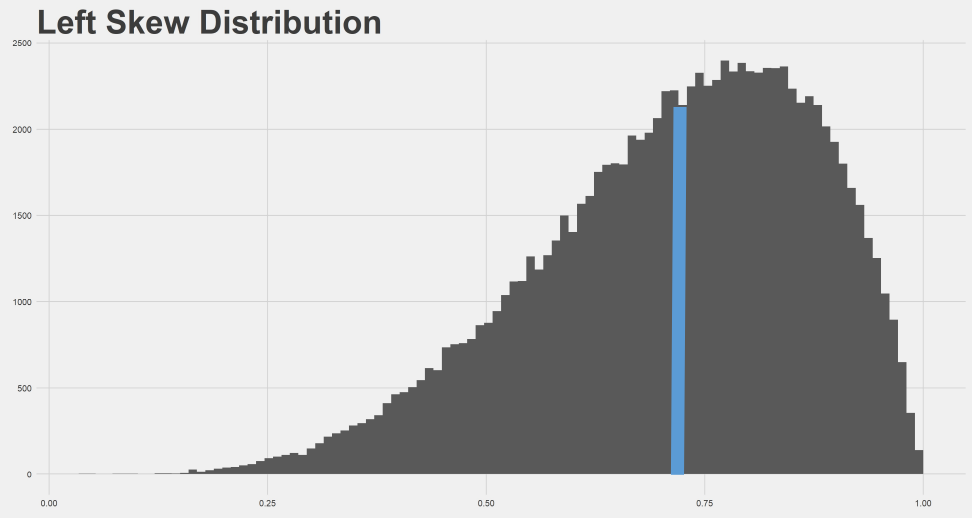

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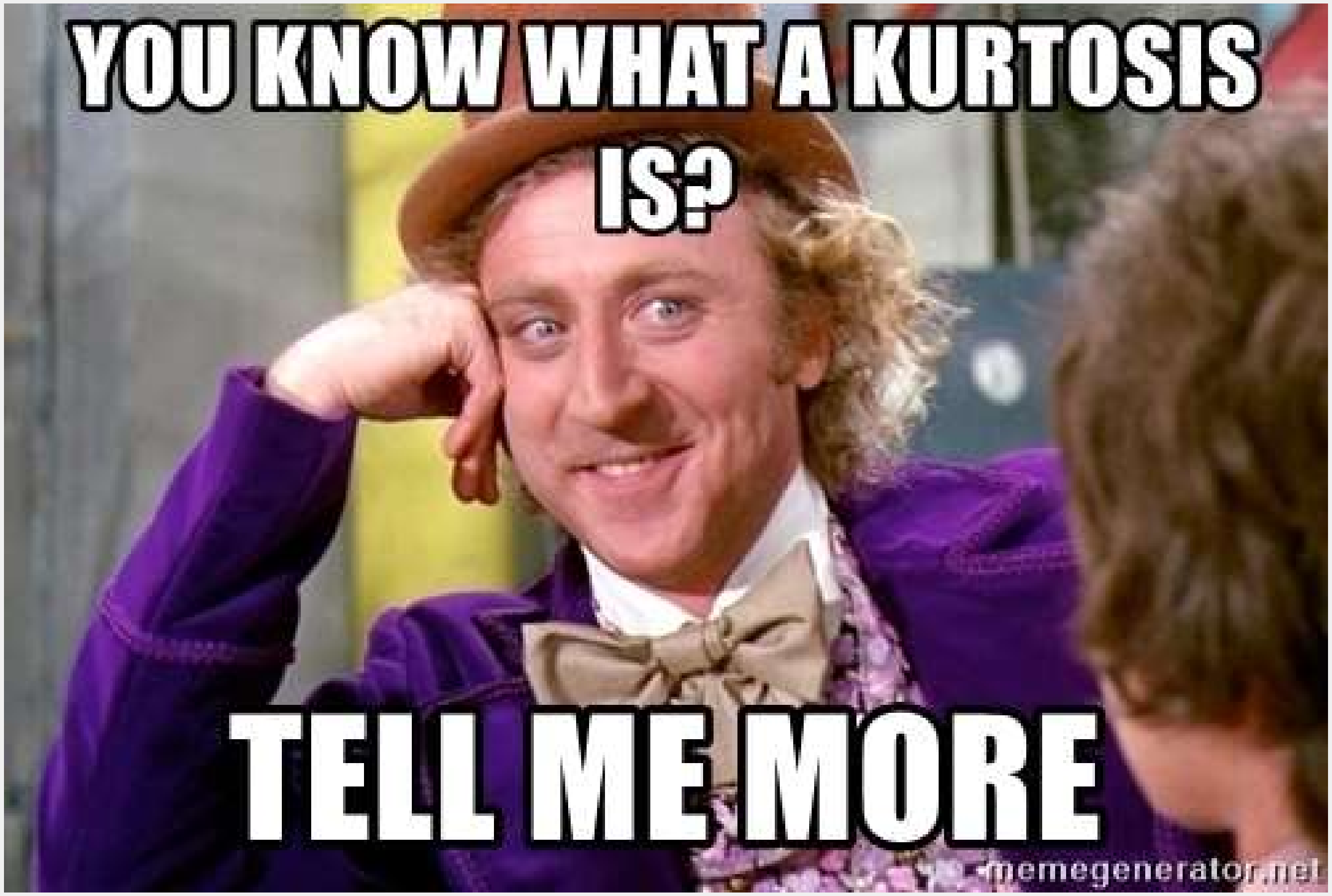
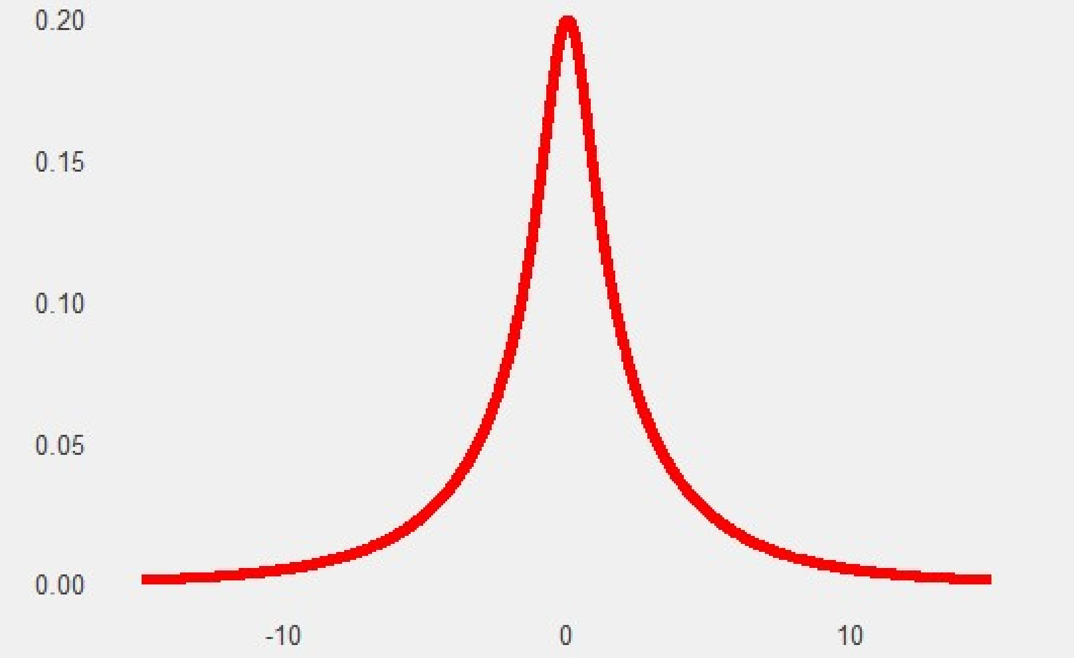
Only use our 68-95-99.97 rule with normal distributions

This is why it is important to know the shape of the distribution

We've described central tendency, spread…



Kurtosis…how “peaky” is a distribution



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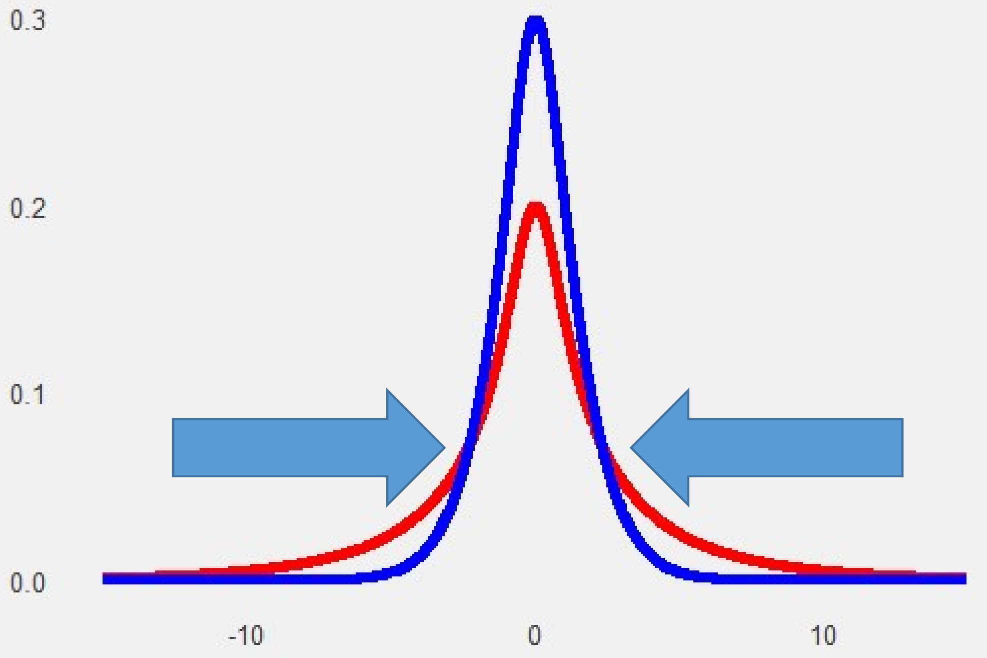

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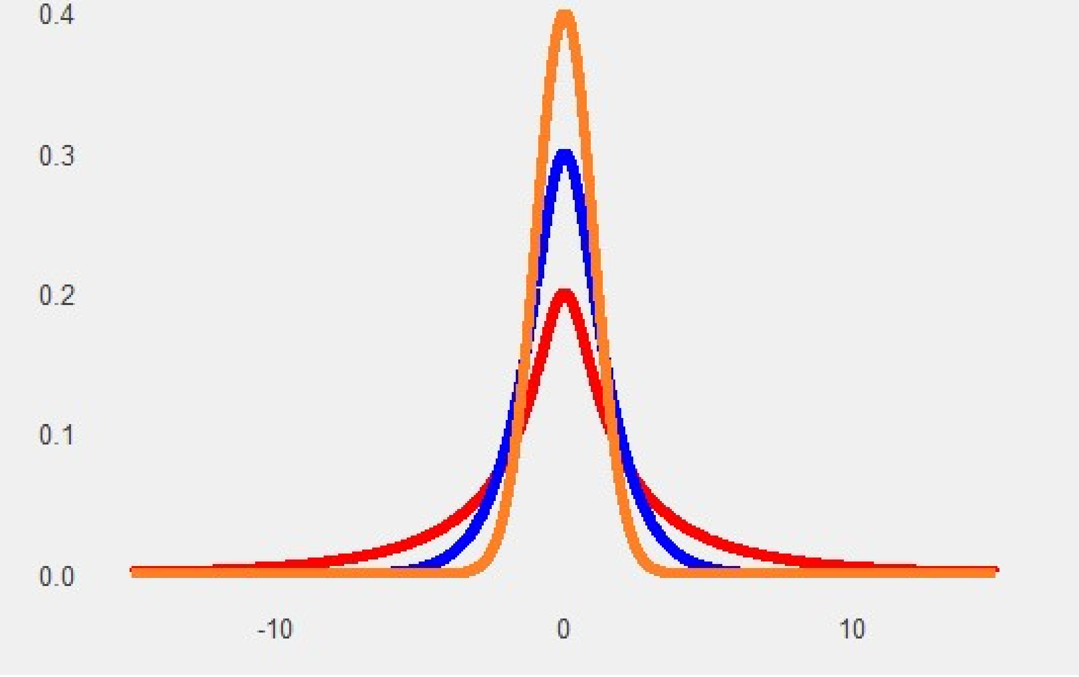

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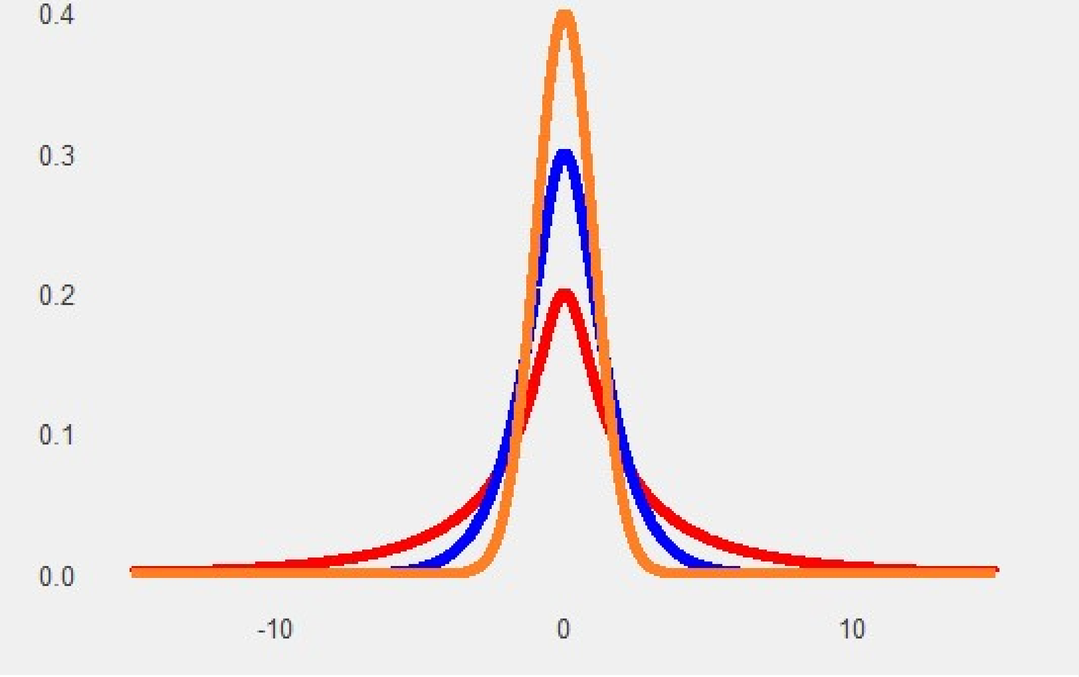
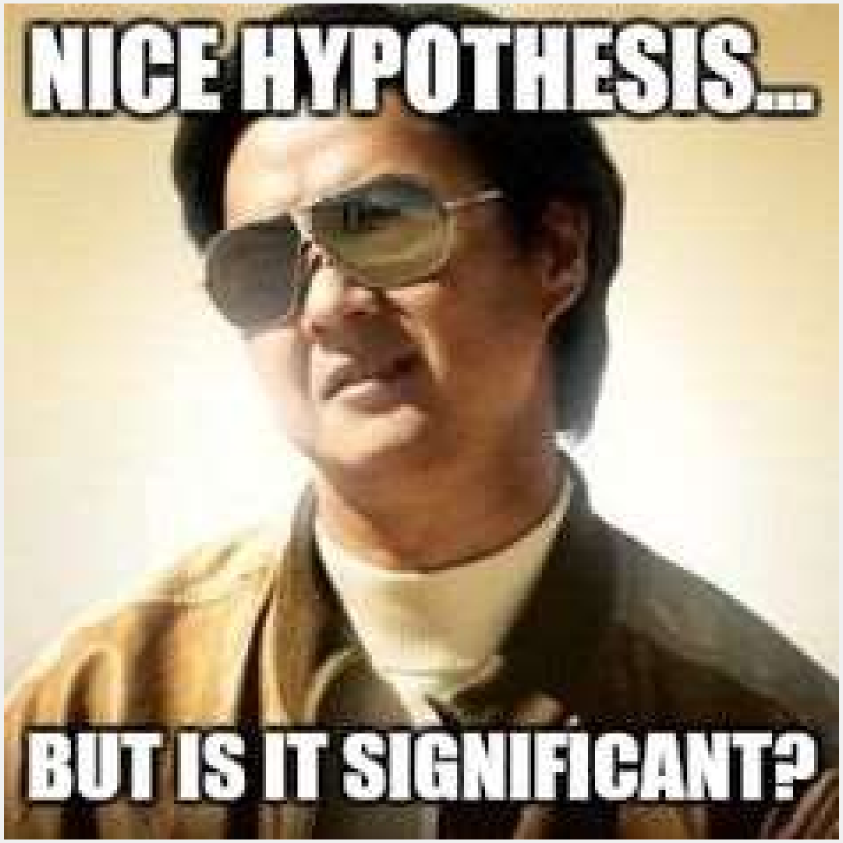


- Kurtosis quantifies how much data exists in the tails of the distribution
- If there is more mass in the tails then more extreme results are likely
- Again…our standard deviation rules for a normal distribution fails with highly kurtotic data

Why do we need to know this…



- When we do hypothesis testing we need to ensure that the distribution of our data meets certain conditions
- It lets us use statistics to say “these are statistically different”