

# Visual Analytics— Communicating Uncertainty

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Slides based off Medium articles by Jessica Hullman and Matthew Kay (<https://medium.com/multiple-views-visualization-research-explained/uncertainty-visualization-explained-67e7a73f031b> )

# Plan for Today

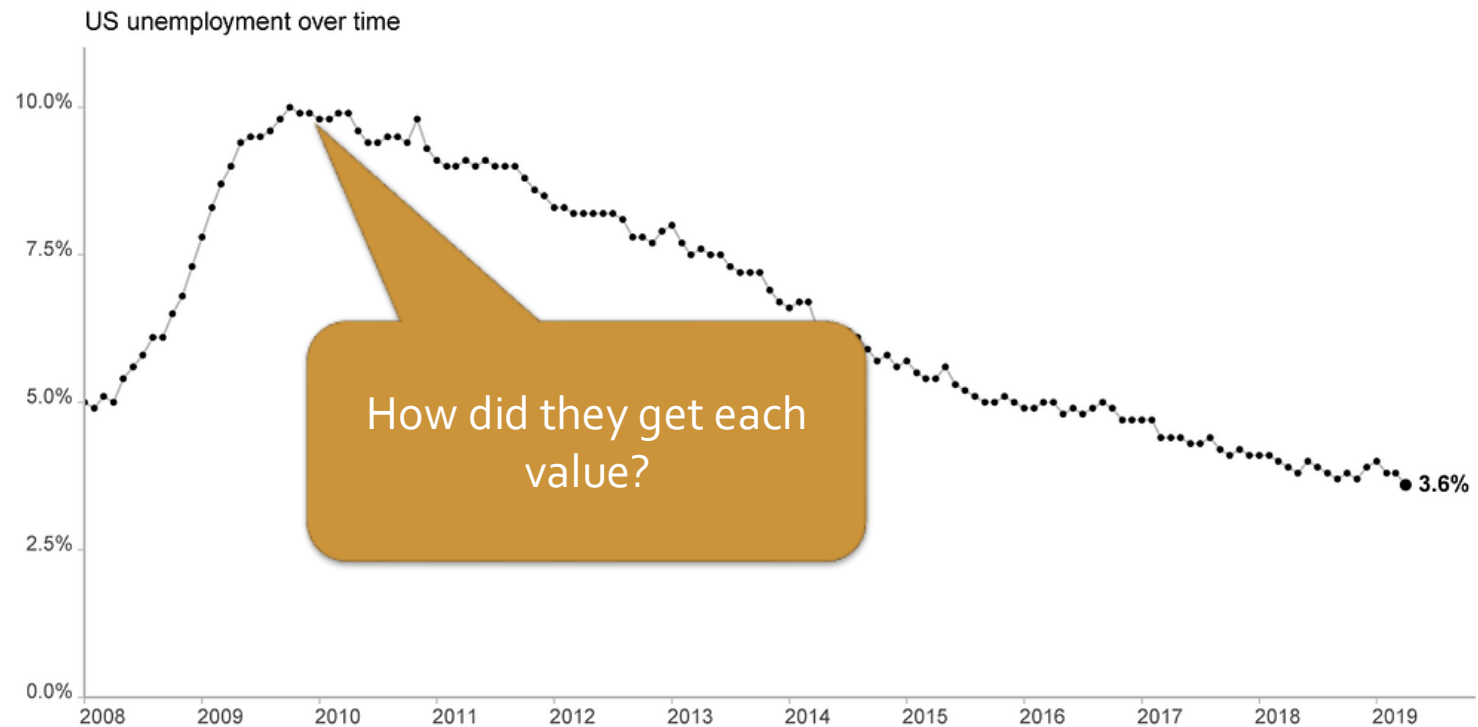
- What is it?
- How do we show it?

# What we mean when we say Uncertainty

- In visualization we're talking about the different values the data could possibly be
- Ex. We have some value we want to know about some population (*parameter* in stats), but we must estimate that value through a *sample* of the population

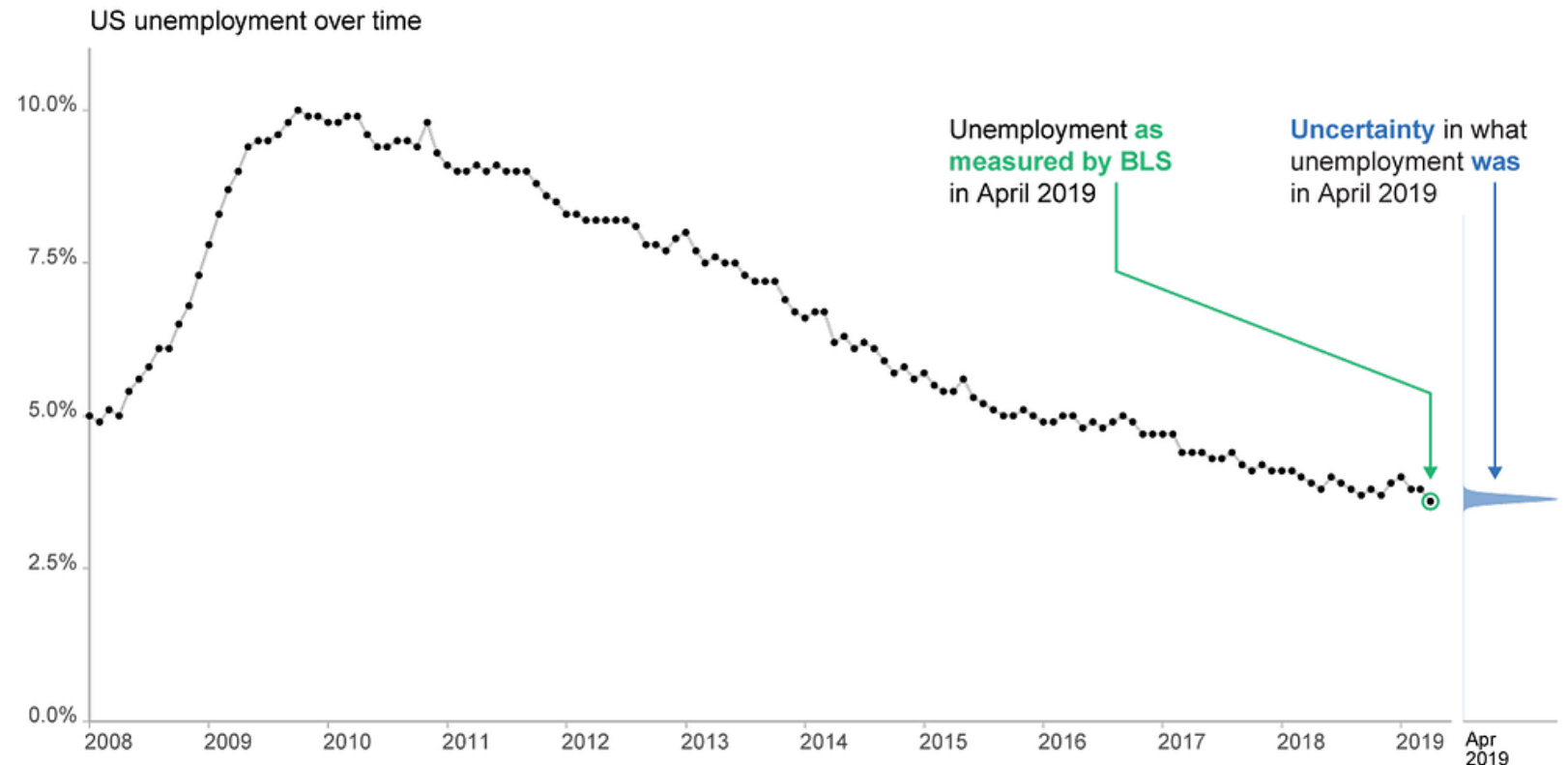
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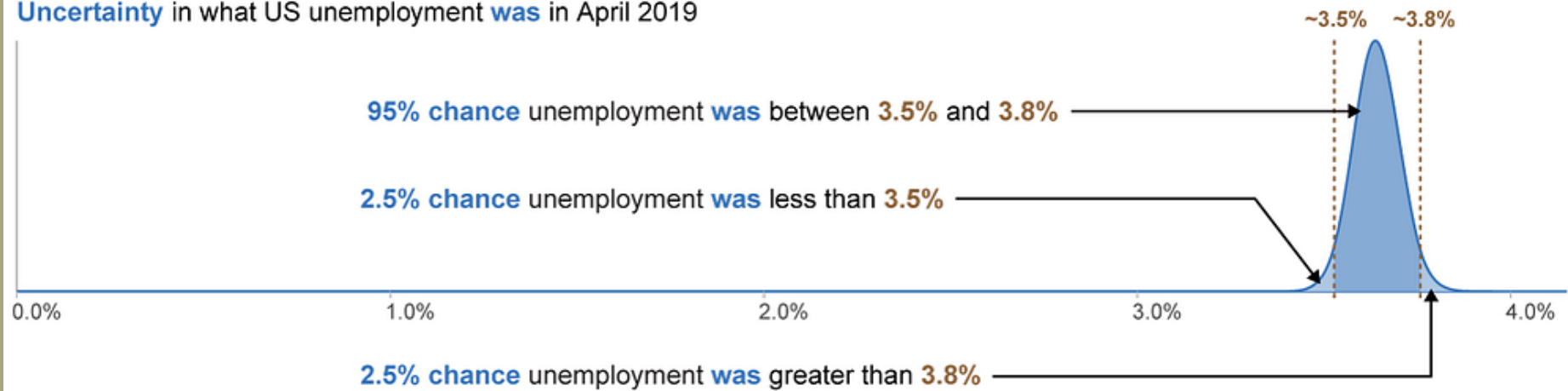
# Estimated Values

- A statistical model is used to estimate a parameter
- The model quantifies the uncertainty around the estimate by considering all values it *could* be (and how likely each is)
- Hence, a parameter's uncertainty can be characterized by a probability distribution



# Probability Distributions

Uncertainty in what US unemployment **was** in April 2019



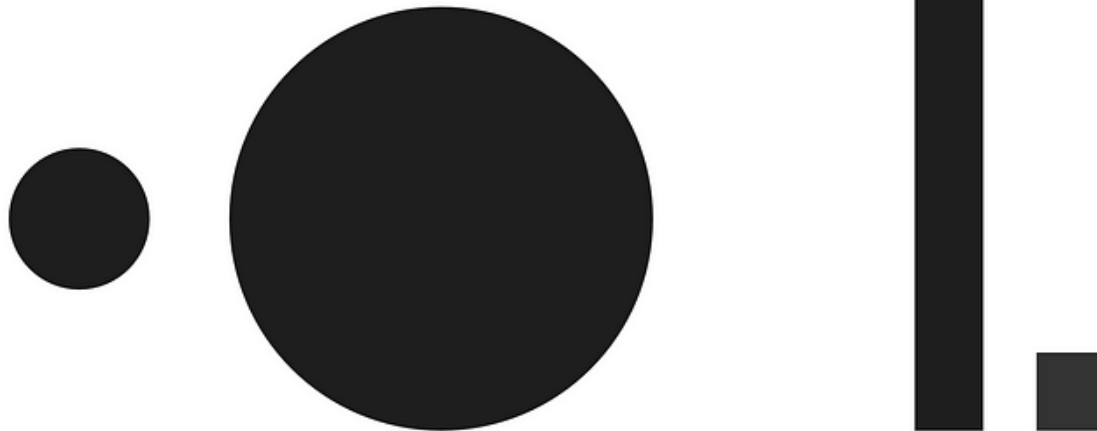
# Communicating Uncertainty

- Imprecise ways to communicate uncertainty:
  - Rounding
  - Choosing a visualization technique that is harder for people to read

## How Much Bigger?

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Why is this imprecise? (Hint: think about perception)



# Communicating Uncertainty

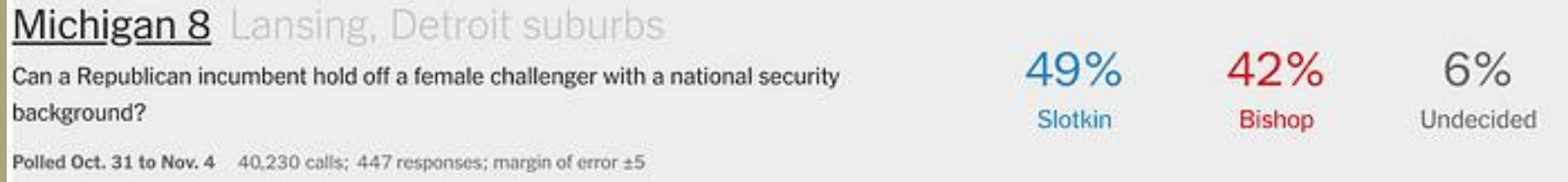
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What drawbacks do you see to these methods?



# Communicating Uncertainty

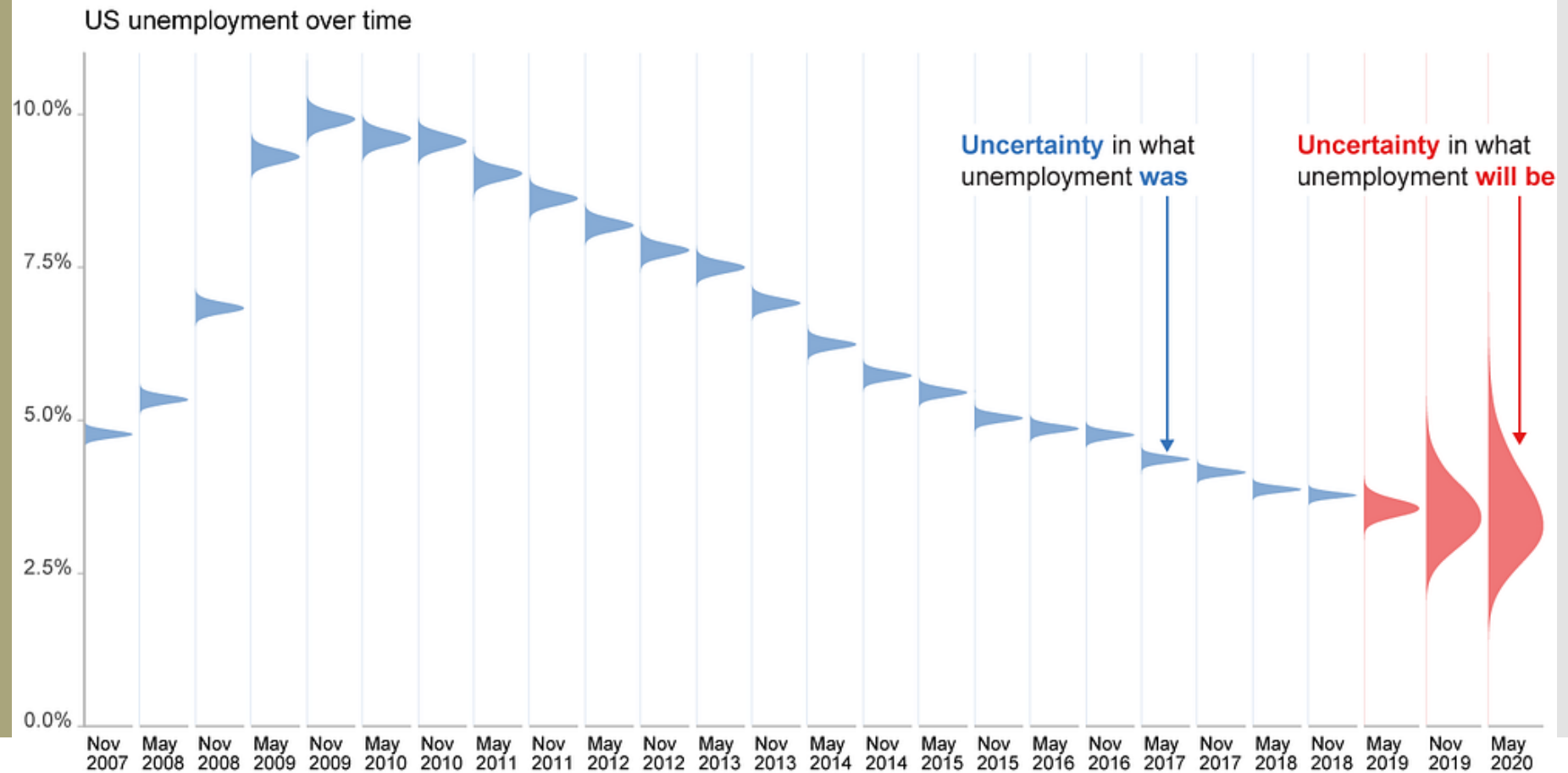
- Subtle ways to communicate uncertainty:



- Can you see the uncertainty estimate?

# Communicating Uncertainty

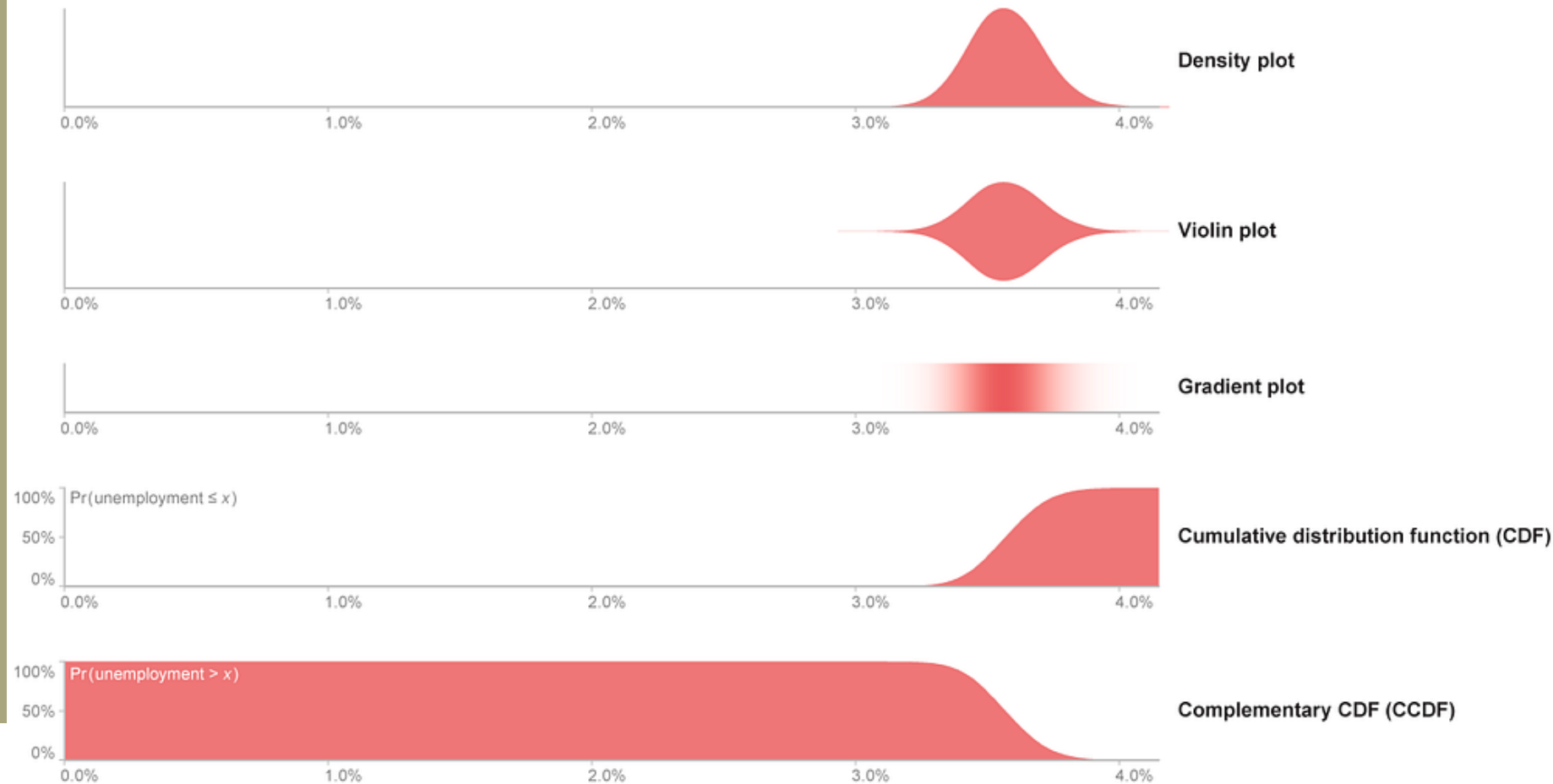
- Direct ways to communicate uncertainty:
  - Map probability density to a visual channel



# Communicating Uncertainty

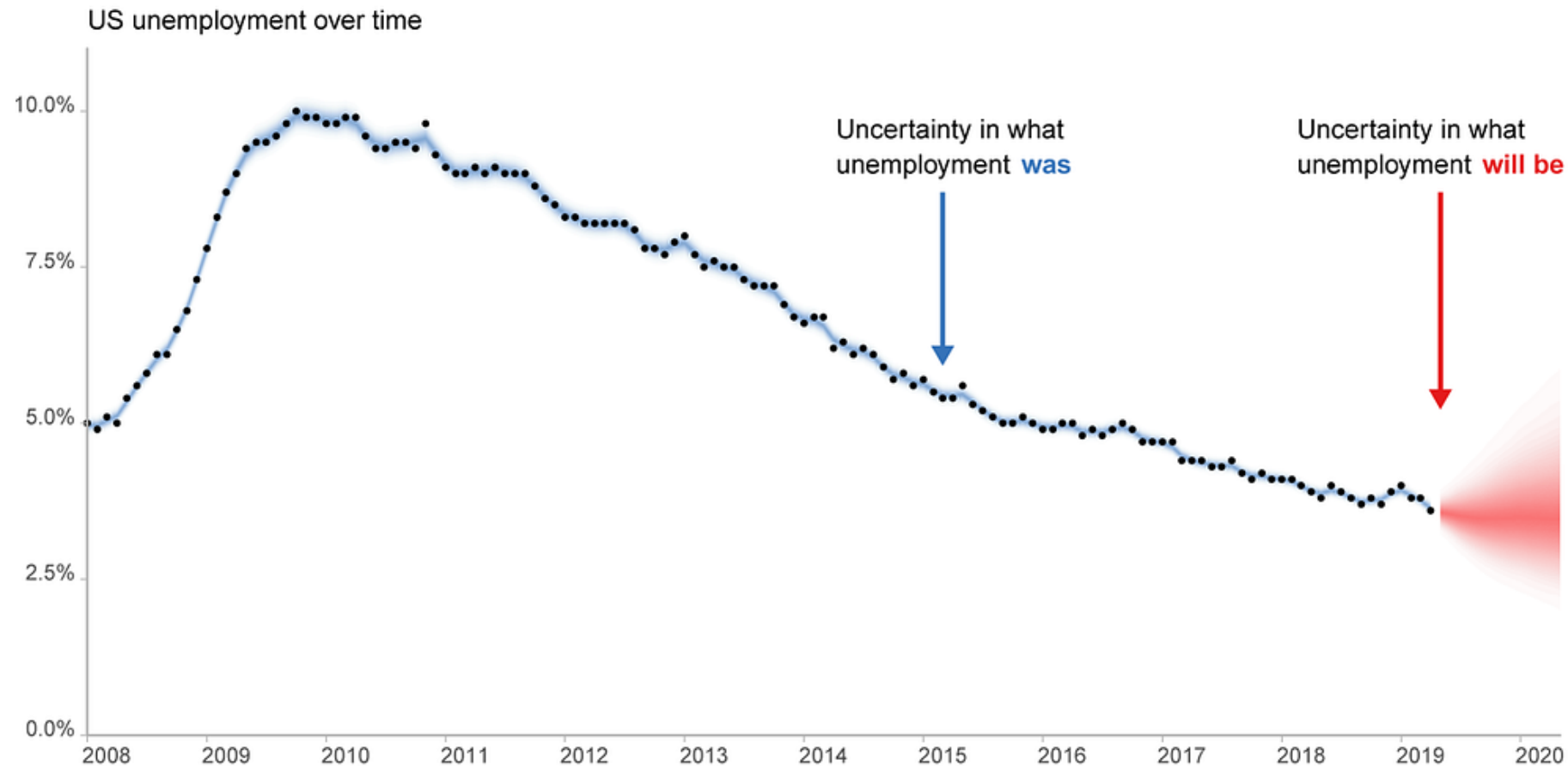
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Uncertainty in what US unemployment will be in May 2019: Continuous encodings



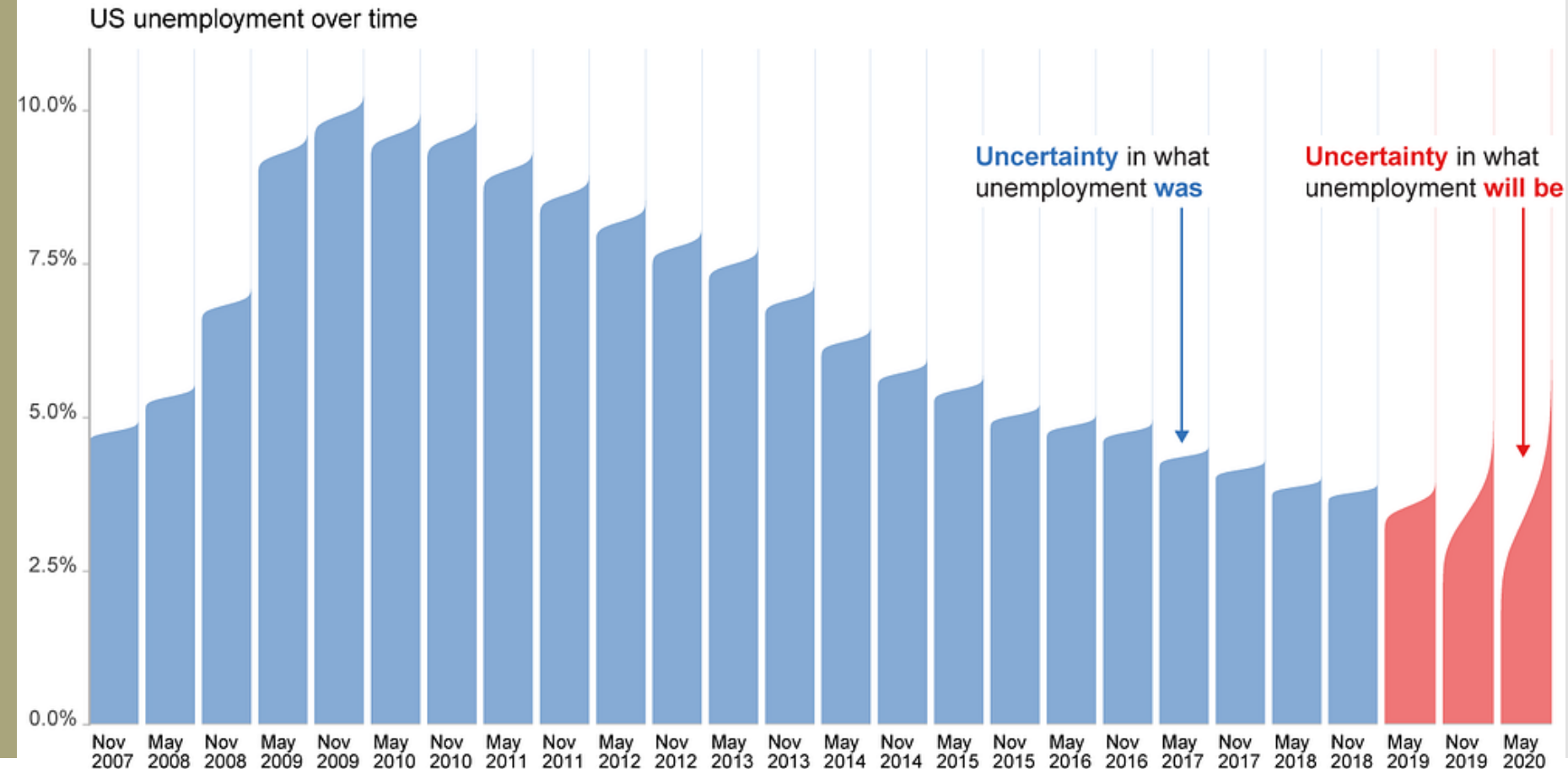
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# Communicating Uncertainty

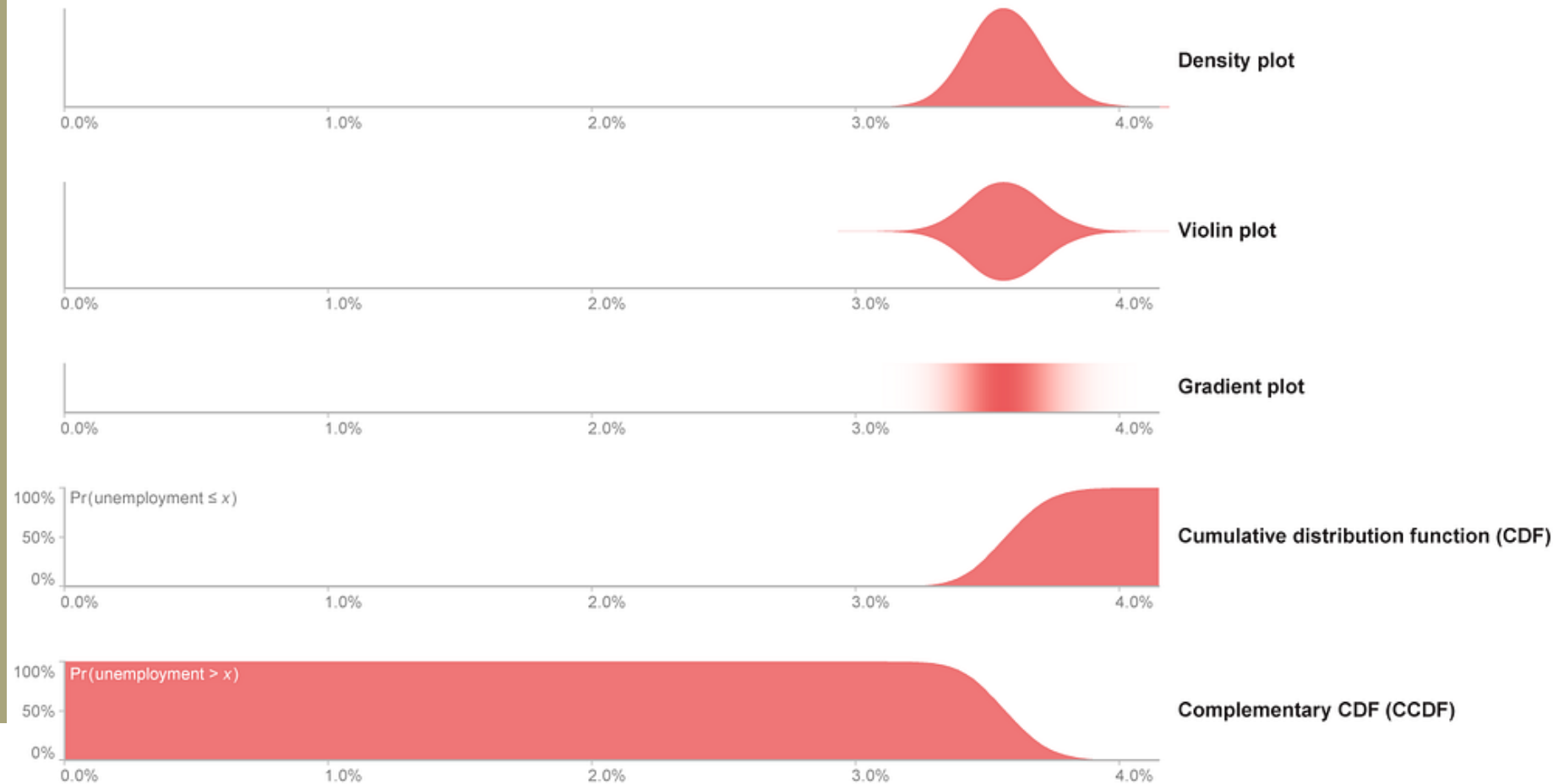
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# Communicating Uncertainty

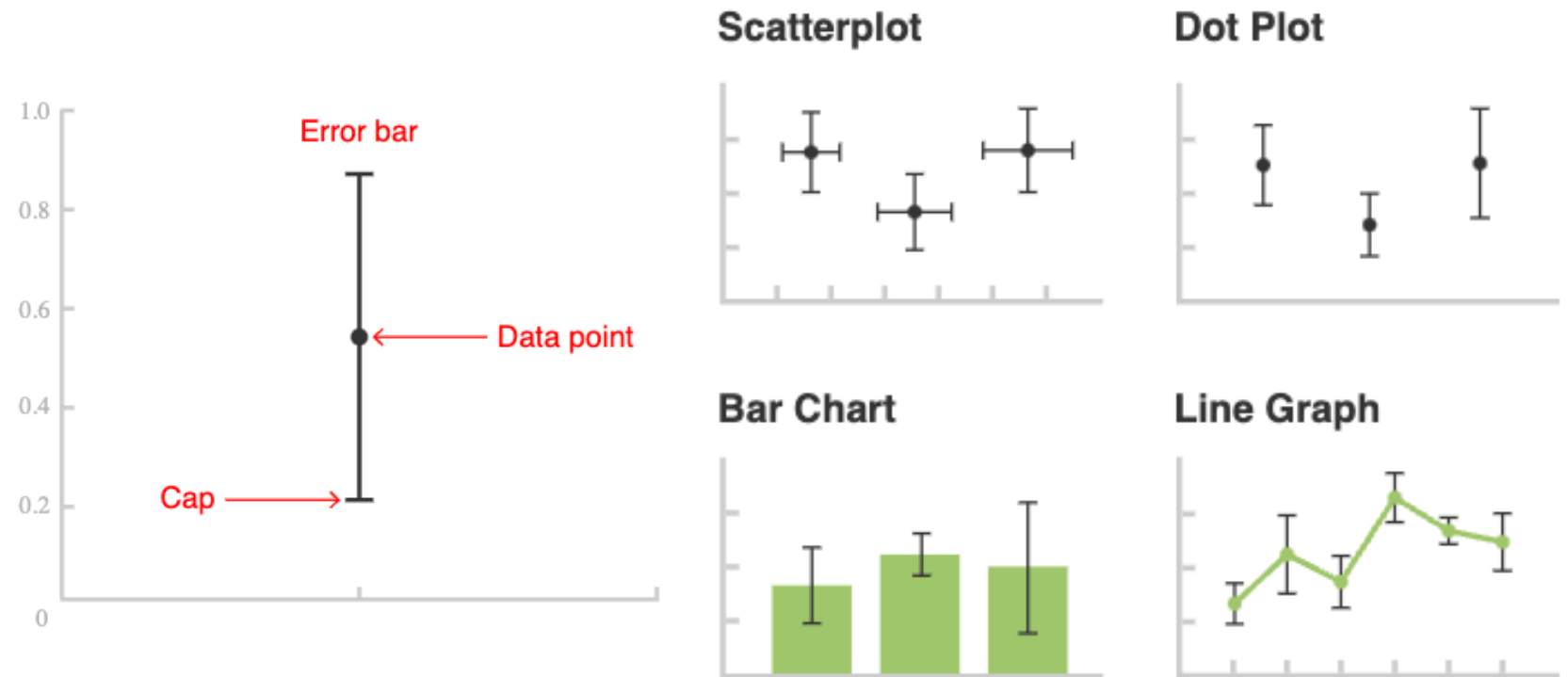
- How should we decide between encodings?

Uncertainty in what US unemployment will be in May 2019: Continuous encodings



# Communicating Uncertainty

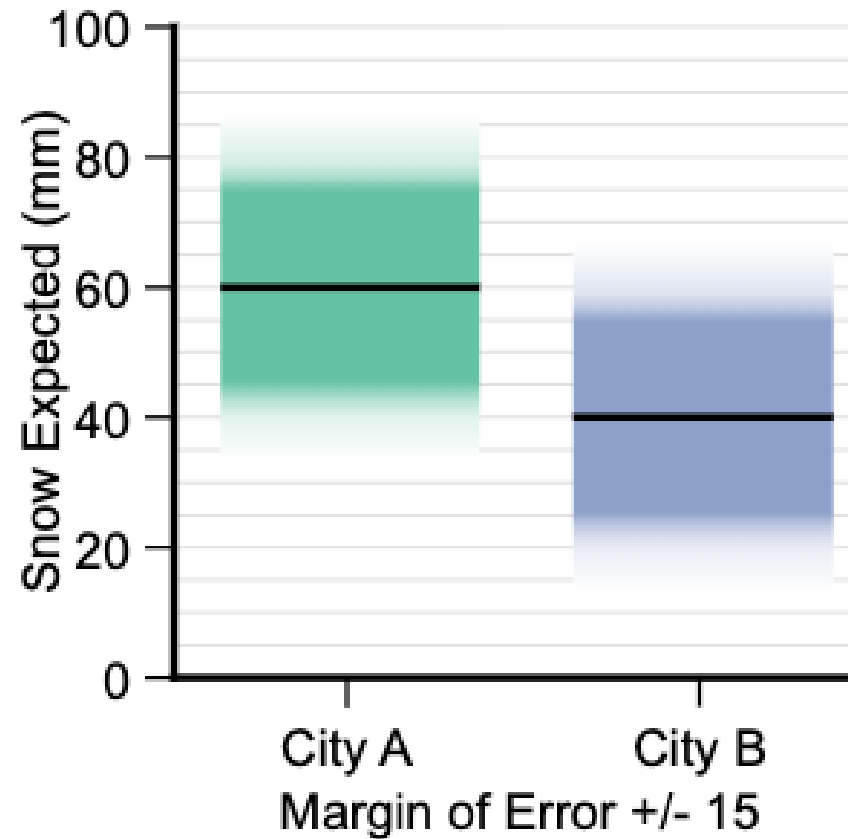
- Direct ways to communicate uncertainty:
  - Error Bars



Proceed with caution! How do you think readers might misinterpret error bars?

# Communicating Uncertainty

- Direct ways to communicate uncertainty:
  - Gradient Plots

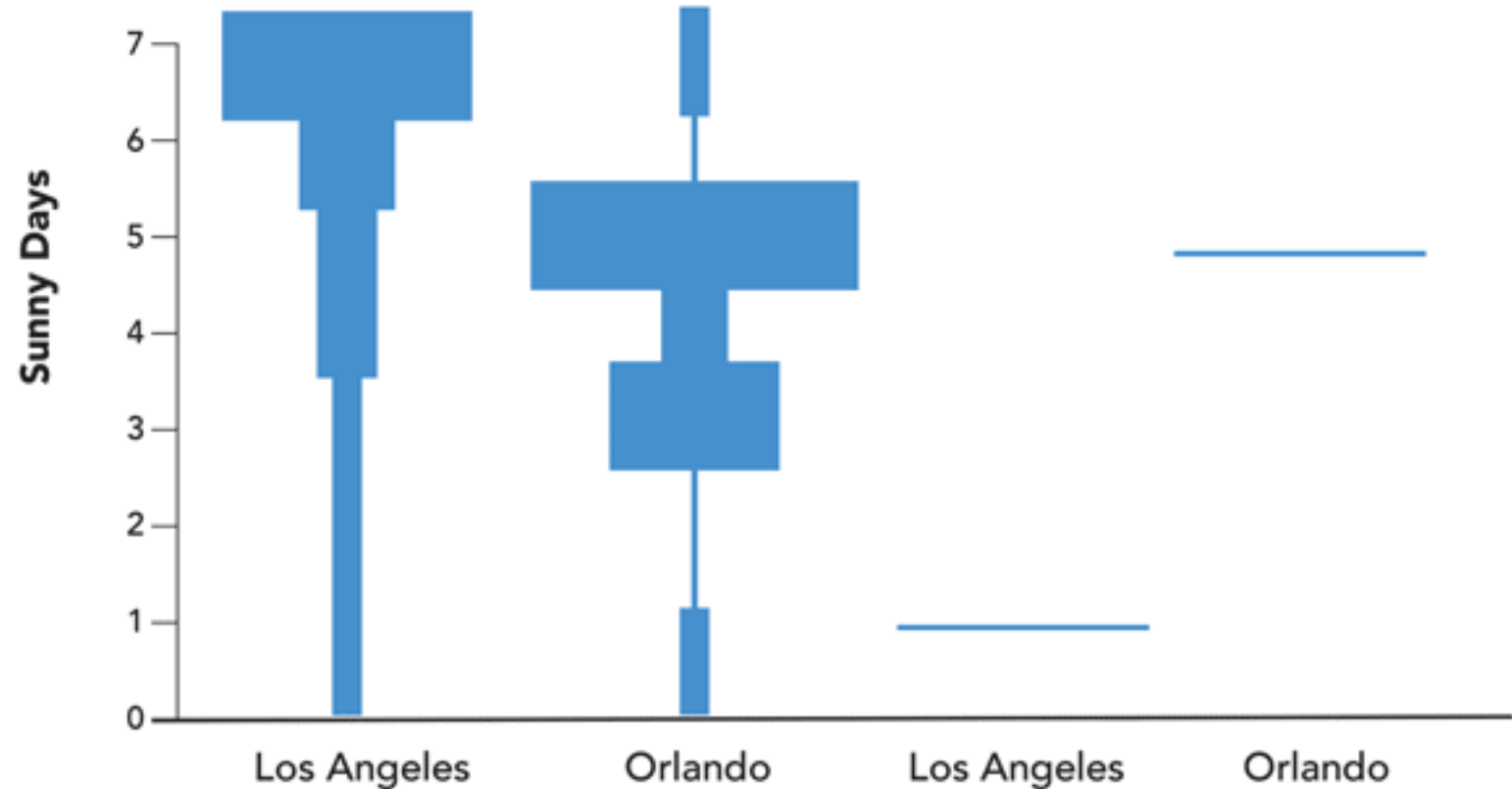


What advantage does this encoding have over error bars?



# Communicating Uncertainty

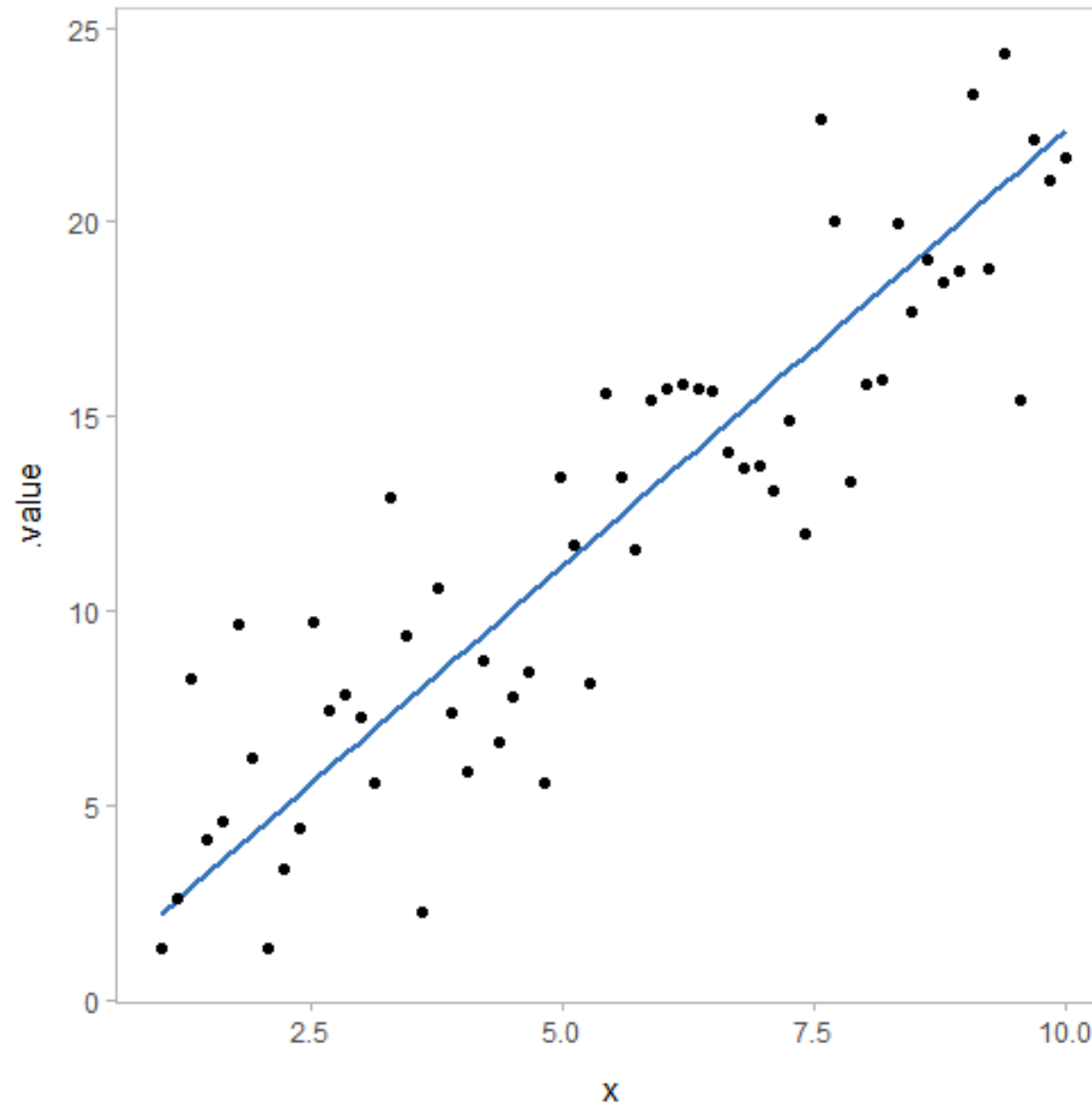
- Direct ways to communicate uncertainty:
  - Show animated visualizations where each frame is a draw from the probability distribution
    - Ex. Hypothetical Outcome Plots (HOPs)



# What we mean when we say Uncertainty

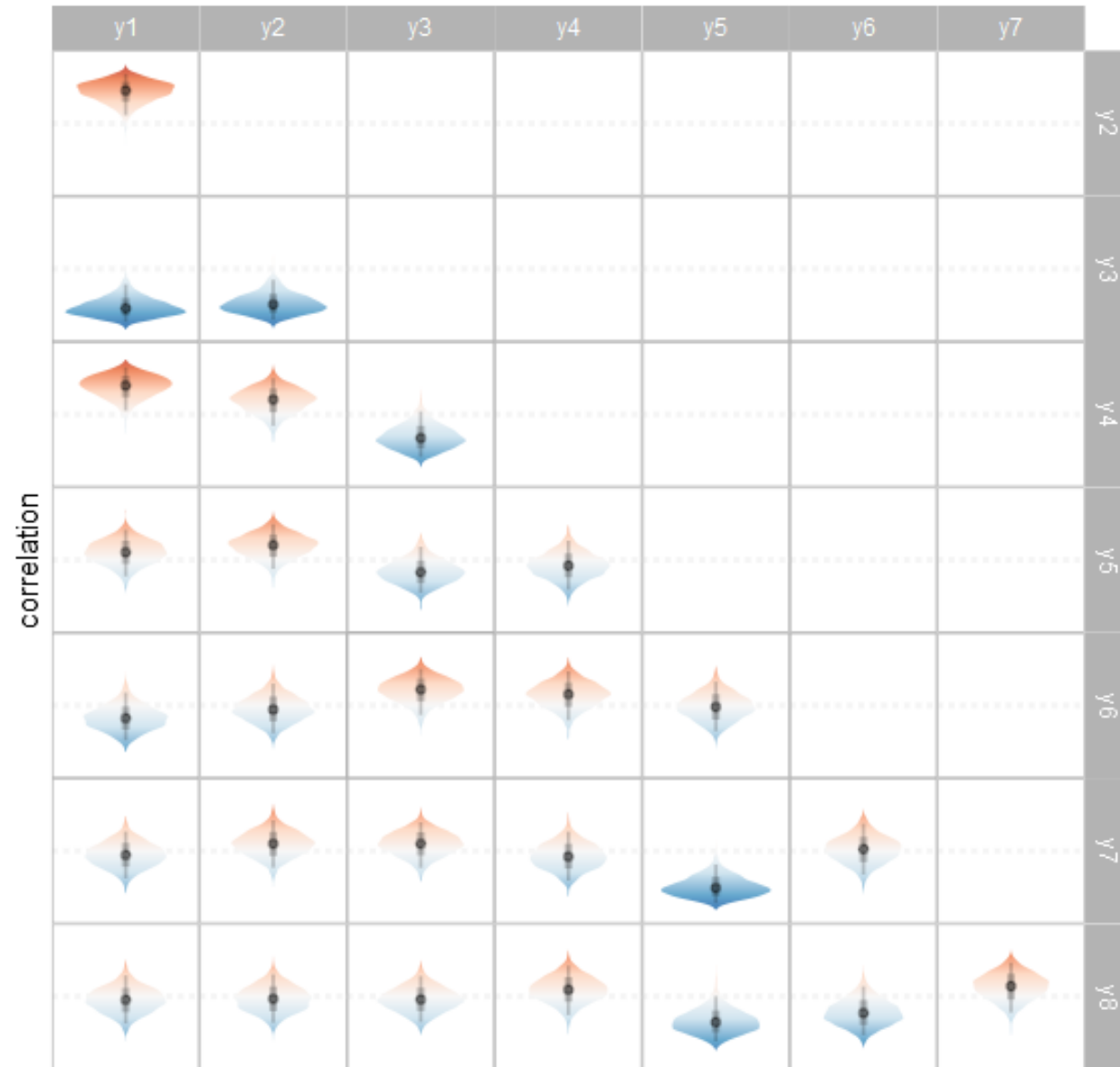
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# Linear Regression



$$y = mx + b$$

# Multivariate Regression



<https://github.com/mjskay/uncertainty-examples/blob/master/linear-regression.md>

# Demos

- R and Python Uncertainty Visualization Demos are on the course website. Work through one with a partner