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Will It Snow?: Using R to Estimate and Visualize Probability of Precipitation

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Using R to Estimate and Visualize Probability of Precipitation

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Data Introduction

- Source: SNOTEL remote sensing station network
- 82 stations scattered throughout Idaho
- ~6000-7000 precipitation measurements per station from 1999-2019 (.csv file)
- Snow depth, average temperature, **accumulated precipitation**, ...
- Create new indicator variable (whether it rained on a certain day) using **dplyr** from **tidyverse**

We aim to estimate the daily precipitation probability, θ.

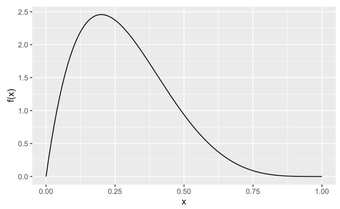
Methods

The Bayesian Machinery

Prior

Beta(θ|a, b)

- **Prior knowledge**
- Initially set a = 1, b = 1 (precip one day, no precip one day)



Beta(5,2) probability density function

$a_{n+1} = z + a_n$

$b_{n+1} = N - z + b_n$

Likelihood

Bernoulli(θ)

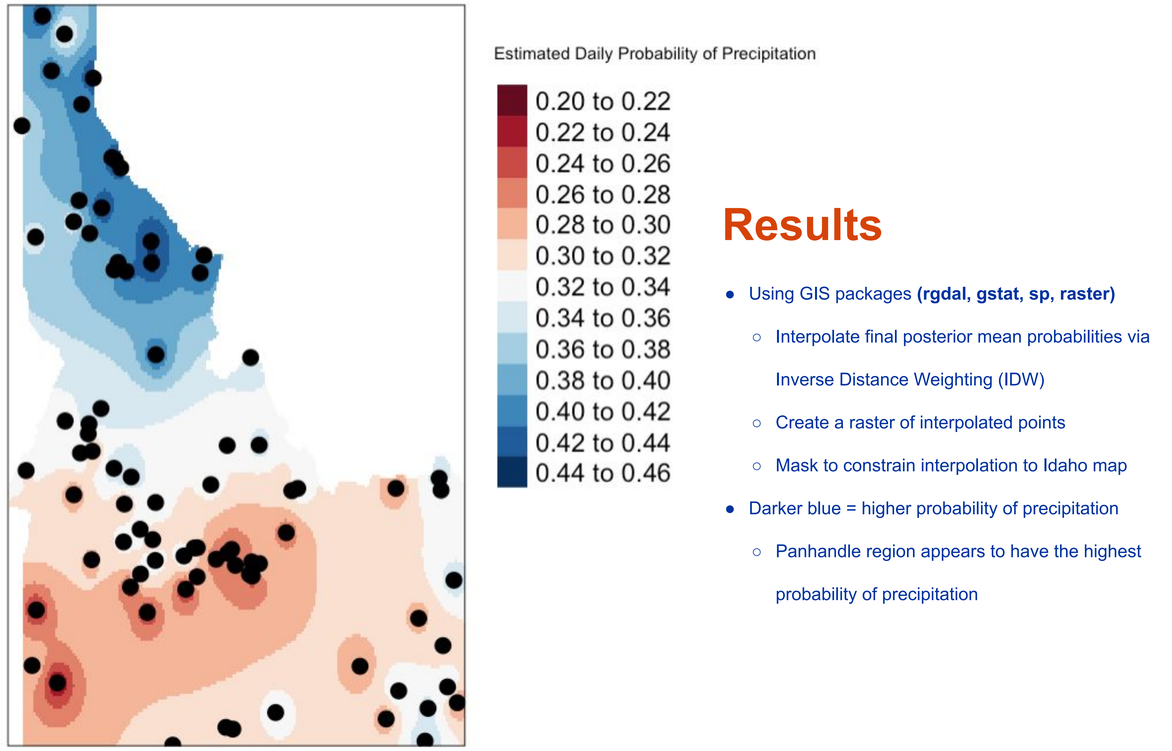
- **New data**
- Shift 10-day moving window

Posterior

Beta(θ|z+a, N-z+b)

- **Updated knowledge**
- N = window size (10)
- z = number of precip days out of N

- Compute posterior distribution mean to obtain one estimate of θ
- Plot 95% highest density interval (HDI) to visualize uncertainty



Inverse distance weighting (IDW) interpolated map of posterior means. Points = weather stations.

Results

- Using GIS packages **(rgdal, gstat, sp, raster)**
  - Interpolate final posterior mean probabilities via Inverse Distance Weighting (IDW)
  - Create a raster of interpolated points
  - Mask to constrain interpolation to Idaho map
- Darker blue = higher probability of precipitation
  - Panhandle region appears to have the highest probability of precipitation

Future Work

- Use data across a bigger region than Idaho
- Build animated maps to show seasonal patterns

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R code in this work: https://github.com/ttsukianto/math496/

References

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