Predicting State Medicare Spending Per Beneficiary

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Background

What is Medicare?

- Health insurance for people
  - ✓ 65 and older
  - ✓ Under 65 with certain disabilities
    - ✓ ALS (Amyotrophic Lateral Sclerosis, also called Lou Gehrig's disease) without a waiting period
  - ✓ Any age with End-Stage Renal Disease (ESRD)
- To get Medicare you must be a U.S. citizen or lawfully present in the U.S. Must reside in the U.S for 5 continuous years.

Why Important?

- 14% of total federal spending
- 21% of total national health spending
- Reflects medical efficiency, good for state budget planning.

Dependent Variable - MSPB

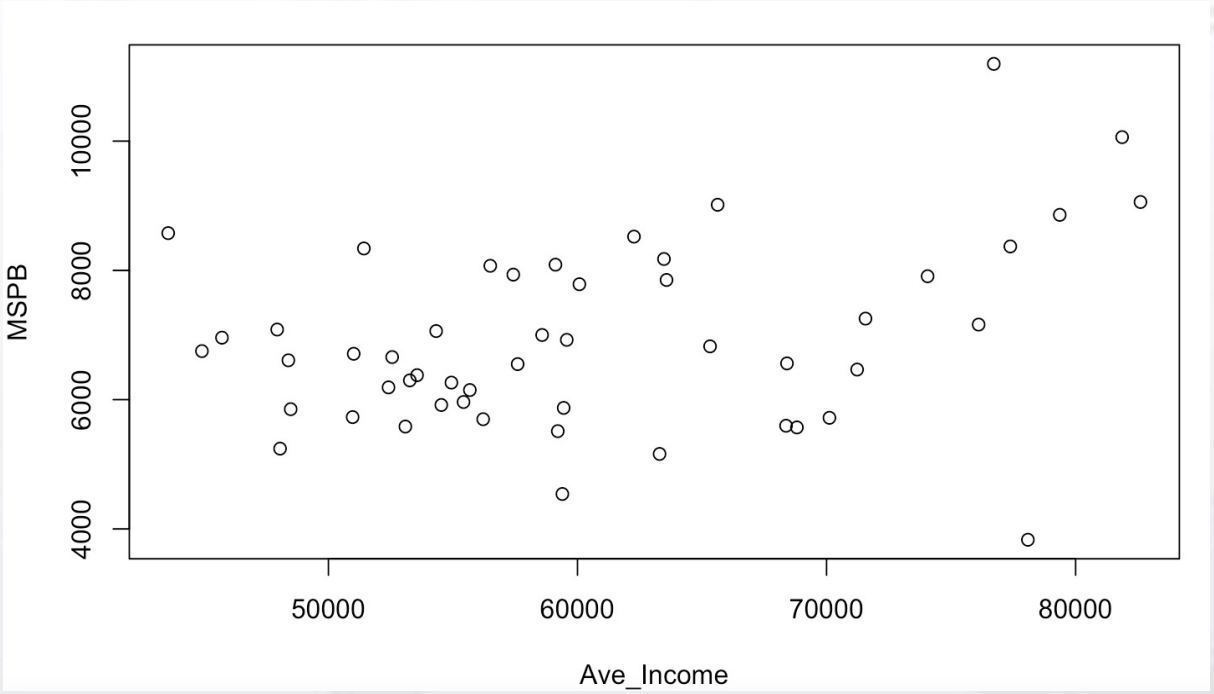
State Medicare Spending Per Beneficiary, 2018

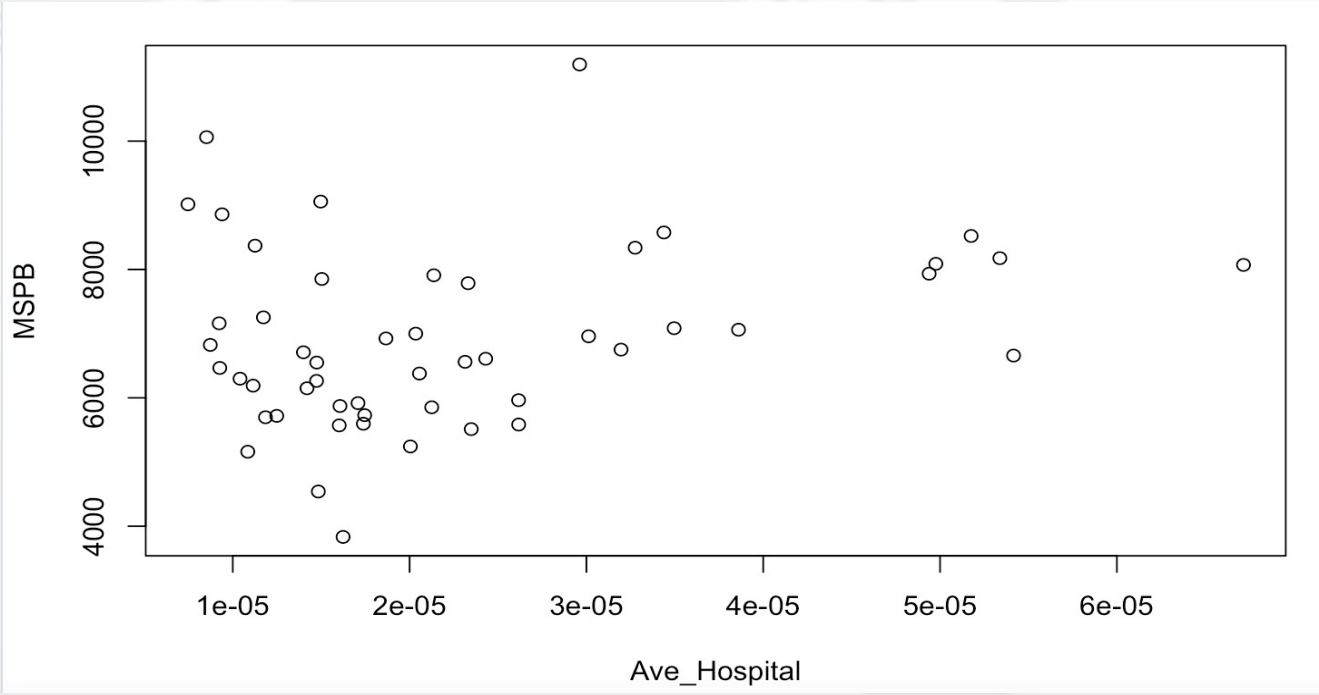
Independent Variables

	Independent Variables	Type	Description
Policy	Obamacare	Qualitative	Whether the State Adopts Obamacare or Not, 2018
Economic Status	Ave_GSP	Quantitative	Gross State Product (in million)/Person, 2018
	Ave_Income	Quantitative	2014-2018 Median Annual Household Income (in 2018 dollars)
	Unemployment_Rate	Quantitative	Unemployment Rate, Sept 2018
Medical Condition	Ave_Hospital	Quantitative	Number of Hospitals per Person, 2018
	Ave_Physicians	Quantitative	Number of Professionally Active Physicians per Person, September 2020
Health Status	Life_Expectancy	Quantitative	Life Expectancy at Birth (in years), 2010-2015
	Smoking_Rate	Quantitative	Percentage of Cigarette Use, 2018
	Vaccined_Rate	Quantitative	Vaccination Rate, 2018-2019
	Senior_Rate	Quantitative	Persons Age 65 and Older as a Percentage of Total Population, 2018

Source: Kaiser Family Foundation

Descriptive Analysis





Average income shows the clearest trend.

Hypothesis

- Medicare targets senior people
  - MSPB increases when seniors as a percentage of population increases.
- Longer lifespan means healthier body
  - MSPB decreases as life expectancy increases.
- Wealthy states have better medical facilities, hence higher medical bills
  - MSPB increases when average income increases.
- More hospitals means more chances for medical treatments, hence higher medical cost
  - MSPB increases when number of hospital per person increases.
- The federal government pays for most Medicare while Affordable Care Act (ACA) plans are usually offered by private health insurance companies
  - States that adopts Obamacare might have lower MSPBs.

First-order Model

- Our first-order model includes all independent variables.

- Summary
  - Global F-test p-value: 9.293e-05
  - R-squared: 0.5592
  - Adjusted R-squared: 0.449

Independent Variables Analysis (First-order Model)

- Coefficients that are significant on 0.1 level:

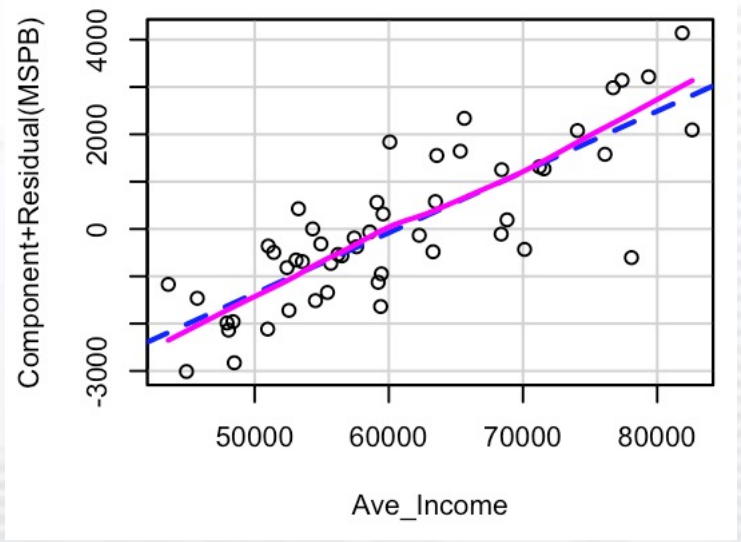
	Estimate	Std. Error	P-value
Ave_Income	1.284e-01	2.976e-02	0.000102 ***
Ave_Hospital	4.349e+07	1.506e+07	0.006249 **
Life_Expectancy	-4.798e+02	2.247e+02	0.038908 *
Unemployment_Rate	5.357e+02	2.732e+02	0.056885 .

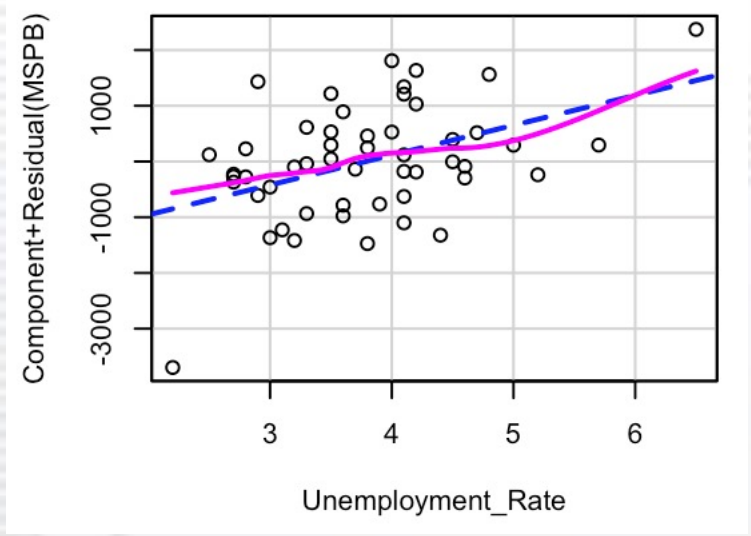
- Variables with VIF>5:

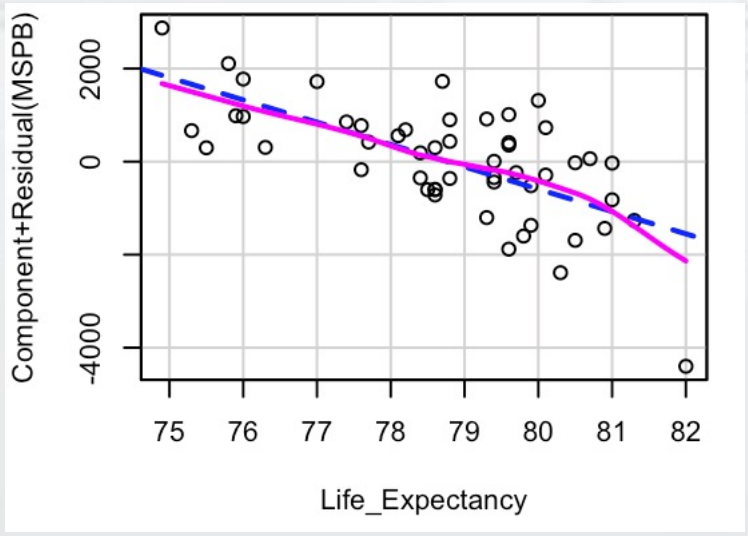
	Life_Expectancy	Ave_Physicians	Ave_GSP	Smoking_Rate
VIF	6.698285	5.897321	5.660827	5.280101

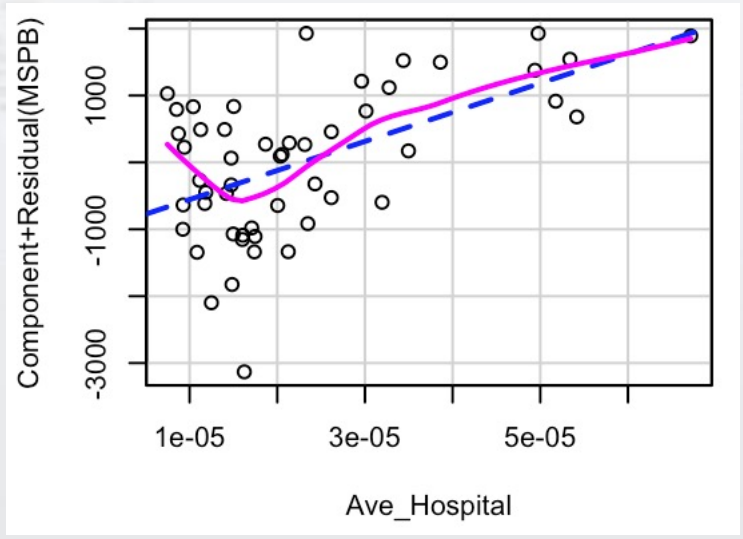
- Correlation:
  - Ave_GSP & Ave_Physicians (0.78)
  - Life_Expectancy & Smoking_Rate (-0.78)

crPlots (First-order Model)









- Ave_Hospital's residual shows heteroscedastic problem.

Improved Model

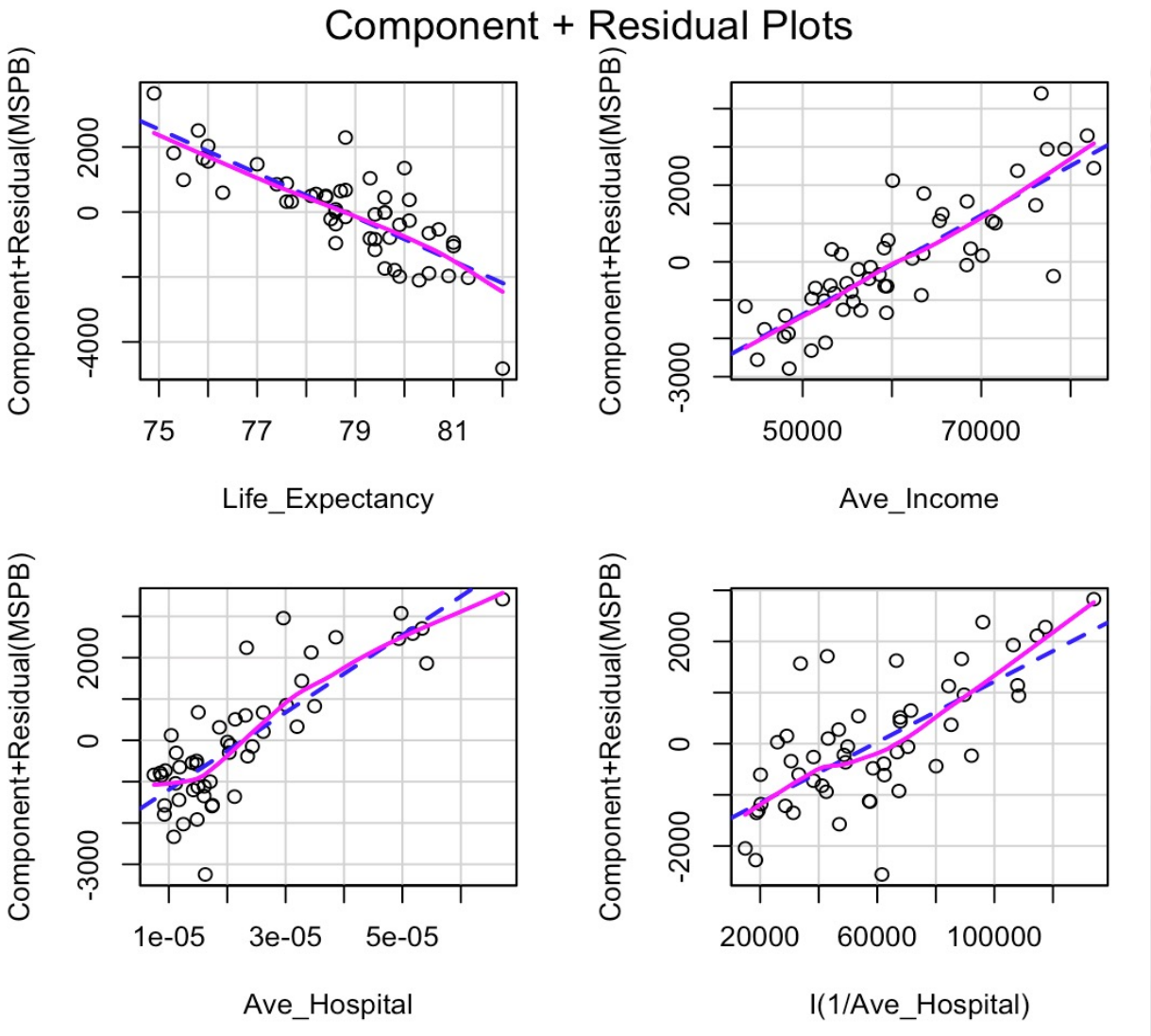
- Sample Regression Equation:

$$\widehat{MSPB} = 48480 + 0.1293 * Ave\_Income - 676.4 * Life\_Expectancy$$

$$+9.35e^{+07} * Ave\_Hospital + 0.0297 * \frac{1}{Ave\_Hospital}$$

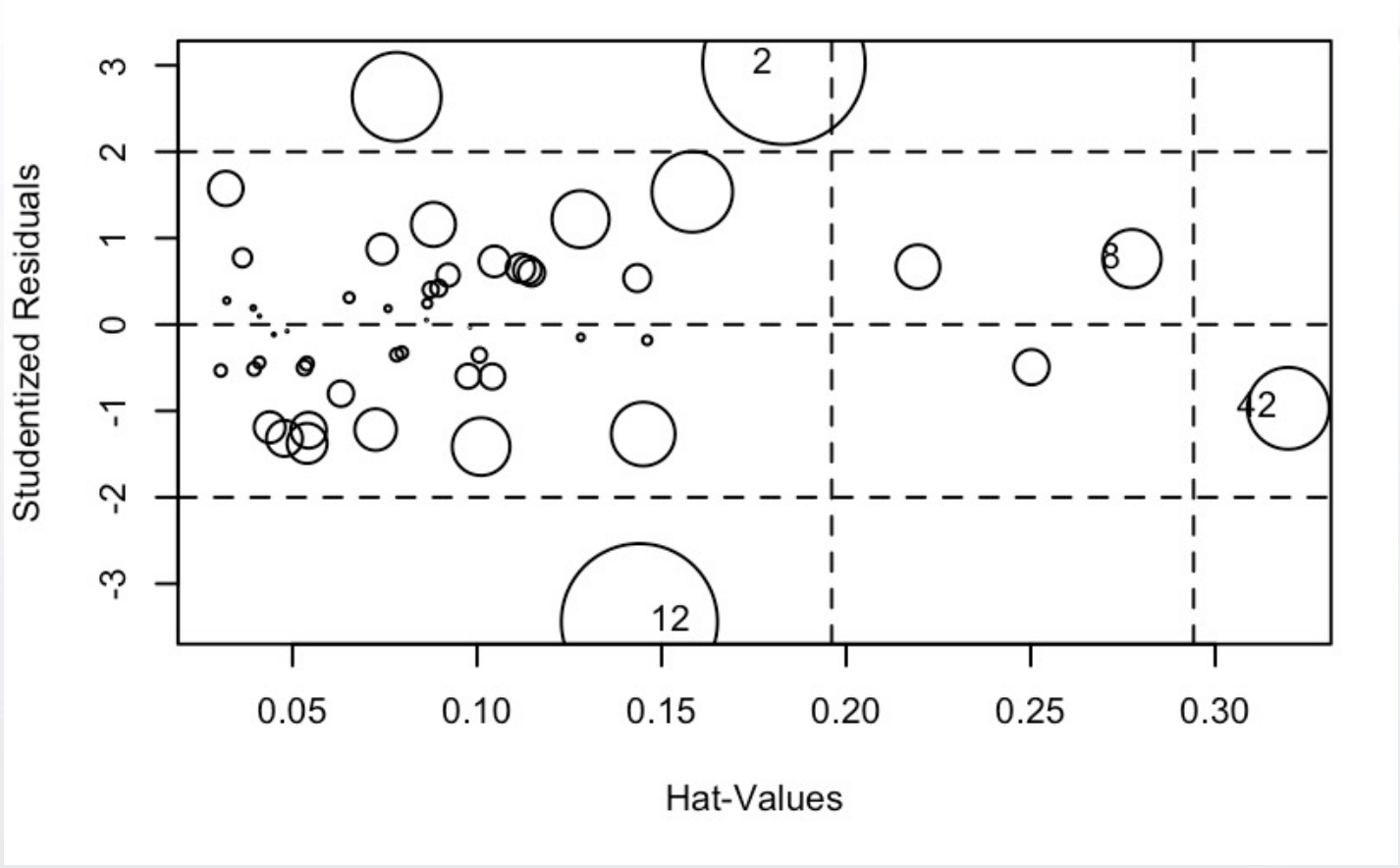
- Summary:
  - Global F-test p-value: 8.164e-09
  - Adjusted R-squared: 0.57 (>0.449 First-order Model)
  - R-squared: 0.6044
  - All coefficients are very significant on the 0.01 level.

Assumptions Check



- No big heteroscedastic problem since no trends are shown in these partial residual plots.
- Durbin-Watson Test P-value: 0.742, no correlated residual concerns.
- Q-Q normal plots show no normality concerns.

Influence Plot



Outliers with high influence:

- #2 Alaska: higher MSPB than the model predicted
- #12 Hawaii: lower MSPB than the model predicted

Conclusion

- Our improved model predicts that when all else are held constant, state MSPB:
  - Increases by $0.129 for every 1-dollar increase in median annual household income.
  - Decreases by $676.4 for every 1-year increase in life expectancy.
  - Decreases for every additional hospital built when hospital per person is below 1.8e-5, then starts to increase.
- Percentage of senior people does not have a significant effect on MSPB.
- Obamacare does not have a significant effect on MSPB.
- The best way to lower MSPB without harming the healthcare system and state economy is by improving overall health.

Further Analysis...

- Add more variables about the number of people under the age of 65 who have been receiving disability benefits for at least two years, and the number of people in the state who receive other Medicare plans, such as Medicare Advantage plan.
- Further investigation into the MSPB number for Alaska.
- Upgrade our single year observations to a longer time span (average, median).

THANK YOU FOR YOUR ATTENTION