ECON 470 HW4

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1 Instructions

In this assignment, you'll again work with the Medicare Advantage data. These data are described in detail in the Medicare Advantage GitHub Repo. We worked with a subset of these data back in assignment 1; however, this assignment requires that you work with a more complete version of the Medicare Advantage data, but for fewer years. Once you have data downloaded and code running, answer following questions:

2 Summarize the data

2.0.1 Question 1. Remove all SNPs, 800-series plans, and prescription drug only plans (i.e., plans that do not offer Part C benefits). Provide a box and whisker plot showing the distribution of plan counts by county over time. Do you think that the number of plans is sufficient, too few, or too many?

Figure 1 displays the distribution of plan counts by county over time from 2007 to 2015. The box and whisker plot shows that there are many extreme values on the upside of the distribution. The distribution has been shifting downwards from 2008 to 2011, and has stayed at a relatively low level from 2011 to 2015.

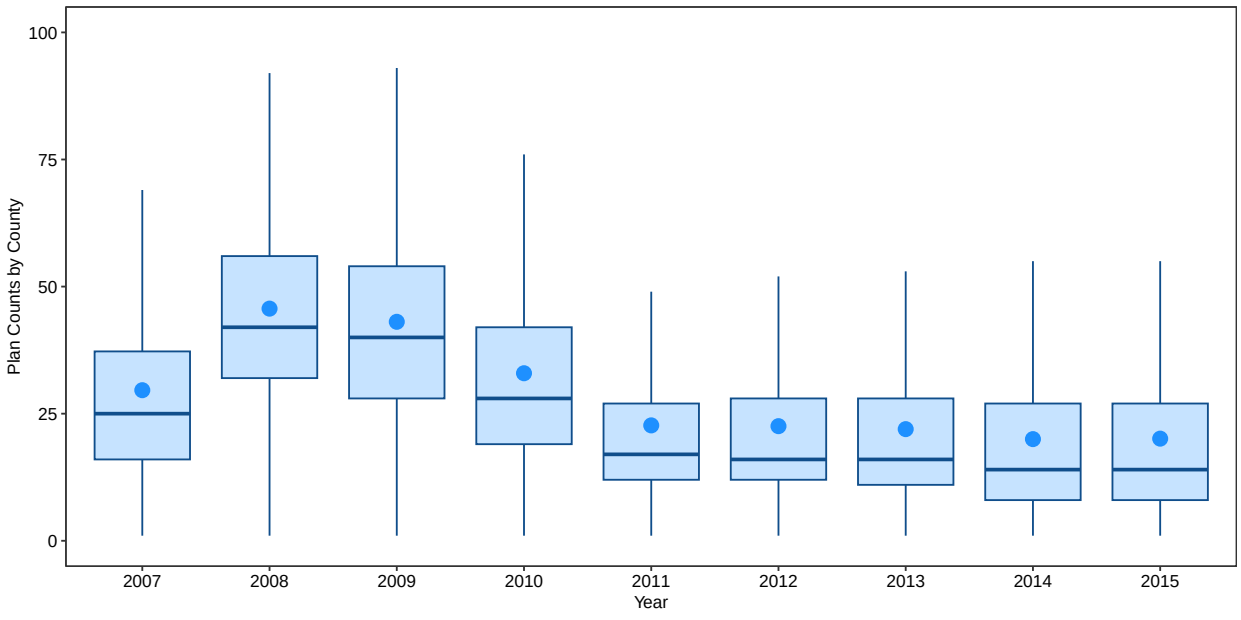

Figure 1: Distribution of Plan Counts by County from 2007 to 2015

Table 1 displays the summary statistics of plan counts by county over time from 2007 to 2015. The number of plans by county on average has been falling overtime with the sharpest decrease happening in 2011. Overall, the number of plans is sufficient, as on average counties have roughly 30 plans in any year between 2011 and 2015. This means that the regional markets of Medicare plans are competitive enough at county level, providing various options with different features for people to choose from. Meanwhile, only 25% of counties have no more than 12 plans, which could be considered as too few. In the extreme cases, a few counties have a rather large number of plans, while others have only one plan.

Table 1: Summary Statistic of Plan Counts by County from 2007 to 2015

year	Mean	Max	Q2	Median	Q3	Min
2007	41.40	800	17	26	43.0	1
2008	72.66	1,343	33	46	70.5	1
2009	69.63	1,307	30	43	69.0	1
2010	48.66	906	20	29	48.0	1
2011	30.21	513	12	18	30.0	1
2012	29.96	522	12	17	31.0	1
2013	29.23	554	11	17	32.0	1
2014	26.57	509	8	15	28.0	1
2015	27.31	492	8	15	29.0	1

2.0.2 Question 2. Provide bar graphs showing the distribution of star ratings in 2009, 2012, and 2015. How has this distribution changed over time?

Figure 2 and Figure 3 display the distribution of star ratings in 2009, 2012, and 2015. The distribution changed from right skewed to left skewed, as the majority of plans moved from the lower end of star ratings to the upper end of star ratings. The mode of the distribution shifted upwards, as most plans are rated 2.5 stars, 3 stars, and 4 stars in in 2009, 2012, and 2015 respectively. This means that the quality of the plans as measured by star ratings has improved overtime.

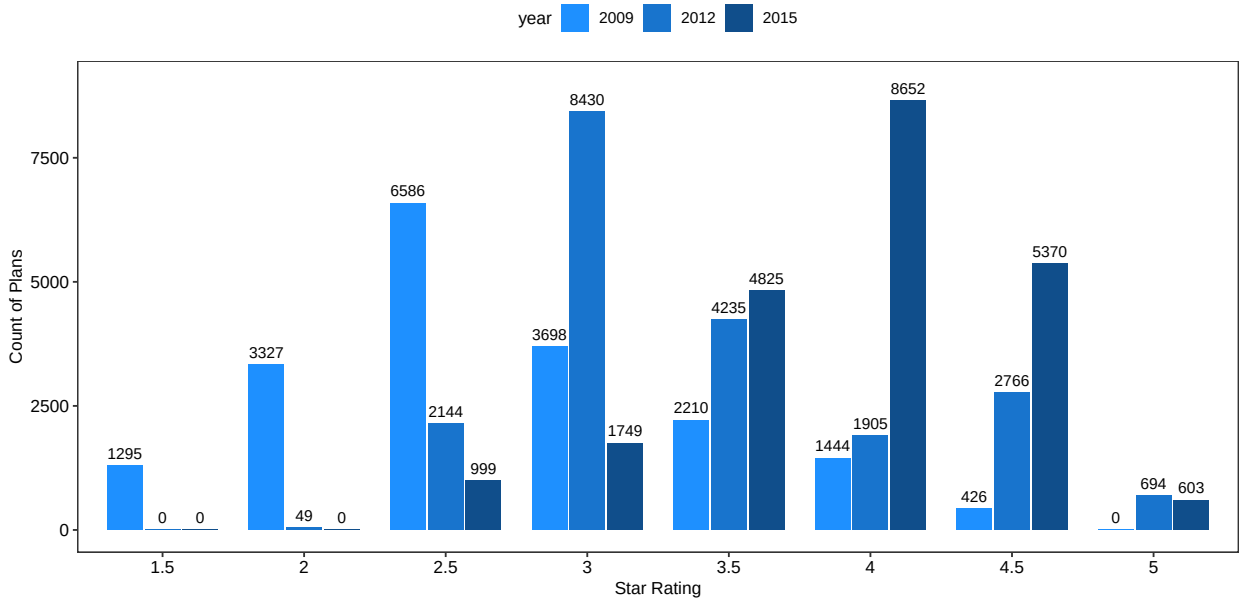

Figure 2: Frequency Distribution of Star Ratings in 2009, 2012, and 2015 (One Plot)

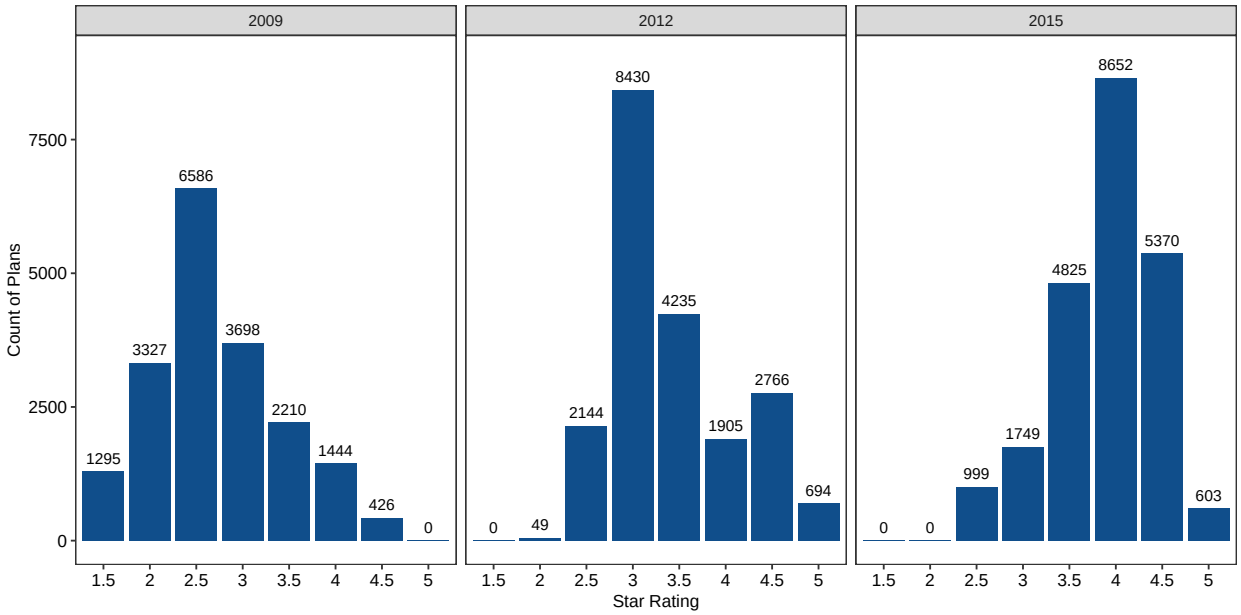

Figure 3: Frequency Distribution of Star Ratings in 2009, 2012, and 2015 (Separate Plots)

2.0.3 Question 3. Plot the average benchmark payment over time from 2009 through 2015. How much has the average benchmark payment risen over the years?

Figure 4 displays the average benchmark payment of Part C over time from 2009 to 2015. The average benchmark payment has been slowly increasing from 2009 to 2014 and fell in 2015. The average benchmark payment has remained stable at roughly 800 with an increase in 2014 and a larger decrease in 2015. From 2009 to 2015, the average benchmark payment decreased by 20.27 from 804.72 to 784.44.

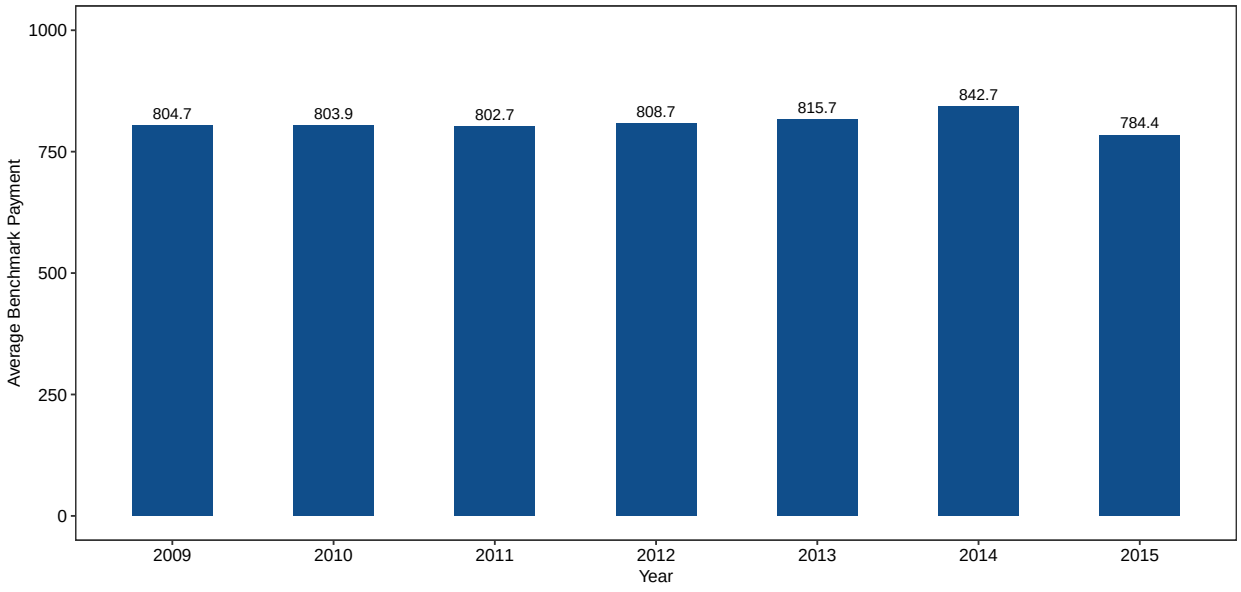

Figure 4: Average Benchmark Payment from 2009 to 2015

2.0.4 Question 4. Plot the average share of Medicare Advantage (relative to all Medicare eligibles) over time from 2009 through 2015. Has Medicare Advantage increased or decreased in popularity? How does this share correlate with benchmark payments?

Figure 5 displays the average share of Medicare Advantage (relative to all Medicare eligibles) over time from 2009 to 2015. Medicare Advantage has increased in popularity as the market share has been consistently rising over time from 2009 to 2015, with a faster rate from 2011 to 2015. The market share of Medicare Advantage increased by 0.07 from 0.15 to 0.23.

The average benchmark payment has remained stable while the average share of Medicare Advantage has been increasing over time from 2009 to 2015. The correlation between the the average benchmark payment and the average share of Medicare Advantage is 0.1371296. Thus, the benchmark payment and the share are positively correlated despite that the size of the correlation is quite small.

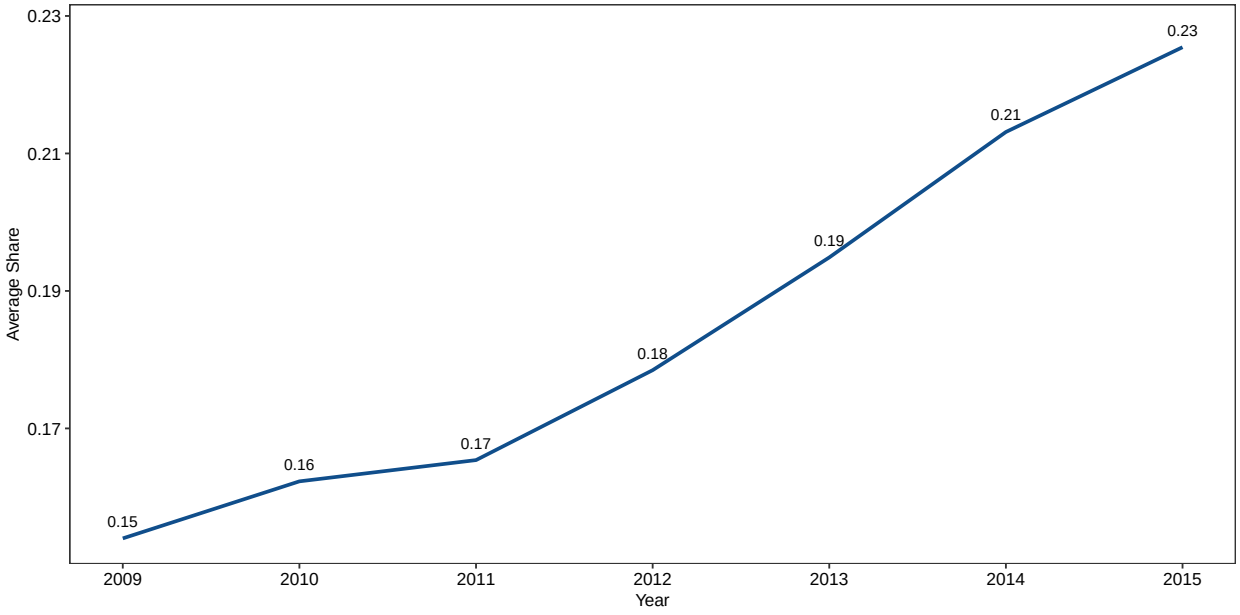

Figure 5: Average Share of Medicare Advantage (Relative to All Medicare Eligibles) from 2009 to 2015

3 Estimate ATEs

For the rest of the assignment, we'll use a regression discontinuity design to estimate the average treatment effect from receiving a marginally higher rating. We'll focus only on 2009, as this is the year in which the star rating running variable is easiest to replicate.

3.0.1 Question 1. Calculate the running variable underlying the star rating. Provide a table showing the number of plans that are rounded up into a 3-star, 3.5-star, 4-star, 4.5-star, and 5-star rating.

Table 2 displays the number of plans that are rounded up into a 3-star, 3.5-star, 4-star, and 4.5-star. Most plans are rounded up into a 3-star rating. There are no plans that have a 5-star rating. There are no plans that are rounded up into a 4.5-star rating, which means that there is no plan with a 4.5-star rating that has a raw rating between the 4.25 cutoff and 4.5.

Table 2: Number of Plans Rounded Up into Each Star Ratings in 2009

Star Ratings	Count
3	2,278
3.5	1,157
4	767
4.5	0

3.0.2 Question 2. Using the RD estimator with a bandwidth of 0.125, provide an estimate of the effect of receiving a 3-star versus a 2.5 star rating on enrollments. Repeat the exercise to estimate the effects at 3.5 stars, 4 stars, and 4.5 stars. Summarize your results in a table.

Table 3 displays the RD estimates, with a bandwidth of 0.125, of the effects of receiving a particular star rating on enrollments at 3 stars, 3.5 stars, and 4 stars. The estimate of the effect at 4.5 stars cannot be evaluated because the data on the right side of the threshold is insufficient. All plans with a raw rating within the range of 4.125-4.375, have a 4.5-star rating and a raw rating that is smaller than the cutoff 4.25.

For RD on 0.125 bandwidth, when imposing constant slopes, there would be a 109.51 decrease in enrollment among 2.5-star plans versus 3-star plans, a 61.29 decrease in enrollment among 3-star plans versus 3.5-star plans, and a 160.06 decrease in enrollment among 3.5-star plans versus 4-star plans.

Table 3: RD Estimates of the Effect of Receiving Stars at 3.0-Star, 3.5-Star, 4.0-Star on Enrollment with a Bandwidth of 0.125

	Brandwidth 0.125		
	3.0-Star	3.5-Star	4.0-Star
Treat	−109.51	−61.29	−160.06
	(349.45)	(101.81)	(245.40)
Score	−6296.53***	−343.82	5041.48***
	(1841.79)	(791.56)	(1425.22)
N	1953	1578	1286
R2	0.05	0.00	0.01

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.0.3 Question 3. Repeat your results for bandwidths of 0.1, 0.12, 0.13, 0.14, and 0.15. Show all of the results in a graph. How sensitive are your findings to the choice of bandwidth?

Table 4, table 5, table 6, table 7, and table 8 display the RD estimates, with different bandwidths, of the effects of star rating on enrollments at 3 stars, 3.5 stars, and 4 stars. The estimate of the effect at 4.5 stars cannot be evaluated because the data on the right side of the threshold is insufficient. All plans with a raw rating within the range of 4.25 plus or minus the bandwidth, have a 4.5-star rating and a raw rating that is smaller than the cutoff 4.25.

For RD on 0.1 bandwidth, when imposing constant slopes, there would be a 748.25 decrease in enrollment among 2.5-star plans versus 3-star plans, a 12.54 decrease in enrollment among 3-star plans versus 3.5-star plans, and a 533.99 decrease in enrollment among 3.5-star plans versus 4-star plans.

Table 4: RD Estimates of the Effect of Receiving Stars at 3.0-Star, 3.5-Star, 4.0-Star on Enrollment with a Bandwidth of 0.1

	Brandwidth 0.1		
	3.0-Star	3.5-Star	4.0-Star
Treat	−748.25*	−12.54	−533.99+
	(353.21)	(92.92)	(319.27)
Score	2462.50	3055.65***	10 812.19***
	(2466.54)	(873.36)	(2486.33)
N	705	1383	1071
R2	0.02	0.01	0.02

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

For RD on 0.12 bandwidth, when imposing constant slopes, there would be a 48.59 decrease in enrollment among 2.5-star plans versus 3-star plans, a 61.29 decrease in enrollment among 3-star plans versus 3.5-star plans, and a 160.06 decrease in enrollment among 3.5-star plans versus 4-star plans.

Table 5: RD Estimates of the Effect of Receiving Stars at 3.0-Star, 3.5-Star, 4.0-Star on Enrollment with a Bandwidth of 0.12

	Brandwidth 0.12		
	3.0-Star	3.5-Star	4.0-Star
Treat	−48.59	−61.29	−160.06
	(350.66)	(101.81)	(245.40)
Score	−6950.88***	−343.82	5041.48***
	(1862.13)	(791.56)	(1425.22)
N	1940	1578	1286
R2	0.05	0.00	0.01

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

For RD on 0.13 bandwidth, when imposing constant slopes, there would be a 109.51 decrease in enrollment among 2.5-star plans versus 3-star plans, a 61.26 decrease in enrollment among 3-star plans versus 3.5-star plans, and a 160.06 decrease in enrollment among 3.5-star plans versus 4-star plans.

Table 6: RD Estimates of the Effect of Receiving Stars at 3.0-Star, 3.5-Star, 4.0-Star on Enrollment with a Bandwidth of 0.13

	Brandwidth 0.13		
	3.0-Star	3.5-Star	4.0-Star
Treat	−109.51	−61.26	−160.06
	(349.45)	(101.74)	(245.40)
Score	−6296.53***	−338.08	5041.48***
	(1841.79)	(789.81)	(1425.22)
N	1953	1580	1286
R2	0.05	0.00	0.01

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

For RD on 0.14 bandwidth, when imposing constant slopes, there would be a 1613.24 decrease in enrollment among 2.5-star plans versus 3-star plans, a 8.23 decrease in enrollment among 3-star plans versus 3.5-star plans, and a 169.89 decrease in enrollment among 3.5-star plans versus 4-star plans.

Table 7: RD Estimates of the Effect of Receiving Stars at 3.0-Star, 3.5-Star, 4.0-Star on Enrollment with a Bandwidth of 0.14

	Brandwidth 0.14		
	3.0-Star	3.5-Star	4.0-Star
Treat	−1613.24***	−8.23	−169.89
	(221.54)	(97.83)	(204.75)
Score	7184.74***	−1230.64*	4986.69***
	(943.61)	(606.13)	(1281.25)
N	5882	1824	1463
R2	0.01	0.00	0.01

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

For RD on 0.15 bandwidth, when imposing constant slopes, there would be a 1446.01 decrease in enrollment among 2.5-star plans versus 3-star plans, a 2.75 decrease in enrollment among 3-star plans versus 3.5-star plans, and a 169.89 decrease in enrollment among 3.5-star plans versus 4-star plans.

Table 8: RD Estimates of the Effect of Receiving Stars at 3.0-Star, 3.5-Star, 4.0-Star on Enrollment with a Bandwidth of 0.15

	Brandwidth 0.15		
	3.0-Star	3.5-Star	4.0-Star
Treat	−1446.01***	−2.75	−169.89
	(214.82)	(97.04)	(204.75)
Score	6370.81***	−1306.60*	4986.69***
	(907.67)	(592.43)	(1281.25)
N	5959	1841	1463
R2	0.01	0.01	0.01

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Figure 6 displays display the RD estimates, with different bandwidths, of the effects of receiving a star rating on enrollments at 3 stars, 3.5 stars, and 4 stars. Using a smaller bandwidth would cause a greater loss of data points. Thus, the findings can be somewhat sensitive to the choice of bandwidth which influences the number of data points that the RD model uses to estimate the effect. In this case, the estimates of treatment of receiving a star rating is more affected by bandwidths for 3-star rating and not really affected by bandwidths for 3.5-star and 4-star ratings.

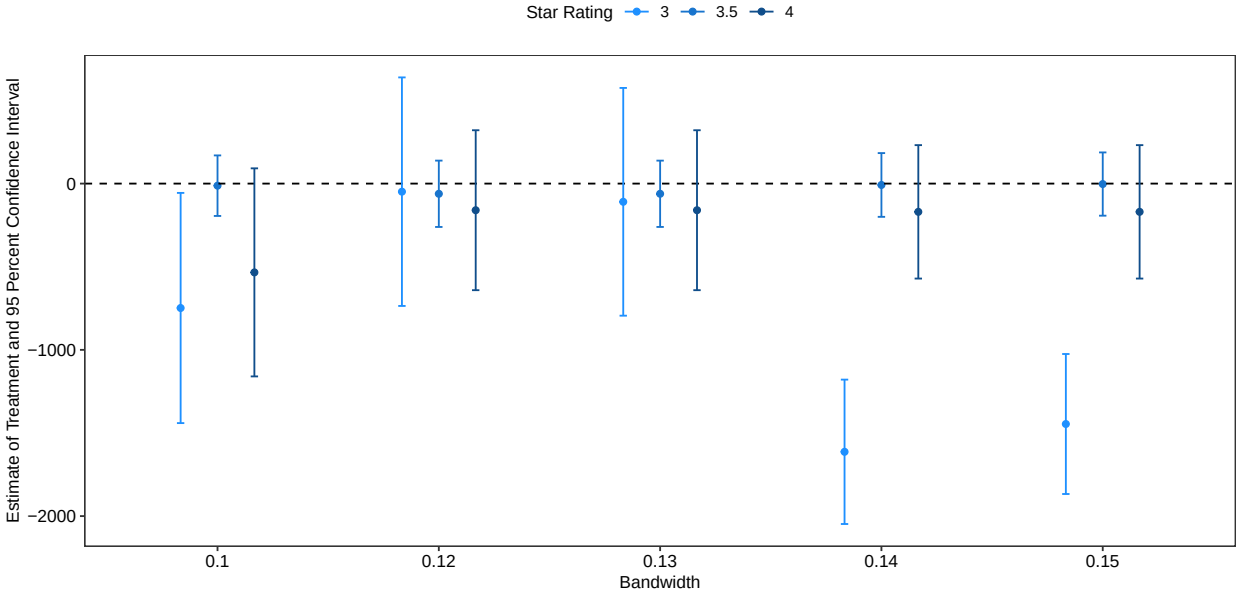

Figure 6: RD Estimates of the Effect of Receiving a Star Rating on Enrollment with Different Bandwidths

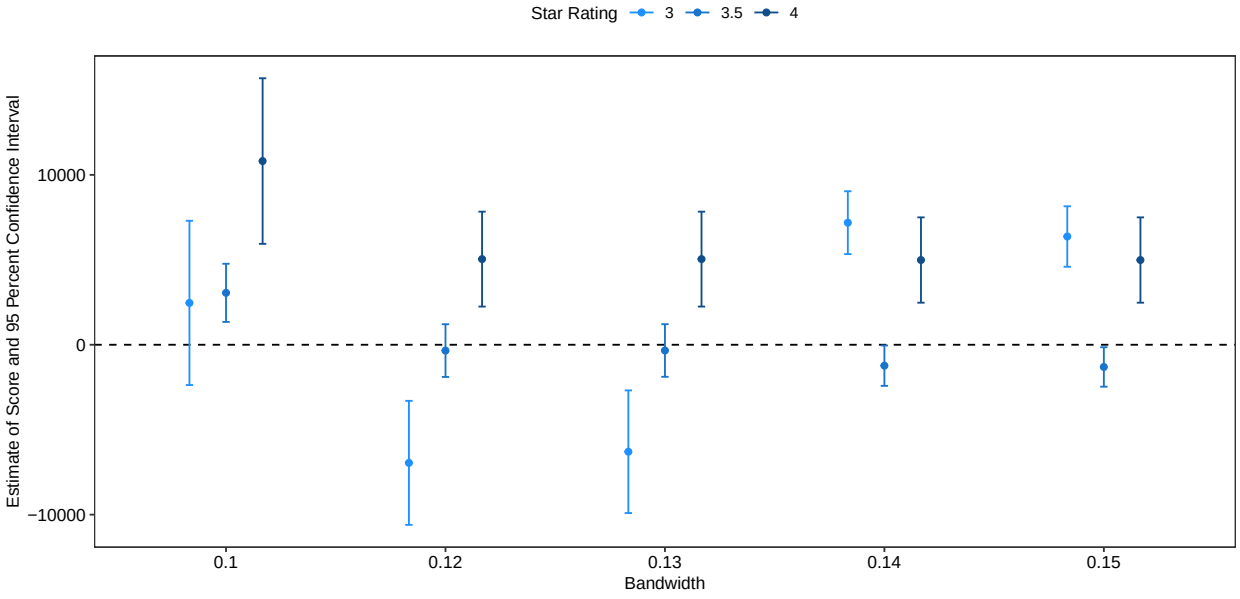

Figure 7: RD Estimates of the Effect of Receiving a Star Rating on Enrollment with Different Bandwidths

3.0.4 Question 4. Examine (graphically) whether contracts appear to manipulate the running variable. In other words, look at the distribution of the running variable before and after the relevant threshold values. What do you find?

Figure 8 displays the distribution of the running variable before and after the relevant threshold values, which shows that the plans on either side of the cutoff seem to be mostly comparable. At 3.0-Star, most of the observations are on the right side of the cutoff, which suggests that there is some evidence of manipulation of the running variable. At 3.5-Star, there are sufficient observations on both sides of the cutoff with some more on the left side, which suggests that there is not much evidence of manipulation. At 4.0-Star, there is no evidence that one side of the cutoff has significantly more observations while the other side of the cutoff has hardly any, which suggests the contracts do not appear to manipulate the running variable.

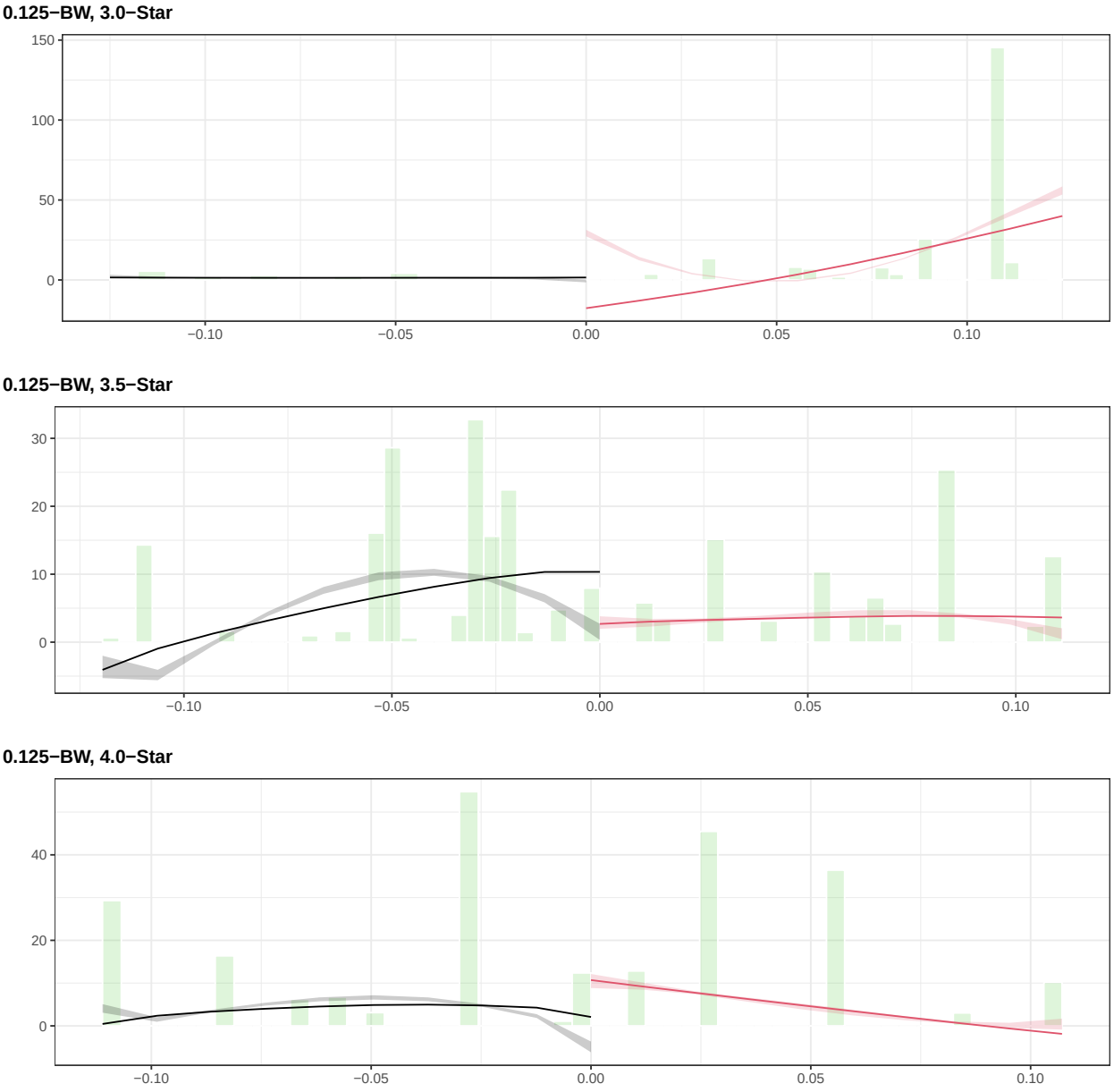

Figure 8: Distribution of the Running Variable Before and After the Relevent Threshold Values

3.0.5 Question 5. Similar to question 8, examine whether plans just above the threshold values have different characteristics than contracts just below the threshold values. Use HMO and Part D status as your plan characteristics.

Figure 9 displays the mean differences of HMO and Part D status above and below threshold, which shows that plans on different sides of the threshold have different characteristics. For 3.0-Star, more plans on the left side of the threshold tend to have both HMO and Part D. For 3.5-Star, more plans on the left side of the threshold tend to have Part D, while more plans on the right side of the threshold tend to have HMO. For 4.0-Star, more plans on the left side of the threshold tend to have HMO, while more plans on the right side of the threshold tend to have Part D.

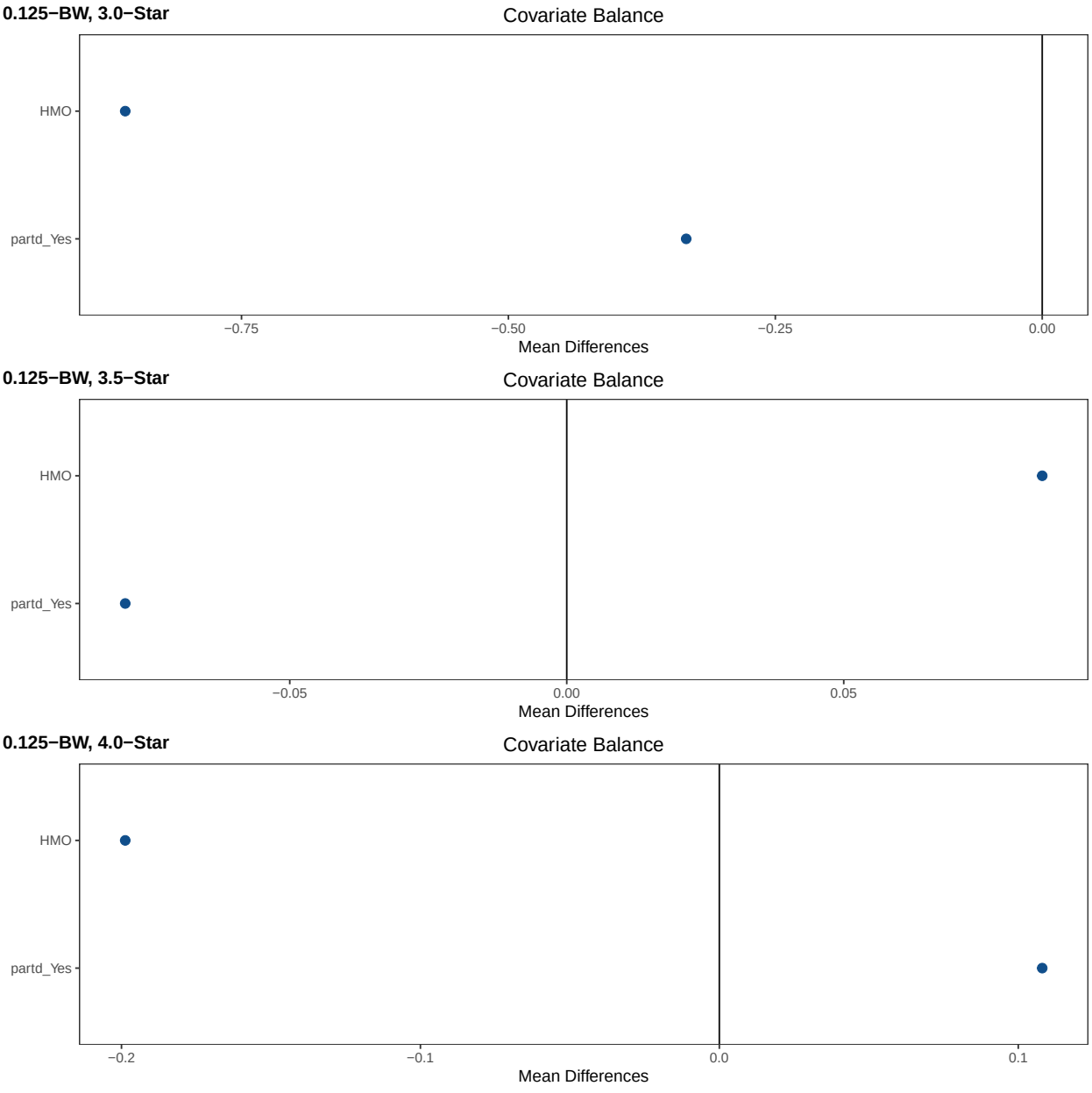

Figure 9: Mean Differences of HMO and Part D Status Above and Below Threshold

3.0.6 Question 6. Summarize your findings from 1-5. What is the effect of increasing a star rating on enrollments? Briefly explain your results.

According to the RD models, the estimates of the regression coefficients of treatment are all negative. This means that when imposing constant slopes, there would a decrease in enrollment among 2.5-star versus 3-star, 3-star versus 3.5-star, and 3.5-star versus 4-star. Thus, increasing a star rating leads to having lower enrollments. Having a higher star rating signifies that the plan has a better quality which makes it more attractive to people. The plans with higher star ratings are entirely different from the plans with lower star ratings in terms of coverage and benefits, as showed by the analysis on HMO and Part D status. Despite the better quality, plans with a higher star rating may be more expensive and less available, which makes the plans less attractive to people. Besides, healthy individuals in search for the most economical plans may not prefer the comprehensive and expensive plans with high star ratings.