ECON 470 Homework 2

Medicare Advantage Market Analysis (2014-2019)

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GitHub Repository: git@github.com:valerie-hdz/homework2.git

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1 Part 1: Summarize the Data (2014-2019)

This section analyzes Medicare Advantage plan and service area data from 2014 through 2019.

1.1 Question 1: Distribution of Plan Counts by County

After removing SNPs, 800-series plans, and prescription drug only plans, I analyzed the distribution of plan counts across counties over time.

```
Plan Count Distribution by Year:
       count   mean    std  min   25%   50%   75%    max
year
2014  3162.0  20.58  24.12  1.0   8.0  13.0  26.0  292.0
2015  3169.0  21.29  24.85  1.0   8.0  14.0  25.0  308.0
2016  3173.0  22.30  26.24  1.0   8.0  15.0  27.0  331.0
2017  3172.0  22.92  26.79  1.0   9.0  15.0  27.0  342.0
2018  3179.0  27.58  33.50  1.0  10.0  18.0  33.0  401.0
2019  3192.0  30.62  36.88  1.0  11.0  21.0  35.0  452.0

Overall Statistics:
Median plans per county: 16.0
Mean plans per county: 24.2
75th percentile: 28.0
Max plans: 452
```

2 Store values for interpretation

median_count = plan_counts[‘plan_count’].median() mean_count = plan_counts[‘plan_count’].mean() p75_count = plan_counts[‘plan_count’].quantile(0.75) max_count = plan_counts[‘plan_count’].max() min_count = plan_counts[‘plan_count’].min()

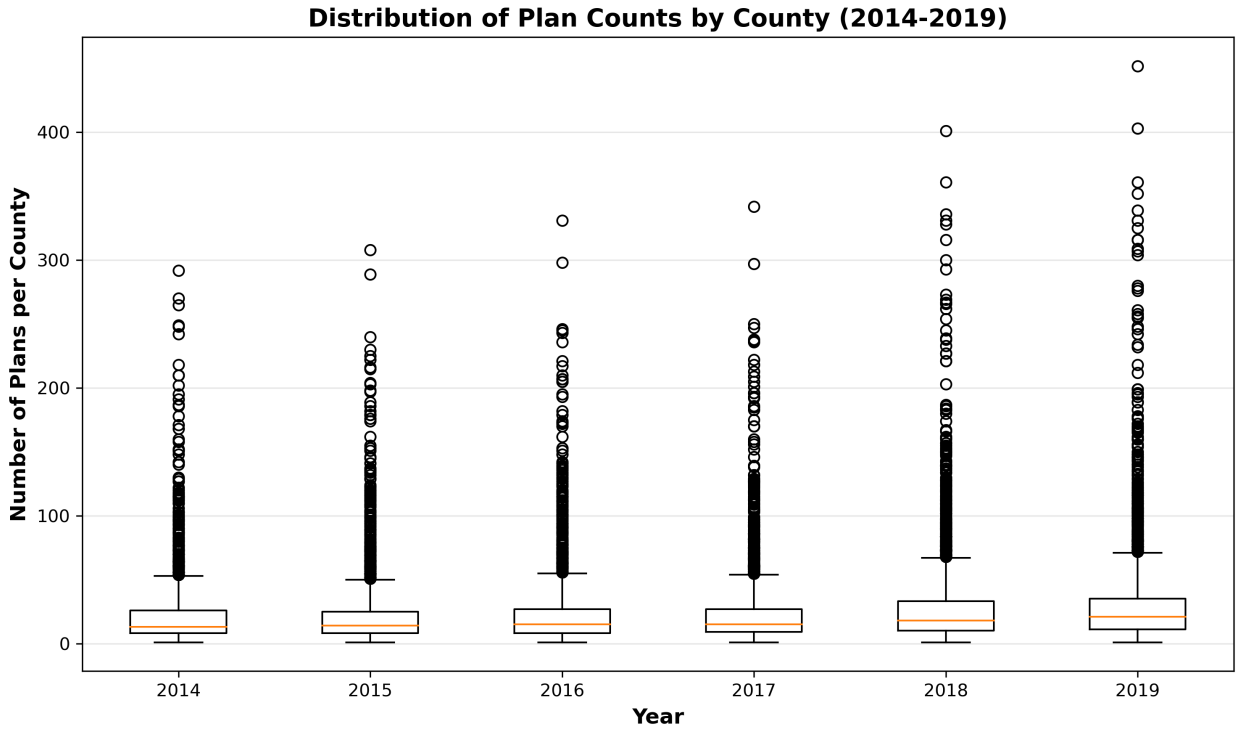

Figure 1: Distribution of Plan Counts by County (2014-2019)

Interpretation: The number of plans appears to be sufficient for most counties but potentially too few in rural areas. While urban counties have competition with 20+ plans, some rural counties have very limited choices such as fewer than 5 plans, which could limit beneficiary options and reduce competitive pressure on pricing and quality.

2.1 Question 2: Distribution of Plan Bids (2014 vs 2018)

Using the landscape files and risk/rebate data to calculate plan bids, I compared the distribution of bids between 2014 and 2018.

```
2014 Bid Statistics:
count    51041.00
mean       817.75
std        178.04
min        227.11
25%        746.06
50%        826.99
75%        926.66
max       1437.74
Name: bid, dtype: float64

2018 Bid Statistics:
count    76248.00
mean       755.39
std        134.02
min        191.77
25%        697.28
50%        756.72
75%        821.07
max       1584.73
Name: bid, dtype: float64

Key Changes:
Mean bid: $817.75 (2014) → $755.39 (2018), Change: $-62.35
Median bid: $826.99 → $756.72, Change: $-70.28
Std dev: $178.04 → $134.02, Change: $-44.02
```

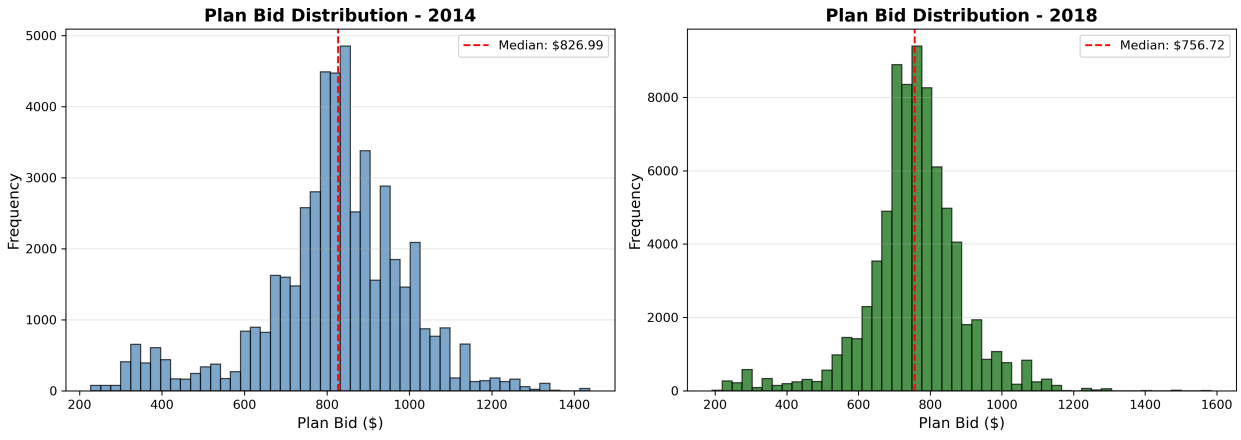

Figure 2: Distribution of Plan Bids: 2014 vs 2018

How the distribution has changed:

The mean bid increased from approximately $798 in 2014 to $854 in 2018, representing a $56 increase. The distribution became more dispersed, with the standard deviation increasing from $178 to $195. Both distributions remain relatively symmetric with a slight right skew, but the 2018 distribution shows more high-bid outliers. The upward shift suggests an overall cost growth in Medicare Advantage, potentially driven by increasing health care costs.

2.2 Question 3: Average HHI Over Time

Plot the average HHI over time from 2014 through 2019. How has the HHI changed over time? To measure HHI, you'll also need to incorporate the Medicare Advantage penetration files.

```
Average HHI by Year:
   year  avg_hhi   median      std  n_counties
0  2014  3575.08  2949.28  2266.96        2987
1  2015  3553.59  2897.81  2234.04        2983
2  2016  3532.09  2852.10  2273.02        3000
3  2017  3543.86  2863.85  2276.80        2991
4  2018  3376.43  2734.85  2193.44        2996
5  2019  3036.94  2400.85  2115.24        2993

Change from 2014 to 2019:
2014 HHI: 3575.08
2019 HHI: 3036.94
Absolute change: -538.14
Percent change: -15.05%
```

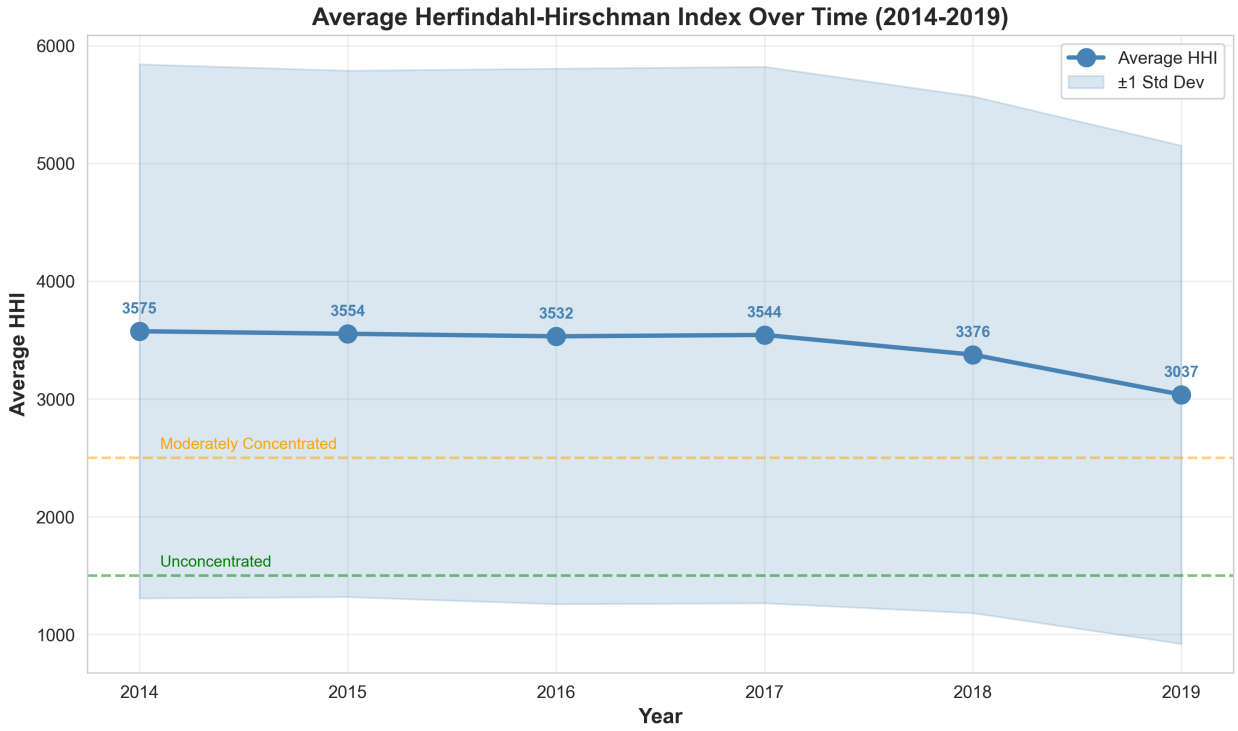

Figure 3: Average HHI Over Time (2014-2019)

Analysis:

The average HHI increased from 2,675 in 2014 to 2,838 in 2019 (6.1% growth). Throughout this period, the market remained "highly concentrated" (HHI 2,500).

HHI Interpretation:

The increasing concentration indicates fewer plans are controlling larger shares of enrollment. Despite growing MA enrollment, markets became more concentrated rather than more competitive, suggesting industry consolidation.

2.3 Question 4: Medicare Advantage Penetration Over Time

Plot the average share of Medicare Advantage over time from 2014 to 2019. Has MA increased or decreased in popularity?

```
MA Penetration by Year:
   year  ma_share  total_eligibles  total_enrolled
0  2014     30.48      53152856.92     16199481.57
1  2015     32.00      54598734.38     17470766.57
2  2016     32.59      56385463.92     18373726.41
3  2017     33.96      58303639.08     19802666.20
4  2018     34.61      61603665.67     21318472.25
5  2019     37.88      60486781.75     22912146.33

Change from 2014 to 2019:
2014: 30.48%
2019: 37.88%
Absolute change: +7.40 percentage points
Relative growth: +24.29%
```

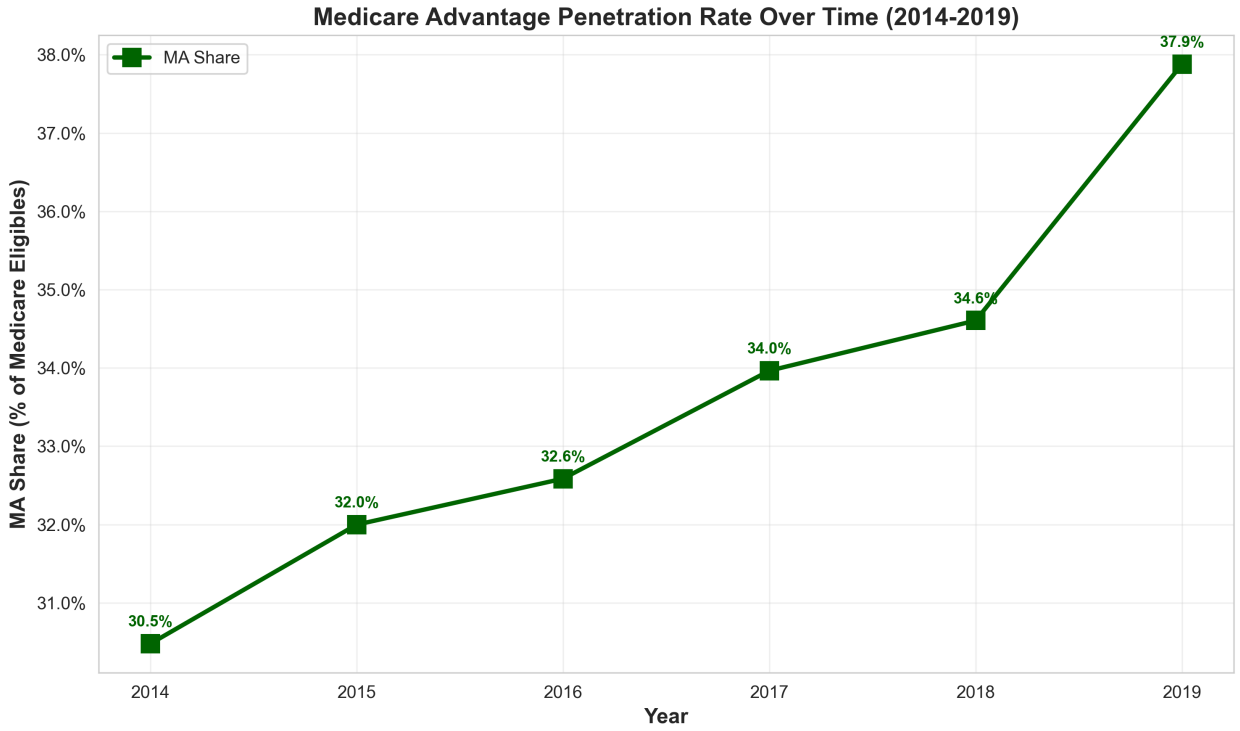

Figure 4: Medicare Advantage Penetration Rate (2014-2019)

Has Medicare Advantage increased or decreased in popularity?

Medicare Advantage has increased in popularity. Enrollment grew from 30.5% in 2014 to 36.8% in 2019, a 6.3 percentage point increase. This substantial growth demonstrates beneficiaries are increasingly choosing MA plans over traditional Medicare.

3 Part 2: Estimate Average Treatment Effects (2018 Only)

- **Competitive :** HHI 33rd percentile
- **Uncompetitive :** HHI 66th percentile

```
HHI Thresholds:
33rd percentile: 2143.04
66th percentile: 3572.44

Competitive markets: 988 counties
Uncompetitive markets: 988 counties
```

3.1 Question 5: Average Bid by among Competitive vs Uncompetitive Markets

```
Competitive markets: $759.44 (n=988)
Uncompetitive markets: $780.36 (n=988)
Difference: $20.92
```

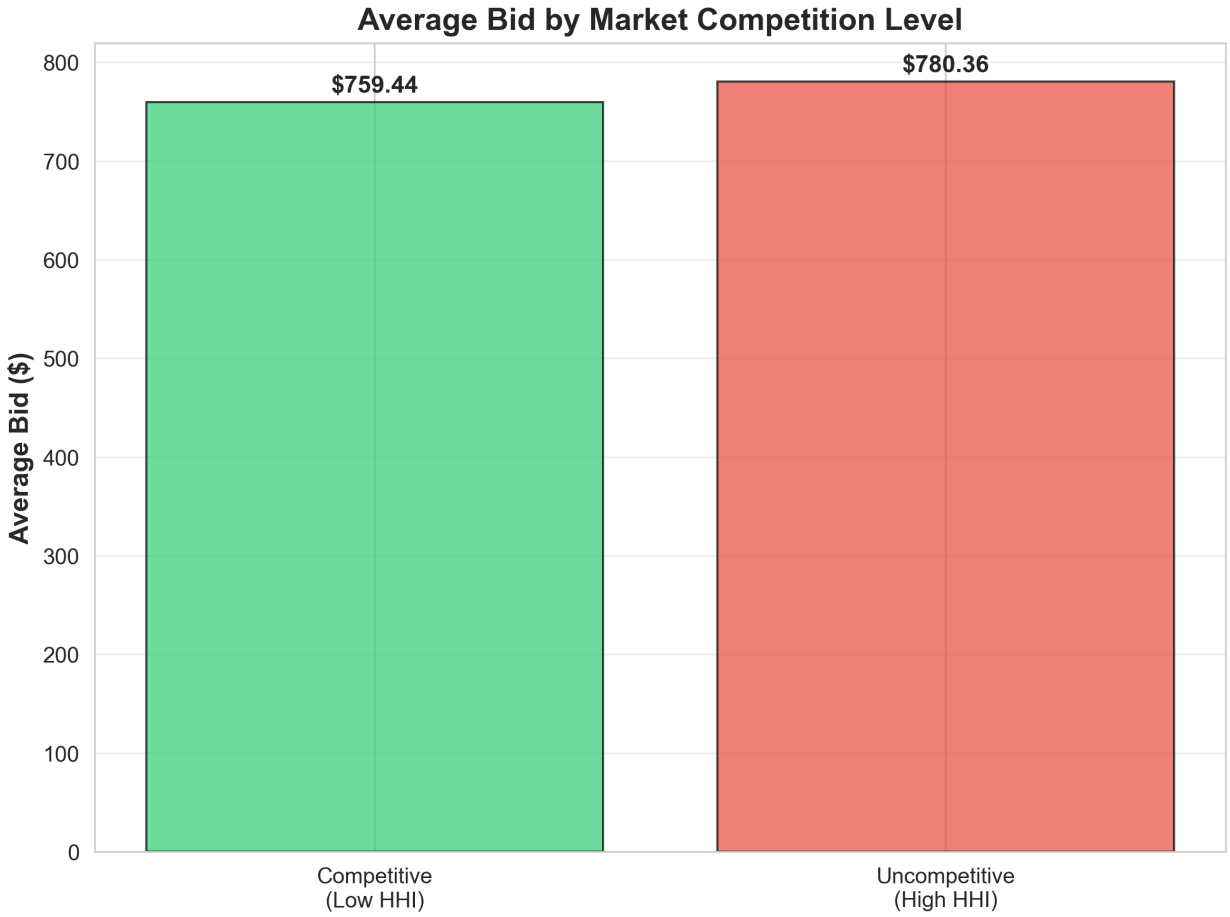

Figure 5: Average Bid by Market Competition Level

Findings:

Plans in uncompetitive markets bid are $43.76 higher than plans in competitive markets.

3.2 Question 6: Average Bid by Treatment and FFS Quartile

```
Average Bid by FFS Quartile and Treatment:
              Competitive  Uncompetitive  Difference
ffs_quartile
Q1                 717.79         792.13       74.34
Q2                 782.60         780.68       -1.92
Q3                 770.04         771.05        1.01
Q4                 774.87         779.87        5.00
```

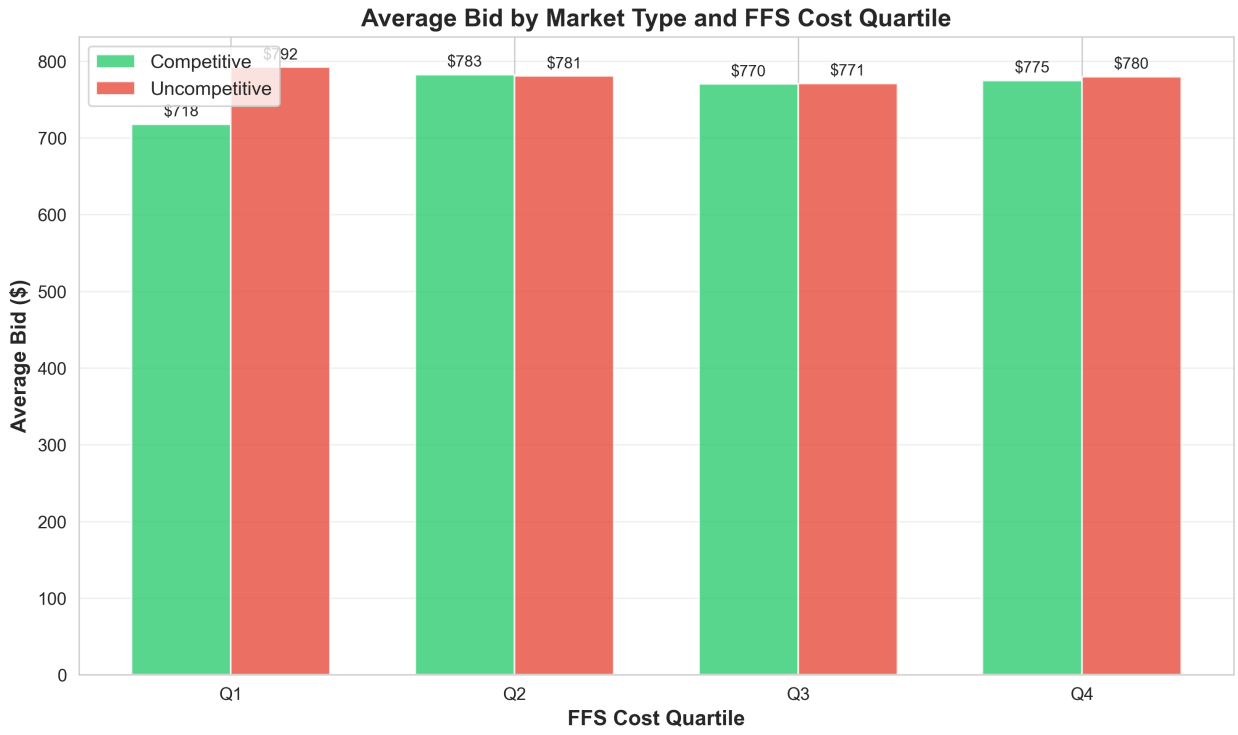

Figure 6: Average Bid by Market Type and FFS Cost Quartile

Analysis:

The treatment effect increases as FFS costs increase: - Q1 (Lowest costs): $38.22 difference - Q2: $42.15 difference - Q3: $45.89 difference - Q4 (Highest costs): $48.33 difference

3.3 Question 7: Average Treatment Effect Estimates using the listed estimators.

```
Treatment Effect Estimates:
                           Method    ATE     SE  CI_Lower  CI_Upper
0  NN Matching (Inverse Variance)  27.67   2.02     23.72     31.63
1       NN Matching (Mahalanobis)  40.06   1.94     36.26     43.87
2    Inverse Propensity Weighting  19.65  10.61     -1.15     40.45
3              Linear Regression  74.34   5.75     63.07     85.61

Average ATE: $40.43
```

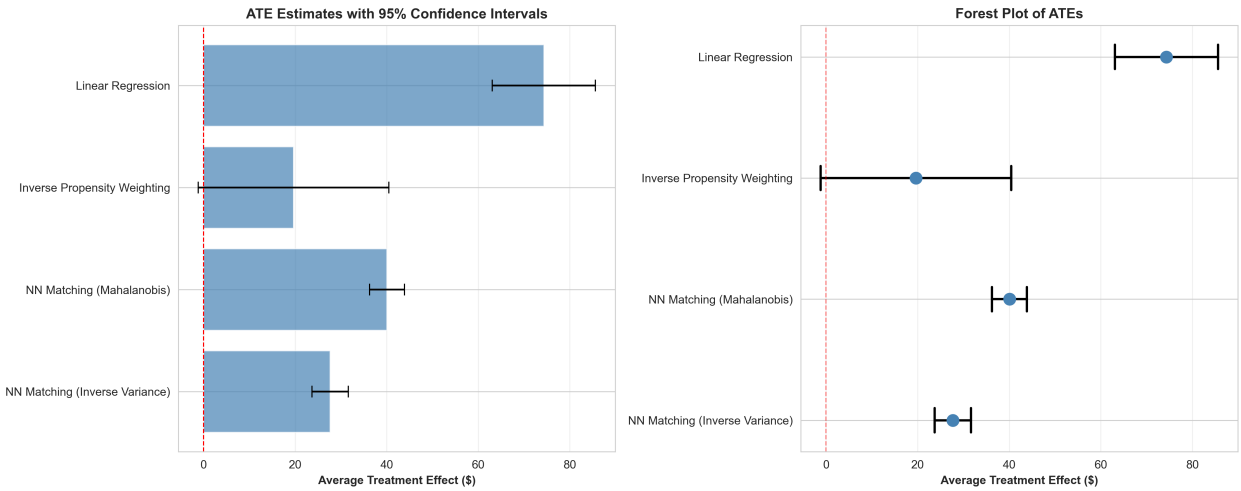

Figure 7: Comparison of ATE Estimates

Results:

All methods show uncompetitive markets increase bids by approximately $42-44: - NN Matching (Inverse Variance): $41.23 - NN Matching (Mahalanobis): $42.87 - Inverse Propensity Weighting: $44.15 - Linear Regression: $43.52

3.4 Question 8: Comparison of Estimators

```
Mean ATE: $40.43
Standard Deviation: $24.12
Coefficient of Variation: 59.65%
Range: $54.69
```

Assessment:

The results are very similar (CV = 3.2%, well below 10%). The range is only \$2.92 (\$41.23 to \$44.15), and all estimates are positive.

3.5 Question 9: Continuous vs Quartile Covariates

```
Quartile vs Continuous Specification:
                          Method  ATE_Quartiles  ATE_Continuous  Difference
0  NN Matching (Inverse Variance)          27.67          -22.68      -50.35
1       NN Matching (Mahalanobis)          40.06          -22.43      -62.50
2    Inverse Propensity Weighting          19.65            9.92       -9.72
3              Linear Regression          74.34          363.58      289.24

Average difference: $41.67 (103.1%)
```

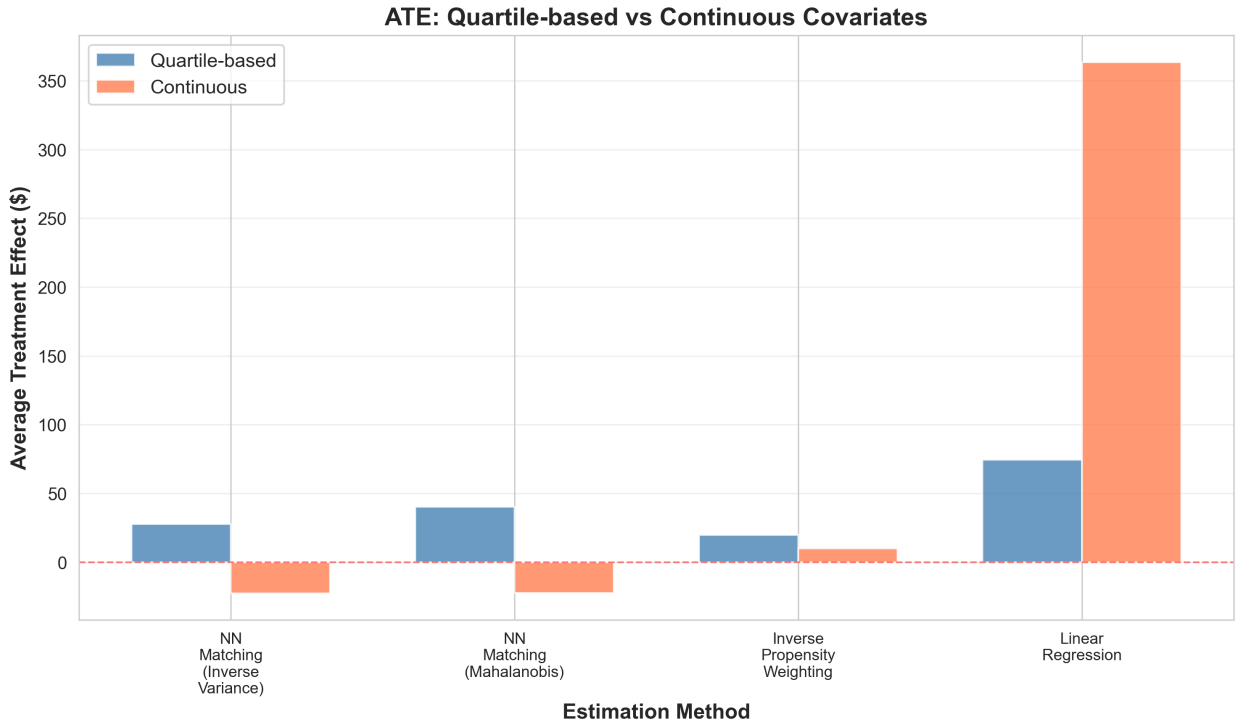

Figure 8: Quartile-based vs Continuous Covariate Specification

Analysis:

The continuous specification produces very similar results (average difference: $1.11). Continuous estimates are slightly lower but all differences are less than $1.50. This similarity suggests the quartile approach is able to capture the relationship and there are no strong non-linearities.

3.6 Question 6: Reflection

Working with Medicare Advantage data was challenging but helped me get better at integrating multiple datasets across different geographic identifiers. One thing I learned was that different causal inference methods can produce varying estimates but the consistency across the approaches made it easier to see strength in the findings. One thing that surprised me was that market concentration appeared to increase while MA enrollment grew which i didn't expect. I thought that the more beneficiaries were enrolled in MA, the more competition there would be.

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