# Study58 Inverse Propensity Treatment Weighting for Subjects With T1 Baseline Images VS Subjects Without

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Goal: Use Inverse Propensity Treatment Weights to achieve balanced baseline variables between subjects who have T1 imaging data and subjects who do not. Compare linear models between weighted data and original data.

The following table summarizes the missing data distribution, while the second table lists the participant id's of subjects with missing T1 baseline images.

|  | No Images | With Images | Sum |
|---|---|---|---|
| 1 | 21 | 45 | 66 |
| 2 | 18 | 48 | 66 |
| Sum | 39 | 93 | 132 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 58013 | 58058 | 58102 | 58112 | 58139 | 58191 | 58235 | 58257 |
| 58017 | 58059 | 58103 | 58129 | 58148 | 58207 | 58237 | 58266 |
| 58046 | 58082 | 58104 | 58130 | 58151 | 58218 | 58240 | 58268 |
| 58050 | 58088 | 58107 | 58131 | 58161 | 58222 | 58246 | 58293 |
| 58054 | 58091 | 58108 | 58133 | 58183 | 58229 | 58256 | |

The following baseline variables were tested for population based differences between both groups. Normality was assesed with qqplots and the Shapiro Wilk test. T tests were used for variables that were concluded to be approximately normal, while Wilcoxon Rank Sum tests were used for the rest. Significant variables are highligted.

| Variable | P Value | Test |
|---|---|---|
| mmemax | 0.4026 | Wilcoxon test |
| np_age | 0.2615 | Wilcoxon test |
| np_tiadl_tot_time | 0.9523 | Wilcoxon test |
| np_tiadl_tot_err | 0 | Wilcoxon test |
| np_tiadl_tot_err_minor | 0.0082 | Wilcoxon test |
| np_tiadl_tot_err_major | 0.001 | Wilcoxon test |
| z_SPEED | 0.4162 | Wilcoxon test |
| z_Episodic_Memory | 0.465 | Wilcoxon test |
| z_Working_Memory | 0.715 | T test |
| z_Language | 0.8386 | T test |
| z_Attention | 0.8839 | Wilcoxon test |
| z_Executive_Function | 0.4696 | Wilcoxon test |
| EF_FLK | 0.1107 | Wilcoxon test |
| vo2_weight1 | 0.7986 | Wilcoxon test |
| h_height1 | 0.3846 | Wilcoxon test |
| bmi1 | 0.3237 | Wilcoxon test |

A logistic regression model, with T1 image availability as the outcome and the prior significant variables as the predictors, was used to acquire propensity scores and propensity weights for each subject. A linear regression model was then used to model change in right hippocampus with random treatment group and baseline right hippocampus as the independent variables. This model was used with both the original data and the weighted data for comparison. The output is as follows:

## (a) Residual Plot for Y (Survival)
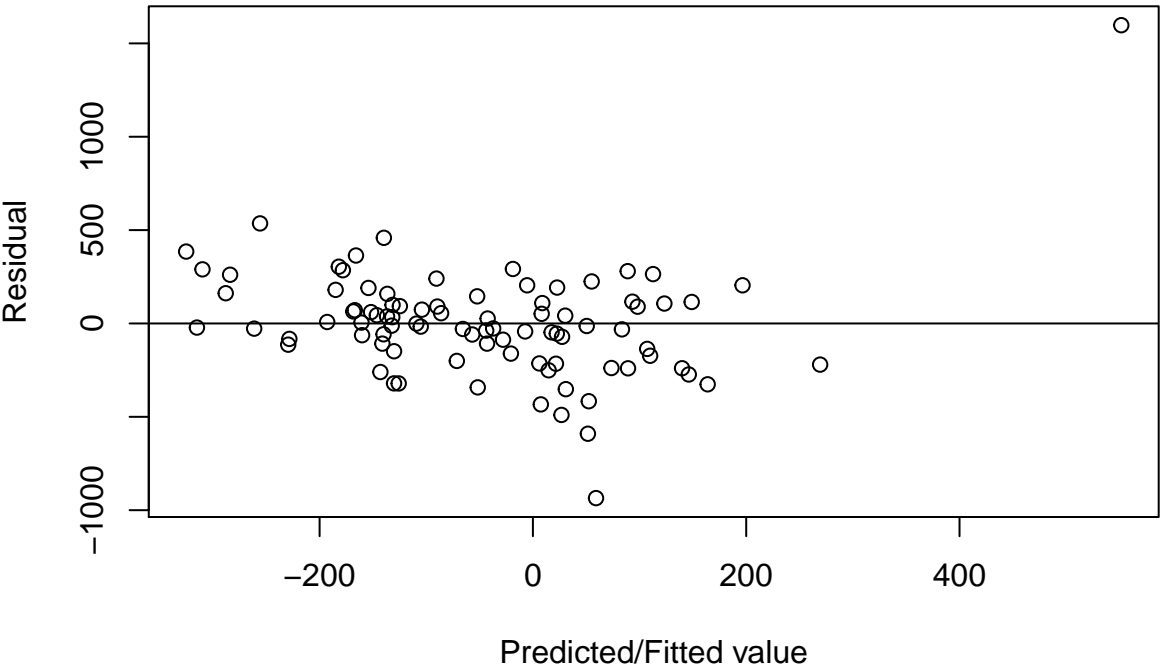


## (a) Residual Plot for Y (Survival)
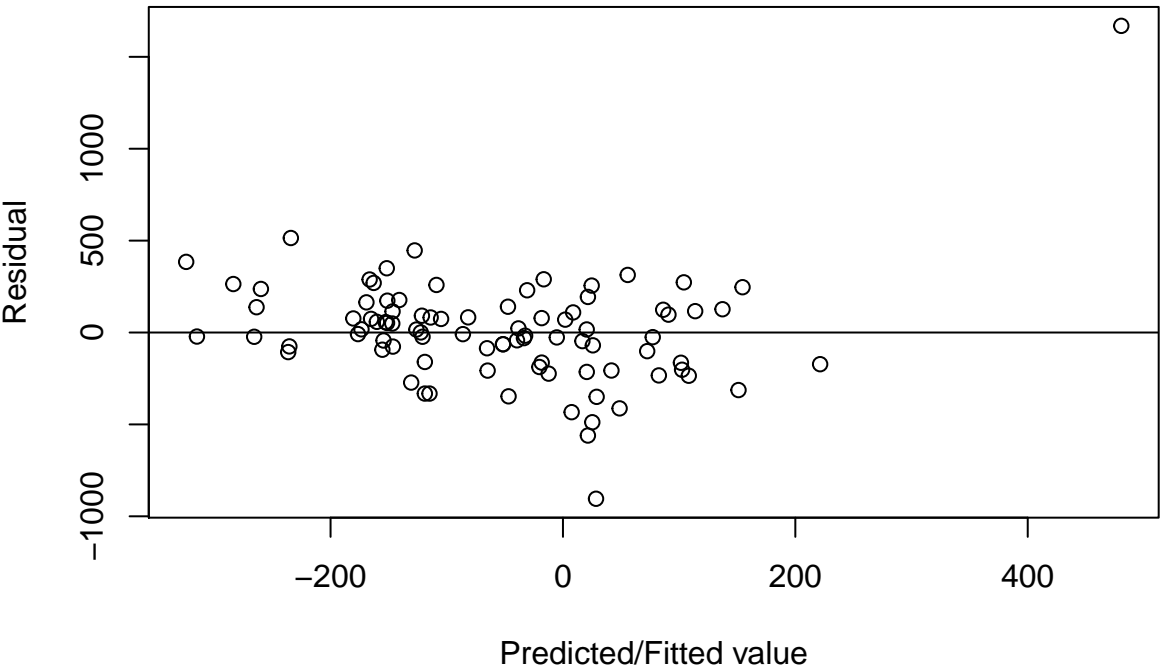
```
##
## Call:
## lm(formula = change_hippocampus ~ random_group + Right.Hippocampus.x,
##     data = study58_merged)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -935.20 -148.81  -11.63  116.70 1597.31
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)        1101.38607  267.79793   4.113 8.92e-05 ***
## random_group          9.29489   62.98252   0.148    0.883
## Right.Hippocampus.x  -0.27255    0.06043  -4.510 2.04e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 295.1 on 86 degrees of freedom
##   (43 observations deleted due to missingness)
## Multiple R-squared:  0.192,  Adjusted R-squared:  0.1733
## F-statistic: 10.22 on 2 and 86 DF,  p-value: 0.0001042

##
## Call:
## lm(formula = change_hippocampus ~ random_group + Right.Hippocampus.x,
##     data = study58_merged, weights = study58_merged$IPW)
##
## Weighted Residuals:
##      Min       1Q   Median       3Q      Max
## -1128.25  -177.01     0.43   152.21  1844.20
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)         958.56407  259.34895   3.696 0.000385 ***
## random_group         35.04773   62.40858   0.562 0.575859
## Right.Hippocampus.x  -0.25017    0.05954  -4.202 6.44e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 345.8 on 86 degrees of freedom
##   (43 observations deleted due to missingness)
## Multiple R-squared:  0.1703, Adjusted R-squared:  0.151
## F-statistic: 8.829 on 2 and 86 DF,  p-value: 0.0003256
```

Comparing both models, the adjusted r squared decreased by 0.0223 for the weighted data model. Both models have baseline right hippocampus as significant and random group as non-significant. The coefficient for baseline right hippocampus increased by 0.02238 units for the weighted model. The random group coefficient increased for the weighted model as well, specifically by 25.75284 units. Therefore, applying propensity weights does not seem to have changed the outcome.