Report Analysis:

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Executive Summary

In this Report your Senior Analyst analyses two questions for you:

- Is an automatic or manual-transmission car better, when considering `MPG` - consumption?
- What is - `quantifying` - the difference in `MPG` between automatic and manual transmissions?

Using data available in the `mtcars` dataset and an initial exploratory analysis, we see that there is a big difference between the means of miles/gallon - comparing automatic-transmission v/s manual cars.

Resuts indicate: automatic-transmission = `17.15` - manual = `24.39`

Analysis

We start by loading the **mtcars** data frame and recode **am** to a logical **automatic** variable.

```
data( mtcars )
mtcars$automatic <- mtcars$am == 0
attach( mtcars )
```

Ordinary Least Square `(OLS)` model is estimated by analysing the distribution of the `automatic`-variable.

```
ols <- lm( mpg ~ automatic, data=mtcars )
summary( ols )
```

```
##
## Call:
## lm(formula = mpg ~ automatic, data = mtcars)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -9.392 -3.092 -0.297  3.244  9.508
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)      24.39       1.36   17.94  < 2e-16 ***
## automaticTRUE    -7.24       1.76   -4.11  0.00029 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.9 on 30 degrees of freedom
## Multiple R-squared:  0.36,   Adjusted R-squared:  0.338
## F-statistic: 16.9 on 1 and 30 DF,  p-value: 0.000285
```

There is a significant negative effect of automatic on `mpg`.

Redoing the estimation with Two-Stage Least Squares (`TSLS`), using weight (**wt**) as an instrument for automatic.

```
tsls.fs <- lm(automatic ~ wt)
tsls <- lm(mpg ~ tsls.fs$fitted.values)
summary(tsls)
```

```
##
## Call:
## lm(formula = mpg ~ tsls.fs$fitted.values)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -4.543 -2.365 -0.125  1.410  6.873
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)              29.08       1.08   26.84  < 2e-16 ***
## tsls.fs$fitted.values   -15.13       1.58   -9.56  1.3e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.05 on 30 degrees of freedom
## Multiple R-squared:  0.753,  Adjusted R-squared:  0.745
## F-statistic: 91.4 on 1 and 30 DF,  p-value: 1.29e-10
```

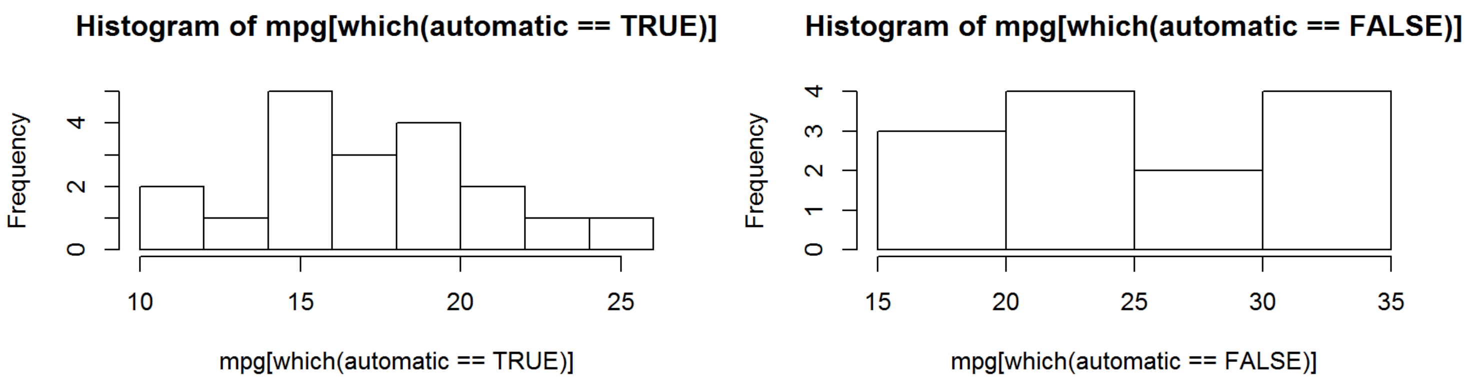
This coefficient is even more negative, and even more significant.

Finally the residuals are plotted for both estimations - please refer to `Appendix`.

The residuals of the OLS estimation appear to be normally distibuted, the TSLS somewhat less, though **n** is too small to make any real claims.

Appendix: Figures

```
par( mfrow=c(1,2) )
hist( mpg[which(automatic == TRUE)] )
hist( mpg[which(automatic == FALSE)] )
```



OLS and TSLS Residual-estimations.

```
par( mfrow=c(1,3) )
hist( ols$residuals )
hist(tsls.fs$residuals)
hist( tsls$residuals )
```