Regression properties

what do we need know about

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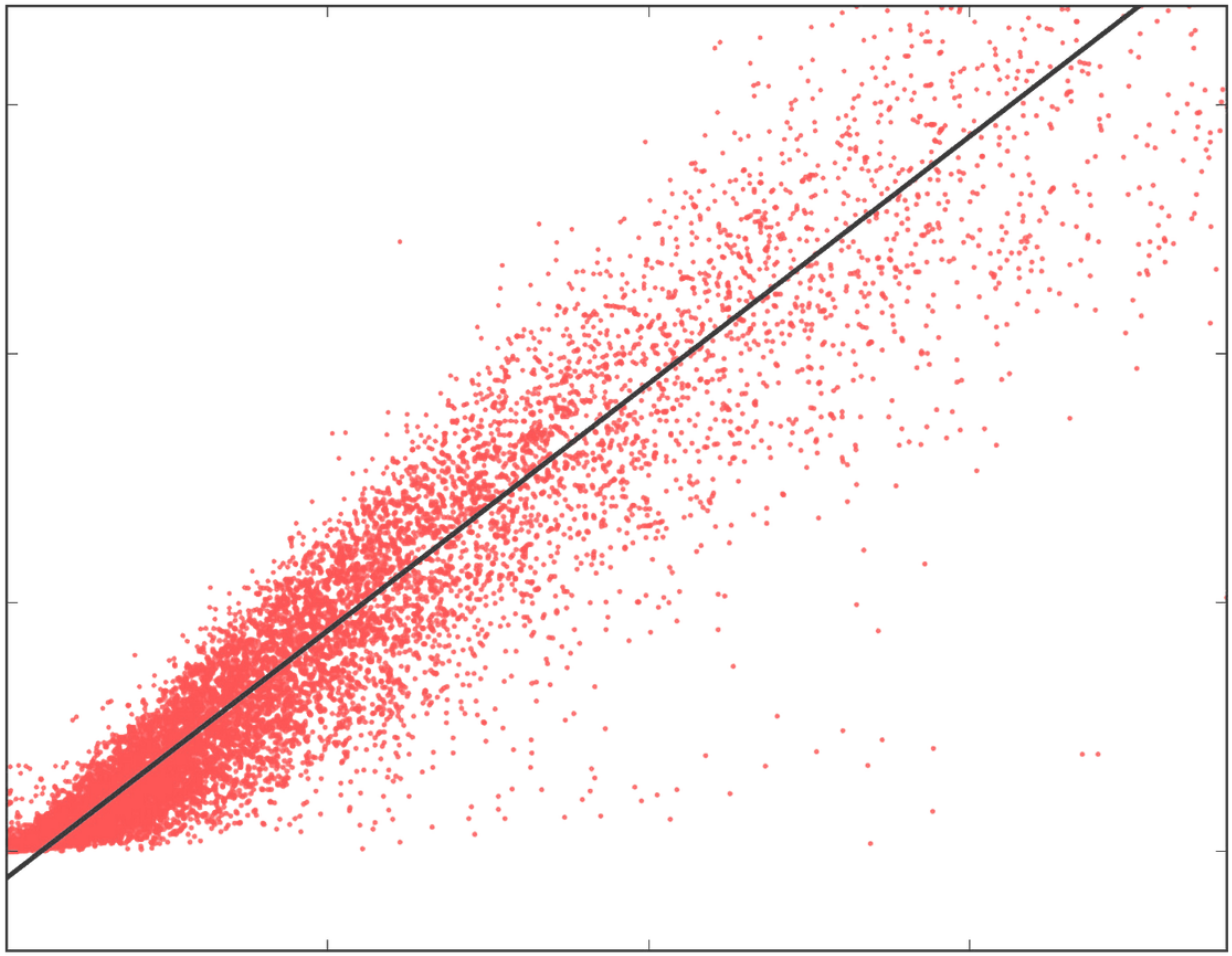
Outline

- Significance
- Regression output (table)
- Regression plot
- Standart Error
- T-value
- P-value
- Confindence Intervals
- R-squared

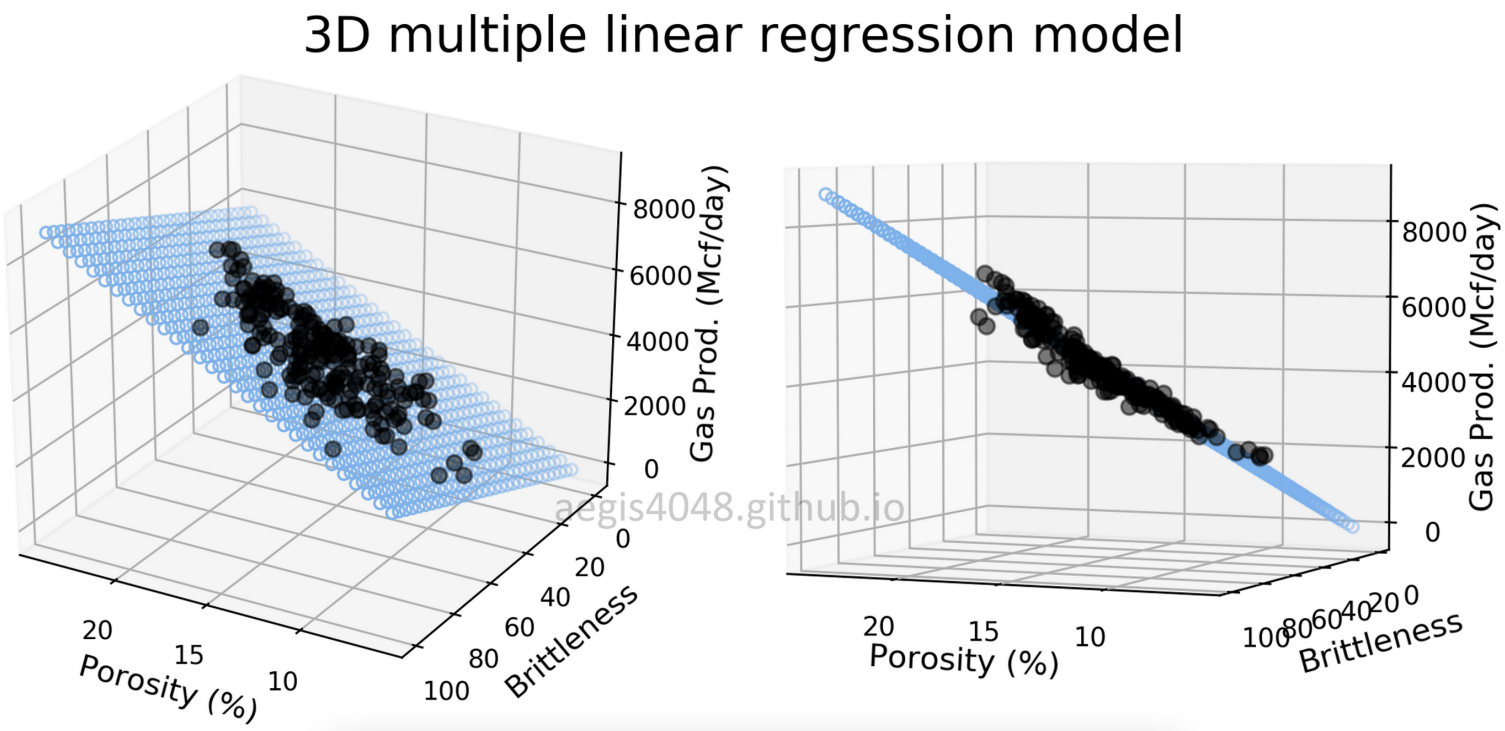
Significance

Significance tells if we can make a proper, consistent and robust inference out of our data.

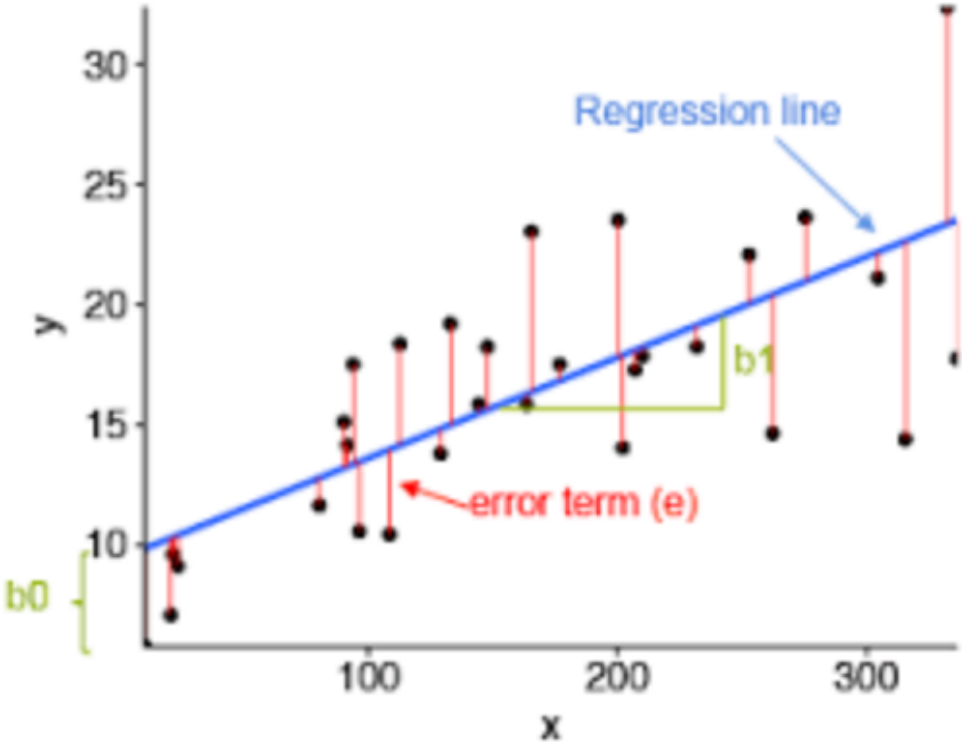
Regression line



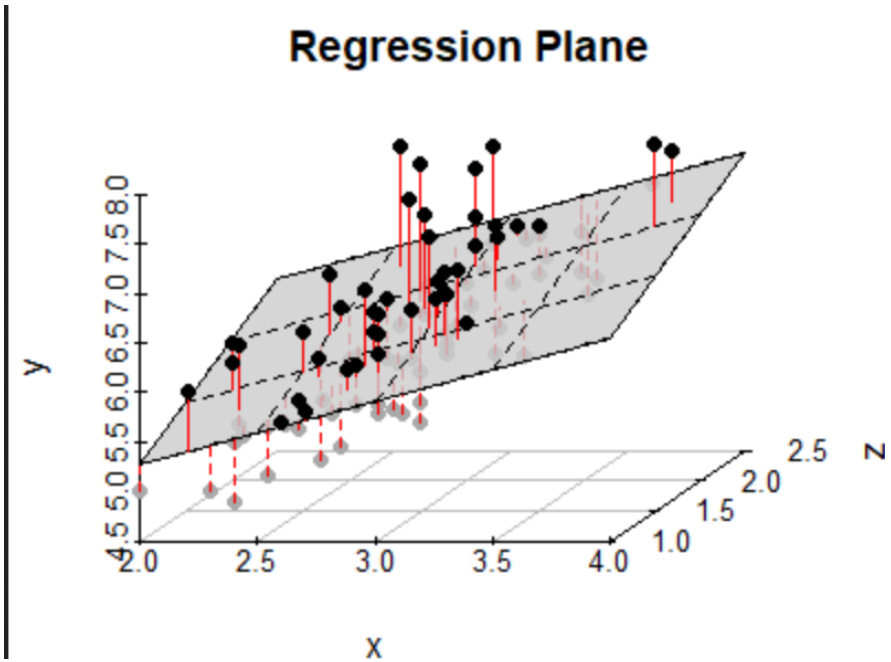
Regression line



Regression line



Regression line



Regression output (table)

```
Call:
lm(formula = Price ~ InMichelin + Food + Decor + Service, data = dfData)

Residuals:
    Min      1Q  Median      3Q     Max
-20.898  -5.835  -0.755   3.457 105.785

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -57.6004     9.2337  -6.238 3.84e-09 ***
InMichelin    1.9931     2.6357   0.756    0.451
Food          0.2006     0.6683   0.300    0.764
Decor         2.2049     0.3930   5.610 8.76e-08 ***
Service       3.0598     0.5705   5.363 2.84e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 13.55 on 159 degrees of freedom
Multiple R-squared: 0.6344, Adjusted R-squared: 0.6252
F-statistic: 68.98 on 4 and 159 DF,  p-value: < 2.2e-16
```

Standart Error

SE - can be interpreted as standart deviation of beta coeficient.

$$se(\beta_i) = \frac{\hat{\sigma}}{\sqrt{\Sigma x_i^2}}$$

$$\hat{\sigma} = \sqrt{\frac{\Sigma \hat{u}_i^2}{n-2}}$$

$$\hat{u}_i = \bar{y}_i - y_i$$

Standart Error

- x - predictor
- β - coeficient
- u - Residual Sum of Squares
- y - target
- $\bar{y}$ - predicted target
- n - number of degrees of freedom

Student's value

t- value - part of T-distribution that helps to uderstatnd if certain coeficient differs from 0.

$$t - value = \frac{\beta}{se(\beta)}$$

What's next?

1. Find number of DF
2. Guess level of significance you need
3. Find treshhold in matrix here
4. If your t-value is higher that means that coef is significant

P-value

P - value - it's just convinient form of t-student value.

- if P-value is below than 0.05 that means that we can reject null hypothesis (coef is signinfcant)
- if P-value is above than 0.05 that means that we can not reject null hypothesis (coef is not signinfcant)

Confidence Intervals

Confidence interval can be calculated even for β coefs.
Steps to calculate:

1. Calculate Margin Error
   ME = treshhold of t-value * standard error
2. Lower and Upper bounds: $CI = \beta \pm ME$

If CI includes zero, this automatically means, that coef is not significant. The same aproach is applied to get Prediction Interval. Ypu need just change β to $\hat{y}$.

Prediction Intervals

The same aproach is applied to get Prediction Interval. Ypu need just change β to $\hat{y}$.

$$\hat{y} \pm t \times \sqrt{MSE \times (1 + \frac{1}{n} + \frac{(x_h - \bar{x})^2}{\Sigma(x_i - \bar{x})^2})}$$

Prediction Intervals