Assignment 2

Formulate an interesting regression problem and solve it.

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Overview

The problem is to find out the cost of treatment of different patients.

About Data

- Data set dedicated to the cost of treatment of different patients.
- The cost of treatment depends on many factors: diagnosis, type of clinic, city of residence, age and so on.
- We have no data on the diagnosis of patients.

Specifications

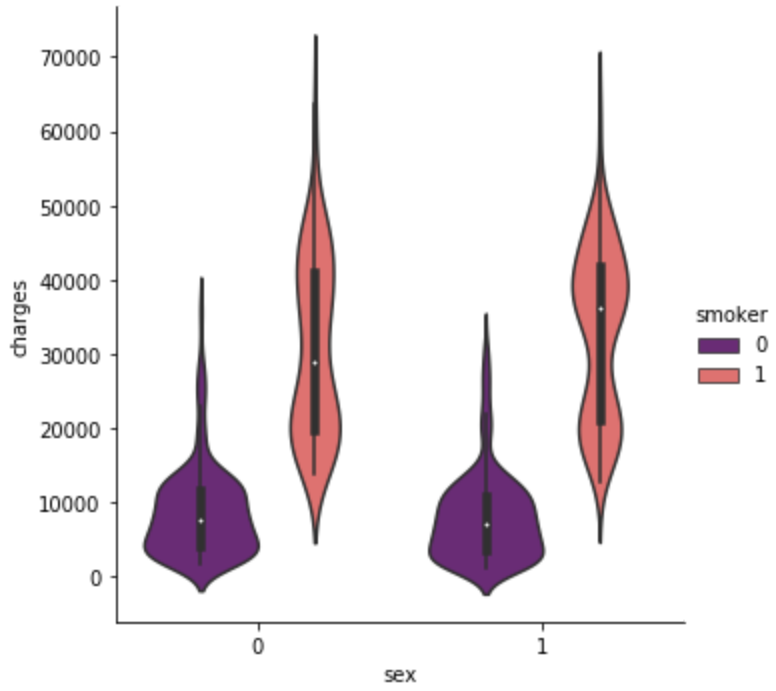
- **Number of Instances:** 1338**.**
- **Number of Attributes :**
    - **age:** age of the primary beneficiary
    - **sex:** insurance contractor gender, female, male
    - **bmi:** Body mass index, providing an understanding of the body, weights that are relatively high or low relative to height, objective index of body weight (kg / m ^ 2) using the ratio of height to weight, ideally 18.5 to 24.9
    - **children:** Number of children covered by health insurance / Number of dependents
    - **smoker:** Smoking
    - **charges:** Individual medical costs billed by health insurance

- **Missing Attribute Values**: No missing value
- **Correlation of attributes with charges**

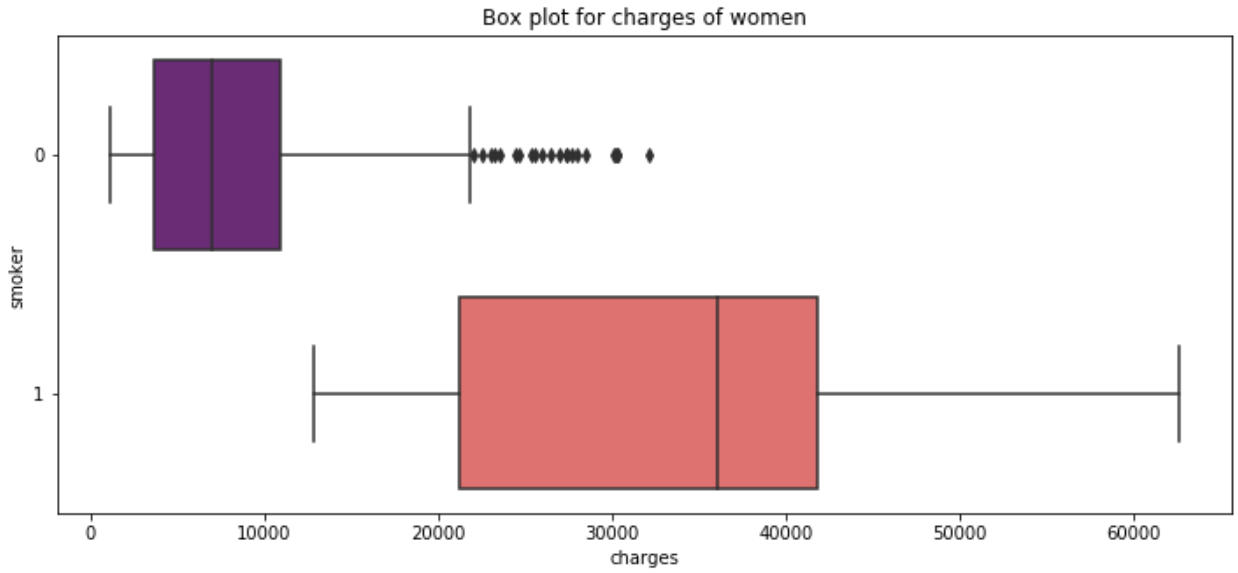
sex	0.057292
children	0.067998
bmi	0.198341
age	0.299008
smoker	0.787251
charges	1.000000

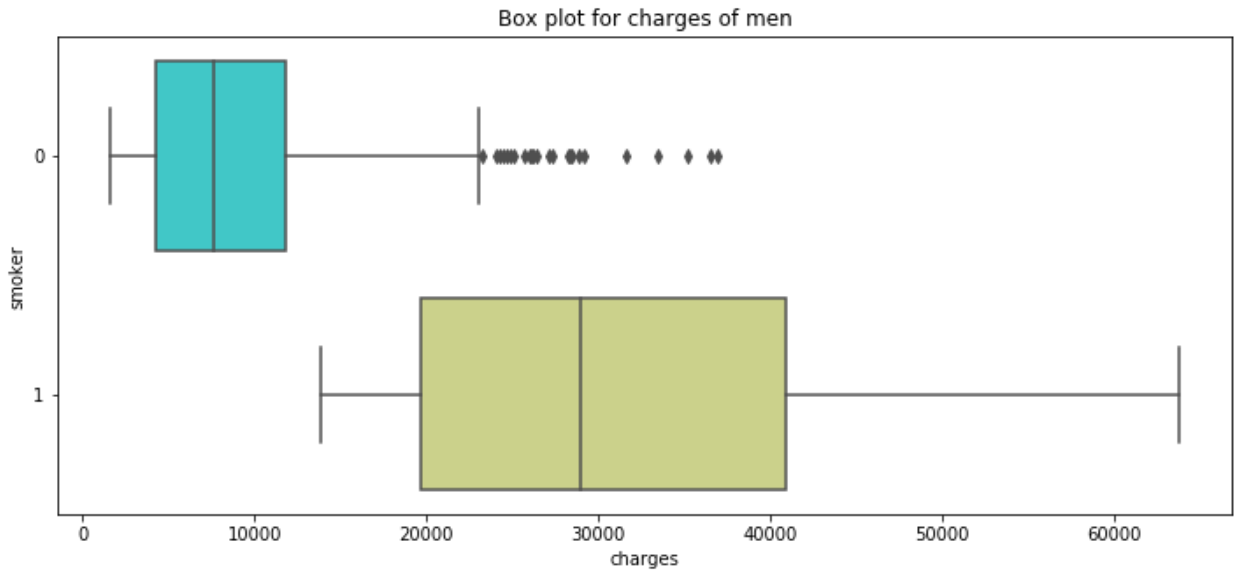
* We can see that charges have an almost linear positive correlation with smokers.

Visualizations

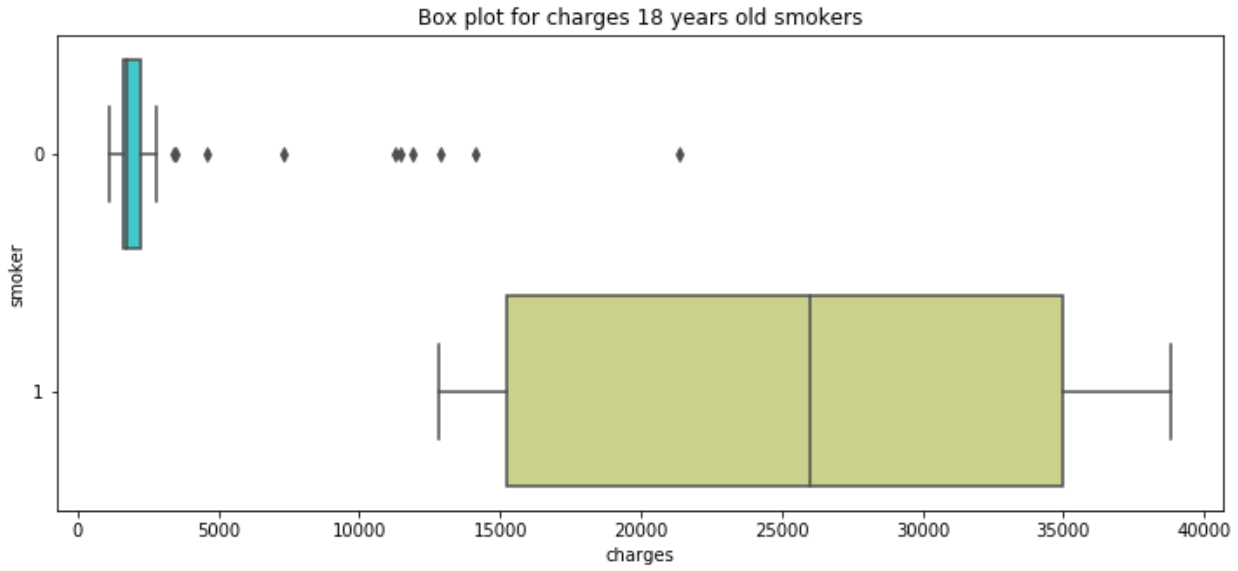


- Women smokers and non-smokers tend to have fewer charges as compared to men smokers and non-smokers respectively.

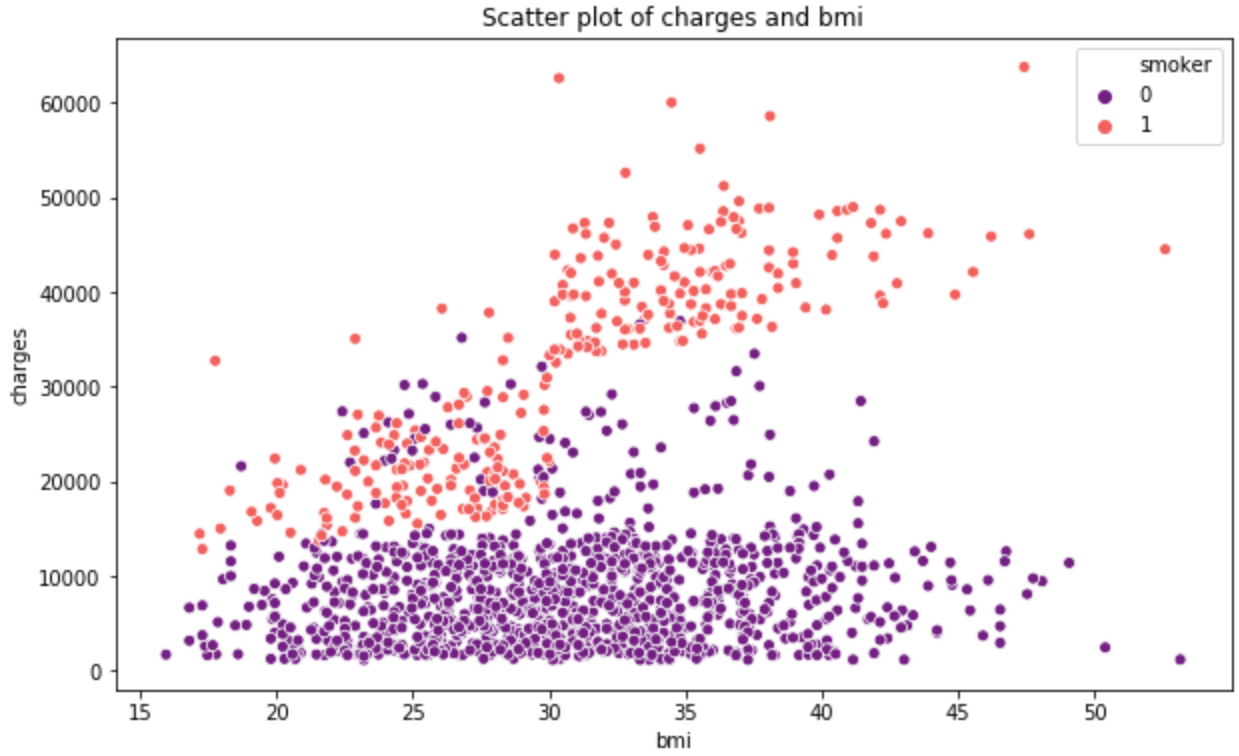




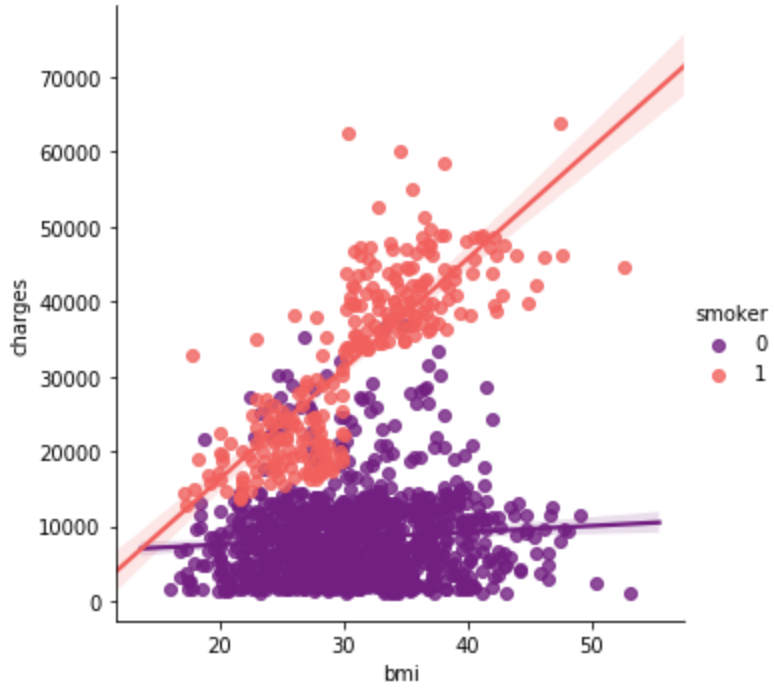
- Both men and women smokers and non-smokers tend to have similar charges but the average charges(mean) are more in case of women smokers.



- The 18-year-old smokers spend much more on treatment than non-smokers.



- Smokers with bmi>30 have very high charges.



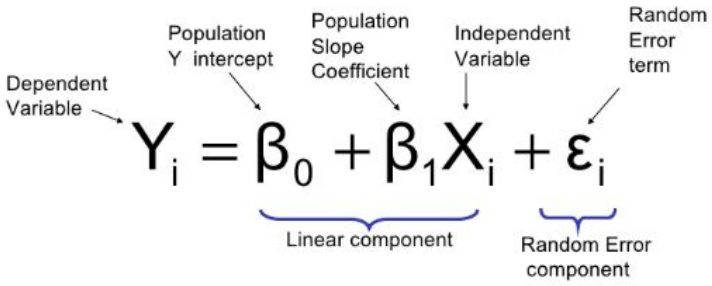
- For smokers, charges have a positive linear relation with bmi.

Methods

Linear Regression

Definition: Linear regression is a linear model that assumes a linear relationship between the input variables (x) and the single output variable (y). More specifically, y can be calculated from a linear combination of the input variables (x).

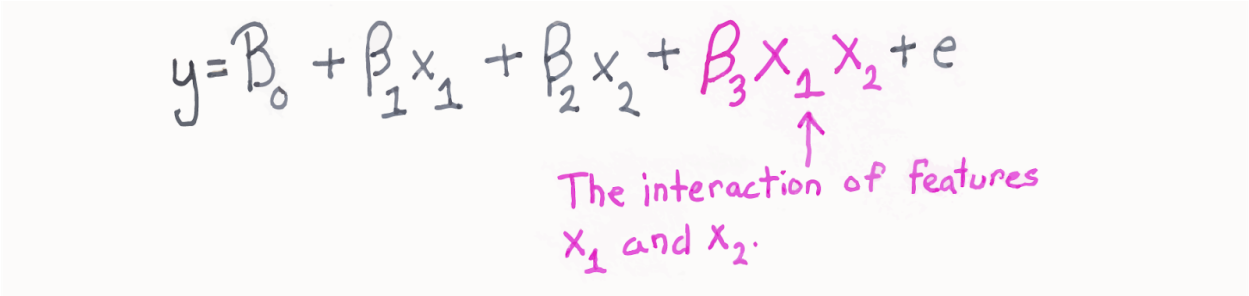
Formula



Linear Regression with polynomial interaction

Interaction terms allow us to model relationships when the effects of a feature on the target are influenced by another feature.

Formula



The model with interaction is more flexible (i.e., we've added a parameter).

The Random Forest Classifier

Definition: A random forest is a meta estimator that fits a number of decision tree classifiers on various sub-samples of the dataset and uses averaging to improve the predictive accuracy and control over-fitting. The sub-sample size is always the same as the original input sample size.

Metrics Used to compare models :

Root Mean Square Error (**RMSE**) is the standard deviation of the residuals (prediction errors). Residuals are a measure of how far from the regression line data points are.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} (Predicted_i - Actual_i)^2}{N}}$$

Findings

Accuracy wise ordering of all three methods from highest to lowest is:

1. Random Forest Classifier (RMSE - 2830.45)
2. Linear Regression with polynomial interaction (RMSE - 5439.77)
3. Linear Regression (RMSE - 6320.04)