Pacmann

Insurance Charges Data Analysis

Probability Course - Sekolah Data Pacmann

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Outline

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1. Introduction
2. Dataset
3. Descriptive Statistic Analysis
4. Categorical Variable Analysis
5. Continuous Variable Analysis
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Introduction

Introduction

- Insurance companies need to take into account **every aspect of the client's data** to determine the **proper price** of the client's **insurance payment.**
- This insurance payment from the clients will be needed to **pay for health bills** to the **healthcare facility** (ex. hospital, clinics).
- Supervisors of a new insurance agency need help to know how is the **user's condition related** to the **insurance price.** He has some data regarding the user's condition and the insurance price in some regions.

Dataset

Dataset

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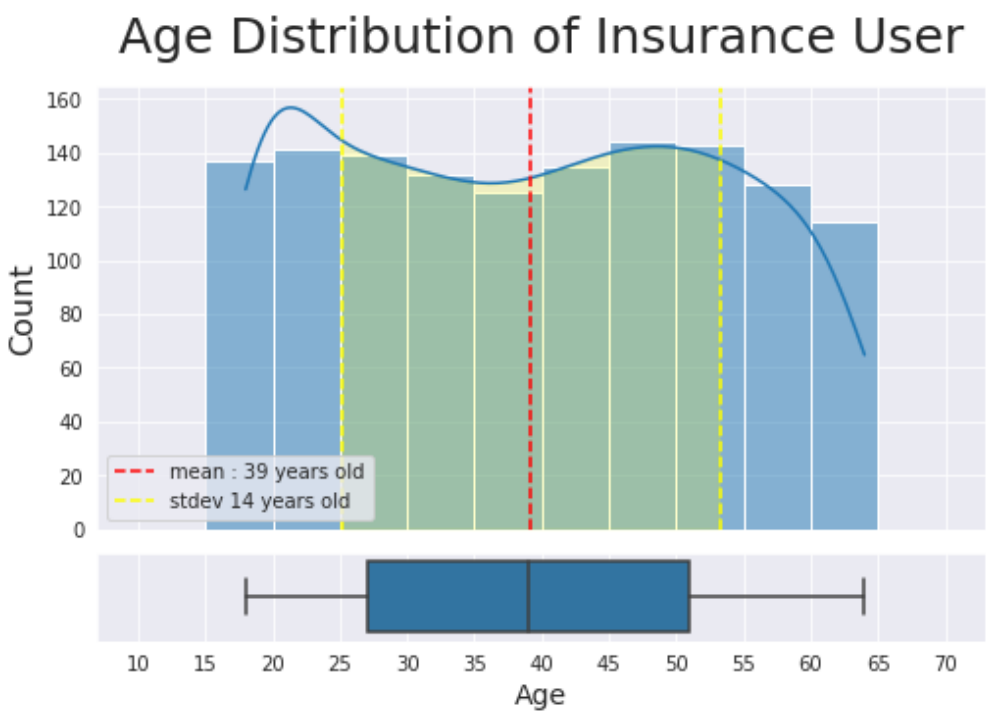
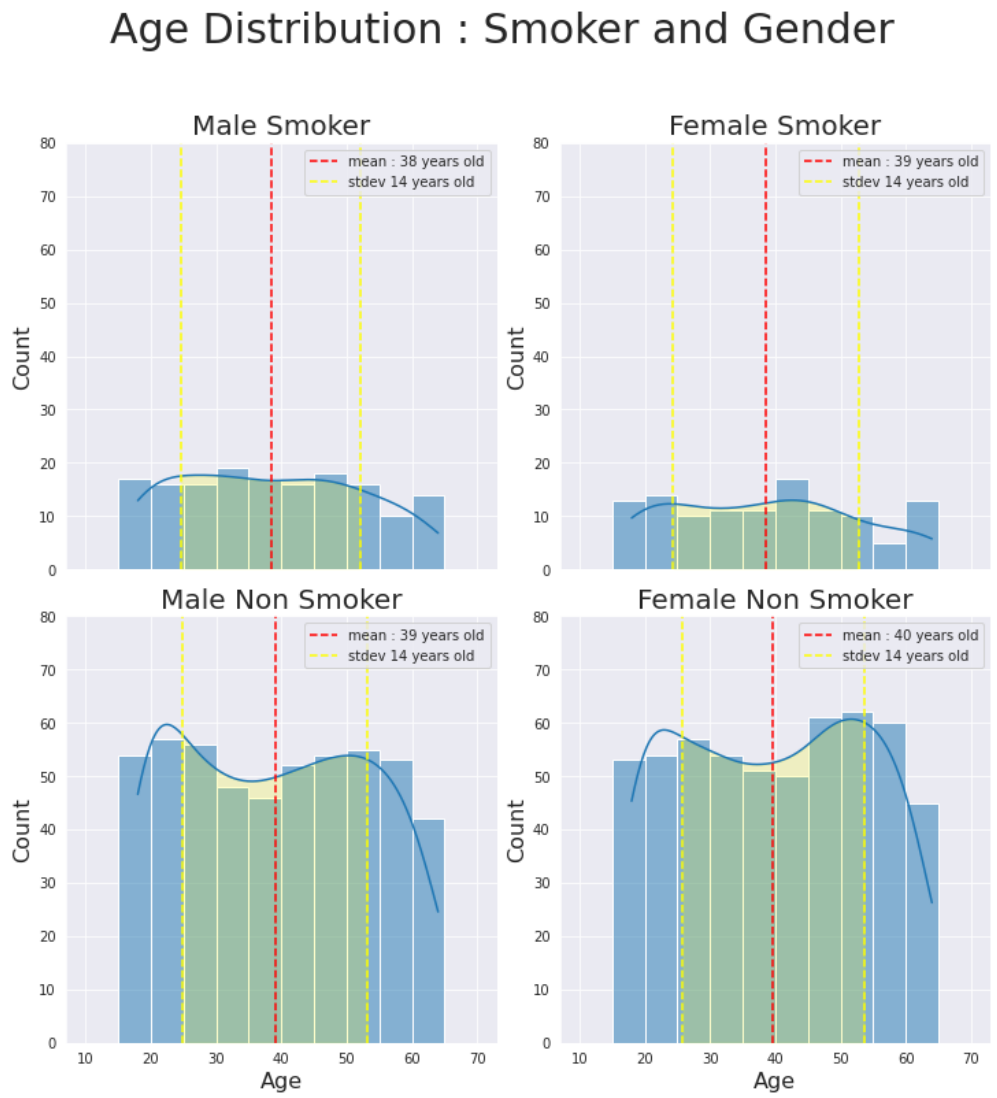
- Dataset comprises **7 columns** and **1338 rows**
- There are **3 categorical data**: Gender, Smoker, and Region
- There are **4 numerical data**: Age, BMI, Children, and Charges

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.92400
1	18	male	33.770	1	no	southeast	1725.55230
2	28	male	33.000	3	no	southeast	4449.46200
3	33	male	22.705	0	no	northwest	21984.47061
4	32	male	28.880	0	no	northwest	3866.85520
5	31	female	25.740	0	no	southeast	3756.62160

Descriptive Statistics Analysis

Analysis on Age

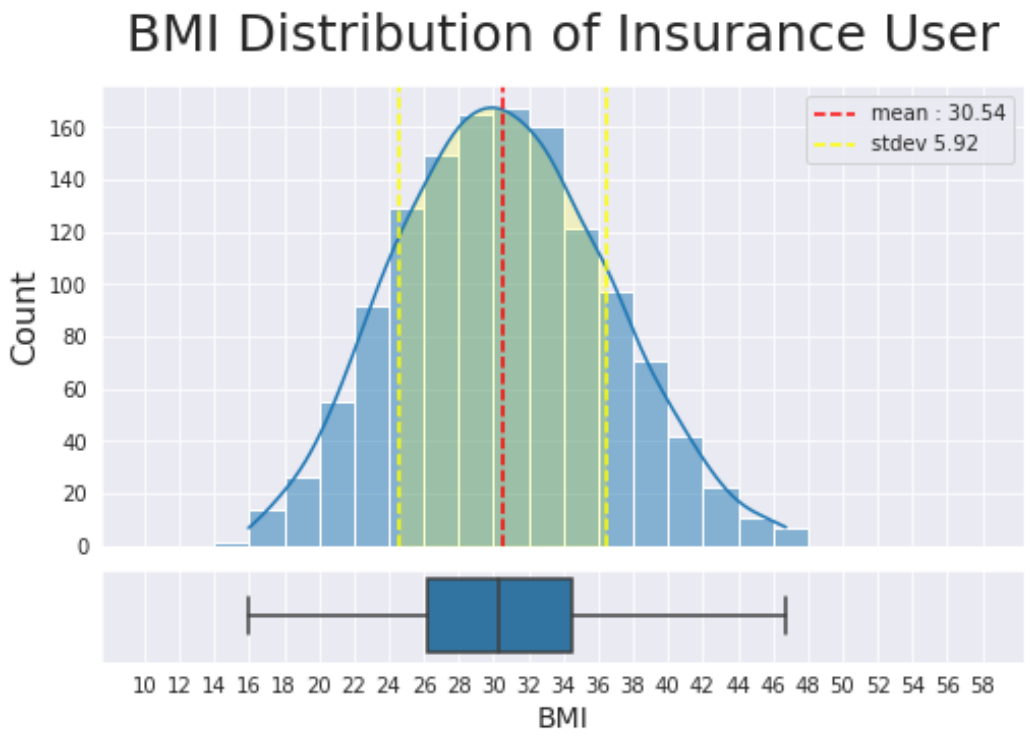


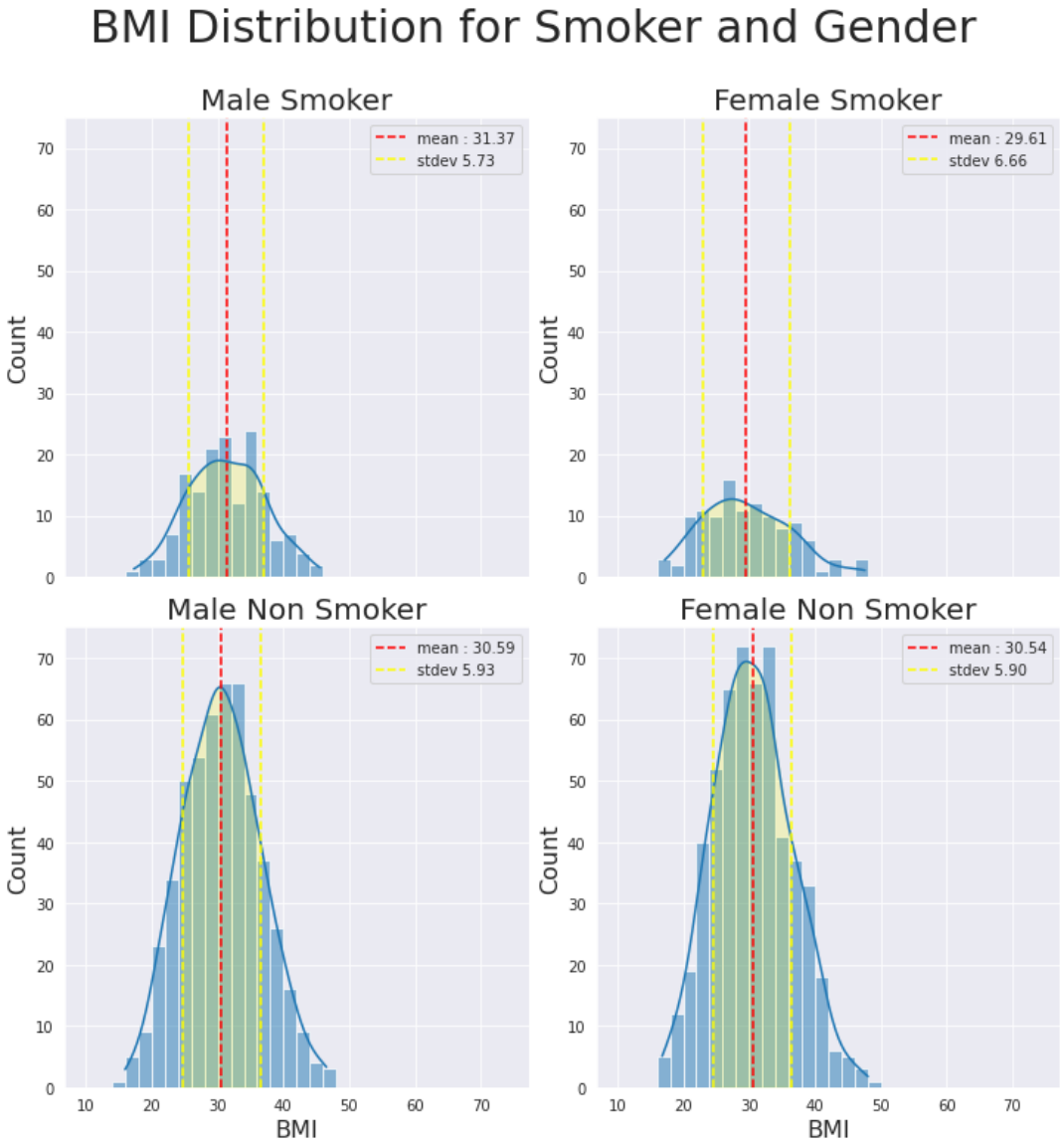


Insight.

- Insurance user age is ranged **from 25 – 51 years old**.
- **Smoker** and **gender** variable are not affecting **age central tendencies.**
- The average age of females is larger than the average age of males by **one year.**
- Smoker people **proportion** is **less than** non-smoker people proportion.

Analysis on BMI

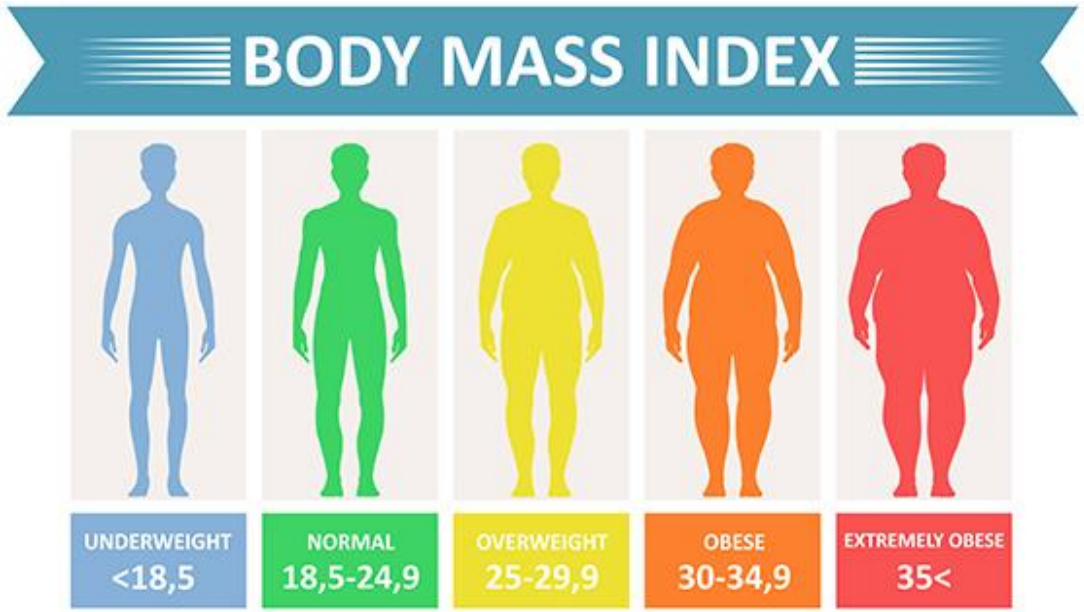




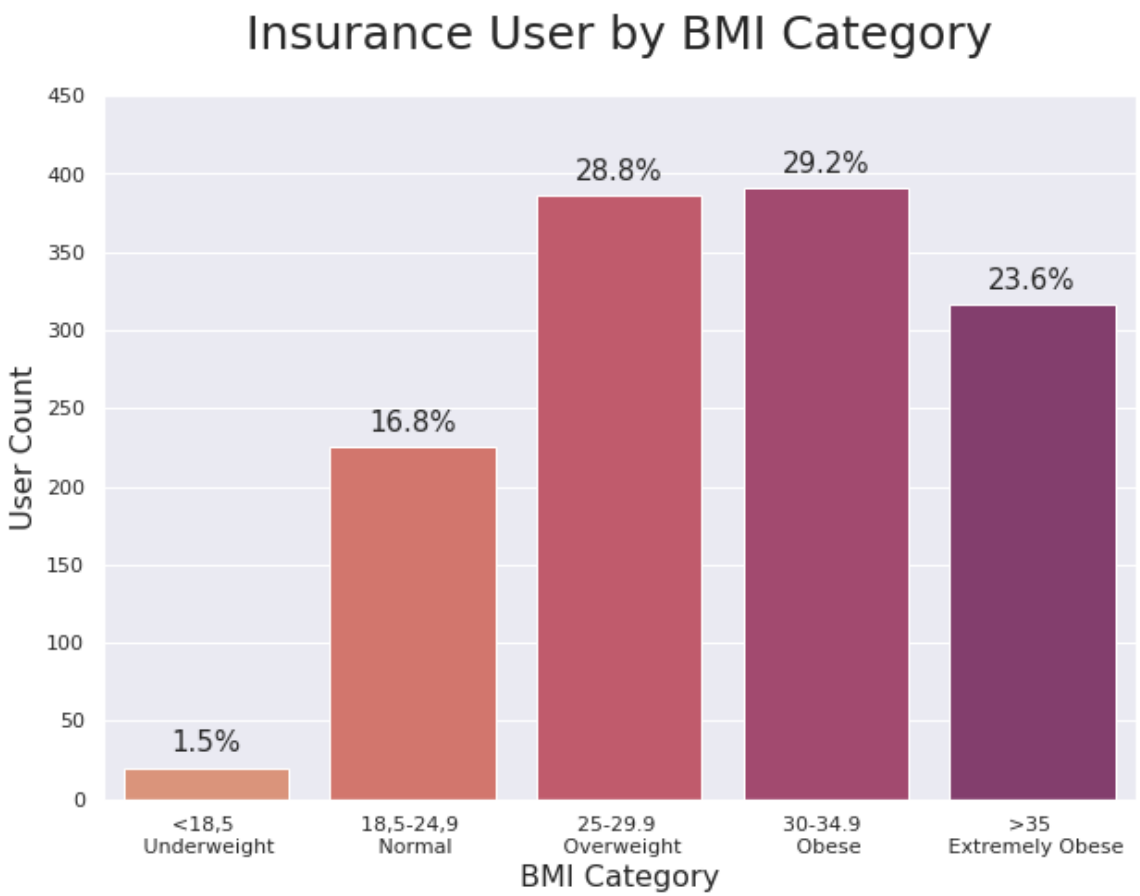
Insight.

- BMI of Insurance users is ranged **from 24.62 – 36.46**.
- **Smoker** and **gender** variable are not affecting **BMI central tendencies.**
- The mean of insurance users lies in **BMI Obese** category**.**

Analysis on BMI



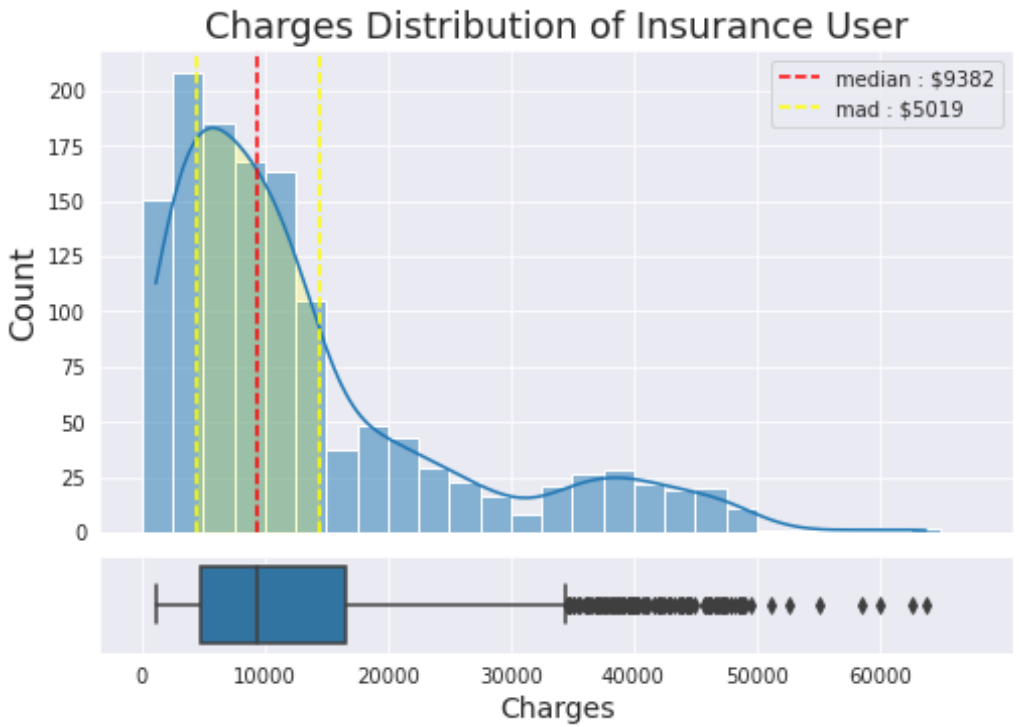
Source : www.cdc.gov

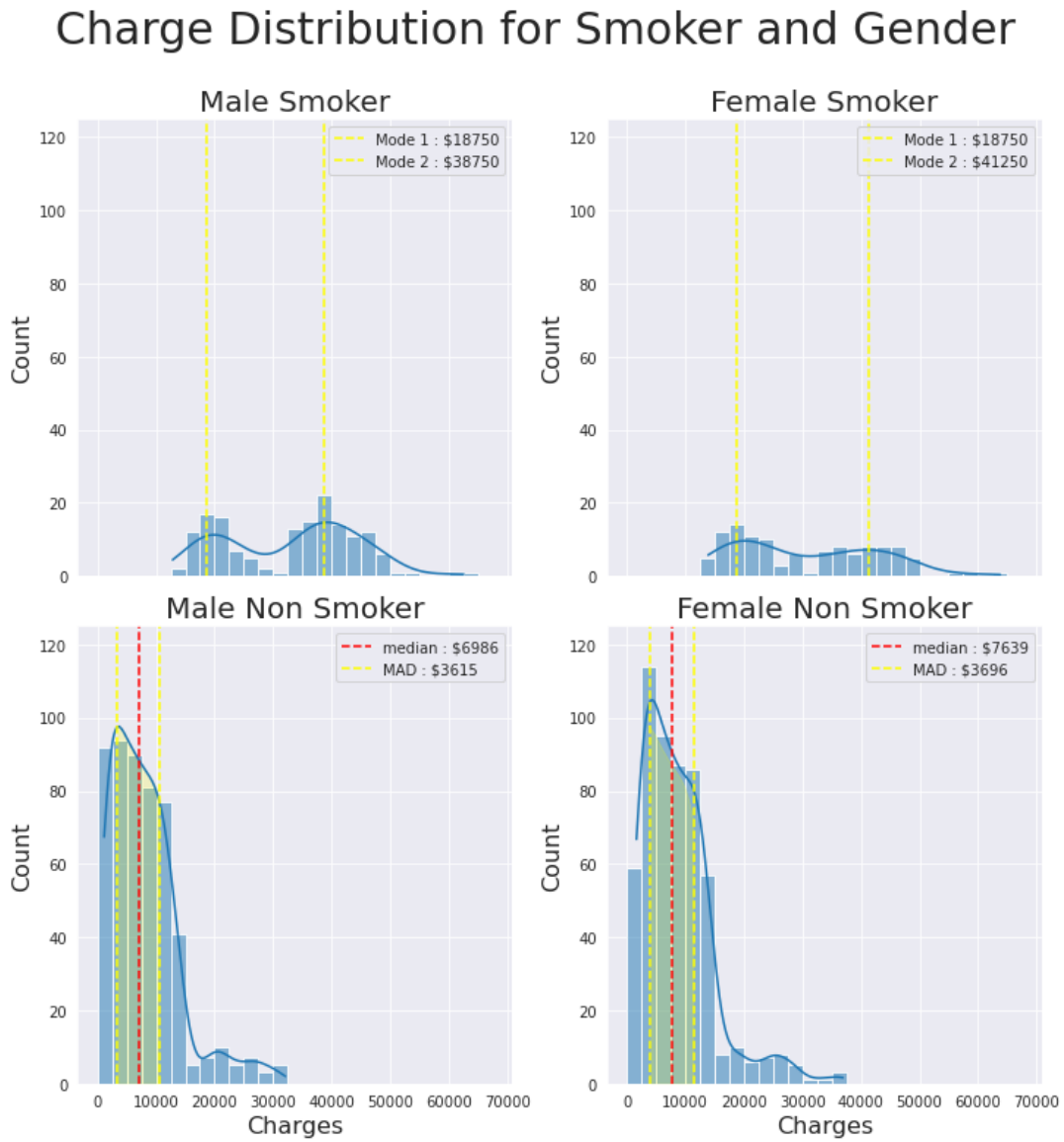


Insight.

- **81,7%** of insurance users is having a BMI of **overweight to extremely obese.** this is the cause why the BMI **average of males, females, smokers, or non-smokers has an obese value.**

Analysis on Charges

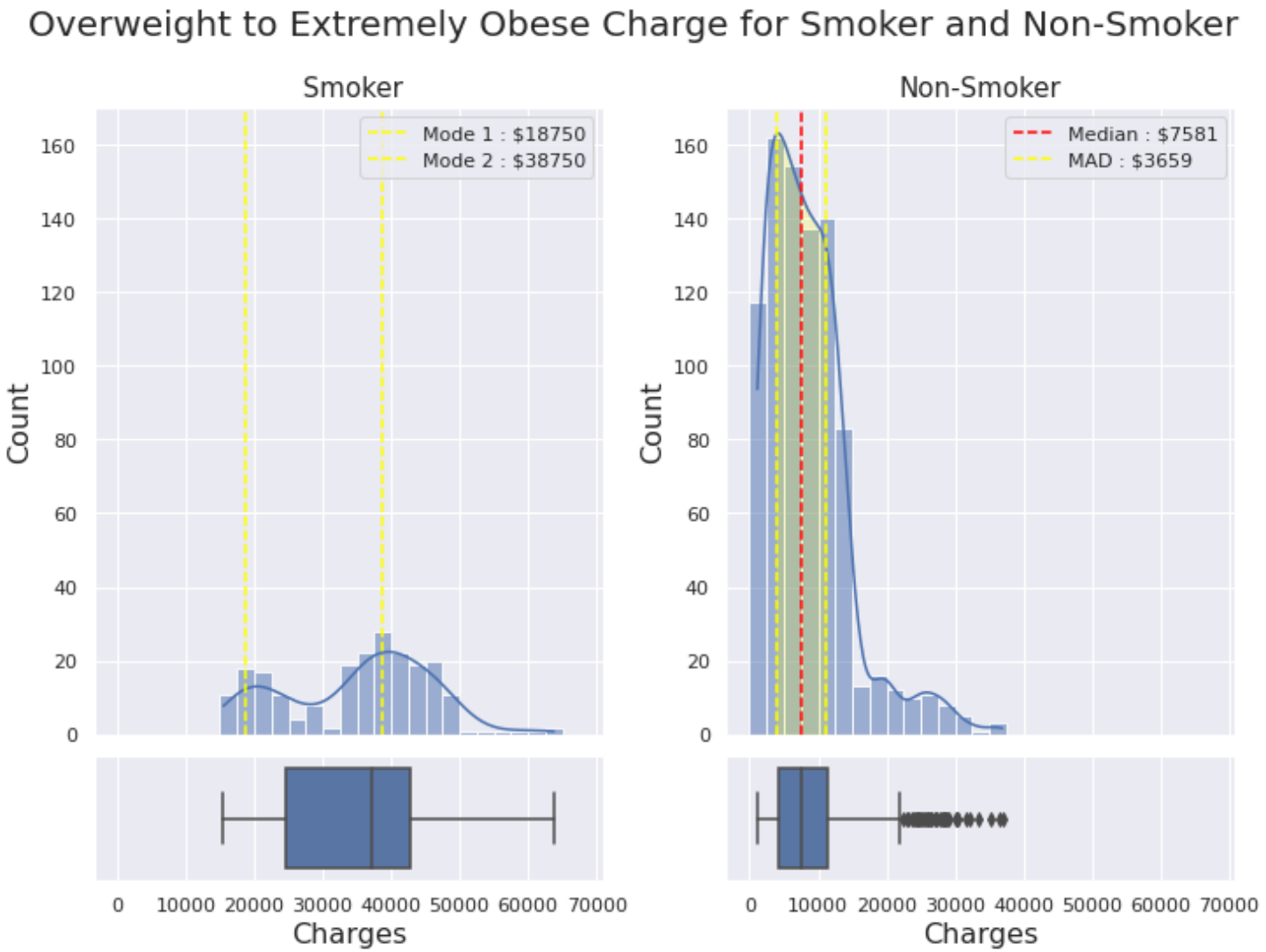




Insight.

- Overall insurance charges value is around **$4363 - $14401.**
- Smoker insurance charges are **more expensive** than non-smoker insurance charges.
- The central tendency of smoker insurance charge value is absolutely larger than **$18000**, whereas the central tendency of non-smoker insurance charge is less than **$10000**.
- For non-smoker people, Female insurance charges are more expensive than male insurance charges, but the difference is not larger than **$1000**.

Analysis on Charges



Insight.

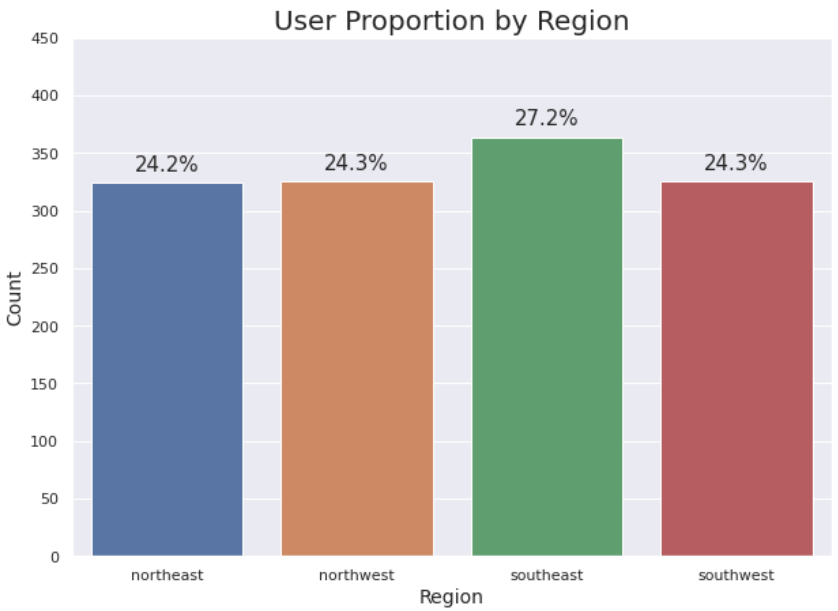
- despite of BMI value, smoker insurance charges is still **more expensive** than non-smoker insurance charges.

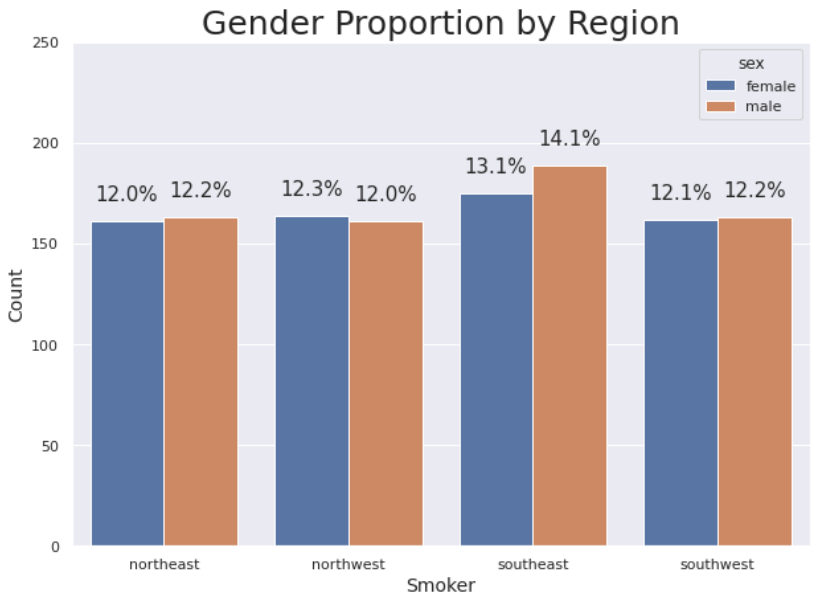
Descriptive Statistic Analysis Summary

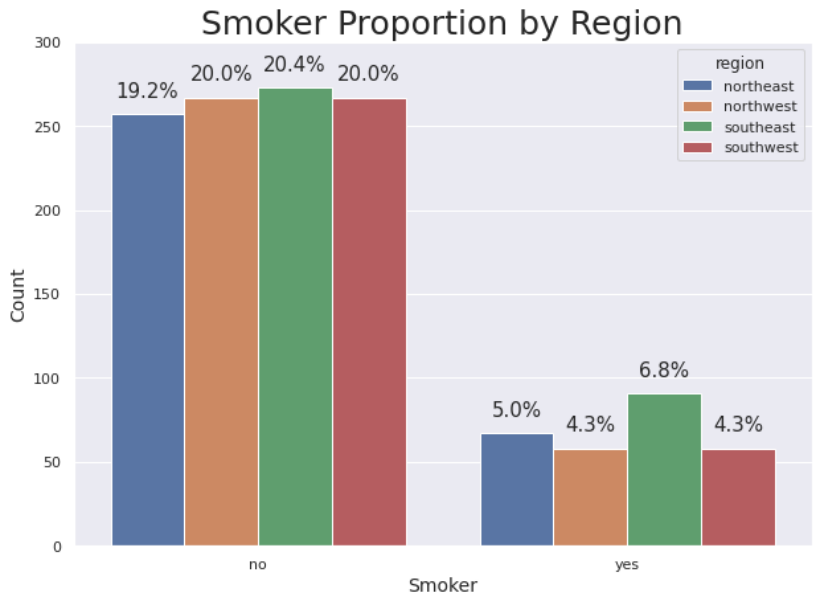
Insurance users come mainly from **productive people**, with age values ranging from **25 to 51 years old**, with an **average** value of **39-40 years old**. The unique part, is those productive people have an **average** value of **BMI** around **30** which lies in the category of **Obese**. After further analysis, I found that **87,1%** of the insurance user is having **BMI from Overweight to Extremely Obese**. This insurance user also covers people who smoke and don't smoke. Because of their habits, the insurance charge of those people will vary, the **most expensive** group of insurance user charges comes from those who **smoke**. The insurance charges for smokers are much more expensive than for non-smokers. The charges values for **smokers are larger than $18000** while charges for **non-smokers are less than $10000**.

Categorical Variables Analysis

Region Analysis



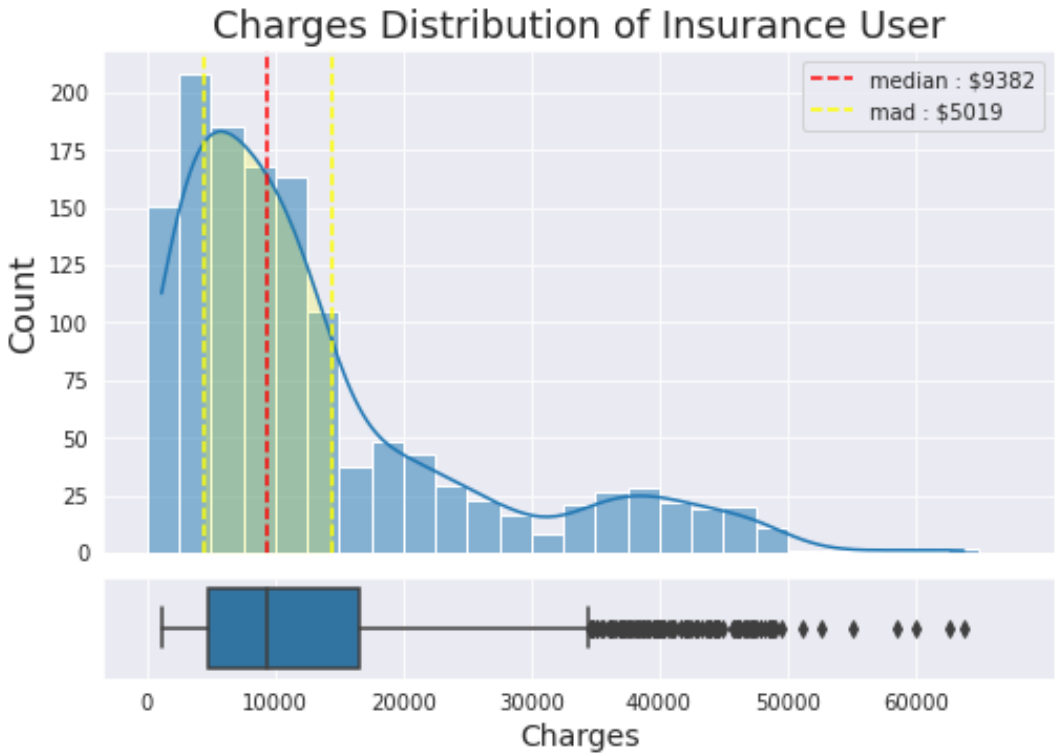


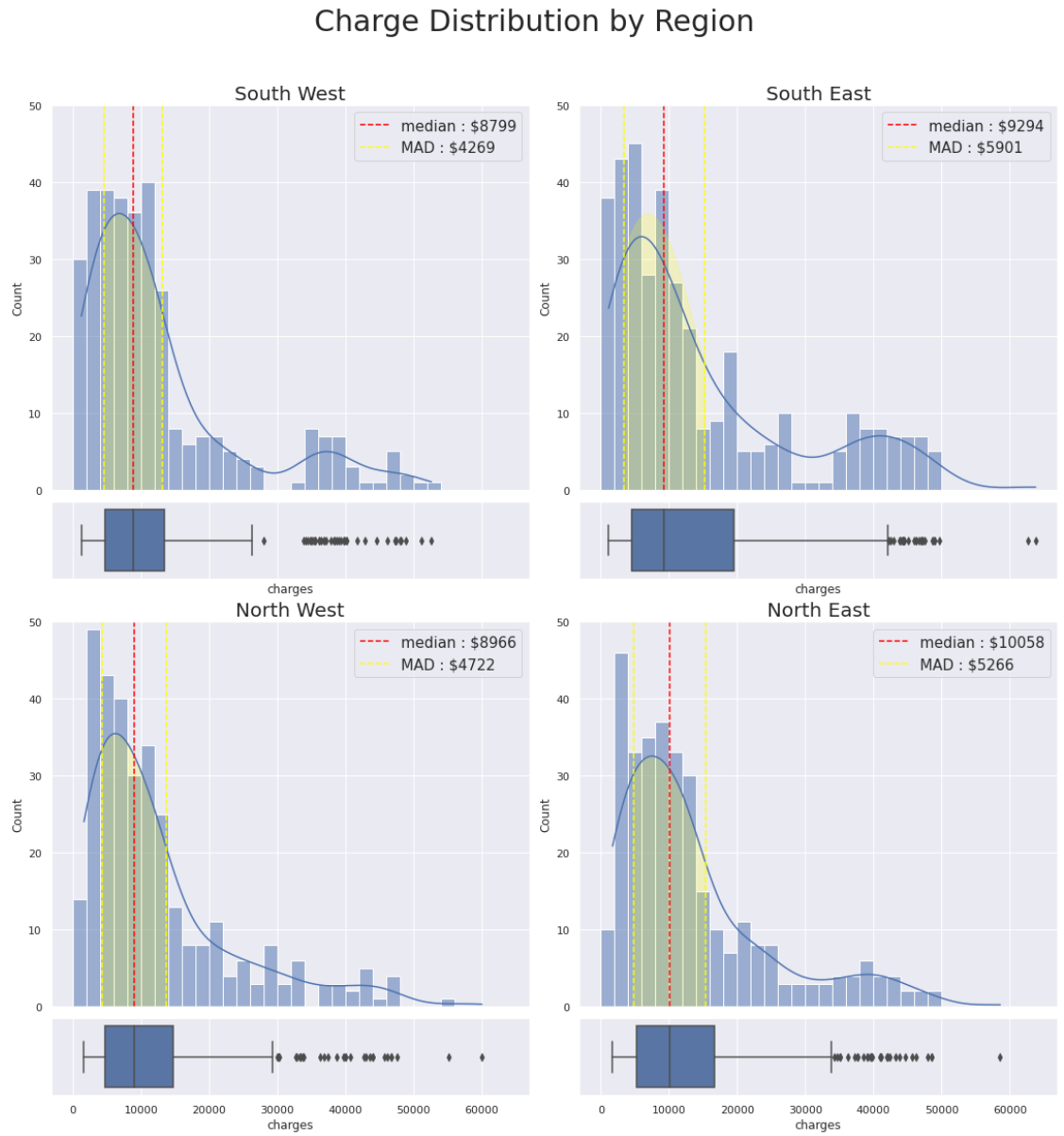


Insight.

- **Northwest**, **southwest**, and **northeast** has the same proportion of user, bar plot showed that the value is 24.2% - 24.3%, whereas the **southeast** has the largest proportion at **27.2%.**
- Every region nearly has a **50:50** female to male ratio, except the **southeast** with a difference of **1%** in gender proportion.
- In **every region** proportion of **non-smokers** is **larger** than the proportion of **smokers**. The ratio of smokers to non-smokers is around **1:4**.
- **Southeast** has the largest proportion of smoker compared to other regions, whereas **northwest and southwest** has the **same head count of smokers**.

Region Analysis





Insight.

- Distribution charge from every region shaping similar shape, **positively skewed distribution**.
- North East became the most expensive charges with median **$10058**, and southwest became the cheapest charges with median **$8799**.

Smoker and Gender Analysis

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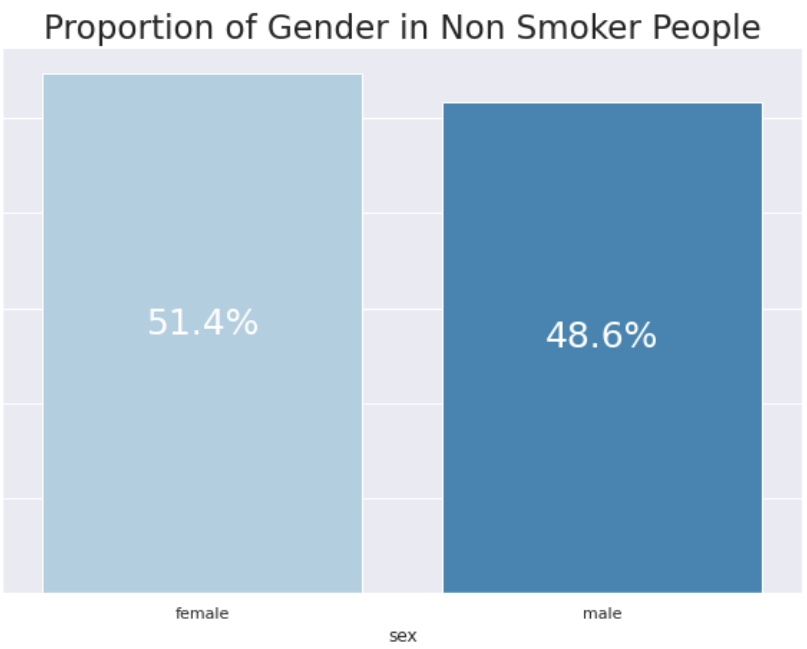

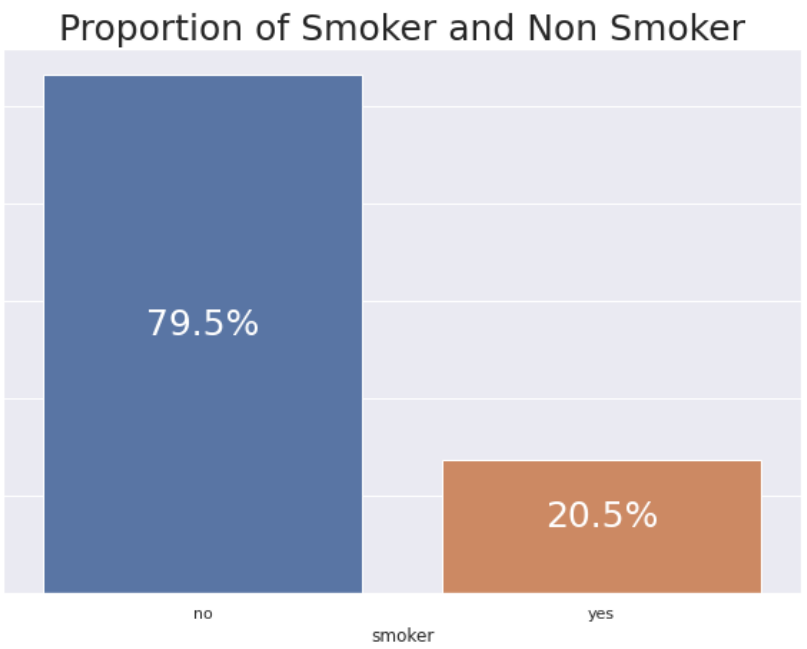

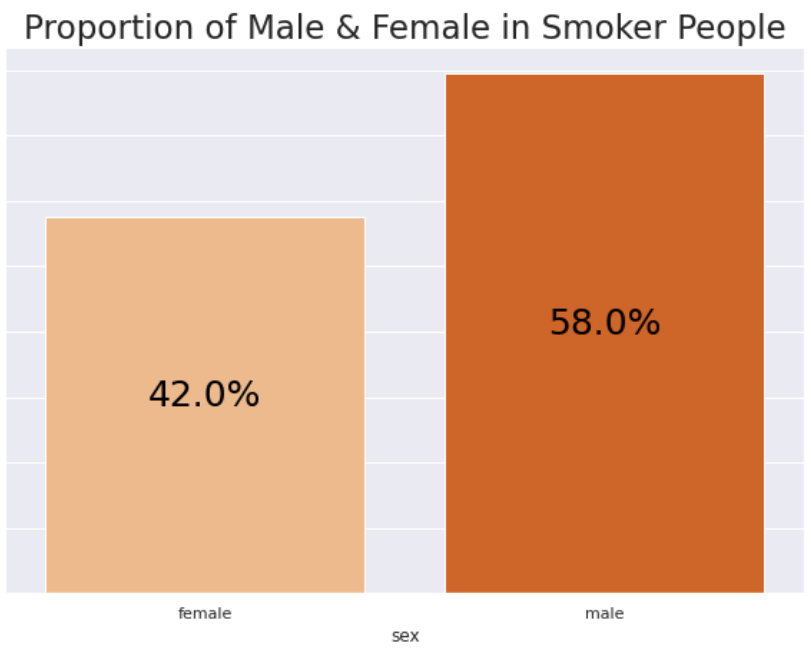

Insight.

- Smoker proportion is much smaller than non-smoker proportion, **20.5% compare to 79.5%**.
- In the smoker group, the male has the largest proportion **58%** compared to female **42%**.
- In non-smoker group, female has the largest proportion **51.4%** compared to male **48.6%**.

Categorical Variable Analysis Summary

Every region has a nearly equal amount proportion of insurance users, **24.2-24.3%**, a slight difference exists in the southeast region with a proportion of **27,2%** of all insurance users. Every region also has a nearly equal amount of gender proportion between male and female, **50:50**, a slight difference also exists in the southeast region with a proportion difference of **1%** between male and female. The data confirm that the proportion of smoker people is less than non-smoker people, the ratio of the smoker and non-smokers in every region is around **1:4.** Within **s**moker people, the male proportion is larger than female, 58% compared to 42%, while in non-smoker people, the female proportion is larger than male, 51.4% compared to 48,6%**.** The northeast region became the region with the relatively expensive amount of insurance charge of around **$100508**, whereas the southwest region become the cheapest region with an insurance charge of around **$8799.**

Continuous Variables Analysis

Smoker Probability Charge Analysis

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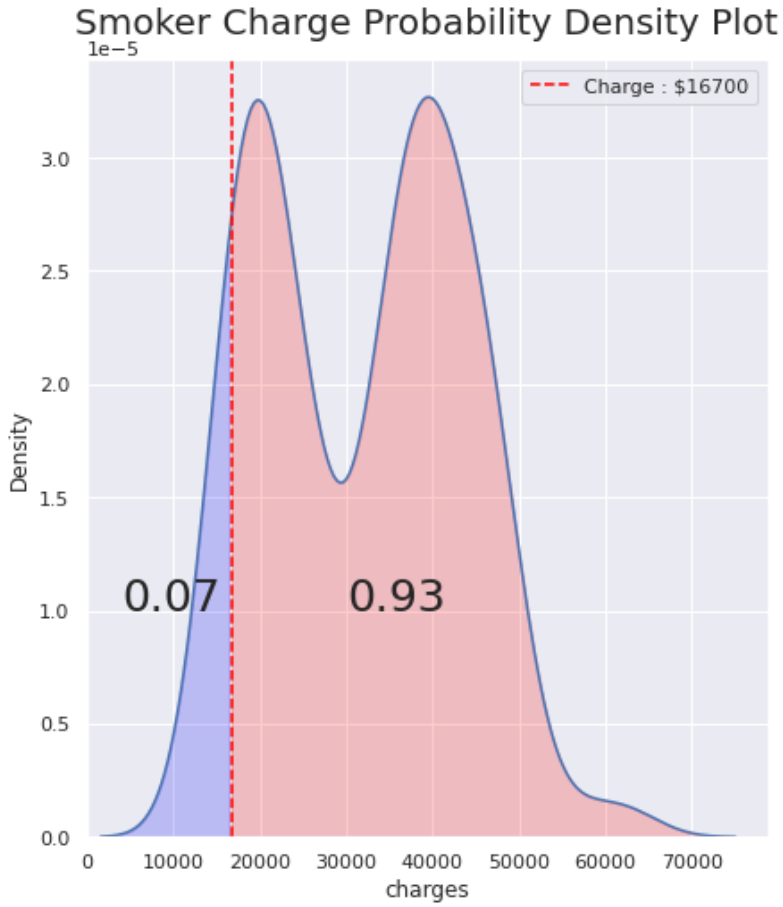

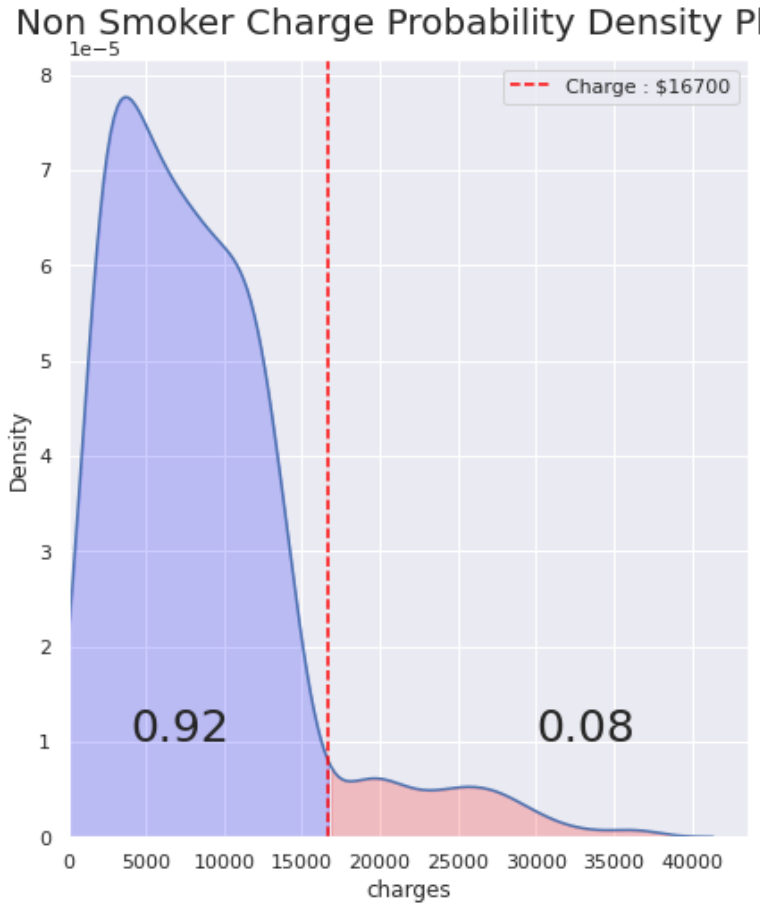

Insight.

- It is **very possible** for **smokers** to get insurance charges **more than $16700,** the probability is **0.93**. And it is **rare** that **smokers** will get insurance **charges below $16700,** the probability is just **0.07.**
- it is **rare** for **non smokers** to have an insurance charge for **more than $16700**. But it is **common** for **non-smoker** to have insurance charges below **$16700**, the probability is **0.92**.

BMI Probability Charge Analysis

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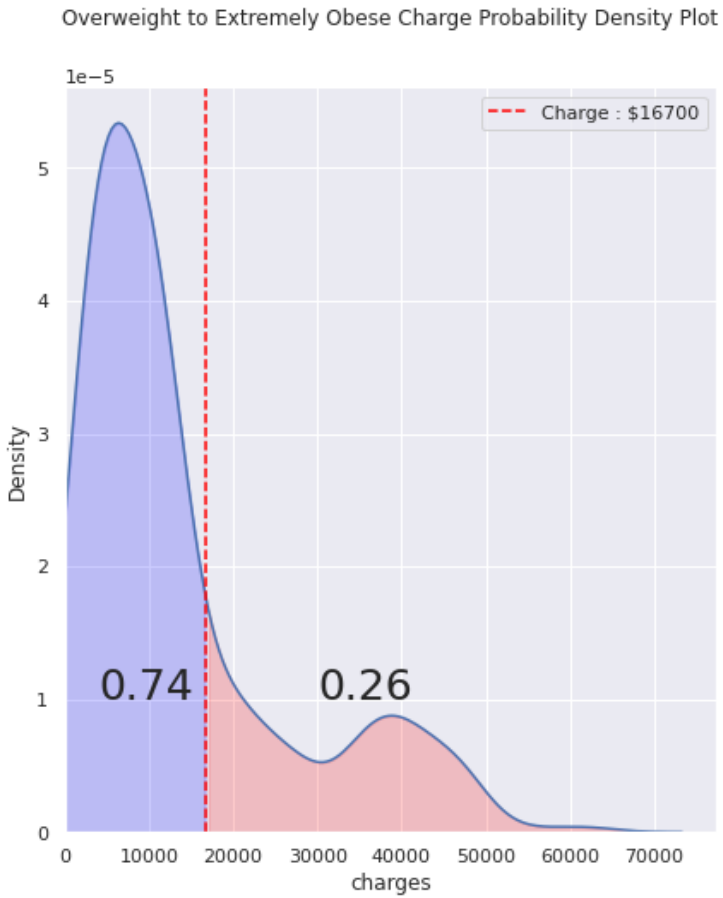
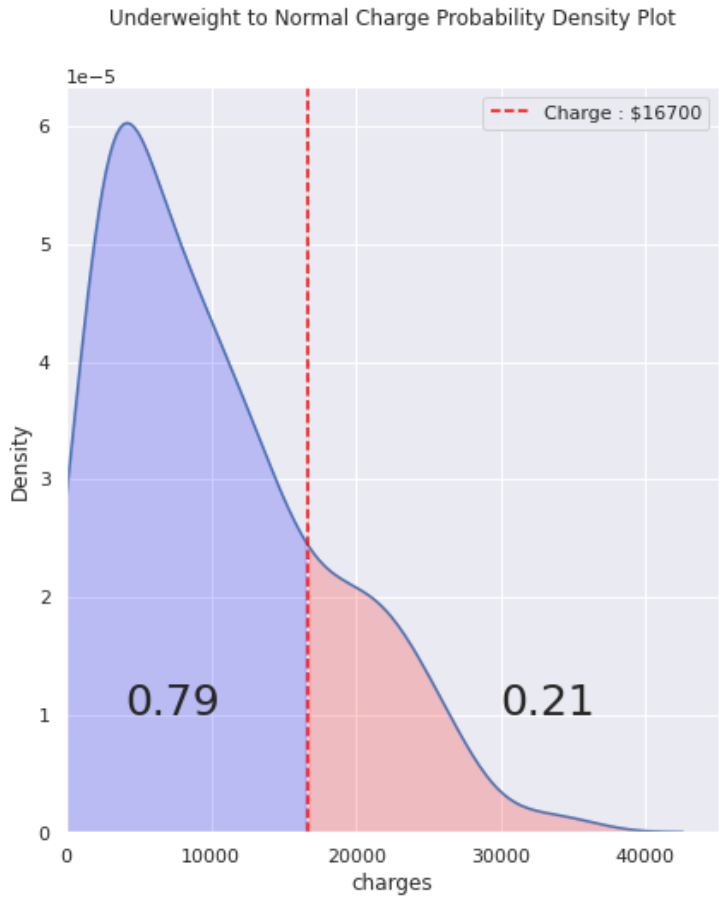
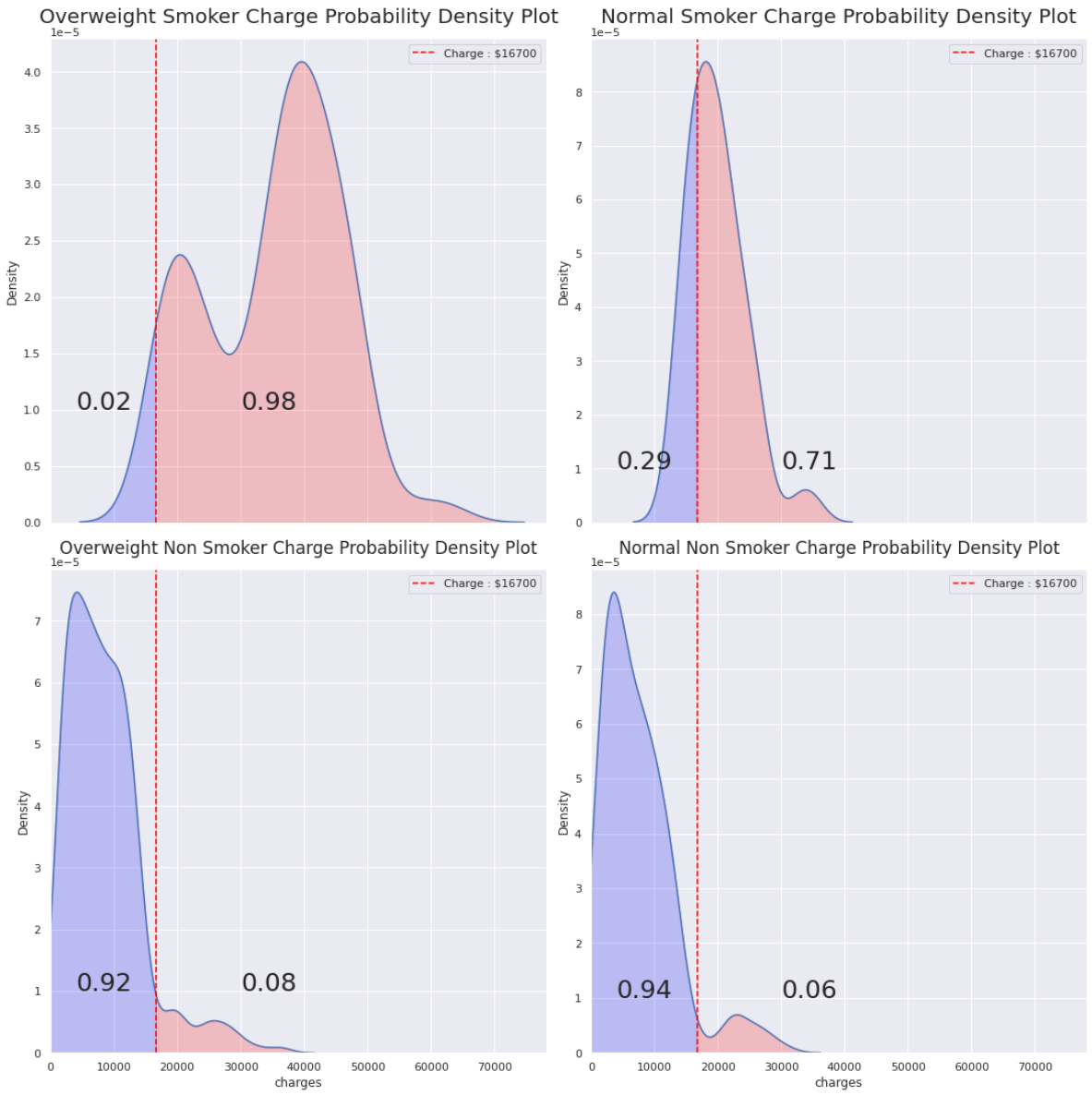




Insight.

- It is more possible for people with **BMI >= 25 (Overweight to Extremely Obese)** to get the insurance charge **below $16700** because the probability is **0.74**.
- Also It is more possible for people with **BMI < 25 (underweight to normal)** to get an insurance charge **below $16700** because the probability is **0.79**.

Smoker and BMI Probability Charge Analysis



Insight.

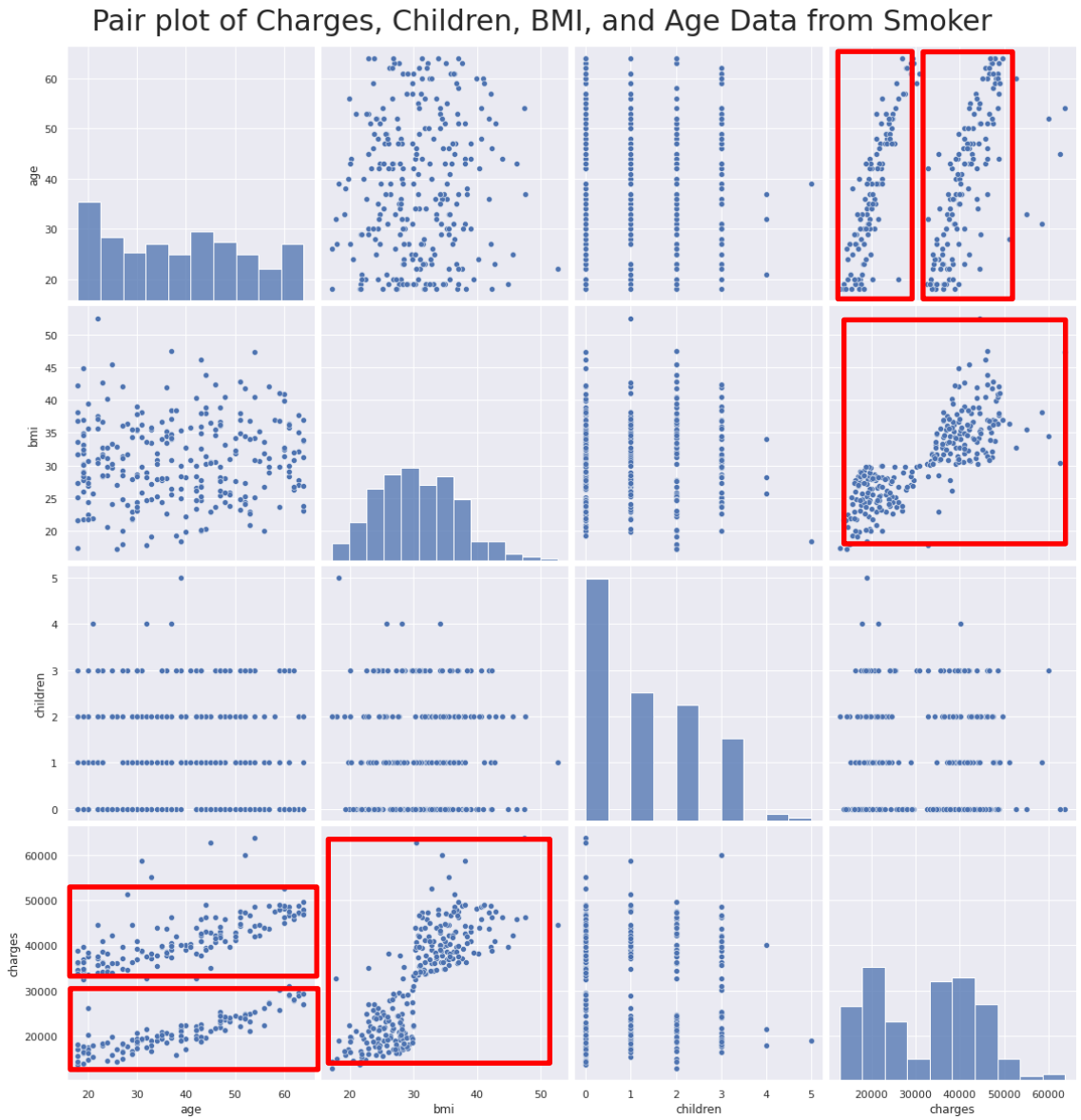
- **smoking** really increases the probability of a person getting an insurance charge for **more than $16700**.
- **overweight** also increases the probability to get an insurance charge for **more than $16700** but **not as strong as smoking**.

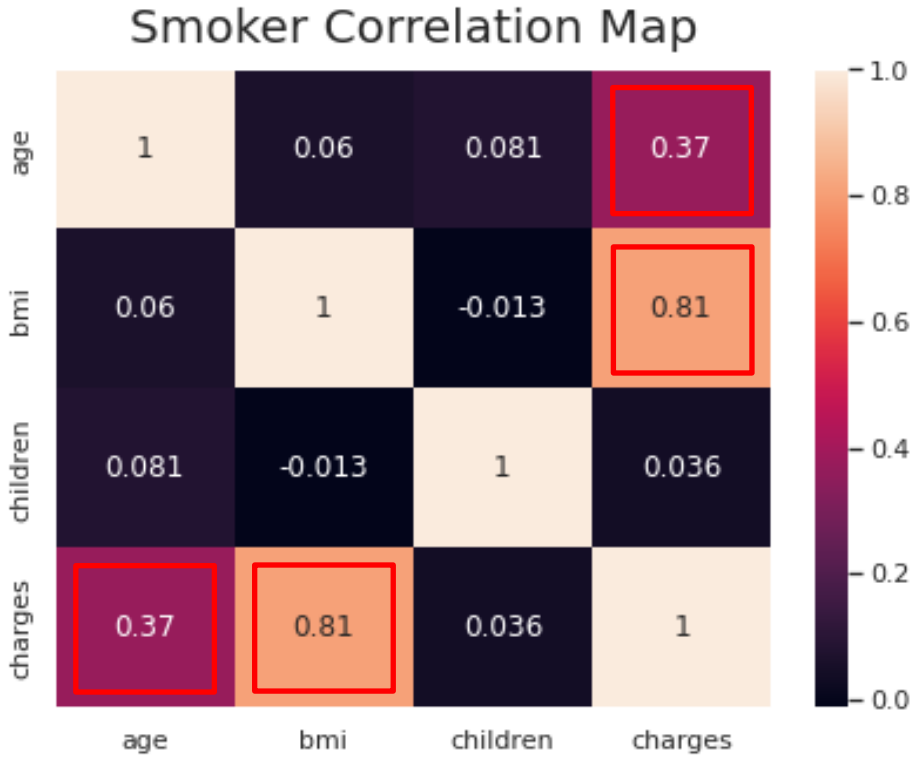
Continuous Variable Analysis Summary

The **probability of a smoker** getting an insurance charge of **more than $16700** is very large, **more than 0.7**, without taking into account his/her BMI factor. **BMI Factor** also contributes to the expensiveness of insurance charges, but the effect is **not as strong** as if he/she **smokes**. For smokers, the difference of probability between a normal BMI smoker, and with overweight BMI smoker is **0.27,** while for non-smokers the difference of probability between a normal BMI smoker, and with overweight BMI smoker is just **0.02**, this difference is very significant, thus smoking is a great factor affecting the insurance charges.

Correlation Analysis

Smoker Correlation Analysis

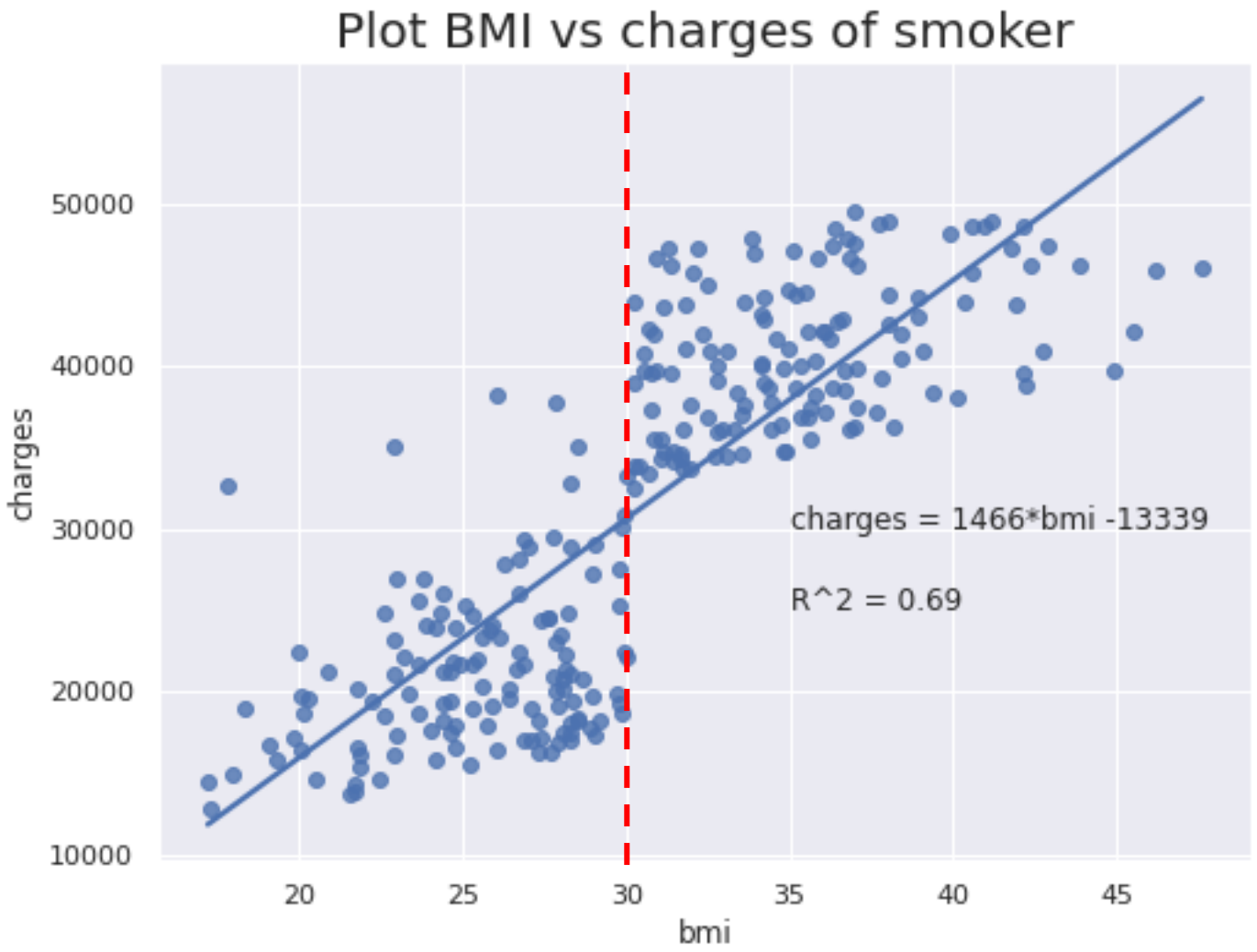




Insight.

- BMI and Charge has a strong correlation, **0.81**.
- there are positive weak correlation, **0.37**, between age and charges, but notice there are pattern in the scatter plot

Smoker Correlation Analysis



Insight.

- For smoker if the **BMI** of insurance user increase by **one value**,
  the **charges** will **increase by $1466**

Smoker Correlation Analysis

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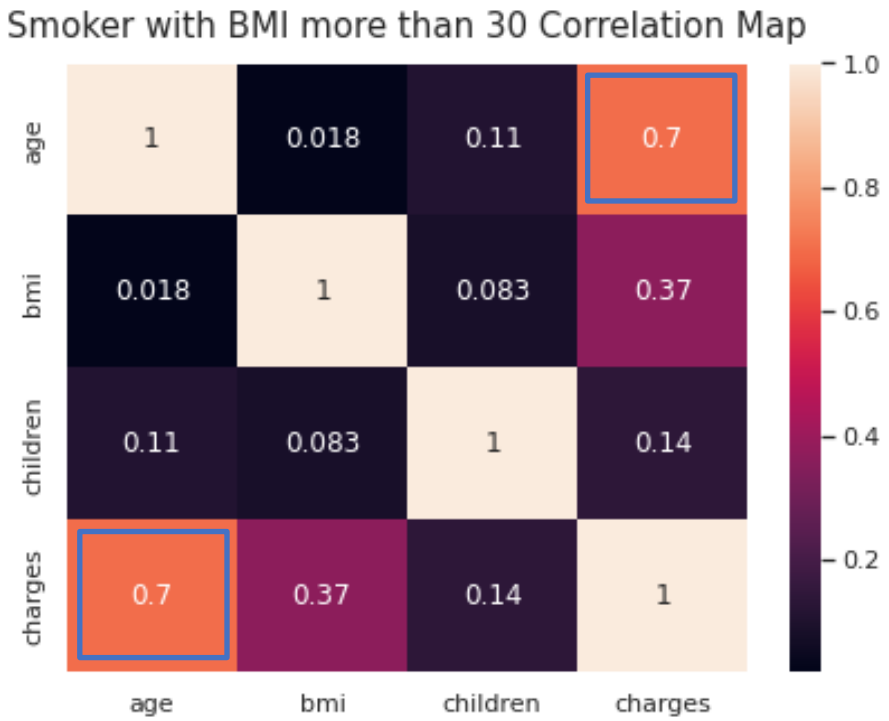

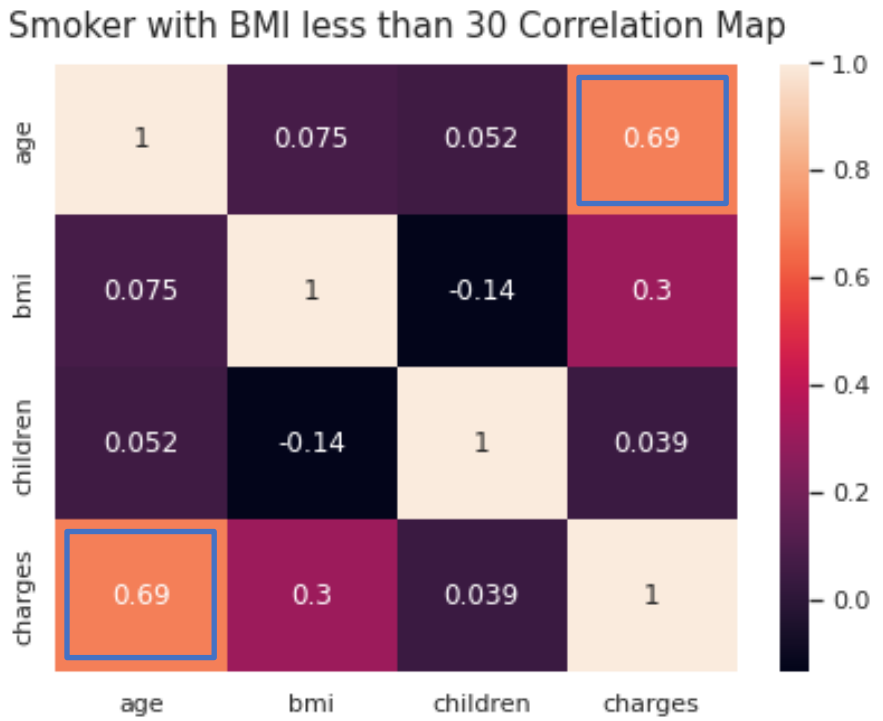

Insight.

- After separation using **BMI = 30** we could see that the **correlation value** from age and charge **increased** to **0.7**, this is a **strong correlation**. This could mean that there are indeed a relationship between **age and charges**.

Smoker Correlation Analysis

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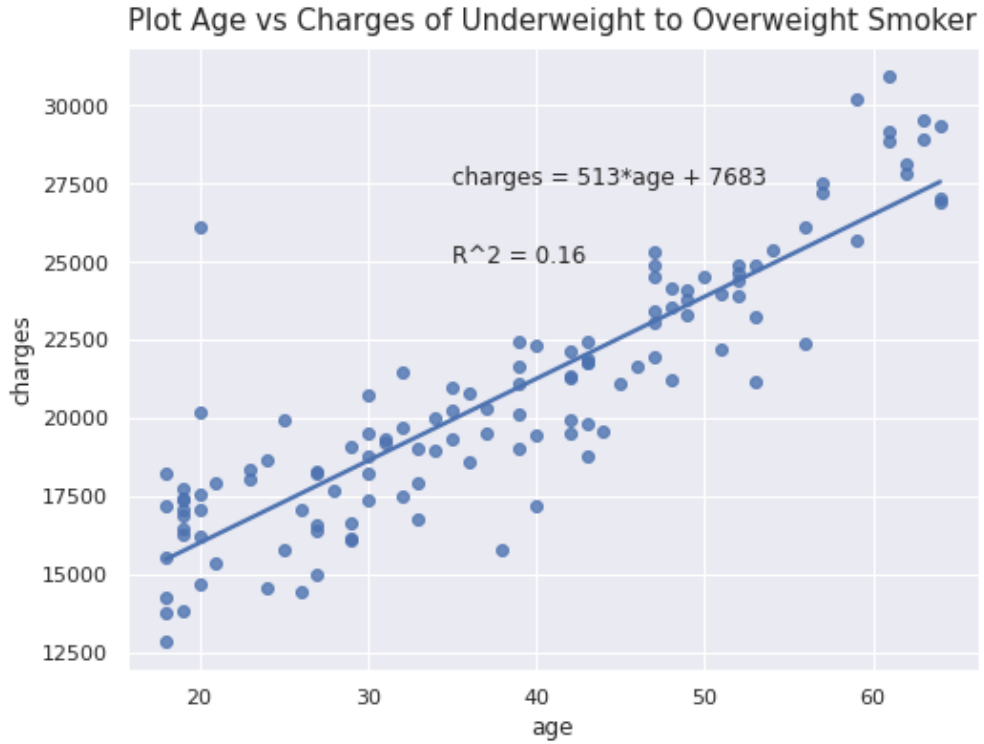

Insight.

- For smokers with BMI > 30, if the age was **increased** by **one value**, there will be an **increase in insurance charges** by **$480**. With charges ranged from **$32500 to $50000**.
- For smokers with BMI <= 30, if the age was **increased** by **one value**, there will be an **increase in insurance charges** by **$513**. With charges ranged from **$12500 to 32500**. This finding confirms analysis before, people who smoke and have a high BMI tend to have an expensive insurance charge.

Non Smoker Correlation Analysis

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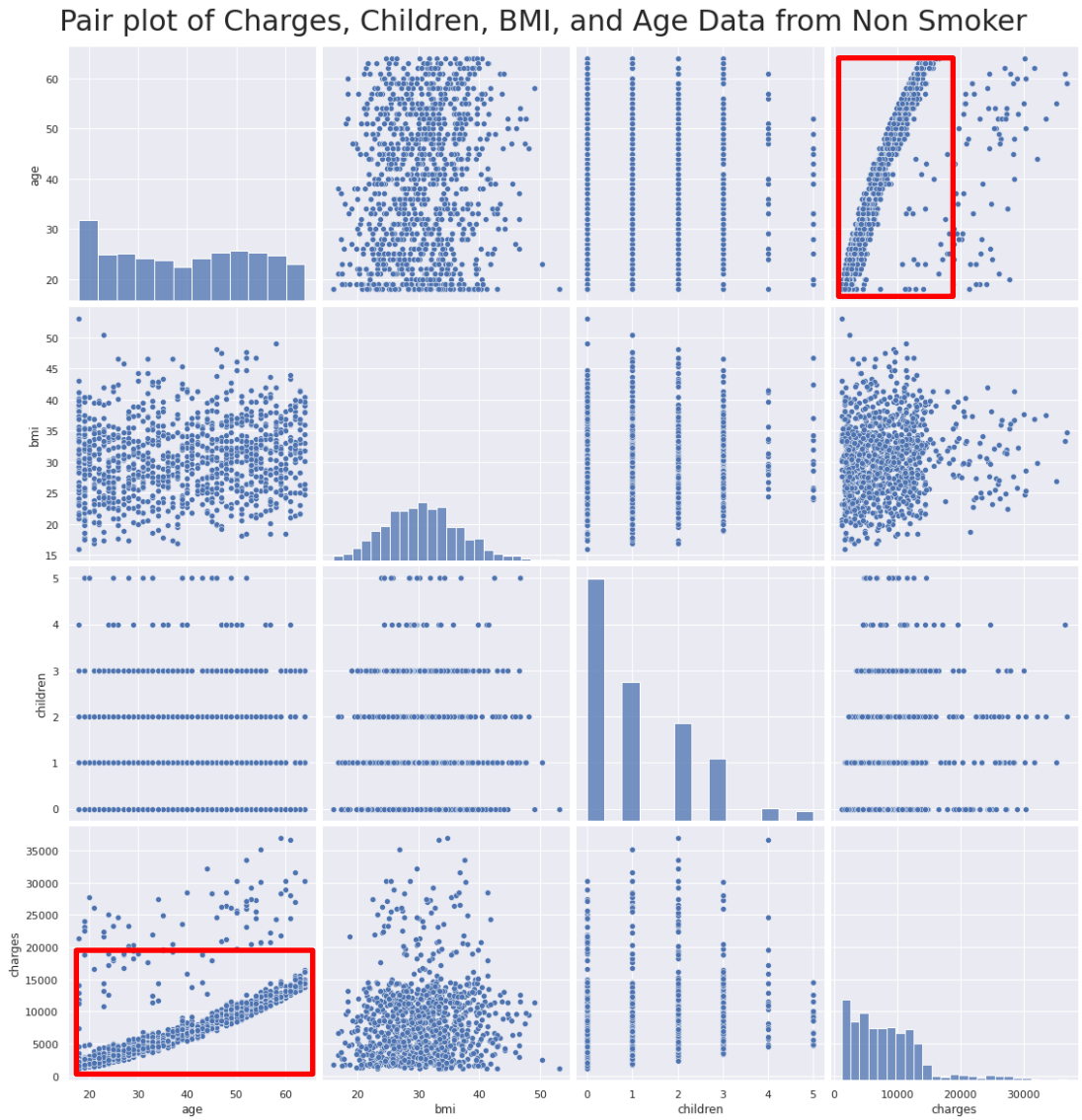
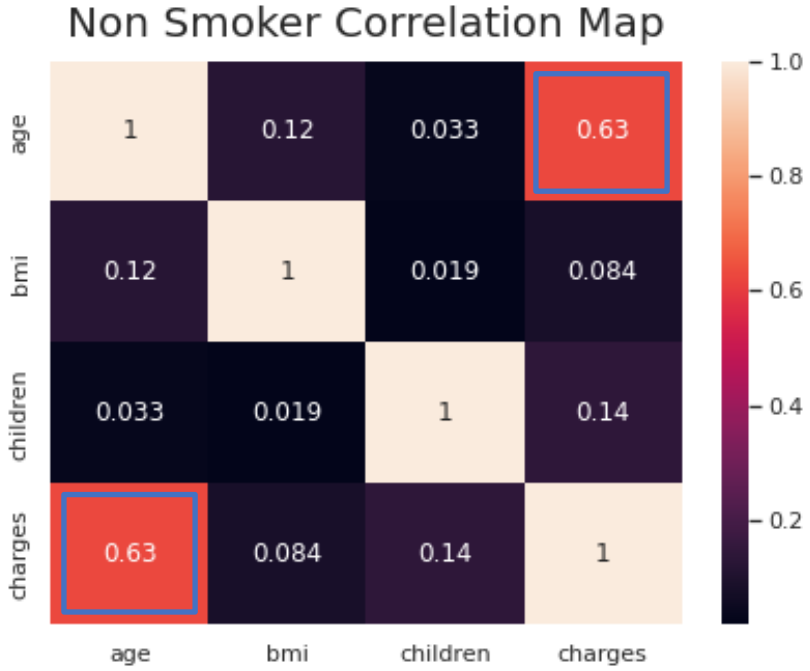




Insight.

- there are positive strong correlation between **age vs charge** for non-smoker, with a correlation value of **0.63**

Non Smoker Correlation Analysis

Insight.

- For non-smokers, if the **age** increased by **one value**, there will be an increase in charge by **$70 dollars**, this is relatively a low value to smoker data. With charges value ranged from around **$1000 to $16000.**
- Compared to the smoker linear regression minimum value, non smoker indeed has cheaper insurance charge.

Correlation Analysis Summary

There is a correlation between smokers, non-smokers, BMI values, and age of insurance users to insurance charges that they have. Correlation analysis shows that people who smoke and have a high value of BMI tend to have an expensive insurance charge, the minimum charge value for them is **$32500** and the value will increase by **$480** dollars if the insurance user gets older. Smoker with middle to low-value BMI will have relatively cheaper insurance charges than smokers with high BMI values, the minimum charge for them is **$12500** and the value will increase by **$513** dollars if the insurance user gets older. Non-smokers, compared to smokers, have really cheap charges, their minimum value is around **$1000** and the charges will increase by just **$70** dollars if they get older. Then we could know that smoking and BMI really affects the expense of insurance charge.

Hypothesis Testing

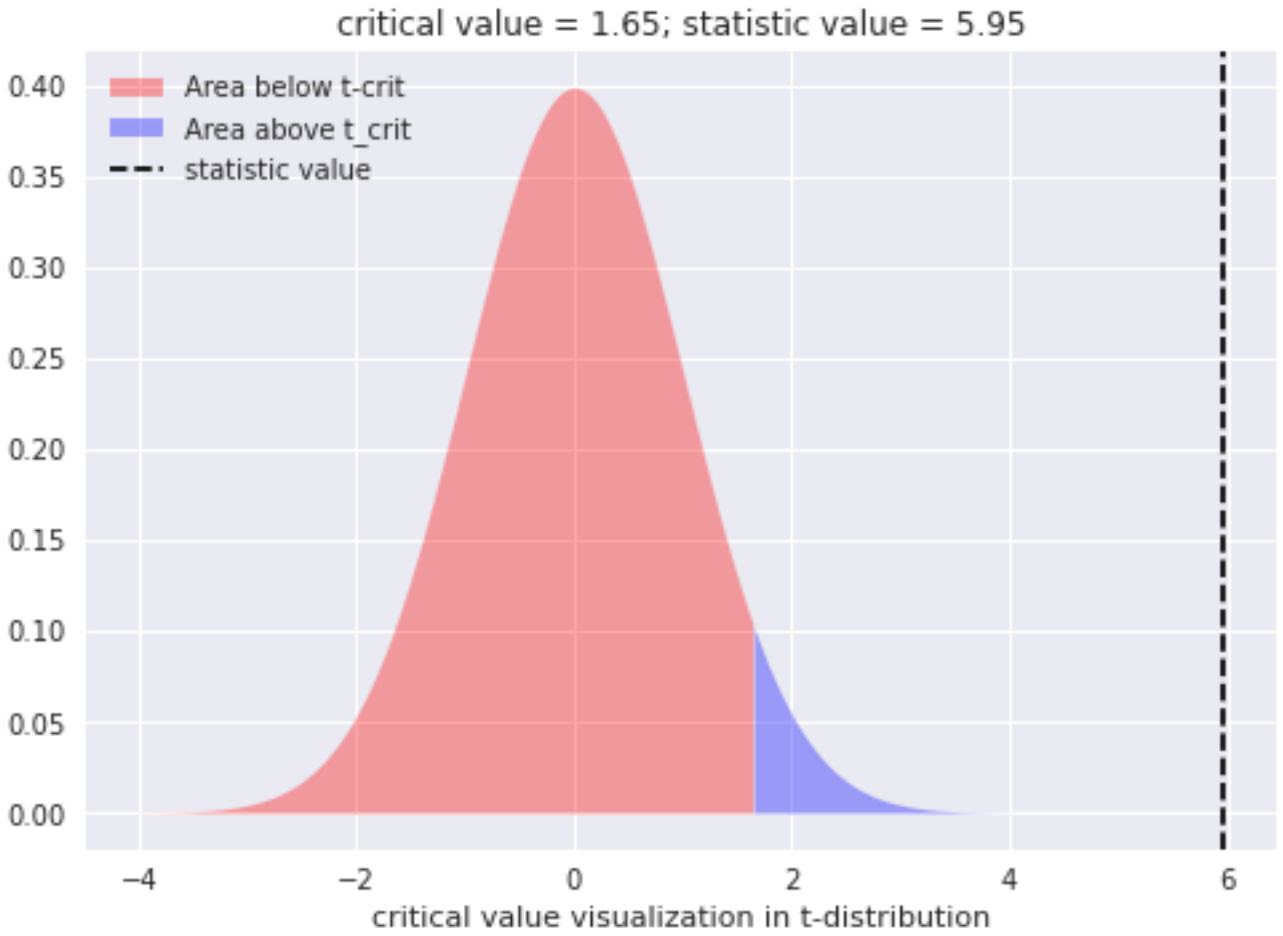
Smoker's charges are higher than non-smoker's

$$H_0 : \mu_{Charge|Smoker} <= \mu_{Charge|Non-Smoker}$$
$$H_1 : \mu_{Charge|Smoker} > \mu_{Charge|Non-Smoker}$$

Insight.

- **Reject H0**, hence in a population of insurance users, we are 95% confident that smoker's insurance charges are higher than non-smoker insurance charges

Insurance charges with BMI > 25 is higher than insurance charges with BMI < 25

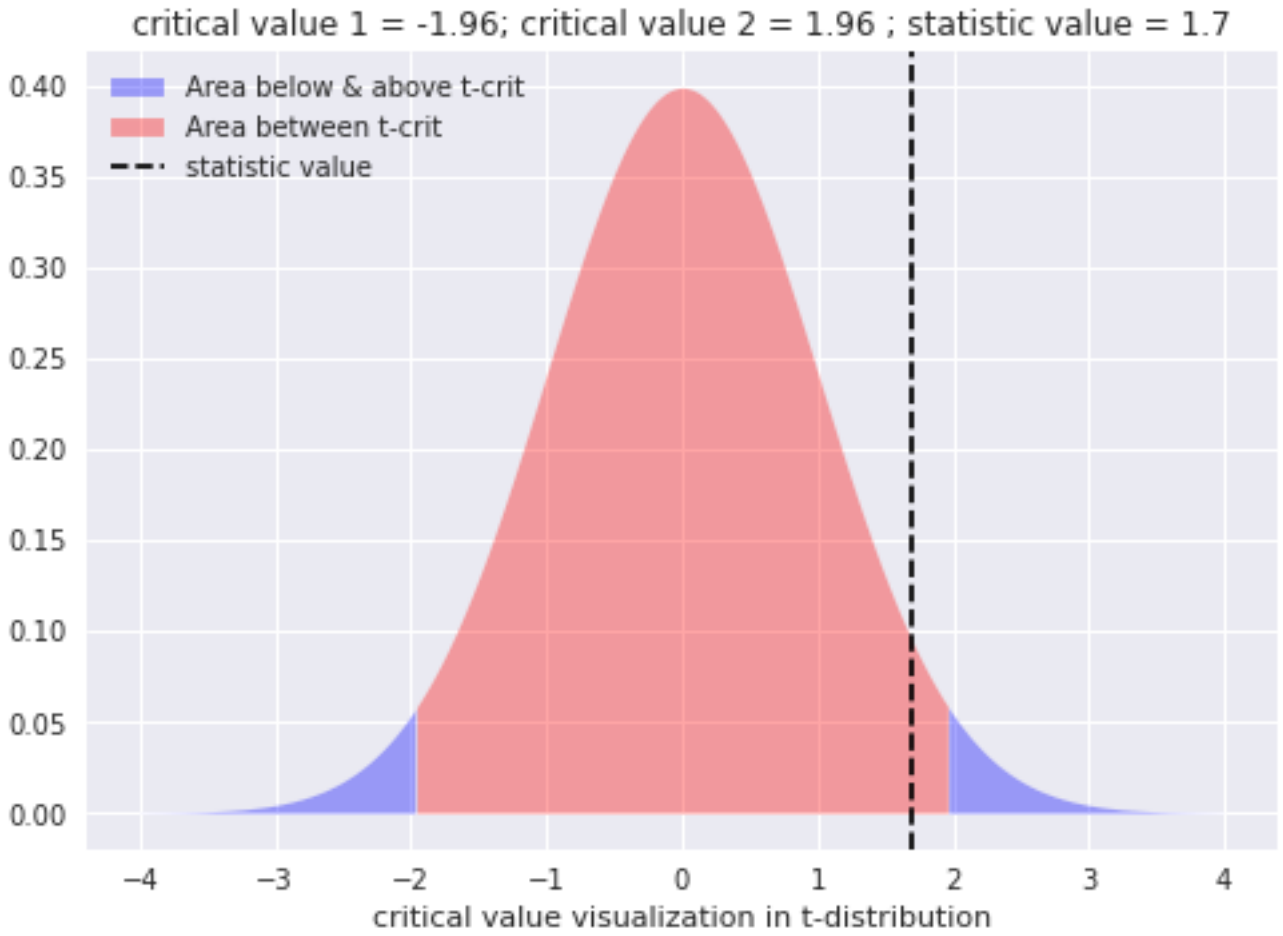


$$H_0 : \mu_{Charge|BMI>25} <= \mu_{Charge|BMI<=25}$$
$$H_1 : \mu_{Charge|BMI>25} > \mu_{Charge|BMI<=25}$$

Insight.

- **Reject H0**, hence in a population of insurance users, we are 95% confident that users with BMI more than 25 will have more expensive charges than users with BMI less than 25.

Male and Female BMI is similar

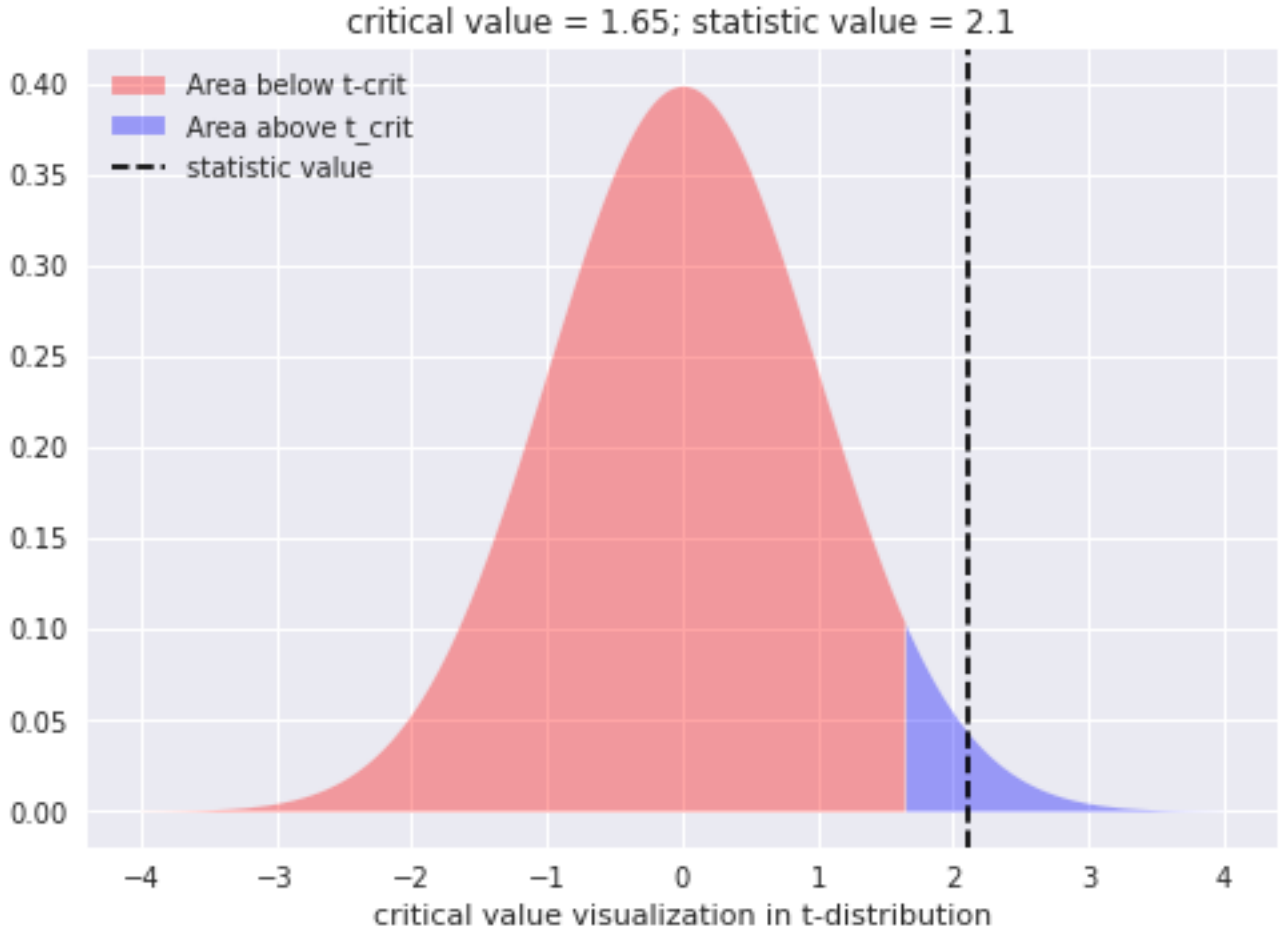


$$H_0 : \mu_{BMI|Male} \neq \mu_{BMI|Female}$$
$$H_1 : \mu_{BMI|Male} = \mu_{BMI|Female}$$

Insight.

- **Fail to Reject H0**. Hence we are 95% confident that there is not enough data/evidence to prove that in a population of insurance users Male BMI is similar to Female BMI.

Male insurance charges is higher than female insurance charges



$$H_0 : \mu_{Charge|Male} <= \mu_{Charge|Female}$$
$$H_1 : \mu_{Charge|Male} > \mu_{Charge|Female}$$

Insight.

- **Reject H0**, hence in a population of insurance users, we are 95% confident that male insurance charges are higher than female insurance charges.

Conclusion

Analysis Summary

There are **several factors** that affect insurance user charges determination like **smoking, BMI value, age, gender, region, and the number of children in a family**. Of those factors, the most **key factor** to determine **how expensive** insurance charges will users have is the **smoking habit**. Analysis shows that people who smoke will get insurance charges higher than people who don't smoke, the **charges for smokers are around $18750** for smokers with **relatively a good value of BMI,** and around **$40000** for smokers with a **bad value of BMI**. Whereas insurance charges for **non-smokers** are just around **$4000**. **BMI** also becomes the **second most contributing factor for insurance charge determination**, but the BMI contribution to charges determination is **larger in smoker people**. The analysis also shows that **as people get older**, the insurance **charge is getting expensive**, this age factor is also different in smokers and non-smokers people. The rest of the factor such as **gender, region, and the number of children** in a family does contribute to the determination of insurance charge but the value is **very small** compared to smoking, BMI, and age factor.

Reference

- Probability and Statistics for Engineers and Scientist, Ronal E. Walpole et. All
- Pacmann : Intro to Probability Learning Module

Reach me ! for further discussion

My_Resume

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