Question 2

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2025-02-02

Question No: 02

Using the "Marketing Customer Value Analysis" dataset, complete the following tasks with proper analysis and interpretation:

i. Load the dataset and explore its structure using basic commands.

```
library(ggplot2)
```

```
df=read.csv("D:/Data Science for Marketing-1/data/WA_Fn-UseC_-Marketing-Customer-Value-Analysis.csv")
```

```
head(df)
```

```
##   Customer     State Customer.Lifetime.Value Response Coverage Education
## 1 BU79786 Washington            2763.519      No    Basic  Bachelor
## 2 QZ44356   Arizona            6979.536      No Extended  Bachelor
## 3 AI49188    Nevada           12887.432      No  Premium  Bachelor
## 4 WW63253 California            7645.862      No    Basic  Bachelor
## 5 HB64268 Washington            2813.693      No    Basic  Bachelor
## 6 OC83172    Oregon            8256.298     Yes    Basic  Bachelor
##   Effective.To.Date EmploymentStatus Gender Income Location.Code Marital.Status
## 1          2/24/11         Employed      F  56274      Suburban       Married
## 2          1/31/11       Unemployed      F      0      Suburban        Single
## 3          2/19/11         Employed      F  48767      Suburban       Married
## 4          1/20/11       Unemployed      M      0      Suburban       Married
## 5          2/3/11          Employed      M  43836         Rural        Single
## 6          1/25/11         Employed      F  62902         Rural       Married
##   Monthly.Premium.Auto Months.Since.Last.Claim Months.Since.Policy.Inception
## 1                   69                      32                            5
## 2                   94                      13                           42
## 3                  108                      18                           38
## 4                  106                      18                           65
## 5                   73                      12                           44
## 6                   69                      14                           94
##   Number.of.Open.Complaints Number.of.Policies   Policy.Type      Policy
## 1                         0                  9 Corporate Auto Corporate L3
## 2                         0                  8  Personal Auto  Personal L3
## 3                         0                  2  Personal Auto  Personal L3
## 4                         0                  7 Corporate Auto Corporate L2
## 5                         0                  1  Personal Auto  Personal L1
## 6                         0                  2  Personal Auto  Personal L3
##   Renew.Offer.Type Sales.Channel Total.Claim.Amount Vehicle.Class Vehicle.Size
## 1           Offer1        Agent          384.8111  Two-Door Car     Medsize
## 2           Offer3        Agent         1131.4641 Four-Door Car     Medsize
## 3           Offer1        Agent          566.4722  Two-Door Car     Medsize
## 4           Offer1   Call Center          529.8813          SUV     Medsize
## 5           Offer1        Agent          138.1009 Four-Door Car     Medsize
## 6           Offer2          Web          159.3830  Two-Door Car     Medsize
```

```
str(df)
```

```
## 'data.frame':    9134 obs. of  24 variables:
##  $ Customer                     : chr  "BU79786" "QZ44356" "AI49188" "WW63253" ...
##  $ State                        : chr  "Washington" "Arizona" "Nevada" "California" ...
##  $ Customer.Lifetime.Value      : num  2764 6980 12887 7646 2814 ...
##  $ Response                     : chr  "No" "No" "No" "No" ...
##  $ Coverage                     : chr  "Basic" "Extended" "Premium" "Basic" ...
##  $ Education                    : chr  "Bachelor" "Bachelor" "Bachelor" "Bachelor" ...
##  $ Effective.To.Date            : chr  "2/24/11" "1/31/11" "2/19/11" "1/20/11" ...
##  $ EmploymentStatus             : chr  "Employed" "Unemployed" "Employed" "Unemployed" ...
##  $ Gender                       : chr  "F" "F" "F" "M" ...
##  $ Income                       : int  56274 0 48767 0 43836 62902 55350 0 14072 28812 ...
##  $ Location.Code                : chr  "Suburban" "Suburban" "Suburban" "Suburban" ...
##  $ Marital.Status               : chr  "Married" "Single" "Married" "Married" ...
##  $ Monthly.Premium.Auto         : int  69 94 108 106 73 69 67 101 71 93 ...
##  $ Months.Since.Last.Claim      : int  32 13 18 18 12 14 0 0 13 17 ...
##  $ Months.Since.Policy.Inception: int  5 42 38 65 44 94 13 68 3 7 ...
##  $ Number.of.Open.Complaints    : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Number.of.Policies           : int  9 8 2 7 1 2 9 4 2 9 ...
##  $ Policy.Type                  : chr  "Corporate Auto" "Personal Auto" "Personal Auto" "Corporate Auto" ...
##  $ Policy                       : chr  "Corporate L3" "Personal L3" "Personal L3" "Corporate L2" ...
##  $ Renew.Offer.Type             : chr  "Offer1" "Offer3" "Offer1" "Offer1" ...
##  $ Sales.Channel                : chr  "Agent" "Agent" "Agent" "Call Center" ...
##  $ Total.Claim.Amount           : num  385 1131 566 530 138 ...
##  $ Vehicle.Class                : chr  "Two-Door Car" "Four-Door Car" "Two-Door Car" "SUV" ...
##  $ Vehicle.Size                 : chr  "Medsize" "Medsize" "Medsize" "Medsize" ...
```

```
summary(df)
```

```
##    Customer            State           Customer.Lifetime.Value
##  Length:9134        Length:9134        Min.   :  1898
##  Class :character   Class :character   1st Qu.:  3994
##  Mode  :character   Mode  :character   Median :  5780
##                                        Mean   :  8005
##                                        3rd Qu.:  8962
##                                        Max.   :83325
##    Response           Coverage          Education          Effective.To.Date
##  Length:9134        Length:9134        Length:9134        Length:9134
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##  EmploymentStatus      Gender              Income       Location.Code
##  Length:9134        Length:9134        Min.   :    0   Length:9134
##  Class :character   Class :character   1st Qu.:    0   Class :character
##  Mode  :character   Mode  :character   Median :33890   Mode  :character
##                                        Mean   :37657
##                                        3rd Qu.:62320
##                                        Max.   :99981
##  Marital.Status    Monthly.Premium.Auto Months.Since.Last.Claim
##  Length:9134        Min.   :  61.00     Min.   : 0.00
##  Class :character   1st Qu.: 68.00      1st Qu.: 6.00
##  Mode  :character   Median : 83.00      Median :14.00
##                     Mean   : 93.22      Mean   :15.13
##                     3rd Qu.:109.00      3rd Qu.:23.00
##                     Max.   :298.00      Max.   :35.00
##  Months.Since.Policy.Inception Number.of.Open.Complaints Number.of.Policies
##  Min.   : 0.00                 Min.   :0.0000           Min.   :1.000
##  1st Qu.:24.00                 1st Qu.:0.0000           1st Qu.:3.000
##  Median :48.00                 Median :0.0000           Median :4.000
##  Mean   :48.06                 Mean   :0.3844           Mean   :2.966
##  3rd Qu.:71.00                 3rd Qu.:0.0000           3rd Qu.:4.000
##  Max.   :99.00                 Max.   :5.0000           Max.   :9.000
##  Policy.Type          Policy          Renew.Offer.Type   Sales.Channel
##  Length:9134        Length:9134        Length:9134        Length:9134
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##  Total.Claim.Amount Vehicle.Class      Vehicle.Size
##  Min.   :  0.099    Length:9134        Length:9134
##  1st Qu.: 272.258   Class :character   Class :character
##  Median : 383.945   Mode  :character   Mode  :character
##  Mean   : 434.089
##  3rd Qu.: 547.515
##  Max.   :2893.240
```

```
dim(df)
```

```
## [1] 9134   24
```

Interpretation: Basic commands provide an overview of the dataset.

ii. Create a new column named "Engaged" by transforming the categorical values in the "Response" variable into numerical values. Why is this transformation important?

```
df$Engaged <- ifelse(df$Response == "Yes", 1, 0)
```

Interpretation: Converts "Yes/No" responses into 1 and 0 for numerical analysis.

iii. Calculate and interpret the Engagement Rate. How is it computed, and what does it indicate about the customer responses?

```
print(sum(df$Engaged)/nrow(df)*100)
```

```
## [1] 14.32012
```

Interpretation: Engagement rate shows the percentage of customers who responded positively.

iv. Analyze engagement rate by "Renew Offer Type" and "Sales Channel":

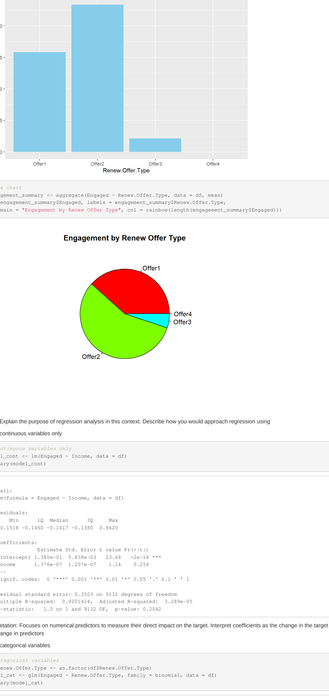
```
aggregate(Engaged ~ Renew.Offer.Type + Sales.Channel, data = df, mean)
```

```
##    Renew.Offer.Type Sales.Channel    Engaged
## 1           Offer1         Agent 0.19881637
## 2           Offer2         Agent 0.31901840
## 3           Offer3         Agent 0.01674903
## 4           Offer4         Agent 0.00000000
## 5           Offer1        Branch 0.15286624
## 6           Offer2        Branch 0.15989848
## 7           Offer3        Branch 0.00000000
## 8           Offer4        Branch 0.00000000
## 9           Offer1   Call Center 0.07182857
## 10          Offer2   Call Center 0.21283926
## 11          Offer3   Call Center 0.00000000
## 12          Offer4   Call Center 0.00000000
## 13          Offer1           Web 0.12000000
## 14          Offer2           Web 0.13713450
## 15          Offer3           Web 0.05240175
## 16          Offer4           Web 0.00000000
```

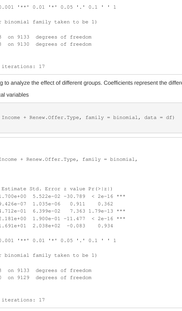
Interpretation: Groups data by "Renew Offer Type" and "Sales Channel" to analyze engagement patterns.

v. Use a pivot table to summarize engagement by "Renew Offer Type" and visualize the results using both bar and pie charts. Why are these visualizations helpful in understanding customer engagement patterns?

```
#bar chart
ggplot(df, aes(x = Renew.Offer.Type, y = Engaged)) +
  stat_summary(fun = mean, geom = "bar", fill = "skyblue") +
  ggtitle("Engagement by Renew Offer Type")
```




```
# Pie chart
engagement_summary <- aggregate(Engaged ~ Renew.Offer.Type, data = df, mean)
pie(engagement_summary$Engaged, labels = engagement_summary$Renew.Offer.Type,
    main = "Engagement by Renew Offer Type", col = rainbow(length(engagement_summary$Engaged)))
```



vi. Explain the purpose of regression analysis in this context. Describe how you would approach regression using

i. continuous variables only

```
# Continuous variables only
model_cont <- lm(Engaged ~ Income, data = df)
summary(model_cont)
```

```
##
## Call:
## lm(formula = Engaged ~ Income, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.1518 -0.1460 -0.1417 -0.1380  0.8620
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1.360e-01  5.838e-03   23.64   <2e-16 ***
## Income      1.376e-07  1.207e-07    1.14    0.254
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3503 on 9132 degrees of freedom
## Multiple R-squared:  0.0001424,  Adjusted R-squared:  1.289e-05
## F-statistic:  1.3 on 1 and 9132 DF,  p-value: 0.2542
```

Interpretation: Focuses on numerical predictors to measure their direct impact on the target. Interpret coefficients as the change in the target for a unit change in predictors

ii. categorical variables

```
# Categorical variables only
df$Renew.Offer.Type <- as.factor(df$Renew.Offer.Type)
model_cat <- glm(Engaged ~ Renew.Offer.Type, family = binomial, data = df)
summary(model_cat)
```

```
##
## Call:
## glm(formula = Engaged ~ Renew.Offer.Type, family = binomial,
##     data = df)
##
## Coefficients:
##                          Estimate Std. Error z value Pr(>|z|)
## (Intercept)              -1.67081    0.04472 -37.359  < 2e-16 ***
## Renew.Offer.TypeOffer2    0.48365    0.06252   7.736 1.02e-14 ***
## Renew.Offer.TypeOffer3   -2.37564    0.38984 -11.449  < 2e-16 ***
## Renew.Offer.TypeOffer4 -16.89525  203.83246  -0.083    0.934
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 7503.3  on 9133  degrees of freedom
## Residual deviance: 6751.8  on 9130  degrees of freedom
## AIC: 6759.8
##
## Number of Fisher Scoring iterations: 17
```

Interpretation: Uses dummy encoding to analyze the effect of different groups. Coefficients represent the difference from the reference group.

iii. both continuous and categorical variables

```
# Both types
model_both <- glm(Engaged ~ Income + Renew.Offer.Type, family = binomial, data = df)
summary(model_both)
```

```
##
## Call:
## glm(formula = Engaged ~ Income + Renew.Offer.Type, family = binomial,
##     data = df)
##
## Coefficients:
##                          Estimate Std. Error z value Pr(>|z|)
## (Intercept)             -1.700e+00  5.522e-02 -30.789  < 2e-16 ***
## Income                   9.426e-07  1.059e-06   0.911    0.362
## Renew.Offer.TypeOffer2   4.712e-01  6.399e-02   7.363 1.79e-13 ***
## Renew.Offer.TypeOffer3  -2.816e+00  1.909e-01 -14.877  < 2e-16 ***
## Renew.Offer.TypeOffer4 -1.691e+01  2.038e+02  -0.083    0.934
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 7503.3  on 9133  degrees of freedom
## Residual deviance: 6751.8  on 9129  degrees of freedom
## AIC: 6761
##
## Number of Fisher Scoring iterations: 17
```

Interpretation: Combines numeric and categorical data for a holistic model. Interpret continuous variables as direct effects and categorical ones relative to their reference.