Date: 01/07/2022

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Project 4:Insurance Factor Identification

Business Scenario:

The data gives the details of third party motor insurance claims in Sweden for the year 1977. In Sweden, all motor insurance companies apply identical risk arguments to classify customers, and thus their portfolios and their claims statistics can be combined. The data were compiled by a Swedish Committee on the Analysis of Risk Premium in Motor Insurance. The Committee was asked to look into the problem of analyzing the real influence on the claims of the risk arguments and to compare this structure with the actual tariff.

Variables of Dataset and their Descriptions:

|  |  |
| --- | --- |
| **Attribute** | **Description** |
| Kilometers | Kilometers travelled per year  1: < 1000  2: 1000-15000  3: 15000-20000  4: 20000-25000  5: > 25000 |
| Zone | Geographical zone  1: Stockholm, Göteborg, and Malmö with surroundings 2: Other large cities with surroundings  3: Smaller cities with surroundings in southern Sweden  4: Rural areas in southern Sweden  5: Smaller cities with surroundings in northern Sweden  6: Rural areas in northern Sweden 7: Gotland |
| Bonus | No claims bonus; equal to the number of years, plus one, since the last claim. |
| Make | 1-8 represents eight different common car models. All other models are combined in class 9. |
| Insured | The number of insured in policy-years. |
| Claims | Number of claims |
| Payment | The total value of payments in Skr (Swedish Krona) |

**Analysis Tasks:**After understanding the data, you need to help the committee with the following by the use of the R tool:

The committee is interested to know each field of the data collected through descriptive analysis to gain basic insights into the data set and to prepare for further analysis.

The total value of payment by an insurance company is an important factor to be monitored. So the committee has decided to find whether this payment is related to the number of claims and the number of insured policy years. They also want to visualize the results for better understanding.

The committee wants to figure out the reasons for insurance payment increase and decrease. So they have decided to find whether distance, location, bonus, make, and insured amount or claims are affecting the payment or all or some of these are affecting it.

The insurance company is planning to establish a new branch office, so they are interested to find at what location, kilometre, and bonus level their insured amount, claims, and payment gets increased. (Hint: Aggregate Dataset)

The committee wants to understand what affects their claim rates so as to decide the right premiums for a certain set of situations. Hence, they need to find whether the insured amount, zone, kilometre, bonus, or make affects the claim rates and to what extent.

Project Code & Output

Karthik

2022-06-28

library(readxl)  
Insurance\_factor\_identification <- read\_excel("C:/Users/HP/Desktop/Insurance\_factor\_identification.xlsx")  
View(Insurance\_factor\_identification)  
#Loading the required Libraries  
library(dplyr) ## For Data Manipulation

##   
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':  
##   
## filter, lag

## The following objects are masked from 'package:base':  
##   
## intersect, setdiff, setequal, union

library(ggplot2) # For Data visualization  
library(mltools) ## For One encoding (Converting factor variable to a numerical variable)  
library(data.table) ## For Data manipulation

##   
## Attaching package: 'data.table'

## The following objects are masked from 'package:dplyr':  
##   
## between, first, last

library(psych)# For Addtional summary Statistics

##   
## Attaching package: 'psych'

## The following objects are masked from 'package:ggplot2':  
##   
## %+%, alpha

#Descriptive Statistics  
dim(Insurance\_factor\_identification)

## [1] 2182 7

str(Insurance\_factor\_identification)

## tibble [2,182 × 7] (S3: tbl\_df/tbl/data.frame)  
## $ Kilometres: num [1:2182] 1 1 1 1 1 1 1 1 1 1 ...  
## $ Zone : num [1:2182] 1 1 1 1 1 1 1 1 1 1 ...  
## $ Bonus : num [1:2182] 1 1 1 1 1 1 1 1 1 2 ...  
## $ Make : num [1:2182] 1 2 3 4 5 6 7 8 9 1 ...  
## $ Insured : num [1:2182] 455.1 69.2 72.9 1292.4 191 ...  
## $ Claims : num [1:2182] 108 19 13 124 40 ...  
## $ Payment : num [1:2182] 392491 46221 15694 422201 119373 ...

summary(Insurance\_factor\_identification)

## Kilometres Zone Bonus Make   
## Min. :1.000 Min. :1.00 Min. :1.000 Min. :1.000   
## 1st Qu.:2.000 1st Qu.:2.00 1st Qu.:2.000 1st Qu.:3.000   
## Median :3.000 Median :4.00 Median :4.000 Median :5.000   
## Mean :2.986 Mean :3.97 Mean :4.015 Mean :4.992   
## 3rd Qu.:4.000 3rd Qu.:6.00 3rd Qu.:6.000 3rd Qu.:7.000   
## Max. :5.000 Max. :7.00 Max. :7.000 Max. :9.000   
## Insured Claims Payment   
## Min. : 0.01 Min. : 0.00 Min. : 0   
## 1st Qu.: 21.61 1st Qu.: 1.00 1st Qu.: 2989   
## Median : 81.53 Median : 5.00 Median : 27404   
## Mean : 1092.20 Mean : 51.87 Mean : 257008   
## 3rd Qu.: 389.78 3rd Qu.: 21.00 3rd Qu.: 111954   
## Max. :127687.27 Max. :3338.00 Max. :18245026

library(psych)  
describe(Insurance\_factor\_identification)

## vars n mean sd median trimmed mad min  
## Kilometres 1 2182 2.99 1.41 3.00 2.98 1.48 1.00  
## Zone 2 2182 3.97 1.99 4.00 3.96 2.97 1.00  
## Bonus 3 2182 4.02 2.00 4.00 4.02 2.97 1.00  
## Make 4 2182 4.99 2.59 5.00 4.99 2.97 1.00  
## Insured 5 2182 1092.20 5661.16 81.53 226.88 110.62 0.01  
## Claims 6 2182 51.87 201.71 5.00 12.92 7.41 0.00  
## Payment 7 2182 257007.64 1017282.59 27403.50 63667.75 40628.43 0.00  
## max range skew kurtosis se  
## Kilometres 5.0 4.0 0.01 -1.29 0.03  
## Zone 7.0 6.0 0.01 -1.24 0.04  
## Bonus 7.0 6.0 -0.01 -1.25 0.04  
## Make 9.0 8.0 0.00 -1.23 0.06  
## Insured 127687.3 127687.3 13.94 249.69 121.19  
## Claims 3338.0 3338.0 8.56 93.06 4.32  
## Payment 18245026.0 18245026.0 9.10 108.56 21777.81

head(Insurance\_factor\_identification)

## # A tibble: 6 × 7  
## Kilometres Zone Bonus Make Insured Claims Payment  
## <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 1 1 1 1 455. 108 392491  
## 2 1 1 1 2 69.2 19 46221  
## 3 1 1 1 3 72.9 13 15694  
## 4 1 1 1 4 1292. 124 422201  
## 5 1 1 1 5 191. 40 119373  
## 6 1 1 1 6 478. 57 170913

glimpse(Insurance\_factor\_identification)

## Rows: 2,182  
## Columns: 7  
## $ Kilometres <dbl> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Zone <dbl> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Bonus <dbl> 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3,…  
## $ Make <dbl> 1, 2, 3, 4, 5, 6, 7, 8, 9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 1, 2,…  
## $ Insured <dbl> 455.13, 69.17, 72.88, 1292.39, 191.01, 477.66, 105.58, 32.5…  
## $ Claims <dbl> 108, 19, 13, 124, 40, 57, 23, 14, 1704, 45, 10, 5, 48, 11, …  
## $ Payment <dbl> 392491, 46221, 15694, 422201, 119373, 170913, 56940, 77487,…

colnames(Insurance\_factor\_identification)

## [1] "Kilometres" "Zone" "Bonus" "Make" "Insured"   
## [6] "Claims" "Payment"

rownames(Insurance\_factor\_identification)

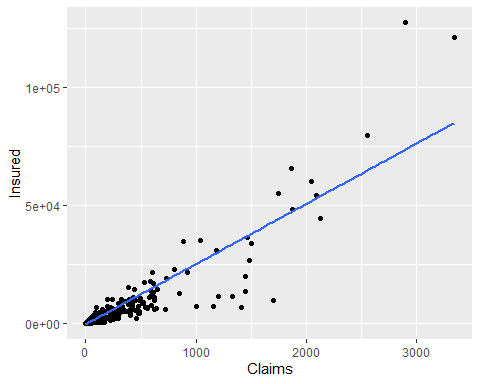
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## [2171] "2171" "2172" "2173" "2174" "2175" "2176" "2177" "2178" "2179" "2180"  
## [2181] "2181" "2182"

#To observe if there is missing observation in DataSet  
sum(is.na(Insurance\_factor\_identification))

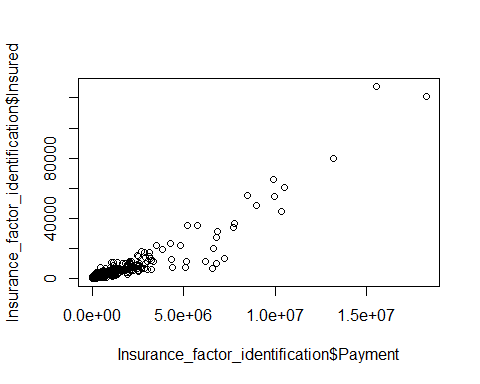
## [1] 0

#as we see we observe that there is no missing values in the dataset  
  
#Visualisation of the DataSet  
## Visualizing the data  
ggplot(data=Insurance\_factor\_identification, aes(x=Claims, y=Insured)) +  
 geom\_point() +  
 geom\_smooth(method=lm, se = FALSE)

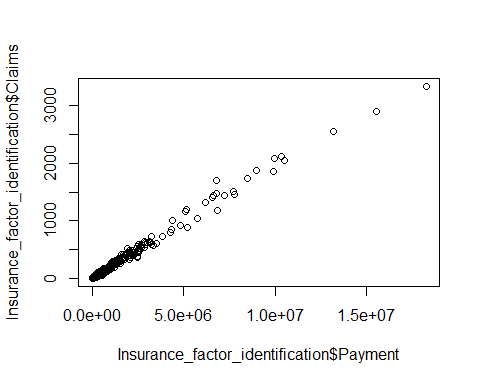
## `geom\_smooth()` using formula 'y ~ x'



## Visualizing the data  
  
plot(Insurance\_factor\_identification$Payment,Insurance\_factor\_identification$Insured)



plot(Insurance\_factor\_identification$Payment,Insurance\_factor\_identification$Claims)



#We found the correlation Coefficient between Insured and Claims and we found out there is high amount of correlation coefficient   
# & there is very strong relationship between Payment v/s Insured,& Payment v/sClaims  
cor(Insurance\_factor\_identification$Insured,Insurance\_factor\_identification$Claims)

## [1] 0.9103478

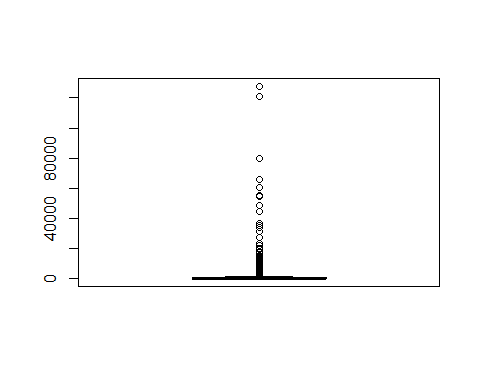
cor(Insurance\_factor\_identification$Payment,Insurance\_factor\_identification$Claims)

## [1] 0.9954003

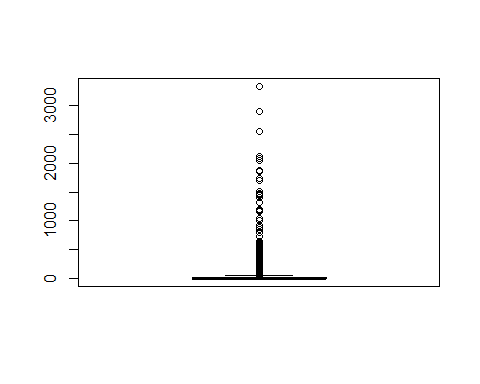
cor(Insurance\_factor\_identification$Payment,Insurance\_factor\_identification$Insured)

## [1] 0.933217

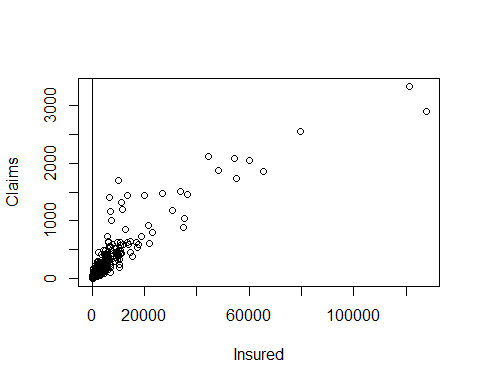
boxplot(Insurance\_factor\_identification$Insured)



boxplot(Insurance\_factor\_identification$Claims)



plot(x=Insurance\_factor\_identification$Insured, y=Insurance\_factor\_identification$Claims, xlab='Insured',ylab='Claims')  
abline(lm(Insurance\_factor\_identification$Insured ~ Insurance\_factor\_identification$Claims))



#Linear Regression <odel  
model=lm(Insurance\_factor\_identification$Payment~Insurance\_factor\_identification$Insured+Insurance\_factor\_identification$Claims)  
summary(model)

##   
## Call:  
## lm(formula = Insurance\_factor\_identification$Payment ~ Insurance\_factor\_identification$Insured +   
## Insurance\_factor\_identification$Claims)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -799392 -12743 -3733 10591 861235   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)  
## (Intercept) 3250.7447 1582.7077 2.054 0.0401  
## Insurance\_factor\_identification$Insured 28.3881 0.6514 43.580 <2e-16  
## Insurance\_factor\_identification$Claims 4294.7750 18.2819 234.920 <2e-16  
##   
## (Intercept) \*   
## Insurance\_factor\_identification$Insured \*\*\*  
## Insurance\_factor\_identification$Claims \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 71270 on 2179 degrees of freedom  
## Multiple R-squared: 0.9951, Adjusted R-squared: 0.9951   
## F-statistic: 2.211e+05 on 2 and 2179 DF, p-value: < 2.2e-16

model$coefficients

## (Intercept) Insurance\_factor\_identification$Insured   
## 3250.74474 28.38806   
## Insurance\_factor\_identification$Claims   
## 4294.77497

model$residuals

## 1 2 3 4 5   
## -87515.69968 -40594.07134 -45457.74124 -150290.28725 -61091.14707   
## 6 7 8 9 10   
## -90699.75927 -48087.78053 13185.37430 -799392.18598 8565.06537   
## 11 12 13 14 15   
## 17349.55563 -5189.56174 11278.12785 -30225.10330 -72029.43698   
## 16 17 18 19 20   
## 13453.17545 -5713.21261 -51973.36908 19805.92481 20492.48060   
## 21 22 23 24 25   
## -12645.05537 -3153.11303 -16317.34929 -1082.88434 8288.44880   
## 26 27 28 29 30   
## -3481.08042 -191571.94392 -32974.24856 42649.74950 -9593.79482   
## 31 32 33 34 35   
## -1631.32765 -7813.26457 64926.73467 15918.81321 -3612.40864   
## 36 37 38 39 40   
## -145026.09506 -54031.92170 -16859.22005 14005.81884 53453.51527   
## 41 42 43 44 45   
## 528.69406 119.08698 -13946.16738 -3767.69133 -314936.07313   
## 46 47 48 49 50   
## -76476.30798 -963.15086 -11758.32808 -27018.57216 18882.11702   
## 51 52 53 54 55   
## 38443.23284 -26800.85362 -10590.75267 -566342.38114 -27795.38641   
## 56 57 58 59 60   
## 18866.59415 37433.59783 -137889.31318 -30761.16546 4996.12741   
## 61 62 63 64 65   
## -40895.55453 -19665.12942 -448566.36320 94926.31091 -17784.70268   
## 66 67 68 69 70   
## 11240.49520 -143389.79646 -1647.22990 -628.22257 -26390.33730   
## 71 72 73 74 75   
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## 76 77 78 79 80   
## -39864.23099 -26031.66978 -81166.98315 10822.73328 -7453.09824   
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## -247222.46873 21766.86720 -5339.72620 -4358.58546 -54756.64168   
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## 91 92 93 94 95   
## 55078.33380 11732.76573 -5790.82931 -34020.64766 -15074.46515   
## 96 97 98 99 100   
## 6525.67889 -9642.42945 -3771.66566 76707.27216 3720.89369   
## 101 102 103 104 105   
## -21071.64880 -9549.81027 -44591.19655 -23367.37163 -6518.15493   
## 106 107 108 109 110   
## -14564.48639 -5528.94870 -290751.04946 -57294.19153 -26134.37946   
## 111 112 113 114 115   
## -5642.23079 -84.68571 -6410.07797 -27523.14932 6408.52507   
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## -20253.75646 -215325.88743 -88336.03555 -3227.65726 -27097.52687   
## 121 122 123 124 125   
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## 246 247 248 249 250   
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## 2137 2138 2139 2140 2141 2142   
## 3271.184 3263.803 3259.261 3288.217 3263.803 8327.327   
## 2143 2144 2145 2146 2147 2148   
## 3384.453 3304.114 3253.016 3251.880 3304.114 3267.210   
## 2149 2150 2151 2152 2153 2154   
## 12511.672 3356.916 3284.810 3270.616 7572.772 3251.596   
## 2155 2156 2157 2158 2159 2160   
## 3949.375 12010.055 3273.455 3281.972 3260.397 3270.616   
## 2161 2162 2163 2164 2165 2166   
## 3321.147 7562.553 3283.107 8646.125 3491.192 3321.431   
## 2167 2168 2169 2170 2171 2172   
## 3332.786 3254.435 3289.353 3368.555 3314.050 3306.385   
## 2173 2174 2175 2176 2177 2178   
## 13818.943 9000.124 12457.451 3532.070 3317.457 3498.856   
## 2179 2180 2181 2182   
## 3722.270 7625.858 3621.493 82892.857

model$df.residual

## [1] 2179

# After Creating the Linear Regression Model we found out that the value of R Squared is 0.9951 which is very high ,  
# And Insured,Claims are having the p value which is less than 5% and shows that there is siginificant among the payment  
  
model1=lm(Insurance\_factor\_identification$Payment~Insurance\_factor\_identification$Insured+Insurance\_factor\_identification$Claims+Insurance\_factor\_identification$Bonus+Insurance\_factor\_identification$Zone+Insurance\_factor\_identification$Make+Insurance\_factor\_identification$Kilometres)  
model1

##   
## Call:  
## lm(formula = Insurance\_factor\_identification$Payment ~ Insurance\_factor\_identification$Insured +   
## Insurance\_factor\_identification$Claims + Insurance\_factor\_identification$Bonus +   
## Insurance\_factor\_identification$Zone + Insurance\_factor\_identification$Make +   
## Insurance\_factor\_identification$Kilometres)  
##   
## Coefficients:  
## (Intercept)   
## -21733.74   
## Insurance\_factor\_identification$Insured   
## 27.88   
## Insurance\_factor\_identification$Claims   
## 4315.88   
## Insurance\_factor\_identification$Bonus   
## 1182.90   
## Insurance\_factor\_identification$Zone   
## 2322.90   
## Insurance\_factor\_identification$Make   
## -754.27   
## Insurance\_factor\_identification$Kilometres   
## 4768.56

summary(model1)

##   
## Call:  
## lm(formula = Insurance\_factor\_identification$Payment ~ Insurance\_factor\_identification$Insured +   
## Insurance\_factor\_identification$Claims + Insurance\_factor\_identification$Bonus +   
## Insurance\_factor\_identification$Zone + Insurance\_factor\_identification$Make +   
## Insurance\_factor\_identification$Kilometres)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -806775 -16943 -6321 11528 847015   
##   
## Coefficients:  
## Estimate Std. Error t value  
## (Intercept) -2.173e+04 6.338e+03 -3.429  
## Insurance\_factor\_identification$Insured 2.788e+01 6.652e-01 41.913  
## Insurance\_factor\_identification$Claims 4.316e+03 1.895e+01 227.793  
## Insurance\_factor\_identification$Bonus 1.183e+03 7.737e+02 1.529  
## Insurance\_factor\_identification$Zone 2.323e+03 7.735e+02 3.003  
## Insurance\_factor\_identification$Make -7.543e+02 6.107e+02 -1.235  
## Insurance\_factor\_identification$Kilometres 4.769e+03 1.086e+03 4.392  
## Pr(>|t|)   
## (Intercept) 0.000617 \*\*\*  
## Insurance\_factor\_identification$Insured < 2e-16 \*\*\*  
## Insurance\_factor\_identification$Claims < 2e-16 \*\*\*  
## Insurance\_factor\_identification$Bonus 0.126462   
## Insurance\_factor\_identification$Zone 0.002703 \*\*   
## Insurance\_factor\_identification$Make 0.216917   
## Insurance\_factor\_identification$Kilometres 1.18e-05 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 70830 on 2175 degrees of freedom  
## Multiple R-squared: 0.9952, Adjusted R-squared: 0.9952   
## F-statistic: 7.462e+04 on 6 and 2175 DF, p-value: < 2.2e-16

# We can observe that except 2 variables bonus and make ,the variables Kilometers,Insured,Claims are strongly affecting the model   
  
#Q4 The insurance company is planning to establish a new branch office, so they are interested to find at what location, kilometre, and bonus level their insured amount, claims, and payment gets increased  
  
grupzone<-apply(Insurance\_factor\_identification[,c(5,6,7)], 2, function(x) tapply(x,Insurance\_factor\_identification$Zone, mean))   
grupzone

## Insured Claims Payment  
## 1 1036.17175 73.568254 338518.95  
## 2 1231.48184 67.625397 319921.52  
## 3 1362.95870 63.295238 307550.85  
## 4 2689.38041 101.311111 537071.76  
## 5 384.80188 19.047923 93001.84  
## 6 802.68457 32.577778 175528.47  
## 7 64.91071 2.108844 9948.19

# We have observed that Zone 4 has the highest number of claims,& the no of payment as well.   
# Top 4 Zones (1-4) have more insured years, claims, and payments as compared to the last third   
grupiycp<-apply(Insurance\_factor\_identification[,c(5,6,7)],2,function(x)tapply(x,Insurance\_factor\_identification$Kilometres,mean))  
grupiycp

## Insured Claims Payment  
## 1 1837.8163 75.59453 361899.35  
## 2 1824.0288 89.27664 442523.78  
## 3 1081.9714 54.16100 272012.58  
## 4 398.9632 20.79493 108213.41  
## 5 284.9475 18.04215 93306.12

# Kilometer group 2 has the maximum payments. Though the insured number of years is lesser than kilometre 1, the claims and payments are higher for group 2  
grupyckp<-apply(Insurance\_factor\_identification[,c(5,6,7)],2,function(x)tapply(x,Insurance\_factor\_identification$Bonus,mean))  
grupyckp

## Insured Claims Payment  
## 1 525.5502 62.50489 282921.99  
## 2 451.0754 34.23397 163316.62  
## 3 397.4737 24.97419 122656.17  
## 4 360.3867 20.35161 98498.12  
## 5 437.3936 22.82109 108790.50  
## 6 805.8167 39.94286 197723.82  
## 7 4620.3728 157.22222 819322.48

# Q5 The committee wants to understand what affects their claim rates so as to decide the right  
#premiums for a certain set of situations. Hence, they need to find whether the insured   
#amount, zone, kilometer, bonus, or make affects the claim rates and to what extent.   
slrn<-lm(Claims~Kilometres+Zone+Bonus+Make+Insured,data=Insurance\_factor\_identification)  
summary(slrn)

##   
## Call:  
## lm(formula = Claims ~ Kilometres + Zone + Bonus + Make + Insured,   
## data = Insurance\_factor\_identification)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1214.57 -25.18 -9.41 10.04 1301.78   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 37.1230027 7.1270679 5.209 2.08e-07 \*\*\*  
## Kilometres -3.9648601 1.2255209 -3.235 0.00123 \*\*   
## Zone -6.2924300 0.8647405 -7.277 4.75e-13 \*\*\*  
## Bonus -4.2468101 0.8707236 -4.877 1.15e-06 \*\*\*  
## Make 6.7725342 0.6755390 10.025 < 2e-16 \*\*\*  
## Insured 0.0318697 0.0003158 100.933 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 80.14 on 2176 degrees of freedom  
## Multiple R-squared: 0.8425, Adjusted R-squared: 0.8421   
## F-statistic: 2328 on 5 and 2176 DF, p-value: < 2.2e-16

slrn

##   
## Call:  
## lm(formula = Claims ~ Kilometres + Zone + Bonus + Make + Insured,   
## data = Insurance\_factor\_identification)  
##   
## Coefficients:  
## (Intercept) Kilometres Zone Bonus Make Insured   
## 37.12300 -3.96486 -6.29243 -4.24681 6.77253 0.03187

#The conclusion of this shows that the p value of Insured,Make,Bonus,Zone,As well as Kilometers

## R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

summary(cars)

## speed dist   
## Min. : 4.0 Min. : 2.00   
## 1st Qu.:12.0 1st Qu.: 26.00   
## Median :15.0 Median : 36.00   
## Mean :15.4 Mean : 42.98   
## 3rd Qu.:19.0 3rd Qu.: 56.00   
## Max. :25.0 Max. :120.00

## Including Plots

You can also embed plots, for example:



Note that the echo = FALSE parameter was added to the code chunk to prevent printing of the R code that generated the plot.