Assignment 02- BA

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library(readxl)  
Online\_Retail <- read\_excel("F:/1st sem/Analytics/Assignment 02/Online\_Retail.xlsx")  
View(Online\_Retail)

install.packages(“lubridate”)

library(dplyr)

##   
## 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(lubridate)

##   
## Attaching package: 'lubridate'

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

library(dplyr)

# 01. Breakdown the number of transactions by countries

#Calculate total number of transactions   
total\_transactions <- nrow(Online\_Retail)  
  
#Group transactions by country and the number of transactions per country   
transaction\_by\_country1<-Online\_Retail %>%  
 group\_by(Country)%>%  
 summarize(num\_transactions = n())  
  
#Calculate the percentage of transactions for each country   
transaction\_by\_country2<-transaction\_by\_country1%>%  
 mutate(percentage=num\_transactions/total\_transactions\*100)  
  
#Filter the countries which accounting for more than 1% of total transactions   
transaction\_by\_country3<-transaction\_by\_country2%>%  
 filter(percentage>1)

# 02. Create new variable “Transaction\_value”

#Create a new variable ‘Transaction Value’   
Online\_Retail2<-Online\_Retail%>%  
 mutate(Transaction\_Value = Quantity\*UnitPrice)  
  
Online\_Retail2

## # A tibble: 541,909 × 9  
## InvoiceNo Stock…¹ Descr…² Quant…³ InvoiceDate UnitP…⁴ Custo…⁵ Country  
## <chr> <chr> <chr> <dbl> <dttm> <dbl> <dbl> <chr>   
## 1 536365 85123A WHITE … 6 2010-12-01 08:26:00 2.55 17850 United…  
## 2 536365 71053 WHITE … 6 2010-12-01 08:26:00 3.39 17850 United…  
## 3 536365 84406B CREAM … 8 2010-12-01 08:26:00 2.75 17850 United…  
## 4 536365 84029G KNITTE… 6 2010-12-01 08:26:00 3.39 17850 United…  
## 5 536365 84029E RED WO… 6 2010-12-01 08:26:00 3.39 17850 United…  
## 6 536365 22752 SET 7 … 2 2010-12-01 08:26:00 7.65 17850 United…  
## 7 536365 21730 GLASS … 6 2010-12-01 08:26:00 4.25 17850 United…  
## 8 536366 22633 HAND W… 6 2010-12-01 08:28:00 1.85 17850 United…  
## 9 536366 22632 HAND W… 6 2010-12-01 08:28:00 1.85 17850 United…  
## 10 536367 84879 ASSORT… 32 2010-12-01 08:34:00 1.69 13047 United…  
## # … with 541,899 more rows, 1 more variable: Transaction\_Value <dbl>, and  
## # abbreviated variable names ¹​StockCode, ²​Description, ³​Quantity, ⁴​UnitPrice,  
## # ⁵​CustomerID

# 03. Breakdown of transaction values by countries

#Group transactions by country and sum the transaction values per country  
transaction\_values\_by\_country <-Online\_Retail2%>%  
 group\_by(Country)%>%  
 summarize(Total\_Transction\_Value=sum(Transaction\_Value))  
  
#Filter the results to only display countries with total transactions exceeding 130,000 British Pound  
transaction\_values\_by\_country2 <-transaction\_values\_by\_country%>%  
 filter(Total\_Transction\_Value > 130000)  
  
#Add a row to the data frame that shows the total sum of all transaction values  
transaction\_values\_by\_country3 <- transaction\_values\_by\_country2%>%  
 bind\_rows(data.frame(Country="Total",Total\_Transction\_Value=sum(transaction\_values\_by\_country2$Total\_Transction\_Value)))

# 04. Dealing with the invoice data variable

Temp <- as.POSIXct(Online\_Retail$InvoiceDate,format="%m%d%Y %H:%M")  
head(Temp)

## [1] "2010-12-01 08:26:00 UTC" "2010-12-01 08:26:00 UTC"  
## [3] "2010-12-01 08:26:00 UTC" "2010-12-01 08:26:00 UTC"  
## [5] "2010-12-01 08:26:00 UTC" "2010-12-01 08:26:00 UTC"

Online\_Retail$New\_Invoice\_Date<-as.Date(Temp)  
Online\_Retail$invoice\_day\_Week<-weekdays(as.Date(Temp))  
Online\_Retail$New\_invoice\_Hour<- hour(Temp)  
  
head(Online\_Retail)

## # A tibble: 6 × 11  
## InvoiceNo StockC…¹ Descr…² Quant…³ InvoiceDate UnitP…⁴ Custo…⁵ Country  
## <chr> <chr> <chr> <dbl> <dttm> <dbl> <dbl> <chr>   
## 1 536365 85123A WHITE … 6 2010-12-01 08:26:00 2.55 17850 United…  
## 2 536365 71053 WHITE … 6 2010-12-01 08:26:00 3.39 17850 United…  
## 3 536365 84406B CREAM … 8 2010-12-01 08:26:00 2.75 17850 United…  
## 4 536365 84029G KNITTE… 6 2010-12-01 08:26:00 3.39 17850 United…  
## 5 536365 84029E RED WO… 6 2010-12-01 08:26:00 3.39 17850 United…  
## 6 536365 22752 SET 7 … 2 2010-12-01 08:26:00 7.65 17850 United…  
## # … with 3 more variables: New\_Invoice\_Date <date>, invoice\_day\_Week <chr>,  
## # New\_invoice\_Hour <int>, and abbreviated variable names ¹​StockCode,  
## # ²​Description, ³​Quantity, ⁴​UnitPrice, ⁵​CustomerID

Online\_Retail$New\_Invoice\_Date[20000]-Online\_Retail$New\_Invoice\_Date[10]

## Time difference of 8 days

Online\_Retail$invoice\_day\_Week= weekdays(Online\_Retail$New\_Invoice\_Date)  
Online\_Retail$New\_invoice\_Hour=as.numeric(format(Temp,"%H"))  
Online\_Retail$New\_Invoice\_Month = as.numeric(format(Temp, "%m"))  
  
# a)Show the percentage of transactions (by numbers) by days of the week   
day\_counts <-table(Online\_Retail$invoice\_day\_Week)  
day\_percent <- prop.table(day\_counts)\*100  
day\_percent

##   
## Friday Monday Sunday Thursday Tuesday Wednesday   
## 15.16731 17.55110 11.87930 19.16503 18.78692 17.45035

# b)Show the percentage of transactions (by transaction volume) by days of the week  
  
day\_totals<-aggregate(Online\_Retail$Quantity,by=list(invoice\_day\_Week=Online\_Retail$invoice\_day\_Week),FUN=sum)  
total\_volume<-sum(day\_totals$x)  
day\_percentages<-data.frame(day=day\_totals$invoice\_day\_Week,percent=(day\_totals$x/total\_volume)\*100)  
print(day\_percentages)

## day percent  
## 1 Friday 15.347197  
## 2 Monday 15.751219  
## 3 Sunday 9.035768  
## 4 Thursday 22.560307  
## 5 Tuesday 18.575336  
## 6 Wednesday 18.730172

# c) Show the percentage of transactions (by transaction volume) by month of the year  
monthly\_counts <- Online\_Retail%>%  
 group\_by(New\_Invoice\_Month)%>%  
 summarise(n=n())  
  
total\_transactions <-sum(monthly\_counts$n)  
  
monthly\_percentages<-monthly\_counts%>%  
 mutate(percentage = (n/total\_transactions)\*100)  
monthly\_percentages

## # A tibble: 12 × 3  
## New\_Invoice\_Month n percentage  
## <dbl> <int> <dbl>  
## 1 1 35147 6.49  
## 2 2 27707 5.11  
## 3 3 36748 6.78  
## 4 4 29916 5.52  
## 5 5 37030 6.83  
## 6 6 36874 6.80  
## 7 7 39518 7.29  
## 8 8 35284 6.51  
## 9 9 50226 9.27  
## 10 10 60742 11.2   
## 11 11 84711 15.6   
## 12 12 68006 12.5

# d)What was the date with the highest number of transactions from Australia?   
Retail\_Aus <- subset(Online\_Retail,Country == "Australia")  
transaction\_by\_date <- aggregate(InvoiceNo~New\_Invoice\_Date,data = Retail\_Aus,FUN = length)  
max\_transactions <- max(transaction\_by\_date$InvoiceNo)  
date\_max\_transactions<-transaction\_by\_date$New\_Invoice\_Date[transaction\_by\_date$InvoiceNo==max\_transactions]  
date\_max\_transactions

## [1] "2011-06-15"

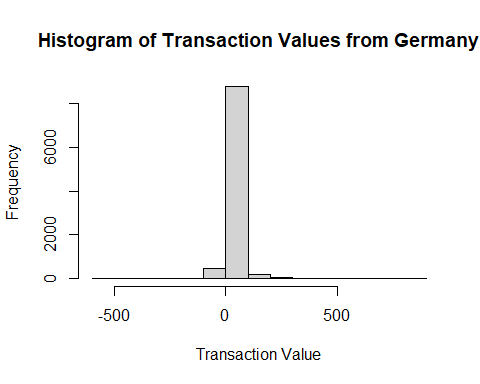
# e)The company needs to shut down the website for two consecutive hours for maintenance. What would be the hour of the day to start this so that the distribution is at minimum for the customers? The responsible IT team is available from 7:00 to 20:00 every day.   
table(Online\_Retail$New\_invoice\_Hour)

##   
## 6 7 8 9 10 11 12 13 14 15 16 17 18   
## 41 383 8909 34332 49037 57674 78709 72259 67471 77519 54516 28509 7974   
## 19 20   
## 3705 871

#Answer: According to the table the fewest number of transactions occurring during the morning hours. Therefore the best two hour for the maintenance is 6.00 to 8.00.

# 05. Plot the histogram of transaction values from Germany.

germany\_data <- Online\_Retail2[Online\_Retail2$Country == "Germany",]  
hist(germany\_data$Transaction\_Value, main = "Histogram of Transaction Values from Germany",  
 xlab = "Transaction Value", ylab = "Frequency")



# 06. Which customer had the highest number of transactions? Which customer is most valuable (i.e. highest total sum of transactions)?

customer\_total <- aggregate(Online\_Retail2$Transaction\_Value, by = list(Online\_Retail2$CustomerID),sum)  
customer\_total <- customer\_total[order(-customer\_total$x),]  
customer\_total

## Group.1 x  
## 1704 14646 279489.020  
## 4234 18102 256438.490  
## 3759 17450 187482.170  
## 1896 14911 132572.620  
## 56 12415 123725.450  
## 1346 14156 113384.140  
## 3802 17511 88125.380  
## 3203 16684 65892.080  
## 1006 13694 62653.100  
## 2193 15311 59419.340  
## 569 13089 57385.880  
## 1301 14096 57120.910  
## 2000 15061 54228.740  
## 4126 17949 52750.840  
## 2538 15769 51823.720  
## 2723 16029 50992.610  
## 1448 14298 50862.440  
## 1296 14088 50415.490  
## 4043 17841 40340.780  
## 1079 13798 36351.420  
## 3015 16422 33805.690  
## 459 12931 33462.810  
## 2709 16013 33366.250  
## 2591 15838 33350.760  
## 3713 17389 31300.080  
## 3723 17404 30300.820  
## 331 12748 29072.100  
## 577 13098 28658.880  
## 565 13081 27964.480  
## 804 13408 27487.410  
## 1729 14680 26932.340  
## 4054 17857 26763.340  
## 2946 16333 26626.800  
## 1068 13777 25748.350  
## 2523 15749 21535.900  
## 2861 16210 21086.300  
## 335 12753 21024.010  
## 3705 17381 20272.430  
## 3926 17675 20098.100  
## 1981 15039 19786.440  
## 319 12731 18793.410  
## 101 12471 18740.920  
## 2080 15159 18573.680  
## 274 12678 17588.260  
## 3742 17428 17078.450  
## 1145 13881 16989.520  
## 1063 13767 16945.710  
## 451 12921 16389.740  
## 437 12901 16293.100  
## 3928 17677 16219.220  
## 2604 15856 16173.670  
## 2100 15189 15802.140  
## 1269 14051 15477.340  
## 3326 16839 15357.780  
## 1252 14031 14634.640  
## 2342 15513 14520.080  
## 2799 16133 14305.660  
## 1862 14866 14197.450  
## 3216 16705 13946.130  
## 277 12681 13677.590  
## 227 12621 13612.070  
## 72 12433 13375.870  
## 158 12540 13309.040  
## 107 12477 13117.010  
## 3974 17735 13110.020  
## 1421 14258 12650.080  
## 2439 15640 12433.340  
## 562 13078 12432.280  
## 2330 15498 12396.460  
## 2699 16000 12393.700  
## 278 12682 12288.220  
## 170 12557 11990.960  
## 3091 16525 11895.570  
## 3672 17340 11891.180  
## 1675 14606 11713.850  
## 465 12939 11581.800  
## 1676 14607 11341.100  
## 1371 14194 11216.750  
## 2053 15125 11117.050  
## 51 12409 11056.930  
## 1884 14895 11020.260  
## 488 12971 10930.260  
## 757 13340 10736.480  
## 3855 17581 10736.110  
## 741 13319 10664.340  
## 1795 14769 10641.600  
## 3538 17139 10585.570  
## 588 13113 10510.000  
## 1278 14062 10464.850  
## 3280 16779 10454.050  
## 3517 17107 10380.430  
## 2421 15615 10360.040  
## 2148 15251 10327.110  
## 2837 16180 10217.480  
## 3329 16843 10183.820  
## 4062 17865 10158.540  
## 3951 17706 10097.370  
## 199 12590 9861.380  
## 653 13199 9803.960  
## 508 13001 9797.920  
## 2014 15078 9623.350  
## 837 13458 9537.920  
## 1769 14733 9451.540  
## 3090 16523 9295.670  
## 299 12709 9294.100  
## 1721 14667 9231.200  
## 1496 14367 9167.820  
## 329 12744 9120.390  
## 179 12567 9114.940  
## 4226 18092 9065.760  
## 1207 13969 8986.690  
## 87 12451 8933.520  
## 860 13488 8910.610  
## 2726 16033 8727.610  
## 570 13090 8689.390  
## 3610 17243 8628.550  
## 3650 17306 8600.730  
## 3450 17017 8574.110  
## 3183 16656 8568.240  
## 4261 18139 8393.220  
## 3114 16558 8257.040  
## 2228 15358 8234.800  
## 279 12683 8221.090  
## 1274 14056 8124.400  
## 1912 14936 8117.420  
## 3195 16672 8093.590  
## 1124 13854 8025.020  
## 4239 18109 7925.320  
## 1920 14952 7912.790  
## 1847 14849 7904.280  
## 67 12428 7877.200  
## 1814 14796 7839.510  
## 74 12435 7829.890  
## 2179 15290 7803.770  
## 960 13629 7792.360  
## 573 13093 7741.470  
## 1616 14527 7711.380  
## 4024 17811 7677.710  
## 1985 15044 7629.380  
## 2103 15194 7521.170  
## 4286 18172 7490.170  
## 699 13263 7454.070  
## 3717 17396 7330.800  
## 4331 18229 7276.900  
## 522 13018 7272.750  
## 192 12583 7187.340  
## 3249 16745 7170.700  
## 104 12474 7116.470  
## 492 12980 7092.060  
## 3238 16729 7076.280  
## 746 13324 7072.800  
## 3347 16873 7066.310  
## 1220 13985 7024.530  
## 1927 14961 7006.580  
## 345 12766 6989.630  
## 366 12798 6977.040  
## 2308 15465 6945.020  
## 526 13027 6912.000  
## 499 12989 6854.510  
## 2844 16187 6841.240  
## 3223 16713 6840.230  
## 3733 17416 6838.340  
## 296 12705 6814.240  
## 1967 15023 6763.160  
## 4198 18055 6752.140  
## 3097 16532 6748.800  
## 386 12830 6748.400  
## 2409 15601 6745.360  
## 927 13576 6703.300  
## 3250 16746 6694.310  
## 2962 16353 6675.710  
## 3384 16923 6666.830  
## 2147 15249 6657.360  
## 3179 16652 6654.260  
## 2839 16182 6617.650  
## 3670 17338 6612.180  
## 2319 15482 6568.720  
## 106 12476 6546.580  
## 2067 15144 6530.040  
## 3307 16814 6500.600  
## 2481 15694 6423.600  
## 70 12431 6416.390  
## 1137 13871 6389.800  
## 232 12626 6388.350  
## 580 13102 6336.290  
## 4325 18223 6315.230  
## 2795 16126 6287.770  
## 1017 13709 6249.110  
## 13 12359 6245.530  
## 102 12472 6229.480  
## 989 13668 6216.070  
## 11 12357 6207.670  
## 3657 17315 6204.460  
## 1954 15005 6180.490  
## 1275 14057 6147.400  
## 1277 14060 6135.380  
## 2658 15939 6102.260  
## 3800 17509 6100.740  
## 670 13225 6083.040  
## 1305 14101 5976.790  
## 239 12637 5953.250  
## 2246 15382 5927.860  
## 576 13097 5893.320  
## 810 13418 5845.440  
## 1914 14944 5842.950  
## 658 13209 5820.160  
## 1600 14505 5818.700  
## 738 13316 5815.490  
## 1529 14415 5811.560  
## 1770 14735 5807.690  
## 2121 15218 5756.890  
## 3935 17686 5739.460  
## 639 13178 5725.470  
## 309 12720 5713.280  
## 544 13050 5684.610  
## 1312 14110 5669.650  
## 3109 16553 5664.570  
## 844 13468 5656.750  
## 1267 14049 5639.150  
## 511 13004 5613.430  
## 900 13534 5613.080  
## 4246 18118 5595.770  
## 3475 17049 5594.780  
## 111 12481 5590.860  
## 3987 17757 5585.490  
## 394 12839 5583.620  
## 3269 16767 5580.600  
## 2332 15502 5541.460  
## 3959 17716 5505.790  
## 3429 16985 5461.620  
## 2564 15805 5452.170  
## 3148 16609 5450.960  
## 2902 16265 5423.150  
## 116 12490 5417.930  
## 3961 17719 5367.800  
## 4327 18225 5361.020  
## 2822 16161 5352.970  
## 704 13269 5315.920  
## 2924 16303 5305.830  
## 2073 15150 5303.970  
## 3969 17730 5288.830  
## 4049 17850 5288.630  
## 2898 16258 5203.510  
## 4328 18226 5192.100  
## 2506 15727 5178.960  
## 4055 17858 5155.660  
## 16 12362 5154.580  
## 3215 16701 5150.270  
## 1055 13756 5145.120  
## 2636 15903 5126.340  
## 3484 17061 5116.130  
## 1734 14688 5107.380  
## 4306 18198 5083.060  
## 1987 15046 5064.010  
## 71 12432 5059.320  
## 608 13139 5055.790  
## 3870 17602 5050.770  
## 2499 15719 5043.960  
## 3214 16700 5040.000  
## 943 13599 5030.600  
## 2187 15301 5028.120  
## 3740 17426 5022.260  
## 80 12444 5005.460  
## 1783 14755 4965.380  
## 2369 15547 4954.840  
## 1467 14329 4928.740  
## 2848 16191 4913.320  
## 1189 13941 4912.410  
## 1751 14709 4911.140  
## 76 12437 4896.660  
## 3534 17133 4892.240  
## 283 12688 4873.810  
## 291 12700 4867.990  
## 263 12664 4863.880  
## 2549 15786 4834.200  
## 1444 14292 4819.330  
## 3693 17365 4801.560  
## 2514 15738 4788.770  
## 517 13013 4786.990  
## 2376 15555 4758.200  
## 3936 17690 4748.450  
## 3907 17652 4737.130  
## 478 12955 4734.260  
## 3232 16722 4711.210  
## 1646 14562 4709.220  
## 303 12714 4708.860  
## 1330 14135 4690.310  
## 2074 15152 4684.240  
## 1349 14159 4678.300  
## 2099 15187 4670.080  
## 1369 14191 4660.010  
## 1364 14180 4640.770  
## 4023 17809 4627.620  
## 1368 14189 4604.310  
## 3391 16931 4604.220  
## 2180 15291 4596.510  
## 1438 14286 4595.810  
## 1511 14390 4592.470  
## 1234 14004 4582.640  
## 3489 17068 4531.340  
## 3877 17613 4509.370  
## 113 12484 4495.270  
## 146 12524 4485.720  
## 233 12627 4478.530  
## 1975 15032 4464.100  
## 3692 17364 4455.730  
## 1294 14085 4435.790  
## 2024 15093 4410.140  
## 702 13267 4404.440  
## 4147 17975 4393.610  
## 3428 16984 4392.420  
## 2670 15955 4389.810  
## 3163 16626 4379.650  
## 334 12752 4366.780  
## 3400 16945 4345.500  
## 2618 15874 4330.670  
## 1242 14016 4328.460  
## 4348 18251 4314.720  
## 2 12347 4310.000  
## 4118 17937 4301.220  
## 875 13505 4282.880  
## 1977 15034 4277.660  
## 1535 14422 4263.640  
## 301 12712 4241.630  
## 1817 14800 4236.340  
## 339 12757 4227.700  
## 1615 14525 4221.370  
## 123 12500 4206.270  
## 4104 17920 4204.100  
## 3735 17419 4200.970  
## 2678 15971 4199.850  
## 330 12747 4196.010  
## 4190 18041 4161.140  
## 3105 16549 4154.640  
## 910 13555 4149.280  
## 473 12949 4143.020  
## 789 13384 4122.280  
## 2386 15570 4109.970  
## 155 12536 4106.820  
## 1222 13988 4098.800  
## 1622 14534 4075.350  
## 3136 16592 4073.280  
## 85 12449 4067.290  
## 180 12569 4064.990  
## 1299 14092 4063.100  
## 2999 16401 4061.240  
## 1517 14401 4039.980  
## 3193 16670 4022.460  
## 1096 13815 4014.910  
## 3845 17567 4012.560  
## 28 12378 4008.620  
## 2843 16186 3991.940  
## 3441 17001 3989.570  
## 1634 14547 3986.740  
## 414 12867 3986.220  
## 257 12656 3982.720  
## 480 12957 3979.040  
## 2271 15416 3974.370  
## 2356 15529 3967.780  
## 3997 17769 3960.630  
## 641 13183 3957.780  
## 1433 14277 3957.000  
## 3875 17611 3947.870  
## 316 12727 3947.700  
## 3703 17377 3925.920  
## 1538 14426 3918.900  
## 3863 17593 3911.560  
## 1083 13802 3906.270  
## 1773 14739 3899.100  
## 3906 17651 3886.670  
## 396 12841 3876.400  
## 1443 14291 3873.300  
## 351 12779 3868.700  
## 332 12749 3868.200  
## 596 13124 3866.330  
## 1230 13999 3865.260  
## 4212 18073 3864.440  
## 2104 15195 3861.000  
## 157 12539 3852.500  
## 2563 15804 3848.550  
## 2943 16327 3844.220  
## 262 12662 3817.080  
## 3507 17091 3802.810  
## 2614 15867 3797.790  
## 3182 16655 3794.520  
## 823 13435 3794.490  
## 2185 15299 3787.090  
## 175 12562 3781.740  
## 2184 15298 3774.100  
## 2826 16168 3770.600  
## 4224 18087 3770.120  
## 3561 17173 3755.650  
## 892 13523 3755.380  
## 3369 16904 3754.270  
## 68 12429 3750.400  
## 3607 17238 3744.650  
## 267 12668 3743.180  
## 2810 16145 3741.980  
## 1435 14282 3729.340  
## 2567 15808 3724.770  
## 125 12502 3723.870  
## 557 13069 3717.820  
## 701 13266 3717.670  
## 1495 14364 3717.350  
## 2883 16240 3693.810  
## 205 12597 3683.130  
## 249 12647 3669.920  
## 2894 16253 3665.620  
## 4029 17819 3661.070  
## 168 12553 3652.250  
## 4217 18079 3651.970  
## 2597 15845 3650.870  
## 3222 16712 3645.430  
## 3029 16440 3640.670  
## 2243 15379 3631.890  
## 787 13381 3626.810  
## 3122 16570 3622.950  
## 748 13327 3617.570  
## 2182 15296 3610.310  
## 606 13137 3605.080  
## 2885 16242 3598.260  
## 566 13082 3595.480  
## 1328 14132 3580.130  
## 57 12417 3578.800  
## 3580 17203 3563.850  
## 2321 15484 3563.110  
## 816 13426 3550.700  
## 21 12370 3545.690  
## 1598 14503 3543.260  
## 2367 15544 3542.510  
## 1260 14040 3542.190  
## 3785 17491 3541.920  
## 3818 17528 3540.100  
## 909 13552 3539.530  
## 753 13334 3536.820  
## 3552 17160 3518.030  
## 1197 13953 3515.680  
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## 3150 16611 120.990  
## 509 13002 120.950  
## 3755 17446 120.900  
## 4174 18015 120.030  
## 1422 14259 120.000  
## 1459 14314 120.000  
## 1559 14453 119.930  
## 3102 16542 119.620  
## 2162 15266 119.300  
## 3189 16666 118.980  
## 2595 15843 118.950  
## 3497 17079 118.800  
## 1345 14155 118.750  
## 930 13581 118.000  
## 649 13193 117.880  
## 3909 17654 117.550  
## 2589 15836 117.470  
## 3412 16959 117.350  
## 1142 13877 117.240  
## 3523 17117 116.200  
## 633 13170 116.010  
## 3869 17601 116.010  
## 1336 14143 115.800  
## 2223 15350 115.650  
## 555 13067 115.460  
## 4181 18027 115.310  
## 1937 14972 114.770  
## 646 13188 114.600  
## 1693 14632 114.560  
## 2889 16247 114.560  
## 1939 14974 114.390  
## 4050 17852 114.340  
## 3590 17219 114.230  
## 1708 14652 114.180  
## 464 12938 114.140  
## 1658 14582 114.110  
## 2124 15221 114.100  
## 127 12504 114.000  
## 253 12651 114.000  
## 1561 14457 113.640  
## 2293 15445 113.500  
## 3588 17217 113.500  
## 4236 18105 113.480  
## 3376 16913 113.440  
## 2173 15280 113.120  
## 1735 14689 112.800  
## 626 13161 112.750  
## 3212 16697 112.750  
## 1088 13807 112.600  
## 4255 18129 112.550  
## 2418 15610 112.460  
## 3465 17038 112.400  
## 1429 14271 112.320  
## 4085 17893 112.250  
## 338 12756 112.080  
## 3630 17274 111.980  
## 4132 17957 111.680  
## 4079 17887 111.350  
## 4248 18120 111.150  
## 878 13508 110.970  
## 612 13144 110.950  
## 2362 15537 110.920  
## 888 13519 110.800  
## 2601 15853 110.800  
## 3680 17349 110.750  
## 3415 16963 110.550  
## 1699 14641 110.460  
## 322 12734 110.400  
## 3289 16792 110.380  
## 4093 17901 110.380  
## 4039 17836 110.210  
## 2949 16339 109.950  
## 602 13133 109.800  
## 2971 16363 109.360  
## 1743 14699 109.130  
## 1480 14345 108.980  
## 3896 17639 108.500  
## 2777 16106 108.380  
## 671 13226 108.210  
## 479 12956 108.070  
## 1716 14661 107.950  
## 3284 16784 107.600  
## 2255 15395 107.450  
## 3260 16757 106.830  
## 2086 15168 106.560  
## 2008 15070 106.200  
## 4013 17791 106.100  
## 457 12929 105.100  
## 2541 15775 104.900  
## 1249 14027 104.820  
## 2415 15607 104.760  
## 2672 15958 104.350  
## 4288 18174 104.000  
## 4350 18255 103.300  
## 1630 14542 103.250  
## 4136 17962 102.830  
## 4171 18011 102.790  
## 1840 14836 102.450  
## 1943 14981 102.120  
## 1192 13948 102.000  
## 3047 16462 102.000  
## 3085 16516 101.700  
## 4208 18068 101.700  
## 3899 17643 101.550  
## 2702 16006 101.400  
## 4223 18086 101.340  
## 579 13101 101.190  
## 678 13235 101.170  
## 2954 16344 101.100  
## 1915 14946 100.900  
## 3741 17427 100.800  
## 1498 14371 100.500  
## 2679 15973 99.770  
## 1011 13703 99.500  
## 4119 17939 99.140  
## 3981 17746 98.800  
## 2153 15256 98.450  
## 3825 17538 98.420  
## 4087 17895 98.000  
## 4184 18033 97.970  
## 2275 15422 97.700  
## 4366 18277 97.630  
## 495 12984 97.500  
## 3663 17325 96.800  
## 2120 15216 96.600  
## 1700 14642 96.120  
## 3454 17024 95.850  
## 4346 18249 95.340  
## 164 12548 95.200  
## 2990 16387 94.360  
## 2754 16073 94.350  
## 977 13651 94.200  
## 2257 15397 94.000  
## 2280 15428 93.780  
## 4329 18227 93.750  
## 715 13283 93.660  
## 4159 17991 93.350  
## 378 12821 92.720  
## 1272 14054 92.460  
## 358 12789 91.850  
## 908 13551 91.800  
## 625 13160 91.800  
## 260 12659 91.680  
## 2323 15488 91.320  
## 1191 13947 90.600  
## 1487 14353 90.600  
## 3079 16506 90.300  
## 2373 15552 90.120  
## 3141 16597 90.040  
## 1318 14117 90.000  
## 1391 14219 89.940  
## 282 12686 89.140  
## 1544 14436 89.060  
## 7 12353 89.000  
## 2116 15212 88.950  
## 2017 15083 88.200  
## 4221 18084 87.530  
## 2093 15180 87.500  
## 722 13296 87.400  
## 3073 16498 86.120  
## 2365 15541 85.130  
## 1114 13841 85.000  
## 987 13666 84.650  
## 44 12401 84.300  
## 3652 17309 82.750  
## 3017 16424 82.560  
## 513 13006 81.570  
## 3883 17620 81.440  
## 4369 18281 80.820  
## 3286 16789 80.800  
## 1206 13967 80.700  
## 3985 17752 80.640  
## 1311 14109 80.200  
## 1047 13747 79.600  
## 2526 15753 79.200  
## 2756 16078 79.200  
## 4122 17942 77.500  
## 1806 14785 77.400  
## 601 13132 77.300  
## 1226 13992 76.800  
## 1499 14373 76.550  
## 3823 17536 76.500  
## 1298 14090 76.320  
## 2462 15668 76.320  
## 2813 16148 76.320  
## 4242 18113 76.320  
## 4161 17995 76.100  
## 3888 17628 75.750  
## 3149 16610 75.660  
## 801 13403 75.000  
## 3051 16468 74.900  
## 4196 18050 74.400  
## 575 13095 74.400  
## 4134 17960 73.780  
## 129 12506 73.500  
## 4183 18032 73.500  
## 2829 16171 73.200  
## 4096 17906 72.900  
## 1001 13686 72.000  
## 1186 13938 71.660  
## 643 13185 71.400  
## 3453 17022 71.000  
## 3128 16581 70.440  
## 4188 18037 70.020  
## 2610 15863 68.840  
## 1512 14393 67.950  
## 3706 17382 65.400  
## 3982 17747 64.650  
## 999 13684 64.230  
## 599 13130 64.000  
## 728 13302 63.750  
## 3624 17263 63.440  
## 1842 14840 62.850  
## 665 13218 62.640  
## 2344 15516 62.430  
## 2508 15729 62.000  
## 264 12665 61.750  
## 650 13194 60.700  
## 3562 17174 59.900  
## 794 13391 59.800  
## 583 13106 59.500  
## 998 13682 59.500  
## 1923 14957 58.490  
## 564 13080 58.080  
## 4002 17775 56.400  
## 2633 15899 56.250  
## 778 13366 56.160  
## 1788 14760 53.800  
## 2958 16349 53.500  
## 2334 15504 52.830  
## 1861 14865 52.200  
## 1731 14682 52.000  
## 2195 15313 52.000  
## 4045 17844 51.560  
## 1485 14351 51.000  
## 515 13011 50.550  
## 4296 18184 49.800  
## 1832 14821 48.800  
## 2411 15603 48.480  
## 2897 16257 46.950  
## 1290 14080 45.600  
## 2276 15423 43.500  
## 1450 14300 43.200  
## 2694 15992 41.990  
## 1109 13832 40.950  
## 2091 15178 40.500  
## 1664 14589 39.750  
## 491 12977 39.240  
## 3186 16659 39.120  
## 4178 18019 38.450  
## 407 12855 38.100  
## 2823 16162 37.400  
## 4027 17816 36.560  
## 1654 14576 35.400  
## 3338 16856 35.400  
## 4036 17831 35.400  
## 2518 15744 34.800  
## 3267 16765 34.000  
## 3726 17408 32.650  
## 2659 15940 31.800  
## 593 13120 30.600  
## 2453 15657 30.000  
## 3515 17102 25.500  
## 3407 16953 20.800  
## 4155 17986 20.800  
## 2766 16093 17.000  
## 731 13307 15.000  
## 3992 17763 15.000  
## 4092 17900 15.000  
## 4131 17956 12.750  
## 3244 16738 3.750  
## 3034 16446 2.900  
## 1 12346 0.000  
## 90 12454 0.000  
## 171 12558 0.000  
## 214 12607 0.000  
## 693 13256 0.000  
## 776 13364 0.000  
## 1060 13762 0.000  
## 1643 14557 0.000  
## 1810 14792 0.000  
## 3246 16742 0.000  
## 3350 16878 0.000  
## 4211 18072 0.000  
## 4359 18268 0.000  
## 4364 18274 0.000  
## 3436 16995 -1.250  
## 1728 14679 -2.550  
## 3021 16428 -2.950  
## 468 12943 -3.750  
## 128 12505 -4.500  
## 213 12605 -7.500  
## 2803 16138 -7.950  
## 3040 16454 -8.150  
## 3829 17547 -11.800  
## 416 12870 -14.900  
## 1800 14777 -17.450  
## 1319 14119 -19.900  
## 1689 14627 -21.850  
## 4030 17820 -24.050  
## 2746 16061 -29.950  
## 2401 15590 -30.190  
## 3127 16579 -30.600  
## 2901 16262 -31.650  
## 1005 13693 -32.000  
## 4262 18141 -35.400  
## 1545 14437 -43.400  
## 4351 18256 -50.100  
## 992 13672 -71.460  
## 2437 15638 -94.000  
## 3104 16546 -95.930  
## 1107 13829 -102.000  
## 1201 13958 -102.450  
## 3488 17065 -112.350  
## 2507 15728 -134.800  
## 3830 17548 -141.480  
## 3651 17307 -152.640  
## 265 12666 -227.440  
## 2893 16252 -295.090  
## 2561 15802 -451.420  
## 620 13154 -611.860  
## 2579 15823 -840.760  
## 126 12503 -1126.000  
## 3871 17603 -1165.300  
## 1385 14213 -1192.200  
## 2237 15369 -1592.490  
## 3757 17448 -4287.630

#Answer: According to the table, the customer ID 14646 is the most valuable customer. The total transaction value of the customer is 279489.020

# 07.Calculate the percentage of missing values for each variable in the dataset

missing\_percent <- colSums(is.na(Online\_Retail2))/nrow(Online\_Retail2)\*100  
print(missing\_percent)

## InvoiceNo StockCode Description Quantity   
## 0.0000000 0.0000000 0.2683107 0.0000000   
## InvoiceDate UnitPrice CustomerID Country   
## 0.0000000 0.0000000 24.9266943 0.0000000   
## Transaction\_Value   
## 0.0000000

# 08. What are the number of transactions with missing CustomerID records by countries?

missing\_cust <- subset(Online\_Retail2,is.na(CustomerID))  
missing\_by\_country <- aggregate(Transaction\_Value~Country,data = missing\_cust,FUN = length)  
print(missing\_by\_country)

## Country Transaction\_Value  
## 1 Bahrain 2  
## 2 EIRE 711  
## 3 France 66  
## 4 Hong Kong 288  
## 5 Israel 47  
## 6 Portugal 39  
## 7 Switzerland 125  
## 8 United Kingdom 133600  
## 9 Unspecified 202

# 09. On average, how often the costumers comeback to the website for their next shopping?

customer\_transactions <- Online\_Retail%>%  
 group\_by(CustomerID)%>%  
 arrange(New\_Invoice\_Date)  
  
time\_diff <- customer\_transactions%>%  
 mutate(last\_purchase= c(NA,diff(New\_Invoice\_Date)))%>%  
 ungroup()  
  
mean\_time\_diff <- mean(time\_diff$last\_purchase,na.rm = TRUE)  
mean\_time\_diff

## [1] 1.088318

#Answer: According to the calculation customers comeback to the website after one day for their next shopping.

# 10 what is the return rate for the French customers?

French\_Retail<-Online\_Retail2[Online\_Retail2$Country=="France",]  
Cancelled\_trans <-French\_Retail[French\_Retail$Quantity <0,]  
total\_transactions<-nrow(French\_Retail)  
Return\_Rate<-nrow(Cancelled\_trans)/total\_transactions  
Return\_Rate

## [1] 0.01741264

#Answer:According to the above calculation the return rate for the french customers is 0.017.

# 11 What is the product that has generated the highest revenue for the retailer?

Prod\_rev <- aggregate(Transaction\_Value~Description,data = Online\_Retail2,sum)  
Prod\_max\_rev<- Prod\_rev[which.max(Prod\_rev$Transaction\_Value),"Description"]  
Prod\_max\_rev

## [1] "DOTCOM POSTAGE"

#Answer: According to the calculation "DOTCOM POSTAGE" is the highest revenue generating product.

# 12. How many unique customers are represented in the data set?

unique\_customers<-unique(Online\_Retail2$CustomerID)  
num\_customers <-length(unique\_customers)  
print(num\_customers)

## [1] 4373

#Answer: according to the calculation, there are 4373 unique customers in the dataset.