

Untitled

Define the question

Formulating the most relevant marketing strategies that will result in the highest no. of sales (total price including tax)

The metric for success

The project will be considered successful when we are able to draw meaningful insights that would be benefit to the marketing department

The context

You are a Data analyst at Carrefour Kenya and are currently undertaking a project that will inform the marketing department on the most relevant marketing strategies that will result in the highest no. of sales (total price including tax). Your project has been divided into four parts where you'll explore a recent marketing dataset by performing various unsupervised learning techniques and later providing recommendations based on your insights.

Experimental design taken

1. Define the question, the metric for success, the context, experimental design taken.
2. Read and explore the given dataset.
3. Define the appropriateness of the available data to answer the given question.
4. Find and deal with outliers, anomalies, and missing data within the dataset.
5. Perform univariate and bivariate analysis recording your observations.
6. From your insights provide a conclusion and recommendation.

The appropriateness of the available data

The data provided is sufficient to carry out our analysis.

Loading the dataset.

```
# Importing the necessary libraries
```

```
install.packages('data.table')
```

```
## Installing package into '/home/jasmine/R/x86_64-pc-linux-gnu-library/4.1'  
## (as 'lib' is unspecified)
```

```
library("data.table")  
install.packages('tidyr')
```

```
## Installing package into '/home/jasmine/R/x86_64-pc-linux-gnu-library/4.1'  
## (as 'lib' is unspecified)
```

```
library("tidyr")
install.packages('devtools')
```

```
## Installing package into '/home/jasmine/R/x86_64-pc-linux-gnu-library/4.1'
## (as 'lib' is unspecified)
```

```
devtools::install_github("moodymudskipper/cutr")
```

```
## Skipping install of 'cutr' from a github remote, the SHA1 (7b8e9cdc) has not changed since last install
## Use `force = TRUE` to force installation
```

```
library(cutr)
devtools::install_github("paulponcet/modeest")
```

```
## Skipping install of 'modeest' from a github remote, the SHA1 (a168f944) has not changed since last install
## Use `force = TRUE` to force installation
```

```
library(modeest)
install.packages('moments')
```

```
## Installing package into '/home/jasmine/R/x86_64-pc-linux-gnu-library/4.1'
## (as 'lib' is unspecified)
```

```
library(moments)
```

```
##
## Attaching package: 'moments'
## The following object is masked from 'package:modeest':
##
##      skewness
```

```
install.packages('janitor')
```

```
## Installing package into '/home/jasmine/R/x86_64-pc-linux-gnu-library/4.1'
## (as 'lib' is unspecified)
```

```
library(janitor)
```

```
##
## Attaching package: 'janitor'
## The following objects are masked from 'package:stats':
##
##      chisq.test, fisher.test
```

```
install.packages('ggcorrplot')
```

```
## Installing package into '/home/jasmine/R/x86_64-pc-linux-gnu-library/4.1'
## (as 'lib' is unspecified)
```

```
library('ggcorrplot')
```

```
## Loading required package: ggplot2
```

```
install.packages('caret')
```

```
## Installing package into '/home/jasmine/R/x86_64-pc-linux-gnu-library/4.1'
## (as 'lib' is unspecified)
```

```
library('caret')
```

```
## Loading required package: lattice
mydata = read.csv("http://bit.ly/CarreFourDataset")
View(mydata)
```

Checking the data

```
# Checking for the first 6 rows
head(mydata)
```

```
##      Invoice.ID Branch Customer.type Gender      Product.line Unit.price
## 1 750-67-8428      A      Member Female      Health and beauty      74.69
## 2 226-31-3081      C      Normal Female Electronic accessories      15.28
## 3 631-41-3108      A      Normal  Male      Home and lifestyle      46.33
## 4 123-19-1176      A      Member  Male      Health and beauty      58.22
## 5 373-73-7910      A      Normal  Male      Sports and travel      86.31
## 6 699-14-3026      C      Normal  Male Electronic accessories      85.39
##      Quantity      Tax      Date Time      Payment      cogs gross.margin.percentage
## 1          7 26.1415 1/5/2019 13:08      Ewallet 522.83          4.761905
## 2          5  3.8200 3/8/2019 10:29      Cash 76.40          4.761905
## 3          7 16.2155 3/3/2019 13:23 Credit card 324.31          4.761905
## 4          8 23.2880 1/27/2019 20:33      Ewallet 465.76          4.761905
## 5          7 30.2085 2/8/2019 10:37      Ewallet 604.17          4.761905
## 6          7 29.8865 3/25/2019 18:30      Ewallet 597.73          4.761905
##      gross.income Rating      Total
## 1          26.1415      9.1 548.9715
## 2           3.8200      9.6  80.2200
## 3          16.2155      7.4 340.5255
## 4          23.2880      8.4 489.0480
## 5          30.2085      5.3 634.3785
## 6          29.8865      4.1 627.6165
```

```
# Checking for the first 6 rows
tail(mydata)
```

```
##      Invoice.ID Branch Customer.type Gender      Product.line Unit.price
## 995 652-49-6720      C      Member Female Electronic accessories      60.95
## 996 233-67-5758      C      Normal  Male      Health and beauty      40.35
## 997 303-96-2227      B      Normal Female      Home and lifestyle      97.38
## 998 727-02-1313      A      Member  Male      Food and beverages      31.84
## 999 347-56-2442      A      Normal  Male      Home and lifestyle      65.82
## 1000 849-09-3807      A      Member Female      Fashion accessories      88.34
##      Quantity      Tax      Date Time      Payment      cogs gross.margin.percentage
## 995          1  3.0475 2/18/2019 11:40      Ewallet 60.95          4.761905
## 996          1  2.0175 1/29/2019 13:46      Ewallet 40.35          4.761905
## 997         10 48.6900 3/2/2019 17:16      Ewallet 973.80          4.761905
## 998          1  1.5920 2/9/2019 13:22      Cash 31.84          4.761905
## 999          1  3.2910 2/22/2019 15:33      Cash 65.82          4.761905
## 1000         7 30.9190 2/18/2019 13:28      Cash 618.38          4.761905
##      gross.income Rating      Total
## 995          3.0475      5.9  63.9975
## 996          2.0175      6.2  42.3675
## 997         48.6900      4.4 1022.4900
## 998          1.5920      7.7  33.4320
## 999          3.2910      4.1  69.1110
```

```
## 1000      30.9190      6.6  649.2990
```

```
# Viewing the structure of the dataset
```

```
# ---
```

```
#
```

```
str(mydata)
```

```
## 'data.frame':  1000 obs. of  16 variables:
```

```
## $ Invoice.ID      : chr  "750-67-8428" "226-31-3081" "631-41-3108" "123-19-1176" ...
```

```
## $ Branch          : chr  "A" "C" "A" "A" ...
```

```
## $ Customer.type   : chr  "Member" "Normal" "Normal" "Member" ...
```

```
## $ Gender          : chr  "Female" "Female" "Male" "Male" ...
```

```
## $ Product.line    : chr  "Health and beauty" "Electronic accessories" "Home and lifestyle" ...
```

```
## $ Unit.price      : num  74.7 15.3 46.3 58.2 86.3 ...
```

```
## $ Quantity        : int   7 5 7 8 7 7 6 10 2 3 ...
```

```
## $ Tax             : num   26.14 3.82 16.22 23.29 30.21 ...
```

```
## $ Date            : chr   "1/5/2019" "3/8/2019" "3/3/2019" "1/27/2019" ...
```

```
## $ Time            : chr   "13:08" "10:29" "13:23" "20:33" ...
```

```
## $ Payment         : chr   "Ewallet" "Cash" "Credit card" "Ewallet" ...
```

```
## $ cogs            : num   522.8 76.4 324.3 465.8 604.2 ...
```

```
## $ gross.margin.percentage: num   4.76 4.76 4.76 4.76 4.76 ...
```

```
## $ gross.income     : num   26.14 3.82 16.22 23.29 30.21 ...
```

```
## $ Rating          : num   9.1 9.6 7.4 8.4 5.3 4.1 5.8 8 7.2 5.9 ...
```

```
## $ Total           : num   549 80.2 340.5 489 634.4 ...
```

We have 1000 rows and 16 columns

```
# Checking whether each column has an appropriate datatype
```

```
sapply(mydata, class)
```

```
##           Invoice.ID           Branch           Customer.type
##           "character"         "character"         "character"
##           Gender             Product.line         Unit.price
##           "character"         "character"         "numeric"
##           Quantity           Tax                 Date
##           "integer"           "numeric"         "character"
##           Time               Payment              cogs
##           "character"         "character"         "numeric"
## gross.margin.percentage     gross.income     Rating
##           "numeric"         "numeric"         "numeric"
##           Total
##           "numeric"
```

Every column has the correct data type.

```
# Checking the unique values in the each of the columns
```

```
sapply(mydata, unique)
```

```
## $Invoice.ID
```

```
## [1] "750-67-8428" "226-31-3081" "631-41-3108" "123-19-1176" "373-73-7910"
```

```
## [6] "699-14-3026" "355-53-5943" "315-22-5665" "665-32-9167" "692-92-5582"
```

```
## [11] "351-62-0822" "529-56-3974" "365-64-0515" "252-56-2699" "829-34-3910"
```

```
## [16] "299-46-1805" "656-95-9349" "765-26-6951" "329-62-1586" "319-50-3348"
```

```
## [21] "300-71-4605" "371-85-5789" "273-16-6619" "636-48-8204" "549-59-1358"
```

```
## [26] "227-03-5010" "649-29-6775" "189-17-4241" "145-94-9061" "848-62-7243"
```

##	[31]	"871-79-8483"	"149-71-6266"	"640-49-2076"	"595-11-5460"	"183-56-6882"
##	[36]	"232-16-2483"	"129-29-8530"	"272-65-1806"	"333-73-7901"	"777-82-7220"
##	[41]	"280-35-5823"	"554-53-8700"	"354-25-5821"	"228-96-1411"	"617-15-4209"
##	[46]	"132-32-9879"	"370-41-7321"	"727-46-3608"	"669-54-1719"	"574-22-5561"
##	[51]	"326-78-5178"	"162-48-8011"	"616-24-2851"	"778-71-5554"	"242-55-6721"
##	[56]	"399-46-5918"	"106-35-6779"	"635-40-6220"	"817-48-8732"	"120-06-4233"
##	[61]	"285-68-5083"	"803-83-5989"	"347-34-2234"	"199-75-8169"	"853-23-2453"
##	[66]	"877-22-3308"	"838-78-4295"	"109-28-2512"	"232-11-3025"	"382-03-4532"
##	[71]	"393-65-2792"	"796-12-2025"	"510-95-6347"	"841-35-6630"	"287-21-9091"
##	[76]	"732-94-0499"	"263-10-3913"	"381-20-0914"	"829-49-1914"	"756-01-7507"
##	[81]	"870-72-4431"	"847-38-7188"	"480-63-2856"	"787-56-0757"	"360-39-5055"
##	[86]	"730-50-9884"	"362-58-8315"	"633-44-8566"	"504-35-8843"	"318-68-5053"
##	[91]	"565-80-5980"	"225-32-0908"	"873-51-0671"	"152-08-9985"	"512-91-0811"
##	[96]	"594-34-4444"	"766-85-7061"	"871-39-9221"	"865-92-6136"	"733-01-9107"
##	[101]	"163-56-7055"	"189-98-2939"	"551-21-3069"	"212-62-1842"	"716-39-1409"
##	[106]	"704-48-3927"	"628-34-3388"	"630-74-5166"	"588-01-7461"	"861-77-0145"
##	[111]	"479-26-8945"	"210-67-5886"	"227-78-1148"	"645-44-1170"	"237-01-6122"
##	[116]	"225-98-1496"	"291-32-1427"	"659-65-8956"	"642-32-2990"	"378-24-2715"
##	[121]	"638-60-7125"	"659-36-1684"	"219-22-9386"	"336-78-2147"	"268-27-6179"
##	[126]	"668-90-8900"	"870-54-3162"	"189-08-9157"	"663-86-9076"	"549-84-7482"
##	[131]	"191-10-6171"	"802-70-5316"	"695-51-0018"	"590-83-4591"	"483-71-1164"
##	[136]	"597-78-7908"	"700-81-1757"	"354-39-5160"	"241-72-9525"	"575-30-8091"
##	[141]	"731-81-9469"	"280-17-4359"	"338-65-2210"	"488-25-4221"	"239-10-7476"
##	[146]	"458-41-1477"	"685-64-1609"	"568-90-5112"	"262-47-2794"	"238-49-0436"
##	[151]	"608-96-3517"	"584-86-7256"	"746-94-0204"	"214-17-6927"	"400-89-4171"
##	[156]	"782-95-9291"	"279-74-2924"	"307-85-2293"	"743-04-1105"	"423-57-2993"
##	[161]	"894-41-5205"	"275-28-0149"	"101-17-6199"	"423-80-0988"	"548-46-9322"
##	[166]	"505-02-0892"	"234-65-2137"	"687-47-8271"	"796-32-9050"	"105-31-1824"
##	[171]	"249-42-3782"	"316-55-4634"	"733-33-4967"	"608-27-6295"	"414-12-7047"
##	[176]	"827-26-2100"	"175-54-2529"	"139-52-2867"	"407-63-8975"	"342-65-4817"
##	[181]	"130-98-8941"	"434-83-9547"	"851-28-6367"	"824-88-3614"	"586-25-0848"
##	[186]	"895-66-0685"	"305-14-0245"	"732-04-5373"	"400-60-7251"	"593-65-1552"
##	[191]	"284-34-9626"	"437-58-8131"	"286-43-6208"	"641-43-2399"	"831-07-6050"
##	[196]	"556-86-3144"	"848-24-9445"	"856-22-8149"	"699-01-4164"	"420-11-4919"
##	[201]	"606-80-4905"	"542-41-0513"	"426-39-2418"	"875-46-5808"	"394-43-4238"
##	[206]	"749-24-1565"	"672-51-8681"	"263-87-5680"	"573-58-9734"	"817-69-8206"
##	[211]	"888-02-0338"	"677-11-0152"	"142-63-6033"	"656-16-1063"	"891-58-8335"
##	[216]	"802-43-8934"	"560-30-5617"	"319-74-2561"	"549-03-9315"	"790-29-1172"
##	[221]	"239-36-3640"	"468-01-2051"	"389-25-3394"	"279-62-1445"	"213-72-6612"
##	[226]	"746-68-6593"	"836-82-5858"	"583-72-1480"	"466-61-5506"	"721-86-6247"
##	[231]	"289-65-5721"	"545-46-3100"	"418-02-5978"	"269-04-5750"	"157-13-5295"
##	[236]	"645-78-8093"	"211-30-9270"	"755-12-3214"	"346-84-3103"	"478-06-7835"
##	[241]	"540-11-4336"	"448-81-5016"	"142-72-4741"	"217-58-1179"	"376-02-8238"
##	[246]	"530-90-9855"	"866-05-7563"	"604-70-6476"	"799-71-1548"	"785-13-7708"
##	[251]	"845-51-0542"	"662-47-5456"	"883-17-4236"	"290-68-2984"	"704-11-6354"
##	[256]	"110-48-7033"	"366-93-0948"	"729-09-9681"	"151-16-1484"	"380-94-4661"
##	[261]	"850-41-9669"	"821-07-3596"	"655-85-5130"	"447-15-7839"	"154-74-7179"
##	[266]	"253-12-6086"	"808-65-0703"	"571-94-0759"	"144-51-6085"	"731-14-2199"
##	[271]	"783-09-1637"	"687-15-1097"	"126-54-1082"	"633-91-1052"	"477-24-6490"
##	[276]	"566-19-5475"	"526-86-8552"	"376-56-3573"	"537-72-0426"	"828-61-5674"
##	[281]	"136-08-6195"	"523-38-0215"	"490-29-1201"	"667-92-0055"	"565-17-3836"
##	[286]	"498-41-1961"	"593-95-4461"	"226-71-3580"	"283-79-9594"	"430-60-3493"
##	[291]	"139-20-0155"	"558-80-4082"	"278-97-7759"	"316-68-6352"	"585-03-5943"
##	[296]	"211-05-0490"	"727-75-6477"	"744-02-5987"	"307-83-9164"	"779-06-0012"

##	[301]	"446-47-6729"	"573-10-3877"	"735-06-4124"	"439-54-7422"	"396-90-2219"
##	[306]	"411-77-0180"	"286-01-5402"	"803-17-8013"	"512-98-1403"	"848-42-2560"
##	[311]	"532-59-7201"	"181-94-6432"	"870-76-1733"	"423-64-4619"	"227-07-4446"
##	[316]	"174-36-3675"	"428-83-5800"	"603-07-0961"	"704-20-4138"	"787-15-1757"
##	[321]	"649-11-3678"	"622-20-1945"	"372-94-8041"	"563-91-7120"	"746-54-5508"
##	[326]	"276-54-0879"	"815-11-1168"	"719-76-3868"	"730-61-8757"	"340-66-0321"
##	[331]	"868-81-1752"	"634-97-8956"	"566-71-1091"	"442-48-3607"	"835-16-0096"
##	[336]	"527-09-6272"	"898-04-2717"	"692-27-8933"	"633-09-3463"	"374-17-3652"
##	[341]	"378-07-7001"	"433-75-6987"	"873-95-4984"	"416-13-5917"	"150-89-8043"
##	[346]	"135-84-8019"	"441-94-7118"	"725-96-3778"	"531-80-1784"	"400-45-1220"
##	[351]	"860-79-0874"	"834-61-8124"	"115-99-4379"	"565-67-6697"	"320-49-6392"
##	[356]	"889-04-9723"	"632-90-0281"	"554-42-2417"	"453-63-6187"	"578-80-7669"
##	[361]	"612-36-5536"	"605-72-4132"	"471-41-2823"	"462-67-9126"	"272-27-9238"
##	[366]	"834-25-9262"	"122-61-9553"	"468-88-0009"	"613-59-9758"	"254-31-0042"
##	[371]	"201-86-2184"	"261-12-8671"	"730-70-9830"	"382-25-8917"	"422-29-8786"
##	[376]	"667-23-5919"	"843-01-4703"	"743-88-1662"	"595-86-2894"	"182-69-8360"
##	[381]	"289-15-7034"	"462-78-5240"	"868-52-7573"	"153-58-4872"	"662-72-2873"
##	[386]	"525-88-7307"	"689-16-9784"	"725-56-0833"	"394-41-0748"	"596-42-3999"
##	[391]	"541-89-9860"	"173-82-9529"	"563-36-9814"	"308-47-4913"	"885-17-6250"
##	[396]	"726-27-2396"	"316-01-3952"	"760-54-1821"	"793-10-3222"	"346-12-3257"
##	[401]	"110-05-6330"	"651-61-0874"	"236-86-3015"	"831-64-0259"	"587-03-7455"
##	[406]	"882-40-4577"	"732-67-5346"	"725-32-9708"	"256-08-8343"	"372-26-1506"
##	[411]	"244-08-0162"	"569-71-4390"	"132-23-6451"	"696-90-2548"	"472-15-9636"
##	[416]	"268-03-6164"	"750-57-9686"	"186-09-3669"	"848-07-1692"	"745-71-3520"
##	[421]	"266-76-6436"	"740-22-2500"	"271-88-8734"	"301-81-8610"	"489-64-4354"
##	[426]	"198-84-7132"	"269-10-8440"	"650-98-6268"	"741-73-3559"	"325-77-6186"
##	[431]	"286-75-7818"	"574-57-9721"	"459-50-7686"	"616-87-0016"	"837-55-7229"
##	[436]	"751-69-0068"	"257-73-1380"	"345-08-4992"	"549-96-4200"	"810-60-6344"
##	[441]	"450-28-2866"	"394-30-3170"	"138-17-5109"	"192-98-7397"	"301-11-9629"
##	[446]	"390-80-5128"	"235-46-8343"	"453-12-7053"	"296-11-7041"	"449-27-2918"
##	[451]	"891-01-7034"	"744-09-5786"	"727-17-0390"	"568-88-3448"	"187-83-5490"
##	[456]	"767-54-1907"	"710-46-4433"	"533-33-5337"	"325-90-8763"	"729-46-7422"
##	[461]	"639-76-1242"	"234-03-4040"	"326-71-2155"	"320-32-8842"	"470-32-9057"
##	[466]	"878-30-2331"	"440-59-5691"	"554-53-3790"	"746-19-0921"	"233-34-0817"
##	[471]	"767-05-1286"	"340-21-9136"	"405-31-3305"	"731-59-7531"	"676-39-6028"
##	[476]	"502-05-1910"	"485-30-8700"	"598-47-9715"	"701-69-8742"	"575-67-1508"
##	[481]	"541-08-3113"	"246-11-3901"	"674-15-9296"	"305-18-3552"	"493-65-6248"
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##	[496]	"632-32-4574"	"556-97-7101"	"862-59-8517"	"401-18-8016"	"420-18-8989"
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##	[561]	"174-75-0888"	"866-99-7614"	"134-54-4720"	"760-90-2357"	"514-37-2845"
##	[566]	"698-98-5964"	"718-57-9773"	"651-88-7328"	"241-11-2261"	"408-26-9866"

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##	[771]	"707-32-7409"	"759-98-4285"	"201-63-8275"	"471-06-8611"	"200-16-5952"
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##
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## [1] "Female" "Male"
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## [4] "Sports and travel" "Food and beverages" "Fashion accessories"
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## [25] 88.63 52.59 33.52 87.67 88.36 24.89 94.13 78.07 83.78 96.58 99.42 68.12
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## [748] 12.7305 38.9160 14.2960 28.9560 9.4250 11.0780 38.6000 36.0650 25.5520
## [757] 2.6725 11.1000 38.1840 11.4090 4.1070 19.1280 3.4290 19.1080 30.0545

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## [811] 13.5520 19.2320 11.7900 10.5780  4.7680  0.5085 10.3065 21.0280  4.4020
## [820] 32.4495  6.1920 32.4750 37.1100  4.2240 12.5140  4.7400  4.5650 14.2555
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## [847] 26.3950 23.9875 16.4295  8.4480  5.6620 17.2770 21.4335  4.3135  1.2760
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## [883] 20.9150 23.1640 23.1225  7.0950 15.1350 39.6640 21.2590 14.1810 29.9600
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## [937] 32.8580  8.4250  2.6890  8.9525 10.5720  5.9865  3.2850  4.2080 19.7730
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## [955]  3.3330  3.8270 14.9850 12.1515  2.3700  8.6225 42.3150 12.9185 30.4780
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## [352] "20:46" "10:34" "13:55" "11:43" "16:03" "20:03" "19:41" "18:04" "10:31"
## [361] "13:28" "17:16" "18:43" "10:30" "20:40" "12:08" "17:45" "10:28" "10:49"
## [370] "12:34" "18:51" "19:38" "12:32" "10:33" "19:55" "14:33" "13:54" "12:15"
## [379] "12:37" "15:06" "15:58" "14:03" "16:38" "11:07" "12:23" "14:13" "19:11"
## [388] "18:53" "14:22" "10:06" "20:08" "12:56" "10:18" "11:45" "16:08" "12:24"
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## [406] "20:00" "15:29" "14:58" "11:52" "17:46" "14:45" "11:39" "13:06" "20:43"
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## [424] "12:51" "13:56" "19:45" "16:18" "18:57" "11:18" "14:06" "20:13" "15:14"
## [433] "16:06" "12:47" "20:42" "20:10" "14:24" "11:42" "17:49" "15:33" "10:38"
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## [451] "20:30" "13:59" "11:58" "16:50" "18:02" "17:52" "20:32" "16:09" "11:33"
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## [469] "10:10" "10:05" "18:15" "11:01" "15:21" "16:16" "11:05" "19:31" "18:35"
## [478] "13:51" "12:35" "11:55" "15:11" "14:48" "12:36" "13:35" "15:45" "14:25"
## [487] "15:18" "10:03" "13:14" "16:35" "20:57" "13:50" "17:35" "17:56" "10:44"
## [496] "10:09" "10:58" "13:49" "11:10" "13:33" "14:05" "16:27" "15:23" "18:18"
## [505] "15:17" "19:12"
##
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## [1] "Ewallet"      "Cash"         "Credit card"
##
## $cogs
## [1] 522.83 76.40 324.31 465.76 604.17 597.73 413.04 735.60 72.52 164.52
## [11] 57.92 102.04 234.75 431.90 713.80 562.32 482.51 435.66 164.01 80.60

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## [21] 430.20 263.94 66.40 172.80 265.89 420.72 33.52 175.34 441.80 224.01
## [31] 470.65 702.63 670.24 193.16 397.68 68.12 313.10 547.92 439.36 240.96
## [41] 86.72 112.22 414.72 789.60 30.74 375.84 510.21 180.09 113.58 826.30
## [51] 639.80 222.95 71.48 15.43 32.32 687.84 88.68 716.80 723.50 183.66
## [61] 74.22 334.38 495.63 158.10 302.96 158.70 66.94 585.66 787.70 18.33
## [71] 894.80 621.20 145.56 455.46 672.03 416.50 441.36 783.10 101.90 595.14
## [81] 290.04 154.00 321.44 244.55 581.42 382.60 345.66 42.47 461.94 189.52
## [91] 448.60 153.86 579.24 89.75 97.16 878.70 74.70 158.25 496.20 48.71
## [101] 706.95 207.63 349.56 212.45 886.70 164.28 372.78 305.82 819.70 32.98
## [111] 294.63 509.88 522.63 727.11 81.06 109.70 51.36 109.60 106.88 796.48
## [121] 399.84 899.64 511.28 451.76 655.83 161.25 285.57 548.32 812.52 277.34
## [131] 552.78 139.36 524.70 487.80 270.66 131.55 206.52 519.10 580.00 898.00
## [141] 905.00 686.00 30.41 467.70 277.56 301.40 264.56 574.88 259.68 366.16
## [151] 241.92 749.16 98.88 647.76 461.45 72.17 251.40 874.98 560.34 345.44
## [161] 63.69 320.53 152.80 399.00 340.56 955.80 989.80 307.68 486.64 350.05
## [171] 400.25 166.80 317.34 158.32 304.56 177.36 157.57 443.28 260.40 449.82
## [181] 307.76 155.00 274.48 86.38 54.24 755.92 185.88 74.07 279.24 231.12
## [191] 147.04 790.20 102.20 163.55 74.29 87.40 25.29 166.00 356.95 114.90
## [201] 229.96 429.87 259.00 88.85 207.27 599.85 285.30 91.11 897.57 236.07
## [211] 839.34 461.80 139.26 18.28 123.85 283.92 758.96 172.02 272.10 434.56
## [221] 59.05 12.54 86.50 174.32 624.33 148.24 544.20 507.36 162.74 31.77
## [231] 756.81 295.28 519.40 186.28 87.05 221.10 66.10 89.69 224.46 119.54
## [241] 186.40 250.60 750.96 380.72 244.20 89.70 310.88 511.42 418.95 351.90
## [251] 28.78 95.00 471.20 130.48 66.35 155.46 129.00 263.76 675.54 65.80
## [261] 153.20 222.40 54.45 688.80 141.88 746.00 282.96 355.40 337.15 42.24
## [271] 193.86 24.06 598.26 335.79 218.20 381.68 709.90 440.20 559.68 37.00
## [281] 15.34 598.98 190.68 333.40 74.86 213.75 339.57 664.16 403.00 194.95
## [291] 62.48 72.72 181.10 259.60 115.36 470.28 240.04 88.61 199.64 39.01
## [301] 48.61 204.76 119.68 505.40 281.61 710.32 79.44 163.82 479.58 138.66
## [311] 71.15 139.95 781.30 198.74 63.24 373.95 207.69 176.28 206.37 39.42
## [321] 91.56 308.85 129.12 390.96 498.90 377.04 204.52 145.44 198.18 98.70
## [331] 385.10 46.96 73.50 142.25 687.60 347.70 142.95 385.38 144.27 391.79
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## [351] 383.11 243.00 30.24 356.56 375.50 954.40 82.50 74.97 647.68 755.76
## [361] 199.58 439.32 164.96 326.72 461.88 143.60 193.50 183.82 121.92 420.66
## [371] 252.48 335.45 483.50 318.42 668.43 387.92 94.60 329.32 53.22 498.45
## [381] 299.56 204.70 75.82 280.62 323.20 486.63 127.54 241.44 379.50 76.82
## [391] 522.60 79.74 387.50 271.35 122.31 246.36 173.16 236.58 184.88 13.98
## [401] 198.75 684.53 269.04 68.95 274.84 226.12 119.10 342.10 43.74 104.85
## [411] 77.52 407.44 96.11 181.52 81.51 114.44 176.54 115.80 252.15 972.10
## [421] 203.36 16.28 365.49 372.19 62.61 336.35 906.50 138.16 86.54 140.76
## [431] 668.78 47.44 893.16 331.72 203.94 68.16 326.88 87.20 707.44 802.89
## [441] 12.78 133.70 19.15 276.60 137.22 27.07 39.12 448.26 132.06 318.05
## [451] 25.00 83.08 147.80 696.60 793.90 465.70 35.89 202.60 730.50 295.80
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## [501] 186.62 88.45 193.44 145.50 504.30 306.45 95.70 635.18 214.55 379.96
## [511] 696.85 408.73 51.47 274.30 196.95 69.46 359.60 137.13 499.02 224.64
## [521] 125.74 490.26 457.05 156.84 119.72 543.60 882.81 152.58 693.44 229.50
## [531] 146.79 141.60 116.69 73.96 97.94 292.20 524.88 92.04 75.88 80.72
## [541] 112.62 71.20 155.24 294.20 548.55 257.70 396.36 171.81 488.79 524.16
## [551] 133.26 135.24 112.44 144.08 985.20 249.96 217.26 194.22 892.00 339.36

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## [561] 447.06 198.50 812.10 493.30 591.66 559.02 517.86 410.20 266.70 70.91
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## [581] 72.32 189.18 206.84 157.02 215.30 596.10 73.10 279.18 169.68 45.58
## [591] 225.60 290.40 44.46 156.60 419.94 184.25 140.64 64.99 775.60 327.06
## [601] 363.23 127.00 375.55 199.16 30.61 115.78 28.96 890.73 279.66 80.93
## [611] 674.50 348.48 435.60 439.55 591.18 260.76 215.04 91.61 662.13 832.50
## [621] 91.35 157.76 121.74 825.80 159.90 12.09 641.90 234.93 167.54 299.10
## [631] 239.73 664.70 202.65 46.20 88.15 157.26 296.37 708.40 111.34 580.16
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## [651] 240.72 47.07 99.69 264.45 139.65 55.45 128.91 119.98 352.50 871.00
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## [671] 454.80 448.56 293.88 589.50 291.00 39.48 34.81 295.92 42.96 138.48
## [681] 98.20 129.66 635.60 145.76 201.30 631.71 385.28 486.30 513.66 473.40
## [691] 436.85 108.16 248.76 626.22 975.00 483.28 96.96 197.70 724.23 795.51
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## [741] 652.30 52.65 110.61 568.61 136.40 174.20 366.40 254.61 778.32 285.92
## [751] 579.12 188.50 221.56 772.00 721.30 511.04 53.45 222.00 763.68 228.18
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## [771] 93.38 126.25 790.83 174.40 379.04 30.62 352.08 50.80 522.06 575.12
## [781] 54.95 181.41 412.37 46.41 274.20 973.70 648.20 93.22 54.36 60.87
## [791] 244.90 92.78 433.45 138.06 241.60 471.73 440.64 680.31 309.88 186.36
## [801] 200.92 17.75 621.80 86.00 402.60 324.85 95.15 388.96 425.68 318.08
## [811] 271.04 384.64 235.80 211.56 95.36 10.17 206.13 420.56 88.04 648.99
## [821] 123.84 649.50 742.20 84.48 250.28 94.80 91.30 285.11 52.38 192.70
## [831] 267.78 558.70 175.32 155.82 60.30 78.94 29.74 21.32 281.34 73.26
## [841] 22.38 655.92 594.60 74.10 196.96 372.33 527.90 479.75 328.59 168.96
## [851] 113.24 345.54 428.67 86.27 25.52 101.52 357.49 238.77 101.43 724.24
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## [871] 39.75 720.16 96.80 332.10 81.44 319.90 166.68 319.06 87.90 734.70
## [881] 97.52 769.20 418.30 463.28 462.45 141.90 302.70 793.28 425.18 283.62
## [891] 599.20 315.36 403.56 183.88 138.65 80.71 116.64 313.52 846.10 414.40
## [901] 159.08 490.10 87.45 224.52 744.96 410.72 298.80 212.94 42.85 378.68
## [911] 206.91 78.78 322.11 98.22 25.46 581.98 211.32 55.12 88.31 356.58
## [921] 794.25 50.62 599.52 166.70 744.40 378.90 257.16 552.23 447.40 276.27
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## [941] 211.44 119.73 65.70 84.16 395.46 297.99 454.41 276.12 158.00 887.94
## [951] 91.98 41.78 15.50 290.46 66.66 76.54 299.70 243.03 47.40 172.45
## [961] 846.30 258.37 609.56 240.24 172.26 99.84 298.64 159.60 25.45 67.77
## [971] 238.36 232.60 877.32 699.72 674.59 318.55 29.52 496.00 823.40 602.96
## [981] 282.80 766.00 116.06 174.90 60.95 40.35 973.80 31.84 65.82 618.38
##
## $gross.margin.percentage
## [1] 4.761905
##
## $gross.income
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## [10] 8.2260 2.8960 5.1020 11.7375 21.5950 35.6900 28.1160 24.1255 21.7830
## [19] 8.2005 4.0300 21.5100 13.1970 3.3200 8.6400 13.2945 21.0360 1.6760
## [28] 8.7670 22.0900 11.2005 23.5325 35.1315 33.5120 9.6580 19.8840 3.4060
## [37] 15.6550 27.3960 21.9680 12.0480 4.3360 5.6110 20.7360 39.4800 1.5370
## [46] 18.7920 25.5105 9.0045 5.6790 41.3150 31.9900 11.1475 3.5740 0.7715

```

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## [55] 1.6160 34.3920 4.4340 35.8400 36.1750 9.1830 3.7110 16.7190 24.7815
## [64] 7.9050 15.1480 7.9350 3.3470 29.2830 39.3850 0.9165 44.7400 31.0600
## [73] 7.2780 22.7730 33.6015 20.8250 22.0680 39.1550 5.0950 29.7570 14.5020
## [82] 7.7000 16.0720 12.2275 29.0710 19.1300 17.2830 2.1235 23.0970 9.4760
## [91] 22.4300 7.6930 28.9620 4.4875 4.8580 43.9350 3.7350 7.9125 24.8100
## [100] 2.4355 35.3475 10.3815 17.4780 10.6225 44.3350 8.2140 18.6390 15.2910
## [109] 40.9850 1.6490 14.7315 25.4940 26.1315 36.3555 4.0530 5.4850 2.5680
## [118] 5.4800 5.3440 39.8240 19.9920 44.9820 25.5640 22.5880 32.7915 8.0625
## [127] 14.2785 27.4160 40.6260 13.8670 27.6390 6.9680 26.2350 24.3900 13.5330
## [136] 6.5775 10.3260 25.9550 29.0000 44.9000 45.2500 34.3000 1.5205 23.3850
## [145] 13.8780 15.0700 13.2280 28.7440 12.9840 18.3080 12.0960 37.4580 4.9440
## [154] 32.3880 23.0725 3.6085 12.5700 43.7490 28.0170 17.2720 3.1845 16.0265
## [163] 7.6400 19.9500 17.0280 47.7900 49.4900 15.3840 24.3320 17.5025 20.0125
## [172] 8.3400 15.8670 7.9160 15.2280 8.8680 7.8785 22.1640 13.0200 22.4910
## [181] 15.3880 7.7500 13.7240 4.3190 2.7120 37.7960 9.2940 3.7035 13.9620
## [190] 11.5560 7.3520 39.5100 5.1100 8.1775 3.7145 4.3700 1.2645 8.3000
## [199] 17.8475 5.7450 11.4980 21.4935 12.9500 4.4425 10.3635 29.9925 14.2650
## [208] 4.5555 44.8785 11.8035 41.9670 23.0900 6.9630 0.9140 6.1925 14.1960
## [217] 37.9480 8.6010 13.6050 21.7280 2.9525 0.6270 4.3250 8.7160 31.2165
## [226] 7.4120 27.2100 25.3680 8.1370 1.5885 37.8405 14.7640 25.9700 9.3140
## [235] 4.3525 11.0550 3.3050 4.4845 11.2230 5.9770 9.3200 12.5300 37.5480
## [244] 19.0360 12.2100 4.4850 15.5440 25.5710 20.9475 17.5950 1.4390 4.7500
## [253] 23.5600 6.5240 3.3175 7.7730 6.4500 13.1880 33.7770 3.2900 7.6600
## [262] 11.1200 2.7225 34.4400 7.0940 37.3000 14.1480 17.7700 16.8575 2.1120
## [271] 9.6930 1.2030 29.9130 16.7895 10.9100 19.0840 35.4950 22.0100 27.9840
## [280] 1.8500 0.7670 29.9490 9.5340 16.6700 3.7430 10.6875 16.9785 33.2080
## [289] 20.1500 9.7475 3.1240 3.6360 9.0550 12.9800 5.7680 23.5140 12.0020
## [298] 4.4305 9.9820 1.9505 2.4305 10.2380 5.9840 25.2700 14.0805 35.5160
## [307] 3.9720 8.1910 23.9790 6.9330 3.5575 6.9975 39.0650 9.9370 3.1620
## [316] 18.6975 10.3845 8.8140 10.3185 1.9710 4.5780 15.4425 6.4560 19.5480
## [325] 24.9450 18.8520 10.2260 7.2720 9.9090 4.9350 19.2550 2.3480 3.6750
## [334] 7.1125 34.3800 17.3850 7.1475 19.2690 7.2135 19.5895 26.9150 24.2575
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## [361] 9.9790 21.9660 8.2480 16.3360 23.0940 7.1800 9.6750 9.1910 6.0960
## [370] 21.0330 12.6240 16.7725 24.1750 15.9210 33.4215 19.3960 4.7300 16.4660
## [379] 2.6610 24.9225 14.9780 10.2350 3.7910 14.0310 16.1600 24.3315 6.3770
## [388] 12.0720 18.9750 3.8410 26.1300 3.9870 19.3750 13.5675 6.1155 12.3180
## [397] 8.6580 11.8290 9.2440 0.6990 9.9375 34.2265 13.4520 3.4475 13.7420
## [406] 11.3060 5.9550 17.1050 2.1870 5.2425 3.8760 20.3720 4.8055 9.0760
## [415] 4.0755 5.7220 8.8270 5.7900 12.6075 48.6050 10.1680 0.8140 18.2745
## [424] 18.6095 3.1305 16.8175 45.3250 6.9080 4.3270 7.0380 33.4390 2.3720
## [433] 44.6580 16.5860 10.1970 3.4080 16.3440 4.3600 35.3720 40.1445 0.6390
## [442] 6.6850 0.9575 13.8300 6.8610 1.3535 1.9560 22.4130 6.6030 15.9025
## [451] 1.2500 4.1540 7.3900 34.8300 39.6950 23.2850 1.7945 10.1300 36.5250
## [460] 14.7900 1.1310 12.8350 27.2750 13.0025 11.1060 1.0790 4.9420 25.1310
## [469] 8.0100 21.5650 29.0280 16.1100 9.7770 8.3150 16.8140 17.1850 1.9300
## [478] 26.3880 16.4000 9.2850 30.1900 18.4900 9.8980 20.5450 7.4300 1.1480
## [487] 34.9560 3.4700 9.8300 10.1280 6.0600 9.9890 30.3680 6.3220 27.0720
## [496] 4.9065 20.6080 3.6985 1.5950 6.9400 9.3310 4.4225 9.6720 7.2750
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## [514] 13.7150 9.8475 3.4730 17.9800 6.8565 24.9510 11.2320 6.2870 24.5130
## [523] 22.8525 7.8420 5.9860 27.1800 44.1405 7.6290 34.6720 11.4750 7.3395
## [532] 7.0800 5.8345 3.6980 4.8970 14.6100 26.2440 4.6020 3.7940 4.0360

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## [541] 5.6310 3.5600 7.7620 14.7100 27.4275 12.8850 19.8180 8.5905 24.4395
## [550] 26.2080 6.6630 6.7620 5.6220 7.2040 49.2600 12.4980 10.8630 9.7110
## [559] 44.6000 16.9680 22.3530 9.9250 40.6050 24.6650 29.5830 27.9510 25.8930
## [568] 20.5100 13.3350 3.5455 7.2390 21.4775 28.4585 12.0600 6.3540 12.8540
## [577] 6.9510 4.0830 15.5360 9.2980 3.6160 9.4590 10.3420 7.8510 10.7650
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## [595] 20.9970 9.2125 7.0320 3.2495 38.7800 16.3530 18.1615 6.3500 18.7775
## [604] 9.9580 1.5305 5.7890 1.4480 44.5365 13.9830 4.0465 33.7250 17.4240
## [613] 21.7800 21.9775 29.5590 13.0380 10.7520 4.5805 33.1065 41.6250 4.5675
## [622] 7.8880 6.0870 41.2900 7.9950 0.6045 32.0950 11.7465 8.3770 14.9550
## [631] 11.9865 33.2350 10.1325 2.3100 4.4075 7.8630 14.8185 35.4200 5.5670
## [640] 29.0080 3.0125 8.7120 21.0630 1.6815 1.5490 12.3700 18.9150 16.7430
## [649] 36.3900 16.7940 12.0360 2.3535 4.9845 13.2225 6.9825 2.7725 6.4455
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## [694] 31.3110 48.7500 24.1640 4.8480 9.8850 36.2115 39.7755 25.1195 8.6000
## [703] 3.4490 6.2480 3.8550 24.1860 15.1060 34.9335 6.2325 8.9200 25.0110
## [712] 1.7910 6.8070 5.2440 8.9460 40.7835 6.6180 12.8695 4.6680 11.4000
## [721] 8.3355 34.8700 19.4520 18.2630 4.4640 8.4000 0.9850 26.5580 2.6860
## [730] 40.9750 28.4200 29.3800 36.6240 42.2820 19.4635 4.2415 7.1630 3.7690
## [739] 12.6680 1.9210 32.6150 2.6325 5.5305 28.4305 6.8200 8.7100 18.3200
## [748] 12.7305 38.9160 14.2960 28.9560 9.4250 11.0780 38.6000 36.0650 25.5520
## [757] 2.6725 11.1000 38.1840 11.4090 4.1070 19.1280 3.4290 19.1080 30.0545
## [766] 23.7965 2.6210 6.5650 7.2150 22.8585 4.6690 6.3125 39.5415 8.7200
## [775] 18.9520 1.5310 17.6040 2.5400 26.1030 28.7560 2.7475 9.0705 20.6185
## [784] 2.3205 13.7100 48.6850 32.4100 4.6610 2.7180 3.0435 12.2450 4.6390
## [793] 21.6725 6.9030 12.0800 23.5865 22.0320 34.0155 15.4940 9.3180 10.0460
## [802] 0.8875 31.0900 4.3000 20.1300 16.2425 4.7575 19.4480 21.2840 15.9040
## [811] 13.5520 19.2320 11.7900 10.5780 4.7680 0.5085 10.3065 21.0280 4.4020
## [820] 32.4495 6.1920 32.4750 37.1100 4.2240 12.5140 4.7400 4.5650 14.2555
## [829] 2.6190 9.6350 13.3890 27.9350 8.7660 7.7910 3.0150 3.9470 1.4870
## [838] 1.0660 14.0670 3.6630 1.1190 32.7960 29.7300 3.7050 9.8480 18.6165
## [847] 26.3950 23.9875 16.4295 8.4480 5.6620 17.2770 21.4335 4.3135 1.2760
## [856] 5.0760 17.8745 11.9385 5.0715 36.2120 6.2820 3.6465 12.9180 8.6870
## [865] 2.8250 10.7150 26.7180 4.6580 26.1040 2.6175 1.9875 36.0080 4.8400
## [874] 16.6050 4.0720 15.9950 8.3340 15.9530 4.3950 36.7350 4.8760 38.4600
## [883] 20.9150 23.1640 23.1225 7.0950 15.1350 39.6640 21.2590 14.1810 29.9600
## [892] 15.7680 20.1780 9.1940 6.9325 4.0355 5.8320 15.6760 42.3050 20.7200
## [901] 7.9540 24.5050 4.3725 11.2260 37.2480 20.5360 14.9400 10.6470 2.1425
## [910] 18.9340 10.3455 3.9390 16.1055 4.9110 1.2730 29.0990 10.5660 2.7560
## [919] 4.4155 17.8290 39.7125 2.5310 29.9760 8.3350 37.2200 18.9450 12.8580
## [928] 27.6115 22.3700 13.8135 17.1870 13.3040 44.9190 22.8400 12.6975 3.5280
## [937] 32.8580 8.4250 2.6890 8.9525 10.5720 5.9865 3.2850 4.2080 19.7730
## [946] 14.8995 22.7205 13.8060 7.9000 44.3970 4.5990 2.0890 0.7750 14.5230
## [955] 3.3330 3.8270 14.9850 12.1515 2.3700 8.6225 42.3150 12.9185 30.4780
## [964] 12.0120 8.6130 4.9920 14.9320 7.9800 1.2725 3.3885 11.9180 11.6300
## [973] 43.8660 34.9860 33.7295 15.9275 1.4760 24.8000 41.1700 30.1480 14.1400
## [982] 38.3000 5.8030 8.7450 3.0475 2.0175 48.6900 1.5920 3.2910 30.9190
##
## $Rating
## [1] 9.1 9.6 7.4 8.4 5.3 4.1 5.8 8.0 7.2 5.9 4.5 6.8 7.1 8.2 5.7
## [16] 4.6 6.9 8.6 4.4 4.8 5.1 9.9 6.0 8.5 6.7 7.7 7.5 7.0 4.7 7.6

```

```

## [31] 7.9 6.3 5.6 9.5 8.1 6.5 6.1 6.6 5.4 9.3 10.0 6.4 4.3 4.0 8.7
## [46] 9.4 5.5 8.3 7.3 4.9 4.2 9.2 7.8 5.2 9.0 8.8 6.2 9.8 9.7 5.0
## [61] 8.9
##
## $Total
## [1] 548.9715 80.2200 340.5255 489.0480 634.3785 627.6165 433.6920
## [8] 772.3800 76.1460 172.7460 60.8160 107.1420 246.4875 453.4950
## [15] 749.4900 590.4360 506.6355 457.4430 172.2105 84.6300 451.7100
## [22] 277.1370 69.7200 181.4400 279.1845 441.7560 35.1960 184.1070
## [29] 463.8900 235.2105 494.1825 737.7615 703.7520 202.8180 417.5640
## [36] 71.5260 328.7550 575.3160 461.3280 253.0080 91.0560 117.8310
## [43] 435.4560 829.0800 32.2770 394.6320 535.7205 189.0945 119.2590
## [50] 867.6150 671.7900 234.0975 75.0540 16.2015 33.9360 722.2320
## [57] 93.1140 752.6400 759.6750 192.8430 77.9310 351.0990 520.4115
## [64] 166.0050 318.1080 166.6350 70.2870 614.9430 827.0850 19.2465
## [71] 939.5400 652.2600 152.8380 478.2330 705.6315 437.3250 463.4280
## [78] 822.2550 106.9950 624.8970 304.5420 161.7000 337.5120 256.7775
## [85] 610.4910 401.7300 362.9430 44.5935 485.0370 198.9960 471.0300
## [92] 161.5530 608.2020 94.2375 102.0180 922.6350 78.4350 166.1625
## [99] 521.0100 51.1455 742.2975 218.0115 367.0380 223.0725 931.0350
## [106] 172.4940 391.4190 321.1110 860.6850 34.6290 309.3615 535.3740
## [113] 548.7615 763.4655 85.1130 115.1850 53.9280 115.0800 112.2240
## [120] 836.3040 419.8320 944.6220 536.8440 474.3480 688.6215 169.3125
## [127] 299.8485 575.7360 853.1460 291.2070 580.4190 146.3280 550.9350
## [134] 512.1900 284.1930 138.1275 216.8460 545.0550 609.0000 942.9000
## [141] 950.2500 720.3000 31.9305 491.0850 291.4380 316.4700 277.7880
## [148] 603.6240 272.6640 384.4680 254.0160 786.6180 103.8240 680.1480
## [155] 484.5225 75.7785 263.9700 918.7290 588.3570 362.7120 66.8745
## [162] 336.5565 160.4400 418.9500 357.5880 1003.5900 1039.2900 323.0640
## [169] 510.9720 367.5525 420.2625 175.1400 333.2070 166.2360 319.7880
## [176] 186.2280 165.4485 465.4440 273.4200 472.3110 323.1480 162.7500
## [183] 288.2040 90.6990 56.9520 793.7160 195.1740 77.7735 293.2020
## [190] 242.6760 154.3920 829.7100 107.3100 171.7275 78.0045 91.7700
## [197] 26.5545 174.3000 374.7975 120.6450 241.4580 451.3635 271.9500
## [204] 93.2925 217.6335 629.8425 299.5650 95.6655 942.4485 247.8735
## [211] 881.3070 484.8900 146.2230 19.1940 130.0425 298.1160 796.9080
## [218] 180.6210 285.7050 456.2880 62.0025 13.1670 90.8250 183.0360
## [225] 655.5465 155.6520 571.4100 532.7280 170.8770 33.3585 794.6505
## [232] 310.0440 545.3700 195.5940 91.4025 232.1550 69.4050 94.1745
## [239] 235.6830 125.5170 195.7200 263.1300 788.5080 399.7560 256.4100
## [246] 94.1850 326.4240 536.9910 439.8975 369.4950 30.2190 99.7500
## [253] 494.7600 137.0040 69.6675 163.2330 135.4500 276.9480 709.3170
## [260] 69.0900 160.8600 233.5200 57.1725 723.2400 148.9740 783.3000
## [267] 297.1080 373.1700 354.0075 44.3520 203.5530 25.2630 628.1730
## [274] 352.5795 229.1100 400.7640 745.3950 462.2100 587.6640 38.8500
## [281] 16.1070 628.9290 200.2140 350.0700 78.6030 224.4375 356.5485
## [288] 697.3680 423.1500 204.6975 65.6040 76.3560 190.1550 272.5800
## [295] 121.1280 493.7940 252.0420 93.0405 209.6220 40.9605 51.0405
## [302] 214.9980 125.6640 530.6700 295.6905 745.8360 83.4120 172.0110
## [309] 503.5590 145.5930 74.7075 146.9475 820.3650 208.6770 66.4020
## [316] 392.6475 218.0745 185.0940 216.6885 41.3910 96.1380 324.2925
## [323] 135.5760 410.5080 523.8450 395.8920 214.7460 152.7120 208.0890
## [330] 103.6350 404.3550 49.3080 77.1750 149.3625 721.9800 365.0850
## [337] 150.0975 404.6490 151.4835 411.3795 565.2150 509.4075 140.6475

```

## [344]	736.4385	75.5475	749.7000	191.2470	141.7500	1042.6500	379.9215
## [351]	402.2655	255.1500	31.7520	374.3880	394.2750	1002.1200	86.6250
## [358]	78.7185	680.0640	793.5480	209.5590	461.2860	173.2080	343.0560
## [365]	484.9740	150.7800	203.1750	193.0110	128.0160	441.6930	265.1040
## [372]	352.2225	507.6750	334.3410	701.8515	407.3160	99.3300	345.7860
## [379]	55.8810	523.3725	314.5380	214.9350	79.6110	294.6510	339.3600
## [386]	510.9615	133.9170	253.5120	398.4750	80.6610	548.7300	83.7270
## [393]	406.8750	284.9175	128.4255	258.6780	181.8180	248.4090	194.1240
## [400]	14.6790	208.6875	718.7565	282.4920	72.3975	288.5820	237.4260
## [407]	125.0550	359.2050	45.9270	110.0925	81.3960	427.8120	100.9155
## [414]	190.5960	85.5855	120.1620	185.3670	121.5900	264.7575	1020.7050
## [421]	213.5280	17.0940	383.7645	390.7995	65.7405	353.1675	951.8250
## [428]	145.0680	90.8670	147.7980	702.2190	49.8120	937.8180	348.3060
## [435]	214.1370	71.5680	343.2240	91.5600	742.8120	843.0345	13.4190
## [442]	140.3850	20.1075	290.4300	144.0810	28.4235	41.0760	470.6730
## [449]	138.6630	333.9525	26.2500	87.2340	155.1900	731.4300	833.5950
## [456]	488.9850	37.6845	212.7300	767.0250	310.5900	23.7510	269.5350
## [463]	572.7750	273.0525	233.2260	22.6590	103.7820	527.7510	168.2100
## [470]	452.8650	609.5880	338.3100	205.3170	174.6150	353.0940	360.8850
## [477]	40.5300	554.1480	344.4000	194.9850	633.9900	388.2900	207.8580
## [484]	431.4450	156.0300	24.1080	734.0760	72.8700	206.4300	212.6880
## [491]	127.2600	209.7690	637.7280	132.7620	568.5120	103.0365	432.7680
## [498]	77.6685	33.4950	145.7400	195.9510	92.8725	203.1120	152.7750
## [505]	529.5150	321.7725	100.4850	666.9390	225.2775	398.9580	731.6925
## [512]	429.1665	54.0435	288.0150	206.7975	72.9330	377.5800	143.9865
## [519]	523.9710	235.8720	132.0270	514.7730	479.9025	164.6820	125.7060
## [526]	570.7800	926.9505	160.2090	728.1120	240.9750	154.1295	148.6800
## [533]	122.5245	77.6580	102.8370	306.8100	551.1240	96.6420	79.6740
## [540]	84.7560	118.2510	74.7600	163.0020	308.9100	575.9775	270.5850
## [547]	416.1780	180.4005	513.2295	550.3680	139.9230	142.0020	118.0620
## [554]	151.2840	1034.4600	262.4580	228.1230	203.9310	936.6000	356.3280
## [561]	469.4130	208.4250	852.7050	517.9650	621.2430	586.9710	543.7530
## [568]	430.7100	280.0350	74.4555	152.0190	451.0275	597.6285	253.2600
## [575]	133.4340	269.9340	145.9710	85.7430	326.2560	195.2580	75.9360
## [582]	198.6390	217.1820	164.8710	226.0650	625.9050	76.7550	293.1390
## [589]	178.1640	47.8590	236.8800	304.9200	46.6830	164.4300	440.9370
## [596]	193.4625	147.6720	68.2395	814.3800	343.4130	381.3915	133.3500
## [603]	394.3275	209.1180	32.1405	121.5690	30.4080	935.2665	293.6430
## [610]	84.9765	708.2250	365.9040	457.3800	461.5275	620.7390	273.7980
## [617]	225.7920	96.1905	695.2365	874.1250	95.9175	165.6480	127.8270
## [624]	867.0900	167.8950	12.6945	673.9950	246.6765	175.9170	314.0550
## [631]	251.7165	697.9350	212.7825	48.5100	92.5575	165.1230	311.1885
## [638]	743.8200	116.9070	609.1680	63.2625	182.9520	442.3230	35.3115
## [645]	32.5290	259.7700	397.2150	351.6030	764.1900	352.6740	252.7560
## [652]	49.4235	104.6745	277.6725	146.6325	58.2225	135.3555	125.9790
## [659]	370.1250	914.5500	207.4800	204.2460	181.8810	75.4740	300.5730
## [666]	85.3020	588.4200	196.1400	231.2415	282.5760	477.5400	470.9880
## [673]	308.5740	618.9750	305.5500	41.4540	36.5505	310.7160	45.1080
## [680]	145.4040	103.1100	136.1430	667.3800	153.0480	211.3650	663.2955
## [687]	404.5440	510.6150	539.3430	497.0700	458.6925	113.5680	261.1980
## [694]	657.5310	1023.7500	507.4440	101.8080	207.5850	760.4415	835.2855
## [701]	527.5095	180.6000	72.4290	131.2080	80.9550	507.9060	317.2260
## [708]	733.6035	130.8825	187.3200	525.2310	37.6110	142.9470	110.1240
## [715]	187.8660	856.4535	138.9780	270.2595	98.0280	239.4000	175.0455

```
## [722] 732.2700 408.4920 383.5230 93.7440 176.4000 20.6850 557.7180
## [729] 56.4060 860.4750 596.8200 616.9800 769.1040 887.9220 408.7335
## [736] 89.0715 150.4230 79.1490 266.0280 40.3410 684.9150 55.2825
## [743] 116.1405 597.0405 143.2200 182.9100 384.7200 267.3405 817.2360
## [750] 300.2160 608.0760 197.9250 232.6380 810.6000 757.3650 536.5920
## [757] 56.1225 233.1000 801.8640 239.5890 86.2470 401.6880 72.0090
## [764] 401.2680 631.1445 499.7265 55.0410 137.8650 151.5150 480.0285
## [771] 98.0490 132.5625 830.3715 183.1200 397.9920 32.1510 369.6840
## [778] 53.3400 548.1630 603.8760 57.6975 190.4805 432.9885 48.7305
## [785] 287.9100 1022.3850 680.6100 97.8810 57.0780 63.9135 257.1450
## [792] 97.4190 455.1225 144.9630 253.6800 495.3165 462.6720 714.3255
## [799] 325.3740 195.6780 210.9660 18.6375 652.8900 90.3000 422.7300
## [806] 341.0925 99.9075 408.4080 446.9640 333.9840 284.5920 403.8720
## [813] 247.5900 222.1380 100.1280 10.6785 216.4365 441.5880 92.4420
## [820] 681.4395 130.0320 681.9750 779.3100 88.7040 262.7940 99.5400
## [827] 95.8650 299.3655 54.9990 202.3350 281.1690 586.6350 184.0860
## [834] 163.6110 63.3150 82.8870 31.2270 22.3860 295.4070 76.9230
## [841] 23.4990 688.7160 624.3300 77.8050 206.8080 390.9465 554.2950
## [848] 503.7375 345.0195 177.4080 118.9020 362.8170 450.1035 90.5835
## [855] 26.7960 106.5960 375.3645 250.7085 106.5015 760.4520 131.9220
## [862] 76.5765 271.2780 182.4270 59.3250 225.0150 561.0780 97.8180
## [869] 548.1840 54.9675 41.7375 756.1680 101.6400 348.7050 85.5120
## [876] 335.8950 175.0140 335.0130 92.2950 771.4350 102.3960 807.6600
## [883] 439.2150 486.4440 485.5725 148.9950 317.8350 832.9440 446.4390
## [890] 297.8010 629.1600 331.1280 423.7380 193.0740 145.5825 84.7455
## [897] 122.4720 329.1960 888.4050 435.1200 167.0340 514.6050 91.8225
## [904] 235.7460 782.2080 431.2560 313.7400 223.5870 44.9925 397.6140
## [911] 217.2555 82.7190 338.2155 103.1310 26.7330 611.0790 221.8860
## [918] 57.8760 92.7255 374.4090 833.9625 53.1510 629.4960 175.0350
## [925] 781.6200 397.8450 270.0180 579.8415 469.7700 290.0835 360.9270
## [932] 279.3840 943.2990 479.6400 266.6475 74.0880 690.0180 176.9250
## [939] 56.4690 188.0025 222.0120 125.7165 68.9850 88.3680 415.2330
## [946] 312.8895 477.1305 289.9260 165.9000 932.3370 96.5790 43.8690
## [953] 16.2750 304.9830 69.9930 80.3670 314.6850 255.1815 49.7700
## [960] 181.0725 888.6150 271.2885 640.0380 252.2520 180.8730 104.8320
## [967] 313.5720 167.5800 26.7225 71.1585 250.2780 244.2300 921.1860
## [974] 734.7060 708.3195 334.4775 30.9960 520.8000 864.5700 633.1080
## [981] 296.9400 804.3000 121.8630 183.6450 63.9975 42.3675 1022.4900
## [988] 33.4320 69.1110 649.2990
```

Tidying the Dataset

```
# Standardize column names by lowering the case using tolower() function

names(mydata) <- tolower(names(mydata))

# display the column names to confirm the changes
colnames(mydata)
```

```
## [1] "invoice.id"      "branch"
## [3] "customer.type"  "gender"
## [5] "product.line"   "unit.price"
## [7] "quantity"       "tax"
## [9] "date"           "time"
```

```
## [11] "payment"          "cogs"
## [13] "gross.margin.percentage" "gross.income"
## [15] "rating"           "total"
```

```
# Summary of our dataset
```

```
summary(mydata)
```

```
##  invoice.id          branch          customer.type          gender
##  Length:1000        Length:1000        Length:1000        Length:1000
##  Class :character    Class :character    Class :character    Class :character
##  Mode  :character    Mode  :character    Mode  :character    Mode  :character
##
##
##
##  product.line        unit.price        quantity          tax
##  Length:1000        Min.   :10.08      Min.   : 1.00      Min.   : 0.5085
##  Class :character    1st Qu.:32.88      1st Qu.: 3.00      1st Qu.: 5.9249
##  Mode  :character    Median :55.23      Median : 5.00      Median :12.0880
##                      Mean   :55.67      Mean   : 5.51      Mean   :15.3794
##                      3rd Qu.:77.94      3rd Qu.: 8.00      3rd Qu.:22.4453
##                      Max.   :99.96      Max.   :10.00      Max.   :49.6500
##
##  date                time                payment          cogs
##  Length:1000        Length:1000        Length:1000        Min.   : 10.17
##  Class :character    Class :character    Class :character    1st Qu.:118.50
##  Mode  :character    Mode  :character    Mode  :character    Median :241.76
##                      Mean   :307.59
##                      3rd Qu.:448.90
##                      Max.   :993.00
##
##  gross.margin.percentage  gross.income        rating          total
##  Min.   :4.762            Min.   : 0.5085      Min.   : 4.000      Min.   : 10.68
##  1st Qu.:4.762            1st Qu.: 5.9249      1st Qu.: 5.500      1st Qu.:124.42
##  Median :4.762            Median :12.0880      Median : 7.000      Median :253.85
##  Mean   :4.762            Mean   :15.3794      Mean   : 6.973      Mean   :322.97
##  3rd Qu.:4.762            3rd Qu.:22.4453      3rd Qu.: 8.500      3rd Qu.:471.35
##  Max.   :4.762            Max.   :49.6500      Max.   :10.000      Max.   :1042.65
```

```
# Checking for missing values
```

```
# to calculate the number of na values
```

```
cat("the number of na values is",sum(is.na(mydata)))
```

```
## the number of na values is 0
```

```
No missing values
```

```
# Checking for duplicates
```

```
cat("The number of duplicate values are: ",sum(duplicated(mydata)))
```

```
## The number of duplicate values are: 0
```

```
No duplicates present
```

```
# Dropping unnecessary columns
```

```
mydata$time <- NULL
```

```
mydata$date <- NULL
```

```
mydata$invoice.id <- NULL
```

```
colnames(mydata)
```

```
## [1] "branch"           "customer.type"
## [3] "gender"           "product.line"
## [5] "unit.price"       "quantity"
## [7] "tax"              "payment"
## [9] "cogs"             "gross.margin.percentage"
## [11] "gross.income"     "rating"
## [13] "total"
```

```
# Convert data types using as.integer
```

```
# Branch
```

```
mydata$branch_enc<-as.integer(as.factor(mydata$branch))
```

```
# Customer Type
```

```
mydata$customer.type_enc<-as.integer(as.factor(mydata$customer.type))
```

```
# Gender
```

```
mydata$gender_enc<-as.integer(as.factor(mydata$gender))
```

```
# Product.line
```

```
mydata$product.line_enc<-as.integer(as.factor(mydata$product.line))
```

```
#Payment
```

```
mydata$payment_enc<-as.integer(as.factor(mydata$payment))
```

```
# Previewing the new dataset
```

```
head(mydata)
```

```
##   branch customer.type gender      product.line unit.price quantity
## 1     A      Member Female  Health and beauty      74.69         7
## 2     C      Normal Female Electronic accessories      15.28         5
## 3     A      Normal  Male   Home and lifestyle      46.33         7
## 4     A      Member  Male   Health and beauty      58.22         8
## 5     A      Normal  Male   Sports and travel      86.31         7
## 6     C      Normal  Male   Electronic accessories      85.39         7
##   tax      payment    cogs gross.margin.percentage gross.income rating
## 1 26.1415      Ewallet 522.83          4.761905      26.1415      9.1
## 2   3.8200        Cash  76.40          4.761905       3.8200      9.6
## 3 16.2155 Credit card 324.31          4.761905      16.2155      7.4
## 4 23.2880      Ewallet 465.76          4.761905      23.2880      8.4
## 5 30.2085      Ewallet 604.17          4.761905      30.2085      5.3
## 6 29.8865      Ewallet 597.73          4.761905      29.8865      4.1
##   total branch_enc customer.type_enc gender_enc product.line_enc payment_enc
## 1 548.9715         1             1         1         1             4             3
## 2  80.2200         3             2         1         1             1             1
## 3 340.5255         1             2         2         2             5             2
## 4 489.0480         1             1         2         2             4             3
## 5 634.3785         1             2         2         2             6             3
## 6 627.6165         3             2         2         2             1             3
```

Dimensionality Reduction

Principal Component Analysis (PCA)

```
# Selecting integer columns
library('dplyr')

##
## Attaching package: 'dplyr'
##
## The following objects are masked from 'package:data.table':
##
##   between, first, last
##
## The following objects are masked from 'package:stats':
##
##   filter, lag
##
## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union
mydata_num <- select_if(mydata,is.numeric)
str(mydata_num)

## 'data.frame':   1000 obs. of  13 variables:
##  $ unit.price      : num  74.7 15.3 46.3 58.2 86.3 ...
##  $ quantity        : int   7  5  7  8  7  7  6 10  2  3 ...
##  $ tax             : num   26.14 3.82 16.22 23.29 30.21 ...
##  $ cogs            : num  522.8 76.4 324.3 465.8 604.2 ...
##  $ gross.margin.percentage: num   4.76 4.76 4.76 4.76 4.76 ...
##  $ gross.income    : num   26.14 3.82 16.22 23.29 30.21 ...
##  $ rating          : num   9.1  9.6  7.4  8.4  5.3  4.1  5.8  8  7.2  5.9 ...
##  $ total           : num  549 80.2 340.5 489 634.4 ...
##  $ branch_enc      : int    1  3  1  1  1  3  1  3  1  2 ...
##  $ customer.type_enc : int    1  2  2  1  2  2  1  2  1  1 ...
##  $ gender_enc      : int    1  1  2  2  2  2  1  1  1  1 ...
##  $ product.line_enc : int    4  1  5  4  6  1  1  5  4  3 ...
##  $ payment_enc     : int    3  1  2  3  3  3  3  3  2  2 ...

# Looking for the Standard Deviation

desc_stats <- data.frame(
  SD = apply(mydata_num, 2, sd)      # Standard deviation
)

desc_stats <- round(desc_stats, 1)
head(desc_stats)

##              SD
## unit.price    26.5
## quantity      2.9
## tax           11.7
## cogs          234.2
## gross.margin.percentage 0.0
## gross.income   11.7
```

```

# Dropping the columns with 0 SD
mydata_num$gross.margin.percentage <- NULL

# now carrying out PCA with center and scale set to true
mydata_num.pca <- prcomp(mydata_num, center = TRUE, scale. = TRUE)

# previewing our PCA summary
summary(mydata_num.pca)

## Importance of components:
##              PC1      PC2      PC3      PC4      PC5      PC6      PC7
## Standard deviation    2.2201 1.06317 1.0317 1.0099 0.99289 0.97714 0.96273
## Proportion of Variance 0.4107 0.09419 0.0887 0.0850 0.08215 0.07957 0.07724
## Cumulative Proportion 0.4107 0.50493 0.5936 0.6786 0.76078 0.84035 0.91758
##              PC8      PC9      PC10      PC11      PC12
## Standard deviation    0.94823 0.29977 1.956e-16 1.395e-16 1.883e-17
## Proportion of Variance 0.07493 0.00749 0.000e+00 0.000e+00 0.000e+00
## Cumulative Proportion 0.99251 1.00000 1.000e+00 1.000e+00 1.000e+00

# Calling str() to have a look at your PCA object
str(mydata_num.pca)

## List of 5
## $ sdev      : num [1:12] 2.22 1.063 1.032 1.01 0.993 ...
## $ rotation: num [1:12, 1:12] -0.291 -0.324 -0.449 -0.449 -0.449 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : chr [1:12] "unit.price" "quantity" "tax" "cogs" ...
##   .. ..$ : chr [1:12] "PC1" "PC2" "PC3" "PC4" ...
## $ center   : Named num [1:12] 55.67 5.51 15.38 307.59 15.38 ...
##   ..- attr(*, "names")= chr [1:12] "unit.price" "quantity" "tax" "cogs" ...
## $ scale    : Named num [1:12] 26.49 2.92 11.71 234.18 11.71 ...
##   ..- attr(*, "names")= chr [1:12] "unit.price" "quantity" "tax" "cogs" ...
## $ x        : num [1:1000, 1:12] -2.013 2.276 -0.134 -1.456 -2.746 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : NULL
##   .. ..$ : chr [1:12] "PC1" "PC2" "PC3" "PC4" ...
## - attr(*, "class")= chr "prcomp"

library(ggbiplot)

## Loading required package: plyr
## -----

## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first, then dplyr:
## library(plyr); library(dplyr)
## -----

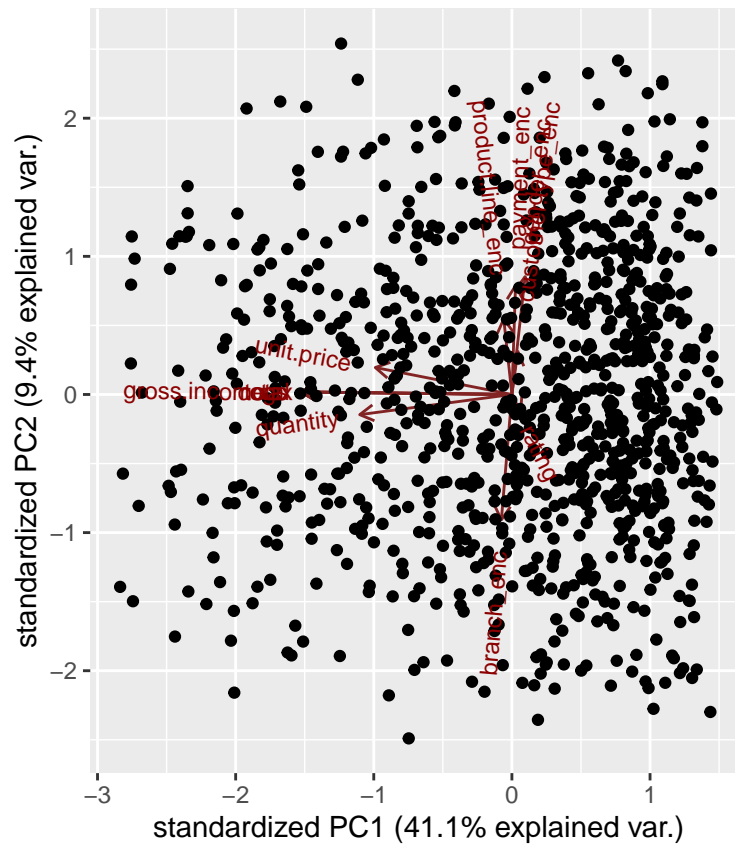
##
## Attaching package: 'plyr'

## The following objects are masked from 'package:dplyr':
##
##      arrange, count, desc, failwith, id, mutate, rename, summarise,
##      summarize

```



```
## Loading required package: scales
## Loading required package: grid
ggbiplot(mydata_num.pca)
```



```
# adding more detail to the plot
ggbiplot(mydata_num.pca, labels = rownames(mydata_num), obs.scale = 1, var.scale = 1)
```



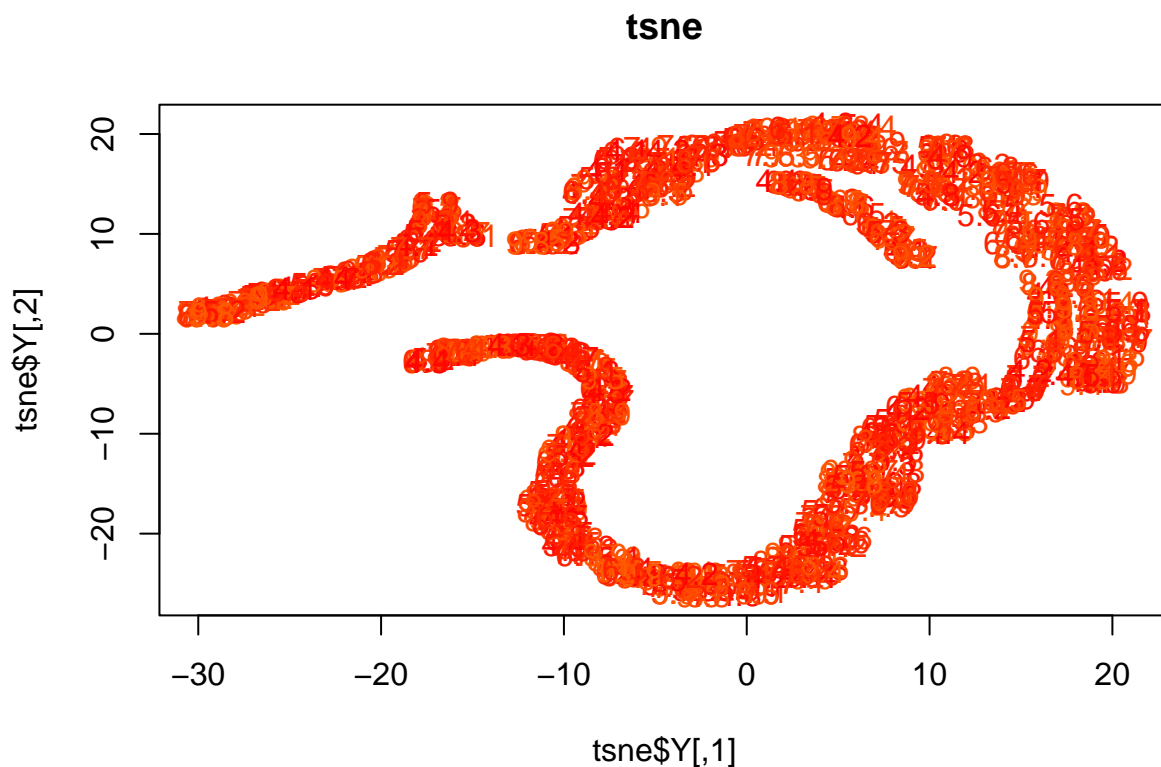
```
## Iteration 250: error is 49.479048 (50 iterations in 0.14 seconds)
## Iteration 300: error is 0.579541 (50 iterations in 0.14 seconds)
## Iteration 350: error is 0.407853 (50 iterations in 0.14 seconds)
## Iteration 400: error is 0.353477 (50 iterations in 0.15 seconds)
## Iteration 450: error is 0.342630 (50 iterations in 0.14 seconds)
## Iteration 500: error is 0.332348 (50 iterations in 0.15 seconds)
## Fitting performed in 1.43 seconds.

mydata_num$rating_num = as.numeric(mydata_num$rating)

# Curating the database for analysis
#
Labels<-mydata_num$rating_num
mydata_num$rating_num<-as.factor(mydata_num$rating_num)

# For plotting
colors = rainbow(length(mydata_num$rating_num))
names(colors) = unique(mydata_num$rating_num)

plot(tsne$Y, t='n', main="tsne")
text(tsne$Y, labels=mydata_num$rating_num, col=colors[mydata_num$rating_num])
```



Feature Selection

Filter Method

```
library(caret)
library(corrplot)
```

```
## corrplot 0.92 loaded
```

```
library(lattice)
```

```
# convert vector from character to numeric
```

```
mydata_num$rating_num <- as.numeric(mydata_num$rating_num)
```

```
# Calculating the correlation matrix
```

```
correlationMatrix <- cor(mydata_num)
```

```
correlationMatrix
```

```
##          unit.price  quantity      tax      cogs gross.income
## unit.price      1.00000000  0.01077756  0.63396209  0.63396209  0.63396209
## quantity      0.010777564  1.00000000  0.70551019  0.70551019  0.70551019
## tax           0.633962089  0.70551019  1.00000000  1.00000000  1.00000000
## cogs          0.633962089  0.70551019  1.00000000  1.00000000  1.00000000
## gross.income   0.633962089  0.70551019  1.00000000  1.00000000  1.00000000
## rating        -0.008777507 -0.01581490 -0.03644170 -0.03644170 -0.03644170
## total         0.633962089  0.70551019  1.00000000  1.00000000  1.00000000
## branch_enc     0.028202440  0.01596379  0.04104666  0.04104666  0.04104666
## customer.type_enc -0.020237875 -0.01676271 -0.01967028 -0.01967028 -0.01967028
## gender_enc     0.015444630 -0.07425831 -0.04945099 -0.04945099 -0.04945099
## product.line_enc 0.019321028  0.02025600  0.03162072  0.03162072  0.03162072
## payment_enc    -0.015941048 -0.00392099 -0.01243364 -0.01243364 -0.01243364
## rating_num     -0.008777507 -0.01581490 -0.03644170 -0.03644170 -0.03644170
##          rating      total  branch_enc customer.type_enc
## unit.price      -0.008777507  0.63396209  0.02820244      -0.02023787
## quantity       -0.015814905  0.70551019  0.01596379      -0.01676271
## tax            -0.036441705  1.00000000  0.04104666      -0.01967028
## cogs           -0.036441705  1.00000000  0.04104666      -0.01967028
## gross.income   -0.036441705  1.00000000  0.04104666      -0.01967028
## rating         1.000000000 -0.03644170  0.01023848       0.01888867
## total         -0.036441705  1.00000000  0.04104666      -0.01967028
## branch_enc     0.010238476  0.04104666  1.00000000      -0.01960787
## customer.type_enc 0.018888672 -0.01967028 -0.01960787       1.00000000
## gender_enc     0.004800208 -0.04945099 -0.05631756       0.03999616
## product.line_enc -0.020528973  0.03162072 -0.05393756      -0.03680031
## payment_enc    -0.005381289 -0.01243364 -0.05010429       0.01807344
## rating_num     1.000000000 -0.03644170  0.01023848       0.01888867
##          gender_enc product.line_enc payment_enc rating_num
## unit.price     0.015444630  0.019321028 -0.015941048 -0.008777507
## quantity       -0.074258307  0.020256001 -0.003920990 -0.015814905
## tax            -0.049450989  0.031620725 -0.012433637 -0.036441705
## cogs           -0.049450989  0.031620725 -0.012433637 -0.036441705
## gross.income   -0.049450989  0.031620725 -0.012433637 -0.036441705
## rating         0.004800208  -0.020528973 -0.005381289  1.000000000
## total         -0.049450989  0.031620725 -0.012433637 -0.036441705
## branch_enc    -0.056317558  -0.053937557 -0.050104288  0.010238476
## customer.type_enc 0.039996160  -0.036800311  0.018073436  0.018888672
## gender_enc     1.000000000  0.005193197  0.044577609  0.004800208
## product.line_enc 0.005193197  1.000000000  0.029896383 -0.020528973
```

```
## payment_enc      0.044577609      0.029896383  1.000000000 -0.005381289
## rating_num       0.004800208     -0.020528973 -0.005381289  1.000000000
```

```
# Getting the highly correlated variables
```

```
highlyCorrelated <- findCorrelation(correlationMatrix, cutoff = 0.75)
names(mydata_num[,highlyCorrelated])
```

```
## [1] "tax"          "cogs"          "gross.income" "rating"
```

```
# We can remove the variables with a higher correlation
# and comparing the results graphically as shown below
```

```
# ---
```

```
#
```

```
# Removing Redundant Features
```

```
# ---
```

```
#
```

```
filter_mydata_num <- mydata_num[-highlyCorrelated]
```

```
head(filter_mydata_num)
```

```
##  unit.price quantity    total branch_enc customer.type_enc gender_enc
## 1      74.69      7 548.9715          1              1          1
## 2      15.28      5  80.2200          3              2          1
## 3      46.33      7 340.5255          1              2          2
## 4      58.22      8 489.0480          1              1          2
## 5      86.31      7 634.3785          1              2          2
## 6      85.39      7 627.6165          3              2          2
##  product.line_enc payment_enc rating_num
## 1              4           3          52
## 2              1           1          57
## 3              5           2          35
## 4              4           3          45
## 5              6           3          14
## 6              1           3           2
```

```
# visualizing
```

```
par(mfrow = c(1, 2))
```

```
# correlation matrix plot of the original dataset
```

```
corrplot(correlationMatrix, order = "hclust")
```

```
# correlation matrix plot of the filtered dataset
```

```
corrplot(cor(filter_mydata_num), order = "hclust")
```

