# Summary of Data

```
## [1] 113937
```

```
## [1] 81
```

Prosper which was founded in 2005 is a peer-to-peer lending platform that people can invest in each other. Prosper connects people who need money with those who have money to invest. Prosper loan data contain 113,937 rows with 81 columns.

```
##  [1] "ListingKey"
##  [2] "ListingNumber"
##  [3] "ListingCreationDate"
##  [4] "CreditGrade"
##  [5] "Term"
##  [6] "LoanStatus"
##  [7] "ClosedDate"
##  [8] "BorrowerAPR"
##  [9] "BorrowerRate"
## [10] "LenderYield"
## [11] "EstimatedEffectiveYield"
## [12] "EstimatedLoss"
## [13] "EstimatedReturn"
## [14] "ProsperRating..numeric."
## [15] "ProsperRating..Alpha."
## [16] "ProsperScore"
## [17] "ListingCategory..numeric."
## [18] "BorrowerState"
## [19] "Occupation"
## [20] "EmploymentStatus"
## [21] "EmploymentStatusDuration"
## [22] "IsBorrowerHomeowner"
## [23] "CurrentlyInGroup"
## [24] "GroupKey"
## [25] "DateCreditPulled"
## [26] "CreditScoreRangeLower"
## [27] "CreditScoreRangeUpper"
## [28] "FirstRecordedCreditLine"
## [29] "CurrentCreditLines"
## [30] "OpenCreditLines"
## [31] "TotalCreditLinespast7years"
## [32] "OpenRevolvingAccounts"
## [33] "OpenRevolvingMonthlyPayment"
## [34] "InquiriesLast6Months"
## [35] "TotalInquiries"
## [36] "CurrentDelinquencies"
## [37] "AmountDelinquent"
## [38] "DelinquenciesLast7Years"
## [39] "PublicRecordsLast10Years"
## [40] "PublicRecordsLast12Months"
## [41] "RevolvingCreditBalance"
## [42] "BankcardUtilization"
```

```
## [43] "AvailableBankcardCredit"
## [44] "TotalTrades"
## [45] "TradesNeverDelinquent..percentage."
## [46] "TradesOpenedLast6Months"
## [47] "DebtToIncomeRatio"
## [48] "IncomeRange"
## [49] "IncomeVerifiable"
## [50] "StatedMonthlyIncome"
## [51] "LoanKey"
## [52] "TotalProsperLoans"
## [53] "TotalProsperPaymentsBilled"
## [54] "OnTimeProsperPayments"
## [55] "ProsperPaymentsLessThanOneMonthLate"
## [56] "ProsperPaymentsOneMonthPlusLate"
## [57] "ProsperPrincipalBorrowed"
## [58] "ProsperPrincipalOutstanding"
## [59] "ScorexChangeAtTimeOfListing"
## [60] "LoanCurrentDaysDelinquent"
## [61] "LoanFirstDefaultedCycleNumber"
## [62] "LoanMonthsSinceOrigination"
## [63] "LoanNumber"
## [64] "LoanOriginalAmount"
## [65] "LoanOriginationDate"
## [66] "LoanOriginationQuarter"
## [67] "MemberKey"
## [68] "MonthlyLoanPayment"
## [69] "LP_CustomerPayments"
## [70] "LP_CustomerPrincipalPayments"
## [71] "LP_InterestandFees"
## [72] "LP_ServiceFees"
## [73] "LP_CollectionFees"
## [74] "LP_GrossPrincipalLoss"
## [75] "LP_NetPrincipalLoss"
## [76] "LP_NonPrincipalRecoverypayments"
## [77] "PercentFunded"
## [78] "Recommendations"
## [79] "InvestmentFromFriendsCount"
## [80] "InvestmentFromFriendsAmount"
## [81] "Investors"
```

## Creating new dataframe based on prosper data

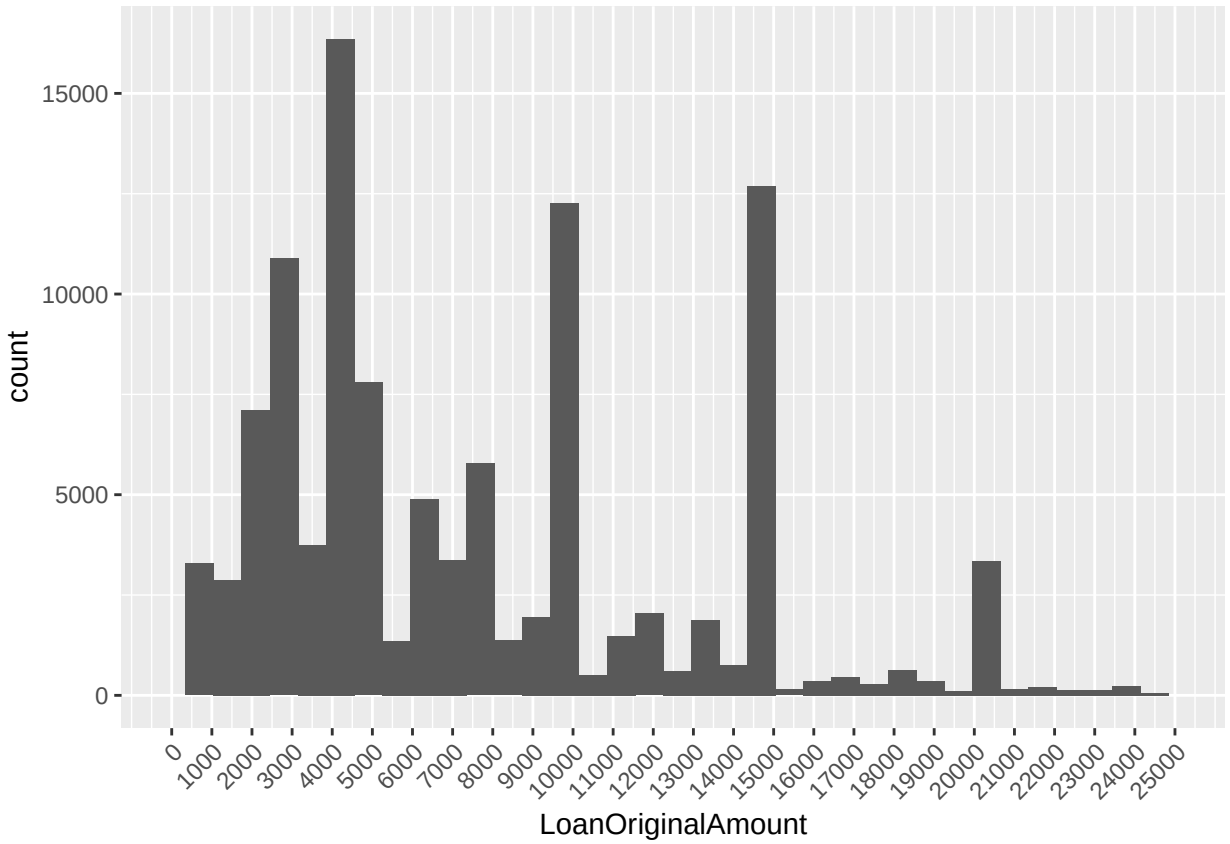
```
## 'data.frame':    113937 obs. of  13 variables:
##  $ DelinquenciesLast7Years : int  4 0 0 14 0 0 0 0 0 0 ...
##  $ PublicRecordsLast10Years: int  0 1 0 0 0 0 0 1 0 0 ...
##  $ DaysWithCreditLine      : num  6243 8276 5954 13043 5381 ...
##  $ InquiriesLast6Months    : int  3 3 0 0 1 0 0 3 1 1 ...
##  $ BorrowerRate            : num  0.158 0.092 0.275 0.0974 0.2085 ...
##  $ Term                    : Factor w/ 3 levels "12","36","60": 2 2 2 2 2 3 2 2 2 2 ...
##  $ ProsperRating           : Factor w/ 7 levels "AA","A","B","C",..: NA 2 NA 2 5 3 6 4 1 1 ...
##  $ ListingCreationDate     : Factor w/ 113064 levels "2005-11-09 20:44:28.847000000",..: 14184 11189
##  $ LoanOriginalAmount      : int  9425 10000 3001 10000 15000 15000 3000 10000 10000 10000 ...
```

```
##  $ ListingCategory         : Factor w/ 21 levels "Not available",..: 1 3 1 17 3 2 2 3 8 8 ...
##  $ EmploymentStatus        : Factor w/ 9 levels "","Employed",..: 9 2 4 2 2 2 2 2 2 2 ...
##  $ AnnualIncome            : num  37000 73500 25000 34500 115000 ...
##  $ RevolvingCreditBalance  : num  0 3989 NA 1444 6193 ...
```

```
##  DelinquenciesLast7Years PublicRecordsLast10Years DaysWithCreditLine
##  Min.   : 0.000          Min.   : 0.0000          Min.   : 2153
##  1st Qu.: 0.000          1st Qu.: 0.0000          1st Qu.: 6819
##  Median : 0.000          Median : 0.0000          Median : 8414
##  Mean   : 4.155          Mean   : 0.3126          Mean   : 8763
##  3rd Qu.: 3.000          3rd Qu.: 0.0000          3rd Qu.:10393
##  Max.   :99.000          Max.   :38.0000          Max.   :26015
##  NA's   :990             NA's   :697              NA's   :697
##  InquiriesLast6Months  BorrowerRate    Term       ProsperRating
##  Min.   :  0.000      Min.   :0.0000   12: 1614   C      :18345
##  1st Qu.:  0.000      1st Qu.:0.1340   36:87778   B      :15581
##  Median :  1.000      Median :0.1840   60:24545   A      :14551
##  Mean   :  1.435      Mean   :0.1928              D      :14274
##  3rd Qu.:  2.000      3rd Qu.:0.2500              E      : 9795
##  Max.   :105.000      Max.   :0.4975              (Other):12307
##  NA's   :697                                      NA's   :29084
##                    ListingCreationDate LoanOriginalAmount
##  2013-10-02 17:20:16.550000000:     6   Min.   : 1000
##  2013-08-28 20:31:41.107000000:     4   1st Qu.: 4000
##  2013-09-08 09:27:44.853000000:     4   Median : 6500
##  2013-12-06 05:43:13.830000000:     4   Mean   : 8337
##  2013-12-06 11:44:58.283000000:     4   3rd Qu.:12000
##  2013-08-21 07:25:22.360000000:     3   Max.   :35000
##  (Other)                       :113912
##            ListingCategory       EmploymentStatus  AnnualIncome
##  Debt consolidation:58308   Employed     :67322   Min.   :       0
##  Not available     :16965   Full-time    :26355   1st Qu.:   38404
##  Other             :10494   Self-employed: 6134   Median :   56000
##  Home improvement  : 7433   Not available: 5347   Mean   :   67296
##  Business          : 7189   Other        : 3806   3rd Qu.:   81900
##  Auto              : 2572                :  2255   Max.   :21000035
##  (Other)           :10976   (Other)      : 2718
##  RevolvingCreditBalance
##  Min.   :      0
##  1st Qu.:   3121
##  Median :   8549
##  Mean   :  17599
##  3rd Qu.:  19521
##  Max.   :1435667
##  NA's   :7604
```

# Univariate Plots Section

## Loan original amount

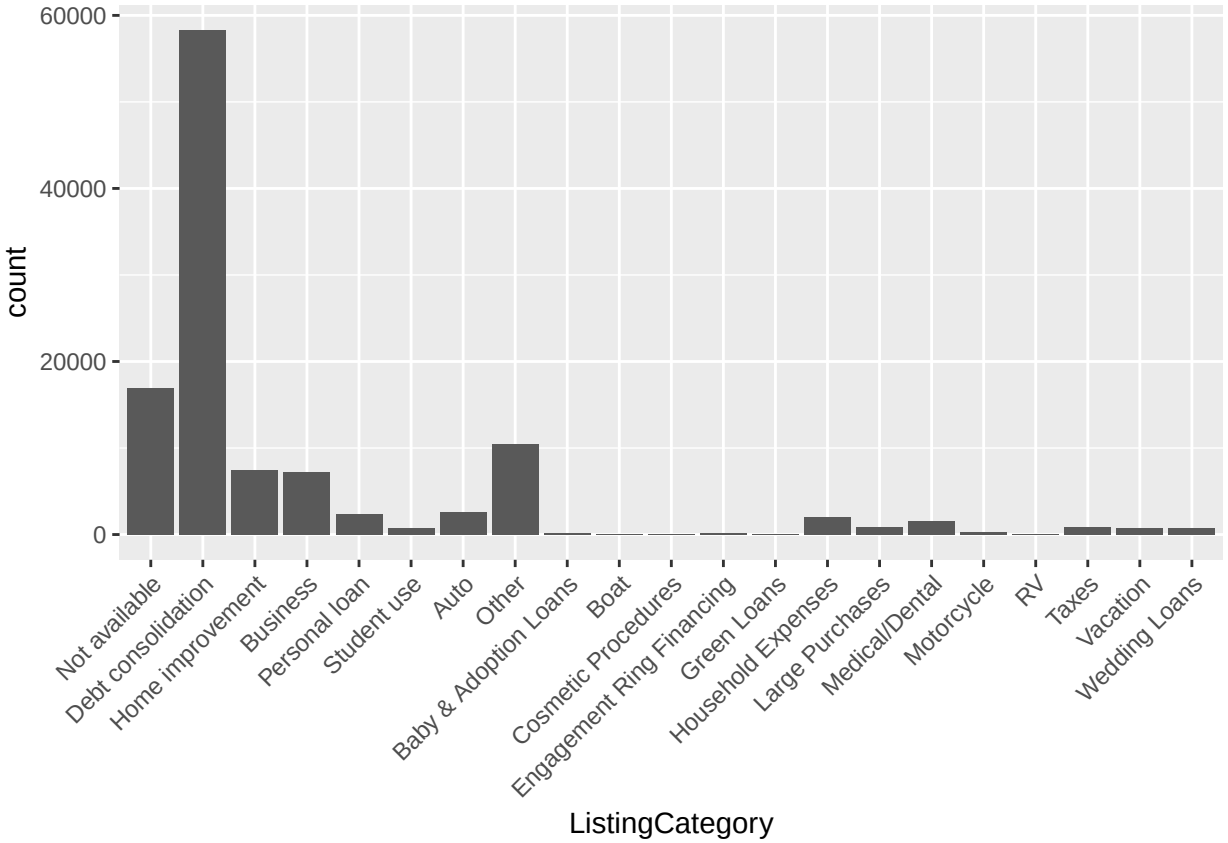



From the figure above we can see the amont of money that people borrow and as we can see people tend to borrow in whole numbers.

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1000    4000    6500    8337   12000   35000
```

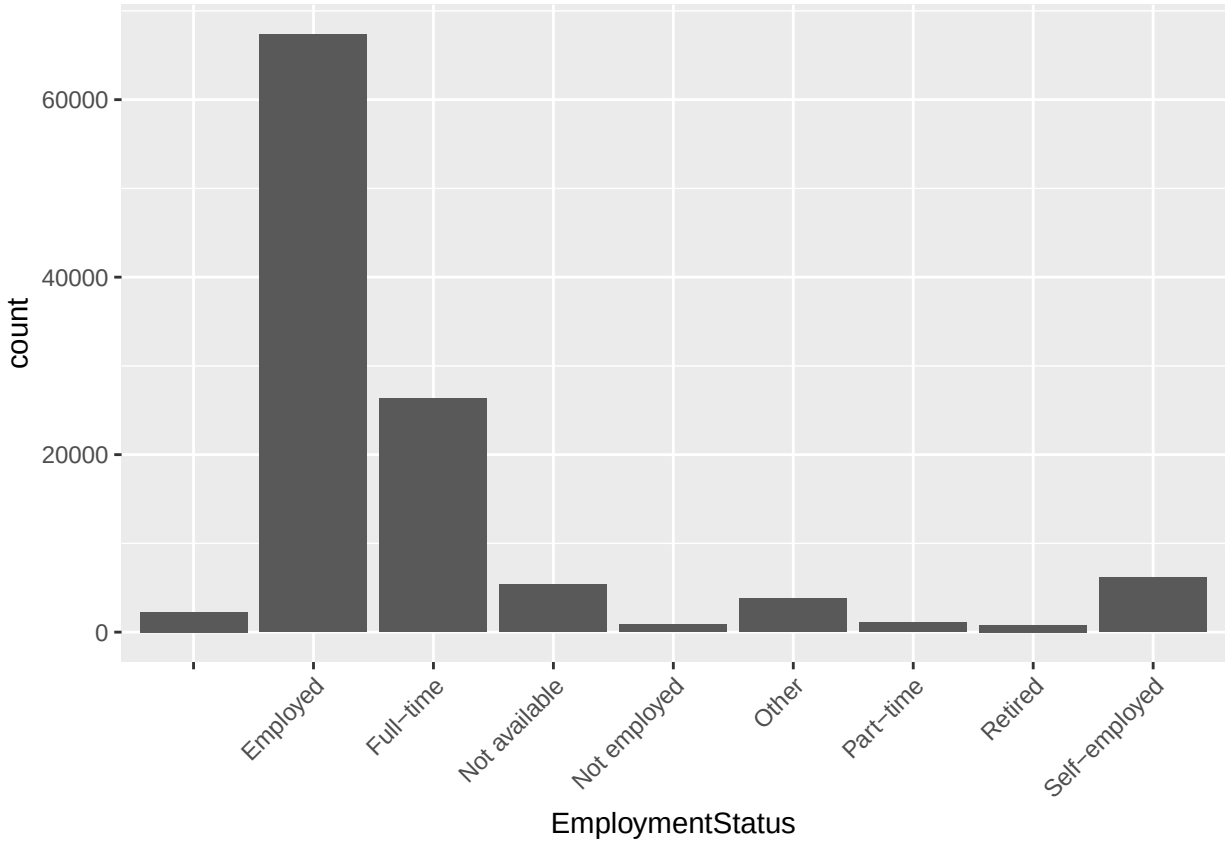
The minimum money that people borrowed is 1000 as opposed to maximum, which is 35000. the median and mean are 6500 and 8337 respectively.

### Loan category



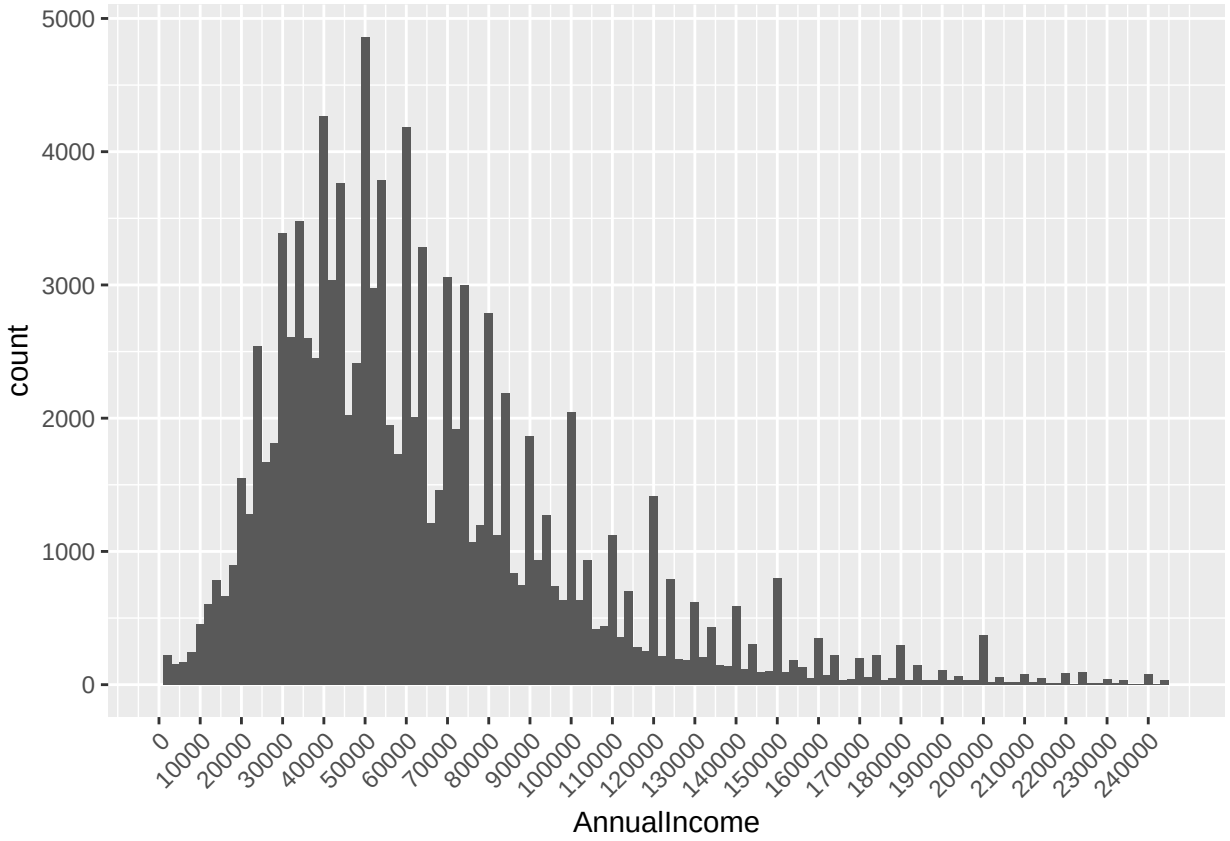

Sounds like most people borrow to cover their debts.

### Employment status




As we can see most of the borrowers are employed.

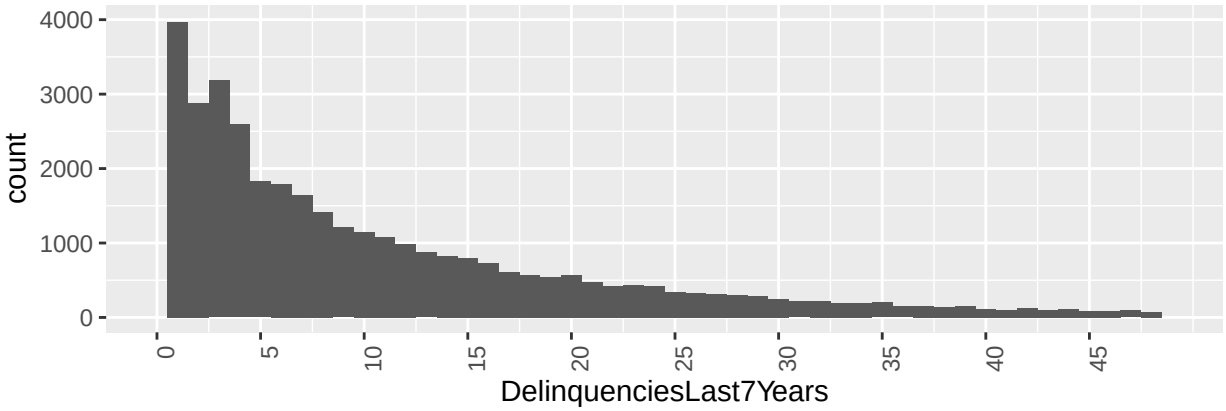
### Income status

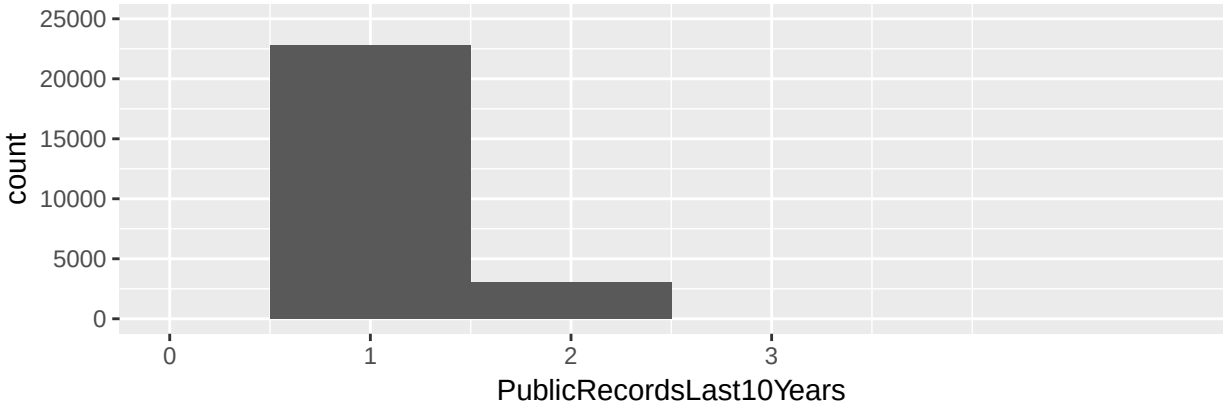



```
##      Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##         0    38404    56000    67296    81900 21000035
```

The majority of income are between 20000 and 90000 annually. The median is 56000 and the mean is 67296.

### Payment history



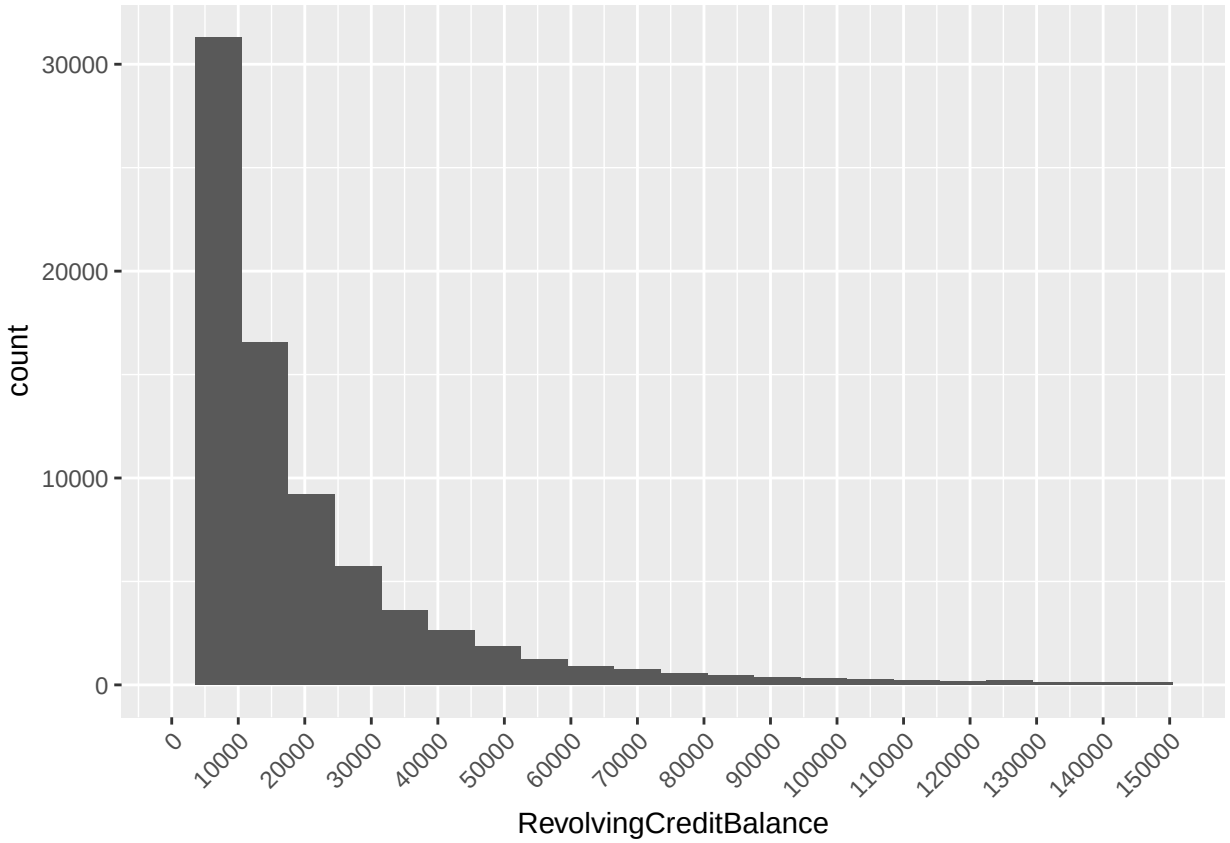




```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   0.000   0.000   4.155   3.000  99.000     990
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##  0.0000  0.0000  0.0000  0.3126  0.0000 38.0000     697
```

It is obvious that most of the borrower have zero or one deliquencies in the last 7 years. Similarly they have zero or one public records in the last 10 years.

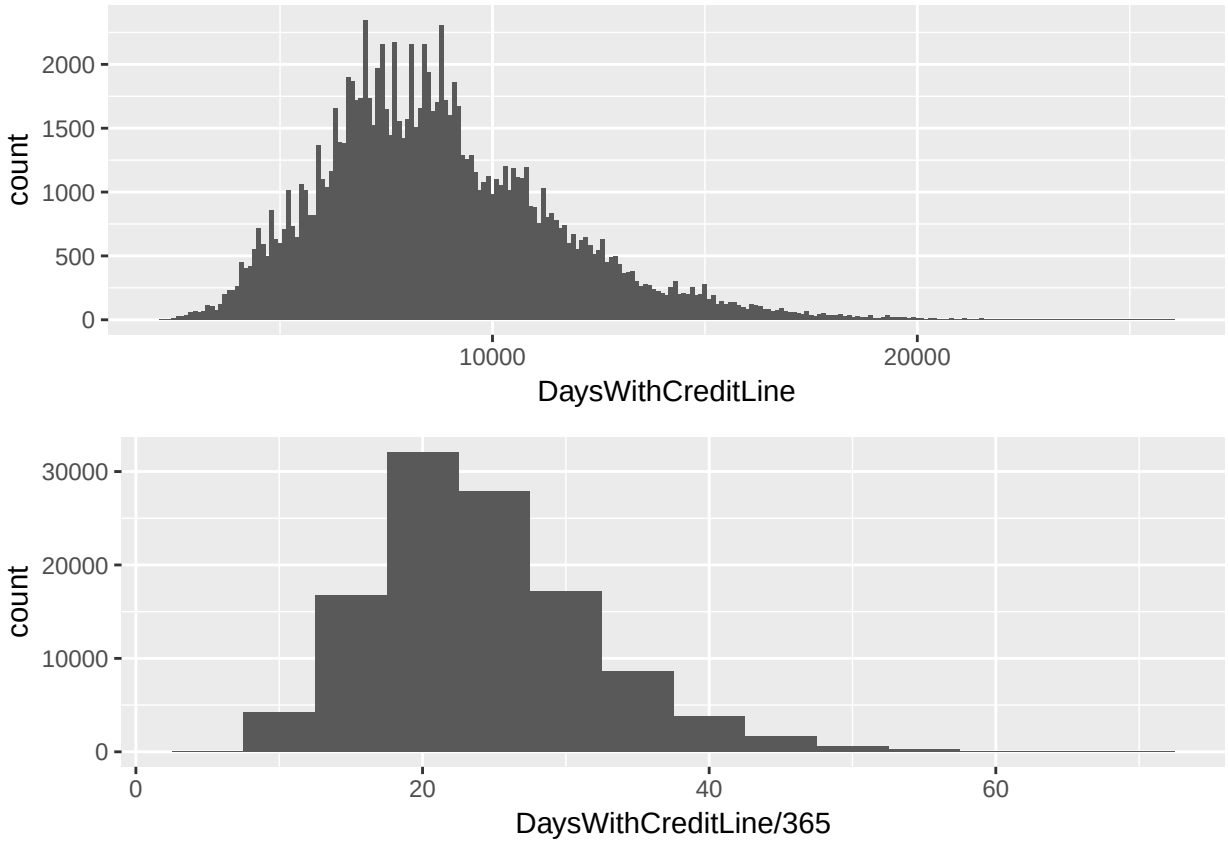
### Revolving Credit Balance




```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##       0    3121    8549   17599   19521 1435667    7604
```

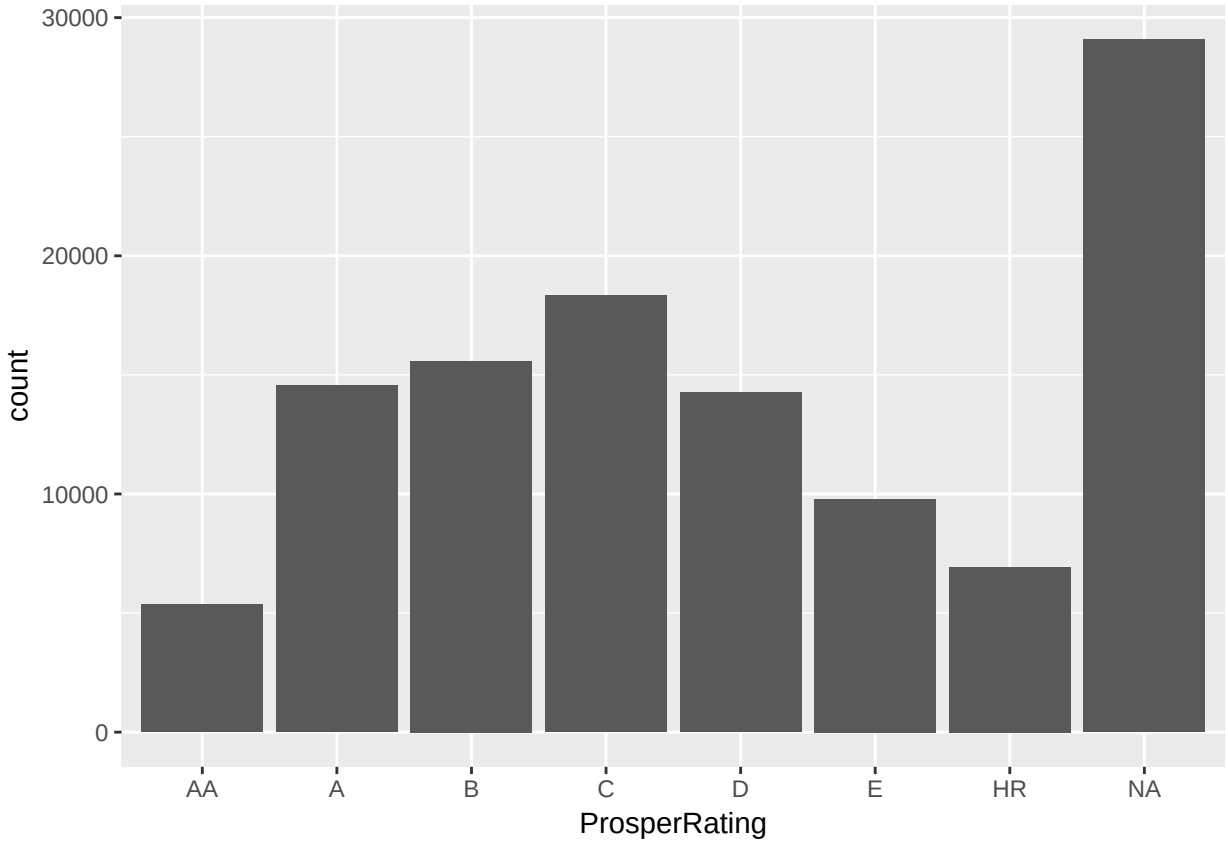
Revolving Credit Balance is the total outstanding balance that the borrower owes on his/her credit accounts. The median and mean are 8549 and 17600 respectively and the most common amount is 0.

### Length of credit history



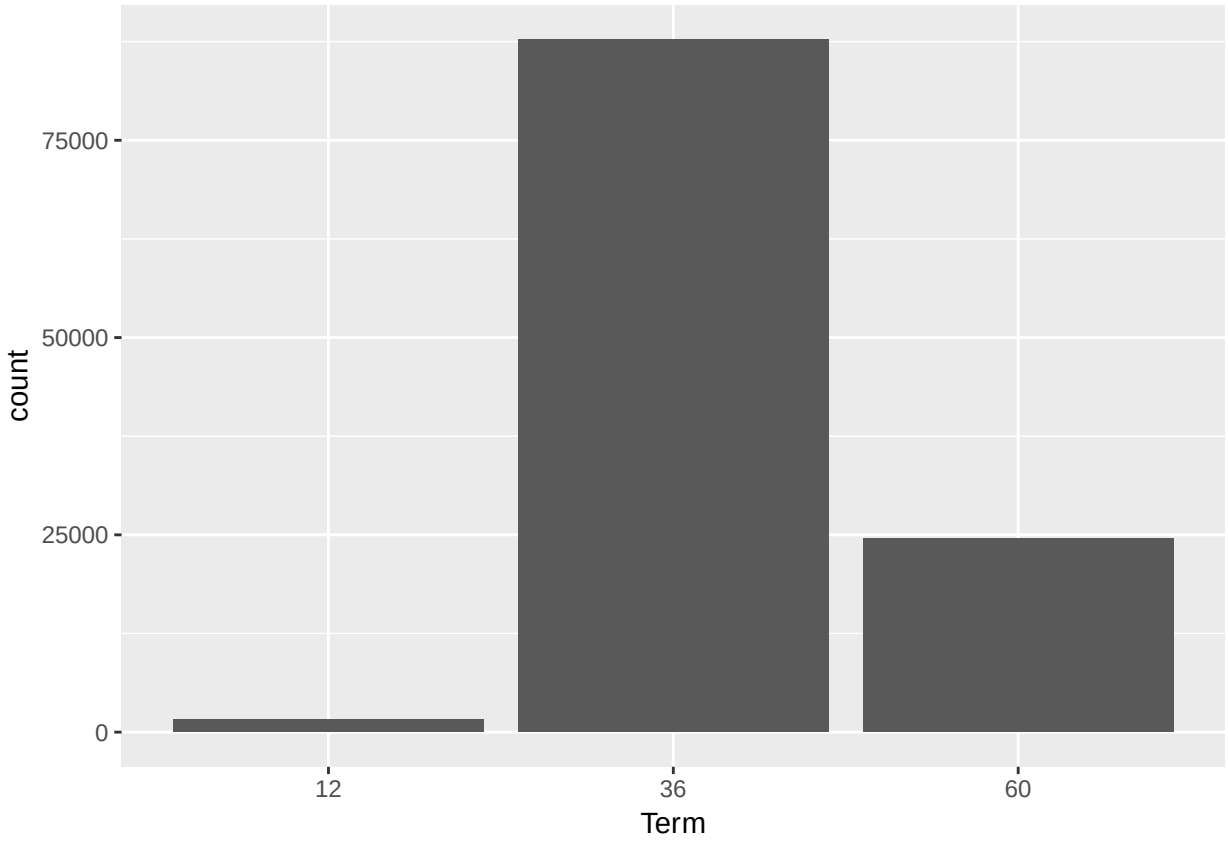

here is a credit line stors the credit story of 60 years.

### Rating




The most common rating is C follows by B. A and D are at the next steps (excluding the NA).

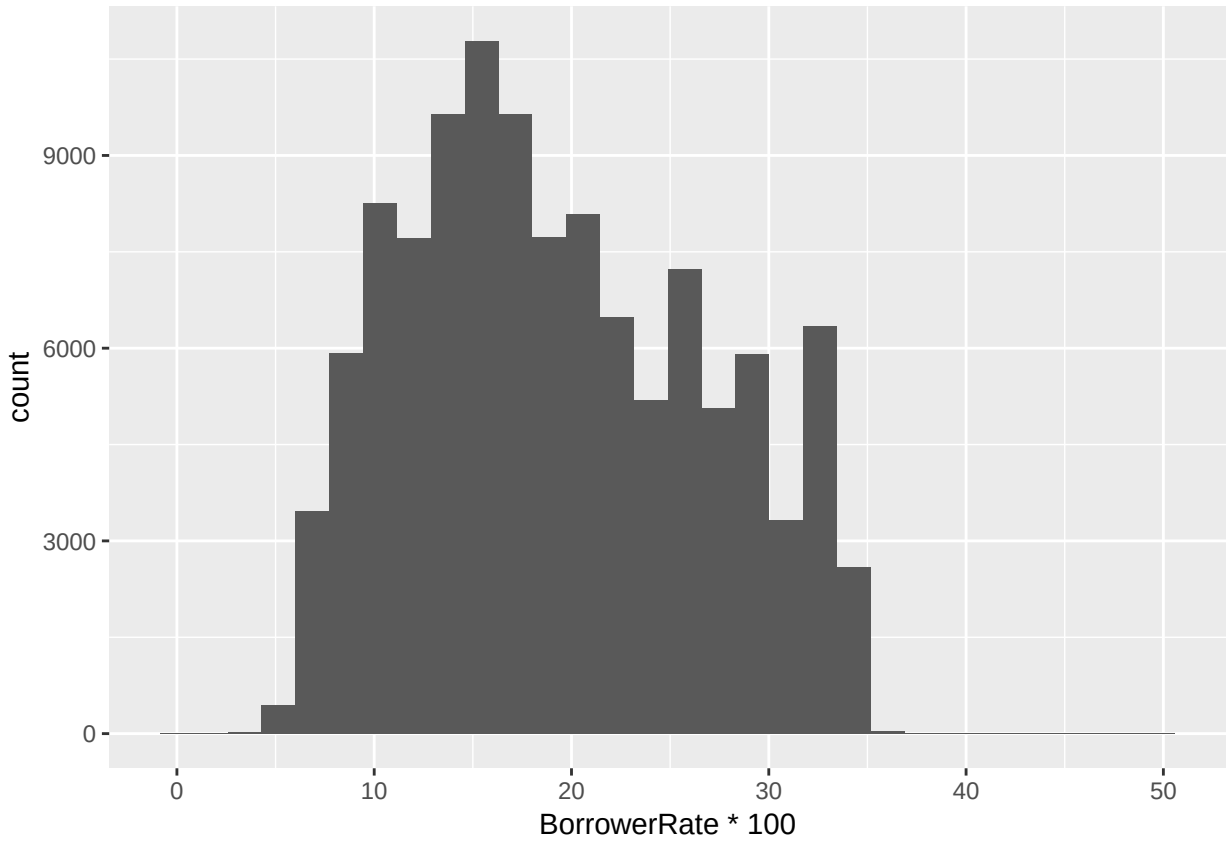
### Loan length




Most loans have 36 months terms

### Borrower Rating

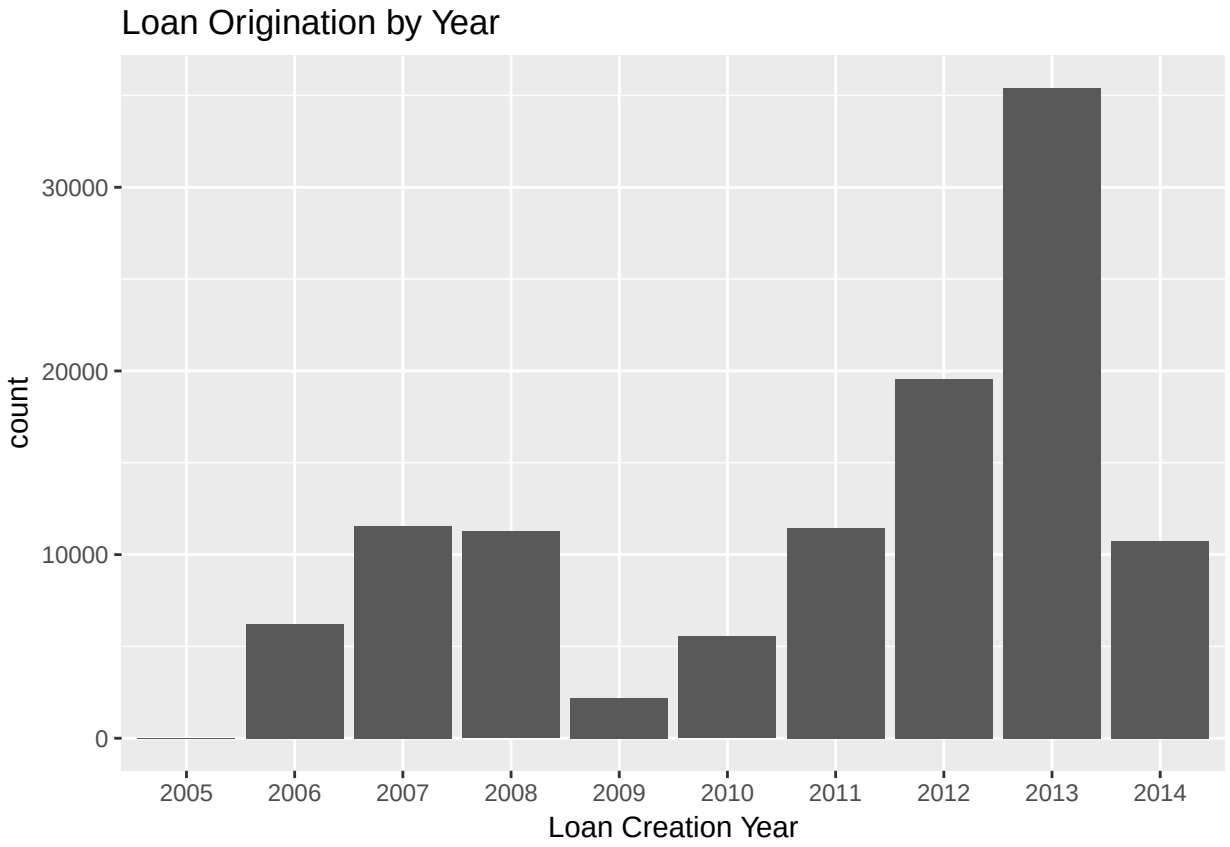
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.0000  0.1340  0.1840  0.1928  0.2500  0.4975
```

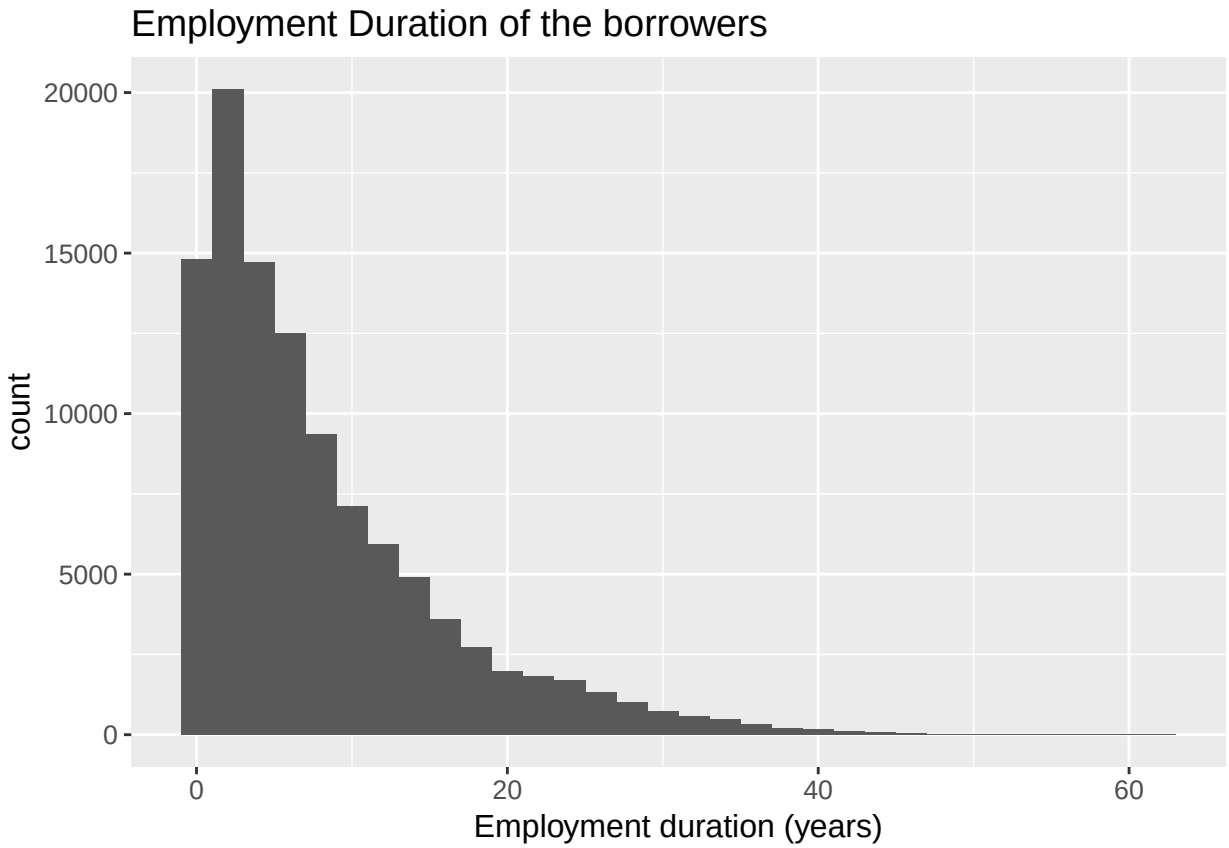
The median and mean for the borrower rate are 18.4% and 19.28% respectively, and The maximum borrower rate is 0.4975 or 49.75%.

### Years borrowing



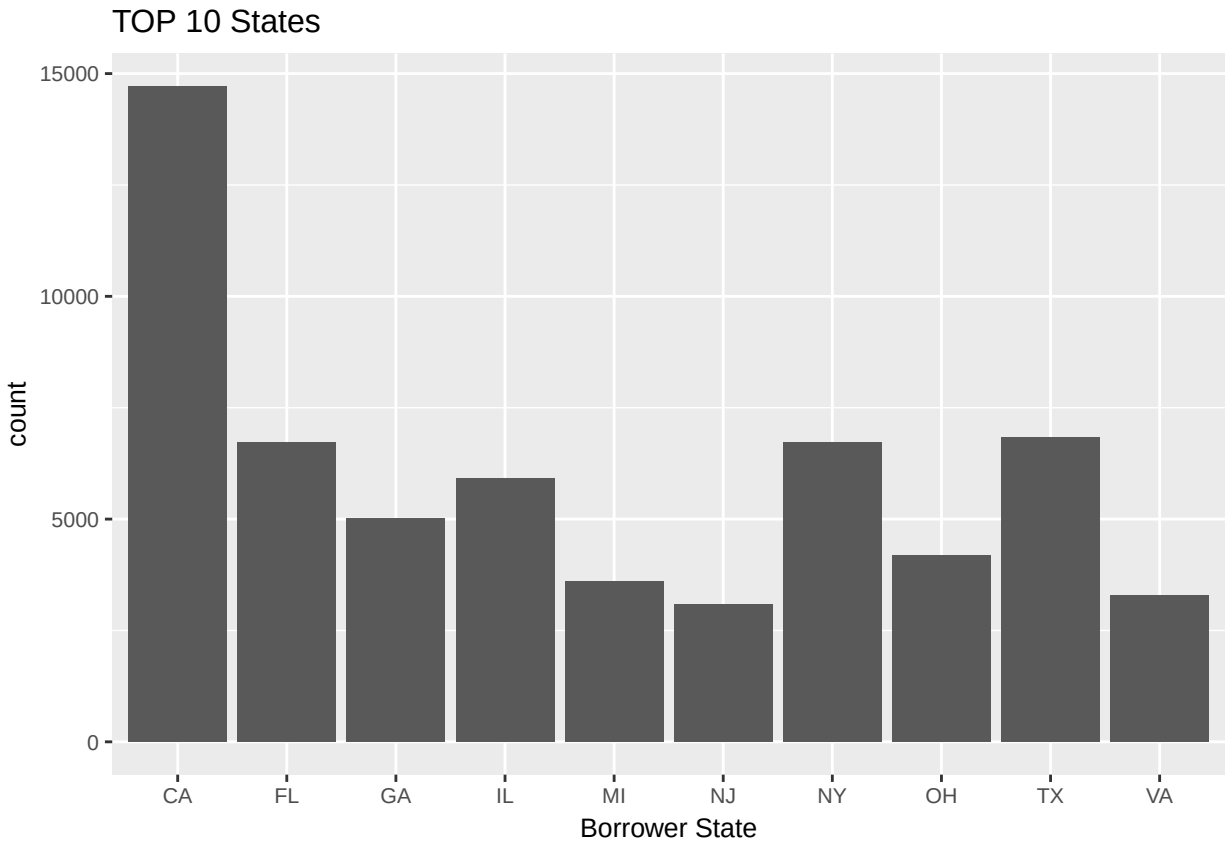

2013 is the year that people borrowed money more than any other years and 2009 is the minimum borrowing year. There can be many resons behind that like economic crises or elections.

**Employment Duration of the borrowers**




With the increase of the length of employment there is a decreas in the number of people who borrow loans.

### Top 10 borrower states




As we can see California is the state that people were more likely to loan and Florida, Illinois, New York and Texas are at the next steps.

## Univariate Analysis

#### What is the structure of your dataset?

For the purpose of this project I am using the Prosper data set, which contains all Prosper loans created until March 11th, 2014. There are discrete and continuous variables in this dataset.Each variable is a column and each row is an observation.

#### What is/are the main feature(s) of interest in your dataset?

- DelinquenciesLast7Years
- PublicRecordsLast10Years
- DebtToIncomeRatio

- RevolvingCreditBalance

- DaysWithCreditLine

- LoanOriginalAmount

- ListingCategory
- EmploymentStatus
- AnnualIncome
- BorrowerRate
- Term
- ProsperRating
- Listing Creation Date

**What other features in the dataset do you think will help support your investigation into your feature(s) of interest?**

Other variables that help me in my investigation are Employment Duration, Debt To Income Ratio, Prosper Rating and Occupation.

**Did you create any new variables from existing variables in the dataset?**

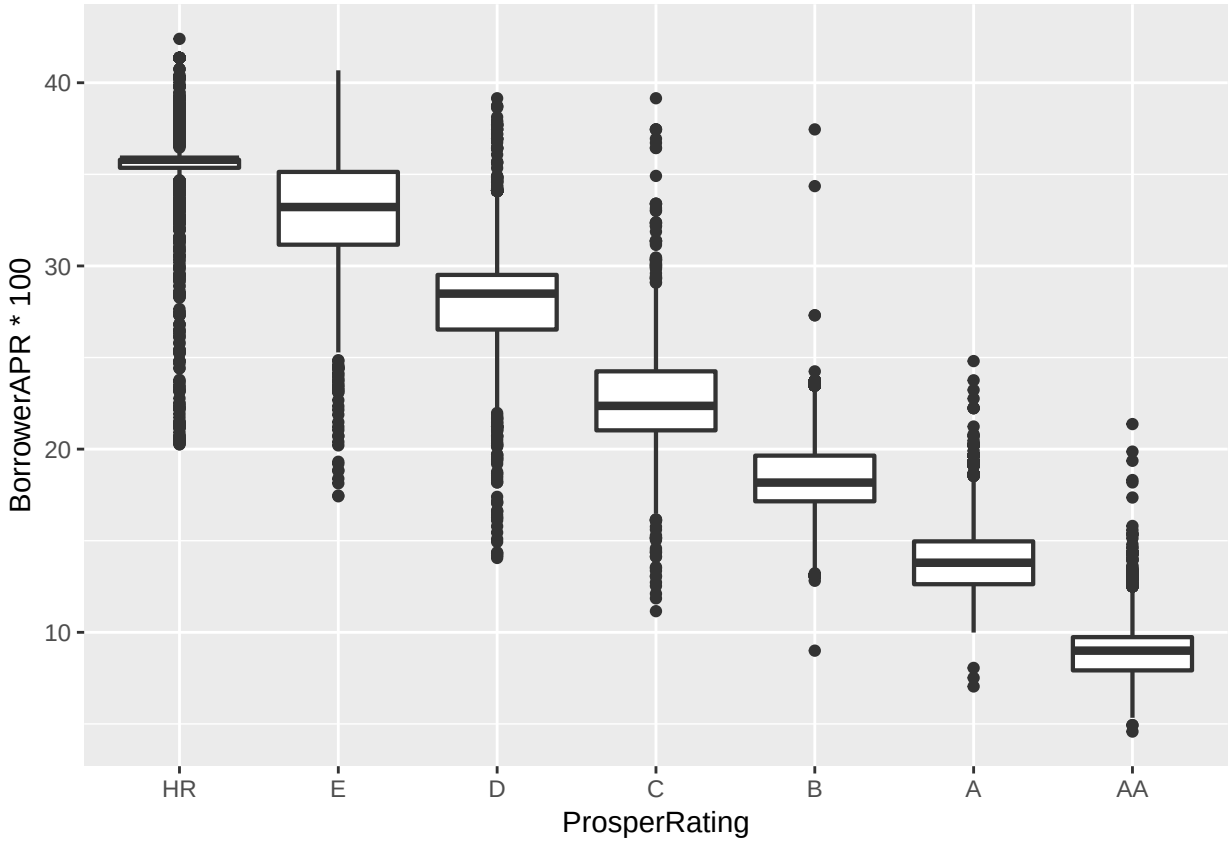
I created following new variables during the analysis: ListingCretionYear and Days with credit line.

**Of the features you investigated, were there any unusual distributions? Did you perform any operations on the data to tidy, adjust, or change the form of the data? If so, why did you do this?**

I set ListingCreationYear variable as a factor so when I plotted it would look discrete. I've alose taked care of ranked variables order in top 10 loan states.

## Bivariate Plots Section

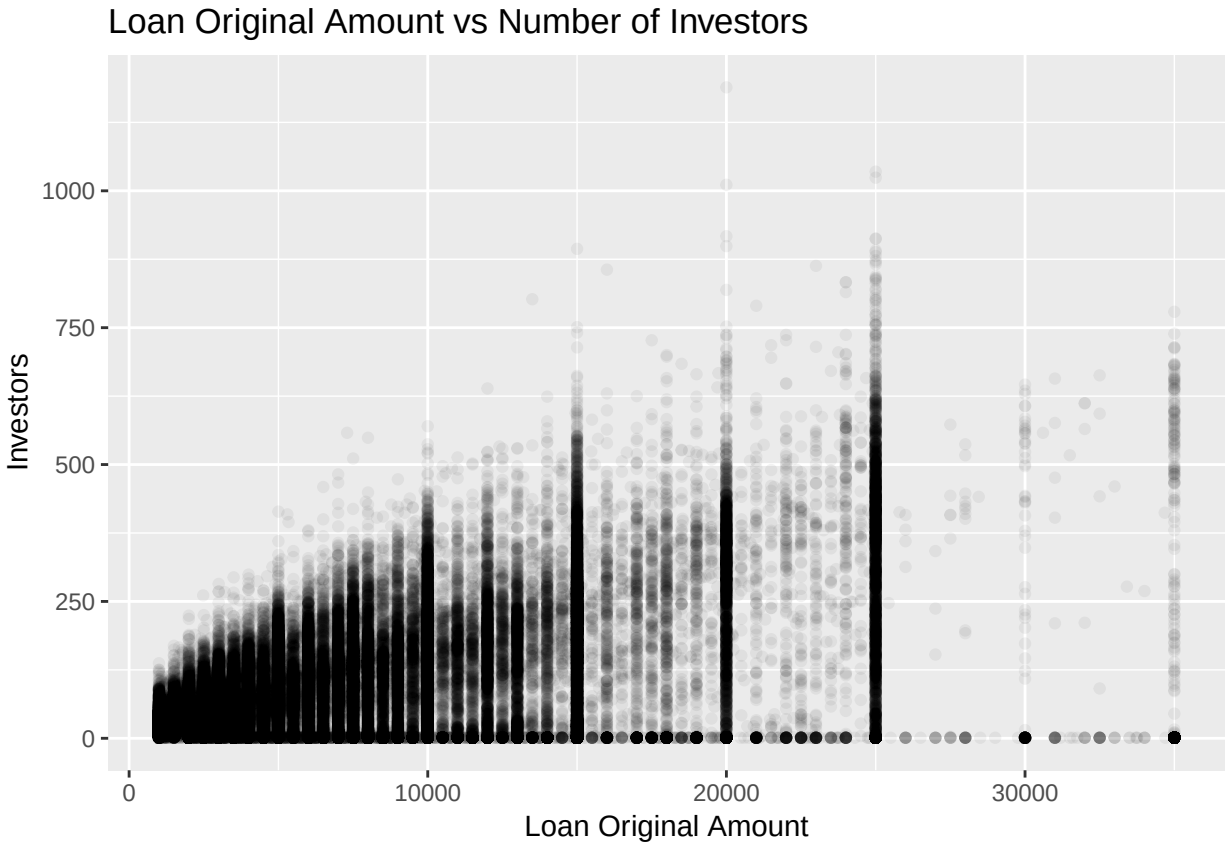
### Relationship between Prosper Rating and BorrowerAPR




As we can see biger APRs have higher risk.

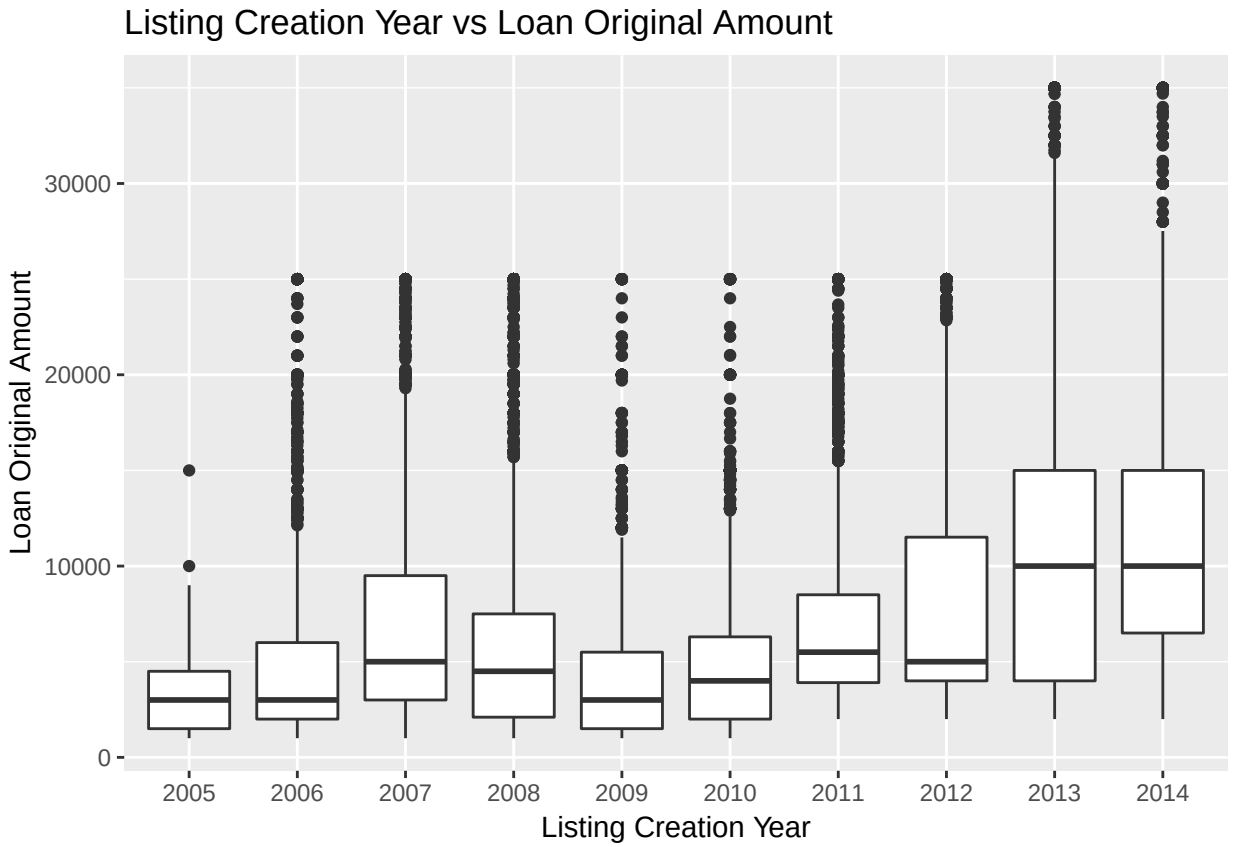
### The relationship between Loan Original Amount and Number of

Investors



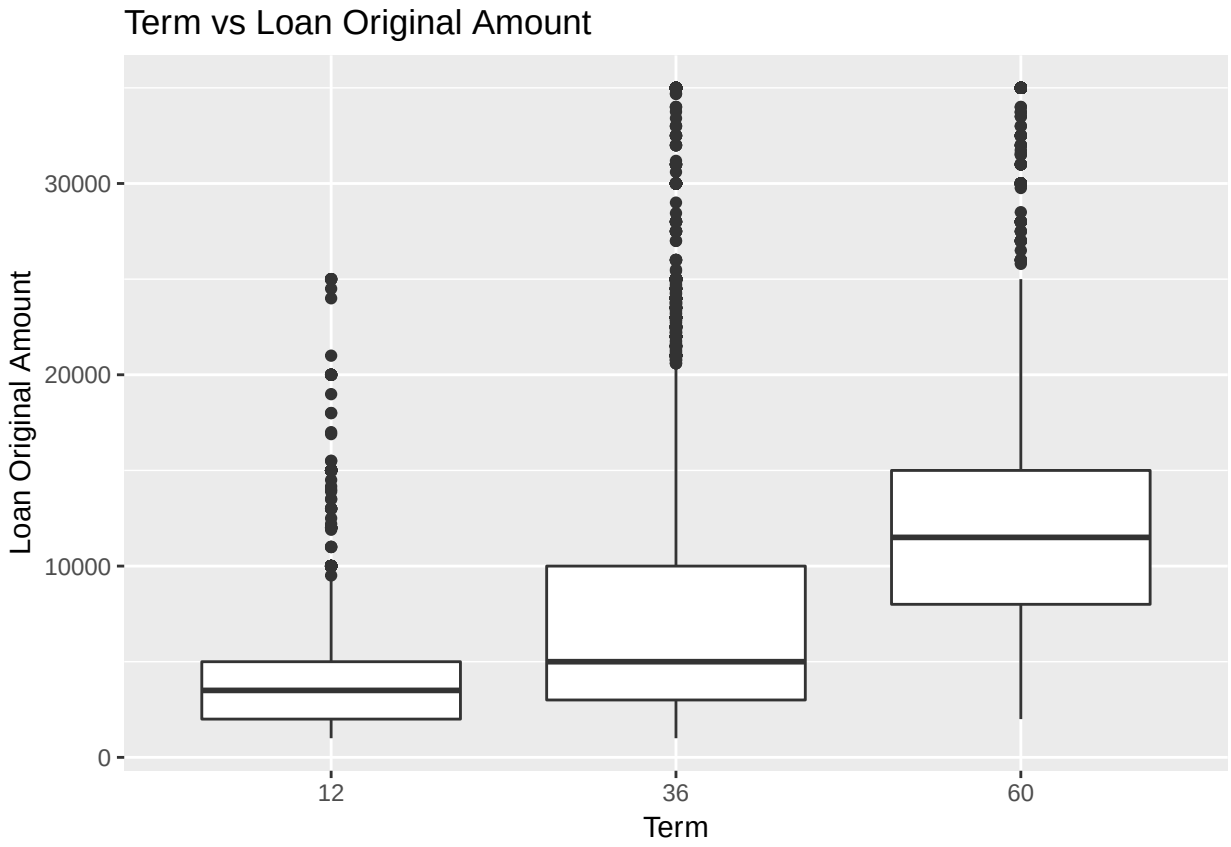

As we can see larger loans have more investors.

**Borrowed loan amount vary trought the years**




Mean loans amounts wen up slowly from 2005 to 2007, then it decreased at 2008 and went down to his minimum value at 2009. After that it recovered and increased and peaked at 2013 and 2014.

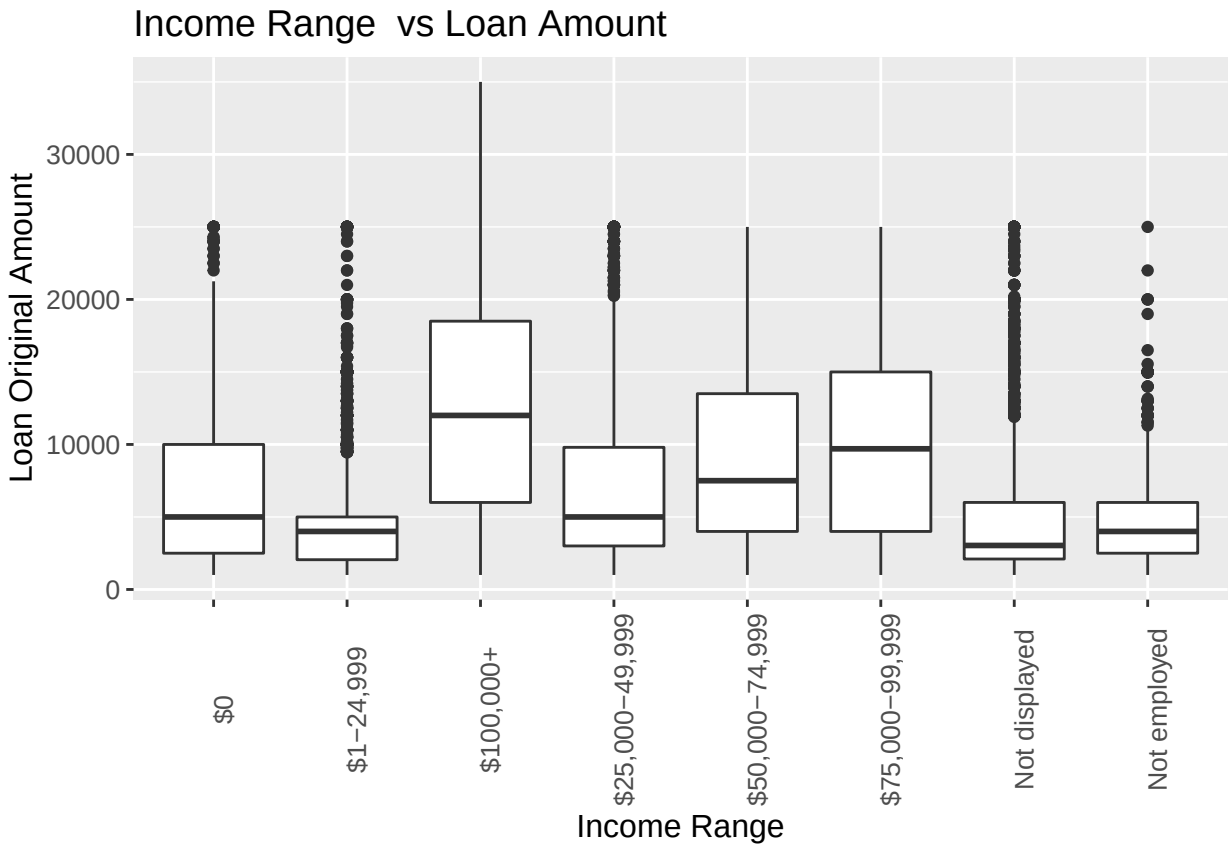
**Relationship between loan amount and terms.**




```
## df$Term: 12
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1000    2000    3500    4694    5000   25000
## ------------------------------------------------------------
## df$Term: 36
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1000    3000    5000    7276   10000   35000
## ------------------------------------------------------------
## df$Term: 60
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    2000    8000   11500   12370   15000   35000
```

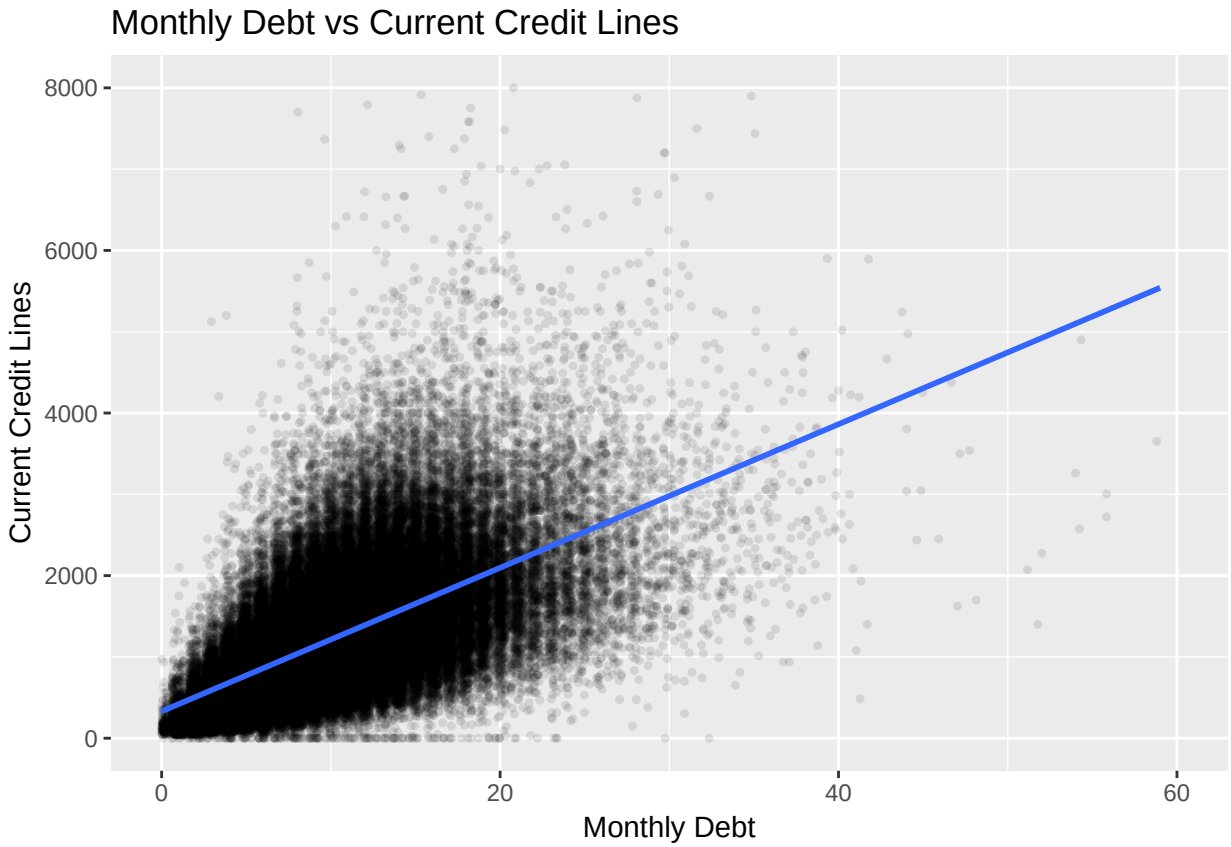
The loan amonts are getting larger with longer terms. As we can see from the Table median and mean are increasing by longer terms.

**Relationships between loan amount and the IncomeRange**



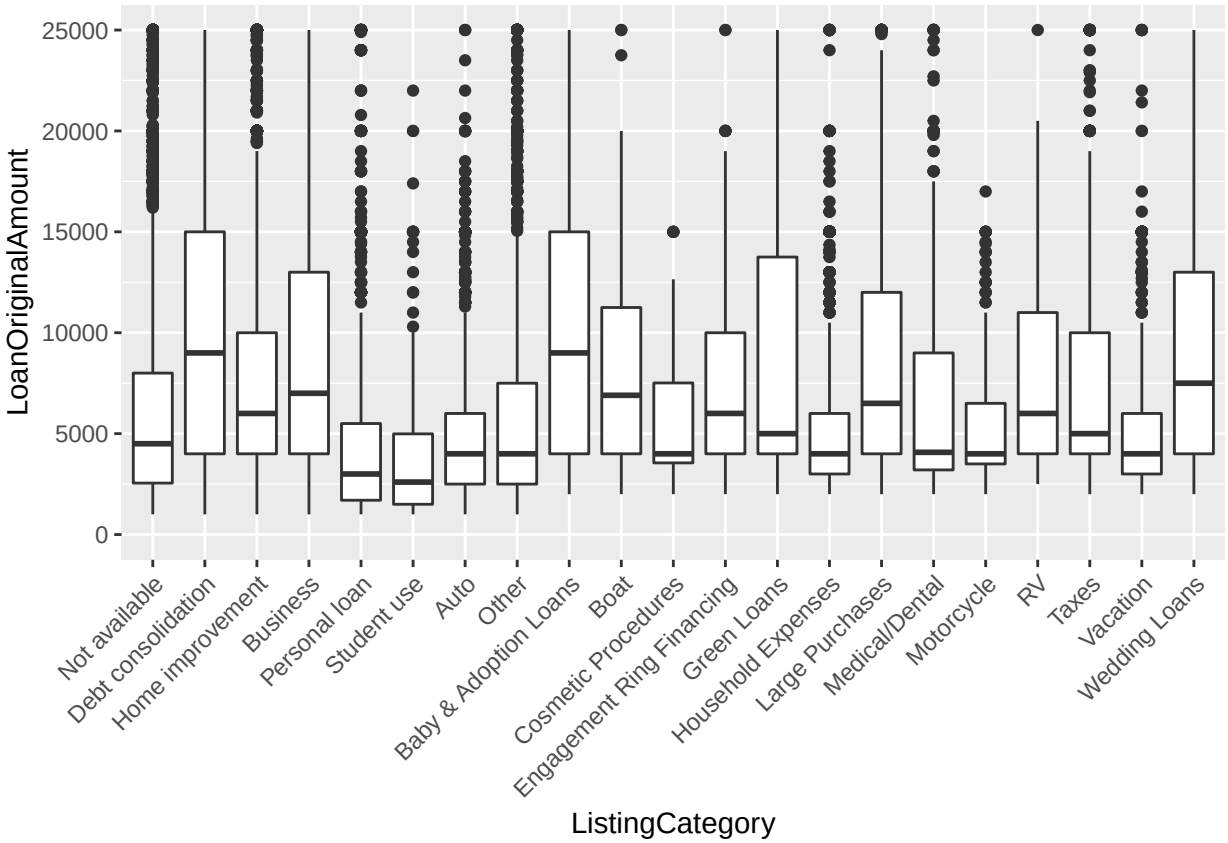

It is obvious from the box pots that larger loans on average are related to larger incomes.

**Relationship between monthly debt and current credit lines**



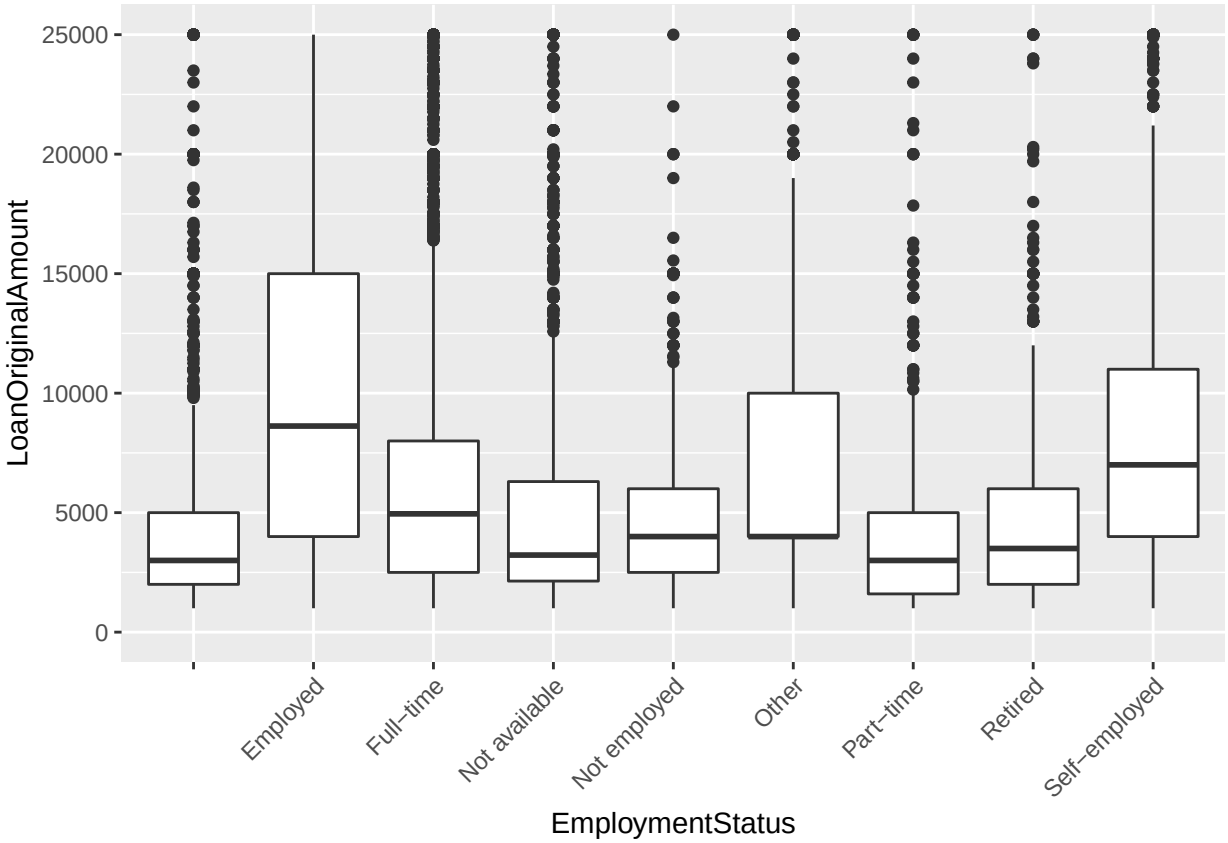

As we can see the amonth of debt is growing by increasing the number of credit lines.

**Relationship between LoanOriginalAmount with ListingCategory.**



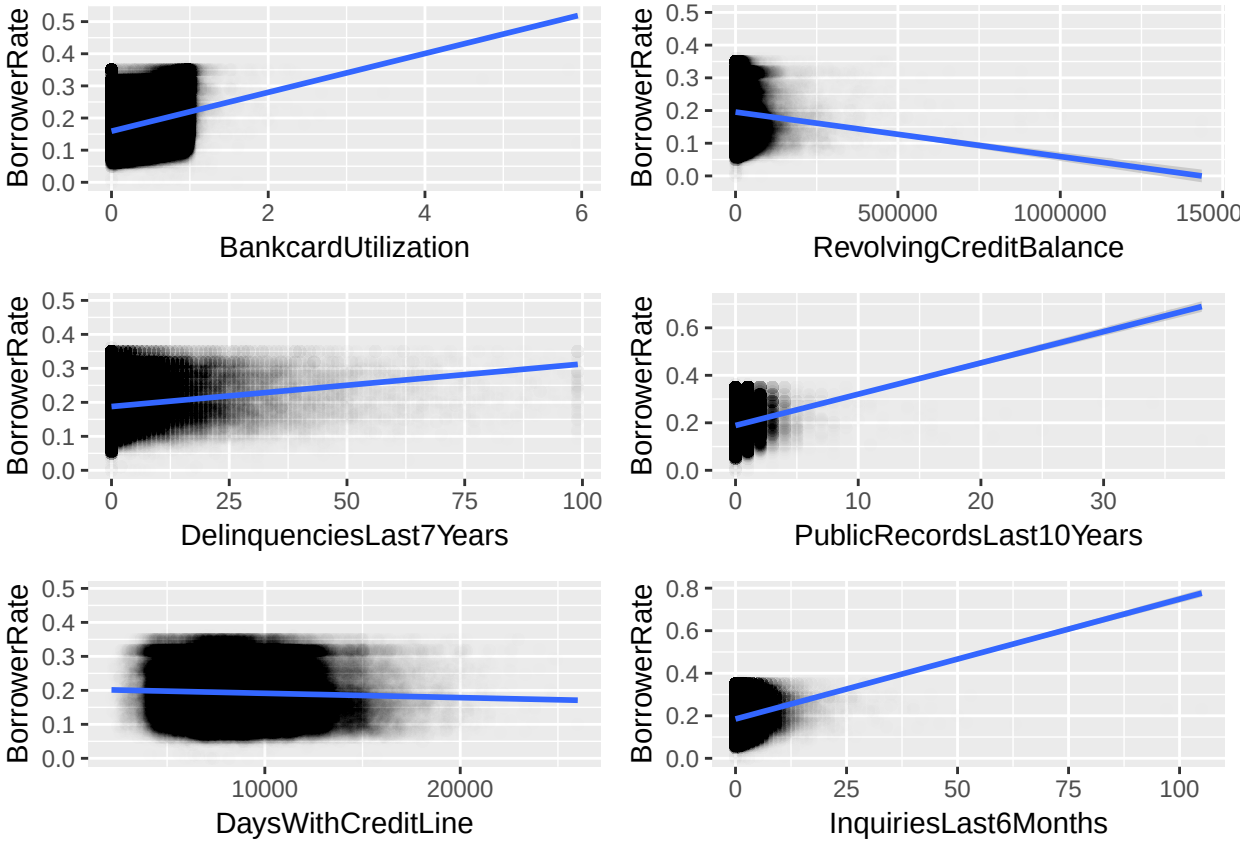

If we look at the mean values we can see that the mean of Baby & Adoption and Dept Consolidation are the highest as opposed to Student and Vacation that are the minimums.

### Employment status and loan amount




As we can see Employed people requested more loans. Interestingly, Not employed people wanted more loan than part-time employed people.

### Relationship of borrower rate and other variables.




As BankcardUtilization, DeliquenciesLast7Years, PublicRecordsLast10Years and InquiriesLast6Months increaseswith the borrower rate,as opposed to RevolvingCreditBalance, whcih decreased. DaysWithCreditLine has no significant change with BorrowerRate.

### Correlation between BorrowerRate with BankcardUtilization:

```
## [1] 0.255482
```

### Correlation between BorrowerRate with RevolvingCreditBalance:

```
## [1] -0.05960823
```

### Correlation between BorrowerRate with DelinquenciesLast7Years:

```
## [1] 0.1702787
```

### Correlation between BorrowerRate with PublicRecordsLast10Years:

```
## [1] 0.1283138
```

### Correlation between BorrowerRate with DaysWithCreditLine:

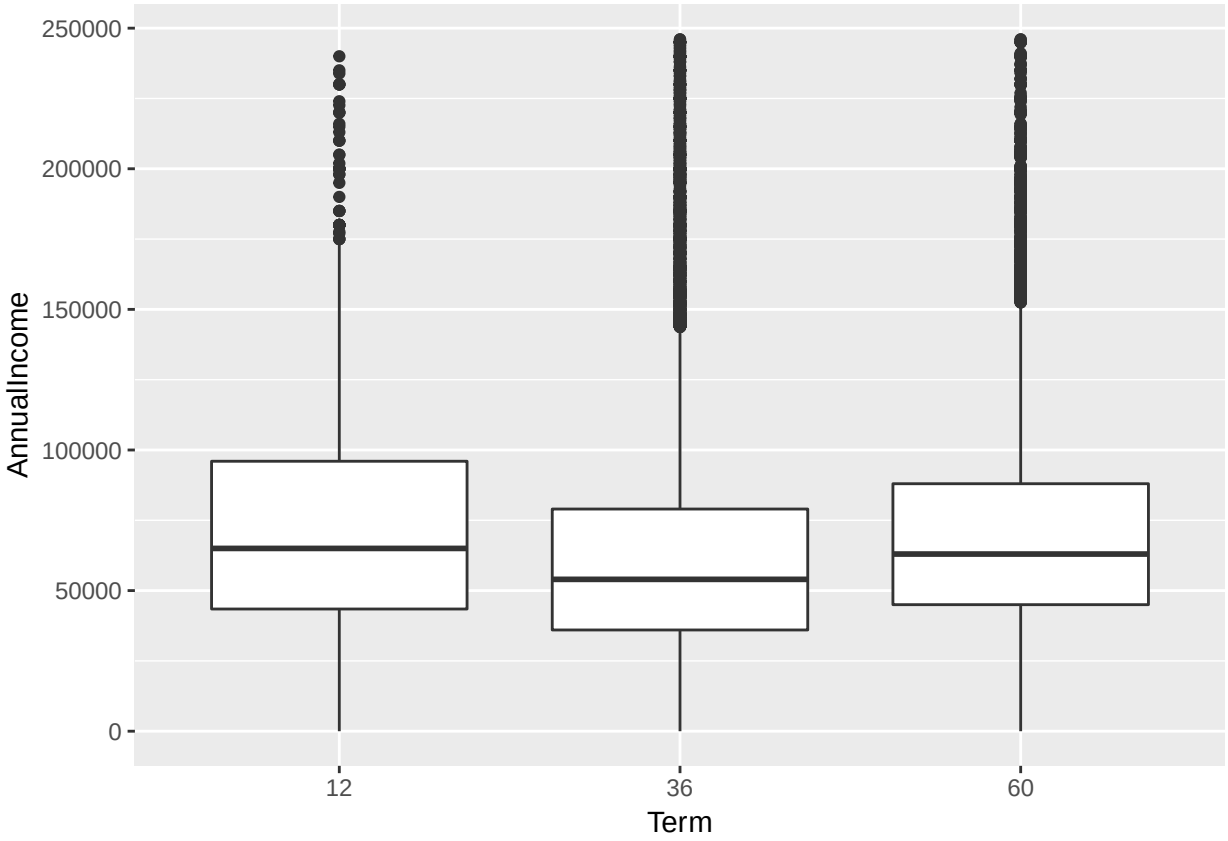
```
## [1] -0.0474466
```

### Correlation between BorrowerRate with InquiriesLast6Months:

```
## [1] 0.18381
```

None of that variebles has strong relatipnship with each other. The strongest relationship is between BorrowerRate with BankcardUtilization with 0.25.

### Relation of Term and AnnualIncome



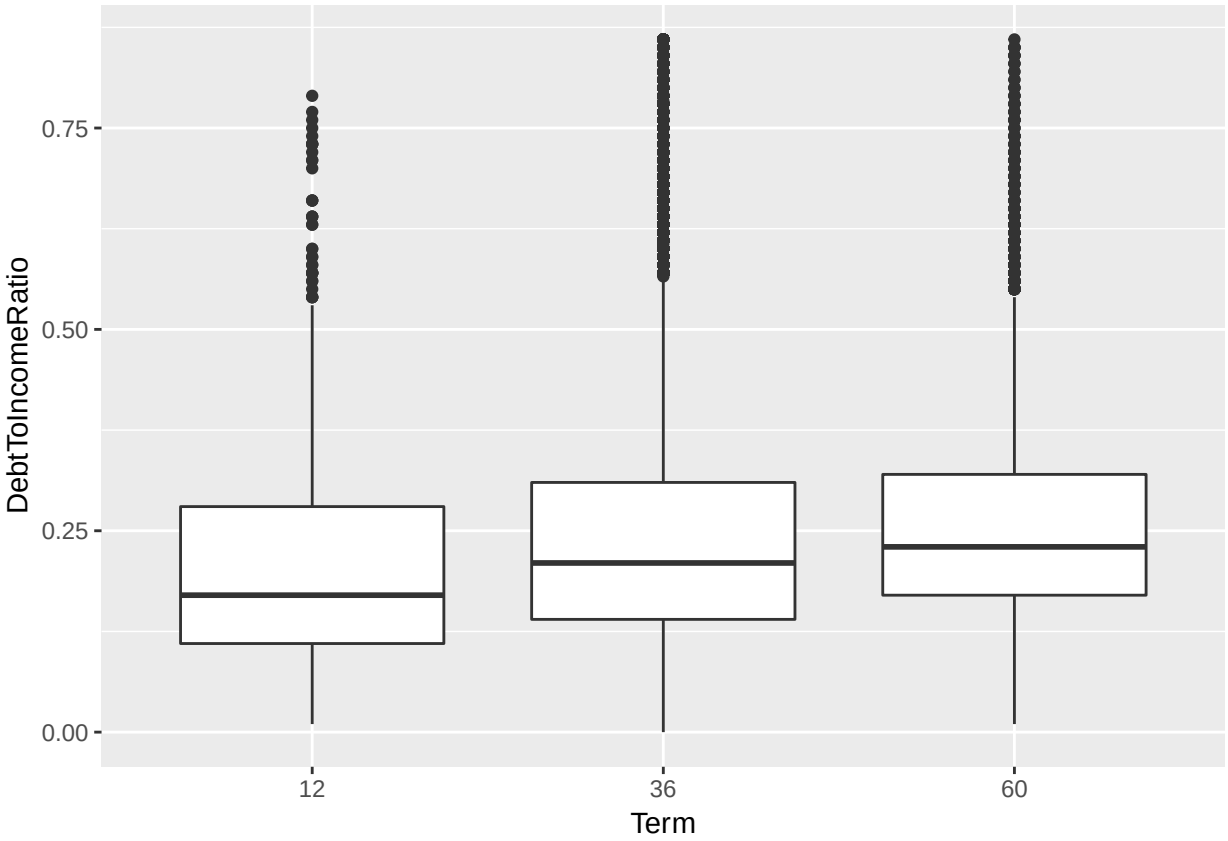

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       0   44200   67000   82658   97925 7422574
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##        0    36000    54000    65289    80000 21000035
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       0   45000   64000   73465   90000 1305000
```

The median and mean for 12 months term are the highest between term of 12,36 and 60.

### Relation betwen Term and DeptToIncomeRatito



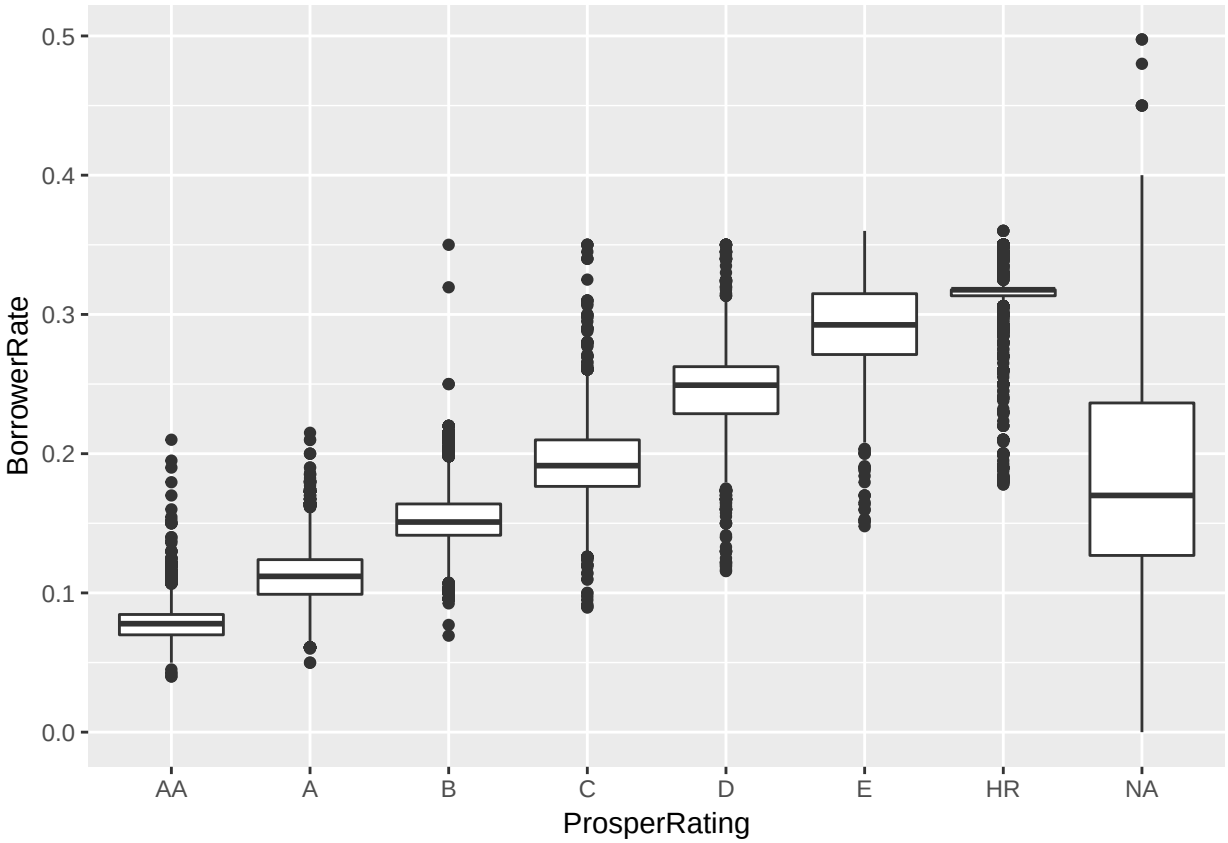

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##  0.0100  0.1100  0.1700  0.2203  0.2800 10.0100     199
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   0.140   0.210   0.283   0.310  10.010    6953
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##  0.0100  0.1700  0.2300  0.2565  0.3200 10.0100    1402
```

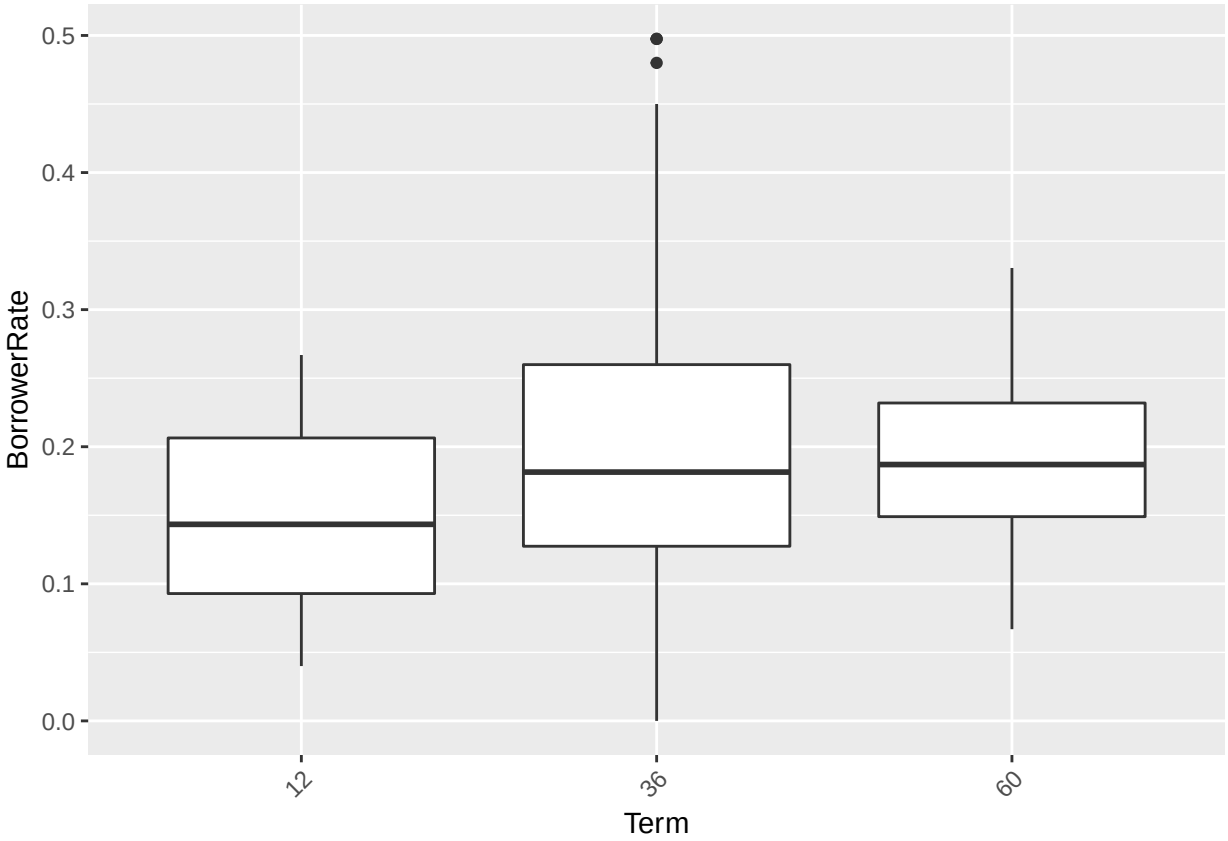
As we can see the median of the DebtToIncomeRatio increases as the terms goes up.

### ProsperRating against BorrowerRate




As we can see The better rating belongs to lower borrower rate.

### Relationship of term and borrower rate




The median of 60 month term is the highest one, while the 12 month has the minimum one.

## Bivariate Analysis

> **Tip**: As before, summarize what you found in your bivariate explorations here. Use the questions below to guide your discussion.

**Talk about some of the relationships you observed in this part of the investigation. How did the feature(s) of interest vary with other features in the dataset?**

The number of investors is increasing with higher prosper score, loan amount is bigger, borrowers have less existing prosper loans, estimated loss is lower. The mean loan amount vary trough years. The minimum mean in 2009 and the maximum one is in 2013 and 2014. We also can see for instance the borrower rate increases as debt to income ratio increases. Moreover, we can see that with bigger amonth of loan the term is also longer.

**Did you observe any interesting relationships between the other features (not the main feature(s) of interest)?**

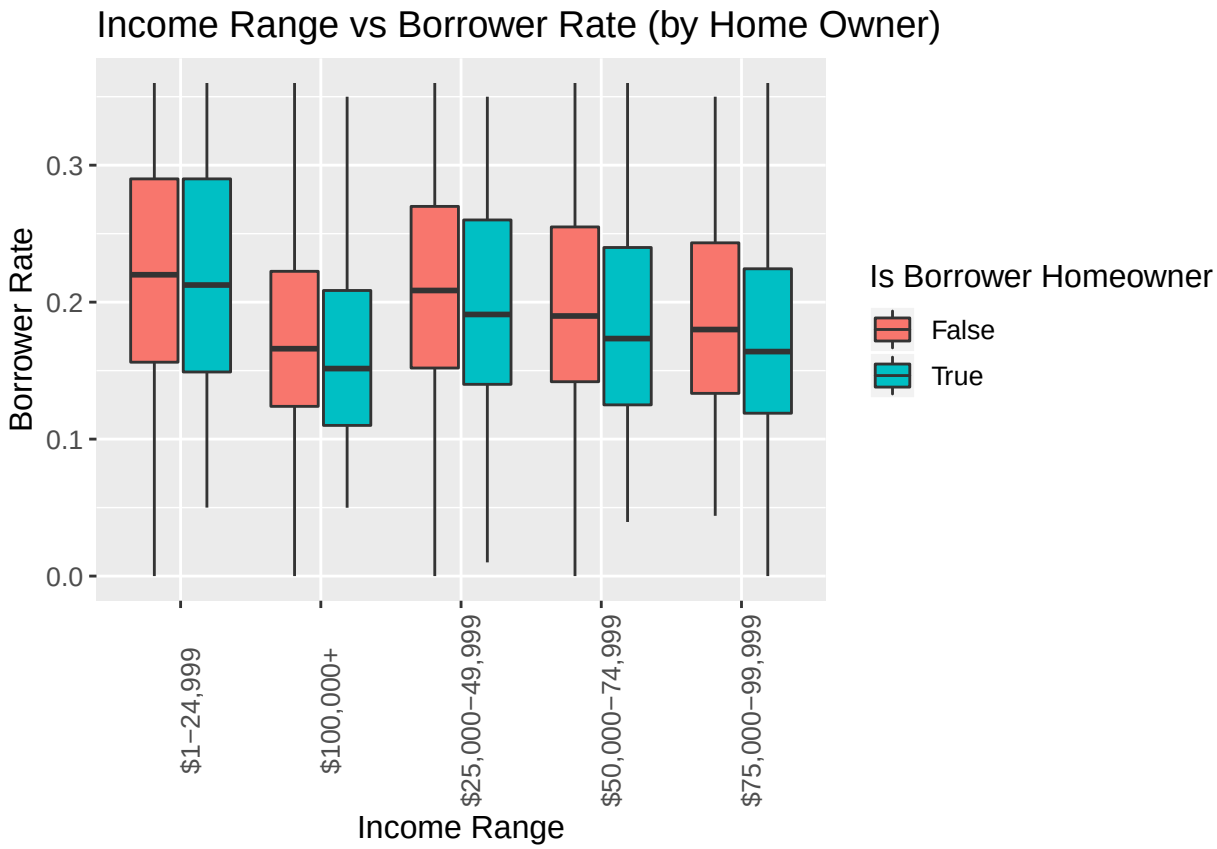
I noticed that employed people are more likely to loan than others. Also debt to income ratio for rating AA is the lowest one.

**What was the strongest relationship you found?**

The strongest relationship that I found was between BorrowerRate with BankcardUtilization with value of 0.255482.

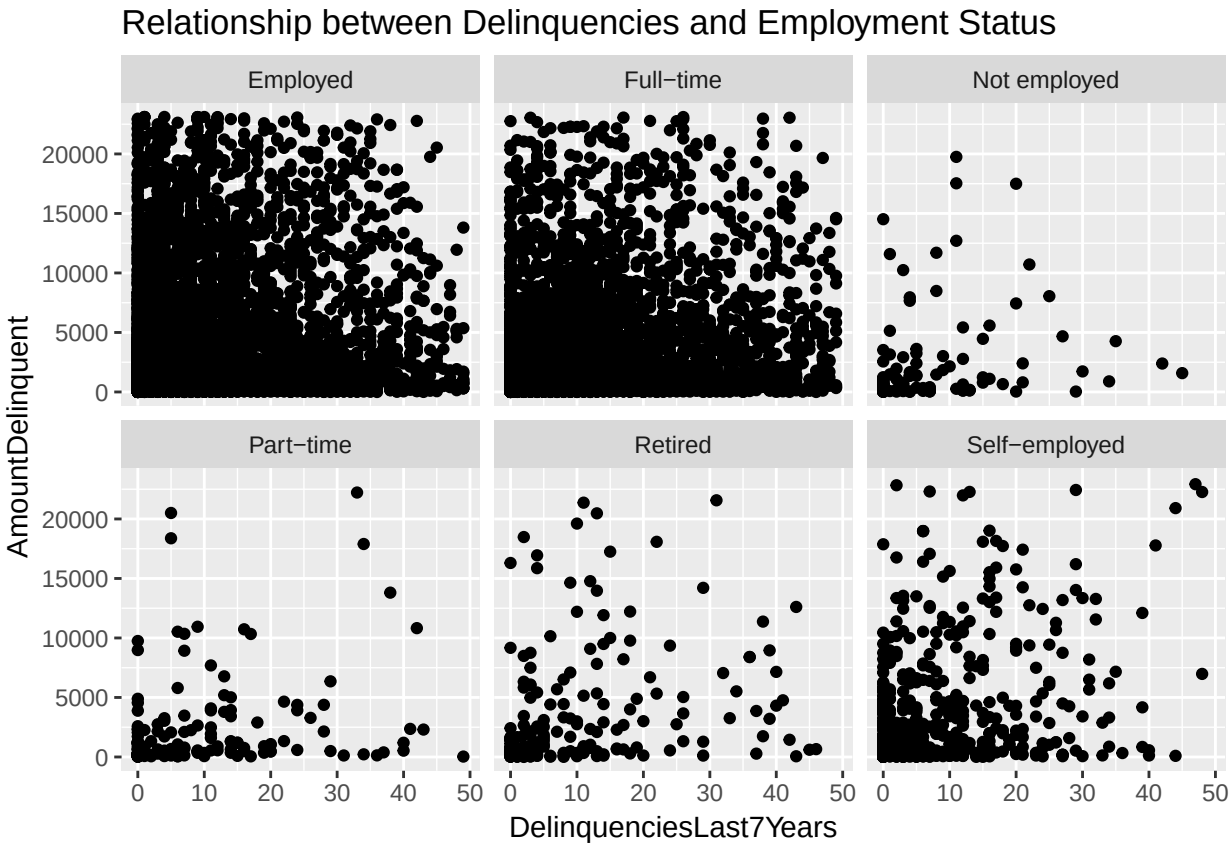
# Multivariate Plots Section

### Borrower Rate vs Income Range vs Is Borrower Homeowner



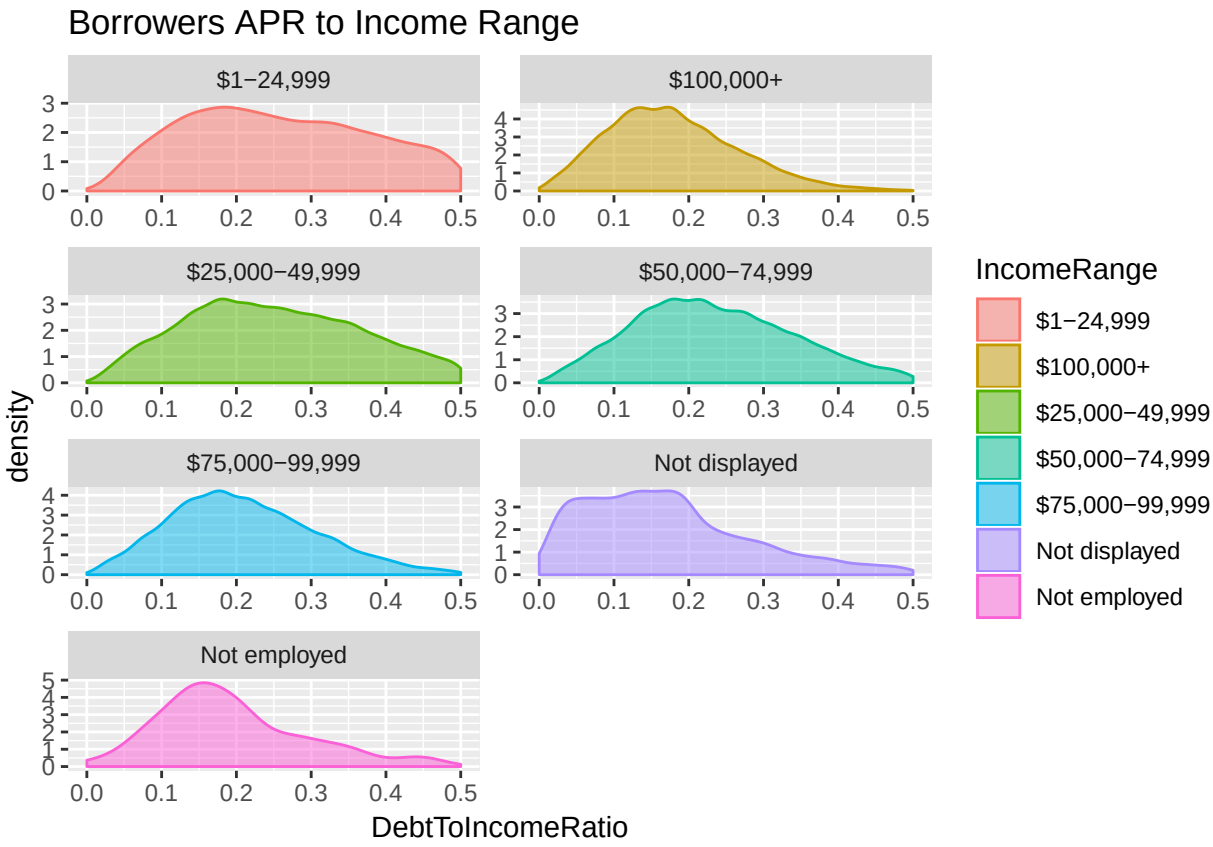

As we can see borrowers with higher income, which are home owners have lower borrower rates.

### Relationship between Delinquencies and Employment Status

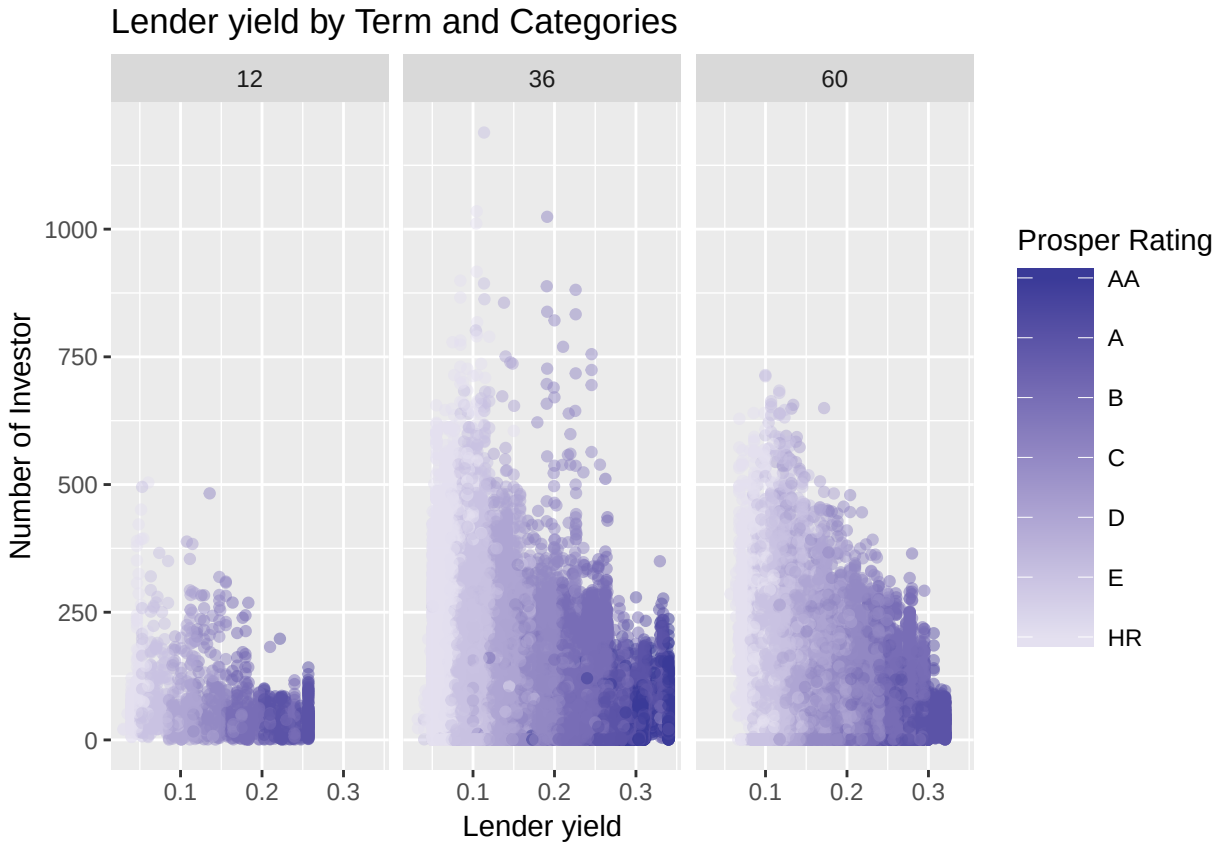



From the above we can see relationship between the amount borrowers were delinquent and the number of delinquencies they've had over the last 7 years then separated that by employment status. Is obvious that Employed and Full time are the maximum.

**Relationshiop between Debt to Income**

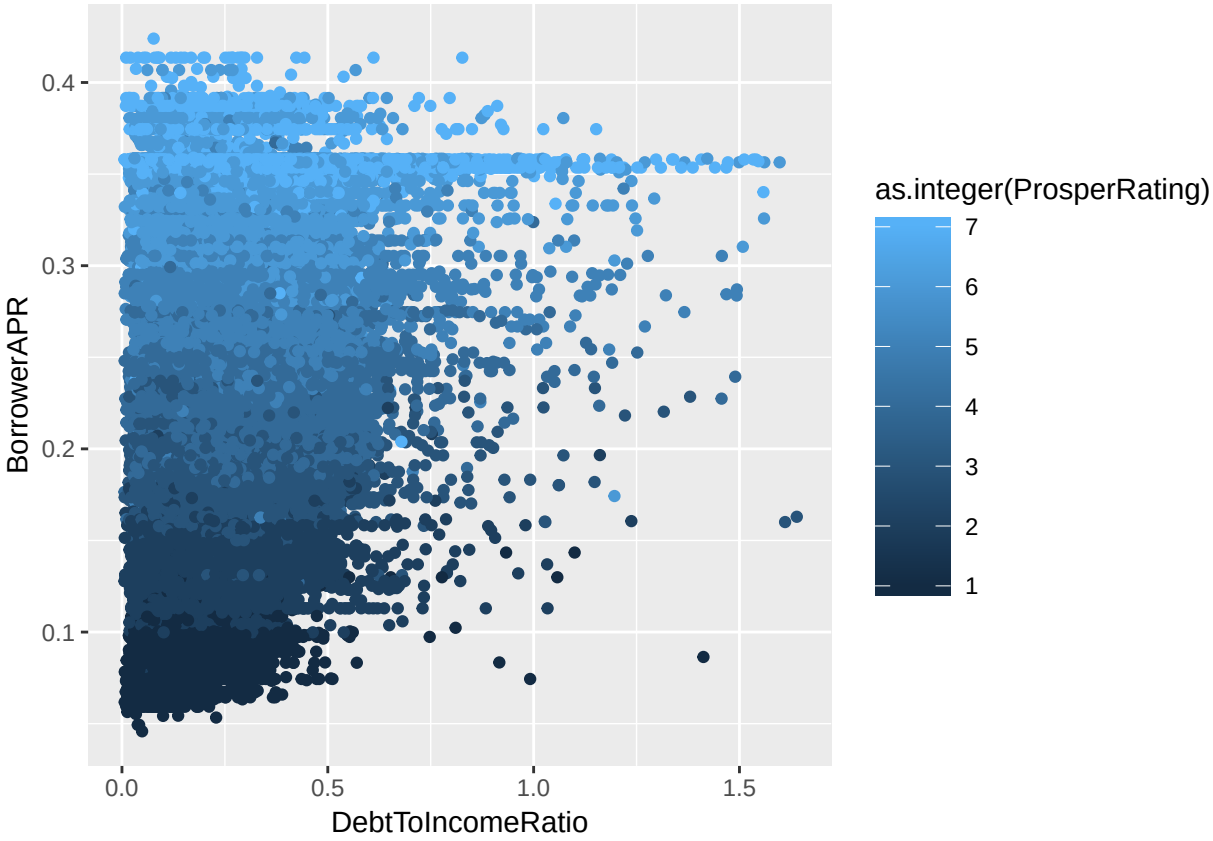


**Relationship between a lender yield on the loan and the number of investors with risk rating**




This plot shows the relationship between a lender yield on the loan and the number of investors with the duration of the loan and the prosper rating.

**Relationship between dept to income ratio and borrowerAPR with prosper rating**




Above plot describes the risk category based on to the particular loan.It displays the progression from a safe area, green color, to a risky area, red color,.

# Multivariate Analysis

**Talk about some of the relationships you observed in this part of the investigation. Were there features that strengthened each other in terms of looking at your feature(s) of interest?**

Monthly income had positive and late payments has negative correlation with Rating. The number of investors is increasing when the prosper score is getting beter and loan amount is getting bigger too. Also we can see that higher loan amounts have longer term.

**Were there any interesting or surprising interactions between features?**

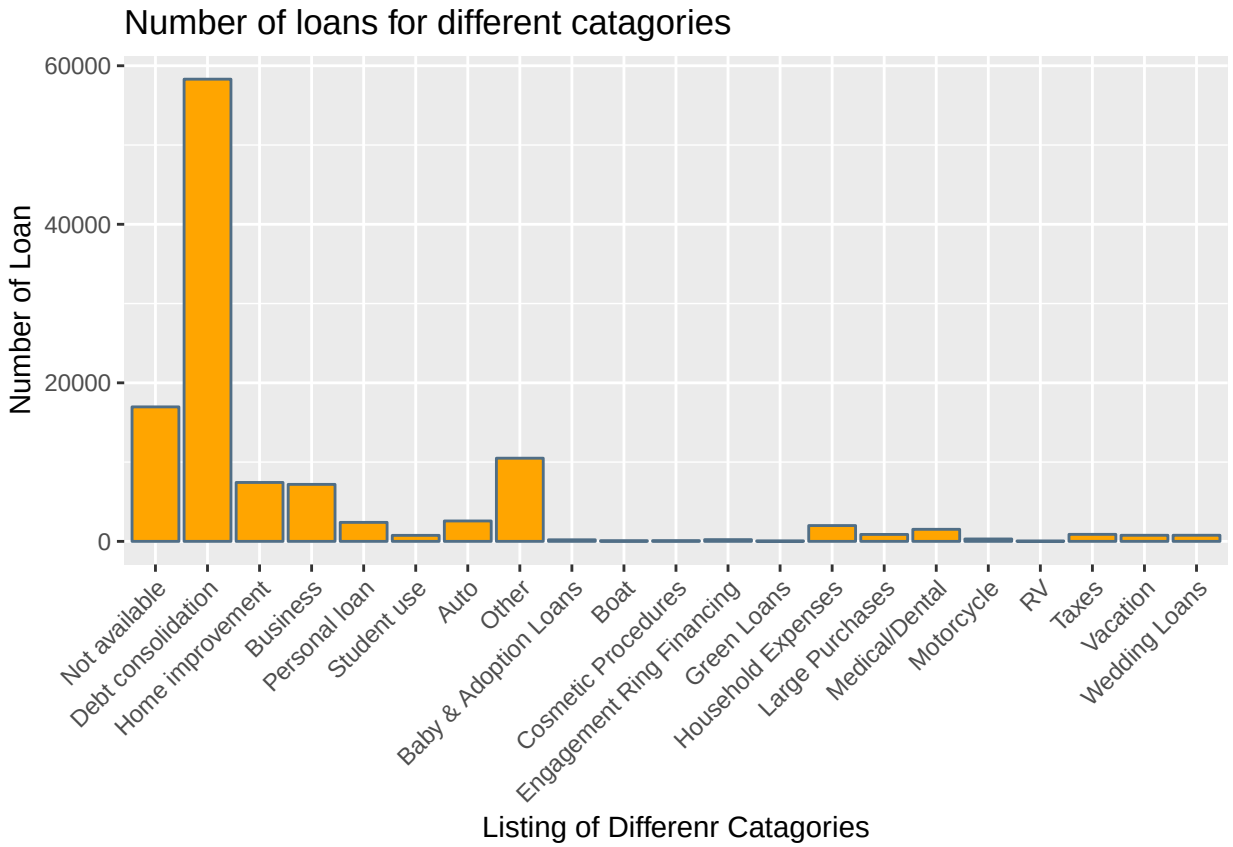
I've observed that employed people are more likely to borrow money.

**OPTIONAL: Did you create any models with your dataset? Discuss the strengths and limitations of your model.**

No I did not.

## Final Plots and Summary

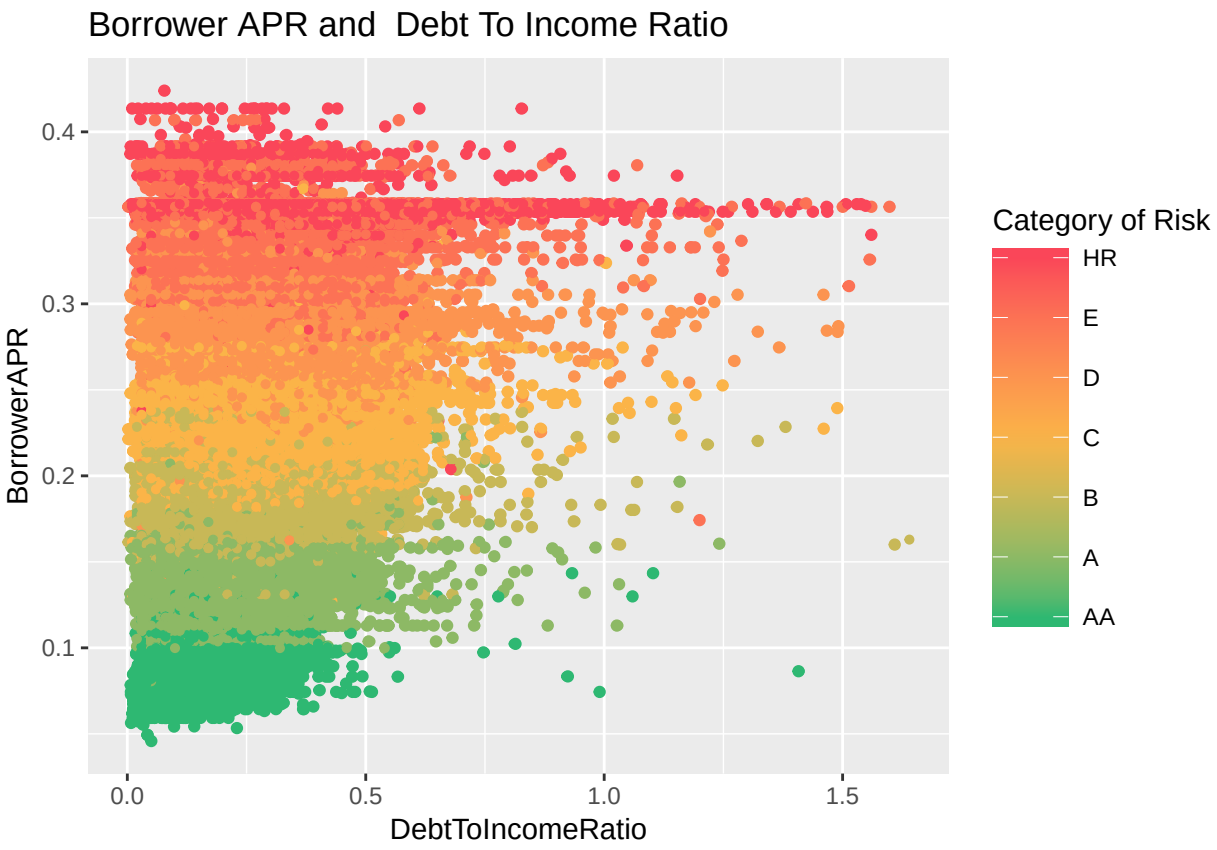
### Plot One




### Description One

As we can see largest number of the loans belongs to debt consolidation, about 60000 loans, while home improvement, business and other are at the next steps (Not Available is not considered). I choose this plot because I wanted to know in which areas people use prosper loan.

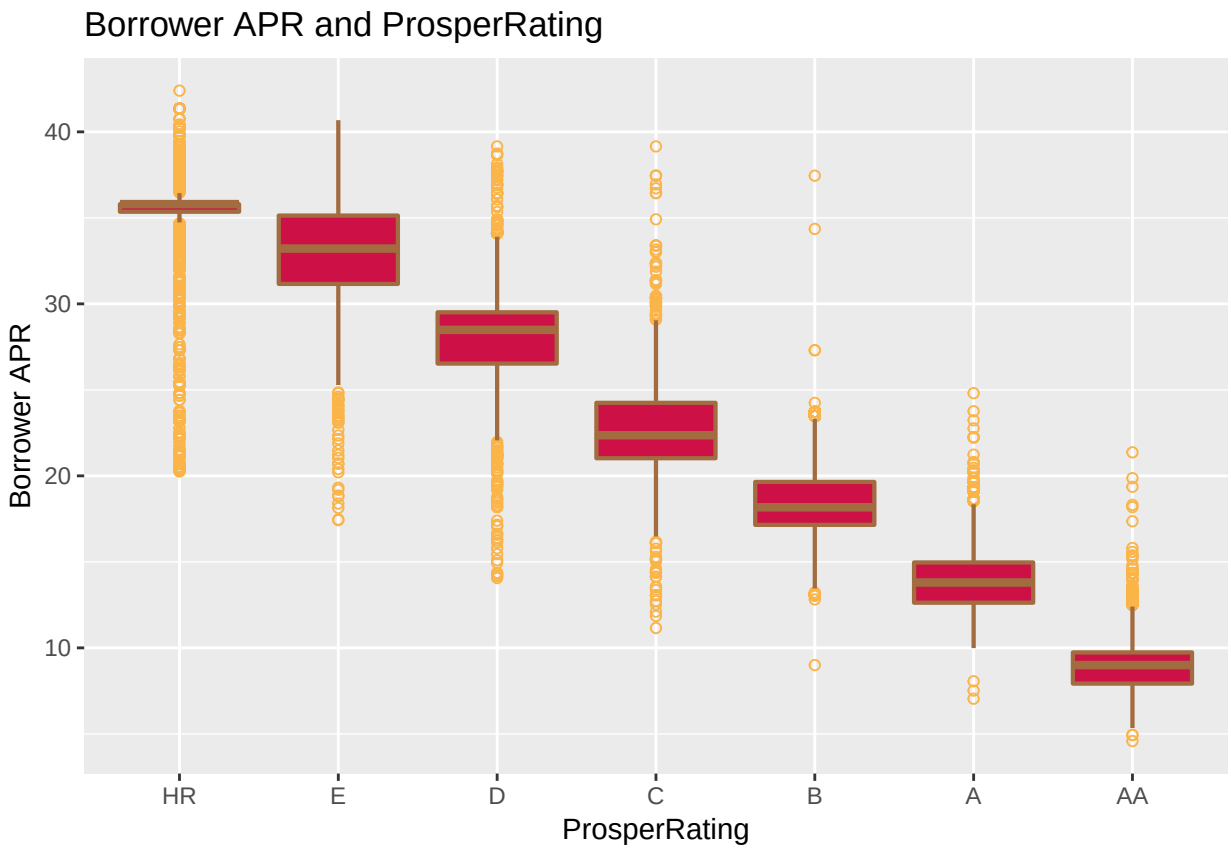
**Plot Two**




**Description Two**

This scatter plot shows us the relationship between Dept to Income Ratio and BorrowerAPR and the colors illustrate the risky areas for the particular loan. The green color is the most safest zone and the red color is the most risky one. I also deleted outliers from this plot(0.05%). We can see that APR is going up with the increase of rating risk. Also we can see that majority of people have debt-to-income ratios below 1.

**Plot Three**




**Description Three**

The boxplots above show the relationship between borrower's Prosper rating and their assigned Annual Percentage Rate. As we can see lower APR has less risk thtan higher one. Moreover, we can see that the variation in APR goes down in safer zones.

# Reflection

Well I selected this project maninly because I did not know anything about loan, peosper loan, peer to peer lending business etc. and I wanted to learn something new. I spent a lot of time to learn about prosper loan and also spent even more time to understand each variable in the dataset. Also I was a little struggling with ggplot syntax and I checked Stackoverflow and Google alot during this project. :)

Following are some of the interesting features which I observed during the exploratory analysis:

- Most of borrowers Income ranges from 25,000 - 74,999.
- Most loans are taken for debt consolidation.
- There are 3 loan terms 12, 36 and 60 months and the most popular one is 36 month.
- Borrower who home owner usually receive bigger loan than others.
- The Borrower rate of Interest and Lender Yield is low for higher Credit Grades and high for lower Credit Grades.
- Employed person are more likley to take loan thatn others.