

Project Report

Increase Rate of An Internet
Financial Company

Enqun Wang, Yiyan Zhou

May 3, 2016

Project Charter

Enqun Wang (EW), Yiyan Zhou (YZ)

April 1, 2016

Problem Statement

Data from January throughout April, 2016, from First P2P, reflects an *average 1.0370%* five-day increase rate of trading volume of the platform with around *15% defective values*. Based on the financial professional knowledge, operation condition of the company, and the financial market environment, it is believed that a five-day increase rate is normally distributed with constant variance, and a value that *less than 0.83% (assumed to be constant in our project)* is regarded as *a defective value*, which can lead to a reduction in benefit of the company.

Project Objective

Reduce the proportion of defective values from *15%* to *9%* (*67% improvement*) by the end of the second quarter (June 30, 2016), given the normality with constant variance assumption. That is equivalent to increase the five-day increase rate of the trading volume from *1.04%* to the *1.10%*.

Project Team

Name	Role	Comments	Phone
Enqun Wang	Operation Analyst	Organize the project and assign the detailed work to team members	(720) 231 5851
Yiyan Zhou	Operation Analyst	Finish what the leader assigned and give advises	(970) 294 5303
Chee-Yong Tan	Operation executive officer	Adjust the strategies	

Project Definition and Scoping

Metrics (unit of measure):

- The percentage (%) of defective values (five-day increase rate of trading volume less than 0.83%).

Critical to Satisfaction (linkage to customer):

Individual investors and companies with financing needs are two major types of our clients. An relatively high proportion of defective values (five-day increase rate of trading volume less than 0.83%) can result financial products of higher prices, therefore individual investors would earn less money and customer companies looking for finance would spend more money. Furthermore, it might lead to a reduction in benefit of the internet finance company.

Defect Definition (include opportunity):

Any five-day increase rate less than 0.83% is regarded as a defective value, which can result financial products of higher prices, therefore individual investors would earn less money and customer companies would spend more money. Furthermore, it might lead to a reduction in benefit of the internet finance company. We assume that the criteria value (0.83%) is a constant in the scope of our project.

Scope of Project:

The project focuses on the first two quarters of 2016, from January 1, 2016 to June 30, 2016. The data is collected at April 20, 2016 from the database of the company, thus we scope this project from January 1 to April 20.

5W2H

Enqun Wang (EW), Yiyan Zhou (YZ)

April 1, 2016

Why?

Why is it important to solve this problem? Why is it important to improve this process? Formulate in terms of expected benefits

A high proportion of defective values (five-day increase rate of trading volumn less than 0.83%) can result to financial products of our company to higher prices; furthermore, investors would earn less and custmoer companies looking for finance would spend more money. Solving this problem can benefit the investors and custmoer companies.

Who?

Who is involved in the process? Who is affected by the problem? Who is interested in solving the problem?

Individual investors and custmor companies are involoved in this process. Low five-day increase rate would cause individual investors earn less and the companies would spend more money.

Where?

Where is the problem located? In which processes do the problems occur?

This problem is located in the process of operation and in the financial market.

When?

When did or does the problem happen? How often did or does the problem happen? When did the problem start?

The opportunity has been exist since November of 2015 and is detected by the Operation Executive Offiecer (OEO) of the company. This kind of issues happed when the strategies are no longer appropriate for the finançail market.

What?

What is the defect? What activities, parts and procedures are involved? What happens, when the problems occur?

Any five-day increase rate less than 0.83% is regarded as a defective value, which can result financial products of higher prices, therefore individual investors would eran less money and customer companies looking for finance would spend more money. Furthermore, it might lead to a reduction in benefit of the internet finance company.

How?

How do you know it is a problem? How was the problem identified? How often does it happen?

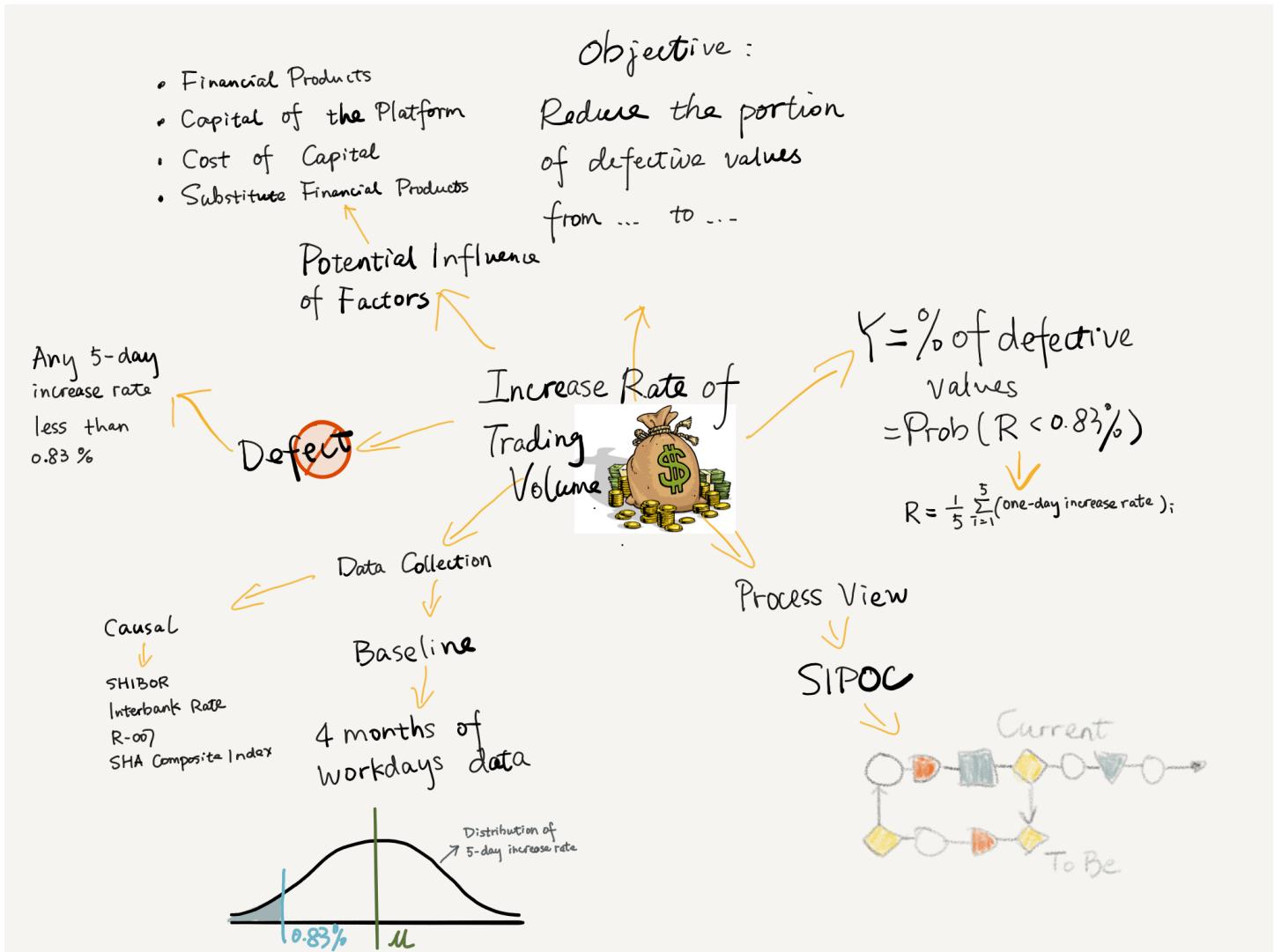
Operation Executive Offiecer (OEO) detected this is a problem and assigned tasks to our team. It is a problem for that it can lead to low increase rate of the trading volume. It is defined as no effective reaction or response to the fluctuation of the finance market. The problem happening follows the periods of the strategies and the fluctuation of the financial market.

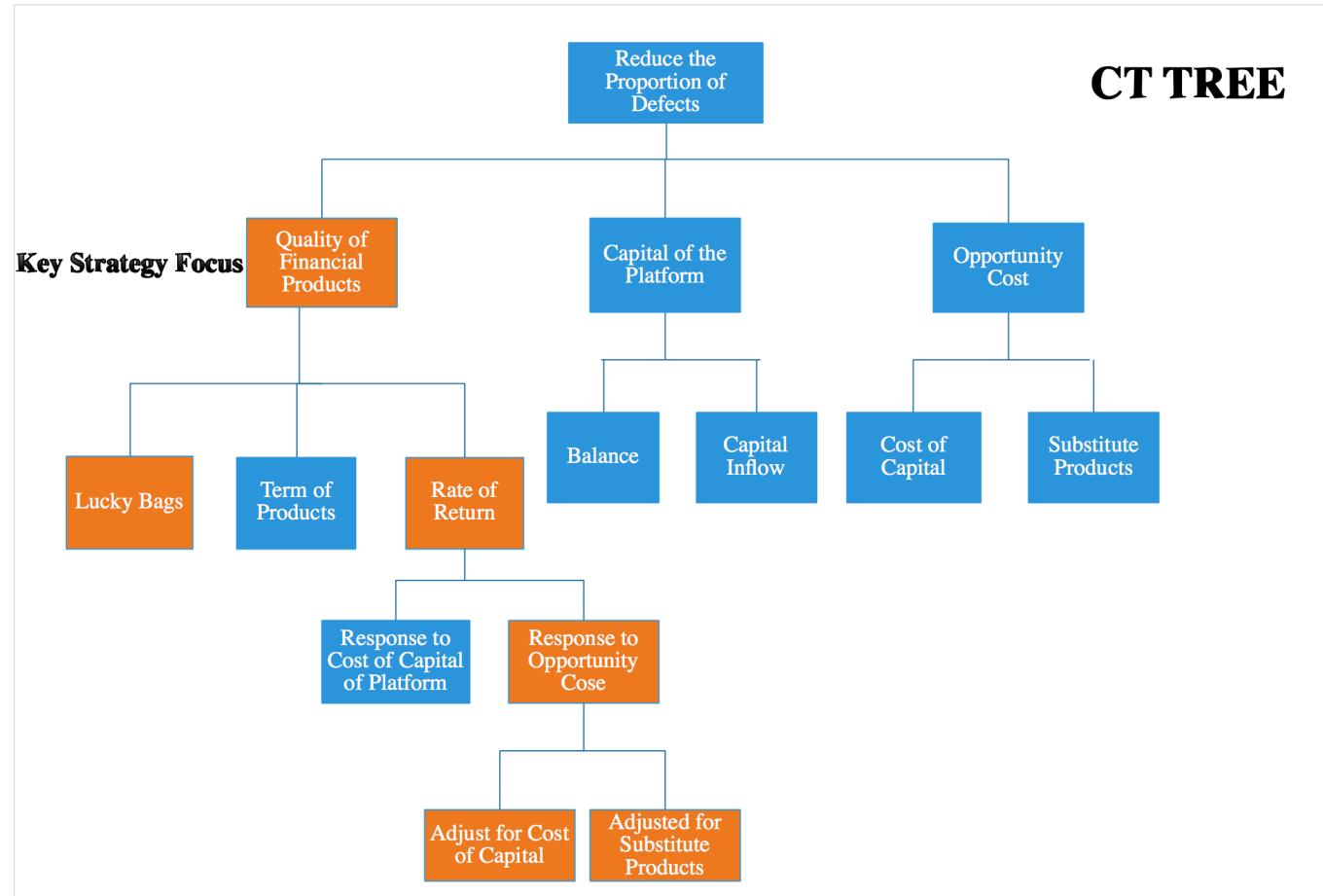
How many?

How many defects/units/people? How much money was spent? Do these numbers change or do they stay the same?

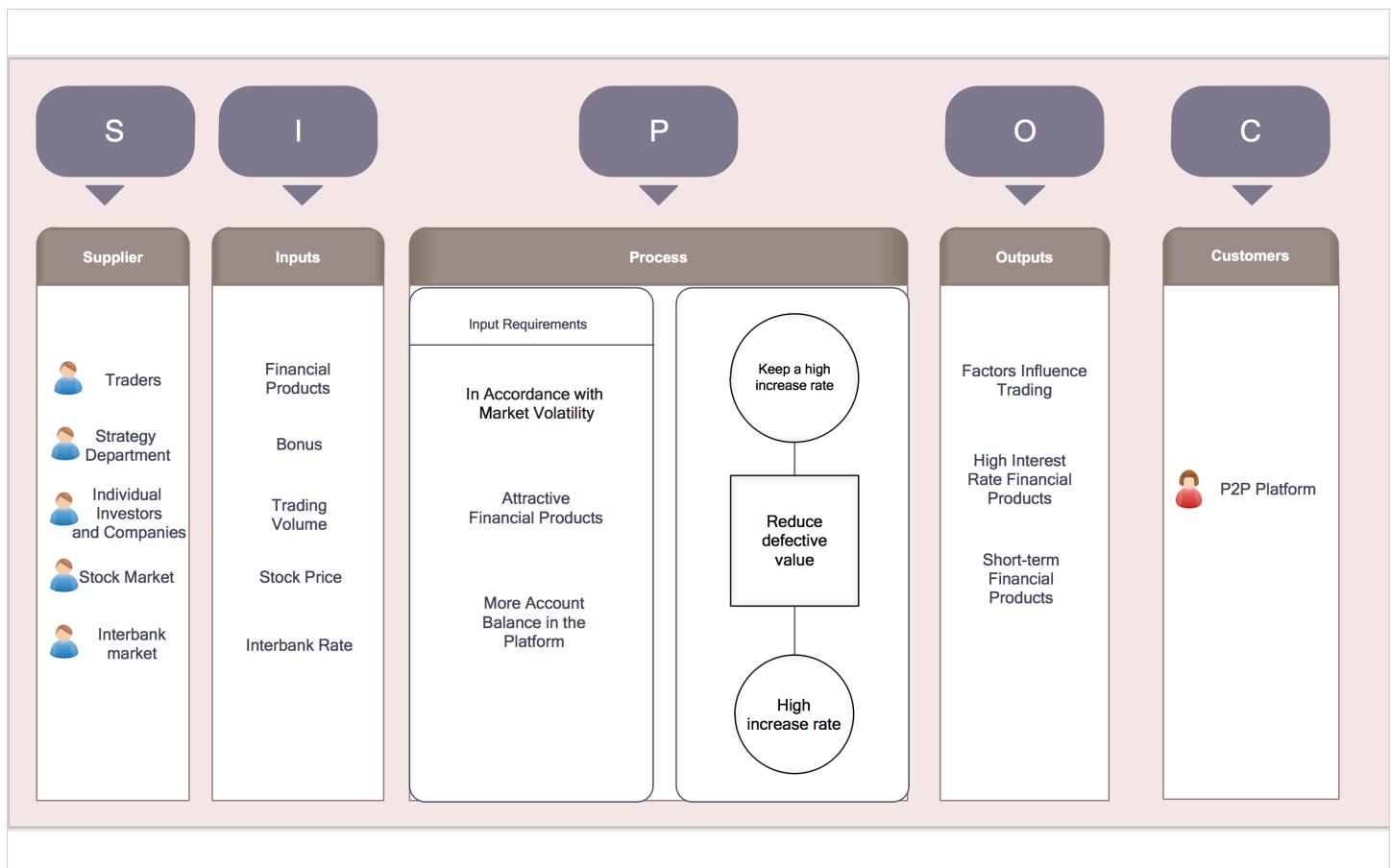
Only one defect but related all individual investors and all custmor companies in this project. The number of investors and companies vary based on the significance of the defect. As the compeny is a internet finance compay, the money spent is a kind of strategy and in high frequency.

Thought Process Map

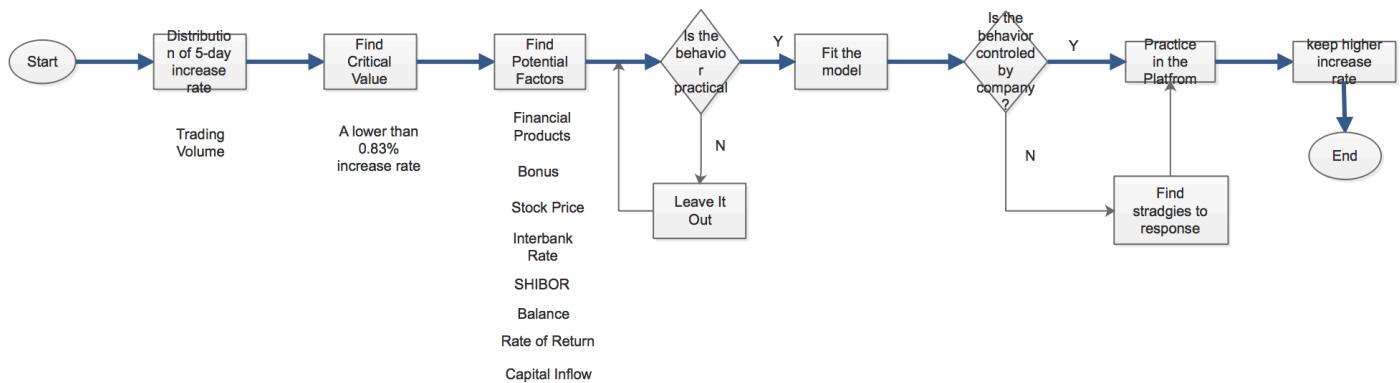




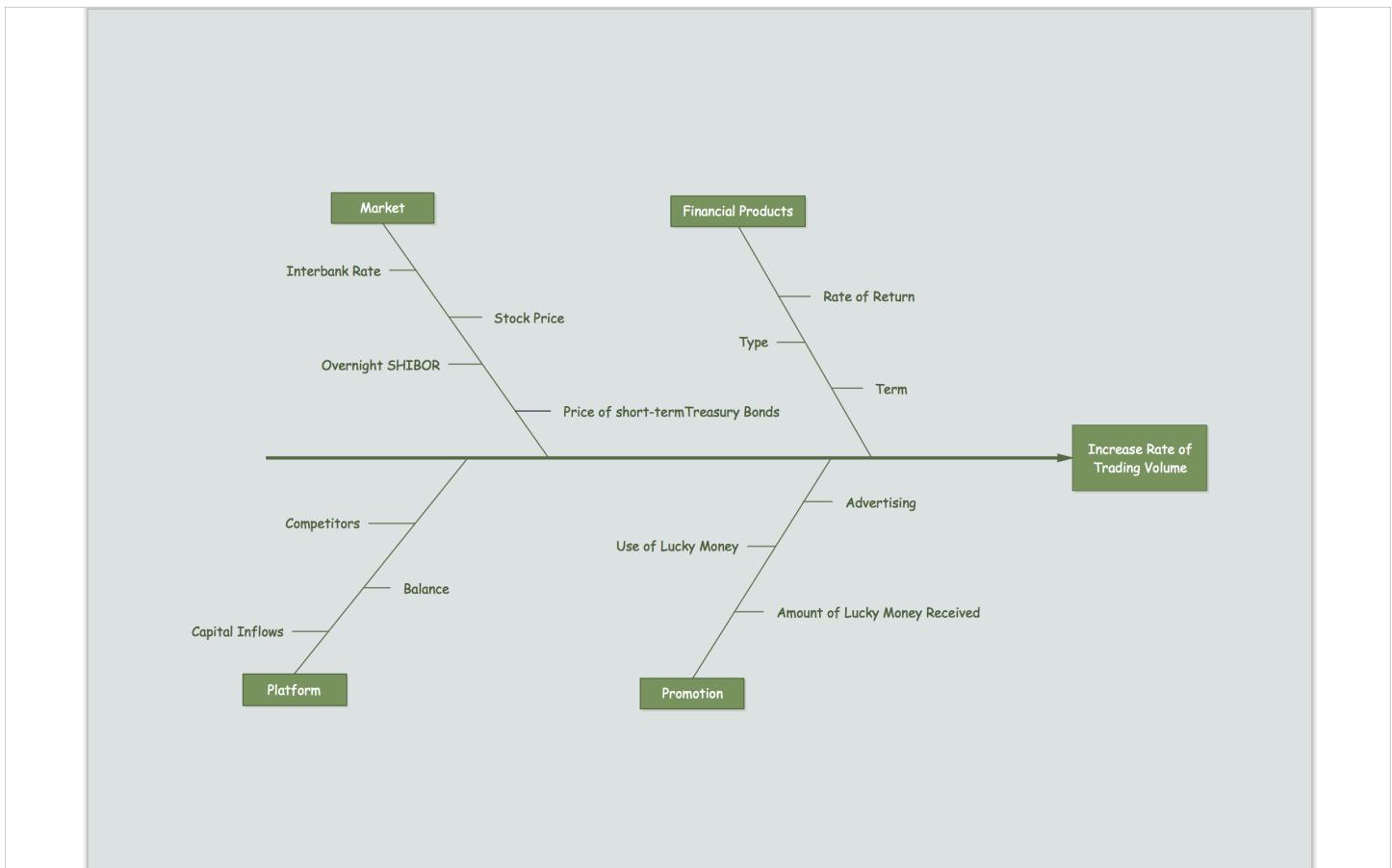
SIPOC



Process Flow Map



C&E Diagram



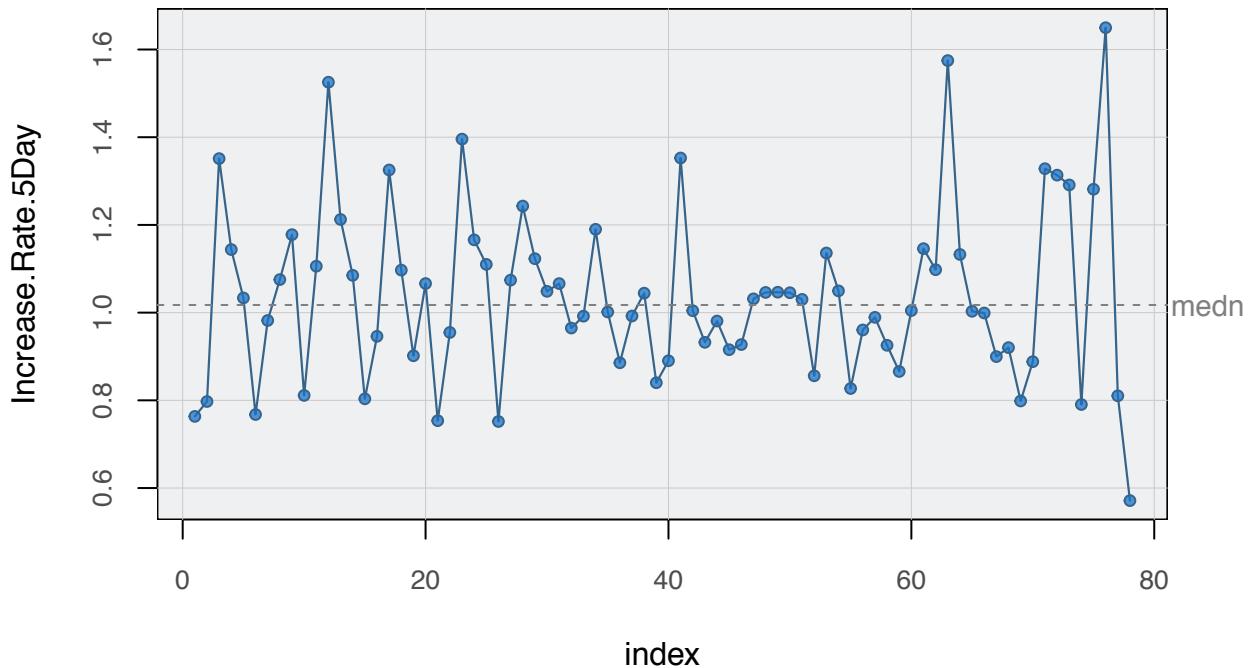
Run Chart

Enqun Wang

April 16, 2016

Run Chart

- The run chart indicates oscillating patterns. Oscillation occurs when the data fluctuates up and down, indicating that the process is not steady. However, this is the common situation in the finance field.



```
## --- Increase.Rate.5Day ---
##
## 
## n: 78
## missing: 0
## median: 1.017472
##
## -----
## Run Analysis
## -----
## 
## size=2  Run  1:      1      2
## size=3  Run  2:      3      4      5
```

```

## size=2 Run 3:   6   7
## size=2 Run 4:   8   9
## size=1 Run 5:  10
## size=4 Run 6:  11  12   13   14
## size=2 Run 7:  15  16
## size=2 Run 8:  17  18
## size=1 Run 9:  19
## size=1 Run 10: 20
## size=2 Run 11: 21  22
## size=3 Run 12: 23  24   25
## size=1 Run 13: 26
## size=5 Run 14: 27  28   29   30   31
## size=2 Run 15: 32  33
## size=1 Run 16: 34
## size=3 Run 17: 35  36   37
## size=1 Run 18: 38
## size=2 Run 19: 39  40
## size=1 Run 20: 41
## size=5 Run 21: 42  43   44   45   46
## size=5 Run 22: 47  48   49   50   51
## size=1 Run 23: 52
## size=2 Run 24: 53  54
## size=6 Run 25: 55  56   57   58   59   60
## size=4 Run 26: 61  62   63   64
## size=6 Run 27: 65  66   67   68   69   70
## size=3 Run 28: 71  72   73
## size=1 Run 29: 74
## size=2 Run 30: 75  76
## size=2 Run 31: 77  78
##
## Total number of runs: 31
## Total number of values that do not equal the median: 78
## Total number of values ignored that equal the median: 0

```

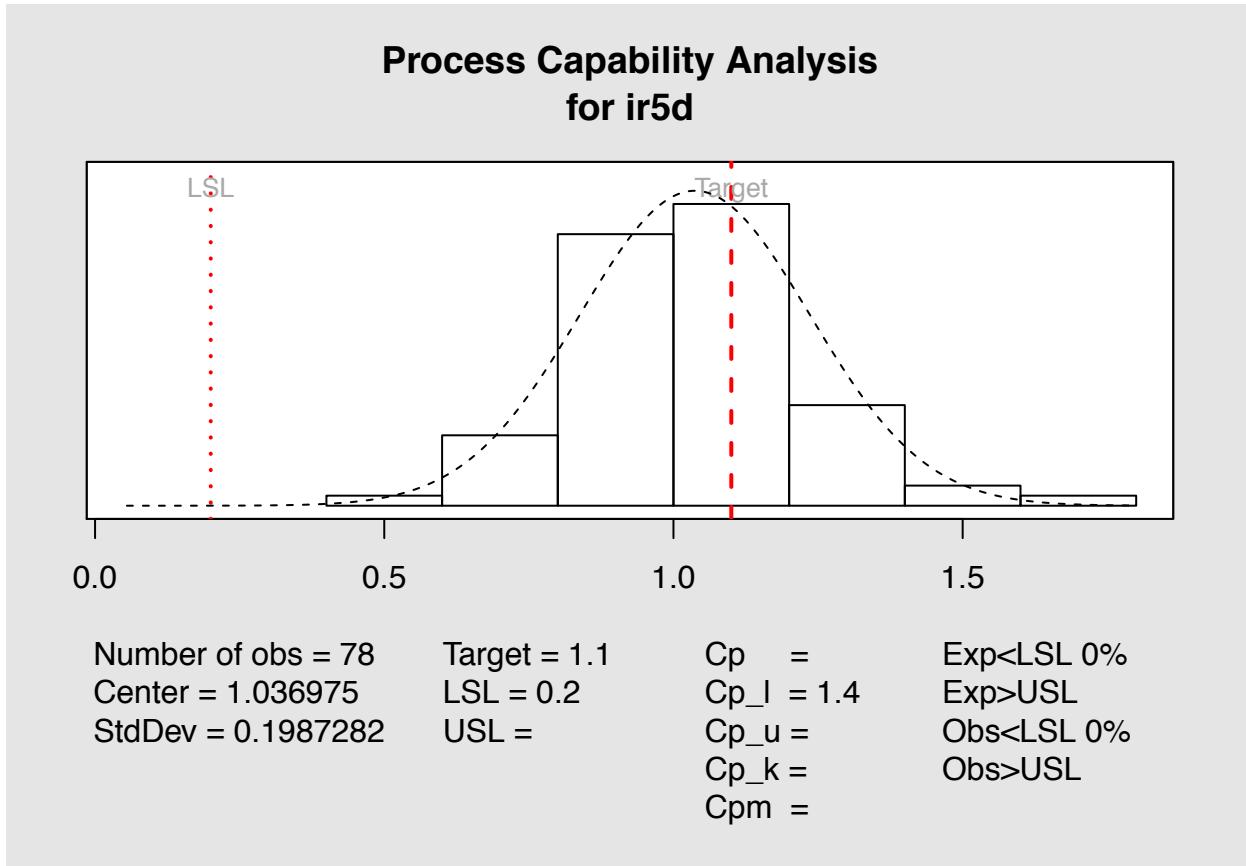
Process Capability Analysis

Enqun Wang

April 20, 2016

Process Capability Analysis

- The Cp_l is 1.404, with a confidence interval (1.208, 1.6), which indicates that the process is capable.



```
##  
## Process Capability Analysis  
##  
## Call:  
## process.capability(object = object, spec.limits = c(lsl, usl),      target = target)  
##  
## Number of obs = 78          Target = 1.1  
##       Center = 1.037        LSL = 0.2  
##       StdDev = 0.1987       USL =  
##  
## Capability indices:  
##  
##       Value   2.5%  97.5%  
## Cp
```

```

## Cp_l  1.404  1.208    1.6
## Cp_u
## Cp_k
## Cpm
##
## Exp<LSL 0%    Obs<LSL 0%
## Exp>USL   Obs>USL

##
## To cite qcc in publications use:
##
##   Scrucca, L. (2004). qcc: an R package for quality control
##   charting and statistical process control. R News 4/1, 11-17.
##
## A BibTeX entry for LaTeX users is
##
## @Article{,
##   title = {qcc: an R package for quality control charting and statistical process control},
##   author = {Luca Scrucca},
##   journal = {R News},
##   year = {2004},
##   pages = {11--17},
##   volume = {4/1},
##   url = {http://CRAN.R-project.org/doc/Rnews/},
## }

```

Variable Explanation

variables	Illustration
Five-day increase rate of trading volume	Recode the increase rate of total trading volume in the platform in five days. Unit: %.
Products weighted rate of return	Recode the weighted rate of return for the products of the day. Weight: Transaction amount; Unit: %.
Product weighted term	Recode the product weighted term of the day. Weight: Transaction amount; Unit: month.
Amount of receiving the lucky money	Recode the amount of users' receiving lucky money of the day. Unit: Chinese Yuan.
Amount of using the lucky money	Recode the total amount of users' using the lucky money of the day. Unit: Chinese Yuan.
Total account balance	Record all users' total account balance at 12:00 am. Unit: Chinese Yuan
Net capital inflows	Recode the platform's (Capital inflows - Capital outflows). Unit: Chinese Yuan.
The closing price of treasury bonds repurchase in 7 days.	The closing price of treasury bonds repurchase in 7 days. Price: APR; Unit: %.
One day term weighted interbank rates	The weighted interbank rates in inter-bank market. Unit: %.
Overnight SHIBOR	Short-term interest rates among banks lending to each other applicable. Unit: %.
Closing price of Shanghai Stock Exchange.	Every day's closing price of Shanghai Stock Exchange
Growth enterprise market(GEM) index	The weighted average of the total shares in the GEM, regarding the starting date as Datum point.
Balance treasure annualized return rate in 7 days.	<p style="text-align: center;">Balance treasure annualized return rate =</p> $\frac{\text{investment income} / \text{principle value}}{\text{Investment Days} / 365} \times 100\%$

Exploratory Data Analysis

Enqun Wang (EW), Yiyuan Zhou (YZ)

April 25, 2016

Preprocess data

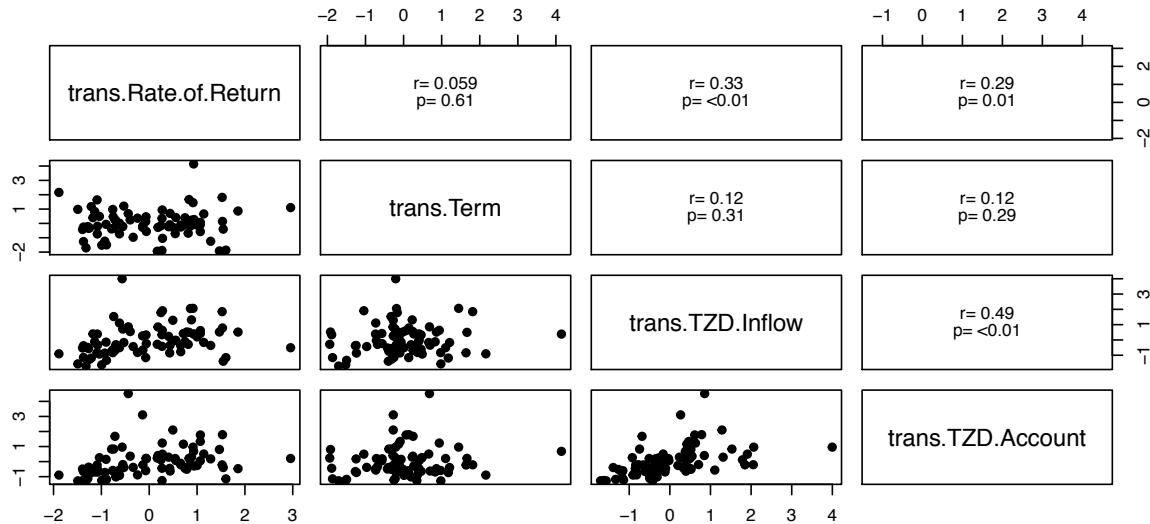
- Based on cause and effect relationship, we divide the variables into four causes: Product Factor, Promotion Factor, Platform Factor, and Market Factor. According to voice of customer (VOC), we would analyze the influence of these factors independently, for that each one represents a different aspect.

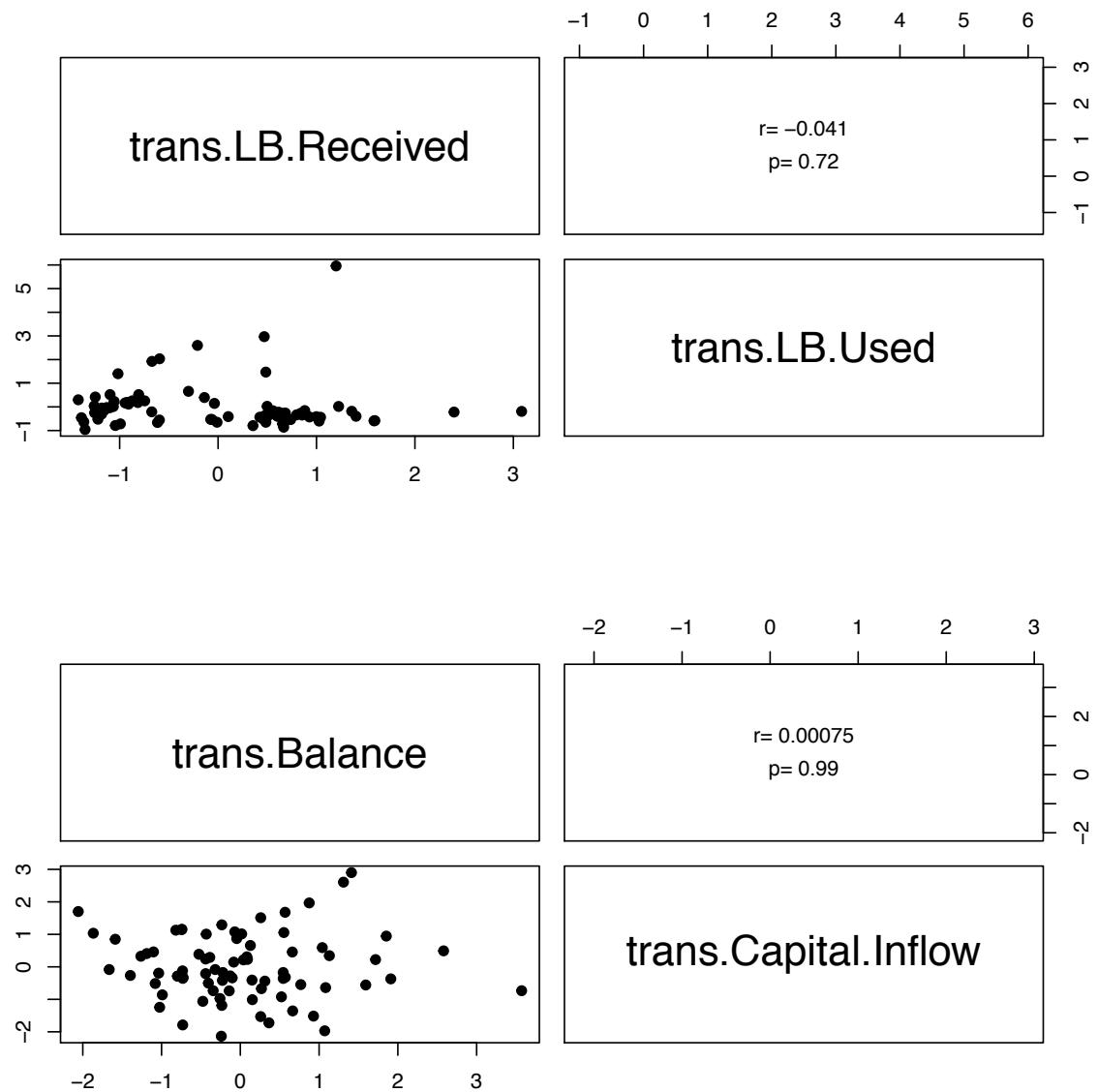
Product Factor	Promotion Factor	Platform Factor	Market Factor
Rate of Return	LB Received	Balance	R.007
Term	LB Used	Capital Inflow	Inerbank Rate
TZD Account			SHIBOR
TZD Inflow			SHA
			GEM

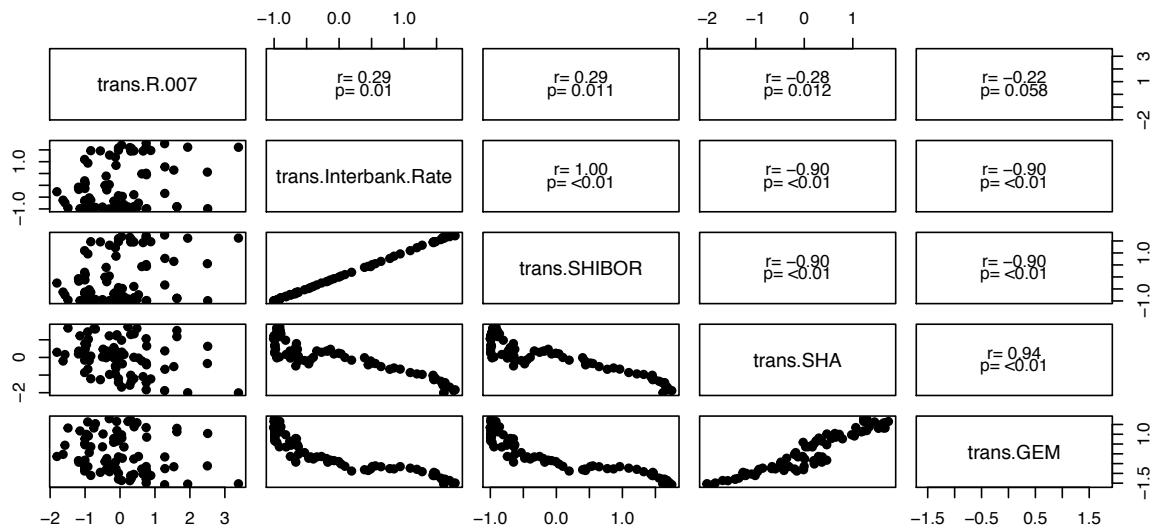
- In order to remove effects of different units, we centered and rescaled the data.

Detect dependent variables

- According to the correlation plot above, we find that `interbank.Rate`, `SHIBOR`, `SHA`, and `GEM` are highly correlated, and that `TZD.Inflow` and `TZD.Account` are highly correlated. So we consider if we could remove some of them.
- Based on the voice of customers (VOC), we decided to remove `interbank.Rate`, which can be represented by `SHIBOR`; remove `GEM`, which can be represented by `SHA`; and remove `TZD.Inflow`, which can be reflected from `TZD.Account`.

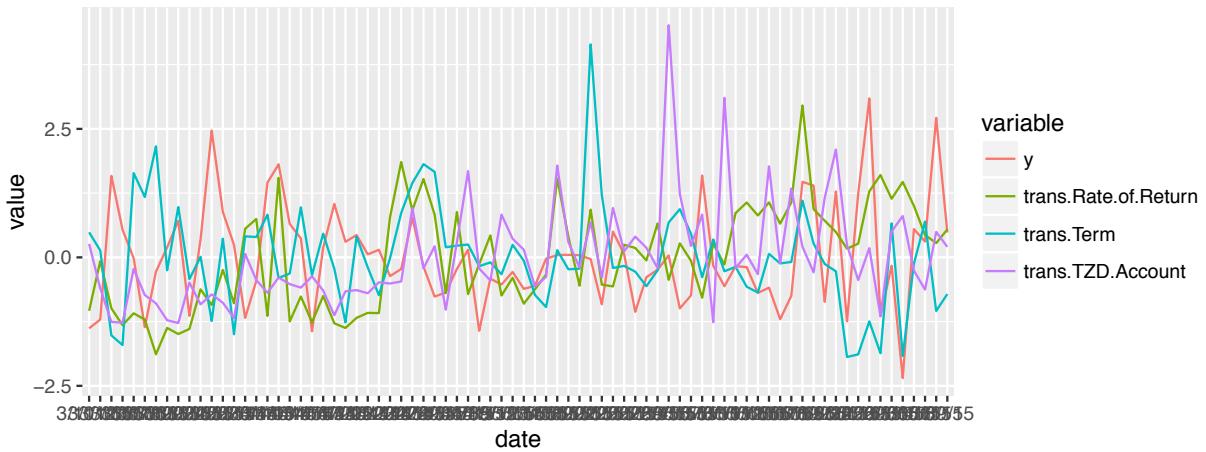


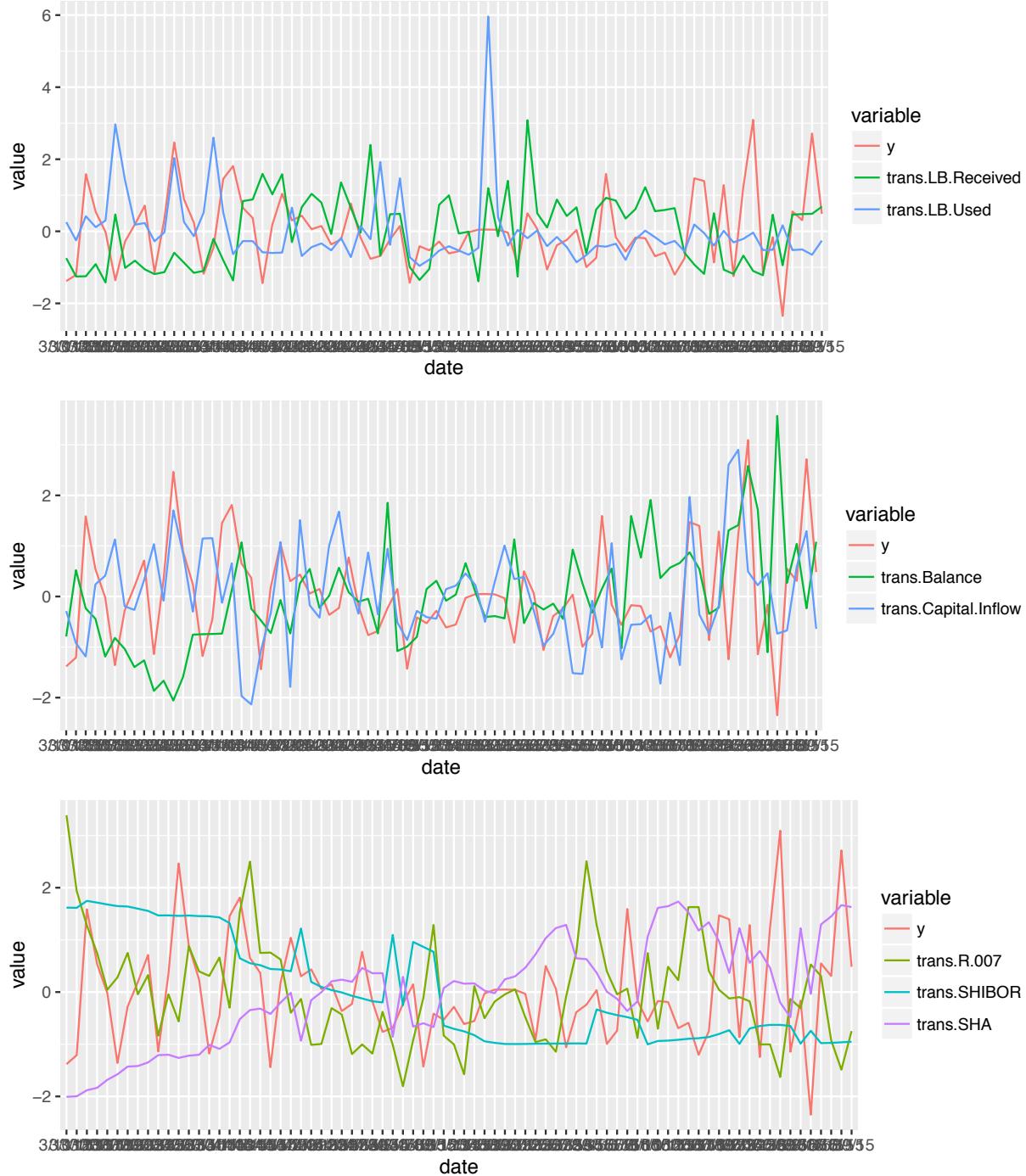




Plot multiple time series

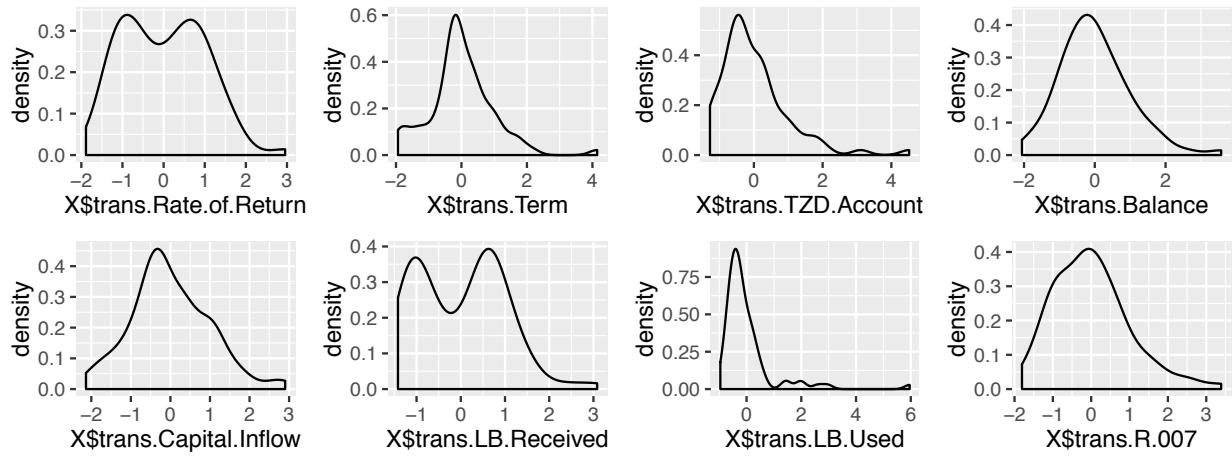
- According to the plots above and VOC, we would remove the variable SHIBOR and SHA.





Density plots

- To explore the distributions of the variables, we plotted density plots as follows. It indicates that Rate of Retrun and LB Received are not normally distributed, while others are basicly normal.



First selection of variables

According to the exploratory data analysis, we decide to first elect variables as follows.

Product Factor	Promotion Factor	Platform Factor	Market Factor
1. Rate of Return	1. LB Received	1. Balance	1. R.007
2. Term	2. LB Used	2. Capital Inflow	
3. TZD Account			

Hypothesis Testing

Enqun Wang (EW), Yiyan Zhou (YZ)

April 26, 2016

Exploratory Data Analysis

According to the exploratory data analysis, we decide to first elect variables as follows,

Product Factor	Promotion Factor	Platform Factor	Market Factor
1. Rate of Return	1. LB Received	1. Balance	1. R.007
2. Term	2. LB Used	2. Capital Inflow	
3. TZD Account			

We use the centered data to test the significance of the variables, and find the significant ones.

1. Increase.Rate.5Day ~ Rate.of.Return

```
##  
## Call:  
## lm(formula = df$trans.Increase.Rate.5Day ~ df$trans.Rate.of.Return)  
##  
## Residuals:  
##      Min       1Q     Median       3Q      Max  
## -1.8454 -0.7421 -0.1314  0.6312  3.4207  
##  
## Coefficients:  
##                               Estimate Std. Error t value Pr(>|t|)  
## (Intercept)             8.331e-19  1.155e-01   0.000   1.000  
## df$trans.Rate.of.Return -5.334e-03  1.162e-01  -0.046   0.964  
##  
## Residual standard error: 1.007 on 74 degrees of freedom  
## Multiple R-squared:  2.845e-05, Adjusted R-squared:  -0.01348  
## F-statistic: 0.002106 on 1 and 74 DF, p-value: 0.9635
```

The p value of the test is 0.9635, which is greater than 0.05. We should not reject the null hypothesis and conclude that the coefficient of Rate.of.Return is not significant.

2. Increase.Rate.5Day ~ Term

```
##  
## Call:  
## lm(formula = df$trans.Increase.Rate.5Day ~ df$trans.Term)  
##  
## Residuals:  
##      Min       1Q     Median       3Q      Max  
## -1.7531 -0.7831 -0.1170  0.6342  3.1287  
##  
## Coefficients:  
##                               Estimate Std. Error t value Pr(>|t|)
```

```

## (Intercept) 2.550e-17 1.141e-01 0.000 1.000
## df$trans.Term -1.564e-01 1.148e-01 -1.362 0.177
##
## Residual standard error: 0.9943 on 74 degrees of freedom
## Multiple R-squared: 0.02445, Adjusted R-squared: 0.01127
## F-statistic: 1.855 on 1 and 74 DF, p-value: 0.1773

```

The p value of the test is 0.1773, which is greater than 0.05. We should not reject the null hypothesis and conclude that the coefficient of Term is not significant.

3. Increase.Rate.5Day ~ TZD.Account

```

##
## Call:
## lm(formula = df$trans.Increase.Rate.5Day ~ df$trans.TZD.Account)
##
## Residuals:
##   Min     1Q   Median     3Q    Max
## -1.7776 -0.7596 -0.0298  0.5272  3.3339
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)            6.943e-17  1.102e-01 0.000 1.00000
## df$trans.TZD.Account -2.976e-01  1.110e-01 -2.682 0.00903 **
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9611 on 74 degrees of freedom
## Multiple R-squared: 0.08857, Adjusted R-squared: 0.07625
## F-statistic: 7.191 on 1 and 74 DF, p-value: 0.009031

```

The p value of the test is 0.009031, which is less than 0.05. We should reject the null hypothesis and conclude that the coefficient of TZD.Account is significant.

4. Increase.Rate.5Day ~ LB.Received

```

##
## Call:
## lm(formula = df$trans.Increase.Rate.5Day ~ df$trans.LB.Received)
##
## Residuals:
##   Min     1Q   Median     3Q    Max
## -1.7086 -0.8061 -0.1410  0.6606  3.2724
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)            5.240e-17  1.129e-01 0.000 1.000
## df$trans.LB.Received -2.098e-01  1.137e-01 -1.846 0.069 .
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9843 on 74 degrees of freedom
## Multiple R-squared: 0.044, Adjusted R-squared: 0.03108
## F-statistic: 3.406 on 1 and 74 DF, p-value: 0.06896

```

The p value of the test is 0.04645, which is less than 0.05. We should reject the null hypothesis and conclude that the coefficient of LB.Received is significant.

5. Increase.Rate.5Day ~ LB.Used

```
##
## Call:
## lm(formula = df$trans.Increase.Rate.5Day ~ df$trans.LB.Used)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -1.7526 -0.7464 -0.1423  0.6034  3.4414
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -1.926e-17 1.148e-01  0.000   1.000
## df$trans.LB.Used 1.066e-01 1.156e-01  0.922   0.359
##
## Residual standard error: 1.001 on 74 degrees of freedom
## Multiple R-squared:  0.01136,   Adjusted R-squared:  -0.001997
## F-statistic: 0.8505 on 1 and 74 DF,  p-value: 0.3594
```

The p value of the test is 0.1695, which is greater than 0.05. We should not reject the null hypothesis and conclude that the coefficient of LB.Used is not significant.

6. Increase.Rate.5Day ~ Balance

```
##
## Call:
## lm(formula = df$trans.Increase.Rate.5Day ~ df$trans.Balance)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -1.8752 -0.7416 -0.1388  0.6520  3.3705
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -1.082e-17 1.154e-01  0.000   1.000
## df$trans.Balance 3.499e-02 1.162e-01  0.301   0.764
##
## Residual standard error: 1.006 on 74 degrees of freedom
## Multiple R-squared:  0.001224,   Adjusted R-squared:  -0.01227
## F-statistic: 0.0907 on 1 and 74 DF,  p-value: 0.7641
```

The p value of the test is 0.8785, which is greater than 0.05. We should not reject the null hypothesis and conclude that the coefficient of Balance is not significant.

7. Increase.Rate.5Day ~ Capital.Inflow

```
##
## Call:
## lm(formula = df$trans.Increase.Rate.5Day ~ df$trans.Capital.Inflow)
```

```

##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.6154 -0.7388 -0.0793  0.6976  2.1425
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -2.907e-17  1.034e-01   0.000     1
## df$trans.Capital.Inflow 4.457e-01  1.041e-01   4.283 5.47e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9012 on 74 degrees of freedom
## Multiple R-squared:  0.1986, Adjusted R-squared:  0.1878
## F-statistic: 18.34 on 1 and 74 DF,  p-value: 5.467e-05

```

The p value of the test is 5.467e-05, which is less than 0.05. We should reject the null hypothesis and conclude that the coefficient of Capital.Inflow is significant.

8. Increase.Rate.5Day ~ R.007

```

##
## Call:
## lm(formula = df$trans.Increase.Rate.5Day ~ df$trans.R.007)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.62852 -0.78853 -0.06729  0.70667  3.14317
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -6.368e-18  1.113e-01   0.000   1.0000
## df$trans.R.007 -2.678e-01  1.120e-01  -2.391   0.0194 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.97 on 74 degrees of freedom
## Multiple R-squared:  0.07169, Adjusted R-squared:  0.05915
## F-statistic: 5.715 on 1 and 74 DF,  p-value: 0.01936

```

The p value of the test is 0.03061, which is less than 0.05. We should reject the null hypothesis and conclude that the coefficient of R.007 is significant.

To sum up, LB.Received, Capital.Inflow, TZD.Account and R.007 are four significant variables.

Considering the above four significant the variables, we do model selection by forward stepwise.

```

## Subset selection object
## Call: regsubsets.formula(df$trans.Increase.Rate.5Day ~ df$trans.LB.Received +
##                         df$trans.Capital.Inflow + df$trans.TZD.Account + df$trans.R.007,
##                         data = df, method = "forward")
## 4 Variables  (and intercept)
##                 Forced in    Forced out
## df$trans.LB.Received      FALSE      FALSE

```

```

## df$trans.Capital.Inflow      FALSE      FALSE
## df$trans.TZD.Account        FALSE      FALSE
## df$trans.R.007              FALSE      FALSE
## 1 subsets of each size up to 4
## Selection Algorithm: forward
##          df$trans.LB.Received df$trans.Capital.Inflow df$trans.TZD.Account
## 1  ( 1 ) " "                "*"                  " "
## 2  ( 1 ) " "                "*"                  "*"
## 3  ( 1 ) "*"                "*"                  "*"
## 4  ( 1 ) "*"                "*"                  "*"
##          df$trans.R.007
## 1  ( 1 ) " "
## 2  ( 1 ) " "
## 3  ( 1 ) " "
## 4  ( 1 ) "*"

```

It seems that the capital inflow is the most significant. We can now select the best model based on the voice of customer.

The importance of the four variables are as followed:

Importance	Variable
1	Capital Inflow
2	Lucky Bag Received
3	R 007
4	The Financial Product TZD Account

Pugh Concept Matrix

Enqun Wang (EW), Yiyuan Zhou (YZ)

April 27, 2016

Criteria	Rating (1-10)	Reset RR	Develop Products	Advertisements	Improve Coping Mechanisms
Cost of Price	10	+	S	-	S
Customer Satisfaction	10	S	+	+	S
Benefit Period	10	S	+	+	+
Efficiency	4	-	-	+	S
Weighted Sum of Positive	7	S	S	+	+
Weighted Sum of Negative					
Weighted Score		10	20	31	20
Weighted Sum of Negative		4	4	10	0
Weighted Score		6	16	21	20

Develop Products, Advertisements, and Improve Coping Mechanisms are the selected concepts.

Solution Selection Matrix

Enqun Wang (EW), Yiyan Zhou (YZ)

April 27, 2016

Explanation for Variables

- Based on the analysis, we finally found three variables highly correlating to the 5-day increase rate – Capital Inflow, LB Received, TZD Account, and R007. The explanation of the variables are shown as follows.

Variables	Explanation
Capital Inflow	Recode the platform's (Capital inflows - Capital outflows)
LB Received	Recode the amount of users' receiving lucky money of the day
TZD Account	A measurement of a kind of financial product (TZD) of the platform
R007	The closing price of treasury bond repurchase in 7 days

Solution for Causes or Influence Factors

Variables	Strategies
LB Received: defective is affected by the expiration of the bonus lucky bag received	To decrease our defect rate of five-day increase rate of trading volume, shorten the expiration days of lucky bags.
TZD Account: the account balance is dependent on the attractive of the product.	To improve the account balance, we may keep improving ability of innovation and develop more competitive products.

Solution Matrix

Solutions	Capital Inflow	LB Received	TZD Account	R007
Settle rate of return of financial products reasonable	✓		✓	
develop more competitive products	✓	✓	✓	✓
Make advertisements to attract more users	✓	✓		
Concern the financial market and establish coping mechanisms	✓			✓
Improve the study about macroeconomic regulatory				✓