FIN3080 Project1 Case 1

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Data pre-processing

```
#include the packages wee need to use
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

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

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

```
library(readxl)
library(lubridate)
```

```
##
## Attaching package: 'lubridate'

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

```
library(ggplot2)
```

```
#include all stock from SSE and SZSE main borads
TRD=read.csv('/Users/stevenzhai/Desktop/satisified_stock.csv')
```

```
#feature selection and data arrangement
TRD_1=TRD[,-1]
TRD_2=arrange(TRD_1,TRD_1$Stkcd)
```

```r
#calculate the return of each stock
TRD_2$Ra=(TRD_2$Wclsprc-TRD_2$Wopnprc)/TRD_2$Wopnprc
```

```r
TRD_3=TRD_2
```

```r
TRD_3$Opndt<-as.Date(TRD_3$Opndt,format="%Y-%m-%d")
```

```r
#import 10-year Bond yield rate data as risk free rate
Rf=read_xlsx("/Users/stevenzhai/Desktop/FE_BONDYIELDSD.xlsx")
```

```r
Rf_1=Rf[-(1:2),]
```

```r
Rf_1$StatsDate<-as.Date(Rf_1$StatsDate)
```

```r
TRD_4 <- merge(x=TRD_3,y=Rf_1,by.x="Opndt",by.y="StatsDate")
```

```r
#import index's rate of return and market risk rate
Index=read_xlsx("/Users/stevenzhai/Desktop/TRD_Weekm.xlsx")
```

```r
TRD_5 <- merge(x=TRD_4,y=Index,by.x="Trdwnt",by.y="Date")
```

```r
TRD_6<-TRD_5[,-(4:8)]
TRD_6<-TRD_6[,-6]
```

```r
TRD_7=arrange(TRD_6,TRD_6$Stkcd)
```

```r
#transform all data into weekly rate and percentage number
TRD_7=TRD_7%>%rename(Rm=Rm,Rf=TenYearBondYield)
TRD_7$Ra=TRD_7$Ra*100
TRD_7$Rf=as.numeric(TRD_7$Rf)
TRD_7$Rm=as.numeric(TRD_7$Rm)*100
TRD_7$Rf=((1+TRD_7$Rf*0.01)^(1/52)-1)*100
```

Stage 1 regression

```r
#Separate the three stage data out (69 weeks)
TRD_S1=with(TRD_7,TRD_7[TRD_7$Opndt>="2017-01-04"&TRD_7$Opndt<="2018-05-02",])
```

```r
TRD_S2=with(TRD_7,TRD_7[TRD_7$Opndt>="2018-05-03"&TRD_7$Opndt<="2019-08-29",])
TRD_S2UD<-TRD_S2
```

```r
TRD_S3=with(TRD_7,TRD_7[TRD_7$Opndt>="2019-08-30"&TRD_7$Opndt<="2020-12-27",])
```

```r
# regress stage one individual stock to calculate the beta of each stock
dat <- TRD_S1

lm.result <- data.frame(Stkcd=unique(dat$Stkcd),alpha=NA,beta=NA)

for (s in lm.result$Stkcd) {

  mod <- lm(Ra~Rm,data=dat[dat$Stkcd==s,])

  lm.result[lm.result$Stkcd==s,c("alpha","beta")] <- as.numeric(coef(mod))
}
```

```r
#arrange the beta we get above from low to high
Step1_Coef=arrange(lm.result,beta)
```

Stage 2 regression

```r
#split the beta into ten groups based on betas' value
q<-quantile(Step1_Coef$beta,c(0,0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8,0.9,1))
Step1_split<-split(Step1_Coef,cut(Step1_Coef$beta,q,include.lowest = T))
```

```r
#assign each stock to one of the ten portfolios
TRD_S2UD$portfolio <- NA
for (i in 1:10) {
  sid <- Step1_split[[i]]$Stkcd
  TRD_S2UD$portfolio[TRD_S2UD$Stkcd %in% sid] <- i
}
```

```r
#regress the ten portfolios with x=portfolios' market risk premium, y=portfolio's risk premium
Portfolio1=TRD_S2UD[which(TRD_S2UD$portfolio==1),]
p_RP1<-aggregate(Ra-Rf~Trdwnt,data=Portfolio1,FUN=mean)
m_RP1<-aggregate(Rm-Rf~Trdwnt,data=Portfolio1,FUN=mean)
RP1<-merge(p_RP1,m_RP1,by.x='Trdwnt',by.y='Trdwnt')
mod1 <- lm(RP1$`Ra - Rf`~RP1$`Rm - Rf`,data=RP1)
Stage2_Coef1<-data.frame(alpha=NA,beta=NA)
Stage2_Coef1[c("alpha","beta")] <- as.numeric(coef(mod1))
summary(mod1)
```

```
##
## Call:
## lm(formula = RP1$`Ra - Rf` ~ RP1$`Rm - Rf`, data = RP1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.0609 -0.7948  0.0947  0.7965  2.7319
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.20066    0.13998  -1.433    0.156
## RP1$`Rm - Rf`  0.69345    0.03905  17.759   <2e-16 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.154 on 66 degrees of freedom
## Multiple R-squared:  0.8269, Adjusted R-squared:  0.8243
## F-statistic: 315.4 on 1 and 66 DF,  p-value: < 2.2e-16
```

```
Portfolio2=TRD_S2UD[which(TRD_S2UD$portfolio==2),]
p_RP2<-aggregate(Ra-Rf~Trdwnt,data=Portfolio2,FUN=mean)
m_RP2<-aggregate(Rm-Rf~Trdwnt,data=Portfolio2,FUN=mean)
RP2<-merge(p_RP2,m_RP2,by.x='Trdwnt',by.y='Trdwnt')
mod2 <- lm(RP2$`Ra - Rf`~RP2$`Rm - Rf`,data=RP2)
Stage2_Coef2<-data.frame(alpha=NA,beta=NA)
Stage2_Coef2[c("alpha","beta")] <- as.numeric(coef(mod2))
summary(mod2)
```

```
##
## Call:
## lm(formula = RP2$`Ra - Rf` ~ RP2$`Rm - Rf`, data = RP2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.1160 -0.4818  0.0746  0.5081  2.7980
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -0.1704     0.1069  -1.594    0.116
## RP2$`Rm - Rf`   0.8329     0.0296  28.144   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8742 on 65 degrees of freedom
## Multiple R-squared:  0.9242, Adjusted R-squared:  0.923
## F-statistic: 792.1 on 1 and 65 DF,  p-value: < 2.2e-16
```

```
Portfolio3=TRD_S2UD[which(TRD_S2UD$portfolio==3),]
p_RP3<-aggregate(Ra-Rf~Trdwnt,data=Portfolio3,FUN=mean)
m_RP3<-aggregate(Rm-Rf~Trdwnt,data=Portfolio3,FUN=mean)
RP3<-merge(p_RP3,m_RP3,by.x='Trdwnt',by.y='Trdwnt')
mod3 <- lm(RP3$`Ra - Rf`~RP3$`Rm - Rf`,data=RP3)
Stage2_Coef3<-data.frame(alpha=NA,beta=NA)
Stage2_Coef3[c("alpha","beta")] <- as.numeric(coef(mod3))
summary(mod3)
```

```
##
## Call:
## lm(formula = RP3$`Ra - Rf` ~ RP3$`Rm - Rf`, data = RP3)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.20048 -0.54384 -0.09551  0.51050  2.45204
##
## Coefficients:
```

```
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.09978    0.11005  -0.907    0.368
## RP3$`Rm - Rf`  0.86349    0.03070  28.129   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9069 on 66 degrees of freedom
## Multiple R-squared:  0.923,  Adjusted R-squared:  0.9218
## F-statistic: 791.2 on 1 and 66 DF,  p-value: < 2.2e-16
```

```
Portfolio4=TRD_S2UD[which(TRD_S2UD$portfolio==4),]
p_RP4<-aggregate(Ra-Rf~Trdwnt,data=Portfolio4,FUN=mean)
m_RP4<-aggregate(Rm-Rf~Trdwnt,data=Portfolio4,FUN=mean)
RP4<-merge(p_RP4,m_RP4,by.x='Trdwnt',by.y='Trdwnt')
mod4 <- lm(RP4$`Ra - Rf`~RP4$`Rm - Rf`,data=RP4)
Stage2_Coef4<-data.frame(alpha=NA,beta=NA)
Stage2_Coef4[c("alpha","beta")] <- as.numeric(coef(mod4))
summary(mod4)
```

```
##
## Call:
## lm(formula = RP4$`Ra - Rf` ~ RP4$`Rm - Rf`, data = RP4)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.9928 -0.4481 -0.0328  0.6562  2.8989
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.19435    0.13415  -1.449    0.152
## RP4$`Rm - Rf`  0.89800    0.03742  23.998   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.106 on 66 degrees of freedom
## Multiple R-squared:  0.8972, Adjusted R-squared:  0.8956
## F-statistic: 575.9 on 1 and 66 DF,  p-value: < 2.2e-16
```

```
Portfolio5=TRD_S2UD[which(TRD_S2UD$portfolio==5),]
p_RP5<-aggregate(Ra-Rf~Trdwnt,data=Portfolio5,FUN=mean)
m_RP5<-aggregate(Rm-Rf~Trdwnt,data=Portfolio5,FUN=mean)
RP5<-merge(p_RP5,m_RP5,by.x='Trdwnt',by.y='Trdwnt')
mod5 <- lm(RP5$`Ra - Rf`~RP5$`Rm - Rf`,data=RP5)
Stage2_Coef5<-data.frame(alpha=NA,beta=NA)
Stage2_Coef5[c("alpha","beta")] <- as.numeric(coef(mod5))
summary(mod5)
```

```
##
## Call:
## lm(formula = RP5$`Ra - Rf` ~ RP5$`Rm - Rf`, data = RP5)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
```

```
## -1.95383 -0.39948 -0.01275  0.37107  2.43692
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.09069    0.09405  -0.964    0.338
## RP5$`Rm - Rf`  0.89026    0.02605  34.181   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7693 on 65 degrees of freedom
## Multiple R-squared:  0.9473, Adjusted R-squared:  0.9465
## F-statistic:  1168 on 1 and 65 DF,  p-value: < 2.2e-16
```

```
Portfolio6=TRD_S2UD[which(TRD_S2UD$portfolio==6),]
p_RP6<-aggregate(Ra-Rf~Trdwnt,data=Portfolio6,FUN=mean)
m_RP6<-aggregate(Rm-Rf~Trdwnt,data=Portfolio6,FUN=mean)
RP6<-merge(p_RP6,m_RP6,by.x='Trdwnt',by.y='Trdwnt')
mod6 <- lm(RP6$`Ra - Rf`~RP6$`Rm - Rf`,data=RP6)
Stage2_Coef6<-data.frame(alpha=NA,beta=NA)
Stage2_Coef6[c("alpha","beta")] <- as.numeric(coef(mod6))
summary(mod6)
```

```
##
## Call:
## lm(formula = RP6$`Ra - Rf` ~ RP6$`Rm - Rf`, data = RP6)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.02709 -0.31874 -0.00861  0.36001  2.15254
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.12903    0.09357  -1.379    0.173
## RP6$`Rm - Rf`  0.93034    0.02610  35.643   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7712 on 66 degrees of freedom
## Multiple R-squared:  0.9506, Adjusted R-squared:  0.9499
## F-statistic:  1270 on 1 and 66 DF,  p-value: < 2.2e-16
```

```
Portfolio7=TRD_S2UD[which(TRD_S2UD$portfolio==7),]
p_RP7<-aggregate(Ra-Rf~Trdwnt,data=Portfolio7,FUN=mean)
m_RP7<-aggregate(Rm-Rf~Trdwnt,data=Portfolio7,FUN=mean)
RP7<-merge(p_RP7,m_RP7,by.x='Trdwnt',by.y='Trdwnt')
mod7 <- lm(RP7$`Ra - Rf`~RP7$`Rm - Rf`,data=RP7)
Stage2_Coef7<-data.frame(alpha=NA,beta=NA)
Stage2_Coef7[c("alpha","beta")] <- as.numeric(coef(mod7))
summary(mod7)
```

```
##
## Call:
## lm(formula = RP7$`Ra - Rf` ~ RP7$`Rm - Rf`, data = RP7)
```

```
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.29184 -0.51020  0.00318  0.53299  2.96449
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.08815    0.11120  -0.793    0.431
## RP7$`Rm - Rf`  0.96918    0.03079  31.472   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9096 on 65 degrees of freedom
## Multiple R-squared:  0.9384, Adjusted R-squared:  0.9375
## F-statistic: 990.5 on 1 and 65 DF,  p-value: < 2.2e-16
```

```
Portfolio8=TRD_S2UD[which(TRD_S2UD$portfolio==8),]
p_RP8<-aggregate(Ra-Rf~Trdwnt,data=Portfolio8,FUN=mean)
m_RP8<-aggregate(Rm-Rf~Trdwnt,data=Portfolio8,FUN=mean)
RP8<-merge(p_RP8,m_RP8,by.x='Trdwnt',by.y='Trdwnt')
mod8 <- lm(RP8$`Ra - Rf`~RP8$`Rm - Rf`,data=RP8)
Stage2_Coef8<-data.frame(alpha=NA,beta=NA)
Stage2_Coef8[c("alpha","beta")] <- as.numeric(coef(mod8))
summary(mod8)
```

```
##
## Call:
## lm(formula = RP8$`Ra - Rf` ~ RP8$`Rm - Rf`, data = RP8)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.3412 -0.6035 -0.1094  0.5504  3.0115
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.08009    0.11404  -0.702    0.485
## RP8$`Rm - Rf`  1.01402    0.03181  31.876   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9399 on 66 degrees of freedom
## Multiple R-squared:  0.939,  Adjusted R-squared:  0.9381
## F-statistic:  1016 on 1 and 66 DF,  p-value: < 2.2e-16
```

```
Portfolio9=TRD_S2UD[which(TRD_S2UD$portfolio==9),]
p_RP9<-aggregate(Ra-Rf~Trdwnt,data=Portfolio9,FUN=mean)
m_RP9<-aggregate(Rm-Rf~Trdwnt,data=Portfolio9,FUN=mean)
RP9<-merge(p_RP9,m_RP9,by.x='Trdwnt',by.y='Trdwnt')
mod9 <- lm(RP9$`Ra - Rf`~RP9$`Rm - Rf`,data=RP9)
Stage2_Coef9<-data.frame(alpha=NA,beta=NA)
Stage2_Coef9[c("alpha","beta")] <- as.numeric(coef(mod9))
summary(mod9)
```

```
##
## Call:
## lm(formula = RP9$`Ra - Rf` ~ RP9$`Rm - Rf`, data = RP9)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.4902 -0.4684 -0.0723  0.6087  3.4468
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.06729    0.12337  -0.545    0.587
## RP9$`Rm - Rf`  1.02223    0.03441  29.705   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.017 on 66 degrees of freedom
## Multiple R-squared:  0.9304, Adjusted R-squared:  0.9294
## F-statistic: 882.4 on 1 and 66 DF,  p-value: < 2.2e-16
```

```
Portfolio10=TRD_S2UD[which(TRD_S2UD$portfolio==10),]
p_RP10<-aggregate(Ra-Rf~Trdwnt,data=Portfolio10,FUN=mean)
m_RP10<-aggregate(Rm-Rf~Trdwnt,data=Portfolio10,FUN=mean)
RP10<-merge(p_RP10,m_RP10,by.x='Trdwnt',by.y='Trdwnt')
mod10<- lm(RP10$`Ra - Rf`~RP10$`Rm - Rf`,data=RP10)
Stage2_Coef10<-data.frame(alpha=NA,beta=NA)
Stage2_Coef10[c("alpha","beta")] <- as.numeric(coef(mod10))
summary(mod10)
```

```
##
## Call:
## lm(formula = RP10$`Ra - Rf` ~ RP10$`Rm - Rf`, data = RP10)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.0885 -0.5148  0.0645  0.5683  3.7673
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.1414     0.1445  -0.979    0.331
## RP10$`Rm - Rf`   1.0314     0.0403  25.593   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.191 on 66 degrees of freedom
## Multiple R-squared:  0.9085, Adjusted R-squared:  0.9071
## F-statistic:   655 on 1 and 66 DF,  p-value: < 2.2e-16
```

```
#combine the beta we get into one dataframe
Stage2_Coef=rbind(Stage2_Coef1,Stage2_Coef2,Stage2_Coef3,Stage2_Coef4,Stage2_Coef5,Stage2_Coef6,Stage2_
```

Stage 3 regression

```
#assign each stock in stage three to one of the ten portfolios
TRD_S3$portfolio <- NA
for (i in 1:10) {
  sid <- Step1_split[[i]]$Stkcd
  TRD_S3$portfolio[TRD_S3$Stkcd %in% sid] <- i
}
```

```
#compute the average risk premium of individual portfolio
NewPortfolio1=TRD_S3[which(TRD_S3$portfolio==1),]
P1<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio1,FUN=mean)
Stage3_Average1<-data.frame(average=NA)
Stage3_Average1[c("average")] <- mean(P1$`Ra - Rf`)
```

```
NewPortfolio2=TRD_S3[which(TRD_S3$portfolio==2),]
P2<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio2,FUN=mean)
Stage3_Average2<-data.frame(average=NA)
Stage3_Average2[c("average")] <- mean(P2$`Ra - Rf`)
```

```
NewPortfolio3=TRD_S3[which(TRD_S3$portfolio==3),]
P3<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio3,FUN=mean)
Stage3_Average3<-data.frame(average=NA)
Stage3_Average3[c("average")] <- mean(P3$`Ra - Rf`)
```

```
NewPortfolio4=TRD_S3[which(TRD_S3$portfolio==4),]
P4<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio4,FUN=mean)
Stage3_Average4<-data.frame(average=NA)
Stage3_Average4[c("average")] <- mean(P4$`Ra - Rf`)
```

```
NewPortfolio5=TRD_S3[which(TRD_S3$portfolio==5),]
P5<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio5,FUN=mean)
Stage3_Average5<-data.frame(average=NA)
Stage3_Average5[c("average")] <- mean(P5$`Ra - Rf`)
```

```
NewPortfolio6=TRD_S3[which(TRD_S3$portfolio==6),]
P6<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio6,FUN=mean)
Stage3_Average6<-data.frame(average=NA)
Stage3_Average6[c("average")] <- mean(P6$`Ra - Rf`)
```

```
NewPortfolio7=TRD_S3[which(TRD_S3$portfolio==7),]
P7<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio7,FUN=mean)
Stage3_Average7<-data.frame(average=NA)
Stage3_Average7[c("average")] <- mean(P7$`Ra - Rf`)
```

```
NewPortfolio8=TRD_S3[which(TRD_S3$portfolio==8),]
P8<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio8,FUN=mean)
Stage3_Average8<-data.frame(average=NA)
Stage3_Average8[c("average")] <- mean(P8$`Ra - Rf`)
```

```r
NewPortfolio9=TRD_S3[which(TRD_S3$portfolio==9),]
P9<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio9,FUN=mean)
Stage3_Average9<-data.frame(average=NA)
Stage3_Average9[c("average")] <- mean(P9$`Ra - Rf`)
```

```r
NewPortfolio10=TRD_S3[which(TRD_S3$portfolio==10),]
P10<-aggregate(Ra-Rf~Trdwnt,data=NewPortfolio10,FUN=mean)
Stage3_Average10<-data.frame(average=NA)
Stage3_Average10[c("average")] <- mean(P10$`Ra - Rf`)
```

```r
Average<-rbind(Stage3_Average1,Stage3_Average2,Stage3_Average3,Stage3_Average4,Stage3_Average5,Stage3_A
```

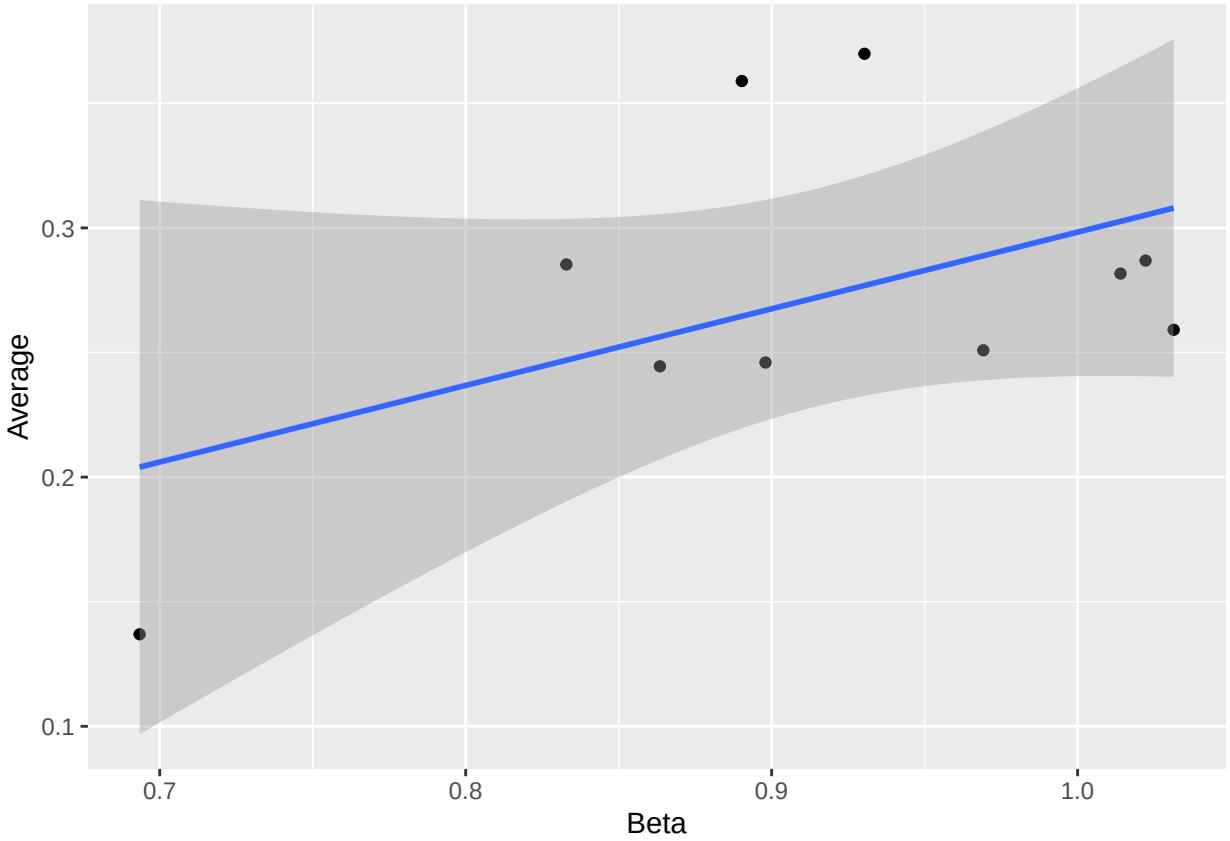
```r
#combine beta in stage 2 regression and average risk premium in stage 3 together
final=cbind(Stage2_Coef,Average)
```

```r
#regress average risk premium on beta and plot
lm.final<-lm(average~beta,data=final)
summary(lm.final)
```

```
##
## Call:
## lm(formula = average ~ beta, data = final)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.06709 -0.03368 -0.01958  0.02585  0.09440
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.009234   0.176567  -0.052    0.960
## beta         0.307532   0.191955   1.602    0.148
##
## Residual standard error: 0.05991 on 8 degrees of freedom
## Multiple R-squared:  0.2429, Adjusted R-squared:  0.1483
## F-statistic: 2.567 on 1 and 8 DF,  p-value: 0.1478
```

```r
ggplot(final, aes(x = beta, y = average)) + geom_point() + geom_smooth(method = "lm") + labs(x = "Beta"
```

```
## `geom_smooth()` using formula 'y ~ x'
```


Average
0.3
0.2
0.1
0.7
0.8
0.9
1.0
Beta